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Life-course milestones inquiry in a low-income setting

Data from a Health and Demographic Surveillance System and a Verbal Autopsy System in Dande, Angola

Edite de Fátima Vila Nova do Rosário

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Nothing exists until it is measured

(Niels Bohr, 1930)

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Índex

List of figures

List of tables

Abbreviations

AIDS - Acquired Immune Deficiency Syndrome

AMD - Municipal Administration of Dande

ANC – Antenatal care

ASAI - Age-sex accuracy index

Camões, I.P. - Institute for Cooperation and Language

CBR - Crude birth rate

CD - Communicable diseases, maternal, perinatal, perinatal, and nutritional conditions

CDR - Crude death rate

CISA – Health Research Centre of Angola (Centro de Investigação em Saúde de Angola)

CoD - Cause of death

CRVS - Civil registration and vital statistics

CWR - Child-women rate

DHS - Demographic Health Surveys

DSA - Demographic Surveillance Area

EU – European Union

FCG - Calouste Gulbenkian Foundation

GBD - Global Burden of Disease

GDP - Gross Domestic Product

GIS - Geographic Information System

GPB - Bengo Provincial Government

GPS - Geographical Positioning System

HDSS - Health and Demographic Surveillance System

HGB - Bengo General Hospital

HIS - Health Information Systems

HIV - Human Immunodeficiency Virus Infection

IBEP - Integrated Population Welfare Survey

ICD - International Statistical Classification of Diseases

IIMS - Multiple Indicator and Health Survey

IND - Indeterminate

INDEPTH - International Network for the Demographic Evaluation of Populations and Their Health

INEA - National Institute of Statistics of Angola

INJ - Injuries

IPAD - Portuguese Institute for Development Assistance

ISPUP - Instituto de Saúde Pública da Universidade do Porto

LMIC - Low and middle-income countries

MDG - Millennium Development Goals

MI - Myers's blended index

MINSA - Ministry of Health of Angola

NCD - Non-communicable diseases

NMR - Neonatal mortality

OMA - Organisation of Angolan Woman

OSS - Objective socioeconomic status

PALOP - Portuguese Speaking African Countries

PCS - Prospective community study

Permanente ID - Permanent Identification Number

ROC - Receiver Operating Characteristics

SD - Standard deviation

SDG - Sustainable Development Goals

SDH - Social Determinants of Health

SEP - Socioeconomic position

SES - Socioeconomic status

SSA - Sub-Saharan Africa

SSS - Subjective Socioeconomic Status

TFR - Total Fertility Rate

UMIC - Upper and middle-income countries

UN - United Nations

UNICEF - United Nations Children's Fund

UR - Update Rounds

VA - Verbal Autopsies

VAS - Verbal Autopsy System

WHO - World Health Organisation

WHOSIS - World Health Organisation Statistical Information Systems

WI - Whipple’s Index

Abstract

The lack of reliable and relevant sociodemographic and health data in most low-income countries significantly undermines their ability to guide public health programs, monitor population dynamics and disease patterns, and measure key health indicators.

Angola is one of the sub-Saharan African countries where systematic information recording is still weak and, thus, official records on births, deaths, causes of death, and social determinants of health are incomplete. These data are essential for measuring a variety of dimensions concerning the health of a population, namely mortality, morbidity, health status, risk factors, and health services coverage.

To fill this gap, the Health Research Centre of Angola (CISA), created in 2007 within the framework of the Portuguese Cooperation with Angola, and located in Caxito (Dande Municipality, Bengo Province, Angola), implemented data collection platforms for population-based research, including a Health and Demographic Surveillance System (HDSS) and a Verbal Autopsy System (VAS).

The Dande HDSS was implemented in 2009 with the primary objective of collecting accurate longitudinal data on population structure, dynamics, and location. It aims to provide reliable and up-to-date denominators for calculating vital rates and analyses requiring at-risk populations and serve as a sampling frame for epidemiological or other health-related studies.

The VAS, implemented in 2010, was developed as part of the population monitoring system to allow longitudinal assessment of mortality trends and investigation of its associated factors.

This thesis aims to explore data collected by the Dande HDSS and the VAS and evaluate their utility for capturing population dynamics, health-related indicators, supporting different health research projects, and contributing with evidence for health planning purposes.

We analysed the longitudinal data gathered within the two data collection systems following a public health perspective to accomplish this purpose. We performed four studies focusing on the surveilled population's life course milestones, namely birth and death events and social paths marked by their living conditions and social determinants of health. We started by describing the design, methods, and characteristics of the HDSS implemented in Dande, Angola, and identify the most important findings generated by this structure (Paper I). From the data extracted from the VAS, we explored the leading causes of death (CoD) of individuals living in the demographic surveillance area (DSA).

Then we studied the associations between demographic or socioeconomic factors and broad mortality groups of the Global Burden of Disease (Paper II). Given that maternal health in Angola is a major public health concern, we focused on this subject. We performed a study aiming to identify demographic and social factors influencing the utilisation of antenatal care and delivery in health facilities and their impact on birth outcomes among women in the Dande HDSS area (Paper III). In the last study presented in this thesis, we sought to understand how subjective socioeconomic status (SSS) associates with health reported needs and health-seeking behaviours of the population in the Dande HDSS area. To perform this research, we tested the application of the MacArthur Scale as a tool to measure SSS and complemented it with objective socioeconomic data of the households collected within the HDSS (Paper IV).

In the following paragraphs, we present a brief description of each performed study's objectives, methods, and results.

Study I

We aimed to describe the HDSS profile, including the reasons for its implementation, participants, data collection methods, main categories of data collected, and the most critical findings generated by this structure.

Demographic indicators were computed annually and based on longitudinal data collected by the demographic surveillance for five years (between 2010 and 2014).

The Initial Census, performed between August 2009 and March 2010, established the baseline population of 59,635 residents. By the end of 2010, the number of individuals registered in the DSA has increased to 63,081. After that, an overall decreasing tendency was observed, except for 2013. The population under surveillance was typical of a developing country, with high fertility (total fertility rate of 4.8 in 2010) and high mortality (crude death rate of 40.4). Individuals were mostly young (on average, 43.0 % were children under 15 years), and there was a low proportion of older persons (3.6% with 65 or more years). The sex ratio and age structure of the Dande HDSS population were identical to those of the national population. The neonatal, infant and under-five mortality rates were 7.1‰, 52.5‰ and 92.1‰, respectively, *versus* 23‰, 50‰ and 91‰ in the country, in the homologous period. A probable under-reporting of neonatal deaths occurred in the HDSS update rounds.

Study II

We assessed the leading causes of the deaths that occurred in the DSA from 2009 to 2012, using Verbal Autopsies (VA) performed after death identification during routine HDSS visits. Associations between demographic and socioeconomic factors and broad mortality groups were explored. Group I included deaths attributed to Communicable diseases, maternal, perinatal, and nutritional conditions (CD); Group II consisted of Non-communicable diseases (NCD); Group III comprised Injuries (INJ). Unknown and unspecified causes of mortality were classified as Indeterminate (IND).

Associations between broad groups of CoD and sex, age, education, socioeconomic position (SEP), place of residence and place of death were explored using chi-square tests and fitting logistic regression models. From a total of 1,488 deaths registered, 1,009 (68%) verbal autopsies were performed. Of the VA, 798 (79%) were assigned a CoD based on the 10th revision of the International Classification of Diseases (ICD).

Mortality was led by CD (61.0%), followed by NCD (11.6%) and INJ (9.1%). A cause of death was not determined (IND) for 18.3% of deaths with VA and assigned CoD.

Intestinal infectious diseases, malnutrition and acute respiratory infections were the main contributors to under-five mortality (44.2%). The most common CoD for children under 15 years old was malaria. Tuberculosis, traffic accidents and malaria were the leading CoD among adults aged 15-49 (13.5%, 10.5% and 8.0%, respectively). For those aged 50 or more, diseases of the circulatory system (23.2%) stood out, followed by tuberculosis (8.2%) and malaria (7.7%). People with no formal education were more likely to die of CD causes (adjusted odds ratio, aOR = 1.68, 95% confidence interval, CI = 1.04-2.72) than those with five or more years of school. On the contrary, they were less likely to die of INJ (aOR = 0.46, 95% CI = 0.21-0.98) independently of age, sex, residence, and place of death. Individuals in the medium SEP index quintile were more likely to die from INJ (aOR = 2.31, 95% CI = 1.00-5.30) than those in the SEP index's highest quintile, with no other statistically significant association found for the remaining SEP groups.

Study III

We aimed to identify sociodemographic factors influencing the utilisation of antenatal care (ANC) and delivery services and their impact on women's birth outcomes in the Dande HDSS.

This study was based on community–based longitudinal data collected by the Dande HDSS between 2009 and 2015. Data on pregnancy outcomes (10,289 outcomes of 8,066 women) were collected for all reported pregnancies, including sociodemographic information, maternal health services utilisation and women's reproductive history. Logistic regression was used to investigate the determinants of birth outcomes, ANC attendance and institutionalised delivery.

Of the 10,289 pregnancy outcomes, 98.5% resulted in live births, 96.8% attended ANC, and 82.5% had four or more ANC visits. Nevertheless, 50.7% of the women delivered outside a health facility. ANC was a determinant of birth outcomes (stillbirth: unadjusted OR = 0.34, 95% CI = 0.16–0.70; abortion: OR = 0.07, 95% CI = 0.04–0.12). Older women, with low education, living farthest from a health facility and in rural areas, were less likely to use maternal health care. Having had previous pregnancies, namely resulting in live births, also decreased the likelihood of pregnant women's health care utilisation.

Study IV

We explored the distribution of a subjective social status measure (using the MacArthur social ladder) according to sociodemographic characteristics and objective socioeconomic status (OSS) indicators and their influence on the population's health reported needs and appropriate health-seeking behaviour in this low-income setting. This research results from a cross-sectional study performed during 2015 in Dande, including 12,246 households. A standardised questionnaire was used to assess OSS indicators (such as household income, education, personal assets ownership), SSS, health reported needs, and the surveyed population's health-seeking behaviour.

Chi-square, ANOVA tests, and Receiver Operating Characteristics (ROC) Curves analysis were computed for testing relationships between SSS ladder quartiles, sociodemographic, and household characteristics. Binomial logistic regression was used to investigate the influence of SSS in reported health care needs and appropriate health-seeking behaviour, adjusting to OSS.

The odds of reporting health care needs were higher for residents who place themselves in the 2nd quartile of the social ladder (aOR = 1.36, 95% CI = 1.18-1.56), compared whit those at the bottom of the scale. A higher income (>30.000 Angolan Kwanzas) also increased the odds of health care need report (aOR=1.56, 95% CI = 1.34-1.81). On the contrary, having more years of schooling and more residents with a fixed salary per household decreased the likelihood of reporting health needs. The subjective scale

showed to be a factor affecting the respondent's choice of health care provider, given that respondents at the top were more than twice likely to seek help from formal health services than those at the bottom of the ladder (aOR= 2.23, 95% CI = 1.52-3.26). The associative filiation and bed net ownership increased the odds of appropriate health-seeking behaviour. In contrast, greater distances to health facilities decreased the likelihood of choosing a formal health care provider (aOR= 0.37, 95% CI = 0.18-0.73). The SSS in the Dande HDSS population follows a socioeconomic position gradient distribution obtained with more objective indicators. The SSS measures influence health needs reporting and appropriate health-seeking behaviour above and beyond OSS.

The main conclusions of this thesis can be summarised as follows:

- The Dande HDSS provides support for health research, serving as a sampling frame for various epidemiological studies, allowing the longitudinal follow-up of the population and the assessment of specific interventions in health. It covers a large area, including rural and urban regions and communities with different accessibilities, lifestyle, and socioeconomic conditions, which has a unique value for implementing research projects designed with attention to public health needs. However, the production of sociodemographic indicators results from the number of registered events, which in turn depends on the number of HDSS update rounds (UR) carried out per year. The decrease in update visits per year might affect the accuracy of the data.

- The sex ratio and age structure of the population and the main sociodemographic indicators (life expectancy at birth, crude birth and death rates, total fertility rates, and specific age mortality rates) are in line with the data for the Angolan population and other developing countries.

- Verbal autopsies proved useful to identify the main CoD at a population level in a setting where vital statistics are scarce and death registration systems have limitations, with no mortality data for those dying outside the formal health system. This point is particularly relevant given that near half (48.5%) of the Dande HDSS population's deaths occurred outside a health facility.

- Infectious diseases were the leading CoD in the region of Dande. The increasing deaths caused by NCD and INJ, the so-called 'triple burden' faced by most developing countries in Africa, suggest an early stage of the epidemiological transition in the leading causes of death. Efforts tackling NCD and INJ cannot be neglected and should initiate to prevent escalation of its burden.

- Improvements in maternal and infant health require the provision of accessible reproductive health care and skilled attendance at delivering. ANC and health facilities delivery were positively associated with birth outcomes, reducing the odds of abortion or stillbirth. The encountered social determinants for utilising ANC and place of delivery have been previously recognised as dimensions to equity in health services utilisation. They were consistent with results reported in other developing countries. These findings support the need for joint health and social policies specifically conceived to address existing maternal health care barriers. A decentralised reality-driven approach, a systematic quality assessment of the services and efficient resource allocation are needed to make health services more socially accountable and develop solutions to improve maternal and child health services.

- SSS may be an important indicator for the study of health inequalities considering the addition it provides to socioeconomic status (SES) assessment. It may be particularly relevant in Angola, where society experienced rapid socioeconomic and structural changes but not followed closely by an improvement in several social indicators. Very scarce evidence exists documenting and contextualising the population's health status and inequalities in access to services, which is of great relevance for health policy. SSS should be considered as a complement to OSS when exploring social determinants of health.

- In a setting where population and health data were not available, the Dande HDSS and VAS provided essential data for public health research, such as sociodemographic indicators and health-related data, including measures of inequalities in access to and use of health care. Both systems offered the opportunity, especially for researchers and decision-makers, to explore data to determine local communities' current health status, study local level health interventions, and plan specific health policies. These qualities should make those surveillance systems valid contributors to local and national health and social development. Nevertheless, its potential has been untapped. Given the complexity and costs of data collection and its usefulness, the HDSS and VAS should be considered both for scientific ground and public health policy purposes.

Resumo

A falta de dados sociodemográficos e de saúde fiáveis e relevantes na maioria dos países de baixa renda prejudica significativamente a sua capacidade de orientar os programas de saúde pública, monitorizar a dinâmica populacional e os padrões de morbilidade, bem como medir os principais indicadores de saúde.

Angola é um dos países da África Subsaariana onde o registo sistemático de dados ainda é fraco e, portanto, os registos oficiais de nascimentos, mortes, causas de morte e determinantes sociais da saúde são incompletos. Esses dados são essenciais para medir uma variedade de dimensões relativas à saúde de uma população, designadamente, mortalidade, morbidade, estado de saúde, fatores de risco e cobertura de serviços de saúde.

De forma a colmatar a falta de dados, o Centro de Investigação em Saúde de Angola (CISA), criado em 2007 no âmbito da Cooperação Portuguesa com Angola, e localizado no Caxito (Município do Dande, Província do Bengo, Angola), implementou plataformas de recolha de dados para investigação de base populacional, incluindo um Sistema de Vigilância Demográfica e de Saúde (SVDS) e um Sistema de Autópsia Verbal (SAV).

O SVDS Dande foi implementado em 2009 com o objetivo principal de recolher dados longitudinais precisos sobre a estrutura, dinâmica e localização da população. Tem como objetivo fornecer denominadores fiáveis e atualizados para o cálculo de taxas vitais e análises que requeiram populações em risco, bem como servir como base de amostragem para estudos epidemiológicos ou outros estudos de investigação em saúde.

O SAV, implementado em 2010, foi desenvolvido como parte do sistema de vigilância populacional para permitir o seguimento longitudinal das tendências de mortalidade e investigação dos fatores associados.

Esta tese tem como objetivo explorar os dados recolhidos pelo SVDS Dande e pelo VAS e avaliar a sua utilidade para captar dinâmicas populacionais, fornecer indicadores de saúde, apoiar diferentes projetos de investigação e contribuir com evidências para fundamentar políticas de saúde.

Para a prossecução deste objetivo, analisamos os dados longitudinais recolhidos nos dois sistemas de recolha de dados numa perspetiva de saúde pública. Realizámos quatro estudos com enfoque nos marcos do percurso de vida da população monitorizada, nomeadamente nos eventos de nascimento e morte, e a conjuntura social marcada pelas condições de vida e determinantes sociais de saúde. Começámos por

descrever o desenho, métodos e características do SVDS implementado no Dande, Angola, e por identificar os resultados mais importantes gerados por esta plataforma de recolha de dados (Artigo I). A partir dos dados extraídos do SAV, exploramos as principais causas de morte de indivíduos residentes na área de vigilância demográfica. Em seguida, estudamos as associações entre fatores demográficos e socioeconómicos e grupos de mortalidade da Carga Global de Doenças (*Global Burden of Disease*, GBD) (Artigo II). Dado que a saúde materna em Angola é um importante problema de saúde pública, focámos também a nossa atenção neste assunto. Desta forma, realizámos um estudo com o objetivo de identificar fatores demográficos e sociais que influenciam a utilização de cuidados pré-natais e partos em unidades de saúde, bem como o impacto destes sobre os resultados de gravidez entre as mulheres na área de estudo do SVDS Dande (Artigo III). No último estudo apresentado nesta tese, procurámos compreender como o estatuto socioeconómico subjetivo (ESS) se associa às necessidades de saúde reportadas e à procura de cuidados de saúde por parte da população residente na área do SVDS Dande. Para realizar esta pesquisa, testamos a aplicação da Escala de MacArthur como ferramenta de medição do ESS e complementámos com dados socioeconómicos dos agregados familiares registados no SVDS (Artigo IV).

Nos próximos parágrafos, apresentamos uma breve descrição dos objetivos, métodos e resultados de cada estudo realizado.

Estudo I

Teve por objetivo descrever o perfil do SVDS, incluindo os motivos para a sua implementação, participantes, métodos de recolha de dados, tipo de informação recolhida e os resultados principais gerados por este sistema.

Os indicadores demográficos foram calculados anualmente e baseados em dados longitudinais recolhidos pelo sistema de vigilância demográfica durante cinco anos (entre 2010 e 2014).

O Censo Inicial, realizado entre agosto de 2009 e março de 2010, registou a população de base de 59.635 residentes. No final de 2010, o número de indivíduos registados na área de estudo aumentou para 63.081. Depois disso, observou-se uma tendência geral decrescente, exceto em 2013. A população sob vigilância é típica de um país em desenvolvimento, com níveis de fertilidade elevados (taxa de fecundidade geral de 4.8 em 2010) e alta mortalidade (taxa bruta de mortalidade de 40,4). Os indivíduos são na maioria jovens (em média 43,0% da população tem menos de 15 anos), e a proporção

de idosos é baixa (3,6% com 65 anos ou mais). A relação de masculinidade e a estrutura etária da população do SVDS Dande são idênticas às da população nacional. As taxas de mortalidade neonatal, infantil e de menores de cinco anos no Dande foram de 7.1‰, 52.5‰ e 92.1‰, respetivamente, *versus* 23‰, 50‰ e 91‰ no país, durante o período homólogo. É provável que tenha ocorrido uma subnotificação de mortes neonatais nas rondas de atualização do SVDS.

Estudo II

Avaliamos as principais causas das mortes ocorridas entre 2009 e 2012 na área de estudo, por meio de autópsias verbais (AV) realizadas após a identificação do óbito durante as visitas de rotina do SVDS. Em seguida, explorámos as associações entre fatores demográficos e socioeconómicos e os grandes grupos de mortalidade. O Grupo I refere-se a mortes atribuídas a doenças transmissíveis, condições maternas, perinatais e nutricionais (DT); O Grupo II é relativo a doenças não transmissíveis (DNT); O Grupo III é composto por lesões. Por último, causas desconhecidas e não especificadas de mortalidade foram especificadas como indeterminadas (IND).

As associações entre grandes grupos de causas de morte e sexo, idade, escolaridade, posição socioeconómica (SEP), local de residência e local de morte foram exploradas por meio de testes de qui-quadrado e modelos de regressão logística. De um total de 1.488 mortes registadas, foram realizadas 1.009 (68%) autópsias verbais. Foi atribuída causa de morte com base na 10ª revisão da Classificação Internacional de Doenças (CID) a 798 (79%) autópsias verbais.

As principais causas de morte foram do grupo de DT (61.0%), seguidas das DNT (11.6%) e lesões (9.1%). Não foram determinadas causas de morte (IND) para 18.3% de mortes com AV realizada e causa de morte atribuída.

As doenças infeciosas intestinais, desnutrição e infeções respiratórias agudas foram as que mais contribuíram para a mortalidade de menores de cinco anos (44.2%). Para crianças com menos de 15 anos, a causa de morte mais comum foi a malária. Tuberculose, acidentes de trânsito e malária foram as principais causas de morte entre os adultos com idades entre 15 e 49 anos (13.5%, 10.5% e 8.0% respetivamente). Para aqueles com 50 anos ou mais, destacam-se as mortes causadas por doenças do aparelho circulatório (23.2%), tuberculose (8.2%) e malária (7.7%). Pessoas sem educação formal apresentaram maior chances de morrer por causas associadas a DT (*odds ratio* ajustado, aOR = 1.68, intervalo de confiança de 95%, IC = 1.04-2.72 para indivíduos sem escolaridade, *versus* indivíduos com cinco ou mais anos de

escolaridade), e menos possibilidade relativa de morrer por lesões (aOR = 0.46, IC 95% = 0.21-0.98) independentemente da idade, sexo, local de residência e local do óbito. Os indivíduos no quintil médio do índice SEP apresentaram maior chances de morrer de lesões (aOR = 2.31, IC 95% = 1.00-5.30), do que os do quintil mais alto do índice SEP, sem outra associação estatisticamente significativa encontrada para os restantes grupos de SEP.

Estudo III

O objetivo deste estudo foi identificar os fatores sociodemográficos que influenciam a utilização de cuidados de saúde pré-natal e parto em unidades de saúde, bem como o seu impacto sobre os resultados de gravidez entre as mulheres registadas no SVDS Dande.

Este estudo foi baseado em dados longitudinais recolhidos na comunidade pelo SVDS Dande, entre 2009 e 2015. Os dados sobre os resultados da gravidez (10,289 resultados de 8,066 mulheres) foram recolhidos para todas as gravidezes reportadas, e incluíram informações sociodemográficas, utilização de serviços de saúde materna e histórico reprodutivo da mulher. Usámos regressão logística para estudar os determinantes dos resultados do parto (nado vivo, aborto ou nado morto), da utilização de consultas pré-natal e do parto institucionalizado.

Dos 10.289 resultados de gravidez, 98.5% resultaram em nados vivos, 96.8% foram a consultas pré-natal e, de entre estas, 82.5% foram a quatro ou mais consultas. No entanto, 50.7% das mulheres teve o parto fora de uma unidade de saúde. As consultas pré-natal foram um determinante dos resultados do nascimento (natimorto: não ajustado OR = 0.34, IC 95% = 0.16-0.70; aborto: OR = 0.07, IC 95% = 0.04-0.12). Mulheres mais velhas, com baixa escolaridade, residindo a maior distância de uma unidade de saúde e em áreas rurais, foram menos propensas a usar cuidados de saúde materna. O facto de terem tido gestações anteriores das quais resultaram nados vivos, também diminuiu a chance de utilização de cuidados de saúde pelas mulheres grávidas.

Estudo IV

Explorámos a distribuição de uma medida subjetiva de *status* social (usando a escala social de MacArthur) de acordo com características sociodemográficas e indicadores objetivos de estatuto socioeconómico, e a sua associação às necessidades de saúde

reportadas e à procura de cuidados de saúde da população no sistema formal, neste contexto de baixa renda.

Esta investigação resulta de um estudo transversal realizado durante 2015 no Dande (correspondendo à 9ª ronda de atualização do SVDS), incluindo 12.246 agregados familiares. Foi usado um questionário padronizado para avaliar os indicadores objetivos de estatuto socioeconómico (como rendimento do agregado familiar, educação e bens pessoais), a perceção subjetiva de status, as necessidades de saúde e a procura de cuidados de saúde apropriados por parte da população.

Calculámos testes de Qui-quadrado, ANOVA e análises de curvas de características operacionais do recetor (ROC) para examinar as relações entre quartis da escada da perceção subjetiva de *status*, características sociodemográficas e dos agregados familiares. A regressão logística binomial foi usada para investigar a influência do estatuto socioeconómico subjetivo nas necessidades reportadas de saúde e no comportamento de procura de cuidados saúde, ajustando-a aos indicadores objetivos de estatuto socioeconómico.

A razão de possibilidades (*odds ratio*) de reportar necessidades de saúde foi maior para os residentes que se posicionaram no 2º quartil da escala social (aOR = 1.36, IC 95% = 1.18-1.56), em comparação com os que estavam na base da escala. Rendimentos mais elevados (> 30.000 Kwanzas angolanos) também aumentaram a razão de possibilidades de reportar necessidade de cuidados de saúde (aOR = 1.56, IC 95% = 1.34-1.81). Por oposição, ter mais anos de escolaridade e mais residentes com salário fixo por agregado diminuiu a chance de reportar necessidades de saúde. A escala subjetiva de *status* mostrou ser um fator que afeta a escolha do prestador de cuidados de saúde do respondente, visto que os que se percecionam como estando no topo apresentaram mais do dobro de chances de procurar ajuda nos serviços de saúde formais do que aqueles na base da escada (aOR = 2.23, IC 95% = 1.52-3.26). A participação associativa e a posse de mosquiteiros aumentaram as possibilidades relativas de procurar ajuda nos serviços de saúde. Em contraste, distâncias maiores até as unidades de saúde diminuíram a chance de escolha por um provedor de saúde formal (aOR = 0.37, IC 95% = 0.18-0.73). A perceção subjetiva de *status* na população do SVDS Dande segue uma distribuição gradiente da posição socioeconómica obtida com indicadores mais objetivos. As medidas subjetivas influenciam o reportar de necessidades de saúde e o comportamento na procura de cuidados de saúde acima e além dos indicadores objetivos de estatuto socioeconómico.

Em resumo, as principais conclusões desta tese são as seguintes:

- O SVDS Dande fornece suporte à investigação em saúde, servindo como base de amostras para diversos estudos epidemiológicos, permitindo o acompanhamento longitudinal da população e a avaliação de intervenções específicas em saúde. Abrange uma área extensa, incluindo regiões rurais e urbanas, e comunidades com diferentes acessibilidades, estilos de vida e condições socioeconómicas, o que tem um valor ímpar para a realização de projetos de investigação em saúde pública. No entanto, a produção de indicadores sociodemográficos resulta do número de eventos registados pelos SVDS, o que por sua vez depende da periodicidade e do número de rondas de atualização (RA) realizadas por ano. A diminuição do número de visitas feitas por ano aos agregados familiares pode afetar a precisão dos dados.

- A relação de masculinidade e a estrutura etária da população, bem como os principais indicadores sociodemográficos (esperança de vida à nascença, taxas brutas de natalidade e mortalidade, taxa de fecundidade geral e taxas de mortalidade específicas por idade) estão em linha com os dados publicados para a população angolana e para outros países em desenvolvimento.

- As autópsias verbais mostraram-se úteis para identificar as principais causas de morte a nível da população, num contexto em que as estatísticas vitais são escassas e os sistemas de registo de mortes têm limitações, sem dados de mortalidade para aqueles que morrem fora do sistema formal de saúde. Este ponto é particularmente relevante dado que cerca de metade (48,5%) das mortes da população do SVDS Dande ocorreu fora de uma unidade de saúde.

- As doenças infeciosas foram a principal causa de morte na região do Dande. O aumento das mortes causadas por DNT e lesões, o chamado ‘fardo triplo’ que a maioria dos países em desenvolvimento em África enfrenta atualmente, sugere um estágio inicial da transição epidemiológica nas principais causas de morte. Os esforços para lidar com as DNT e as lesões não devem ser negligenciados e devem ser iniciadas medidas preventivas de modo a evitar o aumento do peso destas causas de morte.

- As melhorias na saúde materna e infantil requerem a prestação de cuidados de saúde reprodutiva acessíveis e assistência especializada no parto. As consultas pré-natal e o parto em unidades de saúde foram associados positivamente ao resultado da gravidez, ambos reduzindo as chances de aborto ou natimorto. Os determinantes sociais encontrados para a utilização de cuidados de saúde pré-natal e parto institucionalizado foram previamente reconhecidos noutros estudos como dimensões para a equidade na utilização de serviços de saúde. Os resultados foram consistentes com os reportados

noutros países em desenvolvimento e confirmaram a necessidade de políticas sociais e de saúde conjuntas, concebidas especificamente para lidar com as barreiras existentes aos cuidados de saúde materna. Uma abordagem descentralizada, focada na realidade local, uma avaliação sistemática da qualidade dos serviços e uma alocação eficiente de recursos, são medidas necessárias para tornar os serviços de saúde mais socialmente responsáveis e desenvolver soluções para melhorar os serviços de saúde materno-infantil.

- A perceção subjetiva de *status* pode ser um indicador importante para o estudo das desigualdades em saúde, considerando o acréscimo que proporciona na avaliação da condição socioeconómica. Pode ser particularmente relevante em Angola, onde a sociedade passou por rápidas mudanças socioeconómicas e estruturais, mas que não foram acompanhadas de perto por uma melhoria em vários indicadores sociais. As evidências sobre o estado de saúde da população e desigualdades no acesso aos serviços, de grande relevância para a fundamentação de políticas, são escassas. A perceção subjetiva de *status* deve ser usada como um complemento dos indicadores mais objetivos no estudo dos determinantes sociais da saúde.

- Num contexto em que os dados populacionais e de saúde não existem ou são francamente incompletos, o SVDS Dande e o SAV forneceram dados essenciais para a investigação em saúde pública, tais como indicadores sociodemográficos atualizados e fiáveis, indicadores de saúde, e medidas para avaliação das desigualdades no acesso e uso de cuidados de saúde. Ambos os sistemas ofereceram a oportunidade, especialmente para investigadores e decisores públicos, de explorar dados para determinar o estado de saúde atual das comunidades locais, para estudar intervenções de saúde ao nível local e planear políticas de saúde específicas. Estes atributos devem tornar esses sistemas de vigilância contribuintes válidos para o desenvolvimento social e de saúde a nível local e nacional. No entanto, o seu potencial não está totalmente explorado. Dada a complexidade e os custos associados à recolha de dados e à manutenção destas plataformas de dados, bem como à sua utilidade, o SVDS e o SAV devem ser considerados instrumentos úteis e a desenvolver, tanto para fins de investigação, como para fornecer evidências científicas que visem a fundamentação de políticas de saúde pública.

1. Introduction

In the introductory chapter of this thesis, we have sought to present aspects related to the pressing need for data collection and analysis in the context of developing countries, such as Angola and, in particular, the Dande setting. Then, we described the HDSS and VAS data collection platforms and their potential in providing detailed, longitudinal, and comprehensive data about a well-defined population.

Throughout the introduction, we narrate aspects of our experience and research challenges in a resource-poor setting.

1.1. The importance of health and demographic data for public health

Traditionally, Public Health was defined as "The science and art of preventing disease, prolonging life, and promoting health through the organised efforts and informed choices of society, organisations, public and private communities, and individuals." (1) Challenges posed by societal changes, demographic and epidemiological transitions, and health revolutions worldwide reshaped the field and public health definitions. (2) Though, most of them encompass values such as the sense of general public interest, a focus on the broader determinants of health, and a desire to improve the health of the entire population. (3)

Recently, Beaglehole suggested a succinct definition of public health as a *collective action for sustained population-wide health improvement*. (3) Regardless of the concept used, public health presupposes the ability to measure and monitor populations' health. Key disciplines of public health, such as epidemiology, demography, and biostatistics, (4) rely on the study of general characteristics of human populations, as their health status, size, structure, and evolution.

Therefore, data are crucial in improving health. (5) However, as descriptions and measures of characteristics of persons and things, data do not have value for themselves. They must be systematised and analysed to identify patterns and create information. It is the use of information that generates recommendations and rules for action and creates knowledge used to make decisions. (6)

Accordingly, data collection and analysis are essential to inform health programme planning and policy-making by providing useful evidence and generating support for the

health sector in determining what interventions and resources are needed and where. (5, 7)

Reliable and relevant statistics on how many people born and die in a given area, composition and distribution of populations, health impacts of specific exposures, leading causes of death, health populations needs and services lacking are examples of essential issues for public health practitioners. Public health responses, such as outbreak investigations, prevention strategies for diseases, and health system improvements to quality and performance, require timely and accurate health information. The current COVID-19 pandemic scenario has amply demonstrated the need and potential benefits of sensitive and reliable systems for tracking health events and decision-making.

In fact, health information is the foundation of public health. (4, 8) The contribution of John Snow during the cholera epidemics that ravaged London in 1854, is frequently referred to as one of the milestones in public health and epidemiology. (4, 9, 10) Snow helped solve a public health problem using the processes of collecting and analysing data and mapping the mortality in relation to the sitting of water pumps. It is a good illustration of data collection, analysis, interpretation, and dissemination leading to public health interventions. (10) These processes comprise the capacity to measure disease burden, monitor trends, establish determinants, and assess public health interventions. (9)

Critically important data about population health can be provided by different health information sources, such as health unit´s records, immunisation information systems, surveillance systems, and vital records. However, the availability of this information is limited to some parts of the globe. The disparity between rich and poor also applies to the sphere of health information, (11) and the lack of data disproportionally affects low and middle-income countries (LMIC), with 60% of these countries covering two billion people and not reporting any data. The shortage of data constitutes a severe roadblock to improving public health, as many health policy decisions are made without adequate information. (11, 12)

For most LMICs, it is challenging to maintain routine data collection efforts, (5) and the majority have limited capacities to store, analyse, and distribute data. With weak or non-existent civil registration and health information systems, critical demographic statistics, such as fertility and mortality, are not available continuously and do not cover large population segments. (13) Those countries depend on surveys and census to produce estimates for such events usually addressed by public health. (5)

Angola is one of the countries where the availability of health data is limited. (14, 15)

In the following sections, we present some problems regarding the scarcity of health data in the developing world, in general, and Angola in particular.

1.1.1 Civil registration and Health Information Systems

Civil registration and vital statistics (CRVS) systems are perhaps the most widely used national, state, and local level data for identifying and addressing major public health issues. They consist of the record of the occurrence of key events in people's lives in a given geographical area, namely births, deaths, marriages, adoptions, and divorces, as following the legal requirements in each country. (16) In most developed countries, such registration is mandatory and routinely collected at a national level, thus enabling the study of the population dynamics over time.

CRVS systems have a dual nature, legal and statistical, both crucial and of equal importance. The legal function provides identity and registers vital events, and the statistical function generates national vital statistics data. (17, 18)

As a whole, they provide significant benefits to individuals, governments, and the broader global community. Civil registration grants individuals an identity, enabling them access to essential welfare services such as education and health and providing crucial data for policymakers to design and plan health systems. (7, 19) CRVS strengthens governance and public administration, helping governments develop and implement evidence-based policies and programmes, and deliver services to the population. Functioning CRVS systems also contribute to promoting equitable development, furnishing valuable information essential for tackling social, geographic, gender, and other inequalities. (7)

A brief review of the state of CRVS systems worldwide leads us to an almost endless roster of documents: international pacts, numerous recommendations by commissions and councils, handbooks, resolutions, progress reports, and abundant literature on the need to improve civil registration systems in developing countries. (7, 16-18, 20-24)

From the analysis of those documents, we can draw some general ideas about health information and civil registration systems:

- One of the prevalent thoughts is that most developed countries have long-established and effective civil registration systems. The vital statistics derived from those systems have been integrated into their national Health Information Systems (HIS) and have been instrumental in guiding health development policies and priorities. (20, 23, 25, 26).

- On the opposite, developing countries have weak or inexistent civil registration systems and face several problems to provide useful, reliable, and complete vital statistics. As a result, there is a minimal evidence base for much health and social policy. The inexistence or deficiency of statistics in many countries is both a symptom and a cause of underdevelopment. The simple absence of information about the population's distribution and characteristics constrains health policies and general economic and social policies. (25, 27, 28).

Therefore, an inefficient CRVS system is a significant hindrance to a national HIS's effectiveness, as their resulting vital statistics are of utmost importance to produce health indicators. Those indicators are used to measure various dimensions concerning the health of the population, namely, mortality, morbidity, health status, risk factors, and health services coverage. (29)

Health indicators in epidemiology and public health involve knowledge and consideration of both a numerator (*e.g.*, number of cases, deaths, births, services) and a denominator (the general population from which the numerator is taken). (29) Considering, for instance, the prevalence of a specific disease: for its calculation, it is necessary to know the number of cases in a defined population at one point in time (numerator) and the number of persons in a defined population at the same point in time (denominator). Commonly, vital statistics produce data for the denominator, and different sectors of interest, including the health sector, identify the numerator.

Thereby, a robust HIS should collect data periodically from civil registration statistics, including birth, fertility, and death. Furthermore, complement it with epidemiological surveillance, health service records, household health surveys, health trends, plans and accounts, health workforce and infrastructure, among other sources. Most of the world's emerging countries already have the latest sources in place. However, due to financial constraints, inadequate technical capacity and political will, they still have fragmented HIS and debilities in data production to prevent inefficiency, inequity, and waste in providing health care services. (30)

1.1.2 Health Information Systems in developing countries

The word ‘system’ implies a connected whole or organised process. In practice, most country health information systems lack such cohesion, (4) especially in several less developed countries that have yet to establish effective HIS. (31)

1.1.2.1 Fragmentation of Health Information Systems

In many LMICs, it is frequent to find an institutional framework for health information fragmented. The responsibility of collecting health-related data is dispersed across different divisions and offices of ministries and health departments. (5) Besides the lack of interoperability between health services and civil registration, there is also a lack of communication within the health sector. (16)

Classically, the health care sector consists of a large number of institutions ranging from small and simple health care centres up to large and advanced hospitals. Several institutional bodies manage these institutions, organised into geographic areas (district, province, country) and according to specific programmes (HIV/AIDS, malaria, maternal and child health, vaccinations), and services (primary health care, hospital, laboratories, drug supply). (32) The poor linkage and ineffective coordination of the different organisations directly involved in collecting health-related data are critical issues of HIS.

Although global health policies usually recommend local management and the integration of health information from various services and programmes, reality reflects the opposite. Programmes are often influenced by various international donor organisations at the national level and by the World Health Organisation (WHO). Consequently, national health systems are typically made up of several relatively independent health programmes and services that all maintain their own vertical and uncoordinated reporting systems. (32) Frequently, reporting formats and content required for tuberculosis, malaria, HIV, child health, and other programmes are different, creating many parallel data collection systems and contributing to the HIS's severe fragmentation. (5)

The Millennium Development Goals (MDG), which had a strong health component, highlighted HIS's failings. Although MDGs have been suggested as a framework for measuring development progress, it became clear that, in practice, few countries had sufficiently developed systems capable of regular monitoring. (4, 25) The end of the MDG era and the adoption of a new global agenda framed by the Sustainable Development Goals (SDG) kept the pressure on outcome indicators and the focus on evidence and data. (8) The global concern with outcome-based development and the challenges for the accomplishment of the landmark ‘A World that counts’, (33) urged not only United Nations (UN) entities but also a wide range of organisations to work harder than ever to improve data collection, analysis, and communication. Ironically, it is often the donors' action that put hard work and invests so much into information gathering and development goals that eventually contribute to HIS's fragility and fragmentation in

LMICs. (34-36) Driven by the demand for accountability and anxious to maximise comparability between and within countries, donors frequently support and implement their own data collection platforms instead of prioritising the needs of information for the health system as a whole. These actions result in a separate and parallel mechanism that responds to donor requirements rather than country decision-makers' needs. (4, 8, 37) Countries perceive this as an externally driven process designed to meet donor needs and little relevance to country action. (4)

The inconsistencies in definitions and procedures used by different institutional bodies in the data collection process result in redundant data and improper use. (5, 8, 32) Coordination and collaboration are essential to ensure standard concepts, definitions, and classifications and avoid duplication of responsibilities and a large backlog of unused data. This lack of shared standards for data collection means that the same data is often reported separately through different structures, while at the same time, there might be gaps where essential data does not get reported.

Data collection in most developing countries is still dependent on irregular and largely unreliable mensal reports from various entities. Systematic health information collection arrangements involving data gathering from rural and urban areas of local authorities are outstanding for their inadequacy, if not their absence. This situation often leads to gross under-reporting of such events as births, morbidity, mortality, and low estimates of these occurrences. In some cases, births and deaths are reported with incomplete dates, making it difficult to analyse and present such information. (31)

1.1.2.2 Political commitment and financial constraints

As a public good, the supply of health information is the primary responsibility of governments. It is up to national governments to guarantee a jurisdictional framework, through legislation and regulation, for civil registration and HIS, and to manage and create the necessary infrastructures for their functioning. The existence of a legal framework consistent with international standards enhances confidence in the integrity of results and define the ethical parameters for data collection, information, dissemination, and use. (38)

To create effective HIS, governments must finance and develop systems and services to collect, collate, disseminate, and use health information. A substantial part of the national health information is entirely within the control of the Ministry of Health. However, data from the private health sector and other government bodies are also required (*e.g.,* Census and national surveys from the Statistic Institutes, health expenditures, from the Ministry of Finance, among others). (6)

Given the scarcity of resources in many developing countries, donors and international agencies are also essential financial sources, particularly for HIS planning, infrastructure development, and training. Nevertheless, it is crucial that those international institutions work together with national governments for global comparative information and summary data (6) and do not impose particular models of health information systems solely for their own sake.

Despite these governmental responsibilities, the critical aspects usually addressed to the weakness of health information and CRVS in developing counties comprise the lack of political commitment and under-investment in national statistical systems. Many policymakers are still unaware of the value and importance of civil registration records and their role in developing information systems. This devaluation of data contributes to a vicious circle of inefficiency, given that the lack of demand for data leads to fewer resources made available for its production and quality control. (7, 27, 39)

The lack of health statistics ranges from inadequate civil registration systems to poor data on immunisation and child mortality rates. Though many developing countries have difficulties producing reliable and continuous data on deaths by age, sex, and causes, most of them can produce useful economic data. In those countries, data on gross domestic product and inflation are probably better estimated than those for maternal mortality rates. At a political level, there is greater acceptance of the effort and expenses of gathering and interpreting data on national income and trade balances, to monitor economic prospects in the international market, than of the investment needed for social and health data collection. (28, 40)

The absence of health statistics in many developing countries is a matter of great concern, given that without an adequate capacity for obtaining reliable data, it is not possible to assess the magnitude of problems to be solved. Besides, the use of wrong numbers or incomplete information difficult a proper follow-up of more problematic situations and adequate allocation of resources. Lastly, it is very challenging to assess the effectiveness of programmes and health interventions without reliable data. (40)

About the importance of effective HIS as the foundations of public health, AbouZahr and Boerma state that “It is not because countries are poor that they cannot afford good health information. It is because they are poor that they cannot afford to be without it.” (4)

1.1.2.3 Human Resource and Infrastructures

The resource constraints in the health sector and other government bodies in many developing countries constitute a substantial barrier to developing and maintaining an organised HIS. Even if there are regulations and guidelines to follow, it might be difficult to enforce them in the field due to the lack of human resources and logistical means. A HIS's functioning requires trained personnel, logistics means for record data (paper or computer-based), computers for data storage and analysis, transport facilities for information gathering and coordination, among other things.

Some crucial aspects that require attention concerning human resources are training, an incentive to collect health information, remuneration, low morale, poor working conditions and a professional career. There is a general lack of statistical capacity-building, at the national level, in the HIS of most developing countries. Commonly lack professional with numeric and analytical skills, such as epidemiologists, demographers, and statisticians. Those would contribute to overseeing data quality and standards for data collection and ensure the appropriate analysis and utilisation of information. (4, 38) Health information staff should be accountable for data collection, reporting, and analysis at the regional level. However, many field workers have a limited understanding of the rationale for data collection and use and see those tasks as overburden and as unwelcome additional work. (38) Health information officers' duties are often given to health care workers, already overwhelmed in their daily tasks. (41, 42) As a result, they may not fully appreciate the contributions they ought to make towards generating data for health care planning and delivery. Most workers may not bother about the accuracy and completeness of data contained in monthly returns of diseases and other conditions because they do not recognise such information's value. (31)

Besides human resources, logistical and infrastructure needs are of extreme importance in developing and maintaining a HIS. The resources needed can be as simple as pencils and paper or complex as fully integrated and web-connected technologies. Regardless of the kind of record-keeping, a HIS should have the ability to store, file, abstract, and retrieve records.

In a report on standards for countries' HIS, the Health Metrics Network describes the existence of "overflowing storerooms filled with mouldering patients records, facility logbooks, and paperwork that is never sorted or analysed" in many developing countries, which have therefore no use at all. (38)

In Bengo Province, Angola, where this study took place, it is common to find file rooms corresponding to that description (Figure 1).

Figure 1 – File room in a health unit in Bengo, Angola. 2017

The record and storage of health data in notebooks or loose-leaf papers are commonplace in most parts of the developing world, making filtering specific information extremely difficult and time-consuming. Identifying simple details as the date of birth or cause-specific morbidity of a patient might involve manually going through a massive pile of papers, requiring several hours or days to accomplish. In contrast, a similar task on a computer would take only a few minutes to complete. (31) The following examples of clinical records of different health units in Bengo illustrate reality (Figure 2).

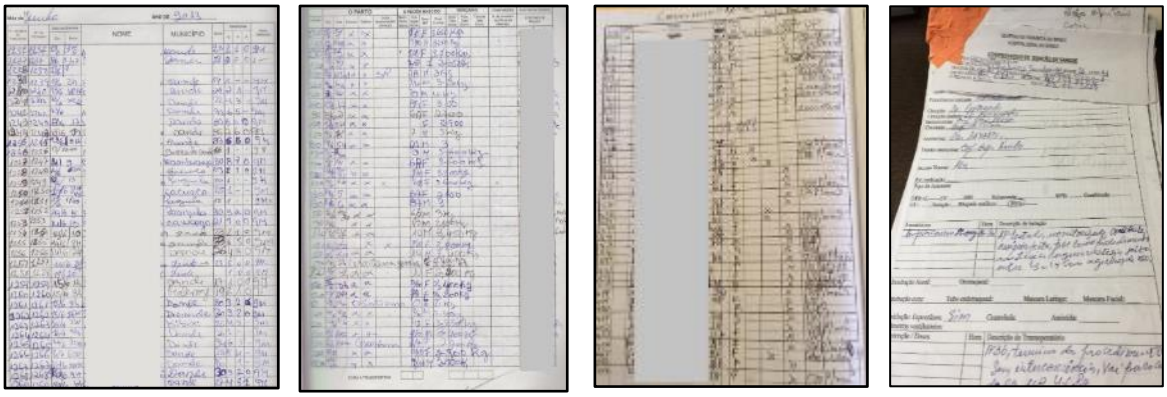

Figure 2 – Example of clinical records in different health units in Bengo, Angola (Dates of the records: 2013, 2018, and 2019).

Note: The columns with patients or health technicians' names have been blurred to anonymise the data.

Indeed, the use of technologies, such as computers, can help countries dramatically increase their storage and performance capacities for dealing with the enormous volumes of data generated and as a means of liberating health workers from the drudgery of paperwork. (31, 38) These technologies can immediately be better used to improve public health. (6) However, most of the developing countries have problems to overcome, such as absence or inadequate power supply, lack of computer equipment and information technology support, poor reliability and prices of Wi-Fi and internet connectivity, lack of computer skills, the resistance of health professionals to using technology, and costs of maintenance. (43) In many low resource settings, there is even a lack of paper for patient records, let alone the means for using technology.

1.2. Crucial data for public health: births, deaths, causes of death and social determinants of health

The preceding discussion has highlighted the importance of data for public health, the value of data such as civil registration and other complementing information for health systems, and failing health information collection and management systems in developing countries.

The lack of adequate HIS leads to several national and global outgrowths on health service delivery, particularly in the areas of public health and primary health care, such as hitches in the assessment of health needs, health planning and priority areas, allocation of responsibilities and resources, programmes evaluation and monitoring of disease trends.

In the present context of rapid epidemiological transition, there is an increasing demand for health care, greater accountability for achieving results and the effective use of resources. (28) The collection, systematisation, and analysis of health-related data to produce reliable, timely and relevant information are an absolute requirement worldwide. There is a strong need to count and measure to provide evidence and respond to local and global challenges. However, the present time is witnessing very different circumstances: a developed world with hitherto unseen technological advances, at the service of HIS and other sectors, contrasting with a developing world still facing considerable barriers in producing, communicating, and using health information.

With the prevalent weakness in the record of critical data, mainly civil registration and health-related data virtually non-existent or incomplete in many developing countries (18, 23, 44), globally, there is still a gap, and the 'scandal of invisibility' remains. (25) Currently, millions of people in Africa and Asia, and in many other regions, are born and die without leaving a trace in any legal record or official statistics and without attaining the UN proclaimed right to a recorded name and nationality. (25, 45)

Births, deaths, and causes of

death (CoD) are the most informative pieces of public health and are essential public goods. (25) These are the crucial events that countries need to know about to guide public health programmes, monitor population dynamics and patterns of disease, and measure key health indicators. (13, 25) Nevertheless, accurate data on births and deaths cover less than a third of the world's population. (19) A CoD is assigned for no more than one in three deaths worldwide, and even for these deaths, there is often substantial uncertainty about the diagnosis. (28, 46)

In addition to these crucial data, public health has been drawing attention to the Social Determinants of Health (SDH), which importance is well established as a critical component for the improvement of populations health and well-being. (47-49)

SDH represent non-medical factors, such as social and economic status, education, employment, housing, and physical and environmental exposures, that interact to cumulatively affect health and disease burdens of individuals and populations. These factors establish health inequities and disparities across and within countries. (50)

The recognition that social and environmental factors decisively influence people's health is not new. (51) As early as the mid-nineteen-century, authors such as Villermé (1782-1863), Chadwick (1800-1890) and Engels (1820-1895) studied the association between disease, death and social circumstances of the populations, just as poverty and environmental conditions. (47, 52, 53) Virchow (1821-1902) affirmed the important effect of the economic and social conditions on health and disease and the need for scientific research on such relations. According to the author, "the very term public health expresses its political character and its practice and should necessarily lead to intervention in social and political life to identify and remove obstacles that undermine the health of a population." (47)

The specific term of SDH came into increasingly widespread use in the mid-1990s. (51) In the last decades, there is a growing interest in the study and knowledge of SDH, aiming to understand the mechanisms by which these factors influence health and promote the production of evidence on the underlying causes of inequality to support policies and interventions to reduce it. (47, 54)

In this thesis, we explore data collected within the HDSS and the VAS regarding these essential indicators: births, deaths, causes of death and social determinants of health.

1.2.1 Birth registration

Birth registration is the continuous, permanent, and universal recording of births' occurrence and characteristics in the national civil registry, following the country´s legal requirements. (55) It is the first step in securing children’s recognition before the law, safeguarding their rights, and ensuring that any violation of those rights does not go unnoticed. (55) Therefore, a name and a nationality are rights enshrined in the Convention on the Rights of the Child. (56)

So important is birth registration to legal identity that it has frequently been described as a fundamental human right (57) and, as a result of the growing awareness for

inclusiveness, it is embodied in target 16.9 of the SDG: “By 2030, provide legal identity for all, including birth registration.”(58)

Reliable data on birth registration should be the primary data source for fertility statistics. Such data are necessary to track changes in fertility levels and patterns, monitor and evaluate family planning programmes, and provide the denominator for an essential selection of critical maternal and child mortality indicators. (57)

1.2.1.1 An assessment of the global status of birth registration

In almost all developed countries, a birth certificate is a legal document that gives identity to a child and automatically confers them some rights: health care, nationality, schooling, passport, property ownership, voting, formal employment, and access to other services. (59) However, in many LMICs, people do not obtain these benefits and may not bother to register their child's birth. (60) Mainly because the efforts that go into registering a child, such as travelling long distances, paying direct and indirect costs (as registration fees, travel, and loss of wage due to work absences), are more substantial than the advantages that people identify in the process. (59)

The globally available data suggest that birth registration rates are higher than death registration, precisely due to some governments' requirements of a birth certificate for later access to specific services, such as school enrollment or health care. (39, 61) Nevertheless, millions of children worldwide lack any record of births. (62)

Several UN and WHO reports and other publications have summarised the state of birth registration globally, especially in low-resource settings. (23, 55, 63, 64)

Table 1 shows the world population's distribution according to country reports to the UN about completeness (at least 90% of events) of registration of births, from 1965-74 to 1995-2004. Until the beginning of the millennium, roughly 30% of the world’s population lived in areas that claimed complete registration of births, and the figures show that overall, there had been little improvement in birth registration levels in the different regions for four decades. (23) Africa and South-East Asia were the regions with the lowest coverage of complete birth registration.

Table 1 – Percentage of population living in countries with complete birth registration, by WHO Region

	1965-74	1975-84	1985-94	1995-2004
Total	**33%**	**31%**	**28%**	**30%**
Africa	7%	7%	9%	5%
Americas	58%	55%	53%	53%
Eastern Mediterranean	21%	25%	17%	42%
Europe	95%	94%	93%	92%
South-East Asia	1%	1%	1%	1%
Western Pacific	12%	14%	13%	18%

Completeness means that the system registers at least 90% of events (births). Figures for 1965-94 from the Demographic Yearbook (historical supplement 1948-1997), UN Statistics Division, New York, 2000. Figures for 1995-2004 are based on the Demographic Yearbook 2004, UN Statistics Division, New York.

Adapted from: (23)

Two decades after the turn of the millennium, the UN report of 2019 on the SDG, (62) covering data from 161 countries over the period from 2010 to 2018, denotes that less than three quarters (73%) of children have their births registered at the age of five years. According to the same report, European and North American countries have reached universal coverage. In Oceania, birth registration is near-universal (98%). However, in Central and South Asian countries, almost one-third of the total born children had never been registered (32%), and in Africa, that proportion is about 54%. (62)

The highest rates of unregistered children are in sub-Saharan Africa (SSA). According to the United Nations Children's Fund (UNICEF), of all infants living in this region, slightly less than 2 in 3 (just over 20 million) do not have their births registered, and around 3 in 4 (roughly 28 million) do not possess a birth certificate. A rapidly growing child population coupled with slow rates of change means that if current trends continue, there could be close to 115 million unregistered children under 5 in SSA by 2030. (55)

Despite the high number of unregistered children, birth registration is compulsory in most SSA countries, including Angola (Figure 3).

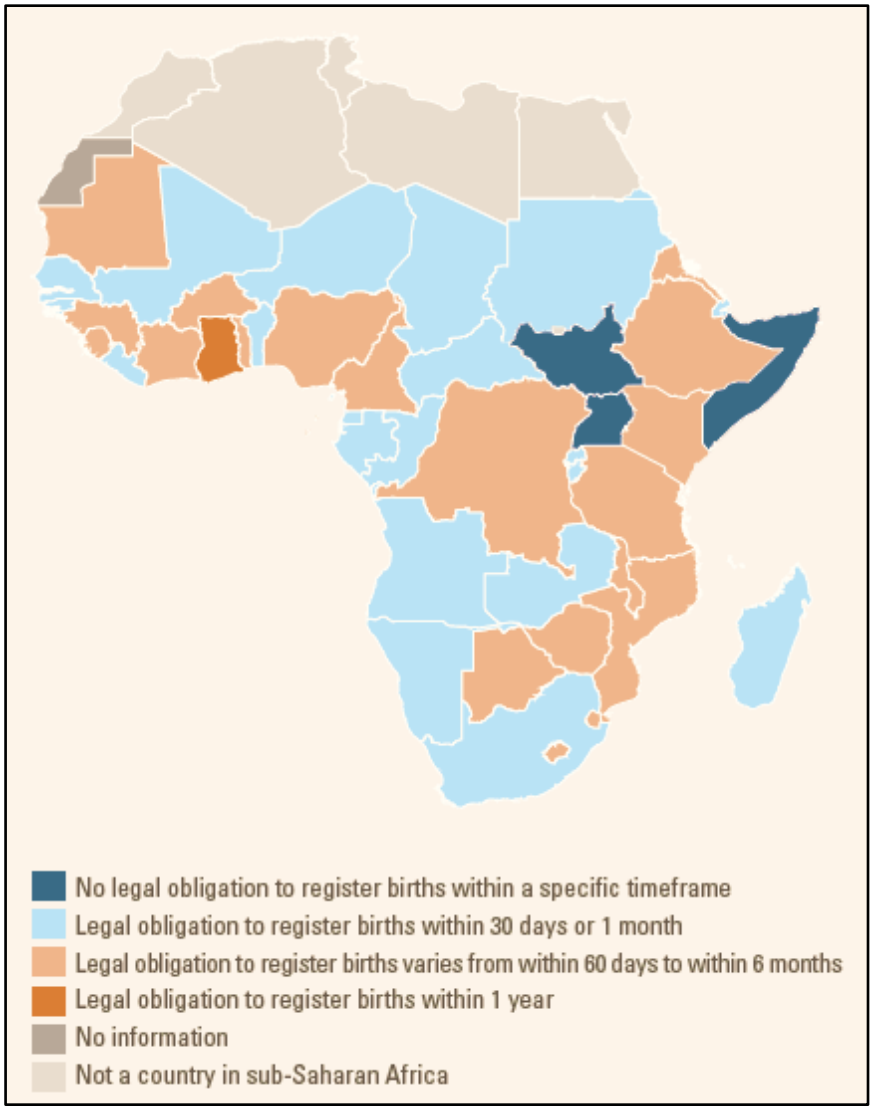

Figure 3– Sub-Saharan African countries according to the legal frame for birth registration

Source: (55)

However, it is often associated with costs, leading to significant barriers to the process of registration. Around 370 million children live in SSA countries where there are fees for birth registration (Figure 4), and in most cases, these reflect fines for late registration. (55)

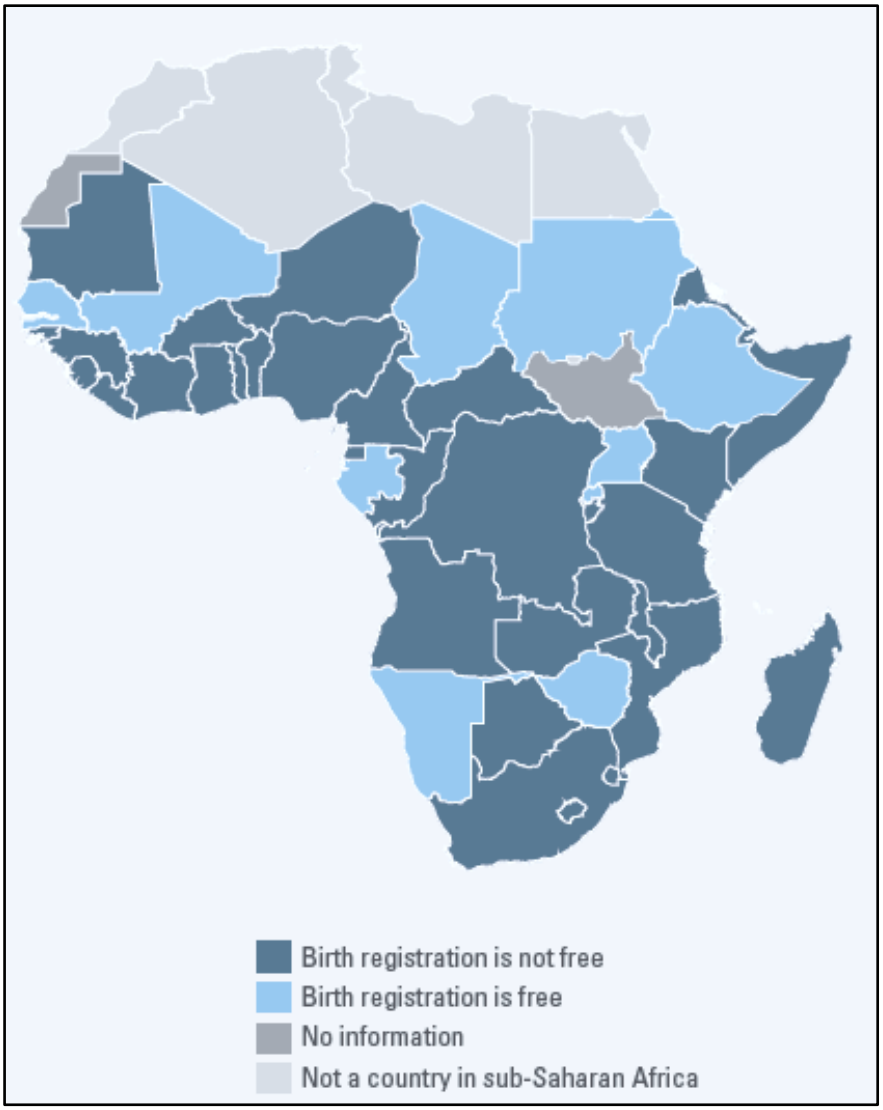

Figure 4 – Sub-Saharan African countries according to whether there are fees to register births, including fines for late registration

Source: (55)

1.2.2 Death registration and causes of death

Death is one of the priority vital events recommended by the UN for registration. In developed countries, it is assumed that all children are registered at birth and that all persons are registered when they die with a medical assigned CoD. In most developing countries, however, the onus of register a birth or a death is generally entirely on the family. Given the barriers mentioned above, many deaths go unrecorded. (59)

Certification of death is the foundation for monitoring mortality patterns and documenting the leading CoD. (65) The number and causes of deaths are primary inputs for governance and development, as that mortality statistics derived from these records provide critical evidence for health policy and planning. Statistics based on death records

are particularly important for identifying the magnitude and distribution of major diseases and are essential for designing, implementing, monitoring, and assessing health programmes and policies. (13) Moreover, death records are used to update individual identification systems, such as social security, electoral lists, taxation, and government service files.

Accordingly, death registration serves two critical functions: providing legal and administrative purposes and vital statistics for government planning and epidemiologic/health policy purposes.

The legal and administrative function concerns an individual's right to be counted at both extremes of life, fundamental to social inclusion. Although a relative's death is a loss that causes grief, it is legally necessary for the next of kin to register the death and obtain a death certificate. Death certificates provide legal evidence of the fact and circumstances of death and are often prerequisites for burial, remarriage, inheritance, social assistance, or the resolution of criminal cases that may arise concerning its occurrence. (66)

The statistical function, resulting in the compilation of deaths and CoD, provides important information for governments to track disease trends, set public health policies, allocate financial and technical resources for appropriate programmes and interventions, and identify and prioritise health research activities. (30, 59, 67) Mortality and CoD statistics benefit societies because they support governments to plan services for their citizens. (66)

Death certificates must be filled out completely, accurately, and promptly (67), but there remain considerable gaps in the availability and the quality of these crucial data in many parts of the world. The value of routine data collection sources for national well-being and public health progress in several poorer countries is often not acknowledged, either by physicians or policymakers. (65)

1.2.2.1 State of death and cause-of-death registration in the world

The above-described absence or fragility of CRVS and efficient HIS in the developing world jeopardises death registration quality in many countries. The coverage of vital routine registration and medically certified CoD in Southern Asia and Africa is minimal. The vast majority of deaths are not individually registered nor assigned a CoD, and thus, such cause-specific mortality data that do exist generally come from health facility records and ad hoc surveys. (68)

The constraints related to quality death data arise from several factors:

- Some countries do not have compulsory national death registration at a policy level, and the existing systems cover only part of the population with no CoD data for those dying outside of health facilities. (69, 70) In many rural or remote areas of LMIC, at least two-thirds and often more than 80% of deaths occur at home. In such countries, summary CoD statistics available are likely to be highly biased. They derive mainly from deaths in health facilities located in urban settings, which are not representative of deaths in the community and do not reliably show the general population's CoD pattern. (71)
- The scarcity of routine compilation of data for analysis, dissemination, and policy purposes leads to a limited understanding of death certification's importance within and outside the health sector. (70)
- Some countries charge fees to the family on registration of deaths or cause of death, increasing barriers to access this type of record. (69)
- Health facilities are not mandated to use Medical Certificate for Cause of Death form on the CoD recording. Nevertheless, even when they are, the poor quality of data can be an issue for policy-making. (70, 72)

Table 2 shows the distribution of world population according to country reports to the UN about completeness (at least 90% of events) of registration of deaths, from 1965-74 to 1995-2004. About 26% of the world's population lived in areas that claimed complete registration of deaths. There has been little improvement worldwide in four decades, and some regions even seem to have worsened their registration systems, such as the Americas and Eastern Mediterranean. The later, together with South-East Asia and Africa regions, present the most significant vulnerabilities in the complete death registration.

Table 2 - Percentage of population living in countries with complete death registration, by WHO Region

	1965-74	1975-84	1985-94	1995-2004
Total	**27%**	**25%**	**28%**	**26%**
Africa	2%	4%	2%	7%
Americas	69%	66%	64%	62%
Eastern Mediterranean	17%	21%	15%	1%
Europe	62%	61%	92%	86%
South-East Asia	1%	1%	1%	1%
Western Pacific	12%	12%	10%	13%

Completeness means that the system registers at least 90% of events (deaths). Figures for 1965-94 from the Demographic Yearbook (historical supplement 1948-1997), UN Statistics Division, New York, 2000. Figures for 1995-2004 are based on the Demographic Yearbook 2004, UN Statistics Division, New York.

Adapted from: (23)

Country reports to the WHO Statistical Information Systems (WHOSIS) are the primary source of international CoD statistics from civil registration systems. (23) As of December 2003, only 115 of 193 member countries, representing 72% of the world's population, had reported cause of death statistics to WHO. The vital registration systems of those 115 countries capture about 18.6 million deaths annually, representing one-third of all deaths occurring in the world. (73)

Table 3 summarises the number of countries reporting these data by WHO region. Death registration coverage varies from close to 100% in Europe to less than 10% in the African region. In only 64 of the 115 countries reporting data was considered complete, and this happens mainly in developed countries of the European, American, and Pacific regions.

Table 3 – Number of countries reporting data from their vital registration system to WHO and countries with no recent data, December 2003

WHO Region	Total no.	Complete data available	Useable data available	No recent data [a]	No data available	Member states with no recent data
Africa	46	1	4	42	25	Algeria,[b] Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Cape Verde,[c] Central African Republic, Chad, Comoros, Congo, Côte d'Ivoire, Democratic Republic of the Congo, Equatorial Guinea, Eritrea, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Mozambique, Namibia, Niger, Nigeria, Rwanda, Senegal, Sierra Leone, Swaziland, Togo, Uganda, United Republic of Tanzania, Sao Tome and Principe,[c] Zambia
Americas	35	14	33	2	0	Bolivia, Honduras[c]
Eastern Mediterranean	21	3	7	12	6	Afghanistan, Djibouti, Jordan[b,c] Iraq, Libyan Arab Jamahiriya, Mediterranean Pakistan,[b] Somalia, Sudan, Saudi Arabia, Tunisia,[b] United Arab Emirates,[b] Yemen
Europe	52	39	50	2	0	Andorra,[b] Monaco[c]
South-East Asia	11	0	4	7	4	Bangladesh,[b] Bhutan, Indonesia, Democratic People's Asia Republic of Korea, Timor-Leste, Maldives,[b] Nepal [b]
Western Pacific	27	7	17	10	4	Cambodia, Lao People's Democratic Republic, Marshall Pacific Islands,[b] Micronesia,[b] Papua New Guinea,[c] Palau,[b] Samoa,[b] Solomon Islands,[b] Vanuatu, Viet Nam
World	**192**	**64**	**115**	**75**	**39**	

[a] Information available from 1990 or later; [b] Information on deaths is available, but the CoD is not included; [c] Latest available year for information on CoD is prior to 1990.

Source: (46)

The map of the overall quality of death registration clearly illustrates the poor quality of reported data in Africa and South-East Asia (Figure 5). It considers criteria such as completeness of coverage of deaths and International Statistical Classification of Diseases (ICD) codes used (particularly the number of ill-defined codes). Angola is one of the countries with no recent data on mortality (Table 3 and Figure 5).

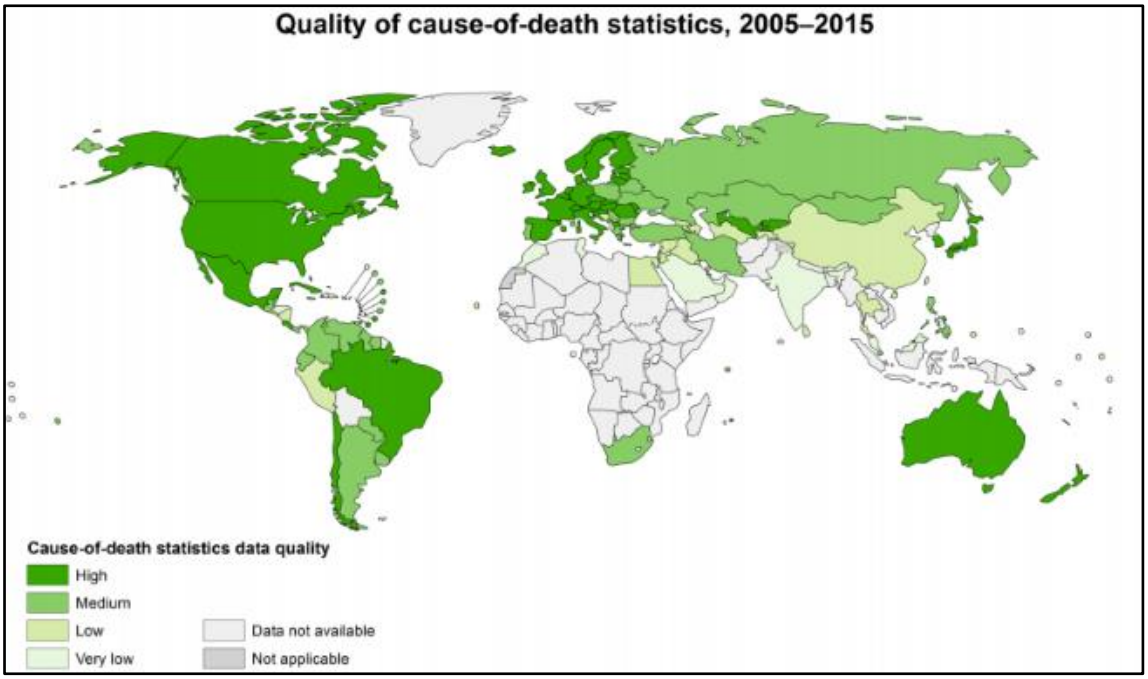

Figure 5 – Quality of cause of death statistics, 2005-2015

Source: (72)

1.2.3 Social determinants of health and public health

The SDH are the circumstances in which people are born, grow, work, live, age, and the broader set of forces and systems shaping daily life conditions. (74) These social conditions result in disparities in health care access, educational achievement, and economic status that influence populations' health, (75) predisposing particular groups to diseases and affecting a wide range of health, functioning, and quality-of-life outcomes and risks.

In 2005, the WHO set up the Commission on SDH to marshal the evidence on what can be done to promote health equity and foster a global movement to achieve it. In its final report, “Closing the Gap in a Generation”, the WHO emphasises the essential role of evidence-based policy-making to tackle health inequities and clearly shows the importance of broadening public health research scope to include a stronger emphasis on the SDH. (48)

Different global organisations have developed frameworks to understand SDH, and each one of them organises categories of determinants, establishing broad areas across multiple domains. The most used categories are related to economic conditions, education, health care, neighbourhood, and social and community context. (76)

The economic conditions commonly studied as determinants of health are household or individual income, asset-based measures, occupation, or subjective social status. Their effect on the health status of specific groups, in morbidity and mortality, is well studied in the scientific literature. (77-82) Even if those factors are not likely to directly affect, they serve as proxies for other determinants, operating through differential exposure to conditions that have more immediate health effects. (83) Some pathways by which socioeconomic status (SES) influences health are related to environmental exposure (such as housing quality aspects, overcrowding, and poor sanitation), health care (access to, use of, and quality of health care), and behaviour and lifestyle (such as smoking, diet, exercise, healthcare-seeking). (83, 84)

Education is usually reported as the completed number of school years, literacy, or as the highest qualification attained. Out of all the SDH, education is consistently ranked among the most important factors concerning health disparities. (85) Its association with adverse health outcomes is well-studied regarding different diseases, maternal, new-born and child health, and mortality. (85-89)

Nevertheless, it is important to stress that education and the other SDH dimensions do not act in isolation from other factors. Individuals exist in multiple, multi-layered, and interacting contexts. Each of these contexts is a social relations and environmental health domain, and education impacts both individuals and each one of those contexts. (90) Hence, education influences health by increasing individual knowledge, literacy, and critical thinking skills, affecting the occupational status and increasing job opportunities, improving healthy behaviours, managing risky activities, and boosting social-psychological factors. (85, 90, 91)

Another component of SDH usually evoked is health care, as limited access leads to an increased risk of poor health outcomes. (92, 93) Access to health care can be defined in a variety of ways, such as health care coverage, provider availability, and quality of care (94) organised in the following dimensions: availability, accessibility, affordability, and acceptability. (95, 96)

Access to, use of, and quality of health care vary by socioeconomic status. People in emerging countries tend to have less access to health services than those in better-off countries, and within countries, the poor have less access to health services. (93) Even

in places that provide universal coverage, persons of low SES, with less income and education, do not use health services in the same way as their counterparts' high SES, wealthier, and better educated. (83)

Several aspects contribute to restraining access to health care, especially in developing countries. Some of them are related to the knowledge and education deficits that prevent illness recognition and the potential benefits of treatment, constraining the demand for health care access. (92, 93) Also, the low quality of care offered, which impedes the development of trust. (96, 97) Finally, the costs appear frequently as a restriction for the use of health care. Even in settings where public care is theoretically free of charge, travel costs can be substantial, mainly for those living in rural areas and distant from health facilities. The poor conditions of roads imply time, effort, and costs to arrive at the point of health services delivery. Besides, informal payments can be frequent and considerable in many public health care systems. Inclusive, they might be higher than the legally charged costs or even exist when formal charges do not. (93, 96)

It has been estimated that scaling up the utilisation of effective health care could avert under-five child deaths by 63% worldwide if coverage rates of effective prevention and treatment interventions were to increase from the current levels to 99%. (98) The raising of critical maternal health interventions to a coverage of 99%, especially in obstetric care, would reduce maternal death by three-fourths. (99) Undoubtedly, these estimates for reducing deaths due to specific care emphasise the importance of access to health care as an essential determinant of health.

Aspects of the neighbourhood, such as place of residence (urban *versus* rural areas), physical environments, and housing conditions of individuals, are also frequently accessed in clinical and epidemiological studies as important SDH. Those from lower SES are more likely to live and work in worse environmental conditions. (83)

The focus on geographic characteristics has shifted in public health research, particularly in international health and community development. In the past, research has mainly documented the difference between urban and rural areas in terms of health care access and utilisation, cost, and geographic distribution of providers and services. However, the rapid increment of urbanisation and the epidemiological transitions began to direct its attention toward variations in population health, environmental health, and the differences between urban and rural health behaviours. Therefore, the dichotomy of urban *versus* rural areas has different epidemiological approaches. On the one hand, several studies prove that inhabitants from rural and remote areas of LMIC experience lower life expectancy and poorer health status than those from urban areas. (93, 100,

101) On the other, there is raising interest in the effects of urbanisation on health, (102, 103) mainly on chronic diseases, (104, 105) which increased in the developing world. (106)

Finally, social and community contexts are considered SDH dimensions, given their importance for individuals' health. Those consist of the social settings in which people live and act, such as relationships and the social, religious, cultural, and occupational institutions with which they interact. Aspects of the social and community context include social cohesion, civic participation, discrimination, and incarceration.

Several studies found a positive relationship between individual self-reported health, morbidity or mortality, and various social capital measures such as trust, participation in local organisations and social isolation. (107-110) Isolation and lack of engagement in social networks are strong predictors of health. Patterns of social interaction also affect disease risk. For sexually transmitted diseases, for example, the transmission is more rapid in high-risk networks, which are often clustered in more deprived areas, thus putting lower SES persons at higher risk for exposure. (83)

1.2.3.1 Research on SDH in developing countries

The previously presented factors are critical determinants of health and related inequalities. Nevertheless, there are differences between and within countries. It would be simplistic to assume that the effect of SDH is homogeneous everywhere. Therefore, the study of SDH aiming to reduce health inequalities might need to be specific since evidence can be context-dependent. (111)

Health inequality as a social phenomenon is multi-faceted with multiple causes, which requires multilevel research at local, national, continental, and global levels. Compared to other parts of the world, there is little research to address SDH and tackle many of the root causes of health inequalities in developing countries, where those are of the highest magnitude. (111-114)

In Angola, a few recent population surveys are addressing social and economic conditions of the population (115, 116) though little research is known on their effects as determinants of health. In this thesis, we include results on the analysis of social determinants of health based on data collected within the HDSS and VAS (Papers II, III, and IV).

1.3. Angola Country Profile

Angola is one of the largest countries in SSA, is situated in Central Africa (WHO Region D), and bordered by Namibia (south), the Democratic Republic of Congo (north), Zambia (east), and Atlantic Ocean (west). Portuguese is the official language of Angola and is spoken by most of the population, but there are more than 18 national languages. (14)

The country covers an area of 1.246,700 km^2 and is divided into eighteen provinces.

The first population census since the country's independence in 1975 was carried out in 2014. The Census registered a population of 25.789,024 residents, 12.499,041 males (48.5%) and 13.289,983 females (51.5%). (115)

Luanda concentrates 26.9% of the country population, with 6,945,386 residents, and the Province of Bengo, where the present study took place, is the least populous in the country, with 1.4% of the total population, corresponding to 356.641 residents. The population density in Angola is 20.6 individuals per km^2, 368.9 in Luanda and 17 in Bengo. (115)

Table 4 shows the distribution of the national population by place of residence, provinces, and age-groups.

Table 4 – Geographic and age group distribution of the population in Angola

		N	(%)
	Angola	25 789 024	(100)
Place of residence	Urban	16 153 987	(62.6)
	Rural	9 635 037	(37.4)
Provinces	Bengo	356 641	(1.4)
	Cuanza Norte	443 386	(1.7)
	Namibe	495 326	(1.9)
	Cuando Cubango	534 002	(2.1)
	Lunda Sul	537 587	(2.1)
	Zaire	594 428	(2.3)
	Cabinda	716 076	(2.8)
	Moxico	758 568	(2.9)
	Lunda Norte	862 566	(3.3)
	Malange	986 363	(3.8)
	Cunene	990 087	(3.8)
	Bie	1 455 255	(5.6)
	Uíge	1 483 118	(5.8)
	Cuanza Sul	1 881 873	(7.3)
	Huambo	2 019 555	(7.8)
	Benguela	2 231 385	(8.7)
	Huíla	2 497 422	(9.7)
	Luanda	6 945 386	(26.9)
Age group	0-14 years	12 196 496	(47.3)
	15-64 years	12 980 098	(50.3)
	≥ 65 years	612 430	(2.4)

Adapted from: (115)

1.3.1 The socioeconomic context and the health sector

The country faced one of the bloodiest and prolonged conflicts in Africa: fourteen years of armed struggle with the Portuguese colonial power, from 1961 until 1975, the year of Angola's independence, followed by a protracted civil war for almost 30 years, ending on April 4, 2002. (117)

The war's repercussions were vast destruction of infrastructures (roads, railways, bridges, agriculture), the country's interior areas heavily mined, and a torn social fabric. The conflict triggered numerous deaths and massive migration from rural to urban areas, exacerbating geographic disparities in income, opportunities, and human capital and leading to a humanitarian crisis, with dramatic consequences on the economy, health system and social welfare. (14, 15) The need to rebuild infrastructures and meet the most pressing needs of the population became a priority. (118, 119)

The rapid economic growth experienced after the end of the civil war was favourable to socioeconomic changes. Between 2000 and 2010, Angola had the fastest growing economy in Africa and one of the fastest in the world, with a Gross Domestic Product (GDP) per capita average annual growth rate of 12.28%. (120)

Especially since the beginning of the century, the country made progress towards improving key health indicators such as life expectancy at birth, which went from 45 years in 2000 to 52 in 2014, and maternal mortality rates, which went from 924 deaths per 100,000 live births in 2000 to 493 in 2014. (15) However, regardless of those improvements, most health key indicators remained weak compared to other LMIC and SSA countries. (15) (Table 5) The economic growth outpaced human development. (121-124)

Table 5 – Social and health indicators in Angola, SSA, LMIC, and upper and middle-income countries (UMIC), 1990-2014

	1990	2000	2010	2014
Life expectancy at birth				
Angola	41	45	51	52
SSA	50	50	56	57
LMIC	60	63	66	67
UMIC	68	71	74	74
Infant mortality rates (per 1,000 live births)				
Angola	134	128	110	99 (44)*
SSA	109	94	66	58
LMIC	83	66	47	41
UMIC	42	31	18	15
Maternal mortality rates (per 100,000 live births)				
Angola	1,160	924	561	493
SSA	987	846	625	560
LMIC	533	410	284	257
UMIC	114	86	63	55

Note: World Bank Development Indicators database data.worldbank.org (*) 2015-16 Multiple Indicator and Health Survey (IIMS)

Source: (15)

Until 2014, the oil-based economy produced growth rates above 8%, but with the decreasing in global prices, rates fell to 4.8% in 2014 and 3.0% in 2015 (124), and, since then, the abrupt and continued fall in oil prices led the country to a financial crisis. According to the World Bank, the recent economic crisis has affected several sectors of society, including the health sector. Therefore, it is likely to have adverse effects on health outcomes jeopardizing the progress made so far. (15)

Between 2013 and 2018, Angola's public debt more than doubled, going from 33% to 70.5% of the GDP. (125) On the contrary, the government budget allocated to health has been decreasing over the years. In 2014 the general government expenditure in health was 4%, in 2015 was 4.4%, and in 2016 had gone to 3.7%. (126)

In Angola, similarly to what happens in other developing countries, domestically financed government expenditures on health fall well short of Abuja Commitment targets (to allocate at least 15% of their annual budget to improve the health sector), and of resource requirements to reach the health SDGs. (127) Therefore, as in most developing countries, the health system is weak, characterized by a lack of planning, inefficient

budgeting and governance, dilapidating infrastructures, shortage of health workforce, and a general lack of adequate information systems. (128, 129)

1.3.2 Health system

In 2001, on the broad government reform sequence, Angola embarked on decentralising the public health system, both at administrative and decision-making levels. (117, 130)

The health system is organised into three levels of care (primary, secondary, and tertiary), corresponding to levels of government (district, provincial, and national) (Decree No.262/10 of November 24, 2010). (15, 130, 131)

The Angolan Ministry of Health (MINSA) is responsible for policy, planning, regulation, training, public health programmes, and essential drugs procurement. The MINSA carries out its technical guidance role through various national health programmes, most of which are heavily dependent on external assistance (*e.g.* malaria, epidemiological surveillance, reproductive health, tuberculosis, among others). (130) The public health delivery system is responsible for the tertiary level, consisting of national and specialised hospitals. With its Provincial Health Directions, the Provincial Governments are responsible for the second level, including general and monovalent hospitals. The Municipal Governments increasingly manage the primary health care network, consisting of health centres and posts, municipal hospitals, nursing stations and doctor's offices. However, there is a limited administrative and technical capacity at the local level, constraining the decentralisation process's challenges. (14, 15)

Documents published recently cite different numbers of health facilities at each level, suggesting some uncertainty in the classification of health posts, for example, and lack of updated information on their functionality. (130) The most recent official report at our acknowledge (MINSA, 2016) indicates 3,023 public health facilities: 2,120 health posts, 700 health centres, 145 municipal hospitals, 46 provincial hospitals, and 12 central hospitals. (132). Private health sector providers include both for-profit and non-profit entities. The formers are mainly in large urban centres and their peripheries, where the public network is limited. The non-profit providers are mostly managed by religious and non-governmental organisations, serving the outskirts of cities and rural areas and mainly disadvantaged communities. (15) Private health insurance must be purchased out-of-pocket and accounts for less than 0.5% of the total health spending. (117)

There is an asymmetric distribution of health facilities in the country: 24% of the rural population has access to a public health centre or clinic within a 2km radius, compared to 63% of the urban population. (117, 132) Besides that, public health services deliveries

are often in an advanced state of degradation and are poorly equipped. Especially primary health care facilities suffer from many lacking proper conditions, such as connection to water, electricity, sanitation pipelines, and clinical equipment. For that reason, Angolans tend to bypass the primary level and go straight to the provincial hospitals, causing overloading at this level. (15)

One of the main problems of the national health system identified by the Ministry of Health is the weak referral and counter-referral mechanisms between the three levels of the service. (132) Another problem is the quantitative and qualitative insufficiency of human resources and poor health workforce distribution in rural and urban areas. (119)

According to the Atlas of African Health Statistics, the physician-to-population ratio (per 10,000 population) for 2007-2013 in Angola was 1.7, inferior to the African WHO Region average, of 2.7. However, the registered ratio of nursing and midwifery per 10,000 inhabitants in the same period was higher in Angola, 16.6, compared with the average of African countries, of 12.4. (133) In 2016, the Ministry of Health registered in the National Development Plan for 2018-2022, 2.38 physicians and 13.22 nurses per 10,000 inhabitants. The goals for 2022 more than double the registered numbers of 2016 and consist of 5 physicians and 35.35 nurses per 10,000 inhabitants. (132)

1.3.3 Health Information System

After the war, Angola was left without a functioning health care system, with limited information/data to support policies and decision-making processes, and serious development challenges, particularly poor public health. (14, 117, 120)

The health sector’s contribution to the National Development Plan emphasises the critical existent information system, establishing the HIS's strengthening as one of the priority keys in health. (117, 132)

The country suffers from many of the contingencies described in previous sections concerning CRVS and HIS status. specific to developing countries.

According to different assessment reports of the Angola Health System, the HIS in Angola lacks funding, efficiency, planning, accurate data, and the ability to analyse and use data for decision-making purposes. (14, 130, 134) There are multiple parallel data flows, with different national programmes that maintain their vertical datasets and forms but mainly operating in a unidirectional way. The flow of routine health information is exclusively one-way from the service delivery and surveillance locations to the national level with little capacity or incentive at any level to use the data for decision-making. (14) This one-way process does not contribute to motivating data collectors to be concerned

about data quality. In this context, the MINSA recognises the need for “The integrated HIS [must] ensure a permanent flow of information from the bottom to the top of the health system, with due feedback from the central and intermediate levels to the primary level.” (134) Out of the national 18 provinces, only Luanda province has a health strategy that includes health data. (130)

Strategic goals to improve the health system and health outcomes in the country include producing reliable and timely statistical data and information for decision-making, planning, resource management, and assessing the health situation and its trend. Moreover, health information capacity improvement also encompasses professionals' training in priority areas, such as public health, epidemiology, statistics, management and administration, logistics, and information technology. (132)

1.3.4 Sociodemographic and health-related data in Angola

Angola is one of Africa's SSA countries, where the systematic recording of vital statistics is still weak.

During the war, as many as one million Angolans died, 4,5 million were internally displaced, and 450,000 had fled the country. (14) The context of prolonged civil conflicts and the respective debilitation of infrastructures, destruction of civil registration services, and massive displacement of populations to escape the war hindered the existence of effective records of structures and population dynamics. (44, 135)

Official records of births, deaths, and causes of death, essential for understanding public health status in the country, are incomplete.

The national Census of 2014 revealed that almost half of the national population (47%) was not registered in the Civil Registration Services. Only one quarter (25%) of children under five years had a birth certificate in Angola, which means that more than 3,5 million children in this age group do not exist in the legal system. (115, 136)

Evaluation reports on the national HIS state that the mortality subsystem has been inconsistent and unable to produce reliable indicators. (119, 134) Mortality rates obtained do not allow an accurate assessment of the country's situation, given that death certification outside the formal health system is limited. (14) Moreover, the estimation of mortality indicators is based on records of public hospitals, mainly from Luanda, which is not representative and sufficient to inform the population's health status. (134) It is estimated that only about 5% of under-five children deaths take place at the hospitals (137) and that barely 44.6% of the population has access to any type of health care. (132)

The shortage of accuracy on reported death's number is aggravated by the lack of knowledge of their causes. (14) As of June 2007, Angola is among the 68 countries (24% of the world population), for which CoD data was not reported to WHOSIS. (23)

Meanwhile, some efforts are being made to maintain systematic data collection systems at the national level by applying health system regulations and introducing provincial health maps to guide infrastructure investment and operational decisions. (14) Further, in the last decades, the country has benefited from several household surveys and other studies, which are examples:

- The Malaria Indicator Survey 2006-07 (138)
- Integrated Population Welfare Survey 2008-09 (IBEP) (139)
- The Malaria Indicator Survey 2011 (140)
- Multiple Indicator and Health Survey 2015-16 (IIMS) (116)

Besides, as we mentioned before, in 2014, Angola carried out the first national population census (115) since the country's independence. Likewise, invested substantially in civil registration infrastructures, particularly birth registration (135).

All those sources provide essential health, population, and social data fundamental to health outcomes measures, although the resources needed to register and report accurate and complete health and vital statistics are not yet fulfilled.

1.4. Health and Demographic Surveillance System (HDSS)

With the rudimentary state of vital registration and HIS in most developing nations, estimated projections are sometimes based on educated guesses and intuition rather than facts. (141, 142)

Several strategies for collecting and analysing data have been developed as interim substitutes for complete civil registration to bridge information gaps, such as population Census, Sample Registration Systems, Demographic Household Surveys, Demographic Surveillance Sites. Each one of them has strengths and weaknesses, and they must be complementary rather than competitive. (6, 143) The latter is the focus of this work, as well as its integrated Verbal Autopsy System, both created to respond to an information gap. They were used as alternative data collection systems, at a local scope, in a context where there were no accurate and sufficient official data to guide research, provide empirical evidence, and direct public health knowledge and interventions.

An HDSS is a longitudinal data collection process that systematically and continuously monitors population dynamics for a specified population in a geographically defined area that lacks an effective system for registering demographic information and vital events. (6, 44, 144-146)

The first HDSS was implemented in 1940 in South Africa, and in the last 40 years, many developing countries have responded to the absence of effective health and population data by establishing such systems. (147) There are 57 known field sites located in LMICs, 42 sites are spread in Africa, 13 in Asia and two in Oceania. (148)

Considering the Portuguese Speaking African Countries (PALOP), there is an HDSS situated in Mozambique, established in 1996 by the Manhiça Health Research Centre (CISM), and the Dande HDSS, situated in Angola, established in 2009 by the Health Research Centre of Angola (CISA). The latter is the focus of this thesis. Its implementation was inspired in the Manhiça HDSS.

The Dande HDSS Centre is the only one in the region of Central Africa (Figure 6).

Most of the HDSS is part of the International Network for the Demographic Evaluation of Populations and Their Health (INDEPTH), a global network of research centres that conduct longitudinal health and demographic evaluation of populations in LMIC (Figure 6). (149)

Figure 6 – HDSS in the World in 2018

Note: The red marks represent countries with HDSS (members of the INDEPTH Network in 2018). The yellow mark represents the Dande HDSS (not a member of the INDEPTH Network).

Adapted from: (148)

The general methodology of an HDSS consists of performing an Initial Census (baseline), enumerating, and registering everyone in a specific demographic surveillance area (DSA) to define the target population. Regular subsequent update rounds, consisting of periodic visits to all the households in the DSA, monitor births, deaths and migrations, the only events that can change the initial population. (150) Figure 7 illustrates the process.

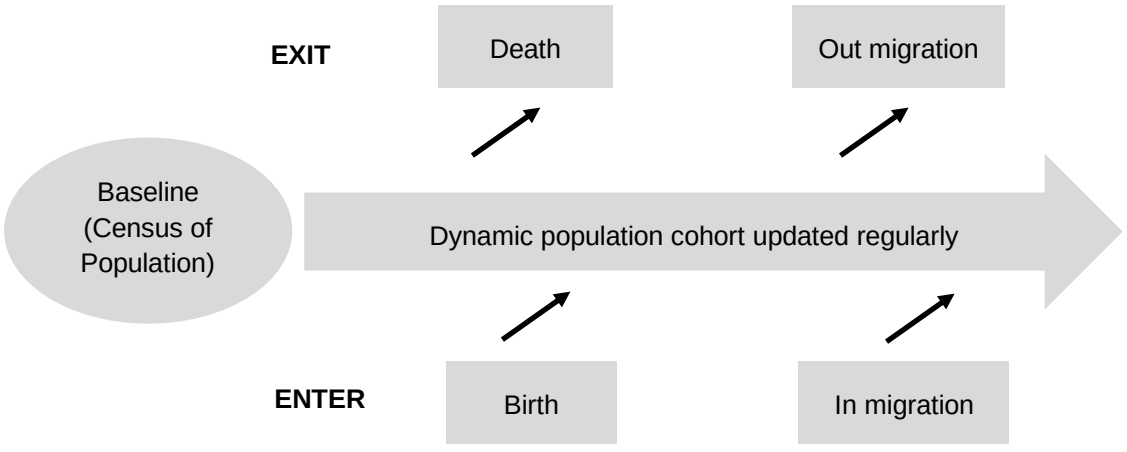

Figure 7 – The structure of an HDSS

Adapted from: (146)

Some HDSS often complement these core demographic data, gathering other variables during follow-up periods, such as health-related and socioeconomic factors, to investigate risks of diseases or health conditions or to identify high-risk groups among communities in the area. (146, 147, 150)

The origin of the HDSSs was based on the concept of a prospective community study (PCS) designed in the early twenty century, aiming at the prospective and systematic follow-up of a community to research fields such as demography or public health. (147) Over the years, numerous HDSS has been instituted with different purposes, but they all track population and demographic changes within their research sites or surveillance areas. (44) Therefore they are effective research instruments that can capture the rapidly-changing dynamics of health and social transitions in developing settings, (145) and their value as a stable and reliable source of information has been increasing with regard to health and demographic data from areas and regions that lack data collection systems for vital statistics. (143, 146, 151)

1.4.1 The Dande HDSS

The profile of the Dande HDSS with more detailed information on questions such as why it was set up, where is the DSA, who covers, what measures and key findings are presented in the Results section of this thesis (Paper I).

This section will briefly describe aspects related to the design and implementation of the Dande HDSS, general data collected, characteristics of the population and housing conditions since the Initial Census, and the main challenges and constraints of research in the resource-poor setting of Dande.

1.4.1.1 Setting up an HDSS in Dande

In 2007, a partnership between the former Portuguese Institute for Development Assistance (former IPAD and currently Camões – Institute for Cooperation and Language), the Calouste Gulbenkian Foundation (FCG), the Angolan Ministry of Health (MINSA), and the Bengo Provincial Government (GPB), created CISA, a project for the implementation of the first Health Research Centre in Angola.

CISA's general objectives were to conduct epidemiological research on the most prevalent diseases affecting the country's population and its risk factors; to promote the integration of Angolan health professionals in national and international research projects; and to provide learning opportunities in its several research areas for national health professionals, graduate students and researchers.

CISA was implemented within the facilities of the Bengo General Hospital (HGB), in Caxito, a city 60 km northeast of Luanda, in the Municipality of Dande and capital of Bengo Province. Its location was fundamentally due to three reasons:

- The proximity of Luanda and the implementation in the same geographic area as that of the Bengo region's referral hospital (HGB) to work in articulation in defining the primary health research needs and collaborating in research hospital-based studies.
- The existence of the Internship Centre of the Faculty of Medicine within the HGB, enhancing the connection and training of medical students in health research.
- Moreover, because Bengo, including Caxito, is an endemic area for the main diseases with public health relevance in the country, which constitute CISA's research interests (such as malaria, schistosomiasis, soil-transmitted helminthiasis, trypanosomiasis).

The scarcity of population and health data (as morbidity and mortality) to support research led to creating an HDSS. The Dande HDSS was implemented in 2009 to collect accurate longitudinal data on population structure, dynamics, and location. It aimed to provide reliable and up-to-date denominators for calculating vital rates and analyses requiring at-risk populations and serving as a sampling frame for epidemiological or other health-related studies. (152)

The implementation of the HDSS was prepared in collaboration with local authorities, including the Municipal Administration of Dande (AMD). The Dande municipality has five communes (Caxito, Mabubas, Úcua, Barra do Dande and Kicabo) with a territorial extension of 7,384 km^2 (Governo Provincial do Bengo, 2014[1]. Unpublished work), and according to data provided by the AMD, the population of the entire administrative area was around 60,000 people. Therefore, the HDSS was planned based on this assumption.

However, before the Initial Census, the households of the area were counted to preview the census dimension and estimate logistic needs. It became evident that the real number of individuals would fairly exceed the estimates of the total population based on AMD data. Given the constraints and logistic challenges of creating an HDSS and maintaining the population's follow-up in such a large area, only three of the five communes of the Dande Municipality were included (Caxito, Mabubas and Úcua), keeping the initial plan of about 60,000 people under surveillance.

[1] Governo Provincial do Bengo. Perfil Municipal do Dande. Dande, Angola: Administração Municipal do Dande, Governo Provincial do Bengo; 2014. [Unpublished work]

The three communes included in the DSA are contiguous (Figure 8) and comprise urban and rural settings, with a variety of landscapes and environmental conditions. The Dande HDSS covers an area of 4,764 km^2 (152) involving 71 neighbourhoods, of which 30 are considered urban (agglomerations of 2,000 or more inhabitants and basic infrastructures), and 41 are rural, following the definitions of the National Institute of Statistics of Angola (INEA). (139)

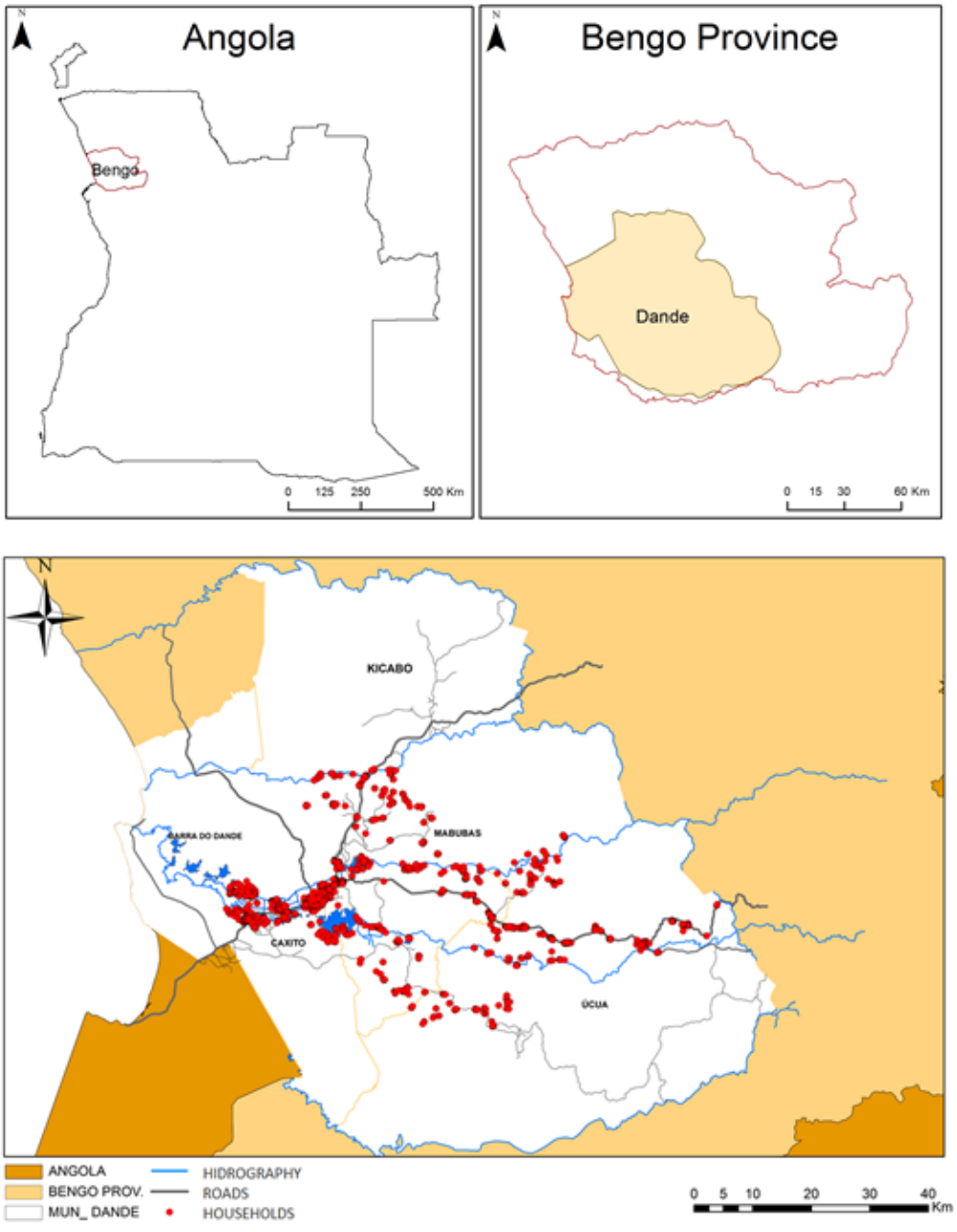

Figure 8 – The Dande HDSS, Dande Municipality Bengo Province, Angola

Source: Dande HDSS

The Initial Census established the baseline population of 59,635 inhabitants, distributed per 15,579 households. The census registered 43,106 residents in Caxito (72% of the DSA total population), much more than the 25,000 estimated by the AMD for the same area. The discrepancy between the Dande HDSS Initial Census results and the official data provided by the AMD, highlights the need for accurate data.

1.4.1.2 Implementation procedures in the field

The Dande HDSS activities were presented and discussed with administrative and traditional authorities (known as *sobas*) and local leaders, especially those usually on community committees, namely coordinators and secretaries of the neighbourhoods, and representative leaders of the Organisation of Angolan Woman (called *Mamã OMA*).

Before the Initial Census, the coordinators collaborated with the Dande HDSS team to recognise the territory and define communes and neighbourhoods borders (Figures 9 and 10).

Figure 9 and Figure 10 – Community leaders working with HDSS field workers in the definition of the neighbourhoods and communes borders within the DSA

Source: Dande HDSS. Photos taken by Maria João Berhan

In a context of a recent prolonged civil war, a very militarised and politicised society, where the population and the local authorities were not used to door-to-door questionnaires or to provide personal and household information, the collaboration with coordinators was essential at the beginning of the HDSS activities. They played a crucial role in raising people's awareness of the objectives of the HDSS and on the periodic presence of surveyors in the field to collect data in all the households. They served as mediators between the population and HDSS team, helped arrange community meetings, and contributed to establishing a relationship based on trust.

These meetings were organised at different moments and had several purposes: before the beginning of fieldwork, to inform the population about the HDSS´s objectives and mobilise people to cooperate, to present and discuss new projects, and to report feedback of results to the community.

Figure 11 shows one of the dozens of meetings with the community.

Figure 11 – Meeting to inform the population about the HDSS´s objectives and mobilise them to cooperate

Source: Dande HDSS. Photo taken by Maria João Berhan

Additionally, before the beginning of fieldwork, there were some meetings with military and police authorities, explaining the objectives of the HDSS and underline the scientific, confidential, and civil (non-political) nature of the data collection.

1.4.1.3 Data collected by the Dande HDSS

The Initial Census was performed between August 2009 and March 2010. After that, the inquirers visited periodically every household in the DSA to update demographic events (births, deaths, migrations, and pregnancies) and housing information. In each of those visits, called Update Rounds (UR), the fieldworker had the support of a UR book (*Livro de Ronda*), a form summarising all the individual and household data collected in the prior visit to guide the interview. The inquirers checked all the information and completed it or changed it according to each household's situation.

Between 2009 and 2017, the Dande HDSS carried out 11 UR and collected information at individual and household levels. Until the 5th UR (end of 2011), data have been obtained through quarterly rounds, and after that, the periodicity varied, mainly for logistical and financial reasons, and the visits started to be biannual or annual.

The Dande HDSS surveys recorded salient features of each household's living conditions and assets in the DSA, covering such areas as building materials, access to improved water and electricity, and ownership of assets, transport, and livestock (detailed in the Methodology chapter). Besides the characterisation of the surveilled population, the data collection of several socioeconomic variables intended to study social determinants of health and compare local results with national and international surveys, such as those of Demographic Health Surveys (DHS).

From the 9th UR (2015) onwards, were introduced health-related questions in the periodic survey visits, namely on health behaviours (such as malaria prevention, antimicrobial storage and use, health-seeking behaviour), reported fever, and health care needs.

In addition to the routine information collected, which was analysed in the studies that make up this thesis, specific questions were introduced to develop studies III and IV. Besides the routine data on pregnancy outcomes, maternal health care access and the woman's reproductive history were added for study III. For study IV, the MacArhurs Scale was tested in the field to measure the subjective perception of status, aiming its validation for further studies on health inequalities. Moreover, were collected data on population health reported needs and health-seeking behaviours.

Farther to the demographic events monitored in all UR (births, deaths, and migrations), were also registered and monitored pregnancies to a better follow-up of birth outcomes, enhancing the reporting of childbirth, as well as neonatal and maternal deaths.

The data collected in each UR at the household, individual, and demographic levels and variables related to health issues are displayed in Table 6.

A detailed description of the HDSS survey instruments will be presented in the Methodology chapter.

Table 6 – Data collected in the Dande HDSS since the Initial Census

	Data collected	Initial Census	1st UR	2nd UR	3rd UR	4th UR	5th UR	6th UR	7th UR	8th UR	9th UR	10th UR	11th UR
Households	House characteristics	X					X				X	X	X
	Assets						X				X	X	X
	Geographical coordinates	X	X	X	X	X	X	X	X	X	X	X	X
Individuals	Personal Data	X	X	X	X	X	X	X	X	X	X	X	X
	Education	X	X	X	X	X	X	X	X	X	X	X	X
	Place of birth						X	X	X	X	X	X	X
Demographic Events	Births	X	X	X	X	X	X	X	X	X	X	X	X
	Deaths	X	X	X	X	X	X	X	X	X	X	X	X
	Pregnancies	X	X	X	X	X	X	X	X	X	X	X	X
	Migrations	X	X	X	X	X	X	X	X	X	X	X	X
Other variables	Household income										X	X	X
	Subjective social status										X		
	Media utilisation										X	X	X
	Social capital										X	X	X
	Health care needs										X	X	X
	Health care seeking behaviour										X	X	X
	Mosquito bed net utilisation										X	X	X
	Reported fevers											X	
	Antimicrobial storage and use											X	

Source: Dande HDSS

Given the importance of the geographical location of events for understanding health outcomes, (153, 154) the households were georeferenced in all UR, using a geographic positioning system (GPS) Garmin 60 Cx. Household georeferentiation was complemented by collecting coordinates of relevant locations such as roads, paths, rivers, lakes, irrigation channels, and buildings (health facilities, schools, administration, churches, among others). All the coordinates were integrated into a geodatabase, which formed a Geographic Information System (GIS) within the HDSS. (152) The use of geographical coordinates allowed the linkage between HDSS data and health data, health facilities, local infrastructures, and environmental conditions (such as roads and rivers). The GIS within the HDSS aimed the organisation of fieldwork (maps with size, distance, accessibility, and the number of households per neighbourhood), the update of existing cartography, geospatial analysis (spatial disparities, delimitation of risk areas, adverse environmental factors) and, finally, the selection of samples for epidemiological studies.

Figures 12 and 13 are examples of some of the maps produced with geographical data collected within the HDSS.

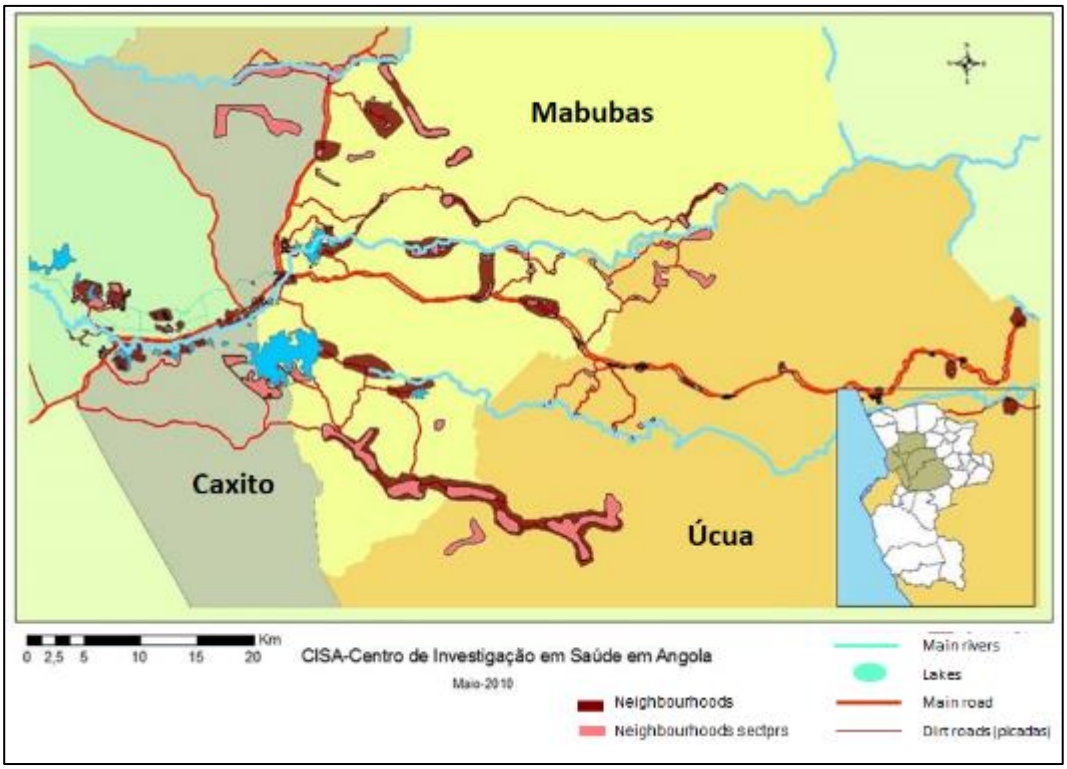

Figure 12 – DSA map showing neighbourhoods, sectors, hydrography, and roads

Source: HDSS and GIS Database

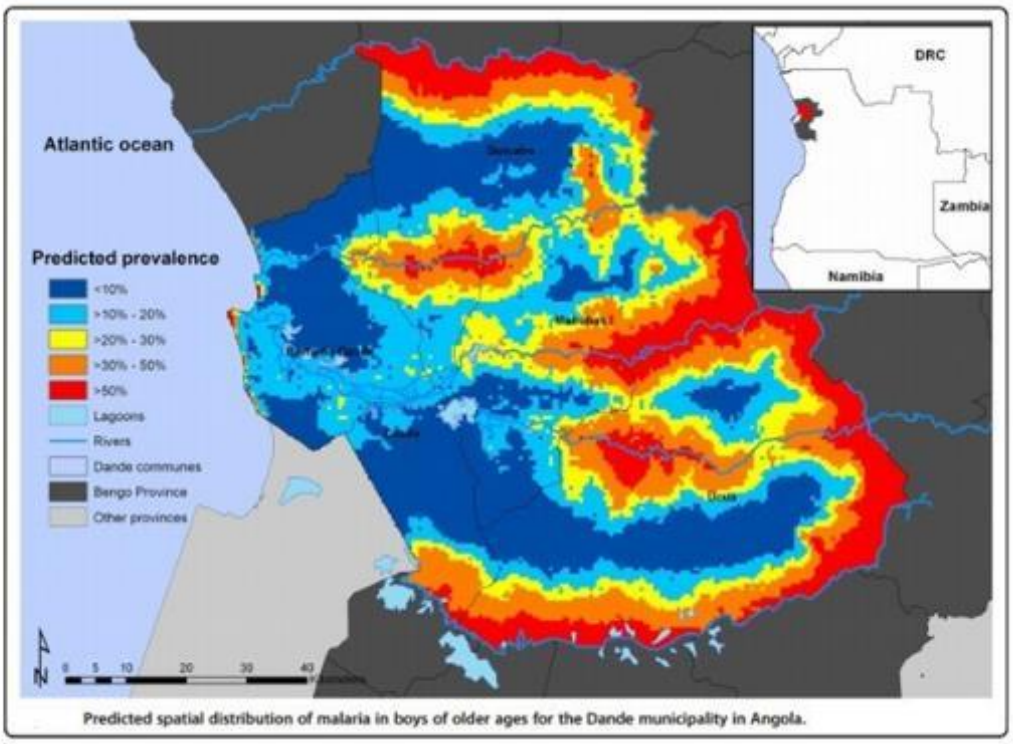

Figure 13 – Map of the predicted spatial distribution of malaria, produced with geographic data collected by the HDSS

Source: (155)

1.4.1.4 An overview of the surveilled population

The number of residents registered in the DSA at the end of 2010 (63,081) registered an increase of 6% compared with the baseline population assessed by the Initial Census (59,635). In the following years, the number of residents registered an overall decreasing tendency, except in 2013. In 2014, the INEA performed the national census. The government promoted an extensive media campaign since the population had not been registered at the national level for over 40 years. The CISA and the HDSS team considered that the coexistence of inquirers in the field was not appropriate so as not to confuse or overburden the population with door-to-door surveys. Therefore, data collection was suspended during 2014 and, in the same year, was completed an exhaustive data cleaning process of the HDSS databases. This pause may be the consequence of the decline in 7% of the registered population observed in the same year. (Table 7)

Table 7 – Number of residents registered in the HDSS area from 2010 (Initial Census) to 2017 (11th UR)

Year	HDSS visits	Number of residents	Annual variation (%)
2009-2010	Initial Census / baseline	59,635	
2010	1st and 2nd UR	63,081	6%
2011	3rd to 5th UR	62,000	-2%
2012	6th UR	60,807	-2%
2013	7th to 8th UR	62,900	3%
2014		58,645	-7%
2015	9th UR	58,276	-1%
2016	10th UR	59,530	2%
2017	11th UR	58,481	-2%

Source: HDSS database. Unpublished data.

The studies included in this thesis were based on data collected from the Initial Census to the 9th UR. Therefore, the following paragraphs describe the characteristics of the HDSS population from the baseline until 2015.

Figure 14 illustrates the age pyramids of the surveilled population in the Initial Census and 2015. The change in age structure is especially evident in the expanding shape of the pyramid in the age groups of 0-4 and 5-9 years in the baseline, opposing to a contracting shape in the same age groups in 2015, suggesting an underreporting of births and under-five children in the 9th UR (Correia and Severo, 2020.[2] Unpublished work). On the contrary, the groups aged 10-14 and 15-19 years were underrepresented in 2010 compared to 2015.

[2] Correia D, Severo M. Report to assess the feasibility of data analysis in the CISA project. Health and Demographic Surveillance Sistem 2019 Profile. Porto: Instituto de Saúde Pública da Universidade do Porto; 2020. [Unpublihed work]

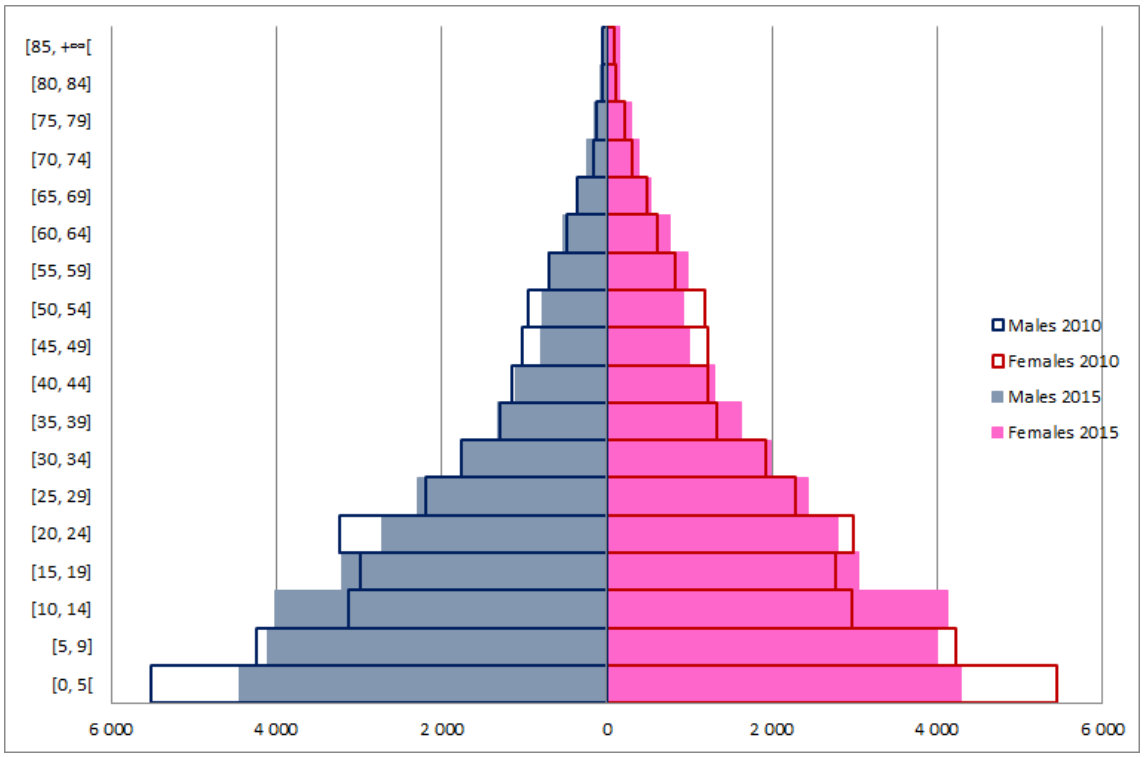

Figure 14 – Age pyramids of individuals registered in the Dande HDSS, at the Initial Census (2010) and in the 9th UR (2015)

Source: HDSS database. Unpublished data.

In 2015, the population density in the Dande HDSS study area was 12.6 inhabitants per km^2. Urban areas concentrated a significant part of the population (78% of the households, corresponding to 84% of residents). The average number of inhabitants per household was 4.4 (4.6 in urban centres and 3.2 in rural areas), which was influenced by the large number of households composed of singular persons (18% of the total, 11% residing in urban and 7% in rural areas).

The average number of rooms per household was 2.7 (Standard deviation, SD=1.3), and 8.9% of the households lived in overcrowding conditions, considered when there were more than three people per room. (156) In the urban areas, households had in mean of 2.8 rooms (SD=1.38), and in rural settings, 2.5 (SD=1.15), with 10.0% and 5.1% being overcrowded, respectively.

The population mean age was 23.4 years (SD=18.1), and predictably younger in urban centres (mean age=22, SD=17.5) than in rural areas (mean age=30.8, SD=23.2). The median age was 18 years, both for the total population and urban areas, and 24 years in rural settings.

Those values and the different demographic ratios presented below (Table 8) show that the age structure differed considerably according to the place of residence.

Of the population living in urban areas, 54% was under 20 years, and 3% was 65 or more years, whereas those proportions were 44% and 10% in the rural areas.

The indicators of fertility also show different patterns according to the place of residence. Women of childbearing ages represented 48% of the female population in urban centres and 36% in rural areas. The ratio that measures the relationship between the two halves of the female population in reproductive ages shows that the potential for fertility, defined as the number of women aged 20-34 per 100 women aged 35-49, was 201 in urban areas, almost the double than in rural settings, which was 105.

The child-women rate (CWR), which can be used as a rough indicator of fertility levels (as it only accounts for children who survive to 4 years of age), showed 663 children per 1,000 women of childbearing age in rural neighbourhoods against 606 in urban areas.

A description of the sociodemographic characterisation of the baseline population was published elsewhere. (152, 157)

Table 8 - Demographic ratios calculated for the Dande DSA, per residence area, 2015

Indicators	DSA	Urban	Rural
Youth dependency ratio *(aged 0-14 / aged 15- 64)*100*	78	80	67
Old-age-dependency ratio *(aged 65 or older / aged 15-64)*100*	7	5	18
Total age-dependency ratio *((aged 0-14 + aged 65 or older) / aged 15-64)*100*	85	85	85
Child to old ratio (aged 0-14 / *aged 65 or older*)*100	1,041	1,473	373
CWR (aged 0-4 / women *aged 15-49*)*1,000	614	606	663
Potential index (Women aged 20-34 / aged 35-49) *100	183	201	105
Ratio of children *(aged 0-4 / aged 5 - 9)*100*	108	108	104
Sex ratio *(men / women)*100*	93	94	90

Source: HDSS database. Unpublished data.

1.4.1.5 Characteristics of the households and living conditions over time

A brief characterisation of the DSA households from the Initial Census to the 9th UR is presented in tables 9 and 10.

Housing conditions are, necessarily, aspects that interfere in people's lives, making those who live in poorer conditions more vulnerable to health threats. The assessment of housing characteristics such as flooring, walls, and roofing materials showed that more durable materials had replaced the most precarious construction type (such as wattle and daub and straw) over the years. In 2015, adobe remained the primary material used in the walls, although brick/block has more than doubled, and walls made of woven straw have practically disappeared. The same happened concerning the material used for the roofs of the houses. There was an increase in the use of sheet iron roofs and a considerable decrease in straw roofs. The information on the floor of the house has only been collected since 2011. The increase in cement and mosaic floors stood out, parallel with the decreasing use of earth floors and carpets (Table 9).

The Annex I show some photographs of houses built with different materials in the DSA.

Table 9 – Characteristics of the households in the Dande HDSS data, from 2009/2010 to 2015. Housing construction materials

	2009/2010 Baseline	2011 5th UR	2015 9th UR
Walls			
Adobe	67.1%	69.5%	67.6%
Brick /bloc	9.4%	13.2%	22.5%
Wattle and daub	13.1%	12.0%	7.6%
Woven-straw	8.6%	3.7%	0.8%
Iron sheet	0.8%	1.2%	1.3%
Wood	0.1%	0.1%	0.0%
Other	0.8%	0.2%	0.1%
Roof			
Straw	13.9%	6.6%	2.1%
Iron sheet	80.2%	88.0%	94.3%
Roofing shingles or Fibrocement	3.8%	3.9%	3.4%
Other	2.1%	1.5%	0.2%
Floor			
Concrete / Cement	-	35.6%	48.5%
Crude floor (cement)	-	7.2%	11.6%
Ceramic tiles	-	2.7%	6.5%
Earth	-	49.9%	31.2%
Carpet	-	4.6%	2.2%
Mean number of rooms per household	2.27 (SD =1.26)	2.43 (SD =1.30)	2.74 (SD =1.34)

Source: HDSS database. Unpublished data.

Table 10 shows an acute lack of basic amenities in the DSA settlements, although some improvement has been recorded over time, such as sanitation conditions. As of 2014/2015, a government programme created a water distribution project, and several taps were scattered throughout the neighbourhoods in the urban area. Those taps were placed in backyards for the usufruct from several households, reflected in the population's access to improved water. The improved water sources (includes piped into dwelling or yard, public tap or standpipe, protected well, tanker truck or car with small tank drum, bottled water) (158) have risen from 38.2% in 2009/2010 to 57.0% in 2015. The use of unimproved water sources (includes unprotected well and open water sources located above ground, such as rivers, lakes, ponds, and irrigation channels) (158) dropped from 61.2% to 42.6%. However, of those reporting the use of water from unimproved sources, in 2015, less than a third (30.7%) declared the habit of treating

water for drinking and cooking. The proportion of households with latrine increased from 53.3% at baseline to 71.1% in 2015. Moreover, the number of latrines without water (from 56.2% to 23.2%) and shared latrines with neighbours (55.7% to 29.0%) decreased.

The number of households with a kitchen had also increased from the baseline (29.5%) to 2015 (42.2%). A kitchen was considered a covered place to prepare and cook meals, even if outside the house.

In 2012/2013, public electricity was extended to practically all the Caxito commune houses (almost the entire urban area of the study area), increasing the population with access to electricity between 2011 and 2015. As a result, there was an increment in assets that usually need energy, such as televisions, freezers and fridges, and the use of generators dwindled.

Differences were also noticed regarding the primary fuel used for cooking, with the drop of more rudimentary sources, such as firewood and charcoal, and an expressive rise in gas use.

Some photos of the common drinking water sources and examples of sanitation (latrines) and kitchen facilities can be found in Annex II.

Table 10 – Characteristics of the households in the Dande HDSS data, from 2009/2010 (at baseline) to 2015. Water and sanitation

	2009/2010 Baseline	2011 5th UR	2015 9th UR
Drinking water source			
Public tap or standpipe	22.8%	25.8%	3.1%
Piped into dwelling or yard	9.3%	12.7%	20.7%
River	48.0%	37.0%	36.5%
Irrigation channel	0.8%	1.0%	0.5%
Lagoon	2.3%	0.2%	0.8%
Well and open sources above ground	10.1%	6.8%	4.8%
Borehole	1.9%	2.5%	2.1%
Water tank	4.2%	12.3%	31.1%
Other	0.7%	1.7%	0.4%
Treat drinking water			
Yes (of the total of respondents)	-	35.6%	34.3%
Yes (total of unimproved sources)	-	40.4%	30.7%
Kitchen			
No	70.5%	64.9%	57.7%
Yes	29.5%	35.1%	42.2%

Latrine			
No	46.7%	39.1%	28.9%
Yes	53.3%	60.9%	71.1%
Yes, with water	43.8%	56.1%	76.8%
Yes, without water	56.2%	43.9%	23.2%
Yes, private for the household	44.3%	60.7%	71.0%
Yes, shared with neighbours	55.7%	39.3%	29.0%
Household assets			
Electricity	-	26.4%	72.7%
Generator	-	70.0%	13.3%
Radio	-	53.6%	56.3%
Television	-	56.7%	70.1%
Cell phone	-	70.4%	75.4%
Satellite dish	-	11.9%	55.2%
Fridge	-	6.7%	13.7%
Freezer	-	29.2%	50.8%
Car	-	12.1%	11.8%
Main cooking fuel			
Firewood	-	28.5%	19.1%
Charcoal	-	10.0%	4.5%
Kerosene	-	2.3%	0.7%
Gas	-	56.4%	74.7%
Electricity	-	0.2%	0.5%
Other	-	2.6%	0.4%

Source: HDSS database. Unpublished data.

1.4.1.6 Starting from scratch

In the following sections, we explore some of the constraints and challenges associated with the HDSS creation and maintenance in the resource-poor setting of Dande.

As we mentioned before, the first step in creating an HDSS is an Initial Census to define the baseline population under surveillance.

Population and household censuses are the processes of collecting, compiling, evaluating, and analysing demographic, economic, and social data pertaining, at a specified time, to all persons, living quarters, and occupants in a well-delimited area. (159) The register should include sufficient identification of each person and household to enable their follow-up over time.

The enumerate process (count and identify) is usually based on the location and respective identification of streets and buildings. However, in Dande, as in a significant part of Angola and other developing countries, there is an absence of a comprehensive system of street names, numbers, or similar addresses. (160) Furthermore, we did not have a list of the living quarters or households in the study area's neighbourhoods. Some populations were in such isolated areas that even the local authorities were unaware of their existence. Therefore, the entire enumeration process started from scratch, and it was necessary to create a numbering system that would allow the identification of households, their linkage to the data collected, and the follow-up of the population and housing.

So, before the beginning of the Initial Census, all the households in the DSA were counted and enumerated. A Residential Identification Number (Residential ID), with the information of the acronym of the neighbourhood, the sector number and the identification of the house was painted in wooden plates (Figure 15) and fixed at the main entrance of each household, facilitating its visibility by the household members and field workers. (152)

Figure 15 – Example of a plate with the Residential ID.

Note: The acronym of the neighbourhood (CBG for Cabungo), the sector number (01) and the identification of the house in the same neighbourhood (0148)

Source: Dande HDSS

Due to the high number of plates needed during the Initial Census (around 17,000), the HDSS hired a group of young people to make the plates. They ended up forming a local business for that purpose, and from then on, they remained responsible for the plates (cutting the wood). However, the painting and enumeration process became the HDSS team's responsibility, as this work required correspondence between the last household number registered in the HDSS database and each plate to be enumerated. In figures 16 to 19, we can see some examples of enumerated houses in the DSA.

Figure 16 and Figure 17 – Examples of enumerated houses in the DSA

Source: Dande HDSS

Figure 18 – A field worker enumerating a house

Source: Dande HDSS

Figure 19 – A field worker collecting geographical coordinates of the house

Source: Dande HDSS

1.4.1.7 Where the kids have no name

The challenges for collecting survey data and obtain accurate data in developing countries, in a context identical to that of the Dande DSA, are well documented. (144, 161-164) Alongside low population literacy, it was common to deal with the interviewees' uncertainty about birth dates and names of themselves or other household members and the lack of identity documents to validate personal information.

In most SSA countries, including Angola, knowing the date of birth is not a very valued aspect of everyday life. In fact, actual birth dates are quite often unknown because many individuals in Africa do not have an official record of their birth date. (165, 166)

Coupled with cultural and social factors, the misreporting of age might also be a consequence of the population's low educational attainment. Respondents' low literacy can affect the reported data quality and precludes other data collection modes than face-to-face interviewing. (167).

In the Dande HDSS UR, all sociodemographic and household data were collected via interviews with the household head or with another adult responsible for the household. Some respondents had difficulty answering questions related to the names and ages of other house residents and occasionally about themselves.

Names are widely collected in almost every micro dataset, including administrative registers. In developed countries, the distinction between civil registration names and eventual nicknames is generally not a problem. However, in many African countries, where the individual registers are not done routinely, and there is no data collection culture, the value attributed to personal information, such as names and ages, is volatile. Garenne and Cantrelle put it in simple words and state the challenges of "carrying out scientific work in traditional societies [referring to Senegal] where nothing is fixed by law, and even name and age are negotiable", (168) highlighting the need for a great effort from the researchers working in these settings (144, 168)

In Angola, people often use distinct names at different moments. It is usual to have a nickname or a 'house name' (*nome de casa*), which is known by family and friends, while the name of the civil registration is mostly used in formal situations. Some children only get to know their 'official' names when they go to school and start being called by teachers by the name on their register. Nevertheless, some close relatives of the children still do not know their registration name. Moreover, the same goes for the names of adults. People frequently go by their nicknames, and those follow different rationales. Sometimes prevails the order of birth, such as the 'eldest one' (*mais velho*), 'the youngest one' (*cassule*), or *'fuxi'*, if the person was born after twin brothers. Other times people are known as their *xarás* (people with the same name) and called by 'mommy', 'daddy', or another name unrelated to the one on their identification document.

Still adding, almost all Africans (and Angolans are no exception) have a traditional name that can be used on certain occasions. (169)

Besides the mentioned issues, sometimes people were not completely aware of their full name. Therefore, it was common to report different names from round to round. Those

situations made it challenging to register names accurately to ensure that residents could be identified in the next visit or if they moved to another household. (152)

In Table 11, there are some translated excerpts of some interviews done with residents in the HDSS area about the rationale for the use of different names. Those excerpts aim to exemplify issues related to proper names in the study area.

Table 11 – Excerpts of interviews about the rationale for the use of different names

Interview 1 (excerpts) / Interviewee: EL (man, 57 years old)
EL: My name is Evaristo Lino Costa, but in our culture of the *nganguelas* [ethnicity from the Huila province region] I have another name. I am called *Ntchamba* for being the third child (boy) in the mother's womb. So to the *ngaguelas*, each child has a name starting with the first girl, second and so on. Boys do not escape the rule. As the mother gives birth, they will be given names by the first boy, second and third. The first boy is called *Ndala*, the second boy is called *Cambinda*, the third *Ntchamba*, the fourth is Cassanga, and the fifth is *Captive*. In girls, the first is called *Nyama*. The second is *Cacuho*. The third is *Mbala* and so on. In recent times, we have noticed that some people prefer to be called other names out of shame for their traditional name, but I am proud to be called *Ntchamba*.
EL: I will give you an example: I have a grandson who is my *xará* Evaristo. My family thought that Evaristo is a house name too heavy for a child. So, I asked my boy to choose a name for his nephew, and he attributed Erivânio (from Evaristo). After he grows up, he can adopt another name if he wants to, but as a little boy, he will be called Erivânio.
Interview 2 (excerpts) / Interviewee: JC (man, 48 years old)
ER: And who chooses those house names (*nome de casa*)?
JC: Well, some people are assigned to them by their parents, for example, I have a daughter whose civil registration name is Adelaide de Carvalho Costa, but her name is Patrícia. I mean, we call her Patricia.
ER: Why do you call her Patricia instead of Adelaide?
JC: Well, when she was born, she was very dark, and I thought to call her dark girl (*escurinha*), but I saw that I did not like it. As she is my older sister's *xará*, I asked my sister to choose which name we could call the baby at home, because I would like to call her another name! My sister chose that my daughter would be called by Patricia. I did not choose the house name because I thought it would be better for my sister. She would be probably angry with me for choosing the name: 'oh, they chose a name without my permission'!. We thought she would be called Dadinha (as my sister), but the aunt's decision was another, and we respect it.
ER: How is your daughter known at school?

JC: Adelaide. Well… Patrícia. Teachers call her Adelaide and colleagues call her Patrícia.
Interview 3 (excerpts) / Interviewee: GS (man, 32 years old)
ER: What is your civil registration name?
GS: Gonçalo Dias dos Santos.
ER: People usually call you Gonçalo in your daily life?
GS: No. Everybody calls me Fábio. Most of the people do not even know that my name is Gonçalo.
ER: Why people call you Fábio?
GS: Because is my house name. My mother liked the name and started to call me Fábio when I was born.
ER: Who chose the name Gonçalo, your civil registration name?
GS: It was my mother.
ER: Why she did not call you Fábio in the register, do you know?
GS: Because she gave the name of my *xará*, my grandfather.

Note: ER=Edite Rosário, interviewer; EL, JC, GS = interviewed 1, 2, and 3, respectively.

Source: HDSS Data from qualitative work. Unpublished data.

As previously described, reporting ages and dates of birth could also be problematic. In the absence of identity documents, when people had difficulties providing information about the birth dates, HDSS inquirers estimated the approximate dates. During the Initial Census and the UR, the field workers estimated 3% of the individual birth dates registered.

The estimation of birth dates was made with the support of 'local calendars', with references to seasons, local and historical events that corresponded to the individual's personal life. The calendar contained, for example, the date of the country's independence, elections, or climatic events like droughts or floods. (152)

Some examples of the interaction with the household respondents demonstrate how field workers collected clues to estimate the birth date of the member of the household:

- "I think my son is four years old. I do not remember the year or month, but I know my son was born at the time of *ginguba* (peanut harvest)."

- "She was born in the 9th in the year that Agostinho Neto (first President of Angola) died."

- “I was born when we started the fight, the national liberation revolution (*Luta da Libertação Nacional*).”

From these memories, the inquirers explored information about the time of the month, year, and others, to estimate an approximate birth date. These techniques of time paths using local calendars are a method commonly used in surveys and census in developing countries, aiming to reduce the non-response rate and to improve the accuracy of age reported data (161, 170)

Table 12 briefly illustrates how challenging the inaccuracy of names and birth dates could be during the process of data cleaning, especially when people moved from one household to another within the DSA (internal migrations) and were registered with different personal information (names and dates of birth). In addition to the inquirers' errors, there was still a need to resolve the bias caused by the variability of the respondents' information supplied.

Table 12 – Individuals registered with different personal data during HDSS UR

Case	Name	Birth date (BD)	House name	Final results
1	ADILSON ANTONIO MANUEL ZUMBI	09/01/2009		4 ENTRIES
	ADILSON ANTONIO MANUEL ZUMBI	09/01/2009		3 different names
	ADILSON ESTEVAO SIMAO ZUMBI	09/01/2009		
	ADILSON MANUEL ZUMBI	09/01/2009	EDI	
2	TEOKAMBE ANDRE SIMAO JOSE CORREIA	24/10/2007		3 ENTRIES
	TEOKAMBE JOSE ANDRE CORREIA	24/10/2007	ESTORIA	3 different names
	ESTORIA ANDRE CORREIA	24/10/2007		
3	JOSUÉ DOMINGOS AFRICANO	12/10/1985		4 ENTRIES
	JOSUÉ BONIFER	15/04/1988		2 different names
	JOSUÉ BONIFER	12/04/1978	JOSUÉ	3 different BD
	JOSUÉ BONIFER	12/04/1978	JOSUÉ	
4	SIMAO JOAO CAFUXI DOMINGOS	15/10/1989		4 ENTRIES
	DOMINGOS SIMAO	30/06/1986		3 different names
	SIMAO JOAO CAFUXI DOMINGOS	15/10/1989	SIMAO	3 different BD
	SIMAO JOAO RUFINO	30/01/1991	SIMAO	
5	DOMINGAS SAMPAIO DEFIATE	09/05/2006	MINGOTA	4 ENTRIES
	DOMINGAS SAMPAIO DEFIATE	09/05/2006		3 different names
	DOMINGAS JOAO SAMPAIO DIFIATE JUNIOR	06/05/2005	MINGA	3 different BD
	DOMINGAS AZEVEDO DIFIATE	07/05/2007	MIMI	
6	PAULINO JOAO JUSTO	22/07/2006	LIXO	2 ENTRIES
	PAULINO JOAO LINO	22/07/2006	LIXO	2 different names
7	SUSANA MANUEL FERNANDES	27/07/1987		3 ENTRIES
	SUSANA FERNANDES CAPEMBA	27/07/1987		3 different names
	SUSANA FERNANDES KATEMBE	26/07/1988	SUSANA	2 different BD
8	ENGRACIA DIAS LOURENCO	11/10/1976		4 ENTRIES
	MARLINDA MORAIS DIAS LOURENCO	15/10/1976	MARINELA	3 different names
	MARLINDA MORAIS LOURENCO	11/10/1977		3 different BD
	MARLINDA MORAIS LOURENCO	11/10/1977	MARINELA	
9	JULIA ALFREDO JOSE SALVADOR	23/05/2004		4 ENTRIES
	JULIA CARIDADE GONCALVES	13/08/2005	JU	3 different names
	JULIA ALFREDO JOSE SALVADOR	23/05/2003		3 different BD
	JULIA JOAO FULA	30/06/2006	JU	
10	EVA GARCIA JOSE	02/07/1991		
	EVA GARCIA JOSE	15/07/1995	VIVI	5 ENTRIES
	EVA GARCIA JOSE	02/06/1991	VIVI	5 different BD
	EVA GARCIA JOSE	02/06/1992		
	EVA GARCIA JOSE	12/06/1991	VIVI	

Source: Dande HDSS Database. Unpublished data.

Note: For ethical reasons, the names of the members have been changed to avoid their identification while maintaining the logical structure that they have in the HDSS database.

1.4.1.8 The fieldwork

Another challenge for research in the Dande setting was associated with fieldwork, namely, data collection in hard-to-reach areas and remote locations. Noteworthy that the UR schedule was planned to interview the populations living in such zones during the dry season (from May to September). Nevertheless, even in these conditions, some communities were in locations extraordinarily difficult to get to. The poor roads created transportation problems, with vehicles often getting stuck or breaking down (Figures 20 and 21). The journey to some of the more distant neighbourhoods could take up to four hours, which was costly and time-consuming.

Figure 20 and Figure 21– Vehicles getting stuck during the fieldwork

Photos taken by Sabino Rodrigues

In some cases, the only way to reach the neighbourhoods was by canoe (Figure 22).

Figure 22 – Canoe crossing during the fieldwork

Dande HDSS. Photo taken by Diogo Francisco

Some geographically isolated populations were coal burners and farmers, which could be very tough to reach. Furthermore, these workers were not available during the day, as they left their houses very early in the morning and returned at the end of the day. For successful data collection, it was necessary to inform them about the HDSS visit. As most of these communities could not be contacted by phone, radio announcements or previous contacts through supervisor visits were used. (152) Once again, the coordinators were important liaisons with the population, mobilising the communities to stay at home, waiting for the field workers to answer the HDSS surveys.

1.5. Verbal Autopsy

Mortality statistics and causes of death are primary inputs as evidence for population assessment of the magnitude and rank order of disease-specific mortality, health policy and planning purposes, and identifying and prioritising health research activities. (171, 172)

With the scarcity of effective CRVS and lack of deaths registration and notification of their medical cause, one in two deaths go unreported globally, the majority occurring in LMICs. (173) To overcome this information gap, over the past decades there has been significant progress in the development of Verbal Autopsy (VA), an alternative method to identify the probable CoD in settings where certification of cause of death is not possible, and CRVS systems are weak. (71, 171) VA has become an increasingly used methodology to assign causes to otherwise uncertified deaths and is applied in over 45 LMICs, (174) particularly in Africa and Asia.

VA results of an interview with an appropriate next of kin, family member, or caregiver of a deceased person, using a standardised questionnaire that elicits information on signs, symptoms, medical history, and circumstances preceding death. The interview occurs after a culturally accepted mourning period. The information collected is then analysed, either by two or more physicians or by an automated computer algorithm, to yield a probable CoD that can be coded according to the International Statistical Classification of Diseases and Related Health Problems (ICD) standards. (71, 175)

In the decades of the 1950s and 1960s, researchers in Asia and Africa used physician interviews with carers of deceased persons to assess the CoD. Workers from the Narangwal project in India labelled this technique as ‘VA ‘. In the 1970s, this tool gained attention, especially when the WHO suggested the use of lay reporting by people with no medical background. In the late 1970s and early 1980s, researchers of Reproductive Age Mortality Studies of Matlab (Bangladesh) and Niakhar (Senegal) developed VA questionnaires to ascertain possible CoD diagnosis in their research settings. (173, 175) The proliferation of the use of this tool ended up triggering a reflection on the standardisation of procedures. Consequently, in the 1990s, expert committees worked out VA standards for maternal deaths, aiming at the validity of VA instruments and data comparability. (173, 176) In 2007, the WHO recommended and developed a harmonised international standard tool for the use of VA and published three standard questionnaires: for newborns (death of a child aged under four weeks), children (death of a child aged four weeks to 14 years), and adults (death of a person aged 15 years and

above). The standards were updated in 2012, 2014, and 2016 to improve cause-specific mortality data and ensure consistency and comparability between countries. (175)

According to WHO, VA is a partial solution to minimise the information gap on CoD in settings and populations lacking vital registration and medical certification. It has become an essential public health tool for obtaining a reasonable direct estimation of the cause-specific mortality at the population level. However, it may not be an accurate method for attributing causes of death at an individual level. (175)

Various studies have questioned the trustworthiness of the VA approach, emphasising their limitations for ascertaining causes of deaths of specific groups or disease-specific mortality. (177, 178) Although, for several authors, it remains the only viable alternative method to identify population-level CoD (18, 179, 180) and the single practical approach to estimate CoD in the most resource-poor setting in which the majority of deaths occur outside the formal health system. (181)

1.5.1 The Dande VAS

Verbal Autopsy Systems (VAS) are often developed as part of population monitoring platforms, namely HDSS, to allow longitudinal assessment of mortality trends and investigate associated factors. The Dande HDSS implemented a VAS in 2010, providing such an opportunity.

Between the Initial Census and 2015, 2,521 deaths were registered by the Dande HDSS. Verbal autopsies were performed for 2,003 (79,5% of the total) of the reported deaths. Of the performed VA, 1,342 (67% of the total VA) were reviewed by at least two physicians for ascertaining a cause of death.

The leading CoD in Dande of the deaths registered by the HDSS from 2009 to 2012 (n=1,488) are presented in the Results session (Paper II). The study explores the associations between demographic and socioeconomic factors and the mortality groups of the Global Burden of Disease (GBD).

Paper II describes the methodology and primary procedures of the VAS. This section will present aspects related to its design and implementation, the imperative ethics of VA, and the cultural context of data collection in the Dande setting.

1.5.1.1 Implementation of VAS

The implementation of VAS in Dande aimed to complement the demographic information collected by the HDSS, deepen the knowledge about the health conditions, and provide more accurate data on the leading CoD affecting the region's population. The data collection objectives were prioritising health research activities and the production of evidence-based research for health policy, both for the Provincial Government of Bengo and MINSA. Besides, it also intended to validate the instrument to replicate its application in other country regions.

As mentioned in previous sections, the medical certification of CoD in Angola existed, in general, for deaths occurring in health facilities, which were not representative of the community and did not show the mortality pattern of the overall population reliably. (14)

As a matter of fact, almost half (48.5%) of the deaths registered in the HDSS surveillance area occurred outside a health facility. Therefore, those deaths were generally not included in official records and local health authorities were not informed of their causes.

Actually, it was not rare to find some graves in Angola, by the road or in the bush, of people who died at home or outside the health units (Figures 23 and 24). Those deaths were simply not considered or counted.

Figure 23 and Figure 24 - Graves by the road, Angola, 2012 and 2015.
Sources: (182) Photo taken by Jorge Varanda and Edite Rosário, respectively.

The approval for the HDSS and VAS surveillance activities was obtained from MINSA and GPB. The VA and other data collection tools have been reviewed and approved by the Institutional Review Board of CISA, composed of several biomedical scientists, epidemiology and public health experts, and local health governmental authorities.

Following the regulatory approvals, several engagement activities were pursued with community leaders (Figure 25), health units, and local health workers (physicians and nurses) to present the objectives and discuss VA's procedures.

Figure 25 – Meeting with community leaders (Municipal and commune administrations and coordinators of neighbourhoods)

Source: Dande HDSS

1.5.1.2 Engaging with the community and local health structures

The involvement of community leaders aimed mostly to ensure that the data collection process to assess CoD did not impose practices that conflict with local culture and traditions. Their role was essential to define the best way to approach bereaved families, establish the appropriate timing for VA considering the culturally accepted mourning period, and explain the VA objectives to the communities to obtain their support and broader participation.

For example, during the VAS initial phase, letters were addressed to the household heads in which the death occurred, expressing regret for their loss. Following the guidance of local leaders, the term ‘condolences’ was replaced in the letter since it was culturally associated with offerings to the bereaved family.

In Angola and reported in other African countries, there were traditional expectations that all visitors to homes where someone died, contributed something in cash or in-kind to show sympathy and acknowledged the real loss in resources to the family due to the

death. (183) However, the VA team was not supposed to pay any contribution to families to avoid the perception of coercion to participate in the study.

The literature does not present clear and defined rules about the appropriate timing for carrying out VA interviews with the deceased's family members. There is a consensus that interviewing a bereaved individual too soon should be avoided. (182-184) Recounting events surrounding the death of a close relative could cause severe emotional distress. The VA application long afterwards, however, may raise doubts as to its validity because of the recall bias. (182, 183) The appropriate timing for VA should depend on various factors such as the deceased's age, relationship to the caregiver, the circumstance of death, the time interval since death, the mourning period, and local culture. (183-185)

Thus, considering these aspects and the advice of community leaders, VA were performed approximately one and a half month after the death, respecting the period of mourning, and preferably up to 12 months later, avoiding recall bias and the emotional harm of recalling the event of death to the family after a long period.

In what concerns the collaboration with health authorities and local health workers before the beginning of the VA, they were essential to adapt the questionnaires to the local context and embed some cultural specificities, particularly local terminology, regarding the region's main pathologies. As the following example illustrates, some peculiarities had to be considered: the disease ‘Gout’ (classified with the ICD-10 code M10) is translated for ‘*Gota’* in Portuguese. However, in Angola, a Portuguese-speaking country, the term ‘*Gota’* is used by the community with an entirely different meaning and refers to Epilepsy (classified with the ICD-10 code G40).

1.5.1.3 Cultural specificities of data collection context

Cultures attribute different meanings to death through distinct symbolic representations, mourning rituals, and emotional reactions. A study about the cultural concept of death in Africa refers that Africans ordinarily do not encourage the contemplation of death or any discussion about their own or their loved ones' death. (186) In Angola, it happens mostly in the case of the death of a child. However, this response is not exclusive to the Africans, given that death and disease are a sensitive matter everywhere. (184) Therefore, as expected, some constraints were found during the fieldwork, both for deaths identification and VA application.

During the HDSS data collection process, when inquirers collected information to update the demographic events that had occurred since the last visit, it was common to

encounter some difficulties in reporting a death. When they asked about a household registered member who had died in the meantime, some families did not report the death immediately. Sometimes respondents used vague expressions such as "that person is no longer here", or "he/she will not be returning", or "is in the woods forever". The fact that the inquirers were local workers, who shared the customs and culture of the community they were interviewing, helped them to have the capacity to interpret these codes and assess whether it was a death.

Another situation usually not spontaneously reported in the Dande area was the death of a newborn. When a child died in the first days of life, the occurrence was hardly counted as death for many families. Typically, newborns were only named after a few weeks or months after birth to avoid creating emotional bonds and great suffering in the event of death. Thus, if the HDSS did not have a previous record of a pregnancy in that household, death could go unreported.

The difficulty of carrying out a VA was related to the emotional distress caused by the interview with the deceased person's closest caregiver. The reactions could also affect the inquirers who were uncomfortable with the interviewee's suffering.

All these questions related to VA sensitivity and cultural specificities were considered for the interviewers' selection and training. They needed to be experienced in applying questionnaires or interviews, and, mostly, they should be sensitive to the interviewee's grieving situation and had positive experiences in interaction with the population. The knowledge of local jargon and cultural representations was a fundamental aspect of communicating with the deceased's family and filling the VA questionnaires, *i.e.*, mediating between local and biomedical cultures. The gender of interviewers proved to be important, namely having a woman interviewing and discussing specific topics related to neonatal or maternal deaths. (182)

However, and despite the sensitivity associated with VA, the main difficulty in conducting interviews was not related to the bereaved family approach but rather to finding caregivers sometime after the HDSS reported the death. This difficulty arose from the household's cultural habit of moving to a new house after a death, mostly if it was a child death. If the family moved within the DSA, it would be located later, and the VA would be applied. Otherwise, the information on probable causes of death of the deceased would be lost.

Various strategies were implemented to improve the data collection and prevent the under-reporting of deaths, namely the triangulation of death data collected by the HDSS

with other sources and the implementation of follow-up visits to pregnant women in late pregnancy to report the birth outcome (birth, neonatal mortality or stillbirth).

The strategy to reduce VA's loss was the incorporation of the VA interviews into routine visits to the HDSS. This approach required intensive training of the entire HDSS team in the application of VA interviews so that these could take place when the family reported the death. If the mourning period defined for the VA had already elapsed, and the caregiver was available to give the interview, the inquirer performed the VA immediately. This method considerably increased the ability to complete the VA. Those increased by 30% per year, and losses due to migrations decreased from 21.2% to 5.5%.

These strategies will be described in detail in the Methodology chapter.

2. Aims

Systematic information recording on births, deaths, and causes of death are crucial informative pieces for public health and the knowledge of social determinants of health. These health-related data are essential for measuring a variety of dimensions concerning a population's health, namely morbidity, mortality, health status, risk factors, inequalities, and health services coverage.

In a setting where lacks comprehensive population-wide demographic and health data, this thesis aims to contribute to provide basic demographic information, and to evaluate the utility of longitudinal data collected by the Dande HDSS and the VAS for capturing population dynamics, health-related indicators, support different health research projects and contribute with evidence for health planning purposes.

Following a public health perspective, we focused on the surveilled population's life course milestones: the events of birth, death, and social paths marked by their living conditions and social determinants of health.

The specific objectives of this thesis were:

- To describe the design, methods, and characteristics of the HDSS implemented in Dande, Angola, and to identify the most important findings generated by this structure (Paper I).

- To estimate the leading causes of death (CoD) that occurred in the demographic surveillance area (DSA) and to explore associations between demographic or socioeconomic factors and broad mortality groups of the Global Burden of Disease (Paper II).

- To identify demographic and social factors influencing the utilisation of antenatal care and delivery in health facilities and their impact on women's birth outcomes in the Dande HDSS area (Paper III).

- To test the MacArthur Scale's application as a tool to measure subjective socioeconomic status (SSS) in the context of health inequalities, and explore how SSS associates with health reported needs and health-seeking behaviours of the population in the Dande HDSS area (Paper IV).

3. Methodology

This thesis is based on quantitative research, which relies on primary data collected through structured questionnaires administered to the households registered in the Dande HDSS area. Data were collected in the initial HDSS census and during the next nine URs carried out and refer to the period from August 2009 to December 2015.

This section attempts to draw together the general conceptual, operational, and data handling elements of the Dande HDSS and VAS.

The methods and the statistical analysis of each specific objective are described in detail in the papers presented in the Results chapter.

HDSSs are commonly used to monitor populations and their health over time within geographically defined DSA. They consist of data collection platforms that track births, deaths, migrations, and socioeconomic and health circumstances over time in places where vital statistics are not reliably collected. (187) The operational procedures of the different HDSS worldwide are adopted according to the circumstances, local needs, priorities, research and policy interests of the place where they are located. Though, most of them share similarities in core conceptual, methodological, and set of instruments used.

At the time of its inception, the Dande HDSS was based on the Manhiça HDSS operational procedures and data collection instruments. (187)

Over the years, several adaptations were made according to local specificities. Additional procedures and data collection instruments were innovated, considering the research interests of CISA and the studies developed for this thesis.

The VAS was implemented following the WHO VA standards (188) with the local context's necessary adaptations.

3.1. Main Concepts used in the Dande HDSS

The HDSS, specified as computing operations to handle the longitudinal follow-up of distinct entities or primary subjects, (189) presupposes the definition of concepts to guide the procedures of the data collection process.

3.1.1. Primary subjects

The primary subjects are the Residential Units, the Households, and the Individuals followed on the HDSS for demographic events or disease exposure.

The residential units corresponded to the houses or places where individuals lived. They were defined in physical and geographic terms.

The households were the groups, family or not, defined as social subunits of the residential unit and to which individual members belong.

The individuals were the people living in the residential units and constituting the households. They were the subject of central interest in the HDSS. (189)

3.1.2. Unique identifiers for primary subjects

Unique identifiers for primary subjects are an indispensable element of an HDSS, being the basis of longitudinal follow-up of events. The Dande HDSS used one of the most common strategies for primary subject identifiers, which consisted of link the subjects in a single residential unit through a hierarchical system of unique numbers. (189)

Each inhabited residential unit was enumerated according to its geographical location (the Residential ID, code with the neighbourhood, sector, and house number). From this code, within each house, identifiers were assigned to individuals listing them all in numeric order: the Permanent Identification Number (Permanent ID).

The Permanent ID was a unique identifier attributed to each individual when first encountered in the field. It was based on the location where each person was living the first time the system identified her/him. The Permanent ID provided the link between the individuals and the remaining information that describe them. The linkage to events and episodes collected over time comprised their life story while under surveillance.

When an individual moved to another residence within the DSA (internal migration), a new ID was registered, the Location Identification Number (Location ID). The association of a Permanent ID to an individual allowed the database to keep the records of all the movements, track migrations, and avoid double enumeration of members in the

database. (152, 190) Most importantly, it allowed the estimates of accurate rates by dividing the number of events by the number of person-years of observation. (191)

3.1.3. Eligible resident in the Dande HDSS

A resident was defined as any person who lived, had been living or intended to stay in a household for a period of at least three months. The residency defined the state of being physically present in a given residential unit for that period. (189) People who lived in more than one household were registered where they spend more than half of their time. A person´s follow-up ended within the HDSS when he/she migrated to an area outside of the DSA. (152, 189)

3.1.4. Household in the Dande HDSS

A household was defined as any group of persons living together and sharing the same economy. Following these criteria, members of the same family living in the same house but having separated domestic expenses and identifying different household heads counted as two or more households. A person living alone was considered a household.

The head of the household was the person that was recognized as such by the members of the household. Some persons headed more than one household but were registered as residents of only one. Polygamous men, for example, could be identified as the head of different households but were registered exclusively in the house of the first wife to avoid duplication of individuals in the database. (152)

3.2. Review of HDSS instruments

The following paragraphs describe the routine primary data collected by the HDSS and the VAS, as well as the data collected specifically for this thesis.

3.2.1. Individual data

Timing	Data collected for all members of the household
Initial Census[3]	Name; sex; birth date; relationship to the head of the household; literacy; the number of completed schooling years; parent's ID (for children under 15 years old) and spouse's (for adults) identification**.**
From the 5th UR[4]	Added to previous: Birth's place; school attendance.
From the 9th UR[5]	Added to previous: Nickname (house name); the number of any personal record (identity card, birth certificate, electoral card, or other); phone number (just for the head of the household and/or the adult responsible answering the questionnaire).

3.2.2. Household data

Timing	Data collected for all households in the DSA
Initial Census	Housing construction materials (walls and roofing); the number of rooms; the source of drinking water; the existence of kitchen and latrines in the house (latrines with or without water, shared with the neighbourhood or private).
From the 5th UR	Added to previous: The house floor; source of water used for bathing; the fuel used for cooking; assets ownership (electricity, generator, radio, TV, satellite dish, cell phone, fridge, freezer). Introduced questions on practices used in the household, specifically the habit of treat drinking water (if yes, which methods were used) and animal husbandry (if yes, what type of animals).
From the 9th UR	Added to previous: Household's monthly income (the exact amount of revenues and/or organised in categories*, i.e.*, income brackets); the number of household members with a fixed salary.

[3] The Initial Census questionnaire is presented in the Annex III.
[4] The 5th update round questionnaire is presented in the Annex IV.
[5] The 9th update round questionnaire is presented in the Annex V.

	In the section on the household's socioeconomic status, a measure of subjective social status (MacArthur social ladder scale) was introduced for the development of the 4th study of this thesis. Media utilisation (habits of watch television, listen to the radio, read newspapers); Social capital (participation of household members in cultural, religious, civic, or sports associations). Questions on the health needs and seeking behaviour were introduced for the development of the 4th study of this thesis: Health-needs in the household: someone in the household felt the need for health care in the month preceding the survey. In the case of reported needs, if sought for help (and where) or not (the reasons why).

3.2.3. Health modules

Timing	Data collected in the households of the DSA
From the 9th UR	Malaria prevention behaviours (such as the ownership of long-lasting insecticide-treated bed nets, the number of bed nets per household, and if someone, and who slept under the bed net during the previous night). Applied in all surveyed households.
10th UR	Prevalence of fevers and health-seeking for fever (applied in all surveyed households), Antimicrobial storage and use (applied to a sample of the population).

3.2.4. Demographic events

One of the vital functions of an HDSS, as its name implies, is the permanent monitoring of demographic events to keep up-to-date information relating to the population under surveillance. The remaining information collected by the different HDSS often vary across the sites and depends on the research focus of each one. However, the minimum data recorded by all HDSS sites include vital events (births and deaths) and migrations (in and out-migrations). These variables constitute the basis of population-based research and capture changes in the population under surveillance, providing an appropriate denominator for calculating rates.

3.2.4.1 Births

During each UR, were collected data on every birth occurring in the households since the last visit. The registration form for each birth[6] consisted of an interview with women

[6] The birth registration form is presented in the Annex VI.

with a recent pregnancy to record the birth outcome (live birth, stillbirth, or abortion) and the newborn.

The form included women's information (name and Residential ID), birth outcome, and place of delivery (health centre, hospital, or outside a health facility). For pregnancies resulting in live births, the form included data on the child (or children, in case of twins), specifically the name, nickname, sex, relation with the head of the household, name, ID location of the father, and birth weight. Given that it was typical in the study area for children to be named after a few weeks or months after their birth, HDSS registered children as 'Nameless' (*Inominada*), followed by the mother's name. The child's name was then captured on the next visit to the household (if the family had already given him/her a name).

In the 9th UR, several questions were added to study the woman's access to maternal health care in Dande DSA, specifically for developing the 3rd study of this thesis, presented in the Results chapter (Paper III). The additional data collected included: the place where the women attended antenatal care (ANC) visits (public or private); the number and timing of ANC visits; if the women had been pregnant before; and if so, how often; and the resulting number of live births out of those pregnancies.

Besides the simple record of a new member in the DSA, the longitudinal data collection on births within the HDSS allowed understanding fertility patterns and reproductive behaviours, estimate birth rates, and monitor the sex ratio at birth. The record of birth outcomes allowed the capturing of stillbirths and other outcomes, notably neonatal deaths, abortion, and gestational age.

Additionally, during the UR, whenever a pregnant woman was identified, the pregnancy[7] was registered to allow the follow-up of pregnancy result.

3.2.4.2 Deaths

The death registration form[8] included data on the deceased (name, Residential ID, date, and place of death).

For each death recorded during the UR, a VA was conducted with the deceased's caregivers after a mourning period of one and a half month. It consisted of an interview to elicit signs and symptoms of the illness or injury before death, using a locally validated VA instrument (Paper II).

[7] The pregnancy observation form is presented in the Annex VII
[8] The death registration form is presented in the Annex VIII.

Three versions of the standard WHO model of VA (188) questionnaires were used, according to the age of the deceased:

- For neonatal deaths (0 to 27 days)[9];

- For children deaths (28 days to 14 years)[10];

- For adult deaths (15 years or more).[11]

Two independent physicians reviewed each VA questionnaire independently to assign a single CoD based on the ICD-10. A third physician reviewed the questionnaire in case of discordance, and the majority rule was applied. If no consensus was reached after the three physicians assigned a CoD, the case was registered as indeterminate.

Since the implementation of VA until 2014, a team of 3 to 4 interviewers specially trained applied the VA questionnaires. A list of deaths resultant of the HDSS database, with information of the deceased (Residential ID, name, age, date of death) and other household members' name, was produced and distributed to the interviewers for them apply the VA. However, due to the time that elapsed between the death report and the VA visit, it was sometimes impossible to find the deceased's families (as previously mentioned in the section on VA), leading to loss of information regarding possible causes of death. Furthermore, having a small team exclusively for the VA interviews was a procedure logistically cumbersome, as it implied the existence of vehicles specifically for them to move within the neighbourhoods where there were reported deaths, with the risk of failure of the VA interview due to the absence of an available caregiver to interview. For those reasons, in 2015, the methodology was modified, and the VA was incorporated into the HDSS UR. For this purpose, all the HDSS field workers received intensive training in the application of VA interviews. They benefited from the fact that they had experience in conducting interviews, contact and empathy with the community, and knowledge of the cultural issues that involved mourning and death in the context of Dande. Thus, whenever a death was reported during the UR, the interviewers applied the VA. They should first ensure that the mourning period for the completion of the VA was appropriate and that the caregiver was available to be interviewed. Otherwise, the interviewers scheduled a date convenient for the respondent.

Informed written consent (signed or fingerprinted in case of illiteracy) was required before the conduct of each VA interview. During the consent process, the information given out to respondents was documented, and fieldworkers have been adequately trained to

[9] The VA Neonatal death questionnaire is presented in the Annex IX.
[10] The VA Children death questionnaire is presented in the Annex X.
[11] The VA Adult death questionnaire is presented in the Annex XI.

administer the consent. The consent information included the VAS's aim; the content of the caregiver's participation (to answer to an interview, giving information about the death of her/his close relative); the voluntary feature of participation; and the confidentiality of the information provided. Consent forms were kept safe, strictly confidential and separated from questionnaires.

Beyond the record of death and respective exit of the DSA, the longitudinal data collection on deaths within the HDSS and the corresponding VA provided information on age and sex-specific mortality, life expectancy at birth, and patterns of cause-specific mortality.

3.2.4.3 Migrations

Migration is a critical component of population change, and its tracking is essential for the longitudinal follow-up of populations.

The attribution of immigrant or emigrant status is based on the definition of resident used in the Dande HDSS, *i.e*., any person who lived, had been living or intended to stay in a household for at least three months.

The in-migration forms[12] (entries in the surveillance area) included data collected at an individual level for all the members of the HDSS, such as name, nickname, sex, birth date, number of an identification card, relationship to the head of the household, literacy, number of completed schooling years, school attendance, parent's (for children under 15 years old) and spouse's (for adults) identification, birth's place, and phone number. Additionally, the entry date in the household / DSA, the place of origin, and the reasons to move were collected. These data were essential to distinguish a new entrance in the area (immigrant) from an internal migration*, i.e.*, people moving from one household to another within the DSA.

In the out-migration forms[13], data were collected on the individuals' name and as much as possible about the departing: if someone in the household informed the field workers about the leaving of one registered resident, the date of departure, the place where he/she went to, and the reasons for leaving (working, studying, family reunion, new house, marriage, among others) were asked. When the field workers found uninhabited houses, they looked for a close informant to understand the situation of the household that was previously registered there. A neighbour, for example, could inform if the residents left the house permanently and when they moved.

[12] The in-migration registration form is presented in the Annex XII.
[13] The out-migration registration form is presented in the Annex XIII.

One important step to track migrations within the DSA was the migration reconciliation process. The movements of residents from one house to another within the DSA were frequent. The houses' property was much rarer than the lease, so people moved house easily if they found better conditions in a new place.

Considering that people could report a different name when registered in a new household (of the name they were registered with before), their identification in the database, as residents in the DSA, sometimes was not immediate.

An individual should only be registered in one household at a point in time within the HDSS database. If someone moved from one household to another (internal migrant), they would be assigned a new location ID and would appear in the database twice. Therefore, in and out-migration reconciliation forms were processed in the data centre to avoid members' duplication. It consisted of tracking internal migrants to link the household of origin and destination for each move made, thereby ensuring a unique identifier (the Permanent ID) for each individual. This process avoided the potential of one person being registered in two different households. (152, 190, 191)

Given the high mobility within the study area and the importance of tracking migration for improving the follow-up of subjects enrolled in cohort studies or other health research projects, in 2015, a data cleaning team was explicitly created for that function. With training and practice, they became more skilful to ensure that reconciliation was done permanently during the UR. This method, coupled with computed operations, improved the reconciliation of in and out-migration within the study area.

3.2.4.4 Triangulation of data

With the periodicity of UR becoming annual, the probability of loss of demographic events increased. In order to complement the identification of births and deaths, the HDSS collected systematically other existing records.

As of 2013, a collaboration was established with the two major hospitals (HGB and Municipal Hospital of Dande) of the DSA and the Civil Registration Services of Bengo. Their logbooks were consulted to record data on the events of deaths and births. This work proved to be time-consuming because the books could not leave the services to be photocopied or typed, having to be copied manually.

These records were mostly incomplete (with no full names, exact dates of events or individuals' residence) and sometimes useless. However, the information was collected to compare the number of records with those collected by HDSS. Additionally, it aimed to cross-check individual data and confirm if the events were registered in the HDSS

database. For example, from the maternity records, it was possible to check whether the women who delivered were registered in the HDSS. If so, if the birth event was already in our database. If the HDSS had not yet registered the delivery, a field worker would go to the woman's residence to collect the respective data related to the birth.

Besides the triangulation with records from the health system and civil registration services, the HDSS maintained a network of key informants at the community level. To this end, it held periodic meetings with neighbourhood coordinators and other local informants, such as traditional midwives, to learn about deaths and births that occurred at home or in other places outside the health units.

3.3. Data collection team, data management and quality control

The data collection field team's dimension has changed according to needs and the periodicity of the UR. On average, twenty field workers collaborated in the HDSS since Initial Census to the 11th UR, namely fifteen inquirers, four field supervisors, and one fieldwork assistant. In addition, three drivers were allocated to the HDSS work.

All workers were recruited in the region of Dande and were required to speak Portuguese and Kimbundo, the national language with more expression in Bengo Province than the Portuguese. Noteworthy that Portuguese was the most widely spoken language, but occasionally, in a few rural neighbourhoods, some older residents were more comfortable interacting with the inquirers in Kimbundu.

The field workers received initial and periodic training on explaining the HDSS and VA objectives, techniques for conducting interviews and communication skills, instruction on how to complete questionnaires, demography, use of GPS, and new procedures in the field. The training sessions included role-play exercises. A manual was provided for different sectors (fieldwork, supervision, data cleaning and database) with instructions regarding all the procedures. Weekly meetings were organised with all the field team for periodic reporting, discussion of issues and problem-solving.

The four field supervisors assured the quality of work, checking all the completed forms, missing answers, and major inconsistencies. Moreover, they monitored the fieldwork through random spot checks (duplication of 5% of the interviews to assure the veracity and quality of fieldwork) and supervised visits with each inquirer (to monitor their performance).

At the Data Unit, questionnaires were recorded and issued a unique ID serial number. Six data clerks assured the entry of data in a system of double entries, verified by

automatic comparison. Regular computer checks looked for inconsistencies (*e.g*. duplicated ID and members, wrong ID on deaths and out-migration). Three data clean supervisors corrected inconsistent or illogical data and were responsible for the reconciliation of migration forms. The questionnaires returned to the field for correction in case of need.

The logistical needs to ensure the operation of HDSS and VAS included:

- On average, three vehicles were used in the fieldwork for the transport of inquirers. In neighbourhoods, up to 3 km, the work was done on foot.
- GPS (15) to record the geographic coordinates of the surveyed households.
- Computers (6 to 10), to type the data collected and data cleaning.
- Servers (4), for database management and file.
- Office supplies (files, paper, pens, fingerprint ink), for data collection and archiving.
- Material for painting and applying for the plates (paint, masks, nails, hammers), to identify households.
- Vests, t-shirts, and caps for the field workers.

When implementing the HDSS in 2009, two essential aspects were considered for paper-based data collection instead of electronic:

- Logistical conditions: electricity supply unstable, the need for a power source for overnight recharging, difficulties in purchasing and maintaining the equipment.
- Ethical issues: considering that was the first approach to the communities, electronic equipment (tablets, computers, mobile devices) could create a barrier between the interviewer and the surveyed population, especially for those living in very remote areas and deprived environments.

Although, the improvement of the logistical and technical provisions, the greater access of the population to mobiles devices, and the more considerable experience of the field workers created the conditions for electronic data collection. In 2016, electronic tablets were purchased for use in the context of the VAS and HDSS UR. However, all the surveys used in this thesis (from 2009 to 2015) were collected using paper, which implied manual encoding and data entry, increased survey and data processing time, manual consistency and completeness checking. Thus, deal with thousands of sheets of paper represented a tremendous effort in the data cleaning process.

The permanent consultation of thousands of paper sheets for cleaning data was a slow and laborious process. In 2014 a digital archive was created and hosted on the server,

with limited access to the HDSS data coordination and cleaning team to ensure data confidentiality. All questionnaires and event forms filled out in the field were then scanned after being cleaned and typed. The digital archive facilitated the data cleaning process since it became possible to consult most of the files through the internal network to check for inconsistency in the information. Thus, the consulted document was exclusively physically accessed if needed to be corrected, whether in the field or database.

The number of events reported by the HDSS and VA performed between 2009 and 2015 is described in Table 13.

Table 13 – Events reported by the HDSS or VAS between 2009 and 2015

Events / Forms	Number
Births outcomes	10,289
Deaths	2,521
In-migration forms (New members)	52,357
Out-migration forms	58.619
Pregnancies	5,356
Verbal Autopsies	2,003

Source: Dande HDSS Database and VAS

Photos of the Dande HDSS and VAS activities (fieldwork, training sessions, meetings, and database) are presented in Annex XIV.

4. Results

4.1. The Dande Health and Demographic Surveillance System Profile

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Health & Demographic Surveillance System Profile

Health & Demographic Surveillance System Profile

HDSS Profile: The Dande Health and Demographic Surveillance System (Dande HDSS, Angola)

Edite Vila Nova Rosário,[1,2]* Diogo,Costa[1,3] Diogo Francisco[1] and Miguel Brito[1,4]

[1]Health Research Centre of Angola (CISA), Caxito, Bengo, Angola, [2]Institute of Public Health, University of Porto (ISPUP), Porto, Portugal, [3]EPIUnit - Institute of Public Health, University of Porto (ISPUP), Porto, Portugal and [4]Lisbon School of Health Technology (ESTeSL), Lisboa, Portugal

*Corresponding author. Health Research Centre of Angola (CISA), Caxito, Bengo, Angola. E-mail: edite.rosario@cisacaxito.org / cisa.evr@gmail.com

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Why was the HDSS set up?

An HDSS aims to systematically and continuously monitor the dynamics of a specified population in a geographically defined area, which lacks an effective system for registering demographic information and vital events.[1–3] An initial census defines the target population and later, through periodic updating rounds, births, deaths and migrations are monitored. The first HDSS was implemented in 1940 in South Africa. There are now around 50 known HDSS worldwide, with surveyed population ranging between 13 350 and 260 000 individuals; 39 sites are spread in Africa, none of them in Central Africa or closest to Angola.[4]

Angola faced a long period of civil war between 1975 and 2002, and most of the previous existing civil registration and other social infrastructures have been severely debilitated. With the massive displacement of people moving to escape the war, the conditions became adverse to keeping effective records of structures and population dynamics.[1,5] In 2014, the country carried out the first national population census since the country's independence (1975), and a large investment has been placed in civil registration infrastructures (particularly birth registration).[5] However, the resources needed to implement an accurate and complete vital statistics system are not yet available.

The Dande HDSS was set up as part of the activities of the Health Research Centre of Angola–CISA. The centre is a collaboration between the Angolan Ministry of Health, the Portuguese Institute of Language and Development and Calouste Gulbenkian Foundation. CISA's general objectives are: to conduct epidemiological research on the most prevalent diseases affecting the country's population, and its risk factors; to promote the integration of Angolan health professionals in national and international research projects; and to provide learning opportunities in its several research areas for national health professionals, graduate students and researchers.

The lack of accurate and up to date information on socio-demographic indicators constitutes a handicap for health research. Therefore, the Dande HDSS was implemented in August 2009 in the Dande municipality, to provide a platform for population-based research on the main causes of morbidity and to allow planning of contextualized health interventions.

The initial census, performed between August 2009 and March 2010, established the baseline population (15 579 households with 59 635 residents). After that, update

rounds (UR) collected data on demographics and household and socioeconomic characteristics. Data about causes of death are inferred from verbal autopsy questionnaires. The household's geographical coordinates are collected using a geographical positioning system (GPS).

The HDSS has served as a sampling platform for several studies, to inform health research activities and to support the evaluation of public health interventions.

Where is the HDSS area?

The HDSS area is located in the Dande municipality in the Bengo province, about 60 km north-east of Luanda. The study area, of approximately 4 700 km^2, covers all neighbourhoods located in three of the five communes of the municipality–Caxito, Mabubas and Úcua–and a smaller portion of neighbourhoods in the Barra do Dande and Kicabo communes (Figure 1).

Savannah is the main landscape feature, with gallery forest around the river banks and forest in the higher lands. The climate is tropical dry, with an average temperature of 25°C. The rainy and hot season spans from October to April, and the cool and dry season from May to September.[6]

Agriculture is the main economic activity, attracting some migrant workers. The main crops grown are maize and cassava. Fishing, in lakes and rivers, and charcoal exploitation are also important economic activities. The existing industrial activity is linked to stone and sand extraction.[6]

There are two main paved roads crossing the HDSS area. Access to several communities is made difficult, especially in the rainy season, since dirt roads constitute the main routes. Three main rivers cross the region, and nine lakes are located within the area. Man made irrigation channels are used for several purposes, namely drinking water, personal hygiene and washing clothes and dishes, which increases the risk for water-related diseases such as urogenital Schistosomiasis, a prevalent disease in the studied area.[7]

The HDSS area is served by 10 primary health care facilities, two health centres, one maternal and infant health centre, one municipal hospital and one general hospital. The number of nurses registered by the Municipal Administration is 180, 61% of them with low qualifications. Health authorities present a ratio of 19 387 inhabitants per physician and 815 per nurse, in the Municipality of Dande. For Caxito, capital of the province and the most populated commune of the study area, those ratios are 6664 and 1370, respectively.[8]

Who is covered by the HDSS?

The HDSS covers households and residents of the described surveillance area. A household is defined as any group of people living together, sharing the same economy and recognizing the same household head. Some people, generally polygamous men, are heads of more than one household but are registered as residents of only one. A resident in the Dande HDSS is defined as: any person who lives, has been living or intends to stay in a household for a period of at least 3 months; or infants born to residents. People who live in more than one household are registered wherever they spend more than half of their time. A person's follow-up ends within the HDSS when he/she migrates outside the study area.[9]

The initial census established the baseline population and registered 15 579 households with 59 635 residents. Between March 2010 and December 2015, the population was enumerated nine times. Data have been collected through quarterly visits until the end of 2011, and thereafter the periodicity varied, mainly for logistical and financial reasons. One UR was carried out during 2012 and two rounds in 2013. Data collection was interrupted in 2014 for an exhaustive data cleaning process of the HDSS database. The national census was also performed in this year, the first in more than 40 years and for which there was a great awareness in the media. The CISA team did not consider appropriate the co-existence of enquirers in the field, so as to not confuse or overburden a population unaccustomed to door-to-door surveys. In 2015 one UR took place.

Participation in the project's activities, both in the initial census and UR, is voluntary and verbal consent is required. The mean participation rate is 88%, considering the number of visits with successful result for all the eligible households. The procedures include five visits per household, to have a successful result; the number of non-included households averages 12% of the total (the main obstacle to register and update all the households is finding a suitable respondent in the house at the time of the visit). The number of refusals is very low and never exceeds 0.03% per round.

What is measured and how have the Dande HDSS databases been constructed?

During the initial census, data were collected at the individual level (sex, date of birth, relationship to the head of household, literacy, parents' and spouse's identifications) and household level (walls and roofing materials, number of rooms, source of drinking water, existence of kitchen and latrines). Each individual is assigned a unique identifier (permanent ID) allowing prospective follow-up.

With the support of a household registration book, a field team visits all the houses during the UR, checking for changes on household composition or demographic events

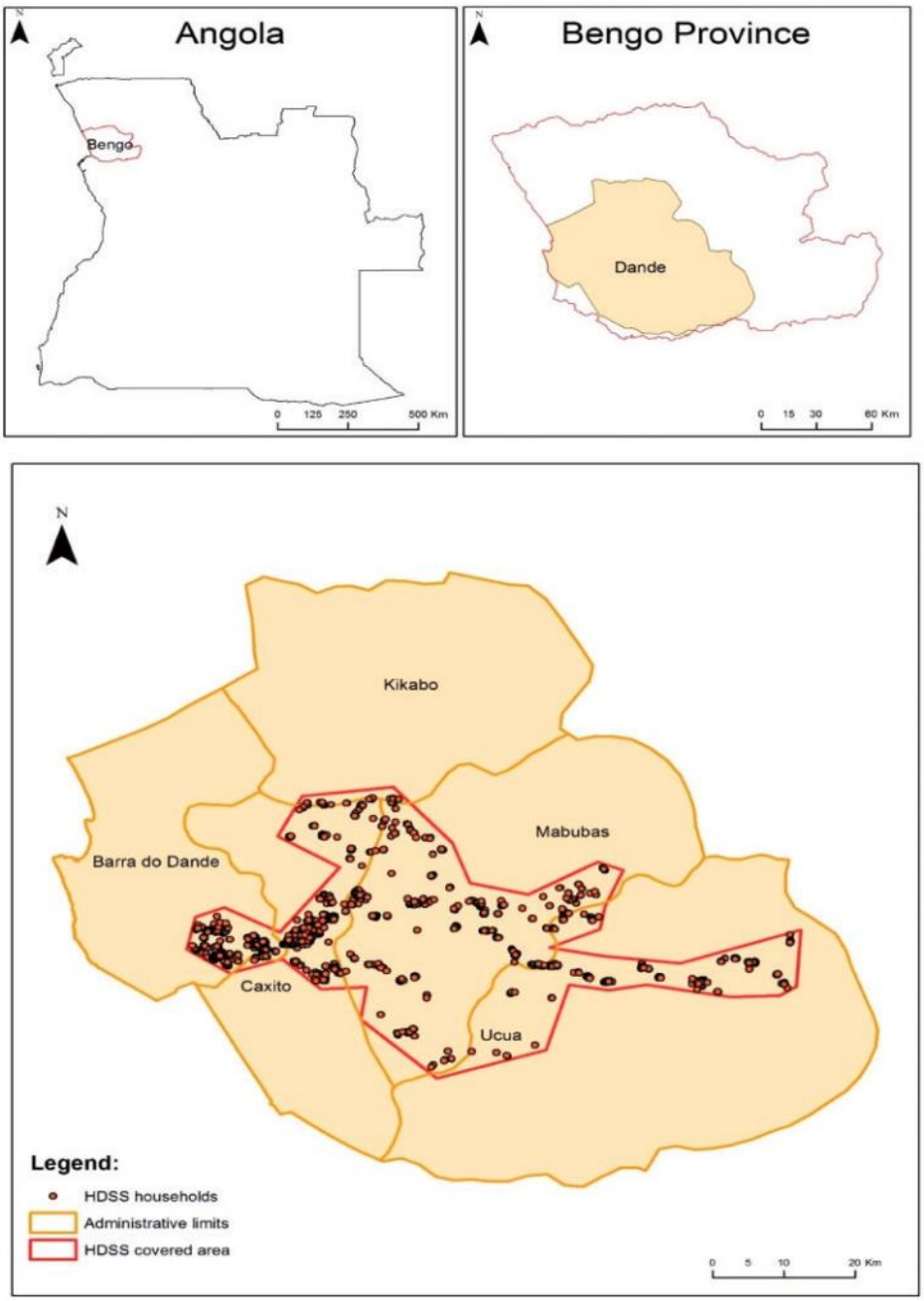

Figure 1. Map of the Dande Health and Demographic Surveillance System study area.

(births, deaths, migrations and pregnancies). At the end of 2011, during the fifth UR, additional variables were included, namely school attendance of all residents, place of birth and socioeconomic assets of the household (Table 1). All households and relevant locations such as roads, paths, rivers, lakes, irrigation channels and public buildings were georeferenced using handheld GPS.

A verbal autopsy system (VAS) has also been implemented in the Dande HDSS area since October 2010. Verbal autopsies are performed for all identified deaths reported in the study area since the initial census (August 2009). Three different versions of VA questionnaires are used (for neonatal deaths, for children and for adults) based on standard INDEPTH/WHO models[10,11] adapted to include the main pathologies known in the region and linguistic local terminologies. Fieldworkers specifically trained to apply the VA tool visit the households of the deceased (after a mourning period of about a month and a half), and interview the deceased's caregiver or other close relative. To ascertain the probable cause of death, each

Table 1. Data collected by the Dande HDSS

Data	Frequency of follow-up	Description of the data collected
Household	Fifth UR (Sept–Dec 2011) and ninth UR (Jun–Dec 2015)	Material of walls, roof and floor, number of rooms, existence of kitchen and latrine, sources of water used to drink and bathe, water treatment, main source of energy used to cook, ownership of electrical generator, radio, TV, cellphone, satellite dish, fridge, freezer, car, motorcycle, bicycle, wheelbarrow and animal breeding
Geographical coordinates	In all UR	Geographical coordinates of every new household
Individuals	In all UR	An individual identifier (ID) is assigned to each resident. Name, nickname, birth date, relation with the head of household, educational level and school attendance. For individuals under 15 years of age, their mother and fathers' ID are collected and for adults, spouse's ID is gathered
Births	In all UR	Name and individual ID of mother, date of birth, pregnancy outcome and place of delivery. Name and sex of the child, relation to the household head and father's name and ID
Pregnancies	In all UR	Name and individual ID, estimated stage of pregnancy (in months)
Deaths	In all UR	Name, sex and individual ID of the deceased, date of death. VA is performed to assess a probable cause of death
Migrations	In all UR	Name and individual ID of the migrant, date of migration, place where they previously lived or where they plan to settle. The names of the household head and other household members of the new house are collected
Other health-related Characteristics	Nineth UR (Jun–Dec 2015)	Health-related characteristics are collected during demographic UR, according to different ongoing project activities (e.g. access to health care, malaria prevention behaviours, reported fever)

questionnaire is interpreted independently by two physicians with local experience and previously trained for VA review. Causes of death are then encoded by a trained physician using the 10th Revision of the International Classification of Diseases (ICD-10).[12] A custom-designed double entry system, written in HTML, Javascript, PHP and POSTGRESQL (database system) is used for data entry and cleaning. Data quality is assured by built-in validation tests. All questionnaires are entered twice by two different data clerks and then verified by comparison of both entries.

Key findings and publications

Basic demographic information for the period 2010 to 2014 is presented in Table 2. The population under analysis is typical of a developing country with both high fertility and high mortality: the population is growing rapidly, and is mostly young, with a low proportion of older persons.

The variation observed in the indicators between different years suggest that the reduction in the number of rounds contributes to a under-reporting of events, consequently impacting on the accuracy of data collected. In 2012 only one UR was conducted, and all fieldwork stopped during 2014.

The neonatal, infant and under-five mortalities reported by the National Institute of Statistics of Angola for the years 2011–15 are 24, 44 and 68 per 1000 for the country, respectively. The total fertility rate for the period 2013–16 is 6.2.[13] Comparing with the Dande HDSS data, a probable under-reporting of neonatal deaths is perceived. These events are very likely not to be reported some time after their occurrence, particularly if the child was not listed in the household registration book. Also, cultural aspects or embarrassment of respondents to talk about deceased relatives might contribute to the omission of death events. This is in line with previously published data, and has been documented as one of the reasons why child mortality is most probably underestimated in many surveys in sub-Saharan Africa.[14] Implementation of new projects in the area of maternal and child health are planned, including a birth cohort which will enable accuracy and a thorough knowledge of these events.

The HDSS has served as a sampling platform for several epidemiological studies regarding infectious diseases and non-communicable diseases. In 2010 (May–August) a cross-sectional study was conducted aiming to understand the distribution of malnutrition, anaemia, malaria, schistosomiasis and geohelminths in the HDSS study area.[7] This community-based random sampling survey included 1237 preschool children (< 6 years old), 1142 school-aged children (6–15 years old) and 960 women (≥ 15 years old). The main findings are shown in Table 3.

Malaria

Bayesian geostatistical models were developed to predict small-scale spatial variation of malaria. Large high-risk

Table 2. Demographic characteristics of the Dande HDSS population, 2010–14

Indicators	2010		2011		2012		2013		2014	
Total resident population	63081		62000		60807		62910		58645	
Male:female ratio	97:100		95:100		98:000		94:100		91:100	
Life expectancy at birth (years)	65.1		66.4		67.1		68.9		63.8	
Crude birth rate/1000 per year	40.4		35.5		32.2		27.2		24.2	
Crude death rate/1000 per year	9.1		8.2		7.3		6.7		8.5	
Total fertility rate	4.8		4.8		4.5		3.9		3.7	
Neonatal mortality rate	7.1		10.8		6.2		15.4		4.8	
Infant mortality rate	52.5		45.9		35.2		40.4		25.6	
Under-5 mortality rate	92.1		90.6		63.3		58.2		60.1	
Percentage of population	2010		2011		2012		2013		2014	
0–4 years old	Fem	Male	Fem	Male	Fem	Male	Fem	Male	Fem	Male
	8.8	8.9	8.6	8.7	6.3	8.3	7.6	7.9	7.2	6.7
5–14 years old	Fem	Male	Fem	Male	Fem	Male	Fem	Male	Fem	Male
	12.3	12.6	13.1	13.1	13.7	13.9	13.9	14.1	14.7	14.8
15–49 years old	Fem	Male	Fem	Male	Fem	Male	Fem	Male	Fem	Male
	23.0	22.7	22.7	22.0	23.4	22.2	23.1	21.6	23.5	21.4
50–64 years old	Fem	Male	Fem	Male	Fem	Male	Fem	Male	Fem	Male
	4.5	3.6	4.6	3.6	4.8	3.7	4.6	3.5	4.7	3.3
65+ years old	Fem	Male	Fem	Male	Fem	Male	Fem	Male	Fem	Male
	2.2	1.3	2.2	1.4	2.3	1.4	2.3	1.4	2.4	1.4

Demographic indicators are computed annually and based on data collected during the UR. Population is yearly average. Births and deaths refer to the number of events during calendar year. The variation in the indicators depends on the number of rounds per year.

Fem, female.

Table 3. Main prevalence of infective conditions: malaria, schistosomiasis, geohelminths and anaemia, 2010[7]

Condition	Pre-school-aged children 1237	School-aged children 1142	Women 960
Malaria	18.4	18.2	9.6
Schistosomiasis	10.0	16.6	21.7
Geohelminths			
Ascaris lumbricoides	15.3	17.3	10.7
Trichuris trichiura	7.2	13.9	9.7
Hookworms	4.2	6.7	13.7
Anaemia	56.9	41.5[a]	44.3[c]
		43.8[b]	44.5[d]

[a]Children (6–12 years old).

[b]Teenagers (13–15 years old).

[c]Pregnant women.

[d]Non-pregnant women.

The results of the previously mentioned survey served as the basis for other studies.

areas of infection (prevalence > 50%) were found in the northern and most eastern areas of the municipality, in line with the observed prevalence.[15]

The prevalence of human *Plasmodium* species was determined by polymerase chain reaction (PCR) using DNA from blood spots collected during the mentioned 2010 survey. *P. falciparum* in the study area comprises an approximately equal mix of genotypes associated with chloroquine (CQ) sensitivity and with CQ resistance, suggesting either lower drug pressure due to poor access to treatment in rural areas or a rapid impact of the policy change away from the use of standard monotherapies. Considering the selective advantage of one pfmdr1 haplotype found under the artemether-lumefantrine treatment (the first-line therapy in Angola), the results raised concern regarding the future artemisinin-based combination therapy (ACT) efficacy within this area.[16,17]

Schistosomiasis

The prevalence survey of 2010 identified *S. haematobium* as the main species responsible for schistosomiasis in the Dande HDSS area. Between December 2012 and July 2013, another study aiming to evaluate the impact of a generalized community treatment, with single doses of praziquantel plus albendazole on urinary schistosomiasis and geohelminthiasis, was set in Cabungo, a hamlet with high prevalence of schistosomiasis; 113 schoolchildren (6–15 years old) participated in the study. At baseline, 70.5% of the children were infected with *S. haematobium*, 29.5% with geohelminths and 14.8% with *H. nana*. Despite the decrease of infection with *S. haematobium* and

geohelminths a month after chemotherapy, at the 6 months follow-up the prevalence was similar to the baseline estimates.

Anaemia

A study on the role of malnutrition and parasite infections in the spatial variation in children's anaemia risk in northern Angola found that an estimated 12.5%, 15.6% and 9.8% of anaemia cases could be averted by treating malnutrition, malaria and *S. haematobium*, respectively.[18]

Cardiovascular disease risk factors

In 2011, a community-based survey of a representative sex- and age-stratified random sample was drawn from the Dande HDSS database and 1464 individuals older than 18 years were recruited and evaluated, following the World Health Organization (WHO) Stepwise Approach to Chronic Disease Risk Factor Surveillance (STEPS).[19] This study showed an overall prevalence of hypertension of 23%. Older ages, lower level of education, higher body mass index and abdominal obesity were associated with hypertension. In 2013, participants without hypertension at baseline ($n = 303$, 29.3% of the eligible participants) were approached and offered a new evaluation, following the same data collection protocol.[19] The incidence of hypertension was 12.2%, much higher in those aged more than 40 years (21.3% versus 8.1%) and living in rural areas (25.0% versus 10.3% in urban areas). Regular alcohol drinkers and overweight or obese individuals presented a higher risk of developing hypertension. This work was integrated in CardioBengo, a cross-sectional community-based study implemented between 2013 and 2014[20] to serve as a new baseline for the prevalence of cardiovascular disease risk factors (e.g. obesity, tobacco and alcohol consumption, hypertension, diabetes and dyslipidaemia) among 2484 individuals aged between 15 and 64 years. Preliminary data show an overall prevalence of 18.0% for hypertension, 9.2% for diabetes and 4.0% for hypercholesterolaemia, with associated low levels of awareness, treatment and control for all conditions.[21]

Verbal autopsy

The VAS implemented within the Dande HDSS allowed the description of the main causes of death that occurred in the study area. Among a total of 1488 deaths registered between 2009 and 2012, 1009 verbal autopsies were performed and 798 of these were assigned a cause of death based on ICD-10. Mortality was led by Communicable Diseases (61.0%), followed by Indeterminate causes (18.3%), Non Communicable Diseases (11.6%) and Injuries (9.1%). Intestinal infectious diseases, malnutrition and acute respiratory infections were the main contributors to under-five-years-old mortality. Malaria was the most common cause of death among children under 15 years old. Tuberculosis, traffic accidents and malaria were the leading causes of death among adults aged 15–49, and diseases of the circulatory system were the most frequent causes of death for adults aged 50 or more.[22]

Future analysis plans

The Dande HDSS plans to maintain the provision of data and long-term indicators of demographic trends in mortality, fertility and migration rates. HDSS residents' causes of death will continue to be assessed through VAS. Reproductive, maternal and child health will comprise an important study target, and several analyses on maternal age and access to and adequacy of antenatal care are currently in progress, to better describe its trends.

The community- and hospital-based epidemiological studies conducted suggest that integrated interventions might be more effective, given the coexistence of several communicable diseases. Malaria, schistosomiasis, soil-transmitted helminthiasis, hymenolepiasis, anaemia and malnutrition are co-endemic and closely related, in turn associated with common behavioural risk factors. Integrating treatment and focused community-based educational interventions could be a strategy to control simultaneously these diseases and reduce their associated morbidity. Accordingly, a community randomized controlled trial to assess the efficacy of a nutritional and a Water, Sanitation and Hygiene (WASH) educational intervention in reducing anaemia, malnutrition and their aetiological agents in preschool children is being implemented in the Dande HDSS area. The results from this study are also expected to extend the knowledge on the aetiological agents.

The centre's diverse scientific agenda includes several other clinical research projects guided by previous findings (e.g. on monitoring of anti-malaria drug efficacy and prevalence of molecular markers of resistance, bacterial infections) and population studies (e.g. socioeconomic inequalities in access to health care) that will provide contextualized and valid information to inform local and national public health stakeholders.

Strengths and weaknesses of the Dande HDSS

The Dande HDSS is the only surveillance system that can serve research purposes in Angola and in the region of Central Africa. It provides updated socio-demographic

information for more than 60 000 inhabitants in an area where vital records are practically inexistent. Additionally, the VAS implemented is a major strength to inform about the main causes of death in the area, complementing the existing official records.

One of the main strengths of the Dande HDSS is to provide support for health research, serving as a sampling frame for various epidemiological studies, allowing the longitudinal follow-up of the population and the assessment of specific interventions in health. It covers a large area, including rural and urban regions and populations with different accessibilities, lifestyle and socioeconomic conditions, which has unique value for the implementation of research projects closely related to health interventions.

The study area faces a process of reconfiguration and rapid growth, particularly in the peri-urban and urban areas. To avoid under-report of demographic events, particularly neonatal deaths and stillbirths, a great logistic and financial effort is required to maintain biannual UR. During 2012 only one round was performed, and none in 2014, which affected the number of reported events and indicators in addition to the acknowledged recall bias. As a recently established platform, the Dande HDSS is gathering the experience that will allow the projection of several scientific publications in a consolidated fashion.

Data sharing and collaboration

The Dande HDSS provides basic aggregated descriptive data to students, researchers or other interested entities. Research instruments, forms and manuals used by the HDSS are also publicly available by request. The centre is available to create close collaborations with other entities, including those performing multi-site large-scale research projects. The proposal for collaborative projects should be addressed to the scientific committee through formal request at[(info@cisacaxito.org].

Dande HDSS in a nutshell

- Dande HDSS covers an area of approximately 4700 km^2, in the Dande municipality, Bengo Province, about 60 km north-east of Luanda, Angola. It was established to support the evaluation of public health interventions and to inform health research activities, serving as a sampling platform for epidemiological studies on infectious diseases and non-communicable diseases.
- The initial census, performed between August 2009 and March 2010, established the baseline population. In 2014, 58 645 individuals were residing in 15 787 households.
- Data have been collected through quarterly visits until the end of 2011, and thereafter the periodicity was reduced to one (2012 and 2015) or two (2013) update rounds per year. Data collection includes demographic, household and socioeconomic characteristics. Geographical coordinates are registered and integrated in a geodatabase. Data on probable causes of death are inferred from a verbal autopsy system.
- Main research lines include clinical studies on malaria (the influence of serum iron levels on *Plasmodium falciparum* infection; optimization of malaria treatment) and antibiotic resistance. Ongoing projects in epidemiological research focus on nutrition, aetiology of anaemia, maternal and newborn health and social determinants of health.
- Aggregated data are available for students or research purposes and collaborations will be considered upon request to the scientific committee.

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4.2. Main causes of death in Dande, Angola: results from Verbal Autopsies of deaths occurring during 2009-2012

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Main causes of death in Dande, Angola: results from Verbal Autopsies of deaths occurring during 2009–2012

Edite Vila Nova Rosário[1*], Diogo Costa[1,2], Luís Timóteo[3], Ana Ambrósio Rodrigues[4], Jorge Varanda[5,6], Susana Vaz Nery[7†] and Miguel Brito[1,8†]

Abstract

Background: The Dande Health and Demographic Surveillance System (HDSS) located in Bengo Province, Angola, covers nearly 65,500 residents living in approximately 19,800 households. This study aims to describe the main causes of deaths (CoD) occurred within the HDSS, from 2009 to 2012, and to explore associations between demographic or socioeconomic factors and broad mortality groups (Group I—Communicable diseases, maternal, perinatal and nutritional conditions; Group II—Non-communicable diseases; Group III—Injuries; IND—Indeterminate).

Methods: Verbal Autopsies (VA) were performed after death identification during routine HDSS visits. Associations between broad groups of CoD and sex, age, education, socioeconomic position, place of residence and place of death, were explored using chi-square tests and fitting logistic regression models.

Results: From a total of 1488 deaths registered, 1009 verbal autopsies were performed and 798 of these were assigned a CoD based on the 10th revision of the International Classification of Diseases (ICD-10). Mortality was led by CD (61.0 %), followed by IND (18.3 %), NCD (11.6 %) and INJ (9.1 %). Intestinal infectious diseases, malnutrition and acute respiratory infections were the main contributors to under-five mortality (44.2 %). Malaria was the most common CoD among children under 15 years old (38.6 %). Tuberculosis, traffic accidents and malaria led the CoD among adults aged 15–49 (13.5 %, 10.5 % and 8.0 % respectively). Among adults aged 50 or more, diseases of the circulatory system (23.2 %) were the major CoD, followed by tuberculosis (8.2 %) and malaria (7.7 %). CD were more frequent CoD among less educated people (adjusted odds ratio, 95 % confidence interval for none vs. 5 or more years of school: 1.68, 1.04–2.72).

Conclusion: Infectious diseases were the leading CoD in this region. Verbal autopsies proved useful to identify the main CoD, being an important tool in settings where vital statistics are scarce and death registration systems have limitations.

Keywords: Verbal Autopsy, Angola, Health and demographic surveillance system, Causes of death

Background

Mortality data are essential for defining and evaluating public health policies and for inferring about the health status of the population in a country [1, 2]. However, medical certification of cause of death is used in only one third of deaths occurring worldwide and a lack of accurate death registration systems is common in most developing countries, particularly where mortality is highest [3].

As in other Sub-Sahara African countries, in Angola the causes of death and their determinants are not well documented [3–5]. In recent years, Angola faced great social and economic changes, resulting from the end of an armed conflict of almost 30 years. Furthermore, in less than a decade, a vibrant economy has transformed the country from a low income centrally-planned system to a middle income market economy [6, 7]. Such development brings changes in the societal and economic

* Correspondence: edite.rosario@cisacaxito.org; cisa.evr@gmail.com
†Equal contributors
[1]Health Research Centre of Angola (CISA), Caxito, Bengo, Angola
Full list of author information is available at the end of the article

structure which, in turn, impacts health and mortality patterns [8–10]. However, the resources needed to implement an accurate and complete vital statistics system are not yet fulfilled.

Even though World Health Organization (WHO) provides estimates of deaths by cause for the country (the main causes in 2012 were respiratory infections, diarrhea, neonatal deaths, cardiovascular diseases and malaria [11]), these figures pertain to aggregated data, not describing regional patterns (for example, cause-specific mortality in identified malaria endemic areas). In Angola, death certification is only done routinely for violent deaths and on those occurring in hospitals or in other health facilities [12]. For example, it is estimated that only about 5 % of under-five children deaths take place at the hospitals [13] and that about 45 % of the population has access to any type of health care [14]. The system thus fails to collect data on deaths occurring at home or at small health units and is therefore insufficient to reliably inform about mortality.

In countries with limited or non-existent death registration systems, the use of verbal autopsy (VA) is recommended to ascertain probable causes of death [1]. Verbal autopsy as a method to estimate cause-specific mortality, but also to study risk factors for specific diseases and the effects of public health interventions, is increasing in the developing world and is now used in more than 115 countries [1, 3]. Verbal autopsy systems are often developed as part of population monitoring platforms, namely Health and Demographic Surveillance Systems (HDSS), to allow longitudinal assessment of mortality trends and exploration of associated factors. The Dande HDSS (Bengo, northern Angola), where a VA system is implemented since 2010, provides such an opportunity [15].

This study aims to describe the main causes of deaths and explore factors associated with broad mortality groups for the period 2009–2012 in the Dande HDSS study area.

Methods

Study area and population

The Dande HDSS is located in Dande municipality, Bengo province, about 60 km northeast of Luanda, in Northen Angola. It was established and is managed by CISA—Health Research Centre in Angola—to overcome the scarcity of complete vital records, the lack of knowledge on demographic characteristics and living conditions of the population in this region and to create a sampling frame for epidemiological studies. Detailed information about the HDSS scope, design and implementation, methodology and data management procedures is published elsewhere [15].

The Dande HDSS covers all 71 hamlets of Caxito, Mabubas and Úcua, 3 of the 6 communes composing the Dande municipality, with a contiguous total area of 4763.6 km^2 (Fig. 1).

Thirty hamlets are considered urban (agglomerations of 2000 or more inhabitants and basic infrastructures) and 41 are rural, according to the National Institute of Statistics of Angola (INEA) definitions [16]. In the initial census, performed in 2009, a population of 59,683 individuals living in 15,643 households was registered. In December 2012, the population covered by the HDSS was of 60,614 residents.

The Angolan Health System encompasses public and private sector providers, the former being the main provider. The national public health system is hierarchically organized in primary health care centers (these include small health care units, nursing centres and municipal hospitals), secondary level general hospitals and tertiary level reference hospitals [14]. The Dande Municipality, where the study area is located, is served by eleven primary health care facilities, one health centre, one maternal and infant centre, one municipal hospital and one general hospital [17].

Data collection

After the initial census, that was performed between August 2009 and March 2010, 18 fieldworkers periodically visited all the households of the study area to record basic demographic events, including reported deaths (quarterly update rounds took place until the end of 2011 and, due to logistic and administrative issues, a single 6-month round was performed in 2012). This study covers the deaths which occurred from August 2009 to December 2012.

After a mourning period of approximately a month and a half, three fieldworkers specifically trained to apply the VA tool, individually visited the households of the deceased and interviewed the caregiver of the deceased or other close relative.

Three versions of the standard INDEPTH/WHO model of the VA questionnaire [18, 19] were used (one for neonatal deaths—0 to 27 days, one for children—28 days to 14 years, and one for adults—15 years or more) adapted to include the main pathologies known in the region and local terminologies. The VA questionnaires are structured into different sections, and include open questions on the circumstances of the death, sociodemographic data of the interviewee and of the deceased, a checklist of signs and symptoms experienced before death (including their duration), accidents, accessibility to health care, place of death and any available health records, namely vaccination register, laboratory exams results and death certificate.

Assigning the cause of death

To ascertain the probable cause of death, each questionnaire was interpreted independently by two physicians

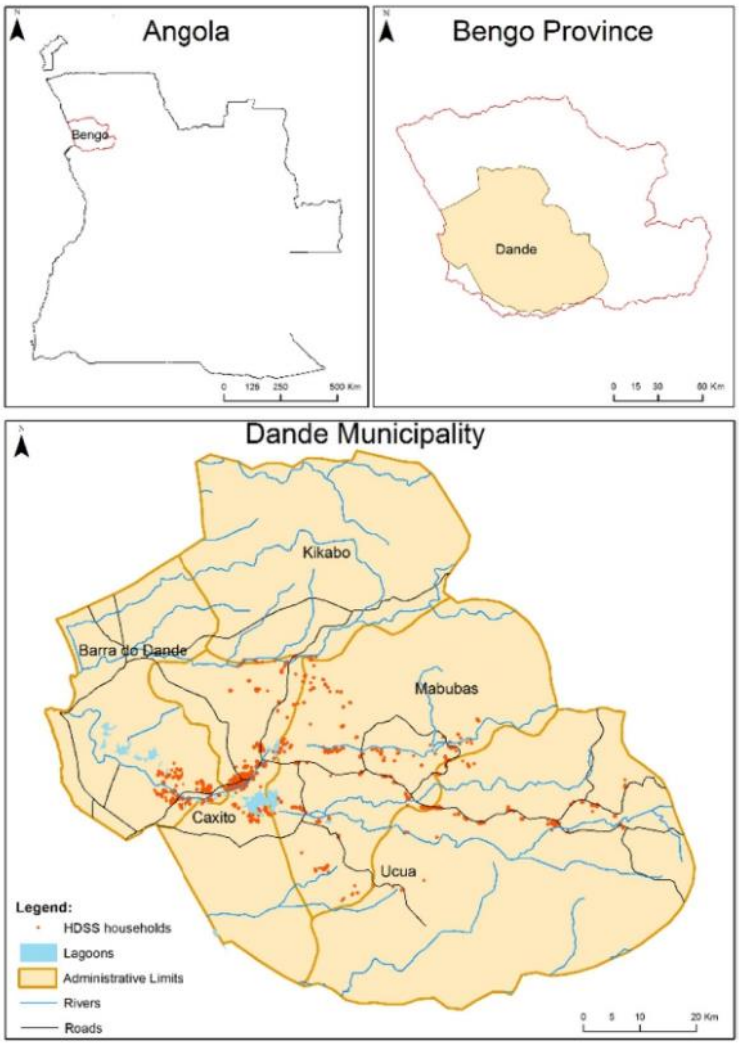

Fig. 1 Map of the study area—Angola, Bengo Province, Dande Municipality

with local experience and trained on reviewing the VA questionnaires and assigning the cause of death. Training of physicians in the interpretation of the questionnaires was based on case definition using clinical diagnostic algorithms adapted from other VA systems [18, 20–23]. In case of discordance between the two physicians, the questionnaire was reviewed by a third physician and the majority rule was applied. Otherwise, if the third physician determined a different cause of death, the case was registered as indeterminate [24, 25].

The reading physicians were staff of the General Provincial Hospital, partner of the Health Research Centre of Angola and also the setting where the Centre is located. This clinical staff is mostly composed of Angolan national practitioners, although there are also foreign doctors (Cuban) working in this context for several years, as part of bilateral cooperation agreements between governments. For each VA questionnaire reading, the Centre paid a symbolic fee to the physicians, in order to compensate their participation. The Hospital benefits of the results of the verbal autopsy system, an important tool to the knowledge of the main causes of death in the study area.

The international form for medical certificate of cause of death was used, which is divided in two parts: the first describes the sequence of morbid conditions directly leading to death; the second describes other diseases or conditions which may have contributed to the death, but which were not involved in the fatal sequence.

Though the international death certificate typically uses the underlying cause of death, ascertaining a single cause of death from various possible causes identifiable from the reported symptoms may be inappropriate using VA data [1]. Mortality is often due to the effects of

multiple conditions, and particularly in the case of infant death, it is more difficult to distinguish, in terms of semiology and differential diagnosis, the main causes that lead to death. Additionally, concerning adults is quite straightforward the distinction between comorbidities and underlying cause for death. For those reasons, multiple causes of death were considered for children under 15 years old and the underlying cause of death was considered for adults.

Causes of death were coded using the 10th revision of the International Classification of Diseases (ICD-10) [26].

Categorization of causes of death

After classification based on ICD-10, specific causes of death were categorized according to the three mortality groups of the Global Burden of Disease (GBD) structure [27] and a fourth for indeterminate causes.

Group I included deaths attributed to communicable diseases and maternal, perinatal and nutritional conditions (CD): intestinal infectious diseases, tuberculosis (TB), other bacterial diseases, rabies, measles, viral hepatitis, human immunodeficiency virus (HIV), malaria, nutritional deficiencies, meningitis, otitis, conditions related to or aggravated by the pregnancy, childbirth or by the puerperium (maternal causes or obstetric causes) and certain conditions originating in the perinatal period.

Group II consisted of non-communicable diseases (NCD): malignant neoplasms, respiratory disorders, mental and behavioral disorders, epilepsy, diseases of the circulatory system, diseases of the digestive system, diseases of the genitourinary system, skin disorders and congenital abnormalities.

Group III comprised of injuries (INJ): injury, poisoning and other consequences of external causes of morbidity and mortality, such as burns and corrosions, toxic effects of substances chiefly nonmedicinal as to source, complications of surgical and medical care, traffic accidents, intentional self-harm, assault, event of undetermined intent, accidental drowning and submersion, struck by thrown, projected or falling object, falls, contact with scorpions, exposure to unspecific electric current and handgun discharge.

Indeterminate causes (IND) included: unknown and unspecified causes of mortality (physicians assigned the VA as ill-defined or as unknown cause of mortality—codes R95-R99 of ICD-10) and those cases that the VA method didn't reach a consensus on the cause of death.

Demographic and socioeconomic characteristics

During the initial census of the HDSS, implemented from August 2009 to March 2010, and during the 5th update round that took place from September to December 2011, demographic characteristics (age and sex) and information on household conditions were collected. In each HDSS update round, demographic events are updated and all the information is collected for new members in the study area.

The educational level of the deceased (or the mother's educational level for children under 15 years of age) was categorized in three groups: no formal education; from one to four—corresponding to primary education; and five or more years of completed schooling.

Several household conditions were used to create a proxy socioeconomic position (SEP) index: type of walls (made of clay, wattle and daub, bricks), type of roof (straw, tin, tile, other), main source of drinking water (public fountain, piped water, river, irrigation ditch, well, plumbed, public tank) and existence of a latrine (with or without water and private or shared with neighbors). For each identified death the most recently updated information on their household conditions was used. The place of residence of the deceased (dichotomized in rural or urban) and place of death (in a health facility or in other/unknown location), were also used.

Statistical analysis

Proportions of the main causes of deaths were computed by sex and the six age groups most commonly used to describe age-specific mortality (<28 days, from 28 days to 12 months, 1 to 5 years, 5 to 15 years, 15 to 50 years and 50 or more years of age).

The chi-square test was used to compare proportions of deaths with and without an assigned cause according to sex and age (Additional file 1).

Principal component analysis (PCA) was used to summarize household conditions and create the SEP index. The first principal component extracted, which explained 17.8 % of variance was then categorized into SEP quintiles (lowest, low, medium, high and highest).

Proportions of the grouped causes of death (CD, NCD, INJ and IND), according to sex, age (for the bivariate and multivariate analysis, age was re-categorized in four groups: under 5 years, 5 to 14, 15–49 and 50 or more), educational level, the quintiles of the SEP index, place of residence (rural or urban), and place of death (in a health facility or other/unknown) were compared using the chi-square test.

The WHO standard population (2000–2025) [28] was used to compute standardized deaths rates using the direct method.

Fully adjusted multivariate logistic regression models were fitted and odds ratios (95 % confidence intervals - OR, 95 % CI) computed to estimate associations between each main group of cause of death (CD, NCD, INJ and IND) and all demographic and socioeconomic characteristics considered in the bivariate analysis. Models were additionally adjusted for multiple causes of death

by adding a dichotomized dummy variable signaling multiple cause cases. Only participants with complete information were used in the regression models. Two variables presented missing information, namely education (5.5 % of missing values) and socio economic position index (0.1 % missing). Analysis was performed using the software SPSS v.22.

Ethical consideration

In the Dande HDSS, we sought verbal consent from household heads or any other adult member of the household, to update the health and demographic information of household members every 6 months. Verbal autopsies for the reported deaths were included as operations of the Dande HDSS.

As a health and demographic surveillance system with frequent visits to households to update demographic information, verbal consent was deemed appropriate for monitoring of the demographic events. In the case of VA, informed written consent (signed or fingerprinted in case of illiteracy) was required before the conduct of each interview. The information given out to respondents during the consent process was documented and fieldworkers have been adequately trained to administer the consent. The consent information included the aim of the verbal autopsy system, the content of the participation of the caregiver (to answer to an interview, giving information about the death of her/his relative), the voluntary feature of participation and the confidentiality of the information. Consent forms were kept safe, strictly confidential and separated from questionnaires.

The scientific committee of CISA, composed of several biomedical scientists, epidemiology and public health experts acted as an institutional review board (IRB) for all studies and reviewed the procedures of the HDSS and VA systems. The IRB approved the consent process and also asked for the advice of the Ministry of Health and of Provincial Health Governor. According to their recommendations, the forms of the HDSS and VA were approved and registered in the National Statistics Institute of Angola (INEA).

The STROBE guidelines were followed.

Results

From August 2009 to December 2012 a total of 1488 deaths were registered by the Dande HDSS, 811 (54.5 %) were males. The mean age at death was 30.0 years (standard deviation = 28.1), with 513 (34.5 %) occurring in children under 5 years of age.

The crude mortality rate in 2010 was 8.7 per 1000 inhabitants, (95 % confidence interval CI: 8.0–9.5) and 8.1 per 1000 (95 % CI: 7.4–8.8) in 2011. In 2012, the estimated crude mortality rate was 6.6 (95 % CI: 5.9–7.2). The standardized deaths rates (WHO standard population 2000–2025) were 10.8, 9.8 and 9.3 per 1000 for 2010, 2011 and 2012 respectively.

Infant mortality rate was 67.1 deaths per 1000 live births in 2010, 78.4 in 2011, and 60.2 in 2012. Under five mortality rate was 90.9, 93.6 and 71.5 per 1000 live births in 2010, 2011 and 2012 respectively.

Of the 1488 deaths, 1009 (67.8 %) verbal autopsies were made. Five families refused (0.3 %) to participate in the study. The difference between the number of reported deaths and the number of interviews was mainly due to 316 families that migrated out of or in the study area (21.2 %), 27 individuals who lived alone at the time of death (1.8 %) making it very difficult to find a primary caregiver to interview and 131 families who were not at home in the various attempts done to conduct the interview (8.8 %). The periodic visits of the HDSS to households allows the surveillance of the population, however when individuals migrate within the study area they are registered in the new house only during the next update round, making it difficult to locate them in the periods between the visits.

Of the 1009 completed verbal autopsies 798 were reviewed and a cause of death was attributed. Of the total of 798 with assigned causes of death, 458 (57 %) had to be reviewed by a third doctor. The remaining 211 were not included in the analysis because they were not read by at least two physicians and therefore had no cause of death assigned. When considering multiple causes of death in children, a total of 934 causes of death were assigned and included in the current analysis. A statistically significant difference in the proportion of deaths with and without a VA reviewed was observed considering the six-age group categories, and no sex-difference was found (Additional file 1: Table S1).

This study revealed that malaria is the most common cause of death in the Dande HDSS, Angola, for the period August 2009 to December 2012, affecting mostly children and adolescents less than 15 years of age. Intestinal infectious diseases, malnutrition and pneumonia were also main contributors to child mortality. For adults, the most common causes of death are diseases of the circulatory system, TB, traffic accidents and malaria.

Specific cause of death by age group and sex

Neonatal deaths

All deaths in female infants <28 days and for 47.4 % of males, were classified as having a perinatal condition as cause of death (Table 1).

Children

In children from 28 days to 11 months of age (Table 2), the main causes of death were intestinal infectious diseases (female: 26.7 %; male: 34.4 %) and malaria (female: 19.8 %; male: 26.7 %). Those were followed by

Table 1 Causes of neonatal death (children < 28 days)

< 28 days	Female (*n* = 8)		Male (*n* = 19)		Total (*N* = 27)	
	N	%	n	%	N	%
Perinatal period conditions	8	100.0	9	47.4	17	63.0
Intestinal infectious diseases (diarrhea)	0	0.0	1	5.3	1	3.7
Malaria	0	0.0	1	5.3	1	3.7
Meningitis	0	0.0	1	5.3	1	3.7
Traffic accidents	0	0.0	1	5.3	1	3.7
Unknow (R95-R99)	0	0.0	1	5.3	1	3.7
Indeterminate	0	0.0	5	26.3	5	18.5
Total	8		19		27	

pneumonia (female: 18.6 %; male: 14.4 %) and malnutrition (female: 15.1 %; male: 11.1 %).

The same diseases were the main causes of deaths among children aged 1–4 years (Table 3): malaria (female: 32.8 %; male: 35.4 %), intestinal infectious diseases (female: 17.6 %; male: 22.0 %), malnutrition (female: 16.0 %; male: 13.4 %) and pneumonia (female: 13.0 %; male: 6.3 %).

Malaria was also the leading cause of death among 5–14 years old children (Table 4), (female: 28.1 %; male: 38.2 %) followed by intestinal infectious diseases (female: 18.8 %; male: 17.6 %). The deaths due to accidental drowning and submersion (female: 3.1 %; male: 14.1 %) were the third specific cause of death for this age group.

Adults

In adults (Table 5), a quarter of all deaths were classified as indeterminate (25.0 %). In the age group 15–49 years, 11.3 % of women died of causes related with pregnancy, childbirth and puerperium, followed by malaria and diseases of the circulatory system (both with 7.5 %). The main causes for male death were TB (15.8 %), traffic accidents (13.3 %) and malaria (8.3 %).

From age 50 onwards (Table 6), 30.0 % of all deaths had indeterminate causes of death. Diseases of the circulatory system were the most common cause of death identified for both sexes (female: 27.6 %; male: 18.6 %), followed by TB (female: 6.7 %; male: 9.8 %) and malaria (female: 7.6 %; male: 7.8 %).

Main categories of mortality according to demographic characteristics, socioeconomic indicators, place of residence and place of death

When specific causes of death are aggregated into GBD main categories of mortality, CD are the leading cause of

Table 2 Causes of death among infants from 28 days to 11 months

28 days-11 months	Female (*n* = 61)		Male (*n* = 63)		Total (*N* = 124)	
	N	%	n	%	N	%
Intestinal infectious diseases (diarrhea)	23	26.7	31	34.4	54	30.7
Malaria	17	19.8	24	26.7	41	23.3
Acute respiratory infections (pneumonia)	16	18.6	13	14.4	29	16.5
Malnutrition	13	15.1	10	11.1	23	13.1
Meningitis	4	4.7	1	1.1	5	2.8
Tuberculosis	3	3.5	0	0.0	3	1.7
Anaemia	3	3.5	0	0.0	3	1.7
Measles	2	2.3	0	0.0	2	1.1
Hepatitis	0	0.0	1	1.1	1	0.6
Lower respiratory infections	0	0.0	1	1.1	1	0.6
Digestive system	0	0.0	1	1.1	1	0.6
Perinatal period	1	1.2	0	0.0	1	0.6
Burn and corrosions	0	0.0	1	1.1	1	0.6
Accidental drowning and submersion	0	0.0	1	1.1	1	0.6
Indeterminate	4	4.7	6	6.7	10	5.7
Total (multiple causes considered)	86		90		176	

Table 3 Causes of death among children from 1 to 4 years of age

1–4 years	Female ($n = 87$)		Male ($n = 95$)		Total ($N = 182$)	
	N	%	N	%	N	%
Malaria	43	32.8	45	35.4	88	34.1
Intestinal infectious diseases (diarrhea)	23	17.6	28	22.0	51	19.8
Malnutrition	21	16.0	17	13.4	38	14.7
Acute respiratory infections (pneumonia)	17	13.0	8	6.3	25	9.7
Measles	5	3.8	7	5.5	12	4.6
Accidental drowning and submersion	2	1.5	5	3.9	7	2.7
Burn and corrosion	2	1.5	1	0.8	3	1.2
Infections of the skin	1	0.8	2	1.6	3	1.2
Meningitis	2	1.5	0	0.0	2	0.8
Congenital malform. circulatory system	2	1.5	0	0.0	2	0.8
Sepsis	1	0.8	1	0.8	2	0.8
HIV	1	0.8	1	0.8	2	0.8
Anaemia	0	0.0	2	1.6	2	0.8
Traffic accidents	1	0.8	0	0.0	1	0.4
Falls	1	0.8	0	0.0	1	0.4
Struck by thrown. proj. or falling object	1	0.8	0	0.0	1	0.4
Digestive system	0	0.0	1	0.8	1	0.4
Nephrotic syndrome	0	0.0	1	0.8	1	0.4
Unknow (R95-R99)	2	1.5	1	0.8	3	1.2
Indeterminate	6	4.6	7	5.5	13	5.0
Total (multiple causes considered)	131		127		258	

deaths (61.0 %), followed by NCD (11.6 %) and INJ (9.1 %). Within CD deaths, 11.2 % were attributed to nutritional conditions, 3.2 % to perinatal conditions and 1.6 % to maternal causes (Additional file 1: Table S2).

A total of 18.3 % of the causes of death were IND (physicians assigned the VA as ill-defined or the three different physicians didn't reach a consensus on the suggested cause of death) (Table 7).

Statistically significant differences were found across all groups for age, education, living in an urban or rural setting and place of death. Deaths in all categories were proportionally more frequent in males than in females except for NCD, although no statistically significant sex-difference was found. Deaths from CD were more frequent in children under 5 years of age (causing 70.0 % of deaths in this age group) while those due to NCD were more frequent in people older than 50 years (63.0 %). INJ were more frequent in the age group 15–49 years (causing 50.6 % of deaths in this age group) and IND causes of death among adults 50 or more years (40.4 %). Mortality was highest among those with no formal education, except for the group of deaths attributed to INJ where people with 5 or more years of school died more frequently (40.5 %). There was no significant relation between the SEP index and the main groups of causes of death ($p = 0.053$). The majority of deaths with an attributed cause occurred in individuals living in urban areas ($p = <0.001$).

Deaths due to CD or NCD were more frequent at health facilities (CD: 59.3 % and NCD: 54.6 %) and deaths caused by INJ and IND occurred mostly on other/unknown place (INJ: 74.1 %, IND: 58.5 %, respectively).

In general, the bivariate associations described above were confirmed in the fully adjusted regression models (Table 8). Children under five were more likely to die from CD when compared to adults aged 50 or more years (adjusted OR, 95 % CI: 8.45, 5.33–13.41), and less likely to die from NCD (aOR 0.09 95 % CI 0.04–0.18). The odds of dying of injuries were 3.91 times (95 % CI: 1.33–11.48) higher for children aged 5–14 years compared to adults older than 50 years and the number of IND causes of death tended to increase with age, independently of the remaining factors.

Compared to individuals with 5 or more years of education, those with no formal education were more likely to die of CD causes (aOR 1.68 95 % CI 1.04–2.72) and less likely to die of INJ (aOR 0.46 95 % 0.21–0.98), independently of age, sex, place of residence and place of death. When stratified by age (under 15 years of age or above), adults with no formal education were

Table 4 Causes of death among children from 5 to 14 years of age

5–14 years	Female ($n = 27$)		Male ($n = 31$)		Total ($N = 58$)	
	N	%	N	%	N	%
Malaria	9	28.1	13	38.2	22	38.6
Intestinal infectious diseases (diarrhea)	6	18.8	6	17.6	12	18.2
Accidental drowning and submersion	1	3.1	5	14.7	6	9.1
Malnutrition	1	3.1	2	5.9	3	4.5
Acute respiratory infections (pneumonia)	2	6.3	0	0.0	2	3.0
Traffic accidents	2	6.3	0	0.0	2	3.0
Tuberculosis	0	0.0	1	2.9	1	1.5
Sepsis	1	3.1	0	0.0	1	1.5
Rabies	1	3.1	0	0.0	1	1.5
Otitis	0	0.0	1	2.9	1	1.5
Injuries knee and lower leg	1	3.1	0	0.0	1	1.5
Toxic effects of nonmedicinal substances	0	0.0	1	2.9	1	1.5
Falls	1	3.1	0	0.0	1	1.5
Exposure to unspecified electric current	0	0.0	1	2.9	1	1.5
Meningitis	1	3.1	0	0.0	1	1.5
Malign neoplasms	1	3.1	0	0.0	1	1.5
Unknow (R95-R99)	1	3.1	2	5.9	3	4.5
Indeterminate	4	12.5	2	5.9	6	9.1
Total (multiple causes considered)	32		34		66	

significantly more likely to die of NCD causes (aOR 2.56 95 % CI 1.30–5.02) and significantly less likely to die of INJ (aOR 0.29 95 % CI 0.12–0.67) compared to those with 5 or more years of education (Fig. 2f and g, respectively).

Compared to those in the highest quintile of the SEP index, individuals in the medium SEP index quintile were more likely to die from INJ (aOR 2.31 95 % CI 1.00–5.30), with no other statistically significant association found for the remaining SEP groups.

Living in a rural setting represented 3.23 (95 % CI: 1.71–6.10) higher odds of dying of INJ compared to residents in urban areas.

Deaths from CD and NCD, were more frequently observed in a health facility (aOR 0.56 95 % CI0.40–0.79 and 0.59, 0.37–0.93, respectively) and deaths from INJ were, expectedly, more frequent in other/unknown places (aOR 3.57 95 % CI 2.04–6.25).

Discussion

The high proportion of deaths occurring in children under five (33.9 % of all deaths occur in this age group) is characteristic of a developing country [4, 29, 30] and is consistent with the WHO latest mortality data estimates for Angola [11]. The 2012 WHO estimates for the distribution of causes of death in children under 5, place respiratory diseases (17.1 %), diarrhea (14.6 %) and malaria (12.6 %) as the main causes of death, which is similar to our findings, although with a higher burden for deaths caused by malaria (28.2 %), diarrhea (23.0 %) and a lower frequency of respiratory diseases as causes of death (11.9 %). Being the Dande HDSS study area a malaria endemic region [31, 32], there might be a tendency to over diagnose malaria and misclassify other fever deaths [33–35]. Over diagnosis of a particular cause of death, known as endemic in a particular region, has been pointed as one of the limitations of the VA methodology, reducing its performance [1, 4, 35]. One other factor that may have contributed to an overestimation of malaria and intestinal infections as causes of death, was the methodology we opted for assigning multiple causes for neonatal and children deaths. Multiple effects and several medical conditions influence mortality, particularly in children and the elderly [36], and in contexts like Dande, the selection of the underlying cause of death is often arbitrary [4, 37]. One of the arguments commonly used in favor of the methodology which involves assigning multiple causes of death is related with the lack of criteria to select a single cause of death to the detriment of others. If the VA system aims to understand epidemiological needs at a population level, rather than describe the causes of deaths at individual level, selecting a single cause may be less appropriate than assigning multiple

Table 5 Causes of death among adults aged 15–49 years

15–49 years	Female		Male		Total	
	n	%	N	%	N	%
Tuberculosis	8	10.0	19	15.8	27	13.5
Traffic accidents	5	6.3	16	13.3	21	10.5
Malaria	6	7.5	10	8.3	16	8.0
Circulatory system diseases	6	7.5	5	4.2	11	5.5
Digestive system	5	6.3	4	3.3	9	4.5
Preg. childbirth and puerperium	9	11.3	0	0.0	9	4.5
Intestinal infectious diseases (diarrhea)	3	3.8	4	3.3	7	3.5
HIV	4	5.0	3	2.5	7	3.5
Accidental drowning and sub.	3	3.8	4	3.3	7	3.5
Intentional self-harm	0	0.0	4	3.3	4	2.0
Burn and corrosion	2	2.5	1	0.8	3	1.5
Malignant neoplasms	0	0.0	2	1.7	2	1.0
Epilepsy	0	0.0	2	1.7	2	1.0
Acute respiratory infections (pneumonia)	0	0.0	2	1.7	2	1.0
Unsp. electric current exposure	0	0.0	2	1.7	2	1.0
Rabies	1	1.3	0	0.0	1	0.5
Acute upper respir. Infections	0	0.0	1	0.8	1	0.5
Conditions of lower respiratory tract	0	0.0	1	0.8	1	0.5
Infections of the skin and subcut. Tissue	0	0.0	1	0.8	1	0.5
Toxic effects of nonmedicinal substances	1	1.3	0	0.0	1	0.5
Complications of surgical and medical care	1	1.3	0	0.0	1	0.5
Handgun discharge	0	0.0	1	0.8	1	0.5
Contact with scorpions	0	0.0	1	0.8	1	0.5
Assault	0	0.0	1	0.8	1	0.5
Event of undetermined intent	0	0.0	1	0.8	1	0.5
Unknow (R95-R99)	5	6.3	6	5.0	11	5.5
Indeterminate	21	26.3	29	24.2	50	25.0
Total	80		120		200	

causes, particularly for the purposes of public-health support [1].

The most common causes of death among all adults aged 15–49 years old were TB and traffic accidents, although for women, pregnancy, childbirth and puerperium complications were responsible for the highest proportion of deaths. The National Plan for Development of Health identifies TB and traffic accidents as enormous problems for the population aged 15–45 years old [14], although accurate statistics are not provided. The Global Health Estimates [11], point to a lower proportion of TB and a higher burden of HIV deaths in this age group. As reported in other studies [4, 29], VA might have contributed to an underestimation of HIV-related deaths, since the co-morbidity of TB and HIV [38, 39] might have influenced the weight of both diagnoses. Traffic accidents were recently pointed as the second major cause of death in the country by the government in the media [40]. The increased availability of motor vehicles and the improvement in life conditions is likely to raise the burden of traffic INJ in this age group [41], which adds to the poor road infrastructures and drinking and driving culture.

Regarding deaths among women of reproductive age, our results confirm the need to prioritize interventions to improve reproductive and maternal health, since maternal-related deaths rates in Angola are amongst the highest in the world [42], and the reduction of its burden is a specific goal envisaged in the Millennium Development Goals.

Among the eldest groups (50 or more years of age), circulatory system diseases were the leading causes of

Table 6 Causes of death among adults aged 50 or more years

50 years +	Female		Male		Total	
	N	%	n	%	N	%
Circulatory system diseases	29	27.6	19	18.6	48	23.2
Tuberculosis	7	6.7	10	9.8	17	8.2
Malaria	8	7.6	8	7.8	16	7.7
Intestinal infectious diseases (diarrhea)	3	2.9	6	5.9	9	4.3
Malignant neoplasms	5	4.8	3	2.9	8	3.9
Traffic accidents	2	1.9	5	4.9	7	3.4
Acute respiratory infections (pneumonia)	4	3.8	3	2.9	7	3.4
HIV	4	3.8	1	1.0	5	2.4
Diabetes Mellitus	1	1.0	4	3.9	5	2.4
Digestive system	1	1.0	3	2.9	4	1.9
Intentional self-harm	2	1.9	1	1.0	3	1.4
Accidental drowning and sub.	0	0.0	2	2.0	2	1.0
Rabies	1	1.0	0	0.0	1	0.5
Mental and behavioural disorders	0	0.0	1	1.0	1	0.5
Infections of the skin and subcutaneous tissue	0	0.0	1	1.0	1	0.5
Injury of unspecified body region	1	1.0	0	0.0	1	0.5
Exposure to unspecified electric current	1	1.0	0	0.0	1	0.5
Sepsis	0	0.0	1	1.0	1	0.5
Asthma	0	0.0	1	1.0	1	0.5
Unknow (R95-R99)	1	1.0	6	5.9	7	3.4
Indeterminate	35	33.3	27	26.5	62	30.0
Total	105		102		207	

death. Such finding is consistent with the results from other studies showing that deaths related to the circulatory system, particularly cardiovascular diseases, increases with age [5, 29, 33, 43]. In 2010, our group conducted a community-based survey of 1464 adults residing in the Dande municipality, and found a 23 % prevalence of hypertension [44]. These findings suggest an expected increase in the burden attributable to chronic diseases among adults, resultant from the country's fast economic growth and lifestyles changes.

Overall, our results show similar distributions of deaths by broad GBD groups compared to those found in Tanzania [33], particularly in what concerns NCD (12 % in our study vs. 15 % in Tanzania) and INJ (9 % in both studies). The higher estimate of CD found in our study (61 %) might be explained by the inclusion of children (the Tanzania study, focused on adult deaths, and found 41 % of CD deaths) and is more close to the findings of a study among adolescents and adults conducted in rural western Kenya, which found 74 % of deaths caused by CD [29].

Mortality in these regions is still largely marked by infectious diseases, despite the increasing deaths caused by NCD and INJ. This phenomenon, which a majority of developing countries in Africa is facing, has been called the "triple burden" [29, 45]. Some of the factors usually linked to the increasing prevalence of NCD and INJ in developing countries are related with socioeconomic conditions improvement which impacts lifestyles changes. Therefore we explored the associations of socioeconomic conditions in broad mortality groups. For this, we used essentially two SEP proxy measures: the educational level and the quintiles of an index summarizing household conditions, which has been extensively used in other HDSSs to study inequalities in several health outcomes [8, 25, 29, 33, 46–48].

No significant associations were observed according to the quintiles of the SEP index created, although point estimates suggest positive associations in those groups who might be considered socially disadvantaged, compared to those less disadvantaged, for CD and NCD. The gradient observed in CD deaths according to the educational level, is in line with the results of a recent study conducted in Chakaria, Bangladesh, where mortality due to CD was more frequent among the poorest [46]. In the same study, NCD as leading causes of death also

Table 7 Distribution of the main causes of death according to demographic and socioeconomic characteristics

		Total	Communicable	Non-Communicable	Injuries	Indeterminate	
		n	n (%)	n (%)	n (%)	n (%)	p
Sex	Female	442	278 (48.8)	55 (50.9)	30 (35.3)	79 (46.2)	0.109
	Male	492	292 (51.2)	53 (49.1)	55 (64.7)	92 (53.8)	
Age (years)	< 5	461	399 (70.0)	14 (13.0)	16 (18.8)	32 (18.7)	<0.001
	5–14	66	44 (7.7)	1 (0.9)	12 (14.1)	9 (5.3)	
	15–49	200	71 (12.5)	25 (23.1)	43 (50.6)	61 (35.7)	
	50+	207	56 (9.8)	68 (63.0)	14 (16.5)	69 (40.4)	
Education[a] (years)	None	332	202 (38.1)	52 (49.1)	16 (20.3)	62 (36.9)	0.001
	1 to 4	316	202 (38.1)	27 (25.5)	31 (39.2)	56 (33.3)	
	5 or more	235	126 (23.8)	27 (25.5)	32 (40.5)	50 (29.8)	
SEP index	Lowest	186	121 (21.2)	23 (21.3)	12 (14.1)	30 (17.6)	0.053
	Low	222	143 (25.1)	27 (25.0)	13 (15.3)	39 (22.9)	
	Medium	170	108 (18.9)	14 (13.0)	21 (24.7)	27 (15.9)	
	High	171	107 (18.8)	18 (16.7)	16 (18.7)	30 (17.6)	
	Highest	184	91 (16.0)	26 (24.1)	23 (27.1)	44 (25.9)	
Residence	Rural	180	88 (15.4)	23 (21.3)	32 (37.6)	37 (21.6)	<0.001
	Urban	754	482 (84.6)	85 (78.7)	53 (62.4)	134 (78.4)	
Place of death	Health facility	490	338 (59.3)	59 (54.6)	22 (25.9)	71 (41.5)	<0.001
	Other/unknown	444	232 (40.7)	49 (45.4)	63 (74.1)	100 (58.5)	

p p-value—chi square test
SEP index: socioeconomic position index
[a]For participants under 15 years of age, the mother's educational level was considered

Table 8 Associations between causes of death and socioeconomic characteristics

		Communicable	Non- Communicable	Injuries	Indeterminate
		*AOR (95 % CI)	*AOR (95 % CI)	*AOR (95 % CI)	*AOR (95 % CI)
Sex	Male	1	1	1	1
	Female	0.92 (0.64–1.32)	1.11 (0.67–1.82)	0.77 (0.44–1.37)	1.18 (0.79–1.76)
Age (years)	<5	8.45 (5.33–13.41)	0.09 (0.04–0.18)	1.01 (0.45–2.26)	0.33 (0.20–0.55)
	5–14	5.36 (2.49–11.54)	n.a.	3.91 (1.33–11.48)	0.38 (0.15–0.97)
	15–49	1.67 (1.05–2.64)	0.29 (0.16–0.50)	3.60 (1.78–7.29)	0.85 (0.54–1.33)
	50+	1	1	1	1
Education[a] (years)	None	1.68 (1.04–2.72)	1.08 (0.57–2.07)	0.46 (0.21–0.98)	0.77 (0.46–1.30)
	1–4	1.15 (0.74–1.79)	0.81 (0.44–1.51)	0.93 (0.50–1.75)	1.03 (0.64–1.65)
	5 or more	1	1	1	1
SEP index	Lowest	1.16 (0.66–2.05)	1.04 (0.50–2.16)	1.18 (0.48–2.92)	0.73 (0.40–1.34)
	Low	1.21 (0.71–2.05)	0.96 (0.49–1.88)	0.86 (0.37–1.98)	0.84 (0.49–1.46)
	Med	0.84 (0.47–1.50)	0.80 (0.36–1.77)	2.31 (1.00–5.30)	0.84 (0.46–1.56)
	High	0.81 (0.46–1.44)	0.96 (0.46–2.01)	1.43 (0.63–3.28)	1.03 (0.57–1.86)
	Highest	1	1	1	1
Residence	Rural	0.65 (0.41–1.05)	0.86 (0.47–1.60)	3.23 (1.71–6.10)	0.87 (0.53–1.42)
	Urban	1	1	1	1
Place of death	Health facility	1	1	1	1
	Other/unknown	0.56 (0.40–0.79)	0.59 (0.37–0.93)	3.57 (2.04–6.25)	1.44 (0.99–2.08)

*AOR (95 % CI) = adjusted odds ratio (95 % confidence Interval). adjusted for all variables listed and for multiple causes
SEP index: socioeconomic position index
[a]For participants under 15 years of age, the mother's educational level was considered

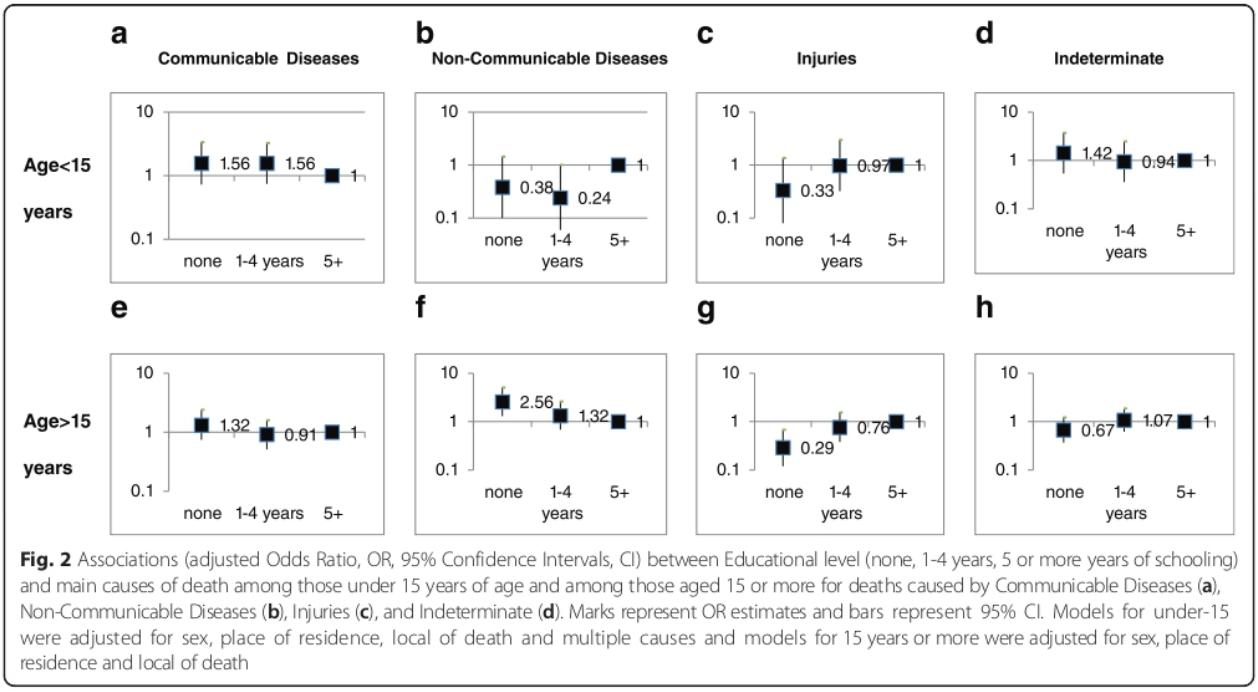

Fig. 2 Associations (adjusted Odds Ratio, OR, 95% Confidence Intervals, CI) between Educational level (none, 1-4 years, 5 or more years of schooling) and main causes of death among those under 15 years of age and among those aged 15 or more for deaths caused by Communicable Diseases (**a**), Non-Communicable Diseases (**b**), Injuries (**c**), and Indeterminate (**d**). Marks represent OR estimates and bars represent 95% CI. Models for under-15 were adjusted for sex, place of residence, local of death and multiple causes and models for 15 years or more were adjusted for sex, place of residence and local of death

concentrated among the population from the higher SEP groups [47], contrasting our results for adult NCD deaths according to the educational level as shown in Fig. 2f. This may suggest that the expected epidemiological transition in the leading causes of death is only in its early stage [49, 50].

Nevertheless, we would expect a steeper socioeconomic gradient for all main causes of death, given the fast development observed in the country in the last decade [6] and the known inequalities in mortality observed worldwide and in the country [42]. It would be interesting to explore other SEP measures, such as the subjective social status [51], potentially more useful to disentangle underlying inequalities of health in this context.

Most deaths studied occurred in the urban area, following the population distribution in the study area. The higher likelihood of an INJ death in residents from rural compared to urban hamlets was a rather surprising finding. However, we should notice that only the deceased residence is known, and death might have happened in an urban area (outside a health facility). When isolating the specific causes of death by injuries, we can observe the weight of those related with traffic accidents and accidental drowning and submersion, both in rural and urban areas. In rural areas the villages are situated along the road and those have relatively poor conditions and some traffic, especially of trucks transporting raw materials. This has been the cause of road and pedestrian accidents. Likewise, people living in rural areas have to travel long distances which may explain the higher likelihood to die of INJ, particularly of transport accidents.

To better understand the context of INJ deaths, we recently included a specific module in our VA questionnaire, which will be the focus of future exploration (as the characterization and context of the main deaths caused by INJ in order to sustain public health interventions and specific campaigns).

Regarding place of death, CD and NCD deaths happened more commonly in a health facility. Nevertheless, more than 40 % of CD and NCD deaths were registered outside a health facility, which emphasizes the usefulness of the VA system in the region.

The identification of causes of deaths through VA methodology in the scope of a continuous surveillance system is the strength of this study considering the lack of information in this context. In Angola where data on mortality is based on hospital and government reports, only the number of people dying under medical care is accounted for and death certificates lack accuracy [12]. However it is of crucial importance to know the causes associated to all deaths [52, 53]. Bengo Province, where the study area is located, is reported as an endemic region for several infectious diseases responsible for morbidity and mortality in Angola [14, 31], however there is a very limited capacity of the health structures of registering and measuring the impact of that endemicity on mortality.

The estimated crude mortality for the 3 years encompassing the study period, suggests a decrease in rates, which is in line with the WHO estimates for the same period [11]. However, the estimated crude mortality rate

for 2012 that we observed (6.6 per 1000, 95 % CI: 5.9–7.2) may be underestimated: during this period, only one update HDSS round was performed, as opposed to the usual biannual rounds, thus fewer events were reported explaining the observed decrease.

In our study, 18.3 % of deaths were IND, 8.7 % for child and 27.5 % for all adult deaths. This figure lies between the results found in other sub-saharan African countries, namely in Ethiopia (reporting VA deaths for the period 2009–2013) [5] where 14.9 % of deaths were IND and a 2012 study from Tanzania reporting 31 % deaths with indeterminate causes [33]. The high proportion of IND causes of death is a common limitation attributed to the VA system, that may result from the relatively low specificity and sensitivity of the VA tool for detecting some causes of death [4, 29], and from other influencing factors such as the interaction between interviewer and respondent, the setting where the VA is performed, recall bias and the subjectivity inherent to the physician review [1]. Further investigation of what determines indeterminate causes is warranted.

One other problem felt in the Dande HDSS, is the scarcity of physicians available to be trained to read VA questionnaires. In the future, the validity of the causes of death derived from VA reviewed by physicians should be tested with the use of a probabilistic approach, such as the InterVA method [1].

Conclusions

The findings of this study confirm international estimates on the main causes of death and provide a more detailed picture of mortality in this region, informing health policies and focused interventions. The VA system proves to be a useful tool in this context, where almost half of deaths occur outside a health facility and mortality data is scarce and often inaccurate.

Preventive measures should be given priority, since infectious diseases remain the major cause of death, despite the country's development in the past decade. Simultaneously, efforts tackling NCD and INJ cannot be neglected and should initiate immediately in order to prevent escalation of its burden.

Additional file

Additional file 1: Table S1. Proportion of deaths with and without a Verbal autopsy reviewed. Table S2 Distribution death attributable do communicable diseases according to demographic and socioeconomic characteristics. (DOCX 17 kb)

Abbreviations

CD, communicable diseases; CISA, Health Research Centre of Angola; CoD, causes of deaths; GBD, Global Burden of Disease; HDSS, health and demographic surveillance system; HIV, imunodeficiency virus; ICD-10, 10th revision of the International Classification of Diseases; IND, indeterminate; INEA, National Institute of Statistics of Angola; INJ, injuries; IRB, institutional review board; NCD, Non-communicable diseases; PCA, principal component analysis; SEP, socioeconomic position; TB, tuberculosis; VA, verbal autopsies; WHO, World Health Organization

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Availability of data and materials

Data are available from the CISA Institutional Data Access / Ethics Committee for researchers who meet the criteria for access to confidential data.

Authors' contributions

ER: Participated throughout the entire data collection process, supervised the implementation of the VA system and data collection, contributed to both data analysis and interpretation, drafted the initial manuscript, critically reviewed the manuscript and approved the final submitted manuscript. DC: Contributed to both data analysis and interpretation, drafted the initial manuscript, critically reviewed the manuscript and approved the final submitted manuscript. LT: Participated in data collection and analysis, critically reviewed the manuscript and approved the final submitted manuscript. APR: Conceptualized and designed the study, supervised the implementation of the VA system and data collection, drafted the initial manuscript, contributed to analysis and interpretation, critically reviewed the manuscript and approved the final submitted manuscript. JV: Conceptualized and designed the study, supervised the implementation of the VA system and data collection, contributed to analysis and interpretation, critically reviewed the manuscript and approved the final submitted manuscript. SVN: Conceptualized and designed the study, coordinated and supervised the implementation of the VA system and data collection, contributed to analysis and interpretation, critically reviewed the manuscript and approved the final submitted manuscript. MB: Contributed to analysis and interpretation, coordinated the VA system and data collection, critically reviewed the manuscript and approved the final submitted manuscript.

Competing interests

The authors declare that they have no competing interests.

Consent for publication

Not applicable.

Ethics approval and consent to participate

In the Dande HDSS, we sought verbal consent from household heads or any other adult member of the household, to update the health and demographic information of household members every 6 months. Verbal autopsies for the reported deaths were included as operations of the Dande HDSS.
As a health and demographic surveillance system with frequent visits to households to update demographic information, verbal consent was deemed appropriate for monitoring of the demographic events which requires routine frequent visits to households. In the case of Verbal Autopsy, informed written consent (signed or fingerprinted in case of illiteracy) was required before the conduct of each interview. The information given out to respondents during the consent process was documented and fieldworkers have been adequately trained to administer the consent. The consent, informed about a) the aim of the verbal autopsy system; b) the content of the participation of the caregiver (to answer to an interview, giving information about the death of her/his relative); c) the voluntary feature of participation and d) about the confidentiality of the information. Consent forms were kept safe, strictly confidential and separated from questionnaires. The scientific committee of CISA, composed of several biomedical scientists, epidemiology and public health experts and local health governmental authorities (Provincial Health Governor, Provincial Hospital Director) act as an

institutional review board (IRB) for all studies and revised the procedures of the HDSS and VA systems. The IRB approved the consent process and also asked for the advice of the Ministry of Health and of Provincial Health Governor. According to their recommendations, the forms of the HDSS and VA were approved and registered in the National Statistics Institute of Angola (INEA) with the number 0019 (Document 746/440/DG/INE/09).

Author details
[1]Health Research Centre of Angola (CISA), Caxito, Bengo, Angola. [2]EPIUnit—Institute of Public Health, University of Porto (ISPUP), Porto, Portugal. [3]Hospital Geral do Bengo, Caxito, Bengo, Angola. [4]National Institute of Health Doutor Ricardo Jorge, Lisboa, Portugal. [5]CRIA, Department of Life Sciences, University of Coimbra, Coimbra, Portugal. [6]Global Health and Tropical Medicine, GHTM, Instituto de Higiene e Medicina Tropical, IHMT, Universidade Nova de Lisboa, Lisboa, Portugal. [7]ANU College of Medicine, Biology and Environment, The Australian National University, Camberra, Australia. [8]Lisbon School of Health Technology (ESTeSL), Lisboa, Portugal.

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Additional file 1

Table S1. Verbal autopsies reviewed with and without an assigned cause.

		Verbal Autopsy		
		No n (%)	Yes n (%)	p
Sex	Female	308 (44.8)	368 (46.1)	0.658
	Male	379 (55.2)	430 (53.9)	
Age	<28 days	18 (2.6)	27 (3.4)	<0.001
	28 days – 11 months	44 (6.4)	124 (15.5)	
	1-4 years	116 (16.9)	182 (22.8)	
	5-14 years	55 (8.0)	58 (7.3)	
	15-49 years	223 (32.5)	200 (25.1)	
	50+ years	231 (33.6)	207 (25.9)	

Table S2 - Distribution death attributable do communicable diseases according to demographic and socioeconomic characteristics

		Nutritional conditions	Maternal causes	Perinatal causes	Other Communicable Diseases	
		n (%)	n (%)	n (%)	n (%)	p
Sex	**Female**	35 (54.7)	9 (100)	9 (50.0)	225 (47.0)	0.012
	Male	29 (45.3)	-	9 (50.0)	254 (53.0)	
Age (years)	**< 5**	61 (95.3)	-	18 (100)	320 (66.8)	<0.001
	5-14	3 (4.7)	-	-	41 (8.6)	
	15-49	-	9 (100)	-	62 (12.9)	
	50+	-	-	-	56 (11.7)	
Education† (years)	**None**	24 (40.7)	3 (33.3)	6 (33.3)	169 (38.1)	0.987
	1 to 4	22 (37.3)	3 (33.3)	8 (44.4)	169 (38.1)	
	5 or more	13 (22.0)	3 (33.3)	4 (22.2)	106 (23.9)	
SEP Index	**Lowest**	12 (18.8)	2 (22.2)	1 (5.6)	106 (22.1)	0.265
	Low	19 (29.7)	1 (11.1)	2 (11.1)	121 (25.3)	
	Medium	13 (20.3)	2 (22.2)	6 (33.3)	87 (18.2)	
	High	15 (23.4)	2 (22.2)	3 (16.7)	87 (18.2)	
	Highest	5 (7.8)	2 (22.2)	6 (33.3)	78 (16.3)	
Residence	**Rural**	8 (12.5)	2 (22.2)	4 (22.2)	74 (15.4)	0.711
	Urban	56 (87.5)	7 (77.8)	14 (77.8)	405 (84.6)	
Place of death	**Health facility**	35 (54.7)	4 (44.4)	8 (44.4)	291 (60.8)	0.327
	Other/unknown	29 (45.3)	5 (55.6)	10 (55.6)	188 (39.2)	

p: p-value – chi square test;

†For participants under 15 years of age, the mother's educational level was considered.

SEP index: socioeconomic position index.

4.3. Determinants of maternal health care and birth outcome in the Dande Health and Demographic Surveillance System area, Angola.

Rosário EVN, Gomes MC, Brito M, Costa D. Determinants of maternal health care and birth outcome in the Dande Health and Demographic Surveillance System area, Angola. PLoS One. 2019;14(8):e0221280. Published 2019 Aug 22. doi:10.1371/journal.pone.0221280

PLOS ONE

RESEARCH ARTICLE

Determinants of maternal health care and birth outcome in the Dande Health and Demographic Surveillance System area, Angola

Edite Vila Nova Rosário[1,2]*, **Manuel Carmo Gomes**[3], **Miguel Brito**[1,4], **Diogo Costa**[2]

1 Centro de Investigação em Saúde de Angola (CISA), Bengo, Angola, **2** Instituto de Saúde Pública da Universidade do Porto (ISPUP), Porto, Portugal, **3** Faculdade de Ciências, Universidade de Lisboa, Lisboa, Portugal, **4** Health and Technology Research Center (H&TRC), Escola Superior de Tecnologia da Saúde de Lisboa, Instituto Politécnico de Lisboa, Lisboa, Portugal

* edite.rosario@cisacaxito.org

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Abstract

Objectives

Maternal health care improvement and reduction of maternal and child mortality are priorities of the global health agenda. In Angola, maternal mortality remains high and the risk of pregnancy-related death was 1 in 32 during 2015. This study aims to identify demographic and social factors influencing antenatal care and health facility delivery among women in Dande and to understand their impact on birth outcomes.

Methods

This study is based on community–based longitudinal data collected by the Dande Health and Demographic Surveillance System between 2009 and 2015. Data on pregnancy outcomes (10,289 outcomes of 8,066 women) were collected for all reported pregnancies, including sociodemographic information, health services utilisation and women's reproductive history. Logistic regression was used to investigate the determinants of birth outcomes, antenatal care attendance and institutionalised delivery.

Findings

Of the 10,289 pregnancy outcomes, 98.5% resulted in live births, 96.8% attended antenatal care, and 82.5% had four or more visits. Yet, 50.7% of the women delivered outside a health facility. Antenatal care attendance was a determinant of birth outcomes (stillbirth: unadjusted OR = 0.34 95% CI = 0.16–0.70; abortion: OR = 0.07 95% CI = 0.04–0.12). Older women, with lower education, living at a greater distance of a health facility and in rural areas, were less likely to use maternal health care. Having had previous pregnancies, namely resulting in live births, also decreased the likelihood of health care utilization by pregnant women.

Competing interests: The authors have declared that no competing interests exist.

Conclusions

The study identifies relevant social determinants for the utilisation of antenatal care, place of delivery and their impact on birth outcome, thereby providing insight on how best to address inequities in health care utilization.

Introduction

Maternal and child mortality reduction and improvements in women and children health care are priorities of the global health and international development agendas. They were integrated into the Millennium Development Goals (MDG) set for accomplishment until 2015, and remain in the Sustainable Development Goals (SDG) agenda for 2030 [1, 2].

By the end of the MDG era, several indicators showed that progress achieved across regions and countries regarding reduction in maternal mortality was below the established target and was geographically unequal [3]. The MDG5 target, aiming maternal health improvement, included a 75% decline in global maternal mortality ratio (MMR) between 1990 and 2015, but the observed reduction was only of 44% [3]. Regional disparities are evident, as deaths occurring in developing countries accounted for 99% of all maternal deaths, with the sub-Sahara African region alone bearing 66% of the burden [1, 3]. In 2015, the global lifetime risk of maternal mortality was approximately 1 in 180, but in sub-Saharan Africa it was estimated to be 1 in 36, in sharp contrast with approximately 1 in 4,900 in developed countries [3].

Most maternal deaths are preventable as they stem from insufficient health support during pregnancy and delivery [3–5]. Improvements in maternal and infant health require, although not exclusively, the provision of accessible reproductive health care and skilled attendance at delivery [4, 6, 7]. In 2013, the global coverage of skilled birth attendants (SBA) was 74% and the percentage of women with the recommended four or more antenatal care (ANC) visits was 64% [8], against 52% and 49% in sub-Saharan Africa [9]. The reduction of inequalities is a keystone in the new 'leaving no one behind' strategic framework for action in the SDG era [3, 10].

Angola had a reduction of 58.9% in MMR between 1990 and 2015. However, by the end of the MDG period, maternal mortality remained high, with a MMR estimated at 477 deaths per 100,000 live births and a risk of pregnancy-related death of 1 in 32 [1].

In Angola, the Multiple Indicator Cluster Survey (MICS) report of 2015–16 provides some information on the use of reproductive health care [11], but the overall data on maternal health are scarce and there is a paucity of research on the subject. The percentage of women attending at least one ANC visit, was 82% in 2015, very close to the global coverage of 83% in 2013 [8]. Nevertheless, more than half of the women still gave birth at home, with only 46% of births taking place in a health facility [11], far less than 71% of births globally attended by skilled personnel in 2014 [12].

This abandoning or lack of access to the health system at the time of delivery is poorly understood as there is a general absence of studies on the determinants of maternal health care utilisation in Angola and their impact on birth outcomes. Although previous studies report the determinants of maternal care utilization and their importance in other Sub-Saharan African countries [3, 13–15], this research is needed in Angola, since evidence can be context dependent. Such evidence is required to understand and reduce health inequities [16].

This study aims to identify demographic and social factors influencing the utilisation of ANC and health facilities for delivery among women in the Dande Health and Demographic Surveillance System (HDSS) area between 2009 and 2015, as well as their impact on birth outcomes.

Materials and methods

Setting

We have analysed data from the HDSS located in Dande Municipality, Bengo Province, located about 60 km to the north-east of Luanda. The area, with approximately 4,700 km^2, covers all the 70 hamlets located in three of the five municipality communes—Caxito, Mabubas and Ucua—plus a smaller portion of hamlets in the Barra do Dande and Kicabo communes [17]. Urban areas cover approximately 77% of the total population (27 hamlets). We adopted the classification of the Angolan National Institute of Statistics (INEA), which defines urban areas as including all province capitals (as Caxito), and towns with 2.000 or more inhabitants, having basic infrastructures like schools, health centres, and paved main roads. Rural areas are mainly dispersed settlements [18] whose socioeconomic conditions, accessibilities and population lifestyle differ markedly from urban living. In general, the accesses are rudimentary for both the rural and urban areas covered: there are only two main paved roads crossing the HDSS area and unpaved dirt roads constitute the main routes, constraining access to some communities, especially in the rainy season [17].

Until 2015, the public health facilities that served the HDSS area were a general hospital, a municipal hospital, a maternal and infant health centre, two health centres and 10 primary health centres. A private health centre, run by the catholic church, was also settled in the surveillance area. Maternal health (pre and postnatal care) was available in eight of those facilities, including the private health centre. Birth delivery support was available in three facilities: two hospitals, both located in the city of Caxito, and the maternal and infant health centre located at the urban area periphery. In most of these health facilities, material and human resources are scarce, causing frequent constraints to both routine and emergency care services that are offered. Additional information on the HDSS area, including health human resources has been published before [17].

The HDSS was implemented in 2009 and an initial census, performed between August 2009 and March 2010, established the baseline study population, registering 15,579 households with 59,635 residents. Women comprised 51% of the population (30,414). The household's geographical coordinates were collected using a geographical positioning system (GPS). After the initial census, update rounds (UR), consisting of periodic house-to-house visits, collected data on households' characteristics and demographic events, such as pregnancies, births, deaths and migrations.

Between 2010 and 2014, women aged 15–49 years living in the Dande HDSS represented on average 23.1% of the total population and the total fertility rate (number of children born or likely to be born to a woman in her lifetime if she were subject to the prevailing rate of age-specific fertility in the population) for the same period was on average 4.3 [17].

Sampling and data collection

Data collection was carried out during nine update rounds, performed between August 2009 and December 2015, using structured questionnaires administered at each household (S1 and S2 Text). Data on pregnancy outcomes were collected for all reported pregnancies, including information on the women, their ANC attendance, birth outcome (live births, stillbirths or abortions) and place of delivery (health centre, hospital or outside a health facility). Information was collected for 10,289 pregnancy outcomes from 8,066 women. In the ninth round (February to October 2015), several questions were added to the inquiry form, namely the place where the women conducted ANC visits (public or private), the number and timing of visits, if the women had been pregnant before, and if so, how often, and the resulting number

of live births out of those pregnancies. This added information was collected for 2,187 pregnancy outcomes.

The data were collected by 18 local fieldworkers who had received training on explaining the HDSS objectives, techniques for conducting interviews and instructions on how to complete the questionnaires. Six supervisors assured the quality of work: four checked all the completed forms and monitored the fieldwork, whereas two identified and corrected errors and incongruences at the data centre. Six data clerks inserted all data following a double entry system. A manual was provided with instructions regarding all procedures.

Women's basic sociodemographic data were retrieved from the HDSS databases, namely birth date, literacy (can read and write), years of schooling and place of residence.

Variables

Dependent variables–Three dependent variables were selected for the analyses: The first was '**birth outcome'**, with three categories: live birth (98.5% of 10,289 birth outcomes), stillbirth (foetal death with a gestation period of 28 or more weeks, 0.9% of birth outcomes), and abortion (foetal death with less than 28 weeks of gestation, comprising 0.6% of birth outcomes). In statistical analysis where independent variables had relatively small samples ($n \leq 2,187$), stillbirths and abortions were lumped into a single category of adverse outcomes. The second dependent variable was ´**ANC attendance**' (yes or no), being yes if women attended at least one appointment. The third was '**place of delivery**'–in a health facility *versus* delivery outside a health facility.

Independent variables–These were women's age (continuous variable), education (school attendance, number of years of schooling and literacy), their geographic location (approximate road distance of their households to health facilities, commune of residence and rural or urban location), number of ANC visits, gestational age at first ANC visit, previous pregnancies and respective outcomes, and number of live children.

Data analysis

Data were entered and analysed for both descriptive and inferential statistics using the Statistical Package for Social Sciences (SPSS) software, version 23.0. Analysis of variance and post-hoc tests were used as appropriate to compare means of continuous variables. The effects of predictive variables over dependent variables were studied by binary logistic regression, except when the dependent variable was pregnancy outcome and independent variables had large sample sizes (>10,000) allowing for the splitting of pregnancy outcome into three categories, which were studied by multinomial logistic regression. Associations were studied by bivariate and multivariate analysis, with the computation of, respectively, crude and adjusted odds ratios (OR). In multivariate analysis, we used an exploratory model building approach, as independent variables were selected for being suspected predictors and were entered in block. We have first studied the association with independent variables with n>10,000 observations, doing a separate analysis for variables with smaller samples, namely those related to women´s past pregnancy experience. Post-hoc power analysis was done with G*Power 3 [19] when there was a suspicion of a Type II error.

Ethical considerations

This study was approved by the Ethics Review Committees of the Ministry of Health of Angola and the Institute of Public Health of the University of Porto. As an HDSS implies frequent visits to households to update information, verbal consent was deemed appropriate for monitoring demographic events. Participation was voluntary. All forms used in the HDSS were

approved and registered in the Angolan National Institute of Statistics, namely the birth outcome form.

Results

A total of 10,289 birth outcome forms were collected between 2009 and 2015. The mean age of women who gave birth was 26.5 years old (± 7.21), with 3,596 (34.9%) of them at ages deemed of higher risk pregnancy (< 20 and > 35 years old) [20]. Women´s education was generally low: the mean number of years spent at school was 2.57 (± 3.48), but more than half of the participants had no education (55.5%). From a total of 10,289 pregnancies, 84.3% of women were living in an urban area and 73.4% at a distance to the nearest facility of less than 2 km. The majority of women attended an ANC visit during pregnancy (96.8%). Information regarding the number of visits and gestational age at first ANC visit was available for, respectively, 1,747 and for 2,007 women. The mean number of ANC visits was 5.84 (± 2.27) and 82.5% reported to have had four or more ANC visits. The first ANC visit occurred mainly in the first trimester of pregnancy (63.7%). Nearly one-sixth of women (15.7%) was *nulligravida* and 84.3% had been pregnant before. For *gravida*, the mean number of pregnancies was 3.21 (±2.99) and the mean number of previous live births was 3.01 (±2.87). About 16.7% of women with previous pregnancies had never had a live birth. Despite high adherence to ANC visits, when asked about the place of delivery only 49.3% reported having had an institutionalized birth (Table 1).

Demographic, social, and obstetric determinants associated with birth outcome

The odds of a pregnancy ending in stillbirth was associated with both ANC attendance and with the place of residence: having at least one ANC visit decreases the odds of stillbirth (unadjusted OR = 0.34, 95% Confidence Interval, CI = 0.16–0.70) and women living in rural areas have higher odds of delivering a stillbirth (OR = 2.11, 95% CI = 1.35–3.29) than those in urban settings. These associations were not significant though when the OR was adjusted for factors like place of delivery, distance to a health facility, women´s age and education (Table 2). Proximity to a health facility tended to decrease the odds of a stillbirth (unadjusted OR's for <2 km, 2–5 km, 6–10 km, and 11–15 km were, respectively, 0.43, 0.54, 1.35, and 1.50), although the protective effect of proximity was significant only for living at < 2 km in the bivariate analysis (Table 2). The odds of a stillbirth decreased for women with more years of school education (unadjusted OR = 0.96, $p = 0.22$) and tended to increase with women's age (OR = 1.02, $p = 0.19$), but none of these associations was significant. In a post-hoc power analysis (one-sided test, with $\alpha = 0.05$), the probability of not incurring in a Type II error, when comparing the risk of stillbirth between women who were one standard deviation apart in years of age was only 35.2%, while in years of schooling was 53.3%. To achieve a power of at least 80%, a sample size four times greater would be required for ages and twice greater for years of schooling.

The odds of abortion were found to decrease when there was ANC attendance (OR = 0.07, 95% CI = 0.04–0.12), both in bi and multivariate analysis. Living in rural areas increases the odds of abortion (unadjusted OR = 2.29, 95% CI: 1.32–3.97), moreover abortion was also associated with the place of delivery (unadjusted OR = 2.00, 95% CI: 1.17–3.42) (Table 2). The odds of abortion tend to decrease for women with more school education (unadjusted OR = 0.91, 95% CI: 0.83–0.99) and no association was found between odds of abortion and women's age (OR = 1.00, $p = 0.99$).

All variables in Table 2 had sample sizes n>10,000. The association with women's obstetric history was examined separately, using variables with smaller sample sizes, namely, the existence of at least one past pregnancy (yes/no; n = 2,187) and, if yes, having already experienced

Table 1. Descriptive statistics of the sample.

Variable	Categories	n (%)
Women´s age (years)	<20 years old	1,975 (19.2)
(N = 10,289)	20–34 years old	6,697 (65.1)
	35–44 years old	1,543 (15.0)
	>45 years old	74 (0.7)
Mean ± sd; min-max	26.5 ± 7.21 (11–57)	
Women´s education	No education	5,776 (55.5)
(Completed years of schooling)	≤ 4 years of schooling	1,647 (16.4)
(N = 10,039)	5–8 years of schooling	2,004 (20.0)
	9–12 years of schooling	727 (7.2)
	>12 years of schooling	85 (0.8)
Mean ± sd; min-max	2.57 ± 3.48 (0–13)	
Women´s Literacy	Yes	2,990 (63.9)
(N = 4,680)	No	1,690 (36.1)
Place of residence	Urban	8,676 (84.3)
(N = 10,289)	Rural	1,613 (15.7)
Approximate distance to	<2 km	7,550 (73.4)
a health facility (N = 10,289)	2–5 km	1,656 (16.1)
	6–10 km	293 (2.8)
	11–15 km	227 (2.2)
	>15 km	563 (5.5)
ANC attendance	Yes	9,759 (96.8)
(N = 10,084)	No	325 (3.2)
Nr. of ANC visits (N = 1,747)	<4	305 (17.5)
	4–8	1,112 (63.6)
	≥9	330 (18.9)
Mean ± sd; min-max	5.84 ± 2.27 (1–10)	
Type of ANC provider	Public	1,895 (91.0)
(N = 2,083)	Private	188 (9.0)
Gestational age at 1st ANC	1st trimester	1278 (63.7)
visit (N = 2,007)	2nd trimester	688 (34.3)
	3rd trimester	41 (2.0)
Have been pregnant	Yes	1,843 (84.3%)
before (N = 2,187)	No	344 (15.7%)
Nr. previous pregnancies	0 times	344 (15.8)
(N = 2,180)	1 time	251 (11.5)
	2 to 3 times	661 (30.3)
	4 to 5 times	557 (25.6)
	6 or more times	367 (16.8)
Mean ± sd; min-max	3.21 ± 2.99 (0–13)	
Parity (Nr. of previous live	0 live birth	364 (16.7)
Births) (N = 2,178)	1 live birth	297 (13.6)
	2 to 3 live births	670 (30.8)
	4 to 5 live births	549 (25.2)
	6 or more live births	298 (13.7)
Mean ± sd; min-max	3.01 ± 2.87 (0–11)	
Place of delivery	Health facility delivery	4,962 (49.3)
(N = 10,059)	Home delivery	5,097 (50.7)

(*Continued*)

Table 1. (Continued)

Variable	Categories	n (%)
Birth outcomes (N = 10,289)	Live birth	10,131 (98.5)
	Stillbirth	97 (0.9)
	Abortion	61 (0.6)

sd = standard deviation; min = minimum; max = maximum; ANC = Antenatal care

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an adverse pregnancy outcome (yes/no; n = 1,836), and number of children alive (data for n = 2,178 women) (Table 3). Because age is a likely confounder in pregnancy history, crude and age-adjusted OR's were estimated for these variables. Women who had past pregnancies were more likely to have an adverse outcome, but the association lacks statistical significance (unadjusted OR = 2.44, $p = 0.39$), and a similar result is observed after adjusting for age (OR = 1.99, $p = 0.54$). Women who had experienced a past adverse outcome had twice the odds of having a new one, but again the association was not significant (crude OR = 2.07, $p = 0.23$) (Table 3). Apparently sample sizes were not large enough to reject the null hypothesis in these associations, given the small numbers of adverse outcomes (14 in 2187 women)–a post-hoc power analysis estimates that the power to associate an adverse outcome with women who had past pregnancies was 26%, and with those who had past adverse outcomes was only 7% (two-sided tests, $\alpha = 0.05$). The number of live children was positively correlated with the occurrence of an adverse pregnancy outcome, but this association was also not significant (OR = 1.21, $p = 0.08$).

Demographic and social determinants associated with the utilisation of ANC services

Several factors significantly increase the risk of not having an ANC attendance. Namely, living at a greater distance to a health facility, living in a rural area, and having lower education, regardless of whether the association is seen from a bivariate or a multivariate viewpoint (Table 4). The association is particularly strong for rural areas (OR = 6.03, 95% CI = 4.81–7.55) and those living more than 6 km off a health facility (OR = 9.36 95% CI = 6.33–13.85, for 11–15 km away). The odds of not attending an ANC visit is also higher for older women, increasing 1.02 (95% CI = 1.00–1.03) per year of age. Having passed more years in school, on the contrary, decreases 0.83 the odds of non-attendance per additional year at school (95% CI = 0.79–0.88). Absence of literacy also increases the risk of no ANC attendance, although this variable becomes non-significant when the OR is adjusted for number of years of schooling.

Having experienced pregnancies in the past was significantly associated with greater odds of not attending antenatal care (crude OR = 2.44, 95% CI = 1.06–5.56) (Table 3). There was an age effect in this association though, as the age-adjusted OR was weaker and statistically non-significant (OR = 1.37, 95% CI = 0.56–3.45). Women who experienced past adverse pregnancy outcomes were also less likely to attend ANC, but this association was not statistically significant. The number of children was, however, significantly associated with an increase in the odds that women did not attend ANC (unadjusted OR = 1.27, 95% CI: 1.16–5.00) remaining significant even after adjusting for the women's age (Table 3).

Demographic and social determinants of place of delivery

Bivariate analysis showed that all the selected explanatory variables were associated with the place of delivery and most associations remained significant after adjusting for the presence of covariates (Table 5). Noteworthy is the increased risk of delivery outside a health facility in

Table 2. Adjusted and unadjusted Odds Ratios (OR) of stillbirth (top table) and abortion (bottom) against predictor variables, from multinomial logistic regression. Values of OR>1 indicate increased risk of stillbirth or abortion.

	n stillbirths / n pregnancies (%)	Unadjusted OR (95% CI)	*p*	Adjusted OR (95% CI)	*p*
ANC attendance					
No	8/325 (3.4%)	1		1	
Yes	87/9759 (0.9%)	0.34 (0.16–0.70)	<0.01	0.57 (0.25–1.29)	0.18
Place of residence					
Urban	70/8676 (0.8%)	1		1	
Rural	27/1613 (1.7%)	2.11 (1.35–3.29)	<0.01	1.59 (0.84–3.03)	0.16
Place of delivery					
Health facility	47/4962 (0.9%)	1		1	
Outside health facility	48/5097 (0.9%)	1.00 (0.67–1.9)	0.99	1.27 (0.83–1.95)	0.27
Km to health facility					
<2 Km	58/7550 (0.8%)	0.43 (0.22–0.84)	0.01	0.64 (0.27–1.53)	0.32
2–5 Km	16/1656 (1.0%)	0.54 (0.24–1.19)	0.13	0.80 (0.30–2.15)	0.66
6–10 Km	7/293 (2.4%)	1.35 (0.51–3.58)	0.55	1.93 (0.67–5.55)	0.22
11–15 Km	6/227 (2.6%)	1.50 (0.54–4.19)	0.44	1.44 (0.52–4.02)	0.49
>15 Km	10/563 (1.8%)	1		1	
Education (nr. years of schooling)	96/10239 (0.9%)	0.96 (0.90–1.02)	0.22	0.99 (0.93–1.06)	0.80
Women's age (years)	97/10289 (0.9%)	1.02 (0.99–1.05)	0.19	1.02 (0.99–1.04)	0.31
	n abortions / n pregnancies (%)	**Unadjusted OR (95% CI)**	***p***	**Adjusted OR (95% CI)**	***p***
ANC attendance					
No	19/325 (3.4%)	1		1	
Yes	41/9759 (0.4%)	0.07 (0.04–0.12)	<0.01	0.07 (0.04–0.13)	<0.01
Place of residence					
Urban	43/8676 (0.5%)			1	
Rural	18/1613 (1.1%)	2.29 (1.32–3.97)	<0.01	1.92 (0.98–3.79)	0.06
Place of delivery					
Health facility	20/4962 (0.4%)	1			
Outside health facility	41/5097 (0.8%)	2.00 (1.17–3.42)	0.01	1.30 (0.74–2.31)	0.36
Km to health facility					
<2 Km	47/7550 (0.6%)	0.87 (0.31–2.41)	0.78	3.57 (1.11–11.45)	0.03
2–5 Km	7/1656 (0.4%)	0.59 (0.17–2.02)	0.40	2.46 (0.63–9.56)	0.20
6–10 Km	1/293 (0.3%)	0.48 (0.05–4.33)	0.51	0.93 (0.10–8.73)	0.95
11–15 Km	2/227 (0.9%)	1.25 (0.23–6.89)	0.80	1.11 (0.20–6.23)	0.91
>15 Km	4/563 (0.7%)	1		1	
Education (nr. years of schooling)	61/10239 (0.6%)	0.91 (0.83–0.99)	0.03	0.94 (0.85–1.04)	0.22
Women's age (years)	61/10289 (0.6%)	1.00 (0.97–1.04)	0.99	0.99 (0.95–1.02)	0.41

ANC = Antenatal care, OR (95% CI) = Odds Ratio (95% Confidence Intervals)

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absence of ANC attendance (adjusted OR = 3.49, 95% CI = 2.57–4.74). Women's odds of delivery outside a health facility was also higher for those living at greater distances and those living in rural areas (Table 5). Having more years of schooling, on the contrary, increased the likelihood of an institutionalised birth (Table 5).

Past pregnancy experience was associated with greater odds that delivery takes place outside a health facility (crude OR = 2.94, 95% CI = 2.27–3.85), and this association remained

Table 3. Unadjusted and age adjusted Odds Ratios (OR, 95% CI, p) for having an adverse pregnancy outcome, not attend ANC, and deliver outside a health facility, against three explanatory variables related with women's history of pregnancy.

	Women (n)		To have an adverse outcome (OR 95% CI)	*p*	Not attend ANC (OR 95% CI)	*p*	Outside health facility (OR 95% CI)	*p*
Previously pregnant								
No	344		1		1		1	
Yes	1843	Unadj	2.44 (0.32–18.69)	0.39	2.44 (1.06–5.56)	0.04	2.94 (2.27–3.85)	<0.001
		Adjust	1.99 (0.23–17.65)	0.54	1.37 (0.56–3.45)	0.49	3.13 (2.38–4.17)	<0.001
Past adverse outcomes								
No	1510		1		1		1	
Yes	326	Unadj	2.07 (0.63–6.77)	0.23	1.56 (0.91–2.63)	0.11	1.03 (0.81–1.32)	0.78
		Adjust	2.01 (0.61–6.59)	0.25	1.43 (0.84–2.44)	0.19	1.04 (0.81–1.32)	0.76
Nr. of live children	2178	Unadj	1.21 (0.98–1.51)	0.08	1.27 (1.16–5.00)	<0.001	1.18 (1.14–1.23)	<0.001
		Adjust	1.28 (0.94–1.75)	0.12	1.22 (1.08–1.39)	0.003	1.30 (1.22–1.39)	<0.001

ANC = Antenatal care; Unadj = Unadjusted; Adjust = Adjusted; OR (95% CI) = Odds Ratio (95% Confidence Intervals)

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significant ($p<0.001$) after adjusting for age (Table 3). Women who had experienced past adverse pregnancy outcomes were also less likely to deliver at a health facility, but this association was not significant (Table 3). The number of children was however significantly associated with the odds of a woman not delivering at a health facility (unadjusted OR = 1.18, 95% CI: 1.14–1.23), remaining significant after adjusting for the women's age (Table 3).

Discussion

We have used Dande HDSS 2009–2015 data, located in Bengo Province of Angola, about 60 km to the NE of Luanda, to identify factors that influence the utilization of health services by pregnant women and the associated risk factors for pregnancy outcome. There were 10,289

Table 4. Adjusted and unadjusted Odds Ratios (OR) of ANC attendance against predictor variables, from binomial logistic regression. Values of OR>1 indicate increased risk of no ANC.

Variables	n attending ANC / n pregnancies (%)	Unadjusted OR (95% CI)	*p*	Adjusted OR (95% CI)	*p*
Place of residence					
Urban	8348/8509 (98.1%)	1		1	
Rural	1411/1575 (89.6%)	6.03 (4.81–7.55)	<0.001	2.95 (2.15–4.05)	<0.001
Distance to health facility					
< 2 km	7263/7414 (98.0%)	1		1	
2–5 km	1574/1612 (97.6%)	1.16 (0.81–1.66)	0.42	1.19 (0.83–1.72)	0.35
6–10 km	262/288 (91.0%)	4.77 (3.09–7.37)	<0.001	3.24 (2.06–5.10)	<0.001
11–15 km	185/221 (83.7%)	9.36 (6.33–13.85)	<0.001	3.17 (1.99–5.03)	<0.001
>15 km	475/549 (86.5%)	7.49 (5.59–10.05)	<0.001	2.61 (1.79–3.81)	<0.001
Literacy					
Yes	2891/2927 (98.8%)	1		1	
No	1488/1546 (96.2%)	3.13 (2.06–4.77)	<0.001	0.92 (0.50–1.68)	0.78
Education (Years of schooling)	9714/10037 (96.8%)	0.79 (0.75–0.83)	<0.001	0.83 (0.79–0.88)	<0.001
Women's age (years)	9759/10084 (96.8%)	1.04 (1.02–1.05)	<0.001	1.02 (1.00–1.03)	0.02

ANC = Antenatal care; OR (95% CI) = Odds Ratio (95% Confidence Intervals)

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Table 5. Adjusted and Unadjusted Odds Ratios (OR) of delivery at health facilities against predictor variables. Values of OR >1 indicate increased risk of delivery outside health facilities.

Variables	n at health facility / n pregnancies (%)	Unadjusted OR (95% CI)	*p*	Adjusted OR (95% CI)	*p*
ANC attendance					
Yes	4908/9733 (50.4%)	1		1	
No	52/321 (16.2%)	5.26 (3.9–7.1)	<0.001	3.49 (2.57–4.74)	<0.001
Place of residence					
Urban	4469/8491 (52.6%)	1		1	
Rural	493/1568 (31.4%)	2.42 (2.16–2.72)	<0.001	1.76 (1.51–2.04)	<0.001
Distance to health facility					
< 2 km	3841/7398 (52%)	1		1	
2–5 km	827/1607 (51%)	1.02 (0.91–1.14)	0.74	1.02 (0.92–1.14)	0.69
6–10 km	72/287 (25%)	3.23 (2.46–4.23)	<0.001	2.56 (1.94–3.37)	<0.001
11–15 km	68/220 (31%)	2.41 (1.81–3.22)	<0.001	1.11 (0.80–1.54)	0.52
>15 km	154/547 (28%)	2.76 (2.28–3.34)	<0.001	1.37 (1.08–1.73)	0.01
Literacy					
Yes	1750/2924 (59.8%)	1		1	
No	656/1538 (42.7%)	2.00 (1.77–2.27)	<0.001	3.32 (0.85–1.20)	0.93
Education (Years of schooling)	4941/10015 (49.3%)	0.9 (0.89–0.91)	<0.001	0.92 (0.90–0.93)	<0.001
Women's age (years)	4962/10059 (49.3%)	1.01 (1.01–1.02)	<0.001	1.00 (1.00–1.01)	0.56

ANC = Antenatal care; OR (95% CI) = Odds Ratio (95% Confidence Intervals)

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reported pregnancies, 98.5% of which resulted in live births, corresponding to about 15 deaths per 1,000 gestations. This compares with the perinatal mortality of 30 deaths per 1,000 gestations reported for Angola [11]. However, the perinatal mortality, includes live births with ensuing death within the first seven days of life [11], whereas the foetal deaths of our study focused exclusively on abortions and stillbirths. Nevertheless, we cannot exclude under-reporting of foetal deaths, as it has been previously documented for the Dande HDSS area [17] and in similar settings of low and middle-income countries [21–23]. Spontaneous and induced abortions are highly stigmatised. The first are related to social representations of women's inability to have children, and the second are illegal. Therefore, abortions have probably been grossly under-reported in our study. Additionally, the lack of effective registration systems, cultural beliefs and stigma are the main obstacles to unbiased estimations of stillbirths and neonatal mortality [24]. Household surveys are very important sources of information in developing countries [23], but even this method does not keep people from omitting information because they don't recognize the importance of reporting stillbirths or the death of infants who had not been previously registered [17, 20–22].

We have found that having at least one ANC visit, decreases the odds of a stillbirth and the odds of an abortion. These results corroborate the importance of ANC attendance for decreasing the risk of foetal death and are in line with a study conducted in Nigeria where, after controlling for variables similar to those we have studied, ANC attendance was the single significant predictor of live birth [25]. A study on ANC services and their implications for vital and health outcomes of children in 69 low and middle-income countries, also reported that the prevalence of newborn deaths was higher among women who did not attend ANC (3.12%) compared to those with at least one visit (1.67%) [26]. Several studies underline the benefits of ANC in the early detection of possible obstetric complications, treatment, and identification or modification of risk factors during pregnancy [2, 14, 27, 28]. Depending on the level of care, women attending ANC become more exposed to proper information, counselling and

education about pregnancy, their health and child care. There is also a positive association between ANC attendance and later institutionalized delivery or use of SBA [29–31], again contributing to maternal and child mortality reduction [29, 32, 33, 34].

We have also found that in the Dande HDSS area, women who attended ANC were more likely to have an institutionalized delivery than otherwise. A similar association was found in Kenia [15, 35], Cambodia [36], Ghana [31, 37] and Bangladesh [38]. This prominence of the ANC appointment prompted us to examine the possible determinants of ANC attendance itself. The prevalence of ANC attendance was 96.8%, which is higher than the national figure of 81.6% [11], and higher than the reported median ANC of 89% in sub-Saharan Africa in 2010–2014 [29]. The number and timing of ANC visits of women participating in our study were in greater compliance with the WHO recommendations than those observed at the national level. In the Dande HDSS area, 82.5% of women had four or more visits and 63.7% had the first ANC contact within the first trimester of gestation, whereas in Angola those percentages were 61% and 40%, respectively [11]. In the Dande area, women may have attended ANC care to receive free medication, a mosquito bed net and a pregnancy card, which facilitates their access to hospital emergency in case of need, even if they were not planning an institutionalised delivery. Nevertheless, these perks probably do not explain the higher values of ANC prevalence when compared to those at national level. One possible explanation is the greater weight of urban women in our study (84.3%), given that in Angola the coverage of prenatal care is 92% in urban areas[11]. Also, 73.4% of households of our study were at less than 2 km from a health facility and this figure may be too optimist for Angola as a whole.

The use of ANC services is significantly influenced by the place where women live. In our study, the distance of the household to the nearest health facility was calculated using geographical information system methods. We have found that living far from a health facility is a major factor, as women living at distances greater than 2 km had an increased risk of missing ANC, compared to those at <2 km. Distance is a known barrier to health care utilization, as it is linked to lack of transport, poor access and costs [39–41]. In our study, women living in rural areas were also at greater risk of not attending any ANC than those in urban settings, and this remained true even after adjusting for distance to a health facility. Other studies also reported a decreased prevalence of ANC in rural areas [13, 42, 43]. The risk associated with distance accumulates with the risk of living in rural settings. The two factors combined, capture other aspects of remoteness such as poor road access, reduced communication between communities, disadvantaged socioeconomic status, adherence to cultural traditions, and limited access to information, among others [40].

Education has been commonly associated with an increased likelihood of health care utilization and is frequently pointed out as an important social determinant of maternal health care [15, 44, 45]. Educated women have more autonomy and capacity to make informed and responsible decisions about their health [45, 46]. They have a better understanding of the information conveyed by health professionals, for them and their children, namely regarding the importance of the continuum maternal care [45]. We have found that education is an important determinant of ANC attendance. One more year in school meant an average decrease in the odds of failing to attend ANC by OR = 0.83 (95% CI = 0.79–0.88), after adjusting for place of residence and age. This is in good agreement with the results of a recently published study conducted in Jordan [47], where the odds of non-utilization of ANC services decreases 0.87 (95% CI = 0.81–0.91) for an additional one-year in school [47]. This concurs with several other studies that found women's education as a motivator and an important determinant of ANC attendance [15, 36, 39, 43, 48].

The influence of women's age in maternal health care utilization is not linear and cannot be determined before an investigation, as different studies have found different lines of evidence

[49]. The association between age and maternal health care utilisation might be related with different aspects: having been pregnant before, previous experiences in the use of ANC services, number of living children, cultural practices, health literacy, among others. In the Dande HDSS, older women had higher odds of not attending ANC visits [20, 50, 51], although other studies found the opposite [52–54]. Besides age, the women's past obstetric experience was an important determinant of health services' utilization in our study area. Generally speaking, older and more experienced women were less likely to use ANC services. Age by itself increased the odds of missing ANC by a factor of 1.02 per additional year of age, but the number of live children was also very influential, even after adjusting for the age effect. Having had a past adverse pregnancy outcome (stillbirth or abortion) did not change this picture, on the contrary, it appears to increase the odds of missing ANC, although this effect was not found significant, eventually due to lack of statistical power. There are a few possible explanations for these findings. On the one hand, older women, more likely to have past pregnancy experience, may have grown an increased feeling of being able to deal with another experience without institutional help. This feeling may become strong enough to make them decide to avoid the eventual inconveniences and costs of visits to the health facility. On the other hand, the quality of services provided during previous pregnancies is also likely to be influential. The acquired perception of how useful the services were in the past, can be crucial for the choices made in future pregnancies. We have not inquired on the women's satisfaction regarding past health services utilization though, and further studies are needed to understand if these results are connected with previous pregnancies experiences.

Universal Health Coverage (UHC), under SDG 3, addresses different gaps in health care delivery [55]. An institutionalized delivery is more likely to provide safe conditions for both the mother and the newborn, thus contributing to prevent neonatal and maternal mortality [12, 29, 48], yet about 60% of births in Sub-Saharan Africa occur at home or in the absence of skilled birth attendants [12, 55]. In the Dande HDSS area, 50.7% of deliveries occurred outside a health facility. The likelihood of a non-institutionalised birth was greater for women who did not attend ANC and lived in rural areas. Corroborating previous studies [12, 48, 55], we have found that greater distance to a health facility was also associated with a non-institutionalized delivery. As for the women´s age and experience, the results were coincident with those mentioned above for the utilisation of ANC: more experienced women, with higher parity, were more likely to deliver outside health facilities, which is also in accordance with studies conducted elsewhere [13, 39, 48]. On the contrary, women with more years at school were more likely to give birth in a health facility, having a decreased odds of 0.92 per additional year in school [13, 30, 55].

The discrepancy between high levels of ANC attendance and low health facility delivery in the Dande HDSS area is in line with findings from studies conducted in other settings of Sub-Saharan Africa [32, 37, 56] and it may be related with the precipitous nature of women´s labour. Antenatal care (ANC) attendance does not demand a specific timing, but the imminence of delivery requires time for women to cover the distance to a health facility. The lack and cost of transportations, as well as poor road infrastructures, become thus involved in the decision on where deliver. In more experienced women (older, with previous pregnancies and with more children), self-confidence, and previous experiences might also be playing a key role in their final decision. A possible explanation is the added inconvenience of a temporary separation from the children, eventually brought about by a visit to the health facility. We have found that women already had an average of 3 live children when they were pregnant, with 39% having 4 or more children. The existence of support in the household for these children may be decisive. Future research should focus on the rationale underlying women´s choices and on the quality of care provided at health facilities, to understand what is constraining the

use of health delivery services. Eventual poor quality of care and equipment, and women's perception of that, is one of the hypotheses for abandoning the health system at the time of delivery.

The use of ANC services and health facilities proved to be positively associated with birth outcome. However, an important result from our study is the lack of equity in accessing these services. The main discriminant factors were the place of residence, namely the rural-urban dichotomy and distance to health facilities, and the women's level of education. These determinants have been previously recognized as dimensions to equity in health services utilization [39] and are consistent with results reported by relevant studies in developing countries [13, 43, 44, 53]. We have also found that women's age, which correlates with experience and number of children, in time, may also become an increasing obstacle to make use of health services. These later factors may result from a combination of factual difficulties with the women's evolving evaluation of the benefits that they anticipate from using the services.

Strength and limitations

This study was conducted within the scope of Dande HDSS activities, covering both urban and rural areas, involving the analysis of a six-year period (from 2009 to 2015), a large sample and a set of individual variables that allowed studying several sociodemographic determinants of maternal health care utilization. This study also focused on pregnancy outcomes that occurred in and outside health facilities, thus encompassing a better knowledge about maternal health care utilisation. To our knowledge, the few pieces of research conducted in Angola that approached determinants of maternal health care [52, 57] were hospital-based studies, therefore excluding women who did not use maternal health services and potential factors that kept them away from health facilities.

There is a wide range of factors that contribute to the utilisation of maternal health care. To assess them we have used a tool that continuously collects information on pregnancy results and allows access to indicators such as ANC attendance, number and timing of attendance, institutionalized births or access to SBA, and birth outcome. Despite the strengths of this study, it is important to acknowledge limitations, namely the probable under-reporting of events related to stillbirths, neonatal and perinatal deaths. Given the importance of data on foetal death to assess maternal and child care, it is extremely important to create reliable and permanent registration mechanisms that contribute to a better understanding of reality, especially in developing countries [3, 27]. The implementation of a pregnant surveillance system (PSS) and the follow-up of a birth cohort are currently being planned, enabling greater accuracy and a thorough knowledge of events concerning maternal and child health [17]. The PSS will enable the exploration of more than the individual determinants of access to maternal health care, namely the social context where women are embedded, and, for those attending ANC, the content, quality and the way interactions with health providers shape the continuum of maternal care. The 2016 WHO recommendations shifted the focus from coverage to content and recent research shows that the quality of ANC and delivery care, both important for the survival of mother and child, carry crucial importance in the use of maternal health care services [2, 3, 58].

An average of 6 months elapsed from pregnancy outcomes to women interviewing, which might still be considered appropriate to avoid recall bias. However, information bias particularly regarding adverse events cannot be completely ruled out. Our adverse events' classification was based on women self-reports of gestational age (28 weeks being the discriminant timing) and these might not be accurate enough, even if women were answering at their best knowledge.

The economic and financial attributes of the household to which women belong might influence some of the variables studied. For example, access to education and transportation,

are surely conditioned by economic status. Economic determinants are widely studied in the context of maternal care use in different settings. The construction of a wealth index with economic data of the households and the analyses of how it might influence relevant risk factors identified here is a logical next step currently under investigation, which we intend to publish in the future.

Conclusions

Given that our study is based on data collected from 2009 to 2015, in this paper we refer to the WHO recommendation of a minimum of four ANC visits during pregnancy. In 2016, at the start of the SDGs, WHO launched new guidelines aiming ANC models with a minimum of eight contacts, with the first taking place between eight and twelve-weeks' gestation. The current results suggest that there are difficulties in the implementation of more demanding models of access to maternal health care. Rich-poor and rural-urban gaps persist in women's access to maternal health care services. Essential improvements are needed in the country's capacity to address the determinants of maternal health and to adopt more appropriate interventions to local contexts. According to the results of our study, specific and articulated health and social policies are needed in Bengo Province, Angola, to address existing barriers to maternal health care, such as availability of proximity services, for instance increasing the number of health facilities, mainly in rural areas. Delivery facilities restricted mostly to urban areas may be preventing women from seeking institutionalized birth, given that place of residence and distance to health facilities are strongly associated with the place of delivery. Improvements in health assistance quality are also needed: in addition to trained and available human resources, maternal health care facilities should provide routine services endowed with basic essential obstetric care, not only capable of early detection and treatment of pregnancy problems but also of managing unexpected complications. Investment should be made in hospitals where there is at present lack of equipment and/or human resources, contributing for women to perceive health units as a safer and more propitious environment for childbirth, overcoming the barriers that have been preventing them from having an institutionalized birth. Referral systems and emergency transports, like ambulances, are essential in settings as Dande, where the lack of private or public transports is a constant.

These measures are critically dependent on the financial investment that authorities are willing to make in maternal health in Angola. However, to maximize their impact, and to reduce the gap between policies and reality on the ground, there is a need to strengthen leadership and governance capacity in the maternal health sector, and to develop information systems capable of informing and improving practices within the health system. Following a rigorous and decentralized reality-driven approach, systematic quality assessments of the services are required to help the identification of the main problems, to assure effective resource allocation, to make health services more socially accountable, and to develop solutions to improve maternal and child health services.

Social programmes aiming to reinforce women's empowerment and education are also essential. Short-term measures, like awareness raising in communities and maternal education programmes are a priority, always involving different participants (women, families and health agents). Given the scarcity of health workers, and taking advantage of the existence of the civic organization Angolan Women Organization (OMA–Organização da Mulher Angolana) whose main objectives are to promote women's health care, legal education and the mediation of family conflicts, community-based initiatives aiming the strengthening of links between health services and women should be developed. OMA is already present in most of the neighbourhoods in the entire country and has a recognised social role both by authorities and by the

community. Their involvement in the improvement of maternal health care could be based on a joint strategy with health services, assisting in health education, awareness raising among pregnant women, acting as mediators and facilitating a monitoring/tracking of women at antenatal care, delivery and postnatal care.

Supporting information

S1 Text. Questionnaire (English version).
(DOCX)

S2 Text. Questionnaire (Portuguese version).
(DOCX)

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Author Contributions

Conceptualization: Edite Vila Nova Rosário, Diogo Costa.

Formal analysis: Edite Vila Nova Rosário, Manuel Carmo Gomes.

Investigation: Edite Vila Nova Rosário.

Methodology: Edite Vila Nova Rosário, Manuel Carmo Gomes.

Project administration: Miguel Brito.

Supervision: Edite Vila Nova Rosário, Diogo Costa.

Writing – original draft: Edite Vila Nova Rosário, Manuel Carmo Gomes.

Writing – review & editing: Miguel Brito, Diogo Costa.

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4.4. Examining the relation between the subjective and objective social status with health reported needs and health-seeking behaviour in Dande, Angola

Edite Vila Nova Rosário, Milton Severo, Diogo Francisco, Miguel Brito, and Diogo Costa (submitted)

Title: Examining the relation between the subjective and objective social status with health reported needs and health-seeking behaviour in Dande, Angola.

Authors' names and affiliations:

Edite Vila Nova Rosário[1;2*], Milton Severo[2], Diogo Francisco[1], Miguel Brito[1;3], and Diogo Costa[4]

1 – Centro de Investigação em Saúde de Angola (CISA)

2 – Instituto de Saúde Pública da Universidade do Porto (ISPUP)

3 – Health and Technology Research Centre (H&TRC), Escola Superior de Tecnologia da Saúde de Lisboa, Instituto Politécnico de Lisboa

4 - Department of Population Medicine and Health Services Research, School of Public Health, Bielefeld University, Germany

*** Corresponding author**

Full name: Edite de Fátima Vila Nova do Rosário

Institutional address: CISA – Centro de Investigação em Saúde de Angola (Health Research Centre of Angola), Hospital Geral do Caxito, Rua Direita. Caxito. Angola

E-mail address: cisa.evr@gmail.com / edite.rosario@cisacaxito.org

Abstract

Background: Assessing subjective social status (SSS) may be easily accommodated in the context of a Health and Demographic Surveillance System (HDSS). To our knowledge, no prior studies have examined the association of SSS and health in Angola. Subjective socioeconomic measures may provide a rapid assessment of a relevant social status construct, important for studying health inequalities. In this study, we addressed social determinants of health by examining the relationship between the subjective and objective social status, reported health and healthcare-seeking behaviour.

Methods: This research results from a cross-sectional study performed during 2015 in the Dande HDSS, in Angola. We tested the application of the MacArthur scale as a measure of SSS in a developing setting, in a sample of 12,246 households. First, we investigated its relation to objective socioeconomic indicators, and then we explored how subjective and objective social status associate with health reported needs and health-seeking behaviour of the surveyed population.

Chi-square, ANOVA tests, and Receiver Operating Characteristics (ROC) Curves analysis were computed for testing relationships between subjective status ladder quartiles, sociodemographic and household characteristics. Logistic regression was used to examine the influence of subjective perception of status in self-reported health and health-seeking behaviour.

Results: Our findings suggest that the SSS follows a gradient distribution obtained with more objective socioeconomic indicators. Additionally, we found that subjective perception of status influence health needs reporting and health-seeking behaviour and its significant effect remained after controlling for the objective socioeconomic markers. Individuals standing in the second quartile of the social ladder have more odds of reporting illness and those in the highest quartiles of the ladder were twice more likely (OR=2.23, 95% CI=1.52-3.26) to seek help from formal health services than those at the bottom of the ladder.

Conclusions: The MacArthur Scale is a valuable tool to measure SSS in the Dande HDSS, relevant for studying socioeconomic disparities and health inequalities. It is also an easier alternative to traditional measures such as income, usually difficult to measure in developing settings. The social perception of status should be considered as a complement with objective indicators when exploring social determinants of health.

Keywords: Subjective social status, MacArthur Scale of Subjective Social Status, Socioeconomic position, Angola, Health and Demographic Surveillance System, Self-reported health, Health-seeking behaviour.

Background

Social and economic conditions and their effects on people's lives determine their risk of illness and their action to prevent or to treat it when it occurs (1, 2). Unequal distribution of resources and social goods leads to different degrees of economic, political, social, and cultural advantage among groups, which may affect individuals' health (3). Among those factors, socioeconomic status (SES), a central feature of all societies' social structure (4), has received remarkable attention on public health and epidemiological research (5, 6).

Socioeconomic status is a theoretical construct encompassing individual, household, and/or community access to resources (7). It measures an individual's economic (e.g., material goods and assets) and sociological (prestige within a community) standing (8), and has been commonly considered an important predictor of health. Indeed, in health science literature, it is well established that SES is a compelling determinant of morbidity, mortality, and self-rated health (9-12).

Wealth indexes, housing conditions, education, income, and occupation, have been widely used and became conventional measures of objective socioeconomic status (OSS) (3, 5, 13, 14). The latter indicators are the most frequently used to operationalise SES and proved to be very useful in describing and evaluating health inequalities (3, 4, 15). Generally, evidence shows that disadvantaged and less educated populations have poorer health than their better-off counterparts, have lower coverage of preventative health interventions, and lower life expectancy, among other health outcomes (1, 16).

The consistent finding of this gradient in health disparities throughout the social hierarchy, and not only below a certain threshold of poverty, suggests that, beyond individuals' material circumstances, dimensions as health behaviours, psychological factors and perceptions of social ordering also intervene in these associations (10, 17). Individuals' perception of their social position, combined with associated emotions resulting from their beliefs, such as stress, self-esteem, and social relations, might be more closely related to health outcomes than their absolute economic measures (18, 19).

This strand of research focused on social comparisons as important psychosocial pathways through which SES determine health (18), contributed to a growing interest in subjective measures of SES (17, 20-22). Subjective social status (SSS) refers to the individual perception of relative position in the social hierarchy and is usually measured relative to others in the respondent's close community (23).

Especially in the last two decades, SSS has been used in a variety of settings and shown to be associated, over and above objective SES markers, with different health outcomes (13, 24), such as self-reported health (21, 25, 26), mental health (22, 26), heart rate and sleep latency (27).

One of the explanations for SSS being a significant predictor of health is that it reflects the cognitive averaging of standard markers of the socioeconomic situation (28), that accounts for the past, current and future prospects and overall life chances (28-30), yielding a more precise measurement of overall SES (20).

The *MacArthur Scale of Subjective Social Status* (MacArthur Scale) (23) is one of the most widely used SSS measures in epidemiological studies. It has been used in some few African countries to study SES's association with health-related outcomes (31-35). However, as far as we know, there is no previous research using this approach to measure health inequalities in Central Africa countries, including Angola.

This subjective measure tool of SES might be particularly informative in settings like Dande, in Angola, where material and knowledge-related assets have little variation (36), and objective indicators such as income and occupation are challenging to measure due to greater reliance on the informal economy, self-employment, and seasonal activity (13, 37). It may be easily accommodated in the context of Health and Demographic Surveillance System (HDSS), which typically perform routine visits to all households in a selected area, to provide a rapid assessment of a relevant social status construct, in addition to OSS indicators.

The effects of SES in mortality and women's access to maternal health care have been previously studied in the HDSS population (36, 38).This study intends to explore health inequality determinants by testing SSS association with reported health and seeking help in formal health providers. To seek help in case of health care need reflects an action to prevent or treat illness (39). The health-seeking behaviour (HSB) study traditionally relies on an individual-level approach, usually based on models of health behaviours, such as the Health Belief Model (40) and the Transtheoretical Model of Change (41). Some of these theories are considered reductive because they give too much weight to individual's behaviour as sole determinants of their health and little to the impact on individual health of environmental conditions that surround them, that are not controlled by individuals and, to a great extent, avoidable, such as a disadvantaged socioeconomic condition (17). In this research, we sought to combine the individual process of health-seeking behaviour and the participants' structural

context by analysing their living conditions, social participation, OSS and SSS, to address health inequalities.

Therefore, our study has two aims. First, test the MacArthur Scale's (23) application, and assess if it is a valuable tool to measure SES in the Dande HDSS area. Moreover, our analysis intends to comprehend how the MacArthur Scale relates to OSS conditions, and, finally, how it is associated with the surveyed population's reported health and appropriate health-seeking behaviour (HSB).

Methods

Study area

We have analysed data from the Dande HDSS, established in Dande Municipality, Bengo Province, located about 60 km to the north-east of Luanda, in Angola. The HDSS was implemented in 2009, and an initial census, performed between August 2009 and March 2010, registered the baseline population of 59,635 residents, distributed for 15,579 households. Since the initial census, update rounds (UR), consisting of periodic house-to-house visits, registered births, deaths, and migrations and collected information on household conditions, socioeconomic characteristics, and health-related issues.

The HDSS aims to provide relevant health, demographic, and socioeconomic data to inform local policies and research on the main diseases that affect the region (36, 42-44). Detailed information about the HDSS has been published elsewhere (45).

Data collection

The data collection was carried out during the 9th HDSS UR performed between January and August 2015, using structured questionnaires administered by trained fieldworkers who visited all the households of the demographic surveillance area (DSA). A total of 12,246 households were assessed and included in the study.

Data were collected via interviews, with the head of the household or an available household adult respondent. The questionnaire, launched after a pilot study, included routine questions collected in all HDSS URs, namely household and sociodemographic characteristics of the surveyed population, and a new section, introducing subjective SES measures, health-related questions, media exposure and social capital of the participants.

The study was designed with two main objectives: first, to test the application of the MacArthur Social Scale, a globally validated instrument in epidemiological research (27, 28, 31, 46), and assess the potential of this tool to measure SSS in the Dande HDSS population. Second, to understand associations between subjective and objective SES and the influence of SSS in reported health and HSB of the participants.

Variables

Routine information collected: Place of residence, number of household residents, sociodemographic characteristics (sex, age, completed years of education), housing conditions (the existence of latrines and kitchen, number of rooms), drinking

water source and the ownership of several assets in the household (as radio, television, freezer, car, and electricity).

The variable 'Crowding' was created to measure the number of residents per room. Overcrowding conditions were considered when there were more than three people per room (47).

The variable 'Drinking water source', was dichotomised based on the categories used by WHO/UNICEF (48). Improved water corresponds to the sum of categories: piped into dwelling or yard, public tap, protected well, tanker truck, bottled water. Unimproved water corresponds to the sum of categories: unprotected well and open water sources located above ground, such as rivers, lakes, ponds, and irrigation channels.

New information collected: Household income, media exposure, participants' social capital, the MacArthur Scale for measuring SSS, the use of mosquito bed nets, health care needs, and health-seeking behaviour.

Household monthly income was assessed and categorised in none or less than 10,000 Angolan Kwanza (AOA) monthly (equivalent to approximately 100 US Dollars in 2015), from 10,000 to 30,000 AOA and more than 30,000 AOA. The number of residents in the household receiving a fixed salary was asked, and its relationship with the total of people living in the household generated the variable 'Proportion of residents with a fixed salary.'

Media utilisation was assessed through questions about whether household residents used to watch television, listen to the radio, and read newspapers.

Participants' social capital was measured through respondents' civic participation by asking them if they were part of a cultural, religious, and civic or sports collectivity/association (associative filiation). There is widespread interest in utilising social capital to understand the social process behind health inequalities, and evidence on his positive effect on health and HSB (49).

The MacArthur Scale of SSS (23) was administered to household respondents. It consisted of a symbolic ladder with ten rungs presented in a picture for which the following instruction was given: "Think of this ladder as representing where people stand in their communities – at the top of the ladder are the people who are best off, with more money, more education and who live better; at the bottom are those who are the worst off, who have the least money, least education and worse conditions. Where would you place your family on this ladder?". Possible scores on the ladder

range from 1 to 10, with higher scores indicating higher perceived social status. The scores of the ladder were grouped into quartiles.

The interview included questions about the existence of long-lasting insecticide net in each household, so as their number and usage (household members who slept under the bed net during the previous night). Those questions also measured health behaviours, given that Dande is an endemic malaria area, and the use of mosquito bed nets constitutes preventive behaviour (43).

Dependent variables: two dependent variables were selected for the multivariate analysis. Participants were asked about any ill-health or injury among household residents within the month preceding the survey (yes/no), used as a proxy of the household health status. The first dependent variable, "**self-reported health care need**" was derived from these answers. Whenever a self-reported health care need was identified, participants were asked if they sought for help (yes/no), and where. This derived a second dependent variable "**appropriate health-seeking behaviour**". Appropriate care in this study refers to the healthcare sought in formal health providers, such as health centres, hospitals, and private clinics, during illness episodes or any situation requiring medical attention (as opposed to those seeking for help from informal sources, namely traditional healers, church, market, pharmacy, nurses working at home, or family members).

The household's geographical coordinates were collected using a geographical positioning system (GPS), and the distance between the households and the nearest health facility was measured based on the same system.

Depending on the date on which the interview took place, the corresponding season was indicated: the dry season, if data collection period occurred from May to September, or rainy season if it was from October to April.

Statistical analysis

Chi-square tests and analysis of variance (ANOVA) were used to compare proportions and means, respectively, of demographic and household characteristics according to the quartiles of SSS distribution.

Receiver Operating Characteristic (ROC) Curves analysis was used to measure the discrimination capacity of the SSS ladder for the sociodemographic and household characteristics mentioned above.

The unadjusted association between self-reported health care needs (Outcome A) and had appropriate health-seeking behaviour (Outcome B), with several

independent variables were measured using Odds Ratio (OR) and respective 95% Confidence Interval (CI). The *independent variables* included in the analysis were: SSS ladder, OSS indicators (household income, the proportion of residents with a fixed salary, years of schooling), the place of residence, household distance to a health facility, drinking water source, associative filiation, and bed net ownership.

In multivariate analysis, an exploratory model building approach was used, entering in block independent variables selected for being theoretically pertinent (based on literature review and previous analysis) to the outcome. The OR and the 95% CI were estimated using a binomial unconditional logistic regression.

The significant level was fixed in 0.05. All analyses were performed with Statistical Package for Social Sciences (SPSS) version 24.

Results

Table 1 presents the households' demographic and socioeconomic characteristics.

From the households assessed 78.5% were in urban areas and 67.8% within a distance to a health facility lower than 2 km. The majority of the respondents were female (60.2%). The mean age of the participants in the study was 38.41 years and mostly had low levels of education (mean of 4.78 years of schooling).

Households had in mean 2.7 rooms (standard deviation, sd=1.3), and 4.4 residents (sd=2.7). We found overcrowding conditions in 8.9% of the households.

More than half of respondents declared owning electricity, radio, television, cell phone, satellite dish and freezer. The assets that respondents less declared to have in the household were a fridge (13.7%), a generator (13.3%), and a car (11.8%).

More than two thirds of the participants (66.2%) declared to have associative filiation.

In most half of the households (48.8%), none of the residents had a fixed salary. The mean of the proportion of residents with a fixed salary per household was 0.16 (sd=0.25).

For the SSS, the sample rated themselves on average below the midpoint of the scale (M = 2.91, sd= 2.17). The ladder's quartiles showed a distribution of 36% of the households in the first quartile (1st of 10 steps of MacArthur ladder), 18.8% in the second quartile (2nd of 10 steps), 24.9% in the third quartile (3rd and 4th of 10 steps), and 20.4% in the fourth quartile (5th to the 10th steps of 10 steps).

Health care needs were reported by 48% of the respondents, of which 94.4% declared to have sought help. Of those who seek help, 93.5% did it in formal health services providers.

Thirty-two per cent of respondents declared owning at least one mosquito bed net in the household, among which 77.3% declared that someone in their household slept under the bed net during the previous night.

Table 1. *Characteristics of the households*

Variable (n)	**Categories**	**n**	**(%)**
Place of residence (n=12,246)	Urban	9,617	(78.5)
	Rural	2,629	(21.5)
Sex (n=12,128)	Male	4,828	(39.8)
	Female	7,300	(60.2)
Age (n=11,040)	Mean ± sd	38.41± 16.19	
	min-max	15-96	
Years of schooling (n=10,753)	Mean ± sd	4.78 ± 3.99	
	min-max	0-20	
Nr. of household rooms (n=12,246)	Mean ± sd	2.74 ± 1.34	
	min-max	1-13	
Nr. of household residents (n=12,246)	Mean ± sd	4.40 ± 2.70	
	min-max	1-20	
Crowding (n=12,246)	Not overcrowding	11,154	(91.1)
	Overcrowding	1,092	(8.9)
Kitchen (n=12,246)	Yes	5,167	(42.2)
	No	7,079	(57.8)
Latrine (n=12,245)	Yes	8,709	(71.1)
	No	3,563	(28.9)
Do households own (n=12,242)	Electricity	8,903	(72.7)
	Generator	1,634	(13.3)
	Radio	6,894	(56.3)
	Televison	8,585	(70.1)
	Cell phone	9,236	(75.4)
	Satellite dish	6,753	(55.2)
	Fridge	1,680	(13.7)
	Freezer	6,219	(50.8)
	Car	1,440	(11.8)
Drinking water source (n=12,232)	Improved	6,978	(57.2)
	Unimproved	5,217	(42.8)
Household members use to (n=12,246)	Watch television	9,006	(73.5)
	Listen to the radio	5,146	(42.0)
	Read newspaper	1,395	(11.4)
Associative filiation (n=12,246)	Yes	8,111	(66.2)
	No	4,133	(33.8)
Distance to a health facility (n=12,246)	< 2km	8,302	(67.8)
	2 - 10 km	2,450	(20.0)
	> 10 km	1,494	(12.2)
Household income (n=9,485)	<= 10,000 AOA	2,709	(28.6)
	10,001-30,000 AOA	5,134	(54.1)
	> 30,000 AOA	1,642	(17,3)
Nr. of residents with fixed salary (n=12,230)	Mean ± sd	0.51 ± 0.50	
	min-max	0-5	
Proportion o f residents with a fixed salary (n=12,230)	Mean ± sd	0.16 ± 0.25	
	min-max	0-3	
SSS ladder (n=11,076)	Mean ± sd	2.91 ± 2.17	
	min-max	1-10	
SSS quartiles (n=11,076)	1st quart. (1st step of the ladder)	3,989	(36.0)
	2nd quart. (2nd step of the ladder)	2,077	(18.8)
	3rd quart. (3rd to 4th steps of the ladder)	2,754	(24.9)
	4th quart. (5th to 10th step of the ladder)	2,256	(20.4)
Someone in the household needed health care during the previous month (n=12,240)	No	6,359	(52.0)
	Yes, and sought for help	5,549	(45.3)
	Yes, but did not seek help	332	(2.7)
Sought help (n=5,549)	Informal sources	360	(6.5)
	Health care services	5,189	(93.5)

Bed net ownership (n=12,056)	Yes	3,855	(32.0)
	No	8,201	(68.0)
Nr. of bed nets in the household (n=3,855)	Mean ± sd	2.03 ± 1.24	
	min-max	0-12	
Someone slept under a bed net during the previous night (n=3,855)	Yes	2,981	(77.3)
	No	874	(22.7)
Season (12,246)	Rainy season	5,330	(43.5)
	Dry season	6,916	(56.6)

Note: sd = standard deviation; min = minimum; max = maximum; AOA= Angolan Kwanza. SSS=subjective social ladder.

As shown in Table 2, the quartiles and the mean of the SSS ladder score differed significantly according to the demographic and socioeconomic characteristics.

The respondents' mean age decreased from the 1st quartile (40.09 years, sd=17.18) to the 4th one (35.19, sd=13.53).

Education followed a different pattern and increased along with the quartiles of the ladder. The mean education in schooling years was 4.44 (sd=3.80) in the 1st quartile and 5.94 (sd=4.32) in the 4th quartile.

There were statistically significant associations between SSS ladder quartiles and the number of rooms, residents in the household, the number of residents with a fixed salary, and the proportion of residents with a fixed salary per household (p<0.001). In each of those variables, the mean increased from the 1st to the 4th quartile of the SSS ladder.

Residents living in households in rural areas, in overcrowding conditions, consuming unimproved water, without a kitchen, latrine, and deprived of electricity, television, cell phone, satellite dish, or freezer, were less frequent in the 4th SSS quartile.

The results showed that people who do not use to have contacts with media (television, radio, or newspapers), were mainly positioned in the 1st quartile of SSS ladder. Those who affirmed to have the habit of reading the newspaper were mostly in the 4th quartile of the ladder.

The distance of the household to a health facility was strongly associated with the quartiles of the ladder (p<0.001) with those living more than 10 km from a health facility, more represented in the 1st quartile.

Households where the declared income was less than 10,000 AOA, were mainly placed in the 1st quartile of the SSS ladder (41.7%).

We also found an association between the ladder quartiles and the reporting of health care needs (p<0.001), as well as having sought for help (p=0.014). Individuals whose HSB was from informal sources were mainly positioned in the 1st quartile of the SSS ladder (41.3%).

A statistically significant association between ladder quartiles and bed net ownership (*p*=0.035), and utilisation (*p*<0.001) was found. The mean number of bed nets in the household increased from the 1st (1.87, sd=1.12), to the 4th quartile (2.39, sd=1.43) of the SSS ladder.

Table 2. *Bivariate analysis of Subjective Social Status ladder quartiles, by sociodemographic and household characteristics*

Variable	Categories	1st quartile n	(%)	2nd quartile n	(%)	3rd quartile n	(%)	4th quartile n	(%)	*p-value*
Place of residence										
	Urban	2,804	(31.6)	1,647	(18.5)	2,363	(26.6)	2,072	(23.3)	<0.001*
	Rural	1,185	(54.1)	430	(19.6)	391	(17.9)	184	(8.4)	
Sex										
	Female	2,256	(33.7)	1,286	(19.2)	1,684	(25.2)	1,460	(21.8)	<0.001*
	Male	1,690	(39.3)	773	(18.0)	1,048	(24.4)	785	(18.3)	
Age										
	Mean±sd	40.09 ± 17.17		37.84 ± 16.16		36.93 ± 14.98		35.18 ± 13.52		<0.001‡
Completed years of schooling										
	Mean±sd	4.44 ± 3.80		4.57 ± 3.77		5.00 ± 4.02		5.94 ± 4.32		<0.001‡
Nr. of household rooms										
	Mean±sd	2.52 ± 1.22		2.76 ± 1.31		2.74 ± 1.36		3.26 ± 1.45		<0.001‡
Nr. of household residents										
	Mean±sd	3.88 ± 2.56		4.52 ± 2.70		4.59 ± 2.68		5.36 ± 2.70		<0.001‡
Crowding										
	Not crowding	3,668	(36.4)	1,891	(18.7)	2,455	(24.3)	2,074	(20.6)	<0.001*
	Overcrowding	321	(32.5)	186	(18.8)	299	(30.3)	182	(18.4)	
Kitchen										
	Yes	1,433	(30.1)	913	(19.2)	1,158	(24.3)	1,257	(26.4)	<0.001*
	No	2,556	(40.5)	1,164	(18.4)	1,596	(25.3)	999	(15.8)	
Latrine										
	Yes	2,576	(32.0)	1,513	(18.8)	2,073	(25.8)	1,878	(23.4)	<0.001*
	No	1,413	(46.6)	564	(18.6)	681	(22.4)	377	(12.4)	
Do household members own										
Electricity	Yes	2,535	(30.6)	1,564	(18.9)	2,158	(26.0)	2,028	(24.5)	<0.001*
	No	1,451	(52.1)	511	(18.3)	596	(21.4)	228	(8.2)	
Generator	Yes	365	(24.3)	278	(18.5)	372	(24.7)	490	(32.6)	<0.001*
	No	3,622	(37.9)	1,799	(18.8)	2,381	(24.9)	1,766	(18.5)	
Radio	Yes	1,938	(30.6)	1,155	(18.2)	1,696	(26.8)	1,544	(24.4)	<0.001*
	No	2,050	(43.3)	922	(19.5)	1,057	(22.3)	710	(15.0)	
Television	Yes	2,305	(28.8)	1,520	(19.0)	2,139	(26.7)	2,045	(25.5)	<0.001*
	No	1,683	(54.9)	556	(18.1)	615	(20.1)	210	(6.9)	
Cell phone	Yes	2,627	(30.5)	1,605	(18.7)	2,268	(26.4)	2,104	(24.5)	<0.001*
	No	1,361	(55.1)	472	(19.1)	486	(19.7)	150	(6.1)	
Satellite dish	Yes	1,656	(26.1)	1,189	(18.7)	1,679	(26.5)	1,820	(28.7)	<0.001*
	No	2,331	(49.3)	888	(18.8)	1,073	(22.7)	435	(9.2)	
Fridge	Yes	307	(19.3)	256	(16.1)	425	(26.7)	602	(37.9)	<0.001*
	No	3,681	(38.8)	1,820	(19.2)	2,329	(24.6)	1,650	(17.4)	

Freezer	Yes	1,526	(26.2)	1,136	(19.5)	1,464	(25.1)	1,701	(29.2)	<0.001*
	No	2,462	(47.0)	940	(17.9)	1,288	(24.6)	552	(10.5)	
Car	Yes	235	(17.1)	215	(15.7)	338	(24.6)	585	(42.6)	<0.001*
	No	3,752	(38.7)	1,862	(19.2)	2,416	(24.9)	1,671	(17.2)	
Drinking water source										
	Improved	1,901	(29.4)	1,174	(18.2)	1,817	(28.1)	1,574	(24.3)	<0.001*
	Unimproved	2,077	(45.5)	896	(19.6)	927	(20.3)	664	(14.5)	
Household members use to										
Watch television	Yes	2,517	(29.8)	1,599	(18.9)	2,231	(26.4)	2,111	(25.0)	<0.001*
	No	1,472	(56.2)	478	(18.3)	523	(20.0)	145	(5.5)	
Listen to the radio	Yes	1,453	(30.1)	774	(16.0)	1,371	(28.4)	1,236	(25.6)	<0.001*
	No	2,536	(40.6)	1,303	(20.9)	1,383	(22.2)	1,020	(16.3)	
Read newspaper	Yes	194	(14.6)	191	(14.4)	398	(30.0)	543	(41.0)	<0.001*
	No	3,795	(38.9)	1,886	(19.3)	2,356	(24.2)	1,713	(17.6)	
Associative filiation										
	Yes	2,442	(32.3)	1,314	(17.4)	1,997	(26.4)	1,802	(23.9)	<0.001*
	No	1,546	(43.9)	762	(21.7)	757	(21.5)	454	(12.9)	
Distance to the health facility										
	< 2km	2,469	(32.4)	1,453	(19.1)	2,018	(26.5)	1,677	(22.0)	<0.001*
	2 - 10 km	806	(36.5)	396	(17.9)	509	(23.0)	500	(22.6)	
	> 10 km	714	(57.2)	228	(18.3	227	(18.2)	79	(6.3)	
Household income										
	< =10,000 AOA	996	(41.7)	366	(15.3)	695	(29.1)	330	(13.8)	
	10,001-30,000 AOA	1,340	(27.9)	912	(19.0)	1,304	(27.2)	1,245	(25.9)	<0.001*
	> 30,000 AOA	494	(31.1)	200	(12.6)	369	(23.2)	526	(33.1)	
Nr. of residents with a fixed salary	Mean±sd	0.42 ± 0.56		0.62 ± 0.65		0.70 ± 0.68		0.93 ± 0.74		<0.001‡
Proportion of residents with a fixed salary Mean±sd		0.13 ± 0.23		0.17 ± 0.24		0.19 ±0.27		0.22 ± 0.26		<0.001‡
Health care needs #										
	Yes	1,783	(32.7)	1,034	(19.0)	1,417	(26.0)	1,218	(22.3)	<0.001*
	No	2,204	(39.2)	1,042	(18.5)	1,337	(23.8)	1,036	(18.4)	
If yes, did he/she sought for help	Yes	1,697	(33.0)	981	(19.1)	1,341	(26.1)	1,127	(21.9)	0,014*
	No	86	(28.1)	53	(17.3)	76	(24.8)	91	(29.7)	
Sought for help										
	Informal sources	129	(41.3)	59	(18.9)	81	(26.0)	43	(13.8)	0.001*
	Health care services	1,568	(32.4)	922	(19.1)	1,260	(26.1)	1,084	(22.4)	
Bed net ownership										
	Yes	1,318	(37.5)	651	(18.5)	826	(23.5)	721	(20.5)	0,035*
	No	2,593	(35.1)	1,397	(18.9)	1,898	(25.7)	1,507	(20.4)	
Nr. of bednets in the household										
	Mean±sd	1.87 ± 1.12		1.95 ± 1.06		2.12 ± 1.29		2.39 ± 1.43		<0.001‡
Slept under a bednet ##										
	Yes	1,065	(39.0)	484	(17.7)	651	(23.8)	533	(19.5)	0,001*
	No	2,846	(34.8)	1,564	(19.1)	2,073	(25.3)	1,695	(20.7)	
Season of the interview										
	Rainy	1,577	(33.9)	864	(18.6)	1,104	(23.8)	1,102	(23.7)	0,001*
	Dry	2,412	(37.5)	1,213	(18.9)	1,650	(25.7)	1,154	(17.9)	

Note: * χ^2

‡ ANOVA

Someone in the household needed health care during the previous month.

Someone slept under a bed net during the previous night.

Considering the significant association between the quartiles of the SSS ladder and almost all sociodemographic and economic characteristics, we tested the capacity

of the ladder to discriminate each variable through the ROC Curves analysis (Table 3). The results showed low AUC (Area Under the Curve) values, demonstrating the ladder's weak ability to predict the household characteristics of the surveyed population. Table 3 describes the responsiveness of the Mac Arthurs' SSS scale in terms of sensitivity and specificity for detecting changes in covariates, namely discriminating those who have and those who do not have certain socioeconomic characteristics.

The variables that the ladder better discriminates in terms of sensitivity are the traditional OSS indicators, namely the lower categories of education, household income, and the number of residents with a fixed salary per household (Sen=0.98). The ladder is very specific for the discrimination of bed net ownership (Spe=0.96).

The values of AUC close to 0.5 showed that the MacArthur Scale was not a good measure of separability regarding the selected economic conditions of the population in the DSA. The higher AUC values found in our results were 0.693, 0.686, 0.677, and 0.675, referring to a 68% to 70% chance of the ladder to distinguish, respectively, between those living in households with none, one or two/more residents with a fixed salary, those with or without the habit of reading the newspaper and watch television, and those with or without a car.

Table 3. *Diagnostic value from ladder according to Objective Socioeconomic Status indicators*

	Cutoff point	Sensitivity	Specificity	Youden Index ‡	AUC#	95% CI
Place of residence (urban)	2.5	0.50	0.74	0.24	0.651	0.639-0.663
Sex (female)	1.5	0.66	0.39	0.06	0.532	0.521-0.543
Education						
No education*	9.5	**0.98**	0.02	0.001	0.549	0.536-0.562
Primary (1-6) *	2.5	0.52	0.45	-0.03	0.519	0.507-0.530
Secondary (7-13)	2.5	0.52	0.56	0.08	0.551	0.539-0.564
Tertiary (University)	3.5	0.59	0.68	0.26	0.649	0.605-0.693
Overcrowding	2.5	0.49	0.55	0.04	0.517	0.499-0.536
Residents with a fixed salary						
None	9.5	**0.98**	0.01	-0.02	0.642	0.631-0.652
One	1.5	0.72	0.42	0.14	0.582	0.571-0.593
Two or more	2.5	0.72	0.57	**0.29**	**0.693**	0.676-0.710
Household income						
<= 10,000 AOA*	9.5	**0.98**	0.01	-0.01	0.594	0.581-0.607
10,001-30,000 AOA	1.5	0.72	0.38	0.10	0.547	0.534-0.559
> 30,000 AOA	4.5	0.33	0.78	0.11	0.548	0.531-0.564
Improved water source	2.5	0.52	0.65	0.18	0.604	0.593-0.615
Kitchen	4.5	0.26	0.84	0.11	0.574	0.563-0.585
Latrine	1.5	0.68	0.47	0.15	0.595	0.584-0.607
Watch television	1.5	0.70	0.56	0.26	0.677	0.666-0.688
Listen to the radio	2.5	0.54	0.62	0.15	0.586	0.573-0.597
Read newspaper	2.5	0.71	0.58	**0.29**	0.686	0.671-0.701
Associative filiation	2.5	0.50	0.66	0.16	0.596	0.585-0.607
Electricity	1.5	0.69	0.52	0.22	0.644	0.633-0.655
Generator	3.5	0.44	0.70	0.14	0.603	0.587-0.618
Radio	2.5	0.51	0.63	0.14	0.587	0.577-0.598
Television	1.5	0.71	0.55	0.26	0.671	0.661-0.682
Cell phone	2.5	0.51	0.74	0.25	0.666	0.655-0.677
Satellite dish	2.5	0.55	0.68	0.23	0.660	0.650-0.670
Fridge	2.5	0.65	0.58	0.23	0.652	0.637-0.667
Freezer	1.5	0.74	0.47	0.21	0.642	0.632-0.652
Car	3.5	0.55	0.72	0.26	0.675	0.658-0.689
Bed net ownership	7.5	0.05	**0.96**	0.01	0.489	0.478-0.501
Season (Rainy)	5.5	0.16	0.90	0.06	0.534	0.524-0.545

Case: yes|true; Control:no|false
AUC – Area under the curve
*Inverted the score
‡ Youden Index (50)

Table 4 analyses how SSS and OSS measures predict a change in self-reported health care needs (Outcome A) and appropriate HSB (Outcome B).

In the bivariate analysis, all the selected explanatory variables, were significantly associated with Outcome A, and most associations remained significant after adjusting for the presence of covariates.

Results from the adjusted model show that both objective and subjective measures of SES predicted the socioeconomic patterning of health care needs differently. The residents who place themselves in the 2nd quartile of the social ladder

had greater odds of reporting health care needs (Adjusted OR = 1.36, 95% CI = 1.18-1.56), compared with those at the bottom of the scale. A higher income also increased the odds of health care need report (OR=1.56, 95% CI = 1.34-1.81). On the contrary, having more years of schooling and a higher proportion of residents with a fixed salary per household decreased the likelihood of reporting a health problem within the household.

Respondents living in urban areas, drinking improved water, with associative filiation, and owning bed nets, were more likely to affirm the existence of health problems in their households. In contrast, those living furthest from health facilities reported less health care needs.

Regarding Outcome B, the bivariate analyses indicate that subjective and objective measures of SES (except years of schooling) were independently associated with appropriate HSB.

In the fully adjusted model, the OSS markers lose statistical significance. The SSS remained statistically significant. Respondents at the top of the ladder were 2.23 (95% CI = 1.52- 3.28) more likely to have an appropriate HSB than those at the bottom, while greater distances to health facilities decreased the likelihood of choosing an appropriate health care provider (Adjusted OR= 0.37, 95% CI = 0.18 – 0.73).

Table 4. *Adjusted and unadjusted Odds Ratio (OR) of reported health care need (Outcome A), and appropriate health-seeking behaviour (Outcome B), against sociodemographic variables, from binomial logistic regression*

Variables	Outcome A					Outcome B				
	n	Unadjusted OR	p	Adjusted OR*	p	n	Unadjusted OR	p	Adjusted OR*	p
SSS quartiles	11,071					5,452				
1st quartile	3,987	1		1		1,173	1		1	
2nd quartile	2,076	1.23 (1.10-1.36)	<0.001	1.36 (1.18-1.56)	<0.001	1,034	1.29 (0.93-1.77)	0.122	1.52 (1.05-2.19)	0.025
3rd quartile	2,754	1.31 (1.19-1.44)	<0.001	1.10 (0.98-1.24)	0.120	1,417	1.28 (0.96-1.71)	0.093	1.74 (1.24-2.43)	0.001
4th quartile	2,254	1.45 (1.31-1.61)	<0.001	1.12 (0.99-1.28)	0.067	1,218	2.07 (1.46-2.95)	<0.001	2.23 (1.52-3.26)	<0.001
Household income	9,840					4,730				
<= 10,000 AOA	2,709	1		1		1,222	1		1	
10,001-30,000 AOA	5,131	1.17 (1.06-1.28)	0.001	0.96 (0.86-1.08)	0.540	2,510	1.66 (1.27-2.17)	<0.001	1.33 (0.97-1.82)	0.074
> 30,000 AOA	1,640	1.89 (1.67-2.14)	<0.001	1.56 (1.34-1.81)	<0.001	998	1.52 (1.09-2.12)	0.014	1.09 (0.74-1.61)	0.663
Proportion res/fixed salary	12,224/12,246	0.76 (0.66-0.88)	<0.001	0.53 (0.43-0.64)	<0.001	5,870/5,881	1.87 (1.06-3.32)	0.032	1.20 (0.63-2.29)	0.586
Years of Schooling	10,747/12,246	1.00 (0.99-1.01)	0.007	0.98 (0.97-0.99)	0.003	5,368/5,881	1.02 (0.99-1.05)	0.129	0.99 (0.96-1.03)	0.673
Place of residence	12,240					5,881				
Rural	2,628	1		1		871	1		1	
Urban	9,612	2.20 (2.01-2.40)	<0.001	1.57 (1.30-1.88)	<0.001	5,010	1.60 (1.23-2.09)	<0.001	0.73 (0.40-1.33)	0.307
Distance to health facilities	12,246					5,881				
<2km	8,302	1		1		4,196	1		1	
2-10 km	2,450	0.92 (0.84-1.01)	0.075	1.05 (0.92-1.19)	0.491	1,187	1.52 (1.11-2.08)	0.010	1.54 (1.03-2.29)	0.0.4
>10 km	1,494	0.49 (0.44-0.55)	<0.001	0.66 (0.52-0.83)	0.001	498	0.51 (0.38-0.70)	<0.001	0.37 (0.18-0.73)	0.005
Drinking water	12,189					5,228				
Unimproved	5,212	1		1		2,015	1		1	
Improved	6,977	1.55 (1.44-1.66)	<0.001	1.15 (1.03-1.30)	0.016	3,513	1.46 (1.18-1.81)	0.001	1.65 (1.20-2.26)	0.002
Associative filiation	12,239					5,881				
No	8,111	1		1		4,324	1		1	
Yes	4,128	1.89 (1.75-2.04)	<0.001	1.17 (1.05-1.29)	0.004	1,557	1.39 (1.10-1.74)	0.005	1.43 (1.08-1.89)	0.013
Bed net ownership	12,051					5,788				
No	3,854	1		1		3,691	1		1	
Yes	8,197	1.46 (1.35-1.57)	<0.001	1.52 (1.38-1.68)	<0.001	2,097	1.35 (1.07-1.71)	0.011	1.46 (1.10-1.95)	0.009

Note: Values of OR>1 indicate increased risk of self-reported health care need and odds of appropriate HSB. * Adjusted for all variables listed

Discussion

We have used data from the Dande HDSS to test the application of the MacArthur Scale as a measure of SSS, to understand how it relates with OSS indicators and to analyse the relationship with reported health need and appropriate HSB. Both health outcomes were positively associated with SSS, independently of OSS.

In general, the respondents were able to understand the question of the MacArthur Scale and to provide valid answers. The ladder is usually considered a streamlined and effective measure of social status, as it offers a viable and easier alternative to traditional SES measures, which require more exhaustive questions and may suffer from reporting issues or bias (23, 51).

The income, for example, is one of those typical SES indicators more susceptible to bias, and high rates of non-response (52). In various LMIC, including Angola, many people do not know or do not want to report their income, and measuring it may be challenging, given the weight of informal sector activities, the revenue fluctuations, and the remittances, that are difficult to quantify. Subsistence agricultural activities are also often not considered (53).

Turrel (54) summarises the results of the non-response rates observed in other settings for income data, that range from 10 to 25%. In our study, the comparison between rates of non-response to the MacArthur ladder (10%) and income questions (44% on the exact amount of revenues and 23% in the question organised in categories), corroborates the idea that the collection of income data is problematic (46, 52, 54).

Additionally, the results suggest that the SSS in the Dande HDSS population follows a socioeconomic position gradient distribution obtained with OSS indicators, reassuring its utility (46, 55). Though SSS was, in part, designed as an attractive and more encompassing alternative to traditional measures, its use still intends to tap objective socioeconomic variation (51).

The perceived perceptions of SES, significantly associated with almost all surveyed sociodemographic and household characteristics, indicate a relative homogeneity of the population. The mean ranking of SSS using a ten rungs ladder, was 2.91 (sd=2.17), with 79.7% of respondents placing themselves on rungs one through four, resulting in a distribution of the ladder strongly skewed to the lower rungs of the scale. At the best of our knowledge, the mean ranking in the DSA is only similar

to the results obtained in a study conducted in rural Ethiopia (M=2.9, sd=1.3) (32). Further research using the MacArthur Scale reported higher and more symmetric SSS mean scores (56).

The concentration of responses on the lower rungs of the ladder can have different explanations. First, the context from which our sample was drawn. Angola is a developing country, ranked number 149 out of 189 countries in the Human Development Index (57), a position that involves poor scores in terms of education and health indicators (37). Since the end of 2014, the country is suffering an economic crisis resultant of the slide in the selling price of crude oil, its main export. In 2015, 29.4% of the national population lived below the poverty line of $1.9/day, and 53.9% lived with less than $3.1/day (58). In our sample, a gross estimate (calculated using the higher interval of household income divided by the number of residents per household) of the population living in those conditions was, at least, 42.2% and 63.5%, respectively. It is possible that the structural/ material conditions under which people live, make them feel deprived of options for upward social mobility (37), and the cycle of disadvantages, including uncertainty, material constraints and/or a feeling of fewer opportunities, influences an almost general low assessment in the subjective social scale (19, 59). According to different authors, someone's placement in the social ladder appears primarily to involve cognitive averaging of standard markers of socioeconomic position along with their assessment of past, current, future prospects, and overall life chances (25, 28-30).

An alternative hypothesis is that the low assessments of social position result from the expected convergence between OSS and SSS. Low educational levels and economic vulnerability characterise the population in our study. In a sample of 12,246 respondents, with a mean age of 38.41 years, 23.7% had no school qualifications, 45.7% primary education, 29.0% secondary education, and only 1.6% had tertiary education. In almost half of the households, no one received a fixed salary, and the average proportion of residents with a fixed salary per household was far from one (M=0.16, sd=0.25). This scenario suggests a high weight of informal economic activities and financial insecurity due to fluctuating incomes. In a study conducted the Angolan neighbourhoods of Luanda and Kalandula, 32.4% and 13.7% heads of the households declared informal employment, respectively, and 1.9% and 69.9% had farming as the main occupation. Those households were vulnerable to sudden shocks, *e.g.*, reduced access to food and income, increases in expenses for health and education, and the death or absence of main breadwinners (37). Previous studies

demonstrated that SSS was determined by aspects such as education, household income, and also feeling of financial security regarding the future (28).

In developed settings, respondents to the MacArthur ladder scale have primarily valued material wealth, occupational status, and education in providing their self-perceptions of social status (23, 60). Nevertheless, the SSS may capture the influence of several other social and psychological variables associated with the relative position in society distinctively relevant to overall health. SSS may perform similarly to measures of self-rated health: capture the influence of variables beyond objectively measured health risk factors, allowing it to be one of the most reliable mortality predictors, worldwide (61, 62).

The SSS ladder provides a collective measure of social status. Respondents are usually asked to consider different aspects of their relative status (as opposed to focusing on specific asset ownership, education or occupation), and thus may attribute different weights to the distinct components of their socioeconomic position (23). SSS should be distinguished from other SES measures since it is purported to be a different construct (63, 64), which might explain the weak capacity of the ladder to discriminate several objective economic conditions in our study. Although related, objective indicators and subjective rankings capture different aspects of social standing (9, 25).

People may have a deeper understanding of the meaning of their position on a given aspect of the social structure that is specific to their context, and this may be particularly useful in rural developing African settings. Even in a small area where the majority of the houses are made of clay, with a tin roof, and most people share a bathroom, there is still someone that places him/herself in a higher social hierarchical position, based on culturally-specific values (21). Such values can be related to television ownership, with the ability to read the newspaper, with the position held in the church, with one's ability to use traditional healing procedures, or even with the number of wives and children, considered a sign of manhood and fertility. These features may thus contribute to a specific 'cognitive averaging' of standard dimensions of SES, as previously suggested (55, 65). A qualitative approach to such representations in this setting would be meaningfully valued.

Our results support previous findings of an association between SES indicators and health-related issues and showed that SSS influence health needs reporting and health-seeking behaviour above and beyond traditional SES indicators (66-68).

It is important to note that our study's health status question referred to all household members and that the reported health needs were not necessarily felt by

the respondents who positioned the household on the SSS. However, in agreement with the literature, we found that SES's objective and subjective measures were associated with reported health when entered separately and that the SSS remains significant after controlling for OSS indicators (25, 27, 28, 69). Although, our findings differ from those observed in some research that found that perception of lower status was associated with poor reported health (20, 52).

In Dande, as in other developing settings in Ghana, Guinea, and Tanzania, the health reported needs were more common among the better-off than in the most deprived households (70-72). Individuals standing in the 2nd quartile of the ladder and with higher income had more odds of reporting illness in their households than those in the bottom of the ladder and with lower incomes. Living in urban areas, having access to improved water, social participation, and bed net ownership also increased the odds of reporting health care needs.

Perhaps that is because the socioeconomic environment influences the concepts of illness, and better-off households are more likely to recognise their signs (70). More deprived people may perceive illness as a normal life feature and do not consider it an event worth reporting (71). Furthermore, they might tend to ignore illness, given the costs that being sick imply, such as treatment costs or work absence (72, 73). Unequal access to health care services, or differences in environmental conditions may lead to divergent health and morbidity experiences resulting in different self-reported health (72).

Considering the reported health status, we analysed the HSB of the participants, *i.e.,* any action or inaction of those who perceive to have a health problem, themselves or within the household, for the purpose of finding an appropriate remedy (39). The appropriate HSB was defined as consulting a qualified medical professional or seeking healthcare in a formal health care provider (39).

In our sample, 93.5% of the individuals that reported care needs and sought for help, used formal health care services, and 6.5% relied on informal sources, proportions identical to those found in the national population, of 93.4% and 6.6%, respectively (74). The utilisation of health care services is considerably higher than that found in studies conducted in rural areas of Nigeria and Kenia (75, 76) and similar to results in South Africa (77). Distance is a known barrier to health care utilization, as it is linked to lack of transport, poor access and costs (78). Therefore, the high proportion of respondents with appropriate HSB might be explained partly by the fact

that in our study, 78.5% of the participants were living in urban areas and 67.8% at distances lower than 2 km from health facilities.

The SSS showed to be a factor affecting the respondent's choice of health care provider, given that people in the highest quartiles of the ladder were twice more likely to seek help in formal health services than those at the bottom of the ladder. The significant effect of SSS on appropriate HSB remained even after controlling for the objective SES markers (20), suggesting that a sense of social ordering is more important for health behaviors than income.

As expected and previously documented, the odds of appropriate HSB decreased with increasing distance of residences to health facilities (79-81), which suggests the need to still work on the main health care access barriers affecting this setting.

The improved water consumption, which in most of the cases in the households of the DSA imply the treatment of drinking water, as well as the ownership of bednet in this endemic malaria area (43) also constitute preventive health attitudes, and both variables remained significant in the adjusted model to determine appropriate HSB.

The social capital, measured through civic participation, defined as any associative affiliation, was also a predictive variable of HSB. It explores individuals' inter-relationships within social systems, cultural norms and system constraints, and interprets their behaviours as a product of these relationships rather than something exclusively intrinsic to the individual (4, 49).

Strengths and limitations

To our knowledge, this is the first study testing the MacArthur Scale, and that uses subjective measures to capture SES in Angola. SSS is an increasingly utilised measure in social and epidemiological studies, and there are several advantages for using it instead or complementing objective measures of SES. The MacArthur Scale is of ease use and was developed to capture the common sense of social status based on usual SES indicators (82). The abstract structure of the question facilitates comparisons between studies conducted in different populations (20) and its use in research worldwide (22, 29, 46, 67) had proved the association between SSS and several health outcomes, usually over and above the influence of OSS measures (20,

82). Therefore, this study contributes to the literature on health determinants in Angola by introducing a more robust indicator of SES.

It is noteworthy that this study has some limitations. The data regarding health is based exclusively on self-reported data. Future investigation should assess participants' current health objectively, to understand the impact of SES, and, in particular, SSS, in the health of the population. Another limitation is the homogeneity of the sampled population. The use of SSS measures with proximal referent groups may not fully capture the impact of the perceived hierarchical rank (21), since that the Dande population may share similar cultural and social ways of living, reflected on health and illness experiences (72). Further research with a more heterogeneous population in Angola is needed to understand how the effects of SES reflect across health outcomes, *i.e.*, greater social and cultural variation may produce a higher level of inequality in reported health needs and health-seeking behaviour.

Finally, it is worth noting that the data used in this research were collected in 2015, so the patterns and trends in the relationship between objective and subjective measures of SES, the reported health needs, and the HSB may have changed. However, this does not alter the viability of using the MacArthur Scale as an appropriate tool to measure SSS in future research to assess its influence on health outcomes.

Conclusions

SSS may be an important indicator considering the addition it provides to SES assessment and for the study of health inequalities. This may be particularly relevant in Angola, where society experienced rapid socioeconomic and structural changes, but huge disparities exist within the country concerning income, opportunities, human capital, access to health care services, and health outcomes (83). Since the end of the civil war (2002), Angola has gone through a robust economic growth but not followed closely by an improvement in several social indicators (84), and very scarce evidence exists documenting and contextualising the health status of the population, which is of great relevance for health policy.

The results of this study suggest that SSS may be a useful, feasible and valuable assessment tool in this developing setting, capturing social status perceptions otherwise unreachable by traditional SES measures, relevant for the study of socioeconomic disparities, and that might translate into health inequalities.

Further research should explore associations between objective health outcomes, such as morbidity and mortality, and SSS. Additionally, it would be interesting to use longitudinal data to understand the extent to which SSS is modifiable over time and integrates past, present experiences and future prospects, and how those impact health outcomes. Both proposals are feasible within the scope of HDSS activities.

List of abbreviations

AOA – Angolan Kwanza

AUC – Area under the curve

CI – Confidence Interval

DSA – Demographic Surveillance Area

GPS – Geographical Positioning System

HDSS - Health and Demographic Surveillance System

LMIC - Low and middle-income countries

MacArthur Scale - MacArthur Scale of Subjective Social Status

OR – Odds Ratio

OSS - Objective socioeconomic status

ROC Receiver Operating Characteristic

Sd – Standard deviation

Sen – Sensitivity

SES - Socioeconomic status

Spe - Specificity

SSS - Subjective social status

UR – Update Rounds

DECLARATIONS

Ethics approval and consent to participate

The Ethics Review Committees of the Ministry of Health of Angola and the Institute of Public Health of the University of Porto approved this study. As an HDSS implies regular visits to households to update information, verbal consent was considered appropriate for monitoring demographic events and household characteristics. Participation was voluntary. In each visit, participants were informed of the HDSS broad objectives, of the optional feature of their participation, and of their right to withdraw from an interview if they decided to. All forms used in the HDSS were approved and registered in the Angolan National Institute of Statistics with the number 0019 (Document 746/440/ DG/INE/09).

Consent for publication

Not Applicable

Availability of data and materials

The datasets generated and analysed during the current study will be publicly available after the acceptance or publication of the manuscript. Until then, it will be available from the corresponding author on reasonable request.

Competing interests

We certify that this paper consists of original, unpublished work which is not under consideration for publication elsewhere. We have no conflict of interests to disclose in the authorship or publication of this contribution.

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Authors Contributions

ER: Conceptualisation, Methodology, Validation, Formal analysis, Investigation, Writing - Original Draft Preparation, Visualisation, Supervision. **MS**: Methodology, Formal analysis. **DF**: Investigation. **MB**: Project administration, Writing - Review & Editing. **DC:** Conceptualisation, Methodology, Investigation, Project administration, Writing - Review & Editing

All authors have read and approved the manuscript.

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5. General discussion and conclusions

The lack of accurate and up to date information on sociodemographic indicators and health-related data constitutes a handicap for health research and is a serious public health issue.

Angola, as most LMIC, has a limited health information system, and therefore, lacks available accurate information and data to support research, policies, and decision-making processes. (15) In the last decade, it has acquired new and valuable health information, but still experiences significant delays and restrictions on the release thereof. Moreover, data management capacities below the national level are limited. (14)

In this context, CISA implemented an HDSS and a VAS in Dande Municipality, Bengo Province, about 60 km NE of Luanda. These systems work as data collection platforms to provide sociodemographic and health indicators for health research and improve evidence-based decision-making. This thesis results from the implementation of these systems and, through the analysis of their data, aims to evaluate their utility as structures suited to capturing population dynamics and health-related data. It also aims to understand how the outputs of the VAS and HDSS supported different health research projects, and whether they have the potential to contribute to policy planning.

Counting human lives and deaths is a pressing priority. (19) In the last decades, especially with the internationally adopted development agenda goals, there has been increasing demand for current and detailed demographic, socioeconomic, and health data, both for households and individuals, in developing and transition countries.

Aside from the question 'How many are we'? it is also important to give answers to 'Who we are'? in terms of sex, age, education, socioeconomic and other fundamental characteristics. Another critical question is 'How do we live'? that is, in terms of housing conditions, access to improved water, sanitation and availability of essential facilities. These features provide a profile of specific communities, essential to gather evidence for decision-making at all levels, (159) and to monitor the health and social status of populations.

In the absence of CRVS or other data sources, such as routine administrative records, several strategies were developed as interim measures for meeting needs for health-sector data. Most of them seek to give answers to the questions above, providing a reliable assessment of the profile of specific populations at a given area. Their objective

is to support evidence-based action by governments, civil society, academics, researchers, and other stakeholders, depending on the purpose for which they were created. The HDSSs are an example of those interim measures. Typically established in a delimited geographical area, they are often debated on the grounds of not having national representativity. (143) Still, they constitute the most reliable source for generating public health evidence in many of these regions. (192, 193)

The argument on the representativeness of the population-based research of the HDSS should not overshadow the usefulness of their data. The HDSSs are observatories of specific settings, usually situated in deprived rural, semi-urban or urban areas, monitoring the levels and trends of vital events and related variables over time, through a close investigation of the contextual, environmental, and community-level information. (145, 194) Rather than seeking national or sub-national population representativeness of sociodemographic and health status data, HDSSs endeavour to address causal relationships by studying courses of events (e.g., infant mortality, emerging diseases) in a population subject to the same local context. Therefore, HDSSs allow a more efficient collection of contextual dependent variables, such as environmental and social, than national-level data collection does. (194) The issues with representativity and generalisability of outcomes can be addressed by triangulation with other data sources (145, 194), although HDSSs are generally located in places where little is known about the surrounding population. (195) Comparative analyses and cross-validation with national censuses, demographic and health surveys, other regional or national surveys, and HDSS sites may help validate and generalise HDSS results. (194, 196)

In Angola, when the Dande HDSS was implemented, the compilation of data for analysis, dissemination, and policy purposes was scarce. The few surveys that had been carried out that far at the national or regional level only made their data available later. Moreover, systematic data collection (sociodemographic and health-related data) was generally poor. At the local level, for example, the municipal administration did not have an estimate of the resident population, never mind the essential characteristics of the population in terms of sex, age, or geographic distribution. This lack of knowledge causes severe gaps in the preparation of public policies, including those regarding health. Ignoring the number of children, their ages, and geographical distribution prevent, for example, the definition of appropriate strategies related to primary and secondary health sectors, such as vaccination and health interventions.

The Dande HDSS was the only demographic surveillance system to serve health research purposes in Angola. The results obtained from the analysis of longitudinal data of the population under surveillance (Paper I) are in line with the findings of other HDSS

in similar lower and middle-income settings. Furthermore, in the latter years of the series, it is also possible to compare them with national and regional data, which in the meantime began being published.

Worldwide, the survey populations covered by HDSSs, range between 8,200 (Mlomp HDSS, Senegal) and 260,000 (Kilifi HDSS, Kenya) individuals. (149) The Dande HDSS monitored a population of about 60,000 individuals and was one of the HDSS that covered a larger geographic area.

The demographic indicators of Dande HDSS are typical of a developing country, with high fertility and mortality. The death rate is lower than the birth rate, but the fertility is still high, pointing to the second stage of the demographic transition scenario. (197)

The age structure of Dande, as well of Angola itself, results then in large youth cohorts leading to high youth dependency ratios. According to the National Census, in 2014, the youth dependency rate was 93 children (under 15) per 100 working-age adults (15-64 years) for the country, (115) and 86 for the Dande Municipality. (198) In the DSA, that ratio was 82 in the homologous period. The difference between the youth dependency ratios of the Dande HDSS and Angola indicate that the population in the surveillance area was slightly older than the national population, which was also demonstrated by comparing the median and average age in the DSA (18 and 23.4 years, respectively) with those of the country (16 and 20.6 years). (115)

The age structure of the HDSS Dande and Angola fits with those of SSA countries. It contrasts with those of developed countries with post demographic transition-aged populations. In 2014, the youth dependency ratio for the Sub-Saharan countries was 88, and the median age of the population 18.6 years. (197) For a polity such as the European Union (EU27), the youth ratio was 23.3 per 100 working-age adults, and the median age of the population was 42.5 years. (199)

The results obtained regarding fertility and mortality in the Dande HDSS are comparable, for instance, with those found in Manhiça (Mozambique), Navrongo (Ghana), Taabo (Cote d'Ivoire), and Rufiji (Tanzânia) HDSSs, (200-203), and with national data. (115, 116, 140, 198) The main findings of the mentioned HDSS sites are summarised in Annex XV. Comparisons between data provided by the Dande HDSS and national sources are in the Annexx XVI.

The demographic trends of the Dande HDSS population between 2010 and 2014 (Paper I), show a decrease in practically all indicators. This trend followed the reduction in the number of update rounds that occurred over the five years. It thus suggests – although

post hoc is not *propter hoc* - that vital events such as births and deaths are being underreported. In turn, this has an impact on the resulting demographic indicators. As a result, the outputs for 2014 were the least accurate, since no update round was performed that year. The demographic events corresponding to that period were collected in subsequent rounds (from 2015) and are therefore more subject to recall bias. The comparison of our findings with national sources is also fitting with the probable underreporting of events in 2014.

The crude birth rate (CBR) in the Dande surveillance area in 2010 was 40.4 births per 1,000 person-years, faintly inferior to the 45.5 ‰ for Angola (140) and close to 42.3 ‰ for Manhiça, in Mozambique, (200) in the same period. In 2014, the HDSS CBR was 24.2 ‰ against 36.1 ‰ reported in the national census. (115)

The crude death rate (CDR) in the DSA was 9.1 per 1,000 in 2010, the same as the reported for Angola in 2014. (115) The age-standardised overall crude mortality rate based on the WHO standard population 2000-2025, was 10.8 ‰. (204) The findings regarding CDR in the Dande HDSS were like those found by the cited HDSSs in Ghana (10.0 ‰), Cote d'Ivoire (8.2 ‰), and Tanzânia (8.0 ‰). (201-203)

Although fertility has declined at a rapid pace in most developing countries, this trend has generally been less pronounced in Sub-Saharan Africa, where the overall levels remain far higher than in the rest of the world. In Africa, the total fertility rate (TFR) declined from 6.5 children per woman in 1950-55 to 5.4 in 2005-10, while in East Asia the fall was from 5.6 to 1.6 in the same period. (197, 205) Angola is among the SSA countries with higher fertility rates, (140, 197) with a TFR of 5.7. (115) In the Dande HDSS, the TFR was 4.8 children per woman, being thus lower than that of the country and equivalent to the rates reported by the Taabo (4.8) and Rufiji (4.6) HDSSs, in Cote d'Ivoire and Tanzânia, respectively. (202, 203)

The infant mortality rate (52.5 per 1,000) and the under-five mortality rate (92.1 per 1,000) found in the Dande HDSS in 2010 were very similar to those described for Angola in the same period, of 50 ‰ and 91 ‰, respectively. (140) Comparing with the results obtained in other HDSSs in developing settings, the infant mortality rate in the DSA was close to the values of Manhiça (58.5 ‰). The under-five mortality rate was analogous to that observed in Taabo (92.0 ‰).

The low neonatal mortality (NMR) rates found in the surveillance area (7.1 ‰ in 2010 and 4.8 ‰ in 2014) compared to those reported for Angola (23 ‰ and 24‰, respectively), (116, 140) suggest under-reporting of neonatal deaths by the Dande HDSS. As other

HDSS sites have pointed out, if these deaths happen before there is a registry of the very births, the HDSS UR may fail to take notice of them. (206, 207)

However, a recent study on the regional variations in NMR (208) using data from IIMS (116) has concluded that significant regional NMR inequalities exist in Angola. Bengo was amongst the three Provinces of the country with lower rates (10.3 ‰). (208) This study's results are much closer to those we found in the HDSS and suggested underreporting was not as expressive as the comparison with the national rate would lead to suppose.

In the study about DSA birth outcomes and maternal health care determinants (Paper III), we also found a reduced number of reported stillbirths and abortions. This observation plausibly indicates omission, by the respondents, of foetal deaths. These findings are consistent with a study on the status of birth and pregnancy outcome capture in 31 HDSS's located in 13 countries. This research concluded that, in many sites, pregnancies and adverse pregnancy outcomes are missing, reflecting the difficulties in measuring these events. (209)

The lack of effective registration systems and cultural beliefs and stigma are the main obstacles to unbiased estimations of stillbirths and neonatal mortality. (210) Moreover, the error is induced from failure to register these events by the informants. People do not recognise the importance of declaring stillbirths and infant deaths (211) and will likely not report them sometime after their occurrence. These factors have been described in the literature as probable reasons for underestimating child mortality in many surveys in SSA and other developing countries. (209, 211-214)

HDSS surveys are considered important sources for reporting pregnancy outcomes, including early pregnancy loss, stillbirths, and neonatal deaths (213, 215). Nevertheless, when vital events update occurs on an annual basis, an undercount of stillbirths and early infant mortality is inevitable. (145)

In Thailand, for example, a study performed in the late 1980s confirmed the under-reporting of the registered national perinatal and infant mortality rates collecting data by a weekly visit to every household in a study area of 80,000 inhabitants. The authors found a perinatal mortality rate (stillbirths plus early neonatal deaths expressed as a rate per 1,000 deliveries) of 22.0 ‰. They also found an infant mortality rate (the sum of early, late, and post-neonatal deaths up to one year expressed as a rate per 1,000 live births) of 23.1 ‰. Both these rates are very superior to the reported national rates of 3.2 ‰, and 9.5 ‰, respectively. (211) Periodic weekly visits would not be feasible in most settings,

including Dande, due to the extent of the geographic area, the costs, and the time involved.

Therefore, we should not exclude that the UR periodicity of the Dande HDSS and the general type of questionnaires*, i.e*., surveys covering wide-ranging issues, might not be sufficiently adequate to cover accurately perinatal and neonatal mortality given the cultural aspects that bias the reporting of such sensitive events. (215) More periodic visits specifically aimed at interviewing women of childbearing age, with highly focused questionnaires, a closer follow-up of the pregnant and the implementation of a birth cohort would enable greater accuracy of data on birth outcomes, maternal deaths and other aspects associated with maternal health care.

Such mechanisms were planned for the Dande HDSS but not implemented due to logistical and financial conditions. In their absence, procedures complementary to registering all pregnancies in the UR were organised to improve the reporting of births and deaths (including neonatal deaths and adverse pregnancy outcomes). These procedures involved triangulating data from different sources, namely: the Angolan health system, Bengo Civil Registration Services, and community informants.

The information in the hospital and maternity services logbooks was incomplete, omitting aspects such as individuals' full name, birth date, or place of residence, thus making it difficult to identify them as members registered in the HDSS. The shortage of health care workers, the unawareness about the importance of recording, processing, and using health data, and the lack of systematisation of data, common in most developing countries, including Angola, (31, 132) were factors that contributed to the scarcity of collected information and little utility of the secondary data existent in the study area. The incompleteness of civil registration records also jeopardised the correspondence between individuals' events recorded and Dande HDSS database registered members. However, it is worth noting that, following the collaboration with the HDSS, both in the provincial and municipal hospitals and in the Bengo Civil Registration Services, there was an effort to improve procedures. Advancements were made in the data registration, proving that adequate training and awareness-raising about the importance of data collection, analysis, and use deliver results.

In what concerns the collaboration with the community informants, some more cooperative field coordinators provided information about births and deaths in the neighbourhoods, but, contrary to expectations, it was difficult to obtain data on neonatal deaths stillbirths. Traditional midwives, who were supposed to be trusted informants on these matters, tended to omit information about pregnancy complications and adverse

perinatal outcomes, such as maternal or child deaths, as this threatened their role in the follow-up of deliveries.

The reporting of births and deaths based on the mentioned additional sources corresponded to 0.8% and 1.9%, respectively, of the total of these events reported in the Dande HDSS database between 2009-2015. Of the registered 10,289 births, 19 were retrieved from hospital records (corresponding to 0.2% of the total), 57 were informed by local informants (0.6%), and seven were collected from the civil registration services (0.1%). Of the 2,521 deaths registered in the same period, 12 were collected from the hospital records (0.5%), 32 were communicated by local informants (1.3%), and four were from the civil registration services (0.2%). However, these sources' contribution had minimal weight in the identification of neonatal deaths and adverse pregnancy results.

Beyond the comparison with additional data sources, standard methods commonly used to test the quality of demographic data, specifically related to the accuracy of age and sex ratio scores, (216) were applied to the Dande HDSS data.

We previously described how the process of age data collection might be affected by different reporting errors, particularly in developing countries and in specific population groups with low literacy, (161, 217) and how challenging it could be in the Dande setting. The age distortions related to the uncertainty about birth date are usually reflected in the tendency for people to report a rounded or 'lucky' age with preferences for certain digits. This process, known as age-heaping, displays excess frequencies of specific ages, commonly those ending in '0' or '5'. (217, 218) Therefore, considering the importance of the variable age in demography and epidemiological studies (218-220) as well as the context of the Dande HDSS, age-heaping summary indices, namely Whipple's Index (WI), Myers's blended index (MI), and age-sex accuracy index (ASAI), were used to measure the quality and consistency of age data (216-218) in different moments of data collection.

The WI for both sexes, essentially designed to detect concentration or heaping in terminal digits '0' and '5', (219) was 107.1 in the initial census data and 101.3 in the 9th UR, indicating the quality of age reporting in the Dande HDSS as fairly accurate (values ranging 105-110) in 2010, and highly accurate (for values <105) in 2015.

The results of the MI, designed for evaluating single year age-sex data, giving the extent of digit preference for the digits from '0' to '9', (216) also confirmed the high quality of data (values < 5), both for 2010 (MI=2.21), and 2015 (MI=2.23).

Less favourable were the results on ASAI, the index proposed by the United Nations for the evaluation of five-years age-sex data. (216) The initial census data's joint score was 29.47 and 29.00 for the data collected until 2015, values that stand within the category of inaccurate data (ranging between 20-39.9). The analyses revealed that the sum of the absolute deviation of age ratios from the unity ('100') was more remarkable for males than for females, both in 2010 and 2015, revealing a better quality of age reporting for women. Anomalies in age reported data for males might be the result of proxy reporting of age data by respondents, which in the Dande HDSS were mostly women.

To compare HDSS and national census data's accuracy, the ASAI was computed using Bengo's population distribution per sex and age-group. (198) The result, of 40.08, indicated a higher inaccurate reported age-sex data collected by INEA than by the Dande HDSS.

Coupled with demographic indicators some of the Dande HDSS's potentialities are to provide relevant information about the circumstances in which people are born, live, age, and die in the DSA, which includes both urban and rural settings, thus encompassing populations with different accessibilities, lifestyle, and risk exposures. The Dande HDSS collects indicators comparable to those of most other surveillance sites, and those collected by the DHS. (221) The location, type of housing (construction materials, number of rooms, crowding, sanitation), income, household assets, education, distance from housing to health facilities, sources of drinking and bathing water, social participation, among others, constitute critical social determinants of health, or are indicators thereof, and thus are essential elements in terms of a public health approach.

The changes observed in the evolution of household characteristics in 6 years, between 2009 and 2015, suggest improvements in the population's general housing conditions in the study area. Factors such as the country's rapid economic growth until 2014, an increase in formal jobs (especially in the public sector, construction, and inert exploration), the timid and slow emergence of a middle class, mainly marked by new modes of consumption, and a growing investment of the population in homeownership, (222) led to a process of reconfiguration and rapid growth, especially in the peri-urban and urban areas of the study area. The self-built home increasingly became more frequent in the DSA. It is evident that more robust materials, such as brick or block, are being used in new constructions, replacing more impermanent materials like wattle and daub, and woven-straw. The increased access of the population to electricity and

improved water also occurred mainly in urban areas, given that the rural areas remained without public electricity and water supply.

Even so, it is noteworthy that, in African countries like Angola, the concept of 'middle class' is more defined by aspiration and modes of consumption rather than living conditions, modes of production, and historical relations in the social structure. (223, 224) Many of those who could be identified as emerging middle class lived under the direst material circumstances, in poor dwellings, and were very vulnerable to sudden shocks or additional hardships, such as the illness of a family member or even a heavy rain that threatens their home and assets. (223)

Hence, in this thesis, we used other approaches to study social determinants of health and measure possible correlations between social and economic status and health outcomes than solely the effect of objectively measured material deprivation. (225)

The longitudinal follow-up of households within the HDSS, linked to the probable causes of death ascertained through the VAS, enhances the understanding of eventual socioeconomic determinants of disease-specific morbid episodes and mortality. (209, 221) Therefore, in the study on the leading causes of death in Dande, results from VA of deaths occurring during 2009-2012 (Paper II), the information available for the households collected during the Initial Census was used to compute a Wealth Index. This index, a measure of SES, reflected the type of walls and roof of the house, the existence of latrines, and drinking water sources. We have not found a significant relationship between socioeconomic status and the broad groups of mortality (p=0.053), specifically 'communicable diseases, maternal, perinatal, and nutritional conditions,' 'non-communicable diseases,' and 'injuries'. However, point estimates suggest positive associations in the groups considered socially disadvantaged, compared with those less disadvantaged, for CD and NCD. These findings are in line with the results found in different settings of other SSA countries, such as Burkina Faso, Ethiopia, Kenia, and Mozambique. (221, 226) Mortality was also highest among those with no formal education. On the contrary, individuals from the high and medium SES index quintiles, and more educated, were more likely to die from INJ, which might be related to better living conditions and greater access to mobility or motor vehicles, giving that traffic accidents are among the leading causes of death in the adult population of the DSA.

As of the 5th UR, the HDSS began to collect more extensive information on households, pursuing the elaboration of indexes with more elements that would, eventually, allow more differentiation of the population in terms of SES. Thus, it is plausible that re-examining these relationships with newer data could reveal a stronger relationship

between SES and mortality than observed in the present study. Further investigation is needed both to check if a more informative wealth index results in significant differences on the major CoD and if the country's fast economic growth and improvement in the living condition of part of the surveyed population establishes different mortality patterns, such as an increase in the burden of NCDs.

In this same study on the causes of death carried out within the Dande VAS (Paper II), we found that the leading causes of death among women of reproductive age were related to pregnancy, childbirth, and puerperium, confirming the need to prioritise interventions to improve reproductive and maternal health, a major public health problem in Angola. A woman's lifetime risk of dying because of pregnancy or childbirth is 1 in 32 in the country (227), as compared to 1 in 4,900 in developed countries. (228) Therefore, we used the data of 10,289 births outcomes registered by the HDSS for six years, to address maternal health inequalities. We focused on the demographic and social determinants influencing the utilisation of antenatal care and health facilities for delivery among women in the Dande HDSS, and their impact on birth outcomes (Paper III).

We have found a prevalence of ANC attendance in the Dande setting (96.8%), higher than the reported for Angola, (81.6%) (116) and the median of the SSA countries (89%). (229) Nevertheless, more than half the deliveries (50.7%) occurred outside a health facility. This discrepancy between high ANC attendance levels and low institutionalised delivery in the Dande HDSS is consistent with findings from studies conducted in other SSA settings. (230) Both the use of ANC and health facilities for delivery proved to be positively associated with birth outcomes. However, a meaningful result of our study was evidencing the lack of equity in accessing these services. The main discriminant factors were the place of residence, namely the rural-urban dichotomy and distance to health facilities, and the women's level of education. These determinants have been previously recognised as maternal health care access dimensions and match the results reported by relevant studies in developing countries. (231-233) We have also found that women's age, which correlates with previous birth experience and higher parity, constituted an obstacle to making use of health services. These factors may result from a combination of real difficulties with the women's evaluation of the benefits they anticipate from using the services. Given the grand dimension of data collected in this longitudinal study, the women's households' objective economic conditions are not presented in this work. However, we intend to address this subject shortly.

Finally, we also addressed social determinants of health by examining the relationship between the subjective and objective social status, the reported health needs, and the health-seeking behaviour of the population living in the DSA (Paper IV). To our

knowledge, this study is the first in Angola using the MacArthur Scale, one of the most widely used measures of subjective social status in epidemiological studies. (234) Our results lead to similar conclusions of association between SES indicators and health-related issues. (79, 82, 225) They showed that SSS influence health needs reporting and health-seeking behaviour above and beyond traditional SES indicators. Different variables influenced the reporting of health care needs, but, as in other African countries, these were more commonly reported among the better-off household than in the poorer. (96, 235). Individuals standing in the 2nd quartile of the ladder, with higher income, living in urban areas, having access to improved water, social participation, and owning bed nets had better odds of reporting illness in their households than their counterparts at the bottom of the ladder, with lower income, from rural settings, consuming unimproved water, without associative filiation, and having no bed nets. This association may reflect the influence of the socioeconomic environment in illness concepts, with better-off households more likely to use this category. (96) The choice of a health care provider was also affected by SSS and distance to a health care facility. People in the highest quartiles of the ladder were twice more likely to seek help from formal health services than those at the bottom of the ladder. The odds of seeking care in health services decreased with distance to a health care facility.

In addition to the HDSS and VAS outputs mentioned above, the Dande HDSS also provided broader platforms for conducting nested research studies. Besides providing a sampling framework and a platform for population-based research, the HDSS and VAS worked like a boomerang while feeding and receiving insights essential to contextualise, support, and confirm relevant research in the region. The leading causes of death in children under five, for example, confirmed the urge of studying malaria, intestinal infectious diseases (diarrhoea), and malnutrition in these ages. In turn, the main CoD among the older population corroborated the need for evidence into cardiovascular diseases. Several epidemiological studies were conducted based on the HDSS, resulting in multiple scientific publications in the related areas of malaria (155, 236, 237), schistosomiasis (238, 239), anaemia (240, 241), nutrition (242, 243), cardiovascular diseases (244-246), and health behaviours (247, 248), among others.

Another important aspect to emphasise is the HDSS and VAS contribution for local structures and the surveillance area's population.

The local and national health structures have benefited from the information produced by the data collection platforms. Always guaranteeing the confidentiality of HDSS members and the individual data analysed in the VAS, aggregated data was formally communicated to the populations, to the communes, to municipal administrations, to the

Bengo Provincial Health Authority, and MINSA. In addition to publications in international journals, information was presented in international and national conferences as well as other *fora*. Informative brochures and reports were produced with simplified results in Portuguese to be disseminated to local authorities. (157, 182)

Local health structures technicians, specifically from hospitals and health centres, benefited from training in data registration, as did physicians in completing the medical certificate for CoD, for example. These groups were also involved in various health research projects.

The HDSS was also valuable for local health authorities in terms of vaccination campaigns. On the one hand, it provided accurate data on the number of children by age group and geographic location. On the other, it occasionally helped to bring vaccines to children living in the most remote villages. Since the local structures did not have adequate means, the vaccine teams were transported by the HDSS when they travelled during the UR to specific difficult-to-reach neighbourhoods.

For ten years, the presence of an HDSS also impacted the region's social and economic development, mainly contributing to local capacity building, the creation of physical infrastructures and national and international visibility, arising from the collaboration with different research networks. VAS and HDSS employed a considerable number of technicians, and the staff received training in various domains. With training and practice, acquired with a decade of experience in the area, they became more skilful and contributed to the general improvement of procedures and data quality.

Besides, HDSS contributed to scientists' training, together with the local and remote universities, by hosting internships and students for their field activities, especially in demography, geographic engineering, and information technology. Several researchers, including local physicians, completed their master and PhD projects in CISA with the support of HDSS activities.

During the Initial Census preparation, in 2008/2009, the HDSS collaborated with the Angolan National Institute of Statistics. The collaboration involved discussing the procedures related to the counting and enumeration of the households. All the survey forms used by the HDSS were approved by and registered in the INEA. In 2013/2014, while the latter was preparing the National Census, the HDSS shared maps, georeferentiation of isolated populations, and housing enumeration methodologies in Bengo Province.

A crucial impact of the HDSS in the Dande setting was related to the ID plates to enumerate the households. Those plates had excellent acceptance and were locally

appropriated with very different purposes. They represented an address that did not exist until then. They were appropriated as police numbers, to use in identification cards, to be able to get a bank account or an electricity contract, for instance. Whenever there were administrative changes at territorial levels, such as the emergence of new neighbourhoods, the local administration asked the HDSS team to list and enumerate the houses. The plates had a symbolic weight for the population since they meant that people were counted, registered and eligible for some rights. In her book “The Address Book, What Streets Address Reveal About Identity, Race, Wealth and Power”, Deidre Mask explores how addresses and house numbers are related to the feeling of inclusion, given that they empower people by helping them feel part of society. She also explores the link between addresses and public health, describing the story of John Snow and cholera mapping in London and related stories of infectious disease tracing in Haiti and Africa. “Location and disease are inseparable for epidemiologists”. (160)

The application of the plates had some drawbacks for the HDSS. Given the growing urbanisation of the study area and the constant emergence of new houses, it became a very demanding task. Besides, both the population and the energy supply company removed plates occasionally from one house to another, causing a disturbance in the fieldwork and errors in identifying households. This situation forced a great awareness of the population and local entities, locally and through radio programs, to prevent the plates' remotion.

The local population had benefited to some extent by their participation in health research projects in terms of diagnosis for specific diseases, follow-up by specialists in the hospital, free treatment for participants, free insecticide-treated bed nets or other resources. Somehow, this could eventually compensate for the interview fatigue caused by periodic visits to their households, as described by other HDSS. (44, 249) However, in the Dande HDSS, the refusal rates were meagre, never exceeding 0.04% per UR.

The challenges and limitations of health research in developing countries and running an HDSS or verbal autopsies are well documented. (187, 249, 250) We addressed some of them in the introduction of this thesis. Tracking large populations over time is intensive and expensive. Financial constraints are among the major obstacles to maintaining a surveillance system (187, 249) and affect data quality. (250) The outputs of an HDSS are not immediate, as the analysis of the evolution of population structures and health-related indicators requires time, which may affect the capacity to attract funds. Besides, an HDSS requires significative locally based staff and logistical means in every step of the process: to visit thousands of households, once or multiple times per year, and collect, process, and analyse data. The challenges include the need for scientific

expertise in different domains, such as extensive surveys and fieldwork methodology, demography, epidemiology, social sciences, statistics, and scientific writing. (187) However, in most settings in which HDSSs are implemented, there is a lack of qualified personnel and limited research capacity. As reported in other HDSS sites, in Dande it was difficult to attract skilled staff because they are scarce and thus disputed by other better-paid jobs in the capital city. (187)

Finally, another challenge usually described in the literature, and that we also felt, refers to the absolute need to have a long-term commitment to the study area and a strong connection with the local environments in which data is collected. (164, 187) The knowledge of local cultural specificities that interfere in the data collection process, the adaptation of the tools for research, and the ability to manage time constraints, as an unexpected day of heavy rain can affect fieldwork for days or cause damage in the servers that accommodate the database, are essential aspects to take into account, from the beginning of the work until the publication phase.

5.1. Strengths and limitations

The strengths and limitations of the studies that make up this thesis have already been detailed in each of the papers, presented in the results section.

This thesis's essence relates to the functioning and potential of the HDSS and VAS as research instruments to monitor the dynamics of health and population in the Dande setting, Angola, which lacks effective vital registration and health-related data. Therefore, in this section, we will focus mainly on the strengths and limitations of those systems in Dande.

The Dande HDSS is the only demographic surveillance system that can serve research purposes in Angola and the only one existing in Central Africa. It monitors population dynamics, health-related indicators, social and economic characteristics, and the surveilled population's health-seeking behaviours. It delivered updated sociodemographic information for about 60,000 residents in an area where vital records are incomplete and provided frames from which representative samples can be selected, allowing individual sampling (random or purposive), stratification (by demographic, geographic or social variables), and longitudinal follow-up of the study population. Those factors are valuable, given that in this era of SDG, there are increasing calls for more geographically specific data, especially if data can be stratified by subpopulation to address health equity. (221) The HDSS also provides support to epidemiological studies,

both trial and observational studies, with potential public health value. It covers a large area, including rural and urban regions, and populations with different accessibilities, lifestyles, and socioeconomic conditions, which has a unique value for implementing research projects closely related to health interventions.

Demographic data quality tests confirmed the accuracy of the data collected by the Dande HDSS. Its findings agree with those found at national and regional levels, which have been collected and published in more recent years by INEA and DHS. (115, 116, 198) HDSS results also demonstrate the Dande population's profile to be typical of a developing setting, virtually indistinguishable from those found at other HDSS sites. (200-203)

One of the main limitations of the Dande HDSS is its ability to monitor the selected population effectively. The dimension of the Dande HDSS is large compared to most of the other HDSS sites. Additionally, the process of reconfiguration and rapid growth led to a considerable increase in the number of houses and neighbourhoods and higher mobility of the population within the study area. The economic changes that resulted in more formal jobs created increased difficulties in interviewing households during regular working hours in some parts of the DSA. All those factors contributed to decreasing the ability to monitor the selected population effectively with a UR per year. Moreover, the reduction in the number of UR lessened the number of reported events, with an impact on the accuracy of the resulting demographic indicators.

Another aspect worth improving is the HDSS capacity to process the large amount of data collected since the Initial Census. The Dande HDSS used paper-based support for extensive data collection, thus requiring tremendous effort and manual procedures to process data: encoding and double-entry data, data cleaning and consistency and completeness checking, leading to long delays between the time of data collection and the availability of data. Smartphone assisted personal interviewing would be a gamechanger in this setting. The timely availability of data would improve the ability to produce richer information. It would have a more substantial and immediate impact on guiding research lines and gathering evidence suitable for health policies. For instance, during the 2016 outbreak of yellow fever in Angola, which mostly affected the country's urban areas, including Caxito, (251) the HDSS conducted a survey to support local authorities in identifying the prevalence of fevers, the most affected populations and their healthcare-seeking behaviour. For effective use of this information, the results should have been immediate.

The VAS improved knowledge of Dande's population cause-specific and age-sex mortality patterns. One of its strengths was that the HDSS helped identify the death, therefore covering deaths occurring inside and outside the health facilities. The VAS provided a simple identification of CoD at the community level since no other functional registration system was in place. This point is particularly relevant given that near half of the Dande population dies at home without contact with the health system. Nevertheless, even for deaths occurring in the hospital, the information was inadequate. Due to the limited diagnostic capacity, physicians often did not assign a CoD, medical certificate for CoD were not routinely completed, and the existing data were not systematised.

Additionally, in general, the VA methodology provides a detailed understanding of death circumstances, how and why they occurred. This information helps identify health system failures related to deaths and critical limiting factors for care-seeking and utilisation at and around the time of death. (174) The circumstances of death reveal many deaths happened due to lack of social conditions, health care access or care-seeking. These insights are essential to tracing the burden of preventable deaths, support focused health research, and inform public health planning and resource allocation.

However, there are some limitations to note regarding the VAS in Dande. The main problem is the scarcity of local physicians, competent and knowledgeable of local disease aetiology and epidemiology, that can be trained to read VA questionnaires and discuss clinical cases to reduce the high proportion of Indeterminate CoD. In addition to hindering the VA's functioning, this presents a conundrum, given that it would be unethical for our system to divert these scarce human resources from meeting the population's immediate health needs.

Moreover, the VA is a widely used tool but with relatively low specificity and sensitivity for detecting some CoD. While VA works well for some diseases of public health relevance in Angola (such as measles, tetanus, whooping cough, and dysentery), as well for injuries, their use is more problematic for diseases which symptoms are relatively non-specific but are equally important (such as HIV/AIDS in children, malaria, and cancers). (252) In Dande, a malaria-endemic region, this may have ted to an overdiagnosis of the disease and a misclassification of other fever deaths. The symptoms of malaria overlap with those of other diseases, such as acute respiratory infections, and the VA might not be accurate enough to distinguish them. Besides, in high malaria transmission areas, there is a tendency to overdiagnose malaria in people with severe febrile illnesses. (253) This limitation of VA shows that its results should be carefully interpreted. Likewise, there must be some caution regarding this tool's potential

for attributing CoD to non-communicable diseases since these are gaining expression in low-income settings where VA is most used, including Dande.

Finally, in the introduction and discussion of this thesis, we mentioned the probable underreporting of neonatal deaths and adverse birth outcomes. Given the sensitivity and cultural norms around those subjects, for these specific cases and maternal deaths, it would be valuable to have women interviewing the deceased's caregivers, which are also, generally, women. Although, as reported in other HDSS, such as Iganga-Mayuge in Uganda, this option is not always possible. (254) In the HDSS and VAS Dande, we tried, since implementation, to have a sex balanced team of field workers. However, it was hard to maintain this balance and the team ended up having more men than women. This situation has to do with the fact that the role of women in Angola is still considerably associated with household assistance (*e.g.*, taking care of children, collecting water, cooking), reducing their chances to keep long-term jobs in the formal labour market.

5.2. Recommendations

The recommendations listed here are, for the most part, to respond to the problems identified throughout this thesis, and aim to contribute to enhance the HDSS and VAS data collection systems and improve their outputs.

In this thesis, we used data from the first six years of HDSS. During this period, the system benefited from: the team's accumulated experience; the increased recognition from the community and local authorities; the evolving connections and know-how exchanges with other HDSSs; the application of new methodologies; and the implementation of procedures to improve different phases of work: from data collection to data processing. However, in parallel, there were gradual changes in the study area and reductions in update rounds' periodicity. These last factors made the follow-up of the population and the capture of vital events more challenging. Nevertheless, health and demographic outcomes require precise information on events of interest and the population at risk. Therefore, we recommend adjusting the study area according to logistical and financial conditions, eventually opting to alter the surveillance area's dimension and the monitored population. This solution has been discussed and should be considered according to existing resources, research priorities and the interest of HDSS results for local health policies.

The introduction of electronic data collection through tablets or other mobile devices may help to overcome some of the issues related to HDSS capacity to process the large

amount of data collected. It is expected to bring advantages for HDSS and VAS, such as lessening survey and data processing time, reducing errors (incorporating automatic consistency and completeness checks), and diminishing the need for archival space. Additionally, the VA and HDSS interviews would become shorter, making data collection less burdensome, both for field workers and respondents.

The introduction of electronic data collection should be complemented with the use of appropriate software, allowing the migration of data from the current database (written in PostgreSQL) and the rationale inherent to a relational database, namely, to maintain track of the temporal sequence of events that characterise the demographic surveillance system. The OpenHDS is a data system designed to be used in population-based surveillance of vital events via HDSS. It manages a standard reference format, is transferrable to different settings, uses rigorous checks on data entry and demographic events, and permits the introduction of questionnaires and variables required for a longitudinal study. (255) It is already in use in several HDSS settings and should be tested in the Dande HDSS. The implementation of this system could facilitate data cleaning, reduce errors, and allow timely data availability.

The VAS could also benefit from automated systems to deliver timely availability of CoD data. In recent years, some novel strategies were developed to interpret VA in resource-poor settings, intending to serve as an alternative to or replacement of physician-certified VA. These strategies aim to overcome the problem of lack of physicians, quite common in these settings, and increase the VA tool's specificity and sensitivity. (179) They consist of computerised coding of VA methods and include an algorithmic approach (InterVA methods), to come up with a probable CoD. The utilisation of these techniques in some HDSSs has shown their capacity to achieve maximum consistency in interpreting VA data, requiring relatively minimal time and labour resources. (179, 184)

Finally, it is recommended to reinforce the connection of the HDSS with all local structures. Existent cooperation should be nurtured. The work done is intense, implies a constant presence on the field, and it is beneficial, at all levels, to build partnerships and share efforts.

The dynamisation of local informants' networks, through more periodic meetings and organisation of occasional workshops, could make them more participatory and collaborative with the activities of HDSS. Furthermore, it would involve them, as representatives of the community, in the study of the main problems affecting the population in the region.

A closer relationship with the local administration could lead, for instance, to a sharing of efforts in the function of enumerating the houses.

Greater involvement of all level health structures is also recommended. HDSS should be able to mobilise more health professionals' participation in activities such as scientific meetings on the topics to be included in the surveys and discussion of HDSS outputs. This synergy could sensitise health professionals to the importance of collecting, recording, and using data in their daily activity. Moreover, it could contribute to taking better advantage of the HDSS in the health sector, given that the limited capacities and resources, human and material, resulting in a weak engagement with HDSS findings

Nevertheless, permanent articulation with local entities requires time, so it is recommended that specific functions be assigned to different purposes. Social scientists could promote the relationship with the community. A person responsible for communicating science should ensure the role of liaison with local authorities and media. Moreover, health workers' involvement should be achieved in articulation with researchers from HDSS and ongoing health projects.

5.3. Conclusions

In general, the studies that make up this thesis contributed to a better understanding of population dynamics, mortality patterns, and social determinants, a pre-requisite for the development of policies, systems and programmes that effectively targeted communities, with a particular focus on primary health care level, a well-identified need in the assessment of health system in Angola. (14, 15)

Accurate and updated data on births and other pregnancy outcomes, deaths, migrations, and living conditions along the populations' life course constitutes relevant information to health, both at research and policy levels. The identification of deaths through VA methodology in the scope of this continuous surveillance system fills a gap in the numbers and causes of death that most affect the region. It also assesses mortality patterns for the whole community rather than the more commonly used health facility records. (68) Bengo Province is an endemic region for several infectious diseases responsible for morbidity and mortality in Angola. (119, 155) However, health structures' capacity for registering and measuring the impact of that endemicity on mortality is limited. Still, our findings concerning the pattern of epidemiological transition constitute grounds for public health action. Public health providers should be prepared to handle the 'triple burden of disease' by improving health interventions (such as raising

awareness for healthier lifestyles, nutrition issues, road safety and prevention campaigns) and equitable health services provision. The evidence regarding social determinants of maternal health care access, factors influencing health care needs reporting, and formal healthcare-seeking, suggests the need to work on the primary health care access barriers affecting the Dande setting. Those data should inform better targeting of health resources, monitor equity and enable evidenced-based policies and interventions increasing access to health and reducing the burden of disease.

The Dande HDSS and VAS have enormous potential, though it remains under-exploited, particularly at the health policies level. Their characteristics bring together conditions for supporting different research projects, conducting clinical trials, monitoring trends in mortality over time, testing and evaluating health interventions, and surveilling outbreaks. The studies conducted in this thesis show some of the contributions of those data collection systems, with meaningful results for the field of public health: birth outcomes, deaths and their causes, and living conditions and social determinants, life course milestones of a population in a low-income setting.

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ANNEXES

Annex I - Characteristics of the households in the Dande HDSS: photos of houses built with different materials.

Figure 26 - **House in the DSA. Block walls and fibrocement roof**

HDSS fieldwork (Photo taken by Diogo Francisco)

Figure 27 - House in the DSA. Adobe walls and iron sheet roof

Source: HDSS fieldwork (Photo taken by Edite Rosário)

Figure 28 - House in the DSA. Wattle and daub walls, iron sheet roof and earth floor

Source: HDSS fieldwork (Photo taken by Edite Rosário)

Figure 29 – House in the DSA. Straw walls and roof

Source: HDSS fieldwork (Photo taken by Edite Rosário)

Figure 30 - House in the DSA. Iron sheet walls and roof.

Source: HDSS fieldwork (Photo taken by Edite Rosário)

Figure 31 – House in the DSA. Wattle and daub walls, straw roof, and earth floor.

Source: HDSS fieldwork (Photo taken by Edite Rosário)

Annex II - Characteristics of the households in the Dande HDSS: photos of common drinking water sources, and examples of some of the sanitation and kitchen facilities

Figure 32 - Water sources - Standpipe

Source: HDSS fieldwork (Photo taken by Maria Berhan)

Figure 33 – Water sources - Public tap

Source: HDSS fieldwork (Photo taken by Maria Berhan)

Figure 34 - Water sources – Unprotected well

Source: HDSS fieldwork (Photo taken by Maria Berhan)

Figure 35 –Water sources – Unprotected tank

Source: HDSS fieldwork (Photo taken by Edite Rosário)

Figure 36 - Water sources – River

Source: HDSS fieldwork (Photo taken by Maria Berhan)

Figure 37 - Water sources - Irrigation channel

Source: HDSS fieldwork (Photo taken by Edite Rosário)

Figure 38 - Houses with kitchen (covered place to cook meals)

Source: HDSS fieldwork (Photo taken by Maria Berhan)

Figure 39 – Houses with kitchen (covered place to cook meals)

Source: HDSS fieldwork (Photo taken by Edite Rosário)

Figure 40 - Houses without a kitchen

Source: HDSS fieldwork (Photo taken by Maria Berhan)

Figure 41 – Houses without a kitchen

Source: HDSS fieldwork (Photo taken by Maria Berhan)

Figure 42 - Backyard latrine for family use

Source: HDSS fieldwork (Photo taken by Maria Berhan)

Figure 43 - Latrine shared by neighbours

Source: HDSS fieldwork (Photo taken by Edite Rosário)

Annex III - Model of the questionnaire used in the Initial Census

CISA CENTRO DE INVESTIGAÇÃO EM SAÚDE EM ANGOLA

SVD • FORMULÁRIO DO CENSO INICIAL

1. Folha n.º ☐ de ☐ **2. Inquiridor** ☐☐

3. Identificação do agregado Bairro ☐☐☐ Sector ☐☐ Casa ☐☐☐

4. Data d d m m a a a a

5. Localização da placa ☐

6. Quem é o chefe de família? (Nome)

7. Agora vou precisar de saber algumas características da sua casa: assinale APENAS UM círculo em cada grupo

7.1. Paredes:

Adobe	1
Tijolo/ blocos	2
Pau a pique e barro	3
Palha entrançada	4
Madeira	5
Outro	6
Qual?	

7.2. Cobertura:

Palha	1
Chapa metálica	2
Telha	3
Outra	4
Qual?	

7.3. Número de divisões (quartos e salas) ☐

7.4. Cozinha

Sim	1
Não	2

7.5. Água utilizada

Chafariz público	1
Torneira privada	2
Rio	3
Vala de irrigação	4
Lagoa	5
Cacimba	6
Furo	7
Outra	8
Qual?	

7.6. Latrina

Não tem	2

Se tem:

Com água	3
Sem água	4
Só para a família	5
Partilhada c vizinhos	6

8. Diga-me o nome do todas as pessoas que vivem nesta casa (MEMBROS RESIDENTES do agregado)

ID Permanente ☐☐☐ **Nome** ______ Sexo: ☐

Data de nascimento d d m m a a a a Aproximada ☐ Relação com o chefe: ☐

ID Permanente do pai ☐☐☐-☐☐☐-☐☐☐-☐☐☐ ID Permanente da mãe ☐☐☐-☐☐☐-☐☐☐-☐☐☐ ID Permanente do esposo ☐☐☐-☐☐☐-☐☐☐-☐☐☐

Instrução: Sabe ler e escrever? ☐ Nº de anos de escolaridade completos ☐ Nº de anos no ensino superior ☐

ID Permanente ☐☐☐ **Nome** ______ Sexo: ☐

Data de nascimento d d m m a a a a Aproximada ☐ Relação com o chefe: ☐

ID Permanente do pai ☐☐☐-☐☐☐-☐☐☐-☐☐☐ ID Permanente da mãe ☐☐☐-☐☐☐-☐☐☐-☐☐☐ ID Permanente do esposo ☐☐☐-☐☐☐-☐☐☐-☐☐☐

Instrução: Sabe ler e escrever? ☐ Nº de anos de escolaridade completos ☐ Nº de anos no ensino superior ☐

ID Permanente ☐☐☐ **Nome** ______ Sexo: ☐

Data de nascimento d d m m a a a a Aproximada ☐ Relação com o chefe: ☐

ID Permanente do pai ☐☐☐-☐☐☐-☐☐☐-☐☐☐ ID Permanente da mãe ☐☐☐-☐☐☐-☐☐☐-☐☐☐ ID Permanente do esposo ☐☐☐-☐☐☐-☐☐☐-☐☐☐

Instrução: Sabe ler e escrever? ☐ Nº de anos de escolaridade completos ☐ Nº de anos no ensino superior ☐

9. Identificação do Respondente: assinale com um círculo a ID da pessoa que está a prestar informações

Localização da placa numerada

Porta da casa	1
Parede lateral / traseira	2
Portão do quintal	3
Outro	4

Instrução

Sabe lêr e escrever?	
Sim	1
Não	2

Relação com o Chefe

Chefe de agregado	1
Esposa do chefe	2
Filho/filha (biológico)	3
Genro/Nora	4
Neto/Neta (biológico)	5
Pai/Mãe (biológico)	6
Sogro/Sogra	7
Irmão /Irmã (biológico)	8
Enteado/ Sobrinho /Adoptado/ Protegido	9
Outro	10

Sexo

Masculino	1
Feminino	2

Não sabe	888
Não se aplica	999

>

Confirme o número de residentes (No fim) ☐

ID Permanente | Nome | Sexo:
Data de nascimento d d m m a a a a | Aproximada | Relação com o chefe:
ID Permanente do pai | ID Permanente da mãe | ID Permanente do esposo
Instrução: Sabe ler e escrever? | Nº de anos de escolaridade completos | Nº de anos no ensino superior

ID Permanente | Nome | Sexo:
Data de nascimento d d m m a a a a | Aproximada | Relação com o chefe:
ID Permanente do pai | ID Permanente da mãe | ID Permanente do esposo
Instrução: Sabe ler e escrever? | Nº de anos de escolaridade completos | Nº de anos no ensino superior

ID Permanente | Nome | Sexo:
Data de nascimento d d m m a a a a | Aproximada | Relação com o chefe:
ID Permanente do pai | ID Permanente da mãe | ID Permanente do esposo
Instrução: Sabe ler e escrever? | Nº de anos de escolaridade completos | Nº de anos no ensino superior

ID Permanente | Nome | Sexo:
Data de nascimento d d m m a a a a | Aproximada | Relação com o chefe:
ID Permanente do pai | ID Permanente da mãe | ID Permanente do esposo
Instrução: Sabe ler e escrever? | Nº de anos de escolaridade completos | Nº de anos no ensino superior

ID Permanente | Nome | Sexo:
Data de nascimento d d m m a a a a | Aproximada | Relação com o chefe:
ID Permanente do pai | ID Permanente da mãe | ID Permanente do esposo
Instrução: Sabe ler e escrever? | Nº de anos de escolaridade completos | Nº de anos no ensino superior

ID Permanente | Nome | Sexo:
Data de nascimento d d m m a a a a | Aproximada | Relação com o chefe:
ID Permanente do pai | ID Permanente da mãe | ID Permanente do esposo
Instrução: Sabe ler e escrever? | Nº de anos de escolaridade completos | Nº de anos no ensino superior

ID Permanente | Nome | Sexo:
Data de nascimento d d m m a a a a | Aproximada | Relação com o chefe:
ID Permanente do pai | ID Permanente da mãe | ID Permanente do esposo
Instrução: Sabe ler e escrever? | Nº de anos de escolaridade completos | Nº de anos no ensino superior

ID Permanente | Nome | Sexo:
Data de nascimento d d m m a a a a | Aproximada | Relação com o chefe:
ID Permanente do pai | ID Permanente da mãe | ID Permanente do esposo
Instrução: Sabe ler e escrever? | Nº de anos de escolaridade completos | Nº de anos no ensino superior

Annex IV - Model of the questionnaire used in the 5th update round

REGISTO DE NOVOS AGREGADOS

1. Folha nº ☐ de ☐

2. Inquiridor: ☐☐ 3. ID Casa: ☐☐☐ ☐☐ ☐☐☐☐ Respondente ☐☐☐

4. Data da visita: ☐☐ ☐☐ ☐☐☐☐ 5. Localização da placa ☐

6. Chefe do Agregado

7. Agora vou precisar de saber algumas características da sua casa:

7.1 Paredes

Adobe	1
Tijolo / Blocos	2
Pau a pique e	3
Palha entrançada	4
Madeira	5
Outro	6
Qual:	

7.2 Cobertura

Palha	1
Chapa metálica	2
Telha	3
Losalite	4
Outra	5
Qual:	

7.3 Qual o tipo de chão da sua casa?

Chão liso / cimento	1
Chão bruto	2
Mosaico	3
Terra batida	4
Tapete	5
Outro	6
Qual:	

7.4 Nº de divisões da casa

(Quartos e salas)	

7.5 Principal fonte de água usada para beber

Chafariz público	1
Água canalizada na residência	2
Rio	3
Vala de irrigação	4
Torneira no quintal (part/ind)	5
Cacimba / poço	6
Furo / sonda	7
Tanque	8
Outra	9
Qual:	

7.6 Trata a água usada para beber?

SIM (Questão 7.6.1)	1
NÃO (Questão 7.7)	2

7.6.1 Se sim (ASSINALE AS NECESSÁRIAS)

Lixívia / cloro	1
Pedra ume	2
Ferve antes de consumir	3
Filtro	4
Outro método	5
Qual:	

7.7 Principal fonte de água usada para banhos

Chafariz público	1
Água calizada na residência	2
Rio	3
Vala de irrigação	4
Torneira no quintal (part/ind)	5
Cacimba / poço	6
Furo / sonda	7
Tanque	8
Outra	9
Qual:	

7.8 Tem cozinha?

SIM	1
NÃO	2

7.9 Qual o principal meio que usa para cozinhar?

Lenha	1
Carvão	2
Petróleo	3
Gás	4
Electricidade	5
Outro	6
Qual:	

7.10 No AF existe (Assinale com X)

	S	N
Electricidade pública		
Elect. Alternativa (geradores/p. solares)		
Rádio		
Televisão		
Telemóvel		
TV por cabo / satélite		
Frigorífico / geleira		
Arca		

7.11 Tem latrina?

SIM (Questão 7.11.1)	1
NÃO (Questão 7.12)	2

7.11.1 Se tem latrina, indicar:

Com água	1
Sem água	2

7.11.2 Assinale ainda se:

Só para a família (AF)	1
Partilhada com viznhos	2

7.12 No AF existe algum destes meios de transporte (Assinale com X):

	S	N
Carro		
Motociclo / mota		
Bicicleta		
Carro de mão		
Outro		
Qual:		

7.13 Faz criação de animais?

SIM (Questão 7.13.1)	1
NÃO (Questão 8)	2

7.13.1 Indique que tipo de animais

Grande Porte (vacas, bois,cavalos)	1
Médio porte (porcos, cabras, ovelhas)	2
Pequeno porte (coelhos, aves)	3

Localização da placa :

1 - Porta da casa
2 - Parede lateral / traseira
3 - Portão do quintal
4 - Outro

Livro de Ronda (5ª)

ID Casa:

Relação com o chefe		Naturalidade (Municípios da prov. do Bengo)	Províncias de Angola		
1 - Chefe do agregado	7 - Sogro / sogra	1 - Ambriz	7 - Benguela	13 - Cunene	19 - Malange
2 - Esposa do chefe	8 - Irmão / irmã (biológico)	2 - Dande	8 - Bié	14 - Huambo	20 - Moxico
3 - Filho / Filha (biológico)	9 - Enteado / sobrinho / adoptado	3 - Bula - Atumba	9 - Cabinda	15 -Huíla	21 - Namibe
4 - Genro / nora	10 - Outro	4 - Dembos	10 - Kuando - Kubango	16 - Luanda	22 - Uíge
5 - Neto / neta		5 - Nambuangongo	11 - Kwanza Norte	17 - Lunda - Norte	23 - Zaire
6 - Pai / mãe (biológico)		6 - Pango - Aluquém	12 - Kwanza Sul	18 - Lunda - Sul	

Inquiridor: **Data:** Último: | **Evento** | **Data**

Nome do membro **Sexo**
Localização **D. Nasc** **Aprox** **Doc** **Rel. chefe**
Localização Pai **Localização Mãe** **Localização Esposo**
Naturalidade
Sabe ler **Anos Esc** **E. Sup**
Munícipio prov. Bengo
Outra prov. (# Bengo)
Está a frenquentar a escola? S N NS NA / 1 2 3 9
Outro país, qual?
Não sabe

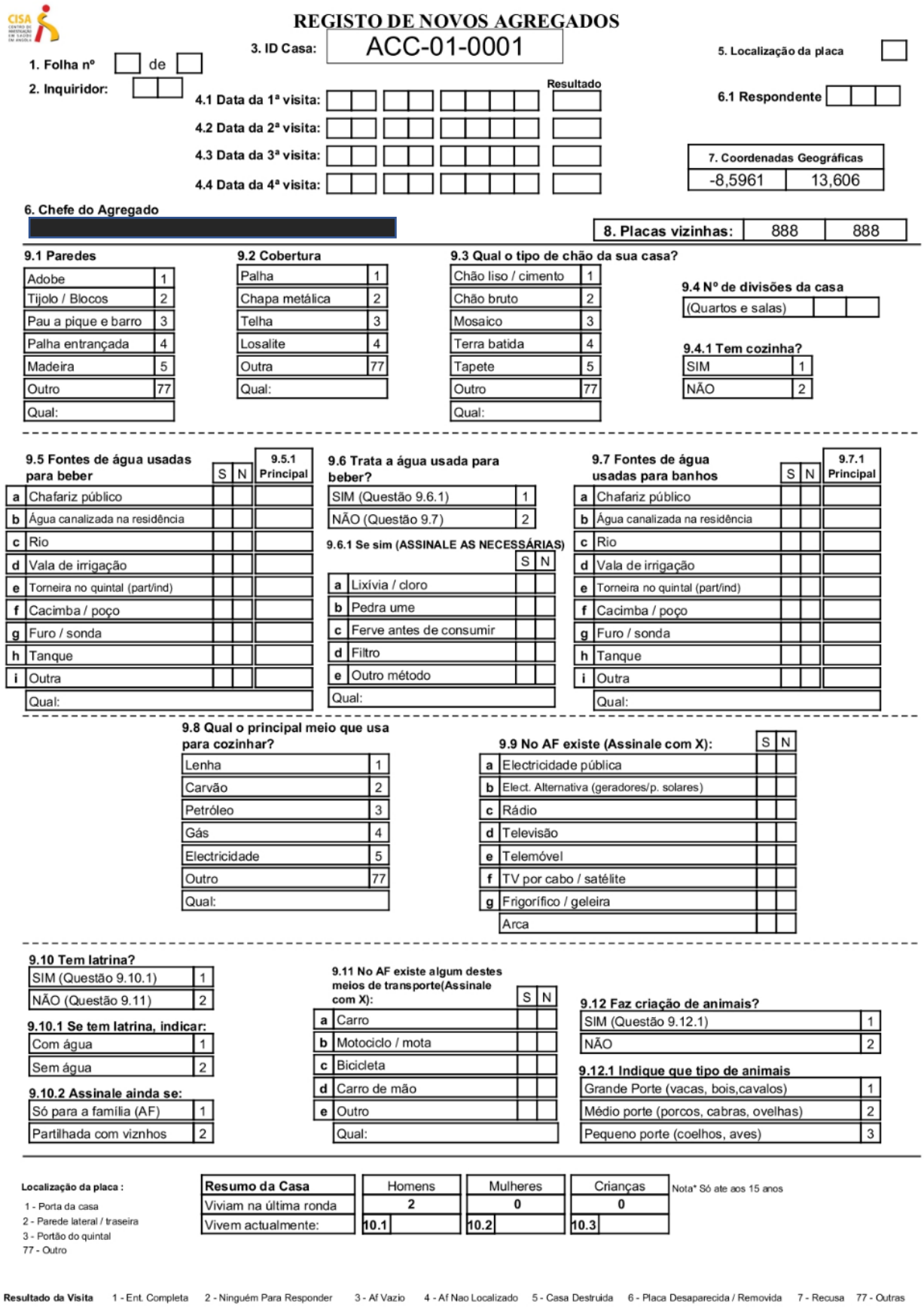
Nome do membro **Sexo**
Localização **D. Nasc** **Aprox** **Doc** **Rel. chefe**
Localização Pai **Localização Mãe** **Localização Esposo**
Naturalidade
Sabe ler **Anos Esc** **E. Sup**
Munícipio prov. Bengo
Outra prov. (# Bengo)
Está a frenquentar a escola? S N NS NA / 1 2 3 9
Outro país, qual?
Não sabe

Nome do membro **Sexo**
Localização **D. Nasc** **Aprox** **Doc** **Rel. chefe**
Localização Pai **Localização Mãe** **Localização Esposo**
Naturalidade
Sabe ler **Anos Esc** **E. Sup**
Munícipio prov. Bengo
Outra prov. (# Bengo)
Está a frenquentar a escola? S N NS NA / 1 2 3 9
Outro país, qual?
Não sabe

Nome do membro **Sexo**
Localização **D. Nasc** **Aprox** **Doc** **Rel. chefe**
Localização Pai **Localização Mãe** **Localização Esposo**
Naturalidade
Sabe ler **Anos Esc** **E. Sup**
Munícipio prov. Bengo
Outra prov. (# Bengo)
Está a frenquentar a escola? S N NS NA / 1 2 3 9
Outro país, qual?
Não sabe

Nome do membro **Sexo**
Localização **D. Nasc** **Aprox** **Doc** **Rel. chefe**
Localização Pai **Localização Mãe** **Localização Esposo**
Naturalidade
Sabe ler **Anos Esc** **E. Sup**
Munícipio prov. Bengo
Outra prov. (# Bengo)
Está a frenquentar a escola? S N NS NA / 1 2 3 9
Outro país, qual?
Não sabe

Annex V - Model of the questionnaire used in the 9th update round



REGISTO DE NOVOS AGREGADOS

1. Folha nº ☐ de ☐
2. Inquiridor: ☐☐
3. ID Casa: ACC-01-0001
4.1 Data da 1ª visita: ☐☐ ☐☐ ☐☐☐☐ Resultado ☐
4.2 Data da 2ª visita: ☐☐ ☐☐ ☐☐☐☐ ☐
4.3 Data da 3ª visita: ☐☐ ☐☐ ☐☐☐☐ ☐
4.4 Data da 4ª visita: ☐☐ ☐☐ ☐☐☐☐ ☐
5. Localização da placa ☐
6.1 Respondente ☐☐☐
7. Coordenadas Geográficas: -8,5961 | 13,606
6. Chefe do Agregado: [redacted]
8. Placas vizinhas: 888 | 888

9.1 Paredes
Adobe	1
Tijolo / Blocos	2
Pau a pique e barro	3
Palha entrançada	4
Madeira	5
Outro	77
Qual:	

9.2 Cobertura
Palha	1
Chapa metálica	2
Telha	3
Losalite	4
Outra	77
Qual:	

9.3 Qual o tipo de chão da sua casa?
Chão liso / cimento	1
Chão bruto	2
Mosaico	3
Terra batida	4
Tapete	5
Outro	77
Qual:	

9.4 Nº de divisões da casa (Quartos e salas) ☐☐

9.4.1 Tem cozinha?
SIM	1
NÃO	2

9.5 Fontes de água usadas para beber
		S	N	9.5.1 Principal
a	Chafariz público			
b	Água canalizada na residência			
c	Rio			
d	Vala de irrigação			
e	Torneira no quintal (part/ind)			
f	Cacimba / poço			
g	Furo / sonda			
h	Tanque			
i	Outra			
	Qual:			

9.6 Trata a água usada para beber?
SIM (Questão 9.6.1)	1
NÃO (Questão 9.7)	2

9.6.1 Se sim (ASSINALE AS NECESSÁRIAS)
		S	N
a	Lixívia / cloro		
b	Pedra ume		
c	Ferve antes de consumir		
d	Filtro		
e	Outro método		
	Qual:		

9.7 Fontes de água usadas para banhos
		S	N	9.7.1 Principal
a	Chafariz público			
b	Água canalizada na residência			
c	Rio			
d	Vala de irrigação			
e	Torneira no quintal (part/ind)			
f	Cacimba / poço			
g	Furo / sonda			
h	Tanque			
i	Outra			
	Qual:			

9.8 Qual o principal meio que usa para cozinhar?
Lenha	1
Carvão	2
Petróleo	3
Gás	4
Electricidade	5
Outro	77
Qual:	

9.9 No AF existe (Assinale com X):
		S	N
a	Electricidade pública		
b	Elect. Alternativa (geradores/p. solares)		
c	Rádio		
d	Televisão		
e	Telemóvel		
f	TV por cabo / satélite		
g	Frigorífico / geleira		
	Arca		

9.10 Tem latrina?
SIM (Questão 9.10.1)	1
NÃO (Questão 9.11)	2

9.10.1 Se tem latrina, indicar:
Com água	1
Sem água	2

9.10.2 Assinale ainda se:
Só para a família (AF)	1
Partilhada com viznhos	2

9.11 No AF existe algum destes meios de transporte(Assinale com X):
		S	N
a	Carro		
b	Motociclo / mota		
c	Bicicleta		
d	Carro de mão		
e	Outro		
	Qual:		

9.12 Faz criação de animais?
SIM (Questão 9.12.1)	1
NÃO	2

9.12.1 Indique que tipo de animais
Grande Porte (vacas, bois,cavalos)	1
Médio porte (porcos, cabras, ovelhas)	2
Pequeno porte (coelhos, aves)	3

Localização da placa :
1 - Porta da casa
2 - Parede lateral / traseira
3 - Portão do quintal
77 - Outro

Resumo da Casa	Homens	Mulheres	Crianças
Viviam na última ronda	2	0	0
Vivem actualmente:	10.1	10.2	10.3

Nota* Só ate aos 15 anos

Resultado da Visita 1 - Ent. Completa 2 - Ninguém Para Responder 3 - Af Vazio 4 - Af Nao Localizado 5 - Casa Destruida 6 - Placa Desaparecida / Removida 7 - Recusa 77 - Outras

Vou agora colocar-lhe uma questão relativa ao rendimento neste AF.

Como em todas as outras questões, a resposta é absolutamente confidencial. O objectivo é ajudar-nos a conhecer a população do Dande no que respeita à relação entre a situação socioeconómica e saúde.

11. Neste agregado, quanto dinheiro entra NORMALMENTE POR MÊS? ☐

Nenhum	☐
Menos de 10.000	☐
Entre 10.001 e 30.000 AOA	☐
Entre 30.001 e 50.000 AOA	☐
Entre 50.001 e 70.000 AOA	☐
Mais de 70.000 AOA	☐
NS	NR

11.1 Quantas pessoas do AF recebem salário fixo?

Nenhuma	☐
1 pessoa	☐
2 pessoas	☐
3 pessoas	☐
4 pessoas	☐
5 ou mais	☐

12. Mostrar ESCADA.

Vamos olhar para esta figura e assumir que:

No topo da escada se situam as pessoas que vivem melhor, com mais saúde, mais educação, mais dinheiro.

No fundo da escada estão as pessoas que vivem menos bem, com menos saúde, menos educação, menos dinheiro.

Em que degrau situaria a sua família nesta escada? ☐

NS NR

---

13. Aqui em casa, costumam ver televisão, ouvir rádio, ler jornais?

SIM	1
NÃO	2

(Se Não, saltar para Q.14)

13.1 Se Sim, quais os meios que usa mais?

Televisão	☐	Qual o canal?
Rádio	☐	Sintonia?
Jornal	☐	Qual?
Outro	☐	Qual?

14. Algum dos membros deste AF pertence a algum tipo de associação, grupo ou colectividade? (NOTE: não queremos saber afiliações políticas)

SIM	1
NÃO	2

(Se Não, saltar para Q.15)

Religiosa	☐
Recreativa/cultural	☐
Desportivo	☐
Cívica	☐
Outra	☐

---

15. No último mês, alguém neste AF sentiu necessidade de cuidados de saúde?

☐ Sim

☐ Não **(Se Não, terminar a aplicação desta parte do questionário)**

15.1. Se Sim, procurou ajuda?

☐ Sim **(Se Sim, saltar para a Q.15.2)**

☐ Não **(Se Não, saltar para a Q.15.3)**

15.2 Onde procurou ajuda? (Assinale TODAS)

Igreja	☐
Junto de familiares ou vizinhos	☐
Mercado ou farmácia	☐
Unidade sanitária (hospital, posto de saúde)	☐
Curandeiro, quimbandeiro, ervanária, tradicional	☐
Enfermeiro	☐
Outro. Qual?	☐

15.3 (Se NÃO) porque não procurou ajuda?

Os problemas desapareceram / já não precisou mais	☐
Custa caro / não tinha dinheiro	☐
Fica muito longe	☐
Fica muito cheio	☐
Outro. Qual?	☐

Livro de Ronda (9ª) ACC-01-0001

Coordenadas Geográficas	
-8,5961	13,606

Chefe do Agregado: [redacted]

Placas vizinhas:	888	888

Nome do membro [redacted] **Sexo** M
Nome de casa **Rel.** 10
Localização ACC-01-0001-001
D. Nasc 12-08-1975 **Idade** 39 **Aprox** Não **Doc.** 888 **Tipo Doc** **Número Doc**
Localização Pai -00-0000-999 **Localização Mãe** -00-0000-999 **Localização Esposo** -00-0000-999 **Naturalidade** 888
Sabe ler Sim **Anos Esc** 3 **E. Sup** 0 **Freq Esc** 888 **Telefone**

Evento	Data
CI 11299	27-01-2010
SAI 26366	05-01-2011

Nome do membro [redacted] **Sexo** M
Nome de casa MIGUEL **Rel.** 1
Localização ACC-01-0001-002
D. Nasc 29-09-1958 **Idade** 56 **Aprox** Não **Doc.** Não **Tipo Doc** **Número Doc**
Localização Pai 0-00-0000-999 **Localização Mãe** 0-00-0000-999 **Localização Esposo** 0-00-0000-999 **Naturalidade** 00
Sabe ler Sim **Anos Esc** 12 **E. Sup** 5 **Freq Esc** 0 **Telefone**

Evento	Data
ENT 20638	11-07-2011
20637	

Nome do membro [redacted] **Sexo** M
Nome de casa HEICTOR **Rel.** 10
Localização ACC-01-0001-003
D. Nasc 02-04-1971 **Idade** 43 **Aprox** Não **Doc.** Não **Tipo Doc** **Número Doc**
Localização Pai 0-00-0000-999 **Localização Mãe** 0-00-0000-999 **Localização Esposo** 0-00-0000-999 **Naturalidade** 00
Sabe ler Sim **Anos Esc** 12 **E. Sup** 5 **Freq Esc** 0 **Telefone**

Evento	Data
ENT 20637	25-03-2011
13544	

Nome do membro **Sexo**
Nome de casa **Rel.**
Localização
D. Nasc **Idade** **Aprox** **Doc.** **Tipo Doc** **Número Doc**
Localização Pai **Localização Mãe** **Localização Esposo** **Naturalidade**
Sabe ler **Anos Esc** **E. Sup** **Freq Esc** **Telefone**

Evento	Data

Nome do membro **Sexo**
Nome de casa **Rel.**
Localização
D. Nasc **Idade** **Aprox** **Doc.** **Tipo Doc** **Número Doc**
Localização Pai **Localização Mãe** **Localização Esposo** **Naturalidade**
Sabe ler **Anos Esc** **E. Sup** **Freq Esc** **Telefone**

Evento	Data

Nome do membro **Sexo**
Nome de casa **Rel.**
Localização
D. Nasc **Idade** **Aprox** **Doc.** **Tipo Doc** **Número Doc**
Localização Pai **Localização Mãe** **Localização Esposo** **Naturalidade**
Sabe ler **Anos Esc** **E. Sup** **Freq Esc** **Telefone**

Evento	Data

Medidas de Prevenção da Malária

Data da entrevista ☐☐ - ☐☐ - ☐☐☐☐

ID Respondente ☐☐☐☐ **ID Inquiridor** ☐☐

Nome Respondente

1. A residência possui redes mosquiteiras que possam ser usadas para dormir?

SIM	1
NÃO	2

(Se Não, saltar para Q.1.2)

1.1 Se respondeu SIM, indique quantas redes, por favor:

Número de mosquiteiros ☐ **(Saltar para a Q. 2)**

Se existem 5 OU MAIS MOSQUITEIROS, registe 5

1.2 Porque razão não têm redes mosquiteiras na casa? (Registe TODAS)

a	Não há mosquitos	
b	Não há redes disponíveis	
c	Não gosta de usar redes mosquiteiras	
d	As redes são muito caras	
e	Outros	

SE NÃO TEM redes mosquiteiras na casa, agradeça e TERMINE AQUI

2. Há quanto tempo tem as redes mosquiteiras aqui em casa: (indicar o NÚMERO)

	Rede 1	Rede 2	Rede 3	Rede 4	Rede 5
Meses					
Anos					
NS/NR					

3. As redes mosquiteiras foram compradas ou oferecidas: (indicar com X)

	Rede 1	Rede 2	Rede 3	Rede 4	Rede 5
Comprada					
Oferecida					
NS/NR					

4. Quando obteve as redes, já estavam tratadas com insecticida para matar ou repelir mosquitos: (indicar com X)

	Rede 1	Rede 2	Rede 3	Rede 4	Rede 5
Sim					
Não					
NS/NR					

5. Desde que obteve a rede mosquiteira, alguma vez foi mergulhado nalgum líquido para matar ou repelir mosquitos: (indicar com X)

	Rede 1	Rede 2	Rede 3	Rede 4	Rede 5
Sim					
Não					
NS/NR					

Se NÃO, passar para a Q.7

6. Há quanto tempo a rede mosquiteira foi embebida ou mergulhada pela última vez

	Rede 1	Rede 2	Rede 3	Rede 4	Rede 5
Meses (indicar NÚMERO)					
Mais de 24 meses (indicar X)					
NS/NR					

7. Alguém deste AF dormiu debaixo de uma rede mosquiteira a noite passada?

SIM	1
NÃO	2

(Se NÃO, agradeça e termine o questionário)

8. Se SIM, quem: (indicar com X)

Membro					
001		011			
002		012			
003		013			
004		014			
005		015			
006		016			
007		017			
008		018			
009		019			
010		020			

Annex VI - Model of birth registration form

SVD - FICHA DE RESULTADO DE UMA GRAVIDEZ

Data da entrevista ☐☐ ☐☐ ☐☐☐☐ **Inquiridor** ☐☐

LOCALIZAÇÃO DA MÃE Bairro ☐☐☐ Sector ☐☐ Casa ☐☐☐☐ Membro ☐☐☐

Nome da mulher: _____

Gravidez Data em que terminou: ☐☐ ☐☐ ☐☐☐☐ **Aproximada** ☐ **Documento** ☐

CONSULTAS

Fez alguma consulta pré-natal?

Sim ☐

Não ☐ **(Se Não, saltar para o Resultado da Gravidez)**

Onde fez a(s) consulta(s)?

- ☐ Público (Centro Materno Infantil Mabubas, Abel dos Santos, Barra do Dande)
- ☐ Privado (Madres / Bom Samaritano)
- ☐ Outro. Qual?
- ☐ Não sabe / Não responde

A quantas consultas foi? (indicar número) ☐☐

Se não souber o número exacto, recorrer à escala:

- ☐ Uma
- ☐ 2 ou 3
- ☐ de 4 a 6
- ☐ de 7 a 9
- ☐ 10 ou mais
- ☐ Não sabe / Não responde

De quantas semanas estava quando foi à primeira consulta pré-natal? (indicar número)

- ☐☐ Semanas
- ☐☐ Meses
- ☐ Não sabe / Não responde

RESULTADO DA GRAVIDEZ

- ☐ Nado vivo
- ☐ Nado morto* >= 7 meses
- ☐ Aborto < 7 meses
- ☐ Falsa informação

☐ Gémeos

Indicar número de gémeos (ex: trigémeos=03) ☐☐

Onde ocorreu o parto / aborto?

- ☐ Centro ou posto de Saúde
- ☐ Maternidade Hospital
- ☐ Em qualquer lugar fora dos serviços de saúde
  - ☐ com parteira tradicional
  - ☐ outro tipo de ajuda
  - ☐ ninguém

Já esteve grávida antes?

Sim ☐

Não ☐

NS/NR ☐ **(Se Não ou Não Sabe, saltar para Dados do Recém-Nascido)**

Se SIM, quantas vezes? ☐☐ (indicar número)

Dessas gravidezes quantos filhos nasceram vivos? ☐☐ (indicar número)

*** NOTA: SE FOR UM NADO MORTO - NÃO PREENCHER DADOS DO RECÉM-NASCIDO**

DADOS DO RECÉM-NASCIDO (ATENÇÃO - PREENCHER APENAS SE NASCIDO VIVO)

IDENTIFICAÇÃO DA CRIANÇA Bairro ☐☐☐ Sector ☐☐ Casa ☐☐☐☐ Membro ☐☐☐ **Sexo** ☐

Nome da criança: _____

Nome de casa: _____ **Relação com o chefe** ☐

Nome do pai: _____

ID Localização do pai ☐☐☐ ☐☐ ☐☐☐☐ ☐☐☐

PESO À NASCENÇA

☐☐☐☐ gr

☐ Não Sabe / Não responde

Pedir à mãe para consultar o CARTÃO DE SAÚDE INFANTIL.

Se a mãe tiver cartão da criança cujo nascimento está a ser reportado, transcrever o peso à nascença

Relação com o chefe: 3 - Filho / Filha 5 - Neto / neta 8 - Irmão / irmã 9 - Enteado / sobrinho / adoptado / protegido 10 - Outro

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Annex VII - Model of pregnancy observation form

SVD • FICHA DE OBSERVAÇÃO DE GRAVIDEZ

Data da informação ☐☐ - ☐☐ - ☐☐☐☐ **Inquiridor** ☐☐

RESIDÊNCIA

Localização:

	Bairro	Sector	Casa	Número de membro
Copie do livro de ronda	☐☐☐	☐☐	☐☐☐☐	☐☐☐

Nome : _____

Data da observação da gravidez ☐☐ - ☐☐ - ☐☐☐☐

Meses de gravidez (aproximados) ☐

Já esteve grávida alguma vez antes? Sim ☐ Não ☐

SVD • FICHA DE OBSERVAÇÃO DE GRAVIDEZ

Data da informação ☐☐ - ☐☐ - ☐☐☐☐ **Inquiridor** ☐☐

RESIDÊNCIA

Localização:

	Bairro	Sector	Casa	Número de membro
Copie do livro de ronda	☐☐☐	☐☐	☐☐☐☐	☐☐☐

Nome : _____

Data da observação da gravidez ☐☐ - ☐☐ - ☐☐☐☐

Meses de gravidez (aproximados) ☐

Já esteve grávida alguma vez antes? Sim ☐ Não ☐

Annex VIII - Model of death registration form

SVD - FICHA DE ÓBITO

Data da entrevista ☐☐ ☐☐ ☐☐☐☐ **Inquiridor** ☐☐

ÚLTIMA RESIDÊNCIA

LOCALIZAÇÃO
Copie do livro de ronda

Bairro ☐☐☐ Sector ☐☐ Casa ☐☐☐☐ Membro ☐☐☐

Nome: _____

Data do falecimento ☐☐ ☐☐ ☐☐☐☐

Local da morte:

1	Unidade de Saúde (Hospital, Centro de Saúde)
2	Exemplos: Na água, na estrada, via pública (casos de acidentes)
3	Casa
77	Outros
88	Não sabe / Não responde

Nome do Chefe de Família:
Copie do livro de ronda _____

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SVD - FICHA DE ÓBITO

Data da entrevista ☐☐ ☐☐ ☐☐☐☐ **Inquiridor** ☐☐

ÚLTIMA RESIDÊNCIA

LOCALIZAÇÃO
Copie do livro de ronda

Bairro ☐☐☐ Sector ☐☐ Casa ☐☐☐☐ Membro ☐☐☐

Nome: _____

Data do falecimento ☐☐ ☐☐ ☐☐☐☐

Local da morte:

1	Unidade de Saúde (Hospital, Centro de Saúde)
2	Exemplos: Na água, na estrada, via pública (casos de acidentes)
3	Casa
77	Outros
88	Não sabe / Não responde

Nome do Chefe de Família:
Copie do livro de ronda _____

v.29012015_DC

Annex IX – Verbal Autopsy Neonatal death questionnaire

QUESTIONÁRIO AUTÓPSIA VERBAL

Crianças 0 a 27 dias

Hora de início (hh/mm) ☐☐ ☐☐

SECÇÃO 1. IDENTIFICAÇÃO

1.1	Inquérito	número ☐☐☐☐	supervisor
1.2	ID entrevistado 1	☐☐☐ ☐☐ ☐☐☐☐ ☐☐☐	supervisor
1.3	ID entrevistado 2	☐☐☐ ☐☐ ☐☐☐☐ ☐☐☐	supervisor
1.4	ID falecido	☐☐☐ ☐☐ ☐☐☐☐ ☐☐☐	supervisor

SECÇÃO 2. INFORMAÇÃO SOBRE A ENTREVISTA

2.1	Código do entrevistador	☐☐	
2.2	Data da entrevista (dd/mm/aaaa)	☐☐ ☐☐ ☐☐☐☐	
2.3	Em que tentativa:	primeira ☐ segunda terceira outra (ESPECIFICAR): _____	
2.4	Notas do entrevistador		

SECÇÃO 3. CONSENTIMENTO INFORMADO

Eu,_____ (nome do entrevistador), informei esta família sobre os objectivos deste trabalho e importância da sua participação.
Eu, _____ (nome do entrevistado) , depois de informado do presente estudo concordo com os seus objectivos e aceito participar neste trabalho.
Fui informado que:
- se pretende obter informação sobre as principais causas de morte nesta região;
- a minha participação consiste em responder a um questionário sobre a doença que conduziu à morte do meu familiar;
- a minha participação é voluntária, pelo que posso não responder a todas as questões ou desistir em qualquer momento;
- a informação que darei é totalmente confidencial e apenas será tratada pela equipa de investigação do CISA (Centro de Investigação em Saúde em Angola), não sendo mostrada a outras pessoas.

DATA: _____/_____ / _____
ASSINATURA:_____

SECÇÃO 4. IDENTIFICAÇÃO E DADOS SOCIO-DEMOGRÁFICOS DO ENTREVISTADO			
4.1	Nome	_____	
4.2	Sexo	feminino ☐ maculino ☐	
4.3	Nível de escolaridade	nenhum ☐ básico (1º-9º ano) ☐ médio (10º-13º ano) ☐ outro (ESPECIFICAR): _____ não sabe ☐	
4.4	Relação com o bebé falecido	pai ☐ mãe ☐ irmão/irmã ☐ avô/avó ☐ tio/tia ☐ outro (ESPECIFICAR): _____	
SECÇÃO 5. CONFIRMAÇÃO DA IDENTIFICAÇÃO E DADOS SÓCIO-DEMOGRÁFICOS DA CRIANÇA FALECIDA			
5.1	Nome	_____	
5.2	Sexo	feminino ☐ maculino ☐	
5.3	Data de nascimento (dd/mm/aaaa)	☐☐ ☐☐ ☐☐☐☐	
5.4	Data da morte (dd/mm/aaaa)	☐☐ ☐☐ ☐☐☐☐	
5.5	Local da morte	unidade sanitária ☐ => 6.1 caminho unidade saúde ☐ => 6.1 casa ☐ => 6.1 outro (ESPECIFICAR): _____ => 6.1 não sabe ☐ => 6.1	
5.6	Nome da unidade sanitária onde o bebé morreu	_____	
SESSÃO 6. QUESTÕES ABERTAS SOBRE A DOENÇA QUE LEVOU À MORTE DO BEBÉ (PASSADO E ACTUAL)			
6.1	Pode dizer-me se a mãe teve problemas durante a gravidez ou o parto? _____		
6.2	Pode dizer-me quando é que o bebé começou a ficar doente? _____		

6.3	Pode dizer-me o que notou quando o bebé ficou doente?		
SECÇÃO 7. CONDIÇÕES MATERNAS (PASSADO DA MÃE)			
7.1	A mãe fez consulta de vigilância da gravidez? (VER O LIVRO DE GRÁVIDA DA MÃE)	sim ☐ não ☐ não sabe ☐	
7.2	A mãe foi vacinada contra o tétano? (VER O LIVRO DE GRÁVIDA DA MÃE)	sim ☐ não ☐ não sabe ☐	=> 7.4 => 7.4
7.3	Com quantas doses foi vacinada? (VER O LIVRO DE GRÁVIDA DA MÃE)	número de doses ☐☐ não sabe ☐	
7.4	Como está a mãe agora?	saudável *(normal)* ☐ doente ☐ morreu ☐ não sabe ☐	
SECÇÃO 8. GRAVIDEZ (PASSADO) - CONDIÇÕES DO BEBÉ NO PERÍODO PRÉ-NATAL			
8.1	Quantos vezes a mãe esteve grávida (*Quantos partos a mãe deu*)? (VER O LIVRO DE GRÁVIDA DA MÃE)	número de gravidezes ☐☐ não sabe ☐	
8.2	Quantos meses durou esta última gravidez?	número de meses ☐	
8.3	Esta gravidez foi de gémeos?	sim ☐ não ☐ não sabe ☐	=> 8.5 => 8.5
8.4	Este bebé foi o primeiro ou segundo a nascer?	primeiro ☐ segundo ☐ outro (ESPECIFICAR) _____ não sabe ☐	
8.5	Onde nasceu o bebé?	casa ☐ unidade sanitária ☐ em trânsito (ESPECIFICAR) _____ ☐ outro (ESPECIFICAR): _____ não sabe ☐	

8.6	Durante a gravidez a mãe teve alguma doença?	s n ns hipertensão arterial ☐ ☐ ☐ doenças de coração ☐ ☐ ☐ diabetes ☐ ☐ ☐ epilepsia ☐ ☐ ☐ outra (ESPECIFICAR): _____	
8.7	Nos últimos três meses de gravidez a mãe teve algum destes problemas de saúde?	s n ns hemorragia vaginal ☐ ☐ ☐ líquido vaginal de mau cheiro ☐ ☐ ☐ cara cheia ☐ ☐ ☐ pés ou pernas inflamadas ☐ ☐ ☐ dor de cabeça ☐ ☐ ☐ visão turva (vultos) ☐ ☐ ☐ convulsões (esticar-se) ☐ ☐ ☐ febre ☐ ☐ ☐ dor de barriga ☐ ☐ ☐ palidez e falta de ar ☐ ☐ ☐ outro (ESPECIFICAR): _____	
8.8	O bebé parou de mexer na barriga da mãe?	sim ☐ não ☐ não sabe ☐	=> 8.10 => 8.10
8.9	Quando é que o bebé parou de mexer?	antes do início do parto ☐ durante o parto ☐ não sabe ☐	
8.10	Quando é que a bolsa de águas rebentou?	antes do trabalho de parto ☐ durante o trabalho de parto ☐ não sabe ☐	=> 8.12
8.11	Quantas horas depois da ruptura da bolsa de águas é que o bebé nasceu?	menos de 24 horas ☐ mais de 24 horas ☐ não sabe ☐	
8.12	As águas da bolsa tinham mau cheiro?	sim ☐ não ☐ não sabe ☐	
8.13	Quem assistiu o parto tentou ouvir o coração do bebé dentro da barriga da mãe?	sim ☐ não ☐ não sabe ☐	=> 8.15 => 8.15
8.14	Conseguiram ouvir o coração do bebé durante o parto?	sim ☐ não ☐ não sabe ☐	
8.15	A mãe sangrou muito no dia do parto?	sim ☐ não ☐ não sabe ☐	

8.16	A mãe teve febre no dia do parto?	sim ☐ não ☐ não sabe ☐	
8.17	Quantas horas durou o parto?	menos de 12 horas ☐ entre 12 a 23 horas ☐ mais de 24 horas ☐ não sabe ☐	
8.18	Foi um parto normal?	sim ☐ não ☐ não sabe ☐	=> 8.20 => 8.20
8.19	Que tipo de parto foi? (VER NO CARTÃO DE SAÚDE INFANTIL)	forceps/ventosa ☐ cesariana ☐ outro (ESPECIFICAR): _____ ☐ não sabe ☐	
8.20	Qual foi a primeira parte do corpo do bebé a sair?	cabeça ☐ "rabo" ☐ mão/braço ☐ pés ☐ outra (ESPECIFICAR): _____	
8.21	O cordão umbilical saiu antes que o bebé?	sim ☐ não ☐ não sabe ☐	
SECÇÃO 9. CONDIÇÕES DO BEBÉ APÓS O NASCIMENTO (PASSADO)			
9.1	De que tamanho era o bebé quando nasceu?	mais pequeno que o normal ☐ normal ☐ maior do que o normal ☐ não sabe ☐	
9.2	Puseram alguma coisa no cordão umbilical do bebé depois do parto?	sim ☐ não ☐ não sabe ☐	 => 9.4 => 9.4
9.3	O que puseram no cordão umbilical?	_____	
9.4	O bebé nasceu com alguma marca ou osso partido?	sim ☐ não ☐ não sabe ☐	 => 9.6 => 9.6
9.5	Em parte do corpo tinha essas marcas?	cabeça ☐ tronco ☐ pernas/braços ☐	
9.6	Alguma parte do corpo do bebé não se mexia?	sim ☐ não ☐ não sabe ☐	

9.7	O bebé tinha alguma malformação ao nascimento?	nenhuma ☐ cabeça muito grande ☐ cabeça muito pequena ☐ defeito na espinha ☐ defeito no lábio / céu da boca ☐ outra (ESPECIFICAR): _____ não sabe ☐	
9.8	De que cor era o bebé quando nasceu? [Ler as opções]	normal ☐ pálido ☐ roxo ☐ não sabe ☐	
9.9	O bebé respirou, mesmo que muito pouco, depois de nascer?	sim ☐ não ☐ não sabe ☐	
9.10	O bebé precisou de ajuda para respirar?	sim ☐ não ☐ não sabe ☐	
9.11	O bebé chorou, mesmo que muito pouco, depois de nascer?	sim ☐ não ☐ não sabe ☐	
9.12	O bebé mexeu-se, mesmo que muito pouco, depois de nascer?	sim ☐ não ☐ não sabe ☐	=> 10.1
9.13	APENAS SE A RESPOSTA ÀS QUESTÕES 9.9; 9.11 E 9.12 FOR NÃO O bebé nasceu morto?	sim ☐ não ☐ não sabe ☐	=> 10.1 => 10.1
9.14	O bebé tinha sinais de maceração?	sim ☐ não ☐ não sabe ☐	=> 13.5 => 13.5 => 13.5
SECÇÃO 10. CONDIÇÕES DO BEBÉ QUE ANTECEDERAM A MORTE (ACTUAL)			
10.1	Quantos dias o bebé ficou doente antes de falecer?	número de dias ☐☐ não sabe ☐	
10.2	O bebé mamou *(chuchou)* depois de nascer?	sim ☐ não ☐ não sabe ☐	=> 10.6 => 10.6
10.3	O bebé parou de mamar *(chuchar)* ?	sim ☐ não ☐ não sabe ☐	=> 10.5 => 10.5
10.4	Quantos dias, depois de nascer, o bebé deixou de mamar *(chuchar)* ?	número de dias ☐☐ não sabe ☐	

10.5	O bebé era alimentado só com o leite da mãe?	sim não não sabe	
10.6	O bebé teve convulsões? (esticar-se) DEMONSTRAR	sim não não sabe	=> 10.8 => 10.8
10.7	Quantos dias depois do nascimento o bebé começou a ter convulsões?	número de dias não sabe	
10.8	O bebé ficou rígido ou com o corpo em arco?	sim não não sabe	
10.9	Notou a fontanela do bebé abaulada?	sim não não sabe	=>10.11 =>10.11
10.10	Quantos dias depois do nascimento notou o abaulamento da fontanela?	número de dias não sabe	
10.11	O bebé ficou inconsciente (Ex. desmaiado, sem sentidos, inanimado)	sim não não sabe	=>10.13 =>10.13
10.12	Quantos dias depois do nascimento o bebé ficou inconsciente?	número de dias não sabe	
10.13	O bebé teve febre?	sim não não sabe	=>10.15 =>10.15
10.14	Quantos dias depois do nascimento o bebé teve febre?	número de dias não sabe	
10.15	O bebé ficou com o corpo muito frio?	sim não não sabe	=>10.17 =>10.17
10.16	Quantos dias depois do nascimento o bebé ficou com o corpo muito frio?	número de dias não sabe	
10.17	O bebé teve tosse?	sim não não sabe	=>10.19 =>10.19
10.18	Quantos dias depois do nascimento o bebé ficou com tosse?	número de dias não sabe	

10.19	O bebé respirava mais rápido do que o normal?	sim não não sabe	=>10.21 =>10.21
10.20	Quantos dias depois do nascimento o bebé começou a respirar mais rápido?	número de dias não sabe	
10.21	O bebé tinha dificuldade a respirar?	sim não não sabe	=>10.26 =>10.26
10.22	Quantos dias depois do nascimento o bebé começou a ter dificuldade a respirar ?	número de dias não sabe	
10.23	O bebé tinha tiragem subcostal (*fazia covas na barriga quando respirava*)?	sim não não sabe	
10.24	O bebé respirava com um gemido? DEMONSTRAR	sim não não sabe	
10.25	O bebé mexia as asas do nariz quando respirava? DEMONSTRAR	sim não não sabe	
10.26	O bebé fazia pausa a respirar?	sim não não sabe	
10.27	O bebé teve diarreia?	sim não não sabe	=>10.32 =>10.32
10.28	Quantos dias depois do nascimento o bebé começou a diarreia?	número de dias não sabe	
10.29	Quantos dias o bebé teve diarreia?	número de dias não sabe	
10.30	Quantas dejecções teve (*quantas vezes obrou*) o bebé no dia em que teve mais diarreia?	número de vezes não sabe	
10.31	O bebé tinha sangue nas fezes?	sim não não sabe	
10.32	O bebé vomitou?	sim não não sabe	=>10.35 =>10.35
10.33	Quantos dias depois do nascimento, o bebé começou a vomitar?	número de dias não sabe	

10.34	Quantas vezes o bebé vomitou no dia em que teve mais vómitos?	número de vezes ☐☐ não sabe ☐	
10.35	O bebé tinha a barriga inchada?	sim ☐ não ☐	=>10.37
		não sabe ☐	=>10.37
10.36	Quantos dias depois do nascimento o bebé começou a ter a barriga inchada?	número de dias ☐☐ não sabe ☐	
10.37	O cordão umbilical ou umbigo do bebé estava inflamado ou deitava líquido?	sim ☐ não ☐ não sabe ☐	
10.38	O bebé tinha borbulhas com pús na pele?	sim ☐ não ☐ não sabe ☐	
10.39	O bebé tinha as plantas dos pés ou as palmas das mãos brancas ou amarelas?	s n ns brancas ☐ ☐ ☐ amarelas ☐ ☐ ☐	Se n ou ns =>11.1
10.40	Quantos dias depois do nascimento o bebé começou a ter as plantas dos pés ou palmas das mãos brancas ou amarelas?	número de dias ☐☐ não sabe ☐	
10.41	Quantos dias é que o bebé ficou com plantas dos pés e mãos amarelas?	número de dias ☐☐ não sabe ☐	
SECÇÃO 11. HISTÓRIA DE ACIDENTES (ACTUAL)			
11.1	O bebé sofreu algum acidente antes de morrer? [Deixar a pergunta aberta. No caso do recém nascido, sugerir ao entrevistado acidentes como "queda" e esperar resposta]	nenhum ☐ acidente de viação ☐ atropelamento ☐ queda ☐ afogamento ☐ envenenamento ☐ queimadura ☐ violência/assalto ☐ picada/mordedura de animal ☐ outro (ESPECIFICAR): _____	=>12.1 =>11.3 =>11.3 =>11.3 =>11.3 =>11.3 =>11.3 =>11.3
11.2	Que tipo de animal?	cobra ☐ cão ☐ insecto ☐ outro (ESPECIFICAR): _____	
11.3	O acidente foi intencionalmente provocado?	sim ☐ não ☐ não sabe ☐	

SECÇÃO 12. CUIDADOS DE SAÚDE (ACTUAL)			
12.1	Quantas vezes o bebé foi a uma unidade sanitária desde que nasceu?	número de vezes não sabe	se 0 =>12.4
12.2	O bebé fez algum tipo de tratamento prescrito pelo médico ou enfermeiro?	sim não não sabe	=>12.4 =>12.4
12.3	Que tratamentos fez?	_____	
12.4	Alguém lhe disse de que morreu o bebé?	sim não não sabe	=> 12.6 => 12.6
12.5	O que lhe disseram sobre a causa de morte do bebé?	_____	
12.6	De que acha que morreu o seu bebé?	_____	
SECÇÃO 13. REGISTOS DE SAÚDE (PEDIR SEMPRE)			
13.1	CARTÃO DE SAÚDE INFANTIL Transcrever os seguintes registos Vacina BCG Vacina Pólio Último peso (Kg) e idade da pesagem APGAR Outros dados	data data _____ _____ _____ _____ _____	=> se tiver registos => 13.3
13.2	A criança foi vacinada? (APENAS SE NÃO TIVER REGISTOS)	s n ns BCG *(marca no braço)* polio *(mímica gota na boca)*	
13.3	ANÁLISES Transcrever os registos Data das análises (dd/mm/aaaa) Gota espessa Hemoglobina Reacção de widall HIV Outros	_____ _____ _____ _____	
13.4	MEDICAMENTOS/RECEITAS Nome dos medicamentos (VER SE TEM RECEITA OU MEDICAMENTOS EM CASA)	1 _____ 2 _____ 3 _____ 4 _____	
13.5	CERTIFICADO DE ÓBITO Transcrever os dados do certificado de óbito Data da morte (dd/mm/aaaa) Causa de morte registada na 1ª linha (A) Causa de morte registada na 2ª linha (B) Causa de morte registada na 3ª linha (C) Outras estados mórbidos (SECÇÃO II)	_____ _____ _____ _____	
AGRADEÇA AO ENTREVISTADO PELA COLABORAÇÃO			
		Hora de finalização (hh/mm)	50

Annex X – Verbal Autopsy Children death questionnaire

CISA CENTRO DE INVESTIGAÇÃO EM SAÚDE EM ANGOLA

QUESTIONÁRIO AUTÓPSIA VERBAL

Crianças de 28 dias a 14 anos

Hora de início (hh/mm) ☐☐ ☐☐

SECÇÃO 1. IDENTIFCAÇÃO

1.1	Inquérito	número ☐☐☐☐	supervisor
1.2	ID entrevistado 1	☐☐☐ ☐☐ ☐☐☐☐ ☐☐☐	supervisor
1.3	ID entrevistado 2	☐☐☐ ☐☐ ☐☐☐☐ ☐☐☐	supervisor
1.4	ID falecido	☐☐☐ ☐☐ ☐☐☐☐ ☐☐☐	supervisor

SECÇÃO 2. INFORMAÇÃO SOBRE A ENTREVISTA

2.1	Código do entrevistador	☐☐	
2.2	Data da entrevista (dd/mm/aaaa)	☐☐ ☐☐ ☐☐☐☐	
2.3	Em que tentativa:	primeira ☐ segunda ☐ terceira ☐ outra (ESPECIFICAR): _____	
2.4	Notas do entrevistador		

SECÇÃO 3. CONSENTIMENTO INFORMADO

Eu,_____ (nome do entrevistador), informei esta família sobre os objectivos deste trabalho e importância da sua participação.
Eu, _____ (nome do entrevistado) , depois de informado do presente estudo concordo com os seus objectivos e aceito participar neste trabalho.
Fui informado que:
- se pretende obter informação sobre as principais causas de morte nesta região;
- a minha participação consiste em responder a um questionário sobre a doença que conduziu à morte do meu familiar;
- a minha participação é voluntária, pelo que posso não responder a todas as questões ou desistir em qualquer momento;
- a informação que darei é totalmente confidencial e apenas será tratada pela equipa de investigação do CISA (Centro de Investigação em Saúde em Angola), não sendo mostrada a outras pessoas.

DATA: _____/_____ / _____
ASSINATURA:_____

SECÇÃO 4. IDENTIFICAÇÃO E DADOS SOCIO-DEMOGRÁFICOS DO ENTREVISTADO			
4.1	Nome	_____	
4.2	Sexo	feminino ☐ maculino ☐	
4.3	Nível de escolaridade	nenhum ☐ básico (1º-9º ano) ☐ médio (10º-13º ano) ☐ outro (ESPECIFICAR): _____ não sabe ☐	
4.4	Relação com a criança falecida	pai ☐ mãe ☐ irmão/irmã ☐ avô/avó ☐ tio/tia ☐ outro (ESPECIFICAR): _____	
SECÇÃO 5. CONFIRMAÇÃO DA IDENTIFICAÇÃO E DADOS SÓCIO-DEMOGRÁFICOS DA CRIANÇA FALECIDA			
5.1	Nome	_____	
5.2	Sexo	feminino ☐ masculino ☐	
5.3	Data de nascimento (dd/mm/aaaa)	☐☐ ☐☐ ☐☐☐☐	
5.4	Data da morte (dd/mm/aaaa)	☐☐ ☐☐ ☐☐☐☐	
5.5	Nível de escolaridade	nenhum ☐ básico (1º-9º ano) ☐ médio (10º-13º ano) ☐ outro (ESPECIFICAR): _____ não sabe ☐	
5.6	Local da morte	unidade sanitária ☐ caminho unidade saúde ☐ casa ☐ outro (ESPECIFICAR): _____ não sabe ☐	 => 6.1 => 6.1 => 6.1 => 6.1
5.7	Nome da unidade sanitária onde a criança morreu	_____	
SESSÃO 6 . QUESTÕES ABERTAS SOBRE A DOENÇA QUE LEVOU À MORTE (ACTUAL)			
6.1	A criança ficou doente muitas vezes?		

6.2	Quando começou a ficar doente?		
6.3	O que notou na criança durante a doença que lhe levou à morte?		
SECÇÃO 7. ANTECEDENTES PATOLÓGICOS DA CRIANÇA (PASSADO)			
7.1	A criança sofria de alguma destas doenças?	s n ns doenças do coração ☐ ☐ ☐ diabetes ☐ ☐ ☐ asma ☐ ☐ ☐ epilepsia ☐ ☐ ☐ malnutrição ☐ ☐ ☐ cancro ☐ ☐ ☐ tuberculose ☐ ☐ ☐ HIV/SIDA ☐ ☐ ☐ outra (ESPECIFICAR): _____	
CRIANÇAS COM MENOS DE UM ANO ⇩		**CRIANÇAS COM MAIS DE UM ANO** ⇨	⇒ 9.1
SECÇÃO 8. PARTO, NASCIMENTO, CRESCIMENTO (PASSADO)			
8.1	Quando nasceu a criança era mais pequena do que o normal?	sim ☐ não ☐ não sabe ☐	
8.2	A criança nasceu com quantos meses?	número de meses ☐☐ não sabe ☐	
8.3	A criança teve um crescimento normal?	sim ☐ não ☐ não sabe ☐	
8.4	A criança teve abaulamento da fontanela?	sim ☐ não ☐ não sabe ☐	⇒ 9.1 ⇒ 9.1
8.5	Quantos dias antes da morte notou o abaulamento da fontanela?	número de dias ☐☐ não sabe ☐	

SECÇÃO 9. CONDIÇÕES DA MAE E DA CRIANÇA QUE ANTECEDERAM A MORTE (ACTUAL)			
9.1	A criança teve febre?	sim não não sabe	 => 9.6 => 9.6
9.2	Durante quanto tempo é que a criança teve febre?	número de dias número de meses não sabe	
9.3	A febre era muito alta?	sim não não sabe	
9.4	A febre era contínua ou intermitente (*ia e vinha*)?	contínua intermitente não sabe	
9.5	A criança teve arrepios?	sim não não sabe	
9.6	A criança teve tosse?	sim não não sabe	 => 9.11 => 9.11
9.7	Durante quanto tempo é que a criança teve tosse?	número de dias número de meses não sabe	
9.8	A criança tinha muita tosse?	sim não não sabe	
9.9	A criança tossia sangue?	sim não não sabe	
9.10	A criança vomitava depois de tossir?	sim não não sabe	
9.11	A criança respirava mais rápido do que o normal?	sim não não sabe	 => 9.15 => 9.15
9.12	Durante quantos dias é que a criança esteve a respirar mais rápido que o normal?	número de dias não sabe	
9.13	A criança tinha dificuldade em respirar?	sim não não sabe	 => 9.19 => 9.19

9.14	Durante quantos dias é que a criança teve dificuldade em respirar?	número de dias não sabe	
9.15	A criança teve tiragem subcostal (fazia covas na barriga quando respirava)?	sim não não sabe	=>9.17 =>9.17
9.16	Durante quantos dias é que a criança teve tiragem subcostal?	número de dias não sabe	
9.17	A criança respirava com um gemido? (DEMONSTRAR)	sim não não sabe	
9.18	A criança mexia as asas do nariz quando respirava? (DEMONSTRAR)	sim não não sabe	
9.19	A criança teve diarreia?	sim não não sabe	=>9.23 =>9.23
9.20	Quantos dias é que a criança teve diarreia?	número de dias não sabe	
9.21	No dia que a criança teve mais diarreia, quantas dejecções teve (*quantas vezes obrou)*?	número de vezes não sabe	
9.22	A criança tinha sangue nas fezes?	sim não não sabe	
9.23	A criança vomitou?	sim não não sabe	=>9.26 =>9.26
9.24	Durante quantos dias vomitou?	número de dias não sabe	
9.25	Quantas vezes vomitou no dia que teve mais vómitos?	número de vezes não sabe	
9.26	A criança teve dor de barriga?	sim não não sabe	=>9.29 =>9.29
9.27	Durante quanto tempo é que a criança teve dor de barriga?	número de dias número de meses não sabe	
9.28	A dor era muito forte?	sim não não sabe	

9.29	A criança teve a barriga inchada?	sim não não sabe	 =>9.32 =>9.32
9.30	A barriga inchou rapidamente ou demorou meses?	rapidamente (dias) gradualmente (meses) não sabe	
9.31	A criança deixou de fazer as necessidades maiores?	sim não não sabe	
9.32	A criança teve algum tumor na barriga?	sim não não sabe	 =>9.34 =>9.34
9.33	Durante quanto tempo é que a criança teve o tumor na barriga?	número de dias número de meses não sabe	
9.34	A criança teve dor de cabeça?	sim não não sabe	 =>9.37 =>9.37
9.35	Durante quanto tempo é que a criança teve dor de cabeça?	número de dias número de meses não sabe	
9.36	A dor de cabeça era muito forte?	sim não não sabe	
9.37	A criança tinha dificuldade a dobrar o pescoço?	sim não não sabe	 =>9.39 =>9.39
9.38	Durante quantos dias é que a criança não conseguiu dobrar o pescoço?	número de dias não sabe	
9.39	A criança ficou inconsciente (Ex. desmaiado, sem sentidos, inanimado, em coma)?	sim não não sabe	 =>9.42 =>9.42
9.40	Durante quantos dias é que a criança esteve inconsciente?	número de dias não sabe	
9.41	A criança ficou inconsciente: subitamente, rapidamente ou lentamente?	súbito rápido (um dia) lentamente (vários dias) não sabe	
9.42	A criança teve convulsões? (esticar-se)	sim não não sabe	 =>9.44 =>9.44

9.43	Durante quanto tempo é que a criança teve convulsões?	número de dias número de meses não sabe	
9.44	A criança ficou sem mexer as pernas?	sim não não sabe	=>9.47 =>9.47
9.45	Durante quanto tempo é que a criança esteve sem mexer as pernas?	número de dias número de meses não sabe	
9.46	A criança ficou sem mexer as pernas subitamente, rapidamente ou lentamente?	súbito rápido (um dia) lentamente (vários dias) não sabe	
9.47	Houve alteração na quantidade da urina *(xixi)* da criança?	sim não não sabe	=>9.50 =>9.50
9.48	A criança urinava mais ou menos do que o normal?	mais que o normal menos que o normal não sabe	
9.49	Durante quanto tempo notou as alterações na urina (xixi) da criança?	número de dias número de meses não sabe	
9.50	A criança tinha manchas na pele antes da morte?	sim não não sabe	=>9.54 =>9.54
9.51	Durante quantos dias é que a criança teve manchas na pele antes de morrer?	número de dias não sabe	
9.52	Onde eram essas manchas?	s n ns cara tronco braços, pernas	
9.53	As manchas pareciam-se com:	s n ns sarampo borbulhas com líquido claro borbulhas com pús	
9.54	A criança tinha os olhos vermelhos?	sim não não sabe	
9.55	Notou se a criança sangrou por exemplo, pela boca, pelo nariz ou pelo ânus?	sim não não sabe	

9.56	A criança perdeu peso?	sim ☐ não ☐ não sabe ☐	 =>9.59 =>9.59
9.57	Quanto tempo antes da morte é que a criança perdeu peso?	número de dias ☐☐ número de meses ☐ não sabe ☐	
9.58	A criança estava muito magra?	sim ☐ não ☐ não sabe ☐	
9.59	A criança tinha feridas na boca ou e manchas brancas na boca ou língua?	sim ☐ não ☐ não sabe ☐	 =>9.61 =>9.61
9.60	Durante quanto tempo é que a criança teve feridas na boca e manchas brancas na boca ou língua?	número de dias ☐☐ número de meses ☐ não sabe ☐	
9.61	A criança tinha algum inchaço (*a criança inflamou em algum lado*)?	sim ☐ não ☐ não sabe ☐	 =>9.64 =>9.64
9.62	Durante quanto tempo é que a criança teve o inchaço?	número de dias ☐☐ número de meses ☐ não sabe ☐	
9.63	Onde tinha o inchaço?	s n ns cara ☐ ☐ ☐ articulações *(juntas)* ☐ ☐ ☐ pés ☐ ☐ ☐ todo corpo ☐ ☐ ☐ outro (ESPECIFICAR): _____	
9.64	Apareceu algum caroço *(ingua)* à criança ?	sim ☐ não ☐ não sabe ☐	 =>9.67 =>9.67
9.65	Durante quanto tempo é que a criança teve os caroços *(inguas)*?	número de dias ☐☐ número de meses ☐ não sabe ☐	
9.66	Onde estavam localizados os caroços *(inguas)*?	s n ns pescoço ☐ ☐ ☐ cova do braço ☐ ☐ ☐ virilha ☐ ☐ ☐ outro (ESPECIFICAR): _____	

9.67	A criança tinha os olhos amarelos?	sim não não sabe	 =>9.69 =>9.69
9.68	Durante quanto tempo é que a criança teve os olhos amarelos?	número de dias número de meses não sabe	
9.69	O cabelo da criança ficou vermelho ou amarelo?	sim não não sabe	 =>9.71 =>9.71
9.70	Durante quanto tempo é que a criança teve o cabelo vermelho ou amarelo?	número de dias número de meses não sabe	
9.71	A criança tinha as plantas dos pés ou unhas e olhos brancos? (*falta de sangue*)	sim não não sabe	 =>9.73 =>9.73
9.72	Durante quantos dias é que a criança teve plantas dos pés ou unhas e olhos brancos ?	número de dias não sabe	
9.73	A criança tinha os olhos encovados?	sim não não sabe	 =>9.75 =>9.75
9.74	Durante quantos dias é que a criança teve olhos encovados?	número de dias não sabe	
9.75	A criança fez alguma operação?	sim não não sabe	 =>9.78 =>9.78
9.76	A que parte do corpo foi operada?	s n ns barriga peito cabeça outra (ESPECIFICAR)_____	
9.77	Quanto tempo antes da morte é que a criança foi operada?	número de dias número de meses não sabe	
9.78	A mãe da criança tem boa saúde?	saudável (normal) doente morreu não sabe	=> 10.1 => 9.79 => 9.80 => 10.1
9.79	De que sofre?	_____	=> 10.1
9.80	De que morreu?	_____	

SECÇÃO 10. HISTÓRIA DE ACIDENTES (ACTUAL)			
10.1	A criança sofreu algum acidente antes de morrer?	nenhum ☐ acidente de viação ☐ atropelamento ☐ queda ☐ afogamento ☐ envenenamento ☐ queimadura ☐ violência/assalto ☐ picada/mordedura de animal ☐ Outro (ESPECIFICAR) _____	=> 11.1 => 10.3 => 10.3 => 10.3 => 10.3 => 10.3 => 10.3 => 10.3 => 10.3
10.2	Que tipo de animal?	cobra ☐ cão ☐ insecto ☐ Outro (ESPECIFICAR): _____	
10.3	O acidente foi intencionalmente provocado?	sim ☐ não ☐ não sabe ☐	
10.4	APENAS PARA CRIANÇAS COM MAIS DE 10 ANOS Pensa que pode ter sido suicídio?	sim ☐ não ☐ não sabe ☐	
SECÇÃO 11. CUIDADOS DE SAÚDE (ACTUAL)			
11.1	Quantas vezes a criança foi a uma unidade sanitária durante o último mês de vida?	número de vezes ☐☐ não sabe ☐	se 0 =>11.4
11.2	A criança fez algum tratamento prescrito pelo médico ou enfermeiro?	sim ☐ não ☐ não sabe ☐	 =>11.4 =>11.4
11.3	Que tratamentos fez?	_____	
11.4	Alguém lhe disse de que morreu a criança?	sim ☐ não ☐ não sabe ☐	 =>11.6 =>11.6
11.5	O que lhe disseram sobre a causa de morte da criança?	_____	
11.6	De que acha que morreu a sua criança?	_____	

SECÇÃO 12. REGISTOS DE SAÚDE (PEDIR SEMPRE)

Peça para ver e copiar os alguns registos constantes nos documentos da criança falecida

12.1	CARTÃO DE SAÚDE INFANTIL Transcrever os seguintes registos Vacina BCG Febre Amarela Sarampo Vacina Pólio DTP Último peso (Kg) e idade da pesagem Tipo de parto Local de parto APGAR Outros dados	data □□ □□ □□□□ data □□ □□ □□□□ data □□ □□ □□□□ número de doses □ número de doses □ _____ , _____ _____ _____ _____ _____ _____ _____	=> se tiver registos => 12.3
12.2	A criança foi vacinada? (APENAS SE NÃO TIVER REGISTOS)	s n ns BCG *(marca no braço)* □ □ □ polio *(mímica gota na boca)* □ □ □ febre amarela (9meses) □ □ □ DTP (vacina perna:2,4,6 meses) □ □ □ sarampo (9meses) □ □ □	
12.3	ANÁLISES Transcrever os registos Data da análise (dd/mm/aaaa) Gota espessa Hemoglobina Reacção de widall HIV Outros	□□ □□ □□□□ _____ _____ _____ _____ _____	
12.4	MEDICAMENTOS/RECEITAS Nome dos medicamentos (VER SE TEM RECEITA OU MEDICAMENTOS EM CASA)	1 _____ 2 _____ 3 _____ 4 _____ 5 _____ 6 _____	
12.5	CERTIFICADO DE ÓBITO Transcrever os dados do certificado de óbito Data da morte (dd/mm/aaaa) Causa de morte registada na 1ª linha (A) Causa de morte registada na 2ª linha (B) Causa de morte registada na 3ª linha (C) Outras estados mórbidos (SECÇÃO II)	□□ □□ □□□□ _____ _____ _____ _____	

AGRADEÇA AO ENTREVISTADO PELA COLABORAÇÃO

Hora de finalização (hh/mm) □□ □□

Annex XI – Verbal Autopsy Adult death questionnaire

CISA
CENTRO DE INVESTIGAÇÃO EM SAÚDE EM ANGOLA

QUESTIONÁRIO AUTÓPSIA VERBAL

Adultos

Hora de início (hh/mm) ☐☐ ☐☐

SECÇÃO 1. IDENTIFICAÇÃO

1.1	Inquérito	número ☐☐☐☐	supervisor
1.2	ID entrevistado 1	☐☐☐ ☐☐ ☐☐☐☐ ☐☐☐	supervisor
1.3	ID entrevistado 2	☐☐☐ ☐☐ ☐☐☐☐ ☐☐☐	supervisor
1.4	ID falecido	☐☐☐ ☐☐ ☐☐☐☐ ☐☐☐	supervisor

SECÇÃO 2. INFORMAÇÃO SOBRE A ENTREVISTA

2.1	Código do entrevistador	☐☐	
2.2	Data da entrevista (dd/mm/aaaa)	☐☐ ☐☐ ☐☐☐☐	
2.3	Em que tentativa:	primeira ☐ segunda terceira outra (ESPECIFICAR): _____	
2.4	Notas do entrevistador		

SECÇÃO 3. CONSENTIMENTO INFORMADO

Eu,_____ (nome do entrevistador), informei esta família sobre os objectivos deste trabalho e importância da sua participação.
Eu, _____ (nome do entrevistado) , depois de informado do presente estudo concordo com os seus objectivos e aceito participar neste trabalho.
Fui informado que:
- se pretende obter informação sobre as principais causas de morte nesta região;
- a minha participação consiste em responder a um questionário sobre a doença que conduziu à morte do meu familiar;
- a minha participação é voluntária, pelo que posso não responder a todas as questões ou desistir em qualquer momento;
- a informação que darei é totalmente confidencial e apenas será tratada pela equipa de investigação do CISA (Centro de Investigação em Saúde em Angola), não sendo mostrada a outras pessoas.

DATA: _____/_____ / _____
ASSINATURA:_____

SECÇÃO 4. IDENTIFICAÇÃO E DADOS SOCIO-DEMOGRÁFICOS DO ENTREVISTADO			
4.1	Nome	_____	
4.2	Sexo	feminino ☐ maculino ☐	
4.3	Nível de escolaridade	nenhum ☐ básico (1º-9º ano) ☐ médio (10º-13º ano) ☐ outro (ESPECIFICAR): _____ não sabe ☐	
4.4	Relação com (NOME)	esposo/esposa ☐ filho/filha ☐ pai ☐ mãe ☐ irmão/irmã ☐ avô/avó ☐ tio/tia ☐ sem relação ☐ outro (ESPECIFICAR): _____	
SECÇÃO 5. CONFIRMAÇÃO DA IDENTIFICAÇÃO E DADOS SÓCIO-DEMOGRÁFICOS DO FALECIDO			
5.1	Nome	_____	
5.2	Data de nascimento (dd/mm/aaaa)	☐☐ ☐☐ ☐☐☐☐	
5.3	Sexo do falecido	feminino ☐ masculino ☐	
5.4	Data da morte (dd/mm/aaaa)	☐☐ ☐☐ ☐☐☐☐	
5.5	Nível de escolaridade	nenhum ☐ básico (1º-9º ano) ☐ médio (10º-13º ano) ☐ outro (ESPECIFICAR): _____ não sabe ☐	
5.6	Ocupação	_____	
5.7	Estado civil	solteiro/a ☐ casado/a ☐ viúvo/a ☐ divorciado/a ☐ outro (ESPECIFICAR): _____ não sabe ☐	
5.8	Local da morte	unidade sanitária ☐ caminho unidade saúde ☐ casa ☐ => 6.1 outro (ESPECIFICAR): _____ => 6.1 não sabe ☐ => 6.1	
5.9	Nome da unidade de saúde onde (NOME) morreu	_____	
SESSÃO 6. QUESTÕES ABERTAS SOBRE A DOENÇA QUE LEVOU À MORTE			
6.1	O/A (NOME) tinha boa saúde ?		

6.2	Quando começou a ficar doente?		
6.3	O que notou no/a (NOME) durante a doença que lhe levou à morte?		

SECÇÃO 7. ANTECEDENTES PATOLÓGICOS (PASSADO)

			s	n	ns	
7.1	O/A (NOME) sofria de alguma destas doenças?	hipertensão arterial	☐	☐	☐	
		diabetes	☐	☐	☐	
		asma	☐	☐	☐	
		epilepsia	☐	☐	☐	
		malnutrição	☐	☐	☐	
		cancro	☐	☐	☐	
		tuberculose	☐	☐	☐	
		HIV/SIDA	☐	☐	☐	
		outra (ESPECIFICAR) _____	☐	☐	☐	

MULHERES ⇩ **HOMENS** ⇨ 10.01

SECÇÃO 8. CONDIÇÕES ASSOCIADAS A PROBLEMAS DE SAÚDE FEMININA (PASSADO)

8.1	A (NOME) teve algum inchaço ou ferida na mama?	sim não não sabe	☐ ☐ ☐	 => 8.3 => 8.3
8.2	Durante quanto tempo?	dias meses não sabe	☐☐ ☐☐ ☐	
8.3	A (NOME) teve períodos menstruais em que sangrou muito?	sim não não sabe	☐ ☐ ☐	 =>8.5 =>8.5
8.4	Durante quanto tempo?	número de dias número de meses não sabe	☐☐ ☐☐ ☐	
8.5	A (NOME) sangrava entre os períodos menstruais?	sim não não sabe	☐ ☐ ☐	 => 8.7 => 8.7
8.6	Durante quanto tempo?	número de dias número de meses não sabe	☐☐ ☐☐ ☐	
8.7	A (NOME) teve algum corrimento vaginal abundante?	sim não não sabe	☐ ☐ ☐	 =>9.1 =>9.1

8.8	Durante quanto tempo?	número de dias número de meses não sabe	
SECÇÃO 9. CONDIÇÕES ASSOCIADAS À GRAVIDEZ (PASSADO DA GRAVIDEZ)			
9.1	A (NOME) estava grávida quando morreu?	sim não não sabe	=> 9.6 => 9.6
9.2	Estava grávida de quantos meses?	número de meses não sabe	
9.3	Quantas vezes a (NOME) esteve grávida?	número de vezes não sabe	
9.4	Nos últimos três meses de gravidez a (NOME) teve algum problema de saúde?	s n ns hemorragia vaginal corrimento vaginal de mau cheiro cara cheia pés ou pernas inflamadas dor de cabeça visão turva (ver vultos) convulsões febre dor abdominal palidez e falta de ar outro (ESPECIFICAR)_____	
9.5	A (NOME) morreu durante o trabalho de parto, antes da expulsão fetal (do bebé nascer)?	sim não não sabe	=> 9.8
9.6	A (NOME) tinha tido parto recentemente?	sim não não sabe	=> 9.20 => 9.20
9.7	Quantos dias depois do parto é que a (NOME) morreu?	número de dias não sabe	
9.8	A (NOME) sangrou muito no dia do parto?	sim não não sabe	
9.9	A (NOME) sangrou muito durante do trabalho de parto antes da expulsão fetal (antes do bebé nascer)?	sim não não sabe	
9.10	A (NOME) sangrou muito depois da expulsão fetal (do bebé nascer)?	sim não não sabe	
9.11	Durante o parto teve dificuldade na expulsão da placenta?	sim não não sabe	
9.12	O parto foi muito prolongado (mais de 24 horas)?	sim não não sabe	
9.13	Foi um parto normal?	sim não não sabe	=> 9.15 => 9.15

9.14	Que tipo de parto foi?	forceps/ventosa ☐ cesariana ☐ outro (ESPECIFICAR)_____ não sabe ☐	
9.15	Quando é que a bolsa de águas rebentou?	antes do trabalho de parto ☐ durante o trabalho de parto ☐ não sabe ☐	9.17
9.16	Quantas horas depois da bolsa de águas ter rompido é que o bebé nasceu?	menos de 24 horas ☐ mais de 24 horas ☐ não sabe ☐	
9.17	As águas da bolsa tinham mau cheiro?	sim ☐ não ☐ não sabe ☐	
9.18	Em que local foi o parto?	casa ☐ unidade sanitária ☐ em trânsito (ESPECIFICAR)_____ outro (ESPECIFICAR)_____ não sabe ☐	
9.19	Quem assistiu (NOME) durante o parto?	médico ☐ enfermeira ☐ parteira ☐ mãe ☐ outro (ESPECIFICAR)_____ não sabe ☐	DEPOIS DESTA QUESTÃO 10.1
9.20	APENAS SE A RESPOSTA À QUESTÃO 9.6 FOR NÃO ou NÃO SABE A (NOME) teve algum aborto recentemente?	sim ☐ não ☐ não sabe ☐	=> 10.1 => 10.1
9.21	A (NOME) morreu durante o aborto?	sim ☐ não ☐ não sabe ☐	=> 9.23 => 9.23
9.22	Quantos dias antes da morte é que a (NOME) teve o aborto?	número de dias ☐☐ não sabe ☐	
9.23	De quantos meses é que a (NOME) estava grávida quando teve o aborto?	número de meses ☐ não sabe ☐	
9.24	Sangrou muito depois do aborto?	sim ☐ não ☐ não sabe ☐	
9.25	O aborto aconteceu espontaneamente, isto é sem ter sido provocado?	sim ☐ não ☐ não sabe ☐	=> 10.1 => 10.1
9.26	A (NOME) fez algum tratamento para provocar o aborto?	sim ☐ não ☐ não sabe ☐	
SECÇÃO 10. CONDIÇÕES QUE ANTECEDERAM A MORTE (ACTUAL)			
10.1	Quanto tempo o/a (NOME) esteve doente antes de morrer?	número de dias ☐☐ número de meses ☐ não sabe ☐	

10.2	O/A (NOME) teve febre?	sim ☐ não ☐ não sabe ☐	 => 10.7 => 10.7
10.3	Durante quanto tempo o/a (NOME) teve febre?	número de dias ☐☐ número de meses ☐ não sabe ☐	
10.4	A febre era contínua ou intermitente (ia e vinha)?	contínua ☐ intermitente ☐ não sabe ☐	
10.5	O/A (NOME) teve febre durante a noite?	sim ☐ não ☐ não sabe ☐	
10.6	O/A (NOME) teve arrepios?	sim ☐ não ☐ não sabe ☐	
10.7	O/A (NOME) teve tosse?	sim ☐ não ☐ não sabe ☐	 => 10.13 => 10.13
10.8	Durante quanto tempo o/a (NOME) teve tosse?	número de dias ☐☐ número de meses ☐ não sabe ☐	
10.9	O/A (NOME) teve muita tosse?	sim ☐ não ☐ não sabe ☐	
10.10	Quando tossia tinha escarro?	sim ☐ não ☐ não sabe ☐	
10.11	O/A (NOME) tossia sangue?	sim ☐ não ☐ não sabe ☐	
10.12	O/A (NOME) teve suores nocturnos (transpirava à noite)?	sim ☐ não ☐ não sabe ☐	
10.13	Durante a doença o/a (NOME) teve dificuldade a respirar (falta de ar)?	sim ☐ não ☐ não sabe ☐	 => 10.18 => 10.18
10.14	Durante quanto tempo o/a (NOME) teve dificuldade a respirar?	número de dias ☐☐ número de meses ☐ não sabe ☐	
10.15	A dificuldade em respirar impedia o/a (NOME) de fazer as tarefas do dia a dia?	sim ☐ não ☐ não sabe ☐	
10.16	O/A (NOME) tinha dificuldade a respirar quando estava deitada?	sim ☐ não ☐ não sabe ☐	
10.17	O/A (NOME) chiava quando respirava ? (DEMONSTRAR)	sim ☐ não ☐ não sabe ☐	

10.18	O/A (NOME) teve dor no peito?	sim ☐ não ☐ não sabe ☐	 => 10.28 => 10.28
10.19	Durante quanto tempo é que o/a (NOME) teve dor no peito?	número de dias ☐☐ número de meses ☐☐ não sabe ☐	
10.20	A dor no peito começou subitamente ou lentamente?	subitamente ☐ lentamente ☐ não sabe ☐	
1 021	A última vez que o/a (NOME) teve dor forte no peito, quanto tempo durou?	menos de meia hora ☐ entre meia hora e 24 horas ☐ mais de 24 horas ☐ não sabe ☐	
10.22	A dor no peito localizava-se atrás do esterno (osso grande do peito) ?	sim ☐ não ☐ não sabe ☐	
10.23	A dor localizava-se por cima do coração e ia para o braço esquerdo?	sim ☐ não ☐ não sabe ☐	
10.24	A dor localizava-se sobre as costelas?	sim ☐ não ☐ não sabe ☐	
10.25	A dor de peito era contínua ou intermitente *(ia e vinha)*?	contínua ☐ intermitente ☐ não sabe ☐	
10.26	A dor do peito piorava com a tosse?	sim ☐ não ☐ não sabe ☐	
10.27	O/A (NOME) teve palpitações (o coração batia mais forte)?	sim ☐ não ☐ não sabe ☐	
10.28	O/A (NOME) teve diarreia?	sim ☐ não ☐ não sabe ☐	 => 10.33 => 10.33
10.29	Durante quanto tempo o/a (NOME) teve diarreia?	número de dias ☐☐ número de meses ☐ não sabe ☐	
10.30	A diarreia era contínua ou intermitente?	contínua ☐ intermitente ☐ não sabe ☐	
10.31	O/A (NOME) tinha sangue nas fezes?	sim ☐ não ☐ não sabe ☐	
10.32	No dia que o/a (NOME) teve mais diarreia, quantas dejecções teve (quantas vezes obrou)?	número de vezes ☐☐ não sabe ☐	

10.33	O/A (NOME) vomitou?	sim não não sabe	 => 10.37 => 10.37
10.34	Durante quanto tempo vomitou?	número de dias número de meses não sabe	
10.35	Os vómitos pareciam borras de café ou tinham sangue ?	sim não não sabe	
10.36	Quantas vezes vomitou no dia que teve mais vómitos?	número de vezes não sabe	
	HOMENS **MULHERES SEM PARTO, SEM ABORTO, NÃO GRÁVIDAS(Ver questões 9.1; 9.;6 9.20)**	**MULHERES GRÁVIDAS, COM PARTO OU COM ABORTO HÁ MENOS DE 6 SEMANAS (Ver questões 9.1; 9.6; 9.20)**	10.46
10.37	O/A (NOME) teve dor de barriga?	sim não não sabe	 => 10.39 => 10.39
10.38	Durante quanto tempo teve dor de barriga?	número de dias número de meses não sabe	
10.39	O/A (NOME) teve a barriga inchada?	sim não não sabe	 => 10.43 => 10.43
10.40	Durante quanto tempo teve a barriga inchada ?	número de dias número de meses não sabe	
10.41	A barriga inchou rapidamente (em dias) ou lentamente (em meses)?	rapidamente (em dias) lentamente (em meses) não sabe	
10.42	O/A (NOME) deixou de fazer as necessidades maiores?	sim não não sabe	
10.43	O/A (NOME) teve algum tumor na barriga?	sim não não sabe	 => 10.46 => 10.46
10.44	Durante quanto teve esse tumor na barriga?	número de dias número de meses não sabe	
10.45	Onde se localizava esse tumor?	superior direita superior esquerdo baixo ventre toda a barriga não sabe	
10.46	O/A (NOME) teve dificuldade em engolir alimentos sólidos?	sim não não sabe	 => 10.48 => 10.48

10.47	Durante quanto tempo o/a (NOME) teve essa dificuldade?	número de dias número de meses não sabe	
10.48	O/A (NOME) teve dificuldade em engolir alimentos liquidos?	sim não não sabe	=> 10.50 => 10.50
10.49	Durante quanto tempo o/a (NOME) teve essa dificuldade ?	número de dias número de meses não sabe	
10.50	O/A (NOME) teve dor de cabeça?	sim nao não sabe	=> 10.53 => 10.53
10.51	Durante quanto tempo o/a (NOME) teve dor de cabeça?	número de dias número de meses não sabe	
10.52	A dor de cabeça era muito forte?	sim não não sabe	
10.53	O/A (NOME) teve dificuldade a dobrar o pescoço?	sim não não sabe	=> 10.55 => 10.55
10.54	Durante quantos dias é que o/a (NOME) teve dificuldade a dobrar o pescoço?	número de dias não sabe	
10.55	O/A (NOME) ficou confuso/a?	sim não não sabe	=> 10.58 => 10.58
10.56	Durante quanto tempo é que o/a (NOME) esteve confuso/a?	número de dias número de meses não sabe	
10.57	Como começou o estado de confusão mental?	subitamanente rapidamente(um dia) lentamente (vários dias) não sabe	
10.58	O/A (NOME) ficou inconsciente?	sim não não sabe	=> 10.61 => 10.61
10.59	Quanto tempo o/a (NOME) esteve inconsciente?	número de dias número de meses não sabe	
10.60	O/A (NOME) ficou inconsciente: subitamente, rapidamente (num dia) ou lentamente (em vários dias)?	subitamente rapidamente (um dia) lentamente (vários dias) não sabe	
10.61	O/A (NOME) teve convulsões? (esticar-se)	sim não não sabe	=> 10.63 => 10.63
10.62	Durante quanto tempo é que a/o (NOME) teve convulsões?	número de dias número de meses não sabe	

10.63	O/A (NOME) era incapaz de abrir boca?	sim não não sabe	 => 10.65 => 10.65
10.64	Durante quantos dias é que o/a (NOME) foi incapaz de abrir a boca?	número de dias não sabe	
10.65	O corpo do/da (NOME) ficou rígido?	sim não não sabe	 => 10.67 => 10.67
10.66	Durante quantos dias é que o/a (NOME) teve o corpo rígido?	número de dias não sabe	
10.67	O/A (NOME) teve paralisia de algum dos lados do corpo?	sim não não sabe	 => 10.70 => 10.70
10.68	Durante quanto tempo é que o/a (NOME) teve a paralisia?	número de dias número de meses não sabe	
10.69	O/A (NOME) ficou paralisada: subitamente, rapidamente (num dia) ou lentamente (em vários dias)?	subitamente rapidamente (um dia) lentamente (vários dias) não sabe	
10.70	O/A (NOME) teve paralisia das pernas?	sim não não sabe	 => 10.73 => 10.73
10.71	Durante quanto tempo é que a/o (NOME) teve a paralisia das pernas?	número de dias número de meses não sabe	
10.72	O/A (NOME) teve a paralisia das pernas: subitamente, rapidamente (num dia) ou lentamente (em vários dias)?	subitamente rapidamente (um dia) lentamente (vários dias) não sabe	
10.73	Houve alteração na cor urina (xixi) do/da (NOME)?	sim não não sabe	 => 10.75 => 10.75
10.74	Durante quanto tempo é que o/a (NOME) teve alteração na cor da urina?	número de dias número de meses não sabe	
10.75	Na fase final da doença o/a (NOME) teve sangue na urina?	sim não não sabe	 => 10.77 => 10.77
10.76	Durante quanto tempo é que o/a (NOME) teve sangue na urina?	número de dias número de meses não sabe	
10.77	Houve alguma alteração na quantidade de urina do/da (NOME)?	sim não não sabe	 => 10.80 => 10.80
10.78	Durante quanto tempo é que notou a alteração da quantidade de urina do/da (NOME)?	número de dias número de meses não sabe	

10.79	A quantidade de urina era…	muita pouca nenhuma (não urinava) não sabe	
10.80	O/A (NOME) teve manchas na pele durante a doença que levou à morte?	sim não não sabe	 => 10.84 => 10.84
10.81	Durante quantos dias é que o/a (NOME) teve manchas na pele?	número de dias não sabe	
10.82	Onde eram as manchas?	s n ns cara tronco braços e pernas outro	
10.83	Como eram essas manchas?	sarampo borbulhas com líquido claro borbulhas com pús não sabe	
10.84	O/A (NOME) teve olhos vermelhos?	sim não não sabe	
10.85	O/A (NOME) sangrou da boca, nariz ou ânus?	sim não não sabe	
10.86	O/A (NOME) teve Zona?	sim não não sabe	
10.87	O/A (NOME) perdeu peso?	sim não não sabe	 => 10.90 => 10.90
10.88	Durante quanto tempo é que o/a (NOME) perdeu peso?	número de dias número de meses não sabe	
10.89	O/A (NOME) estava muito magra?	sim não não sabe	
10.90	O/A (NOME) teve feridas na boca, e manchas brancas na boca ou língua?	sim não não sabe	 => 10.92 => 10.92
10.91	Durante quanto tempo é que o/a (NOME) teve feridas na boca e manchas brancas na boca ou língua?	número de dias número de meses não sabe	
10.92	O/A (NOME) teve alguma zona do corpo inchada?	sim não não sabe	 => 10.95 => 10.95
10.93	Durante quanto tempo é que o/a (NOME) teve o inchaço?	número de dias número de meses não sabe	

10.94	Onde tinha o inchaço?	s n ns cara ☐ ☐ ☐ cotovelo, joelho (juntas) ☐ ☐ ☐ pés ☐ ☐ ☐ todo corpo ☐ ☐ ☐ outro _____	
10.95	Apareceu alguma ingua ao/à (NOME)?	sim não ☐ não sabe ☐	 => 10.98 => 10.98
10.96	Durante quanto tempo é que o/a (NOME) teve as inguas?	número de dias ☐☐ número de meses ☐ não sabe ☐	
10.97	Onde estavam localizadas as inguas?	s n ns pescoço ☐ ☐ ☐ cova do braço ☐ ☐ ☐ virilha ☐ ☐ ☐ outro _____	
10.98	O/A (NOME) teve os olhos amarelos?	sim não ☐ não sabe ☐	 => 10.100 => 10.100
10.99	Durante quanto tempo é que o/a (NOME) teve os olhos amarelos?	número de dias ☐☐ número de meses ☐ não sabe ☐	
10 100	O/A (NOME) tinha as plantas dos pés ou unhas e olhos brancos?	sim não ☐ não sabe ☐	 => 10.102 => 10.102
10 101	Durante quantos dias é que o/a (NOME) teve plantas dos pés, unhas ou olhos brancos?	número de dias ☐☐ não sabe ☐	
10 102	O/A (NOME) tinha úlceras, abcessos ou feridas no corpo?	sim não ☐ não sabe ☐	 => 11.1 => 11.1
10 103	Durante quantos dias é que o/a (NOME) teve úlceras, abcessos ou feridas no corpo?	número de dias ☐☐ não sabe ☐	
10 104	Onde se localizavam essas úlceras, abcessos ou feridas ?	_____	
SECÇÃO 11. HISTÓRIA DE ACIDENTES (ACTUAL)			
11.1	O/A (NOME) sofreu algum acidente antes de morrer?	nenhum ☐ acidente de viação ☐ atropelamento ☐ queda ☐ afogamento ☐ envenenamento ☐ queimadura ☐ violência/assalto ☐ picada/mordedura de animal ☐	=> 12.1 => 11.3 => 11.3 => 11.3 => 11.3 => 11.3 => 11.3 => 11.3
11.2	Que tipo de animal?	cobra ☐ cão ☐ insecto ☐ outro (ESPECIFICAR)_____	
11.3	Foi intencional?	sim ☐ não ☐ não sabe ☐	

11.4	Pensa que pode ter sido suicídio?	sim não não sabe	
SECÇÃO 12. CUIDADOS DE SAÚDE (ACTUAL)			
12.1	Quantas vezes o/a (NOME) foi a um hospital (unidade de saúde) durante o último mês de vida?	número de vezes não sabe	se 0 =>12.4
12.2	O/A (NOME) fez algum tipo de tratamento prescrito pelo médico ou pelo enfermeiro?	sim não não sabe	=>12.4 =>12.4
12.3	Que tratamentos fez?	_____	
12.4	O/A (NOME) fez alguma operação?	sim não não sabe	=>12.7 =>12.7
12.5	A que parte do corpo foi operado/a?	s n ns barriga peito cabeça Outra _____	
12.6	Quanto tempo antes da morte é que o/a (NOME) foi operada?	número de dias número de meses não sabe	
12.7	**SÓ PARA MULHERES GRÁVIDAS, COM PARTO OU ABORTO HÁ MENOS DE 6 SEMANAS (VERIFICAR AS QUESTÕES 9.1; 9.6; 9.20)** Quantas consultas de vigilância da gravidez a (NOME) fez?	nenhuma número de consultas não sabe	
12.8	Alguém lhe disse de que morreu (NOME)?	sim não não sabe	=>12.10 =>12.10
12.9	O que lhe disseram sobre a causa de morte do/da (NOME)?	_____	
12.10	De que acha que morreu o/a (NOME)?	_____	
SECÇÃO 13. REGISTOS DE SAÚDE			
13.1	ANÁLISES Transcrever os registos Gota espessa Hemoglobina Reacção de widall HIV Outros	_____ _____ _____ _____ _____	
13.2	MEDICAMENTOS/RECEITAS Nome dos medicamentos (VER SE TEM RECEITA OU MEDICAMENTOS EM CASA)	1 _____ 2 _____ 3 _____ 4 _____	
13.3	CERTIFICADO DE ÓBITO Data da morte Causa de morte registada na 1ª linha Causa de morte registada na 2ª linha Causa de morte registada na 3ª linha Causa de morte registada na 4ª linha Outras doenças (seccção B do certificado)	(Transcrever os dados do certificado de óbito) _____ _____ _____ _____ _____	
AGRADEÇA AO ENTREVISTADO PELA COLABORAÇÃO			
		Hora de finalização (hh/mm)	

Annex XII – Model of In-migration registration form

FICHA DE REGISTO DE NOVOS MEMBROS

Data da entrevista ☐☐ ☐☐ ☐☐☐☐ **Inquiridor** ☐☐

LOCALIZAÇÃO (casa para onde entrou) ☐☐☐ ☐☐ ☐☐☐☐ ☐☐☐

DADOS DO NOVO MEMBRO

Nome: _____ **Sexo** ☐

Nome de casa: .....

Data de nascimento ☐☐ ☐☐ ☐☐☐☐ **Aproximada** ☐ **Relação c/ chefe** ☐

Documento ☐ **Tipo Doc** ☐☐ **Num Doc** ☐☐☐☐☐☐☐☐☐☐☐☐☐☐

Telefone ☐☐☐☐☐☐☐☐☐

Localização do pai ☐☐☐ ☐☐ ☐☐☐☐ ☐☐☐

Localização da mãe ☐☐☐ ☐☐ ☐☐☐☐ ☐☐☐

Localização do/a esposo/a ☐☐☐ ☐☐ ☐☐☐☐ ☐☐☐

Sabe ler e escrever

S	N	NS	NA
1	2	8	9

Está a frequentar a escola?

S	N	NS	NA
1	2	8	9

Número de anos de escolaridade completos

Ensino não superior	☐☐
Ensino superior	☐☐
Não sabe	☐☐
Não se aplica	☐☐

Naturalidade (indique o código)

Município da província do Bengo	☐☐
Outra província de Angola	☐☐
Outro país, qual?	
Não sabe	☐☐

Data da Mudança ☐☐ ☐☐ ☐☐☐☐

RESIDÊNCIA DE ORIGEM

PERGUNTE: De que bairro veio? O bairro é da província do Bengo? Do município de Dande? Pertence a qual comuna?

CONSULTE: A lista de bairros e decida se o bairro de origem está ou não dentro da área de estudo.

A residência de onde veio pertence à área de estudo? Sim ☐ Não ☐ NS / NR ☐

Se SIM, registe: **Nome de bairro** ..... **Código** ☐☐☐

Nome do chefe de família .....

Nomes de outros membros do AF .....

Por que razão se mudou para esta casa?

1	Por motivos de maioridade / independência (sair de casa dos pais)
2	Por motivos familiares (exemplo: casamento, filhos que se juntam aos pais, etc.)
3	Por motivos de trabalho (exemplo: novo emprego)
4	Para estudar
5	Por causa das condições da casa (exemplo: casa mais barata, casa maior, a família cresceu)
6	Por motivos de óbito na família
7	Para trabalhar na lavra - PERGUNTAR: tem outra casa? onde e quanto tempo vai ficar na residência em que está a entrar?
77	Outros motivos. Quais:
88	Não sabe / Não responde

O NOVO MEMBRO JÁ ESTÁ REGISTADO? Sim ☐ Não ☐
(Buscar na base de dados)

SE SIM, ESCREVA A ID PERMANENTE: ☐☐☐ ☐☐ ☐☐☐☐ ☐☐☐

Relação com o chefe

1 - Chefe do agregado
2 - Esposa do chefe
3 - Filho / Filha
4 - Genro / nora
5 - Neto / neta
6 - Pai / mãe (biológico)
7 - Sogro / sogra
8 - Irmão / irmã
9 - Enteado / sobrinho / adoptado
10 - Outro

Naturalidade (Municípios da prov. do Bengo)

1 - Ambriz
2 - Dande
3 - Bula - Atumba
4 - Dembos
5 - Nambuangongo
6 - Pango - Aluquém

Províncias de Angola

7- Benguela
8 - Bié
9 - Cabinda
10 - Kuando - Kubango
11 - Kwanza Norte
12 - Kwanza Sul
13 - Cunene
14 - Huambo
15 - Huíla
16 - Luanda
17 - Lunda - Norte
18 - Lunda - Sul
19 - Malange
20 - Moxico
21 - Namibe
22 - Uíge
23 - Zaire

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Annex XIII – Model of Out-migration registration form

SVD - FICHA DE EMIGRAÇÃO [SAÍDA]

Data da entrevista ☐☐ ☐☐ ☐☐☐☐

Inquiridor ☐☐

LOCALIZAÇÃO: Bairro ☐☐☐ Sector ☐☐ Casa ☐☐☐☐ Membro ☐☐☐

Nome: _____

Copie do livro de ronda

Data de saída ☐☐ ☐☐ ☐☐☐☐

RESIDÊNCIA PARA ONDE SE MUDOU

PERGUNTE: Para que bairro se mudou? O bairro é da província do Bengo? Do município de Dande? Pertence a qual comuna?

CONSULTE: A lista de bairros e decida se o bairro de origem está ou não dentro da área de estudo.

A residência para onde mudou pertence à área de estudo? Sim ☐ Não ☐ NS / NR ☐

Se SIM, registe: **Nome de bairro** ..... **Código** ☐☐☐

Nome do chefe de família .....

Nomes de outros membros do AF para onde entrou .....

Por que razão saiu desta casa?

1	Por motivos de maioridade / independência (sair de casa dos pais)
2	Por motivos familiares (exemplo: casamento, filhos que se juntam aos pais, etc.)
3	Por motivos de trabalho (exemplo: novo emprego)
4	Para estudar
5	Por causa das condições da casa (exemplo: casa mais barata, casa maior, a família cresceu)
6	Por motivos de óbito na família
7	Para trabalhar na lavra - PERGUNTAR: tem outra casa? onde e quanto tempo vai ficar na residência em que está a entrar?
77	Outros motivos. Quais:
88	Não sabe / Não responde

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SVD - FICHA DE EMIGRAÇÃO [SAÍDA]

Data da entrevista ☐☐ ☐☐ ☐☐☐☐

Inquiridor ☐☐

LOCALIZAÇÃO: Bairro ☐☐☐ Sector ☐☐ Casa ☐☐☐☐ Membro ☐☐☐

Nome: _____

Copie do livro de ronda

Data de saída ☐☐ ☐☐ ☐☐☐☐

RESIDÊNCIA PARA ONDE SE MUDOU

PERGUNTE: Para que bairro se mudou? O bairro é da província do Bengo? Do município de Dande? Pertence a qual comuna?

CONSULTE: A lista de bairros e decida se o bairro de origem está ou não dentro da área de estudo.

A residência para onde mudou pertence à área de estudo? Sim ☐ Não ☐ NS / NR ☐

Se SIM, registe: **Nome de bairro** ..... **Código** ☐☐☐

Nome do chefe de família .....

Nomes de outros membros do AF para onde entrou .....

Por que razão saiu desta casa?

1	Por motivos de maioridade / independência (sair de casa dos pais)
2	Por motivos familiares (exemplo: casamento, filhos que se juntam aos pais, etc.)
3	Por motivos de trabalho (exemplo: novo emprego)
4	Para estudar
5	Por causa das condições da casa (exemplo: casa mais barata, casa maior, a família cresceu)
6	Por motivos de óbito na família
7	Para trabalhar na lavra - PERGUNTAR: tem outra casa? onde e quanto tempo vai ficar na residência em que está a entrar?
77	Outros motivos. Quais:
88	Não sabe / Não responde

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Annex XIV – HDSS and VAS activities - photos

Figure 44 – Using the GPS for houses location

Source: HDSS fieldwork (Photo taken by Edite Rosário)

Figure 45 – Georeferentiation of households

Source: HDSS fieldwork (Photo taken by Edite Rosário)

Figure 46 - HDSS household interviews

HDSS fieldwork (Photo taken by Diogo Francisco)

Figure 47 – HDSS household interviews

Source: HDSS fieldwork (Photo taken by Edite Rosário)

Figure 48 - VAS interview

Source: HDSS fieldwork (Photo taken by Edite Rosário)

Figure 49 – HDSS household interviews

HDSS fieldwork (Photo taken by Eduardo Saraiva)

***Figure 50* – Meetings with community informants**

Source: HDSS fieldwork (Photo taken by Edite Rosário)

Figure 51 – Meetings with community informants

HDSS fieldwork (Photo taken by Raquel Pereira)

Figure 52 – Meetings with traditional midwives

HDSS fieldwork (Photo taken by Francisco Politano)

Figure 53 – Meetings with local administration

Source: HDSS fieldwork (Photo taken by Edite Rosário)

Figure 54 – Meetings with health professionals

Source: HDSS fieldwork (Photo taken by Edite Rosário)

Figure 55 – Weekly HDSS team meeting

HDSS fieldwork (Photo taken by Diogo Francisco)

Figure 56 – Training sessions

Source: HDSS fieldwork (Photo taken by Edite Rosário)

Figure 57 – Training sessions (role-play exercises)

HDSS fieldwork (Photo taken by Edite Rosário)

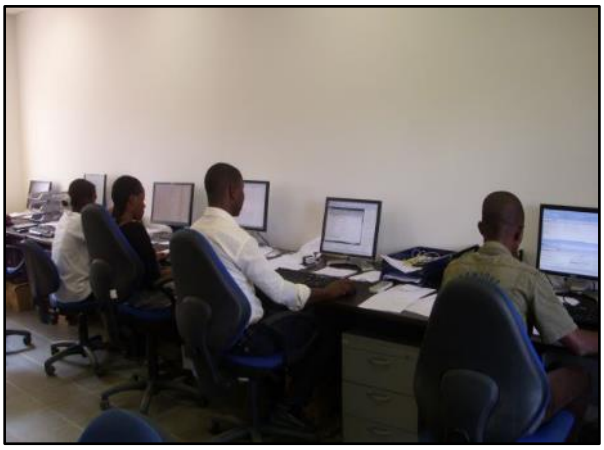

Figure 58 – Data clerks

HDSS fieldwork (Photo taken by Maria Berhan)

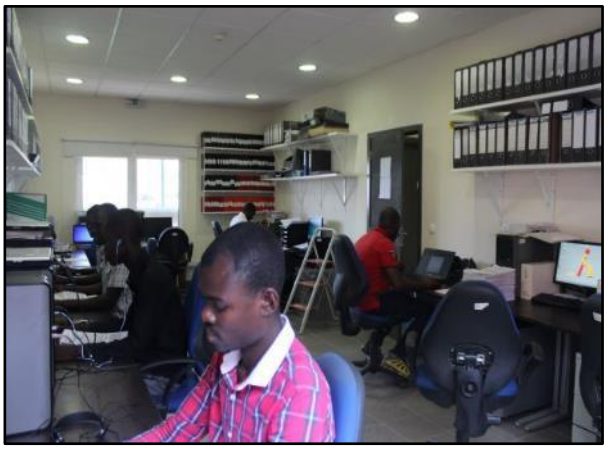

Figure 59 – Data clerks

Source: HDSS fieldwork (Photo taken by Edite Rosário)

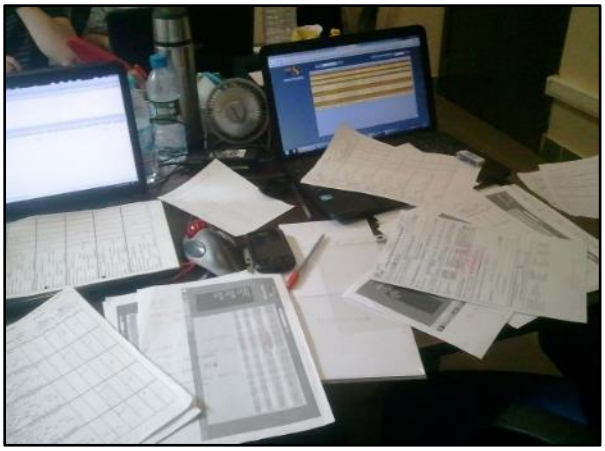

Figure 60 – Data cleaning

HDSS fieldwork (Photo taken by Eduardo Saraiva)

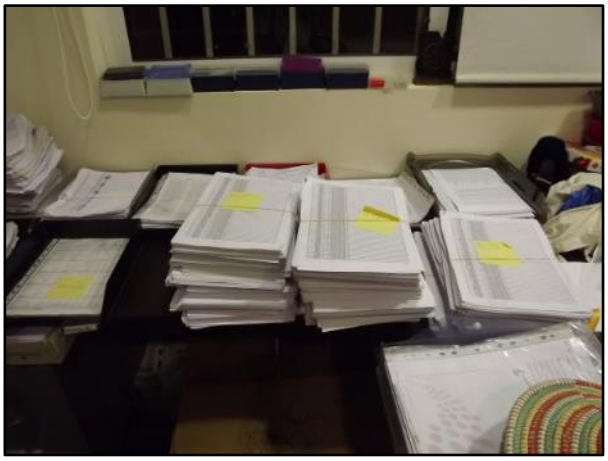

Figure 61 – Data cleaning

HDSS fieldwork (Photo taken by Edite Rosário)

Figure 62 – HDSS field Team 2015

Figure 63 – HDSS field Team 2010

Figure 64 – HDSS Database team-

Annex XV – Comparisons between data provided by the Dande HDSS and other HDSS sites

Table 14 – Comparisons between data provided by the Dande HDSS and other HDSS sites

HDSS site	Dande			Manhiça	Navrongo	Taabo	Rufiji
Country	Angola			Mozambique	Ghana	Cote d'Ivoire	Tanzania
Indicators / Year	2010	2011	2012	2010	2011	2012	2012
Total resident population	63,081	62.000	60.807	89,617	153,293	42,480	103,503
Inhabited households	15,767	15,129	14,582	20,354	33,600	6,707	19,315
Male: female ratio	97: 100	95: 100	98: 100	79: 100	92: 100	104: 100	93: 100
Life expectancy at birth (males) (years)	59.70	62.6	63.3	43.0	56.4	61	63
Life expectancy at birth (females) (years)	70.9	71.2	70.4	54.5	67.0	65	69
Crude birth rate / 1,000 persons year	40.4	65.5	32.2	42.3	25.0	33.9	29.2
Crude death rate / 1,000 persons year	9.1	8.2	7.3	15.3	10.0	8.2	8.0
Total fertility rate (children per women 15-49 years old)	4.8	4.8	4.5	5.5	3.8	4.8	4.6
Neonatal mortality / per 1,000 live births	7.1	10.8	6.2	21.6	13.4	14.5	24.4
Infant mortality rate / per 1,000 live births	52.5	45.9	35.2	58.8	32.1	43.1	36.0
Under-5 mortality rate / per 1,000 live births	92.1	90.6	63.3	100.6	608	92.0	61.4

Source: Dande HDSS database / Paper I. Manhiça HDSS: (200, 256). Navrongo HDSS: (201). Taabo HDSS: (202). Rufiji HDSS: (203)

Annex XVI – Comparisons between data provided by the Dande HDSS and national sources

Table 15 - Comparisons between data provided by the Dande HDSS and national sources

	DANDE		ANGOLA			BENGO
	Dande HDSS		Country level			Regional level
Indicators / Year	2010	2014	2010	2014	2015	2014
Male: female ratio	97: 100	91: 100	-	94: 100	-	100: 100
Life expectancy at birth (both sexes) (years)	65.1	63.8	-	60.3	-	-
Crude birth rate / 1,000 persons year	40.4	24.2	45.5	36.1	43.4	-
Crude death rate / 1,000 persons year	9.1	8.5	-	9.1	-	-
Total fertility rate (children per women 15-49 years old)	4.8	3.7	6.3	5.7	6.2	-
Neonatal mortality / per 1,000 live births	7.1	4.8	23	-	20	10.3**
Infant mortality rate / per 1,000 live births	52.5	25.6	50	-	44	-
Under-5 mortality rate / per 1,000 live births	92.1	60.1	91	-	68	-
Population aged 0-14 years (percentage)	42.7	43.4	-	47.3	-	45,8
Population aged 15-64 years (percentage)	53.8	52.8	-	50.3	-	50,7
Population aged 65 years or more (percentage)	3.5	3.8	-	2.4	-	3,6
Average population age	22.4	23.4	-	20.6	-	22.1
The median age of the population	18	18	-	16	-	17
The average number of residents per household	3.8	4.4	-	4.6	-	4.1
Households composed of singular persons (percentage)	19	18	-	12	-	18
Number of rooms per house	2.3	2.7	-	2.7	-	2.7

Source: DANDE: Dande HDSS database / Paper I. ANGOLA: 2010 (140); 2014 (115); 2015 (116). BENGO: (198) **(208). Note:| - | = Data not available