Maternal and child health in a rural area of northern Angola: epidemiology of malaria, schistosomiasis, geohelminths, anaemia and malnutrition in a demographic surveillance area

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Abstract

Background: Malaria and neglected tropical diseases (NTDs) are linked to maternal and child morbidity and mortality in sub-Saharan Africa. Identifying areas of transmission is the first step for the implementation of successful and cost-effective integrated control initiatives.

Principal Findings:

- Malnutrition was common among children (23.3% for wasting and 32.2% for stunting), and anaemia was found to be a severe public health problem (i.e., >40%) .
- Malaria prevalence among preschool children was 20.2%, 19.8% among school-aged children and 7.2% among mothers.
- Mcro-haematuria prevalence levels reached 10.0% of preschool children, 16.6% of school-aged children and 21.7% of mothers.
- STH infections were common, affecting 22.3% of preschool children, 31.6% of school-aged children and 28.0% of mothers.

Conclusions:

- Associations between the studied infections and levels of anaemia and malnutrition justify the implementation of integrated interventions for malaria and NTDs.
- The use of a DSS can help set-up and maintain an integrated epidemiological initiative in a poorly described region.
- Improving the understanding of disease distributions can greatly enhance performance of the government initiatives that are in place.

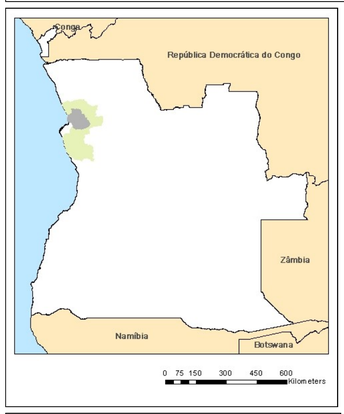


Fig. 1—Localization of CISA Project´s DSS in Angola: Caxito, Mabubas and Úcua Communes, Dande Municipality, Bengo Province; a largely rural area 60 km north of the capital Luanda.

Context

In 2007 the CISA project (*Health Research Centre in Angola*,), was established as a result of a partnership between the Angolan Ministry of Health, the Bengo Provincial Government, the Portuguese Institute for Development Support and the Calouste Gulbenkian Foundation.

CISA's first venture was to start a Demographic Surveillance System (DSS) in Northern Angola monitoring over 60,000 people.

The DSS provides reliable information for the calculation of demographic indicators and facilitates the implementation of epidemiological studies.

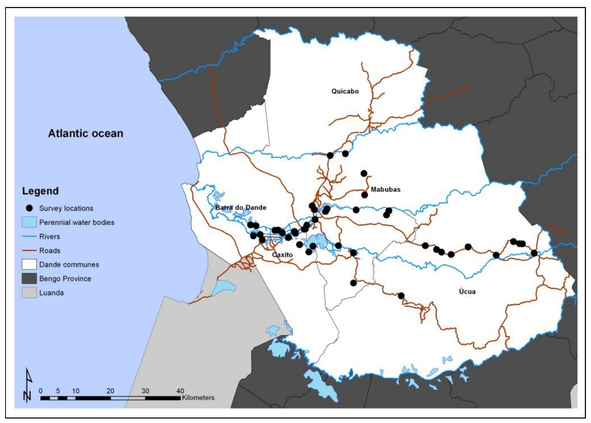
Here we report on how one can build from the DSS strengths to design and implement an integrated malaria and NTD survey.

Aims

The aim of this community based random sampling cross sectional study was to determine the prevalence levels of (and associated variables for) malaria, schistosomiasis (urinary and intestinal), STHs, anaemia and malnutrition among pre-school (0-5 years old), school-aged (6–15 year old) children and their mothers or caregivers in rural and peri-urban areas in Dande Municipality (Bengo Province, Northern Angola) using the CISA DSS as the design and implementation platform.

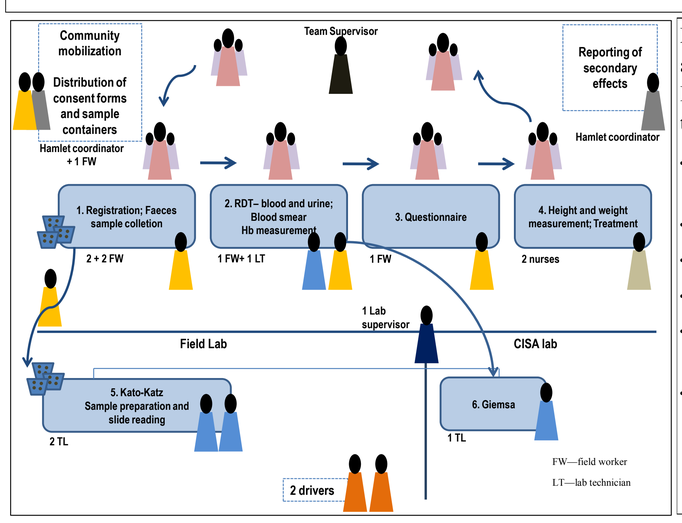
Methods

The DSS and Study area Fig. 2 – Map showing the location of the selected hamlets within the DSS area . CISA´s DSS has 60,075 registered inhabitants in 15,643 households distributed in 69 hamlets.



Sample size calculation and sample selection

- sample size based on estimates of infection prevalence levels according to national surveys (21% for schistosomiasis and 35% for STH), leading to a sample size of 2835
- Each commune divided in 3 regions of equal area, and from each subdivision 3 hamlets were initially randomly selected (total of 27hamlets, 9 per commune)
- From each hamlet randomly selection of 35 HH form the DSS list of eligible HH (at least one caregiver and 2 children); leading to 105 people/hamlet, 945/commune, total of 2835
- To compensate for smaller hamlets with less than 35 eligible HH, up to 50 HH were selected in the larger hamlets; and additional hamlets were included in Mabubas and Úcua.
- Final sample: 9 hamlets in Caxito, 17 in Mabubas and 10 in Úcua (36 total), representing 972 HH, 960 mothers and 2379 children (1-15 year old)



Measurements and Parasitological techniques

- Informed consent
- RDTs
- Kato Katz
- Giemsa (lab)
- Height, weight, MUAC
- Treatment, referral, IPTp, LLINs

Fig 3—General overview of field work, which took place between May and August 2010

Fig 4—Lab technicians and field workers performing rapid diagnostic tests

Results

Malnutrition:

- 23.3% of children between 6 months and 10 years were underweight
- chronic malnutrition (stunting) was found in 32.2% of the population between 6 months and 20 years

Anthropometric measure	Value	Total No. (%)	Total CI_{95} (%)
Weight-for-age	<-3 Z-score	143 (7.6)	6.5-8.9
	<-2 Z-score	437 (23.3)	21.4-25.2
Height-for-age	<-3 Z-score	267 (11.0)	9.8-12.3
	<-2 Z-score	781 (32.2)	30.3-34.1
Weight-for-height	<-3 Z-score	32 (3.1)	2.1-4.3
	<-2 Z-score	104 (9.9)	8.2-11.9
BMI-for-age	<-3 Z-score	70 (2.9)	2.3-3.6
	<-2 Z-score	258 (10.7)	9.5-12.0
MUAC-for-age	<-3 Z-score	4 (0.4)	0.1-1.1
	<-2 Z-score	23 (2.6)	1.6-3.8
MUAC	<134 mm	52 (5.8)	4.4-7.5
	<125 mm	8 (0.9)	0.4-1.7

Table 1 – Prevalence of individuals (stratified by gender) with -2 Z-scores or lower (malnutrition) and -3 Z-scores or lower (severe malnutrition) relating to each of the anthropometric measurements taken in the field: weight-for-age Z-scores (914 boys and 965 girls aged 6 to 120 months); height-for-age Z-scores (1148 boys and 1278 girls aged 6 to 240 months); weight-for-height Z-scores (501 boys and 545 girls aged 6 to 60 months); BMI-for-age Z-scores (1145 boys and 1276 girls aged 6 to 240 months); and MUAC-to-age Z-scores (441 boys and 457 girls aged 6-60 months). SD stands for standard deviation, BMI stands for body mass index and MUAC stands for mid-upper arm circumference. Note that percentage of children with Z-scores of <-3 are a subset of children with value <-2, not a separate group.

Anemia: prevalence in under 5s reaching 56.9% and not less than 40% in any of the age groups (table 2).

	N	Mean Hb (SD) in g/L	Prevalence in % (and CI_{95}) of anaemia*
Children (0.5–5 years)	1203	105.4 (15.5)	**56.9 (54.0–59.7)**
Girls	619	106.8 (14.5)	51.5 (47.5–55.5)
Boys	584	104.0 (16.1)	62.5 (58.4–66.4)
Children (6–12 years)	946	116.2 (14.1)	41.5 (38.4–44.8)
Girls	464	115.9 (14.3)	41.6 (37.1–46.2)
Boys	482	116.4 (14.0)	41.5 (37.1–46.0)
Teenagers (13–15 years)	169	121.5 (13.3)	43.8 (36.2–51.6)
Girls	108	121.6 (11.4)	43.5 (34.0–53.4)
Boys	61	121.2 (16.2)	44.3 (31.5–57.6)
Women (pregnant)	131	110.1 (14.5)	44.3 (35.6–53.2)
Women (non-pregnant)	805	120.4 (14.5)	44.5 (41.0–48.0)

Table 2 – Anaemia (and mean haemoglobin concentrations) in the studied population (stratified by age and gender) from the three communes of the Bengo Province, Northern Angola.

SD = standard deviation; CI_{95} = 95% confidence intervals; * anaemia was classified according to age, according to WHO guidelines

Malaria: prevalence in children was 18.4/18.2%, and 9.6% in women (Table 3); parasitemia was higher in pre-school aged children.

32.8% of pregnant women were doing IPTp, net coverage was 25.1% (with usage of 52.8% in preschool children, 38.1% in school-aged children and 55.1% in mothers).

Schistosomiasis: prevalence of micro-heamaturia was 10.0% in preschool children, 16.6% in school-aged children and 21.7% in mothers .

STHs: 22.6% (CI_{95} 20.2–25.2%) of preschool children, 31.6% (CI_{95} 28.9–34.5%) of school-aged children and 28.0% (CI_{95} 25.0–31.1%) of mothers were diagnosed with least one STH . 3.8% (CI_{95} 2.7–5.1%) of preschool-aged children, 5.9% (CI_{95} 4.6–7.5) of school-aged children and 5.6% (CI_{95} 4.2–7.3%) of mothers were diagnosed with two or more STH infections . Individual infections see table 3.

Table 3– Prevalence (and CI_{95}) of infections malaria and neglected tropical diseases. Infection intensities were categorized according to WHO guidelines. Children were divided into two groups: preschool children (0-5 years of age) and school-aged children (6-15 years of age).

	Preschool–aged children	School–aged children	Mothers
No. of individuals recruited	1237	1142	960
Malaria (Giemsa-stained microscopy)	18.4 (16.2–20.6)	18.2 (16.0–20.6)	9.6 (7.8–11.6)
Light parasitaemia 1–499 parasites/μL of blood	50.2 (43.5–56.9)	70.2 (63.5–76.3)	81.5 (72.0–88.9)
Moderate parasitaemia 500–1,999 n/μL of blood	20.7 (15.6–26.6)	19.7 (14.5–25.8)	10.9 (5.3–19.0)
Heavy parasitaemia 2,000–9,999 n/μL of blood	19.8 (14.8–25.6)	6.7 (3.7–11.0)	4.3 (1.1–10.8)
Very heavy parasitaemia >10,000 n/μL of blood	9.3 (5.8–13.8)	3.4 (1.4–6.8)	3.3 (0.7–9.2)
Geometric mean of positives (CI_{95}) in n/μL of blood	649.9 (648.6–651.1)	309 (307.7–310.2)	194.4 (193.1–195.7)
Micro-haematuria (proxy for urinary schistosomiasis)	10.0 (8.2–11.9)	16.6 (14.5–18.9)	21.7 (19.1–24.4)
Ascaris lumbricoides:	15.3 (13.2–17.6)	17.3 (15.1–19.7)	10.7 (8.7–12.9)
Light parasitaemia 1–4,999 epg	9.4 (7.7–11.2)	10.5 (8.7–12.5)	7.7 (6.1–9.7)
Moderate to heavy parasitaemia ≥5,000 epg	5.9 (4.6–7.5)	6.8 (5.4–8.5)	3.0 (1.9–4.3)
Geometric mean (CI_{95}) in epg	2.20 (1.02–3.38)	2.75 (1.55–3.95)	1.09 (0.00–2.25)
Trichuris trichiura:	7.2 (5.8–8.9)	13.9 (11.8–16.1)	9.7 (7.8–11.8)
Light parasitaemia 1–999 epg	7.1 (5.7–8.8)	13.4 (11.4–15.6)	9.6 (7.7–11.7)
Moderate to heavy parasitaemia ≥1,000 epg	0.1 (0.0–0.5)	0.5 (0.2–1.1)	0.1 (0.0–0.6)
Geometric mean (CI_{95}) in epg	0.37 (0.00–1.45)	0.90 (0.00–2.01)	0.52 (0.00–1.61)
Hookworms (Kato–Katz)	4.2 (3.1–5.6)	6.7 (5.3–8.4)	13.7 (11.5–16.1)
Light parasitaemia 1–1,999 epg	3.9 (2.8–5.2)	6.5 (5.1–8.1)	13.1 (10.9–15.5)
Moderate to heavy parasitaemia ≥2,000 epg	0.4 (0.1–0.9)	0.3 (0.1–0.8)	0.6 (0.2–1.3)
Geometric mean (CI_{95}) in epg	0.24 (0.00–1.31)	0.42 (0.00–1.51)	1.02 (0.00–2.15)
Other intestinal parasites (Kato–Katz)			
Enterobius vermicularis	0.3 (0.1–0.8)	0.2 (0.0–0.7)	0.1 (0.0–0.6)
Hymenolepsis nana	6.2 (4.9–7.8)	7.3 (5.8–9.0)	1.9 (1.1–3.1)
Taenia spp.	0.1 (0.0–0.5)	0.2 (0.0–0.7)	0.1 (0.0–0.6)

Table 4 - Model-fitting for anaemia (1913 children >2 years of age), malaria as diagnosed by microscopy (2309 children and 878 mothers) and urinary schistosomiasis (2094 children and 894 mothers) in Northern Angola, controlling for random-effects at the hamlet level.

Condition	Demographic group	Response variable	Baseline	Factor	Odds ratio (and CI_{95})	*P-value*
Anaemia *	Children	Gender	Boy	Girl	0.82 (0.68–0.98)	0.032
		Age (continuous)		+1 year	0.92 (0.90–0.95)	<0.00001
		Malaria (microscopy	Negative	Positive	1.79 (1.37–2.32)	<0.00001
		Urinary schistosomiasis (Hematix®)	Negative	Positive	1.30 (0.97–1.75)	0.078
Malaria	Children	Gender	Boy	Girl	0.82 (0.66–1.03)	0.082
		Age (continuous)		+1 year	1.01 (0.98–1.04)	0.61
		Mother knows malaria?	No	Yes	0.63 (0.47–0.85)	0.002
	Mothers	Age		+1 year	0.96 (0.94–0.98)	<0.001
		Pregnant	No	Yes	0.46 (0.24–0.90)	0.023
		History of previous treatment	No	Yes	0.60 (0.40–0.92)	0.02
S. haematobium	Children	Gender	Boy	Girl	0.99 (0.74–1.34)	0.97
		Age		+1 year	1.12 (1.07–1.16)	<0.00001
		Self-reported blood in urine?	No	Yes	4.72 (3.32–6.70)	<0.00001
		Child bathes in river?	No	Yes	1.75 (1.06–2.91)	0.03
		Child bathes in dam?	No	Yes	20.23 (1.30–314.9)	0.032
	Mothers	Age		+1 year	0.99 (0.97–1.01)	0.2
		Self-reported blood in urine?	No	Yes	2.57 (1.63–4.05)	<0.001
		Menstruating?	No	Yes	7.63 (4.49–12.98)	<0.00001
		Pregnant?	No	Yes	0.56 (0.32–1.00)	0.049
		Self-reported water contact	Less frequently	Daily	2.08 (1.22–3.53)	0.007

Statistical associations (table 4):

Anemia: Associated with gender, age, malaria and micro-haematuria

Malaria: in children, knowledge of mothers decreases risk; in mothers, older age, being pregnant and having been treated for malaria in the past decrease the risk of infection

Schistosomiasis: increased age, bathing at the dam or river increase risk of infection in children. In mothers, frequent contact with water bodies increases the likelihood of infection.

Table 5 - Model-fitting for STH infections in general (2085 children), as well as more specifically for *Ascaris lumbricoides* (2093 children and 830 mothers), *Trichuris trichiura* (2139 children and 844 mothers) and Hookworms (2110 children and 843 mothers) in Northern Angola, controlling for random-effects at the hamlet level.

Condition	Demographic group	Response variable	Baseline	Factor	Odds ratio (and CI_{95})	*P-value*
STH infections*	Children	Age		+1 year	1.08 (1.06–1.11)	<0.00001
		Gender	Boy	Girl	0.90 (0.74–1.10)	0.313
		Self-reported worms in stool?	No	Yes	1.45 (1.17–1.80)	<0.001
		Self-reported tummy pain?	No	Yes	1.29 (0.96–1.74)	0.095
A. lumbricoides	Children	Age		+1 year	1.01 (0.98–1.05)	0.448
		Gender	Boy	Girl	0.97 (0.76–1.24)	0.82
		Self-reported worms in stool?	No	Yes	1.63 (1.27–2.09)	<0.001
		Hookworms infection status	Negative	Positive	1.97 (1.22–3.16)	0.005
		T. trichiura infection status	Negative	Positive	2.45 (1.74–3.44)	<0.00001
	Mothers	Age		+1 year	0.97 (0.94–0.99)	0.002
		Self-reported eczema in past?	Negative	Positive	3.06 (1.36–6.88)	0.007
		Hookworms infection status	Negative	Positive	1.85 (1.06–3.22)	0.031
		T. trichiura infection status	Negative	Positive	3.02 (1.73–5.27)	<0.001
T. trichiura	Children	Age		+1 year	1.11 (1.07–1.15)	<0.00001
		Gender	Boy	Girl	0.92 (0.70–1.20)	0.525
		Hookworms infection status	Negative	Positive	1.84 (1.12–3.00)	0.016
		A. lumbricoides infection status	Negative	Positive	2.43 (1.75–3.37)	<0.00001
	Mothers	Age		+1 year	0.99 (0.97–1.01)	0.26
		A. lumbricoides infection status	Negative	Positive	3.27 (1.89–5.66)	<0.00001
Hookworms	Children	Age		+1 year	1.12 (1.07–1.17)	<0.00001
		Gender	Boy	Girl	0.73 (0.51–1.04)	0.08
		Mother knows about STHs	No	Yes	0.57 (0.35–0.92)	0.023
		T. trichiura infection status	Negative	Positive	1.93 (1.21–3.10)	0.006
		A. lumbricoides infection status	Negative	Positive	2.07 (1.33–3.23)	0.001
	Mothers	Age		+1 year	1.01 (0.99–1.03)	0.34
		Goes to school?	No	Yes	0.44 (0.23–0.83)	0.011
		A. lumbricoides infection status	Negative	Positive	1.89 (1.07–3.35)	0.028

STHs: in children, having seen worms in the past , regular abdominal pain, older age, are risk factors for infection. Infection with one parasite increases the risk of infection for other parasites., in children and mothers.

Discussion

- Planning of the survey took advantage of a DSS, which can also be valuable to follow up the population after an intervention
- Anemia and malnutrition were widespread and linked to the infections studied here
- Malaria, schistosomiasis, and STH are all present in the DSS study area, making the case for an integrated approach for the control of these diseases
- Further studies should investigate geographical variation in the prevalence of the infections and associated mordities investigated here

Ethical Approval: The study protocol was approved by the Angolan Ministry of Health Ethics Committee.

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