The burden of lymphatic filariasis in Africa for 2000, 2020 and 2025

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Global lymphatic filariasis endemicity

- *Wuchereria bancrofti*
- *Brugia malayi*
- *Brugia timori*

Hoeraf et al. CMI 2011
Objectives

- To estimate the burden of lymphatic filariasis in Africa for 2000, 2020, 2025, in terms of:
  - Number of cases with clinical manifestations:
    - Lymphoedema/elephantiasis
    - Hydrocele
  - Disability-adjusted life years (DALYs)
Methodology

Step 1 • Develop methods to **standardise mf prevalence** measured with different diagnostic tests

Step 2 • Quantify the **pre-control association between mf and disease prevalence**

Step 3 • Use existing maps of mf prevalence in Africa and the associations under 2) to **estimate pre-control disease prevalence**

Step 4 • **Project trends in disease prevalence** since start of MDA
Step 1. Standardise mf prevalence

- Literature review: identify studies comparing mf prevalence measured by TBS-20μL and another diagnostic technique
Step 1. Standardise mf prevalence (cnt’d)

Vinkeles Melchers et al.
Submitted Lancet ID 2019

Reference technique | Diagnostic techniques
--- | ---
TBS (20 µL) | Knott’s (1 mL)
TBS (20 µL) | TBS (≥40 µL)
TBS (≥20 - ≤60 µL) | CCT (≥20 µL)
TBS (20 µL) | MFT (1 mL)
Step 2. Association between mf and morbidity

- Systematic literature review to identify papers presenting estimates of mf and disease prevalence at population level, by age and sex
- Morbidity outcomes of interest: lymphoedema/elephantiasis, hydrocele
- Data extracted from 153 papers (out of 3,212 hits)
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- Plot pre-control prevalence of standardised mf infection vs morbidity to identify key influential variables (age, sex, parasite species, geographical region)
  - Age standardisation of mf and morbidity prevalence to UN Population Division data of Africa

- Associations between infection and morbidity prevalence, described by non-linear functional relationship of infection x and morbidity y:
  \[ y = \frac{a + b \times x^c}{1 + b \times x^c} \]  
  (vd Werf et al. 2002, schisto)
Step 2. Association: mf and morbidity in Africa

**Lymphoedema**

![Graph showing the prevalence of lymphoedema against age-standardised community mf prevalence (all ages) standardised to TBS 20 uL blood (%).]

**Hydrocele**

![Graph showing the prevalence of hydrocele against age-standardised community mf prevalence (all ages) standardised to TBS 20 uL blood (%).]
Step 3. Estimate pre-control disease prevalence

- Existing maps of infection prevalence (Moraga et al 2015, Parasites & Vectors, recently updated by Cano et al.)
- Apply association between infection and morbidity prevalence for Africa on pixel-level mf prevalence
  ➔ Estimate pre-control number of people with morbidity by pixel
- Population estimates by pixel

Fig. Pixel-level map of mf infection

Moraga et al 2015, Parasites & Vectors
Step 3. Estimate pre-control disease prevalence

Lymphoedema / elephantiasis

Hydrocele

Estimated prevalence
Lymphoedema (%)
- Non-endemic (0%)
- >0 - 1.4
- 1.5 - 1.9
- 2.0 - 2.4
- 2.5 - 3.9
- >=4.0

Estimated prevalence
Hydrocele (%)
- Non-endemic (0%)
- >0 - 7.3
- 7.4 - 8.5
- 8.6 - 10.5
- 10.6 - 14.1
- >=14.2
Step 4. Project trends in disease prevalence and burden

- Projected estimates of numbers of cases and disease prevalence based on:
  - Geostatistical map of pre-control mf prevalence (pixel-level estimates), overlaid with a raster for borders of MDA implementation units (IU)
  - Statistical model for the pre-control association between community-level mf prevalence and overall prevalence of morbidity
  - ESPEN data on history of MDA (<2019)
  - A cohort model for changes in morbidity prevalence by age and sex over time (De Vlas et al. PLoS NTDs 10 (2) 2016), based on the following assumptions:
    - Stable equilibrium before start MDA (<2000)
    - Morbidity incidence linearly declines to zero during the entire duration of a MDA campaign
    - Zero excess mortality due to symptoms
### Number of diseased cases

<table>
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<tr>
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<th>Number of individuals (x1000) (% of total population at risk)</th>
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<tbody>
<tr>
<td></td>
<td>2000</td>
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<tr>
<td><strong>Total pop. at risk</strong></td>
<td>303,033</td>
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<td><strong>Lymphoedema / elephantiasis</strong></td>
<td>4,499 (1.5%)</td>
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<td>[3,499 – 5,621]</td>
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<tr>
<td><strong>Hydrocele</strong></td>
<td>12,207 (4.0%)</td>
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<td>[9,326 – 15,168]</td>
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Total DALYs lost per country for 2025

- Nigeria
- DRC
- Tanzania
- Madagascar
- Côte d’Ivoire
- Mozambique
- South Sudan
- Burkina Faso
- Mali
- Cameroon
- Angola
- Ghana
- Uganda
- Zambia
- Niger
- Malawi
- Zimbabwe
- Senegal
- Guinea
- Sierra Leone
- Ethiopia
- CAR
- Kenya
- Benin
- Chad
- Liberia
- Guinea-Bissau
- Eq. Guinea
- Congo
- Togo
- Gabon
- Sao Tome and Principe
- Eritrea
Conclusion and implications

Case estimate:

- Cases remaining with any clinical manifestation due to LF in Africa by 2025: >22 million cases
  - Hydrocele (74%)
  - Lymphoedema/elephantiasis (26%)

Burden estimate:

- Predicted total disease burden due to LF in Africa by 2025: 2.2 million DALYs lost
  - Pre-control DALYs lost (1.7 million) are of same order of magnitude as GBD (1.6 million)

- Between 2000 – 2020 an increase in DALYs lost due to LF. Since 2020, a slight reduction (~6%) in total DALYs thanks to MDA alone.
- 16.3 million men with hydrocele requiring surgery (2025).
- 5.9 million people with any stage of lymphoedema / elephantiasis requiring morbidity management to prevent progression and episodes of adenolymphangitis (incl. antibiotics).
- Most cases in Nigeria (~29%), DRC (~9%), and Tanzania (~7%): all under MDA or surveillance
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