Estimation of mortality in South Africa: Challenges and methods

Rob Dorrington
Centre for Actuarial Research (CARe), University of Cape Town, South Africa
Range of life tables

• **National & sub-national** (urban/rural, regional, etc.) (vital registration (VR) & census data)

• **Insured** (Claims and ‘inforce’ data – company-specific or industry-wide)
  – Type of product, Underwriting class

• **Retired** (Notification of death/VR and ‘inforce’ data – company-specific or industry-wide)
  – Voluntary annuitant, Pensioner, Size

• **Employed** (Group scheme insurance claim and ‘inforce’ data – large employers or insurers, etc.)
  – ‘class’/income/occupation
Cohort vs period: $45q_{15}$ South African females
Life expectancy at birth
Both sexes, 2016

Life expectancy (years)

- <50.0
- 50.0–59.9
- 60.0–69.9
- 70.0–79.9
- 80.0–87.0

Source: World Health Statistics 2016, WHO
Note: WHO Member States with a population of less than 90,000 in 2015 were not included in the analysis.

The boundaries and names shown and the designations used on this map do not imply the expression of any opinion whatsoever on the part of the World Health Organization concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. Dotted and dashed lines on maps represent approximate border lines for which there may not yet be full agreement.

Data Source: World Health Organization
Map Production: Information Evidence and Research (IER)
World Health Organization

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% Death registration completeness

WHO - FAMILY OF INTERNATIONAL CLASSIFICATIONS NETWORK
ANNUAL MEETING 2018
Report from the Regional Advisor

2017: MCCoD adopted
2018: First COD data submission
2018: First COD data submission; COD national curriculum
2016: First vital Statistics report; data submission
2017: First Cause of Death Report
2017: First CoD data submission, CHAMP/CRVS
2015: First Mortality trend report

2017: IDSR(Event Surveillance)/HMIS/DHIS2 integration
2017: Health Ministry launch national system tracking real-time death statistics
2015: First ICD10 national workshop
2015: ICD10 in Insurance
2015 first national ICD10 training
2018: eDeath notification, First VS and COD/ICD11 report
2017: Mortality and CoD Trend Report

2016: First mortality statistics report
Methods of estimating mortality when little or no VR data

• Model life tables (if indicator of level)
• Sets of tables:
  – Princeton (Coale & Demeny (1966));
  – Brass logit relational model
    \[ \hat{\lambda}(l(x)) = \alpha + \beta \cdot \lambda(l^s(x)) \]
    • Brass General Standard & Brass African Standard
  – Variations (e.g. Ewbank et al (1983), Zaba (1979), Murray et al (2003), Bhat (2004))
  – UN Model life tables for developing countries (1982);
  – INDEPTH Network (2002);
  – Sharrow, Clark & Raftery (2014);
  – others
Methods of estimating mortality when little or no VR data

• Deriving estimates of indicators of level (if not ‘shape’)
  – Indirect estimation
    • Child
      – Full birth/pregnancy histories (FBHs) (from surveys, e.g., DHSs)
      – Summary birth histories (SBHs) (censuses/surveys)
    • Adult
      – Orphanhood – asking respondents about survival status of parents
      – Sibling – asking respondents about the survival status (and date of birth and death (if died)) of siblings who survived to age 15
  – Direct estimation
    • Question in census/survey about deaths in households in past year
Other methods of estimating mortality when little or no VR data

- Delphi technique (IIASA)
  - Not the focus of the population projections
- Regressions with ‘ensemble’ modelling (IHME)
  - Complex and opaque process
  - Not exactly country-specific for African countries
Methods of estimating mortality when less than complete VR data

• Death distribution methods (generalized growth balance or synthetic extinct generations)

• Essentially estimating the completeness of reporting by comparing the recorded deaths in a period to the number of deaths implied by change in population numbers over period
  – Generalized growth balance (Hill (1987))
    \[ n(x) = r(x +) - d + b \cdot d'(x +) \text{ with } d = \ln(k_1/k_2)/t \text{ & } b = (k_1k_2)^{0.5}/c \]

  – Synthetic extinct generations (Bennett & Horiuchi (1981, 1984))
    \[ \left[ \int_y^\infty D(x,t) \exp \left[ - \int_y^x r(a,t) da \right] dx = N(y,t) \right] \]
Particular problems with reported death data in developing countries

- Incomplete or very limited registration of deaths (particularly at older ages – if proportion rural high at old ages)
- Cause of death (% unknown, misclassification, vagueness of classification)
- Limited and inaccurate other information (e.g. place of residence, employment/SEC, etc.)
- Heterogeneity (ethnicity/race, insured/uninsured, urban/rural, employed/unemployed) more extreme?
Problems with rates at old ages

• Old ages – age exaggeration, higher under-reporting, particularly deaths reported by households in censuses

• Problems at old ages dealt with by:
  – Model life table
  – Models of the force/hazard of mortality at old ages (e.g. Gompertz, various logistic curves, Kannisto, etc.)
  – Li & Gerland (to correct for constant proportional age exaggeration) and Ron Richman NEG-GAM (year of birth & age digit preference)
Other problems with the data

• Exposure
  – Census – coverage/completeness (e.g. SA PES undercount 1996, 2001 & 2011, ‘demographic undercount’)
  – Age exaggeration, digit preference

• Direct measures
  – Deaths reported by households
    • Disintegration of households on deaths of older adults/breadwinner
  – HDSSs
    • not representative (select site(s), mostly rural, bias due to monitoring)

• Unknown/underestimated uncertainty
Performance of indirect measures

**Females**

- TRUE
- 1996
- 2001
- 2007
- 2011
- 2 surveys
- HH deaths
- Sibling

**Males**

- TRUE
- 1996
- 2001
- 2007
- 2011
- 2 surveys
- HH deaths
- Sibling
Insurance-specific life tables
Problems producing industry-specific life tables in Africa

- Small insured population, particularly at the old ages
- Limited aggregation of data
- Possibly increasing heterogeneity with the shrinking of the previously privileged population in some countries
- No organised monitoring of mortality of employed (by ‘class’) vs unemployed
- Lack of country-specific skills (at least of ‘volunteers’)

South Africa: national

• South African Life Tables (SALTs): For 3 population (ethnic/race) groups (excluding Africans): centred around censuses 1946-1985 (some groups even earlier)

• Registered deaths
  – Completeness (adults): risen from circa 50% in mid-1980s to circa 90% for adults in since 2005
  – Causes: About 10% ill-defined cause, some misclassification (e.g. AIDS), injuries of ‘undetermined intent’

• Other data:
  – DHSs
  – HDSSs
  – SBH, orphanhood
‘Age-ratios’ in 2011 census and VR data

- Black – years of birth ending in “0”
- Red – 1914, 1918 years of birth
Various estimates of $e_0$
Underestimation of uncertainty

RMS2017  GBD2013  GBD2015  GBD2016  GBD2017

Years

South Africa: industry/profession

• Standard life tables:
  – Annuitants: SAIML98 & SAIFL98 (Dorrington & Tootla (2007))

• No new standards, but a number of CSI reports
  – Funeral insurance mortality investigation, 2001 – 2002

• Mortality of employed (members of group insurance schemes) (Clur et al (2013) & Schrieck et al (2013))
Male assured 2003-2013
Female assured 2003-2013
Pensioner mortality 2005-2010
Other sources of demographic estimates of mortality of countries


• Institute of Health Metrics and Evaluation: Global Burden of Disease (GBD) 2017: National and global regions (includes ‘provincial’ for a number of countries) (http://ghdx.healthdata.org/gbd-results-tool)

• US Census Bureau International Database (https://www.census.gov/programs-surveys/international-programs/about/idb.html)

• Latin America Human Mortality Database (http://www.lamortalidad.org/)
Final thoughts

• Data on mortality still extremely limited in many African countries
• Some signs of improvement in building/maintaining CRVS systems

BUT

• Also signs of weakening of systems and local skills in some countries
• The requirements of MDGs and particularly SDGs, and the production of estimates by international agencies undermine the development of skills locally
• Uncertainty about the estimates is often underestimated