Burden of infectious disease studies in Europe and the United Kingdom: a review of methodological design choices

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Disability-adjusted life years (DALYs) are a summary measure of the impact of mortality and morbidity

- Years of Life Lost (YLL) measures the frequency and age upon which death occurs
- Years Lived with Disability (YLD) measures the frequency and severity of disease

The DALY metric allows comparisons of (heterogeneous) causes of disease across subgroups of population and over time

Interpretation of DALY estimates in burden of disease studies requires detailed methodological knowledge
Data input, processing, and burden of disease calculations

**YLL**

\[ \text{YLL} = \sum \text{Number of deaths} \times \text{Remaining life expectancy} \]

1. Age-and-sex cause-specific mortality counts
2. Identification of ill-defined deaths
3. Redistribution of ill-defined deaths
4. Final mortality estimates
5. Choice of life table

**YLD**

\[ \text{YLD} = \sum \text{Number of cases} \times \text{Duration of illness} \times \text{Disability Weight} \]

6. Counting number of incident or prevalent cases
7. Applying disease duration and disease severity
8. Applying disability weights
9. (Applying time-discounting and age-weighting)
10. Dealing with uncertainties in estimates

**DALY**

\[ \text{DALY} = \text{YLL} + \text{YLD} \]
To date, there have been three large-scale multi-country studies using DALYs to estimate the burden of infectious diseases

- Burden of Communicable Diseases in Europe (BCoDE)
- Global Burden of Disease (GBD)
- Global Burden of Food-borne Diseases (FERG)

These studies have used different methodological approaches

- Differences in design choices may affect the comparability and interpretation of DALYs resulting from infectious diseases

Many countries and public health agencies have adopted the DALY metric for monitoring population health and identifying priorities in preventive efforts
Aims

- In which countries have independent burden of infectious disease studies been performed?
- For which infectious diseases have independent burden of infectious disease studies been performed?
- Which methodological design choices have been used to estimate YLL and YLD in these independent burden of infectious studies?
Methods

- **Systematic (literature) review approach**
- Multiple international databases, search engines, platforms, and grey literature sources

- Studies estimating the burden of infectious diseases in terms of **YLL, YLD, and/or DALY** utilizing their own national or sub-national data

- Studies in which the **infection** was defined as an **illness** due to a pathogen arising through transmission from an **infected individual**, or from an **infected animal**, or from other **pathways**

- Studies estimating the disease burden attributable to environmental stressors and/or risk factors were excluded
Methods

- Data synthesis
  - Year of publication
  - Single-country vs. multi-country
  - COVID-19; Food- and water-borne disease; Respiratory infections; Sexually transmitted infections; Healthcare-associated infections; Zoonotic diseases; Vaccine-preventable diseases; and Other

- Vaccine-preventable disease

  A vaccine-preventable disease refers to an infection/disease for which an effective preventive vaccine exists
Results

- 105 burden of infectious disease studies were included
  - 22 multi-country and 83 single-country studies

Results

- 11 studies have estimated the burden of vaccine-preventable diseases only
  - The Netherlands (n=7)
  - Germany (n=1)
  - Slovenia (n=1)
  - Spain (n=1)
  - Multi-country level (n=1)

- Influenza, tick-borne encephalitis, measles, hepatitis B, pertussis, invasive pneumococcal diseases, herpes zoster
  - most frequently studied vaccine-preventable diseases
Results

**YLL**

\[ YLL = \sum \text{Number of deaths} \times \text{Remaining life expectancy} \]

1. Age-and-sex cause-specific mortality counts
2. Identification of ill-defined deaths
3. Redistribution of ill-defined deaths
4. Final mortality estimates
5. Choice of life table

- 63% of the included studies estimated **YLL** using *aspirational* model life tables (e.g., GBD 2019)

- Some studies **did not report** on the YLL methods used
Results

\[ \text{YLD} = \sum \text{Number of cases} \times \text{Duration of illness} \times \text{Disability Weight} \]

- **Incidence-based YLD calculations:** 97% applied a pathogen-based approach

- **48%** of the included studies used **GBD disability weights**
- **26%** of the included studies used **European disability weights**

- Some studies *did not report* on the YLD methods used

6 Counting number of incident or prevalent cases

7 Applying disease duration and disease severity

8 Applying disability weights
Discussion

- For some European countries, such as France, Greece, Belarus, Croatia, and Cyprus we identified a very low number or no burden of infectious disease studies at all.

- Food- and water-borne diseases were the most frequently studied infectious diseases.

- Few studies have estimated the burden of vaccine-preventable disease among (young) adults.
  - Inequalities in vaccine coverage by geography and/or socio-economic status may contribute to the (high) burden of vaccine-preventable diseases.

- Understanding the impact of vaccine-preventable diseases is important for developing policies to support a life-course immunization programmes.
Discussion

- Development and use of guidelines will promote performing burden of infectious disease studies and facilitate transparency and comparability of the results

- Reporting guidelines for burden of (infectious) disease studies will serve as an educational tool for better understanding the complexity of DALY methods
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