Global Estimates of Meningococcal Meningitis Case Fatality Ratios by Region for Children and Adults

Adena Greenbaum, MD MPH1,2; Maria Deloria-Knoll1; Cristina García1; Brian Wahl1; and Katherine L. O’Brien1

1Division of Infectious Diseases, Johns Hopkins School of Medicine, Baltimore, MD, USA
2International Vaccine Access Center, The Johns Hopkins Bloomberg School of Public Health (JHSPH), Baltimore, MD, USA

BACKGROUND

Neisseria menigitidis — a significant cause of bacterial meningitis
- can be severe and often fatal
- has the potential to cause epidemics, affecting large numbers of people
- Age-stratified global disease burden estimates exist for Ne meningitidis

METHODS

- Systematically searched 10 publication databases to identify studies conducted 1960–2019 reporting CFRs for meningococcal meningitis
- Obtained data from national surveillance reports from: Australia, Canada, New Zealand, South Africa, Bulgaria, France, United States, and several European countries
- Abstracted cases, deaths, CFR, and demographic and epidemiologic data

OBJECTIVE

- Evaluate meningococcal meningitidis CFRs by country, region, and mortality strata

RESULTS

- CFRs are mutually exclusive. Number of studies or country may not sum to total if different age groups are available.
- We developed a model to estimate meningococcal deaths using incidence rates and CFRs calculated by dividing number of meningococcal meningitis cases that died by total number of confirmed meningococcal meningitis cases
- Global estimates calculated using meta-analysis of cross-sectional data from studies conducted 1980–2019

Global estimates of CFR (Figure 3)

- CFRs generally increase with rising population mortality rate for adults and are highest in the high mortality settings where incidence is likely also highest
- CFRs are higher among adults than children
- Many studies have small sample size, contributing to large uncertainty around point estimates
- Complete ascertainment of deaths in some studies is unclear, which would lead to an underestimate of CFR

CONCLUSIONS

- Meningococcal meningitis CFRs varied widely by age, region, and mortality strata, and are higher in Africa, Latin America, and Asia than in other regions
- CFRs are higher among adults than children
- Global estimates of CFR range from 3 to 28 in children and 1 to 32 in adults in the meningitis belt
- CFRs tend to be lower during epidemics in the meningitis belt compared to endemic periods
- CFRs generally increase with rising population mortality rate for adults

LIMITATIONS

- Many studies have small sample size, contributing to large uncertainty around point estimates
- Quality of studies and surveillance systems to detect deaths vary worldwide
- Large quantity of data is not stratified by age
- Complete ascertainment of deaths is some studies is unclear, which would lead to underestimation of CFR

REFERENCES AND NOTES


2Includes studies screened for other meningococcal episodes (meningococcal, etc.)

Figure 1. Global estimates of meningococcal meningitis Case fatality ratios by region and overall mortality rate (n=18, worst CFR). The region included is based on the best available incidence data

Table 1. Number of studies and countries with case fatality ratio (CFR) data by United Nations region and age

<table>
<thead>
<tr>
<th>Region</th>
<th>CFR by region</th>
<th>CFR by overall mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Africa Meningitis Belt</td>
<td>1.1 (0.7, 1.9)</td>
<td>3.1 (1.1, 10.1)</td>
</tr>
<tr>
<td>Africa Non Meningitis Belt</td>
<td>1.1 (0.7, 1.9)</td>
<td>1.8 (0.9, 3.5)</td>
</tr>
<tr>
<td>Asia</td>
<td>1.1 (0.7, 1.9)</td>
<td>1.8 (0.9, 3.5)</td>
</tr>
<tr>
<td>Europe</td>
<td>1.1 (0.7, 1.9)</td>
<td>1.8 (0.9, 3.5)</td>
</tr>
<tr>
<td>Latin America &amp; Caribbean</td>
<td>1.1 (0.7, 1.9)</td>
<td>1.8 (0.9, 3.5)</td>
</tr>
<tr>
<td>North America</td>
<td>1.1 (0.7, 1.9)</td>
<td>1.8 (0.9, 3.5)</td>
</tr>
</tbody>
</table>

Table 2. Number of studies and countries with meningococcal meningitis CFR data by United Nations region and age

<table>
<thead>
<tr>
<th>Region</th>
<th>CFR by region</th>
<th>CFR by overall mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Africa Meningitis Belt</td>
<td>1.1 (0.7, 1.9)</td>
<td>3.1 (1.1, 10.1)</td>
</tr>
<tr>
<td>Africa Non Meningitis Belt</td>
<td>1.1 (0.7, 1.9)</td>
<td>1.8 (0.9, 3.5)</td>
</tr>
<tr>
<td>Asia</td>
<td>1.1 (0.7, 1.9)</td>
<td>1.8 (0.9, 3.5)</td>
</tr>
<tr>
<td>Europe</td>
<td>1.1 (0.7, 1.9)</td>
<td>1.8 (0.9, 3.5)</td>
</tr>
<tr>
<td>Latin America &amp; Caribbean</td>
<td>1.1 (0.7, 1.9)</td>
<td>1.8 (0.9, 3.5)</td>
</tr>
<tr>
<td>North America</td>
<td>1.1 (0.7, 1.9)</td>
<td>1.8 (0.9, 3.5)</td>
</tr>
</tbody>
</table>

Figure 2. Case fatality ratios (95% Confidence Intervals) in studies with data in specified age group by region

A. Children under 5 years of age

B. Adults 20–64 years of age

Figure 3. Global estimates of case fatality ratios (CFR) by region and overall mortality rate

CANADA MONGOLIA JHSPH:
NIAID
NOTICE: This document is not the final document and is subject to change. Please use the final document for the most up-to-date information.

Baltimore, MD 21205
agreenbaum@jhu.edu