COVID-19 pandemic and demographic research questions in Africa

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1. Describe what is known about COVID-19 in Africa, 6 months after onset
2. Describe heterogeneity in incidence (cases/population)
3. Relate heterogeneity with known demographic and economic factors
4. Source of data:
   - WHO, daily reports
   - International databases
Uncertainty about data

5 majors steps / Reporting statistics may be far away from true infections
African countries reporting cases
(first = Egypt, 15/02; by 17/05 = all 56 countries and territories)
Dynamics of the epidemic:
Notified cases in Africa

Exponential increase from April 12 to July 12, slower thereafter
Incidence per population in the world

Huge heterogeneity across continents: 1 to 13 to America; 14 to 1 to China. Closest to Africa is the Indian sub-continent.
Estimates of $R_0$ in Africa
(net reproduction rate ~ 1.35 before mid-July)

Ro stable around 1.35 from April 12 to July 12 / marked reduction thereafter
Prospects for reduced incidence / end of first phase?
Heterogeneity in cumulated incidence: large regions in Africa

Range = 1 to 21
Heterogeneity in incidence: countries in Northern Africa

Range = 1 to 6.5
Heterogeneity in incidence: countries in Western Africa

Range = 1 to 30
Heterogeneity in incidence: countries in Central Africa

Range = 1 to 106
Heterogeneity in incidence:
countries in Eastern Africa

Range = 1 to 637
Heterogeneity in incidence: countries in Southern Africa

Range = 1 to 110

- South Africa: 9841 cases per million population
- Eswatini: 3228 cases per million population
- Namibia: 1538 cases per million population
- Botswana: 516 cases per million population
- Lesotho: 422 cases per million population
- Zimbabwe: 348 cases per million population
- Mozambique: 89 cases per million population
Heterogeneity in incidence:
African islands

Cases per million population

0 10000 20000 30000 40000 50000 60000 70000 80000 90000 100000 110000 120000 130000 140000

Mayotte  Cabo Verde  São Tomé and Príncipe  Seychelles  Réunion  Madagascar  Comoros  Mauritius

Range = 1 to 42
Conclusions on incidence in Africa

- All African countries infected by May 2020
- Huge differences among countries in cumulated incidence by August 2020
- Min = 9 per million (Tanzania)
- Max = 11433 per million (Mayotte)
- Range = 1342 to 1

Questions:
- What is due to true dynamics of the infection?
- What is due to testing and reporting?
Correlates of incidence in Africa

• If data were reliable, there should be correlations with other variables, as expected:
  – Demographic correlates:
    • population density, urbanization → higher incidence
    • age structure, fertility, mortality ?
  – Economic correlates:
    • higher income → more moves, more interactions, less isolation
      → higher incidence
  – Public health correlates:
    • health personnel: more physicians → more testing, higher incidence
    • but also lower case-fatality
Correlation of incidence with population density

Inhabitants per km²

Incidence per million population

- < 40: 706
- 40-79: 1730
- 80-199: 1074
- 200-399: 1063
- 400+: 2477
Correlation of incidence with urbanization

- Incidence per million population

<table>
<thead>
<tr>
<th>Percent urban</th>
<th>Incidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 20%</td>
<td>142</td>
</tr>
<tr>
<td>20-35%</td>
<td>482</td>
</tr>
<tr>
<td>35-49%</td>
<td>1213</td>
</tr>
<tr>
<td>50-64%</td>
<td>2168</td>
</tr>
<tr>
<td>&gt; 65%</td>
<td>2389</td>
</tr>
</tbody>
</table>
Correlation of incidence with income per capita (GDP-PPP)

<table>
<thead>
<tr>
<th>Income per capita (GDP-PPP in 2011 $)</th>
<th>Incidence per million population</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 2000</td>
<td>274</td>
</tr>
<tr>
<td>2000-3999</td>
<td>1080</td>
</tr>
<tr>
<td>4000-7999</td>
<td>1582</td>
</tr>
<tr>
<td>8000-19999</td>
<td>3616</td>
</tr>
<tr>
<td>&gt; 20000</td>
<td>1774</td>
</tr>
</tbody>
</table>
Correlation of incidence with air traffic

Incidence per million population vs. Passengers per 1000 population

- < 10: 179
- 10-19: 504
- 20-99: 624
- 100-999: 2277
- > 1000: 3913
Correlation of incidence with age structure of population

Incidence per million population

Mean age of population (years)

- 20-21: 175
- 22-23: 735
- 24-25: 2370
- 26-29: 3807
- 30-39: 809

The graph shows a significant increase in incidence rates as the mean age of the population increases, particularly between the ages of 26-29 years.
## Multivariate analysis of incidence (country differences)

<table>
<thead>
<tr>
<th>Variable</th>
<th>B coeff.</th>
<th>St. Error</th>
<th>P-value</th>
<th>Signif</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>-3035.5</td>
<td>2244.0</td>
<td>0.182</td>
<td></td>
</tr>
<tr>
<td>Population density</td>
<td>4.373</td>
<td>1.797</td>
<td>0.018</td>
<td>**</td>
</tr>
<tr>
<td>Percent urban</td>
<td>4249.7</td>
<td>1904.9</td>
<td>0.030</td>
<td>**</td>
</tr>
<tr>
<td>Log(GDP)</td>
<td>763.3</td>
<td>380.4</td>
<td>0.050</td>
<td>*</td>
</tr>
<tr>
<td>Mean age</td>
<td>-173.1</td>
<td>101.3</td>
<td>0.093</td>
<td>*</td>
</tr>
</tbody>
</table>
Conclusion on correlations

• Correlations with demography and development
  – With population density, urbanization
  – With income per capita, air traffic
  – Stable in multivariate analysis, no other factor significant
  – Relation with age structure changes in multivariate analysis: younger populations have higher incidence

• Then, many reasons why incidence may be lower in Africa than elsewhere, and similar to Indian sub-continent
Towards further research

• Many opportunities for research
  – Biologists / Virologists /
  – Vaccines & Medicines
  – Epidemiologists
  – Economists
  – Social sciences
  – And… Demographers

• Population based research
  – Main determinants of country differences seem to be demographic
Towards demographic research on Covid-19

• When will the epidemic calm down; trends in $R_0$?
• Why are differences between countries so huge?
• Why is Covid-19 inversely related to the demographic transition (fertility & mortality)?
• Why is Covid-19 inversely related to economic development (GDP)?
• What is the role of the youth (< age 20) in the dynamics of transmission?
• Are sex-differences in Africa the same as in Europe?
• What will be the impact of disease control policies?
A difficult question

• We have seen many negative impacts of the management of the Covid-19 pandemic on
  – Health: Morbidity, Mortality, Reproductive health, Prevention, Treatments, Health services, Health personnel, Violence, etc.
  – Economics: Growth, Unemployment, Poverty, etc.
  – Other sectors: Education, Nutrition, Households, etc.

• Q: Will policies to control Covid-19, in particular lockdown and travel restrictions, have more deleterious effects than the disease itself?
  – How do we address this difficult question?
Concluding remarks

• Still at the beginning of the epidemics in August 2020 (3 to 6 months since first cases)
• The huge differences in incidence are due to a variety of factors, many of them are demographic factors
• Case fatality is still low in Africa, but this may change in the future
• We should not forget the problems in testing and reporting cases and deaths in Africa,
How long will last the new fashion? …