Climate Change and Health

Climate change and the spread of the Zika virus, along with its health impacts in the city of Rio de Janeiro, Brazil

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Climate change and health

Source: adapted from WHO, 2016
Vector-borne diseases

Direct impact

- i.e. change of environment creating a more or less suitable habitat for the vector
- i.e. life cycle and behavior of vector and pathogen

Indirect impact

- Creating a more or less suitable habitat for the vector
- Influence on human behavior like water storage, garbage collection, population movement
- i.e. life cycle and behavior of vector and pathogen
Vector-borne diseases

Complex interaction of various influencing factors...

Climate factors
- humidity
- rainfall
- temperature
- extreme events
- water storage
- housing quality
- population

Non-climate factors
- urbanization
- population density
- access to health care
- population immunity

...can promote or inhibit the spread and spatial distribution of vector-borne diseases.
Vector-borne diseases

Originally circulating in rainforest environments, mostly infecting monkeys...

- Neurological and congenital complications
- Mild disease, 80% without symptomatic transmission

Transmission: mosquito-bite/blood, semen, placenta

Main vector: *Aedes spp.*

*ZIKV*...nowadays present in warm and urban areas, affecting the human population.
<table>
<thead>
<tr>
<th>Year</th>
<th>Location</th>
<th>Mosquito Species</th>
</tr>
</thead>
<tbody>
<tr>
<td>1947</td>
<td>Uganda, East Africa</td>
<td>Ae. africanus</td>
</tr>
<tr>
<td>1954</td>
<td>Nigeria, West Africa, Asia and Africa</td>
<td>Ae. africanus</td>
</tr>
<tr>
<td>2007</td>
<td>Gabon, South Africa</td>
<td>Ae. albopictus</td>
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<tr>
<td>2007</td>
<td>Yap Islands, North Pacific Ocean</td>
<td>Ae. hensilli</td>
</tr>
<tr>
<td>2013</td>
<td>French Polynesia, South Pacific Ocean</td>
<td>Ae. aegypti</td>
</tr>
<tr>
<td>2014</td>
<td>New Caledonia, South Pacific Ocean</td>
<td>Ae. aegypti</td>
</tr>
<tr>
<td>2015</td>
<td>State of Bahia, Northeast Brazil</td>
<td>Ae. aegypti</td>
</tr>
<tr>
<td>2015</td>
<td>Rio de Janeiro, Northeast Brazil</td>
<td>Ae. aegypti</td>
</tr>
<tr>
<td>2016</td>
<td>Colombia</td>
<td>Ae. aegypti</td>
</tr>
<tr>
<td>2016</td>
<td>United States, South Florida, Southeast Asia, Singapore</td>
<td>Ae. aegypti</td>
</tr>
</tbody>
</table>
Climate Evolution in Rio

Rio de Janeiro, Brazil: tropical-subtropical climate

Urbanization: high densely populated areas/communities
Global warming and heat accommodation in urbanized areas

(1) A evolução da ilha de calor na região metropolitana do Rio de Janeiro. Lucena et al., 2012
(2) Clima e mudanças climáticas na cidade do Rio de Janeiro. Dereczynski et al., 2012
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Climate Evolution in Rio
Climate Evolution in Rio

Global warming and heat accommodation in urbanized areas

Number of days with minimum temperature higher than 20°C

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Aedes aegypti in Rio de Janeiro

Disease:
Zika, dengue, chikungunya, (yellow fever)

Characteristics:
→ “sip feeder”
→ “container breeder”
→ eggs can survive over a year in dry state
→ completely adapted to human habitat

Climate dependence:
→ vector survival (22-30°C), development (21-29°C) and reproduction
→ the vector’s biting rate, limited feeding activity (>17°C)
→ the pathogen’s incubation rate within the mosquitoes organism
Co-circulating viruses

ZIKV
2014*
2015**

DENV
1986*
2012**

CHIKV
2015*
2016**

* first occurrence in Rio de Janeiro, Brazil
** main outbreak in Rio de Janeiro, Brazil
Facts about Zika virus disease

**ZIKV**

- Itching rash/pruritus
- Headache/various pain
- Enlarged lymph nodes
- Conjunctivitis

**Distinctive symptoms**

- Neurological complications, GBS
- Congenital malformations, microcephaly

**Often misdiagnosed**

Due to similar syndromic clinical picture of ZIKV, DENV, CHIKV
What lessons can we learn from the past outbreaks?

Can climate parameters be seen as influencing factors?
Rio de Janeiro 2015

Epidemiological curves (suspected cases, proxy data):
- **red** – Zika virus
- **green** – dengue virus
- **yellow** – chikungunya

- **vector (%)**
- **humidity (%)**
- **temperature (°C)**
- **rainfall (ml)**

Graph showing the incidence of Zika, dengue, and chikungunya viruses over the months of 2015.
Rio de Janeiro 2015

Climate components:
- range of temperature
- sum of precipitation
- average humidity level

Graph showing the climate components over the months of the year.
Vector index:

Building infestation index of *Aedes aegypti*
What is next?
Purpose: to investigate the interface between epidemiological aspects of mosquito-borne diseases and climate conditions in the city of Rio de Janeiro, Brazil, discussing the influence of socio-economic and environmental determinants.

Setting: city of Rio de Janeiro, Brazil

Focus: climate conditions, co-circulating arborviruses, *Aedes aegypti*

Study design: Mixed-methods approach
Mixed-methods approach

Quantitative Approach

Time series analysis (2014-2016)
- precipitation, temperature, humidity (monthly/weekly)
- suspected cases of ZIKV, DENV and CHIKV (monthly/weekly)
- vector population index (monthly/weekly)

Qualitative Approach

Conduction of conversations, observations, material screening
- clinical research
- entomology
- climate/environmental sciences
- field work/interventions
What to expect?

Socio-environmental Influences

Human Behavior

Extreme Weather Events

Research

Communication

Interventions

Public Health

VECTOR-BORNE DISEASES
Conclusion

Challenges to face

- Surveillance
- Influencing factors besides climate
- Impact of human behavior

Vector Control
Transmission Control
Case Control

Further investigations
Thank you very much for your attention!

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Report of suspected Zika cases, Rio de Janeiro state/curves taken from:

Report of suspected Dengue cases, Brazil/curves taken from:

Report of suspected Chikungunya cases, Brazil/curves taken from:

Report of maximum and minimum temperature per month, Rio de Janeiro city/curves taken from:
Barcellos, C./ICICT, Fiocruz; weather data taken from São Cristovão weather station, Rio de Janeiro city center

Report of amount of precipitation per month, Rio de Janeiro city/curves taken from:
Barcellos, C./ICICT, Fiocruz; weather data taken from São Cristovão weather station, Rio de Janeiro city center

Report of average humidity per month, Rio de Janeiro city/curves taken from:
Barcellos, C./ICICT, Fiocruz; weather data taken from São Cristovão weather station, Rio de Janeiro city center

Report of Building Infestation Rate of Aedes aegypti larvae per month, Rio de Janeiro city/curves taken from:
Ministry of Health of Brazil: Online: Levantamento de Índice Rápido para Aedes aegypti (LIRAa)

Data preparation and editing: Microsoft Excel 2015, Microsoft Powerpoint 2015, GIMP 2.8
References


References


Morin CW, Comrie AC, Ernst, K (2013): Climate and dengue transmission: evidence and implications. Environmental Health Perspectives (Online), 121(11-12), 1264. doi:10.1289/ehp.1306556.
References


Images

Microcephaly: http://a.abcnews.com/images/Health/rtr_zika_infant_microcephaly_jc_160413_16x9_992.jpg

Neurological Disorders: http://static.wixstatic.com/media/9b3fb80f30eaf31779760fb57139c0b0.wix_mp_512

Aedes Aegypti: https://upload.wikimedia.org/wikipedia/commons/d/d0/Aedes_aegypti.jpg

Icon Diseases: http://www.saude.ba.gov.br/novoportal/index.php?option=com_content&id=9496&Itemid=17


