Impacts of Climate Change on Human Health in Central and South America: Evidences, Exacerbating Factors and Adaptation Strategies

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The Broader Context: Vulnerability to Disease and Injury due to Climate Variability and Climate Change

- Geographically-Different Vulnerability
- Current Health Status
- Age and Gender
- Socioeconomic Status
- Public Health and Other Infrastructure
- Projections for Vulnerability

Key Issues (1)

- Latin America is vulnerable to multiple human health impacts from long-term climate change and natural climate variability (Moreno 2006; Winchester & Szalachman, 2009; Rodriguez-Morales 2011).

- Urban areas and megacities in Latin America are becoming more vulnerable due to migration from rural areas, fleeing wars and conflicts, but also with environmental degradation and disasters.

Key Issues (2)

- Human health problems caused by climate change can be exacerbated by the frailty and precariousness of health systems throughout the region.
- Intertwined with socio-economic factors, education level (Luber and Prudent, 2009), poverty, unemployment, and violence, in addition to inadequate water and sanitation coverage, poor solid and liquid waste collection and treatment systems, air, soil and water pollution, lack of social participation and inadequate governance structures (Sverdlik 2011).

Key Issues (3)

- Informal settlements are on the rise in Latin America, on land sites at high risk from extreme weather (storms, floods, landslides), whose inhabitants are more likely to experience disease, injury and premature death. Ill health and poverty are entrenched in a vicious circle that exacerbates disadvantages over time (Sverdlik 2011).

4. Direct Impacts of Climate Meteorological Changes on Health

4.1. Heat and Cold Extremes:

- Affecting mortality rates mainly in cities (*McMichael et al., 2006; Bell et al., 2008; Hardoy and Pandiella, 2009; Muggeo and Hajat, 2009; Hajat et al., 2010*).

4.2. Floods:

- Deaths and vector-borne diseases (e.g. Colombia) (*Poveda et al., 2011*).
- Dengue in Brazil in last decade (*Teixeira et al., 2009*).

4.3. Ultraviolet Radiation

- Skin cancer in Chile is increasing in Chile correlated with climate and geography (*Salinas et al., 2006*).

5. Ecosystem-Mediated Impacts of Climate Change on Health Outcomes (1)

5.1. Vector-Borne and Other Infectious Diseases

5.1.1. Malaria: Climate and environmentally-driven:

- Colombia (*Poveda et al., 2011*; *Arevalo-Herrera et al., 2012)*
- Urban and rural Amazonia *(Da Silva-Nunes et* al., 2012).
- Vector densities increased in northwestern Argentina (*Dantur Juri et al., 2011*).
- ENSO-associated malaria:
  - Colombia (*Poveda et al., 2011*).
  - Ecuador and Peru (*Anyamba et al., 2006; Kelly-Hope & Thomson, 2010*).
  - French Guiana (*Hanf et al., 2011*).
  - Amazonia (*Olson et al., 2009*).
  - Venezuela (*Moreno et al., 2007*), including unheard malaria in the Andes up to 2200 m a.s.l. (*Benítez and Rodríguez-Morales, 2004*).

5. Ecosystem-Mediated Impacts of Climate Change on Health Outcomes (2)

5.1.2. Dengue Fever: Annual toll of USD 2.1+[1 to 4] billion (*Shepard et al., 2011).*

Climate and Environmentally-associated:

- Honduras and Nicaragua (*Rodríguez-Morales et al., 2010*).
- Costa Rica (*Fuller et al., 2009; Mena et al., 2011)*.
- French Guiana: also with malaria *(Carme et al., 2009; Gharbi et al.,2011).*
- Cities of Colombia and Venezuela *(Arboleda et al., 2009; Herrera-Martinez and Rodríguez-Morales, 2010).*
- Southern South America (*Honório et al., 2009; Costa et al., 2010; De Carvalho-Leandro et al., 2010; Degallier et al., 2010; Lowe et al., 2011; Gomes et al., 2012*).

5.1.3. Yellow Fever outbreaks increasing in tropical America with changes in climate and environmental conditions (Jentes et al., 2011), mainly in densely populated poor urban settings *(Gardner and Ryman, 2010).*

5. Ecosystem-Mediated Impacts of Climate Change on Health Outcomes (3)

5.1.5. Other Vector-Borne Diseases

- Schistosomiasis (SCH) is an endemic Neglected Tropical Disease in rural Brazil *(Igreja, 2011)*, Suriname, Venezuela, and the Andean highlands. Uncontrolled urbanization and environmental degradation is increasing incidence in Brazil *(Barbosa et al., 2010; Kelly-Hope and Thomson, 2010).*
- Hantaviruses (HV) in Honduras, Panama, Costa Rica, Venezuela, Argentina, Chile, Paraguay, Bolivia, Peru, and Brazil (*Jonsson et al., 2010; MacNeil et al., 2011*). El Niño enhance the prevalence of HV (Dearing and Dizney, 2010).
- Rota viruses (RV) exhibit clear climate-driven seasonality as in Guatemala (Cortes et al., 2012).

5. Ecosystem-Mediated Impacts of Climate Change on Health Outcomes (4)

5.1.5. Other Vector-Borne Diseases (Contd.)

- Chagas disease is closely associated with climate and environmental changes in Panama and Argentina *(Tourre et al., 2008; Gottdenker et al., 2011).*

- Ciguatera fish poisoning (CFP) is a tropical disease correlated with water temperature, and thus climate change could increase its incidence across the Caribbean *(Tester et al., 2010)*.

- Climate is an important factor of Paracoccidioidomycosis, Latin America's most prevalent mycosis *(Barrozo et al., 2009).*

- ENSO is associated with recent outbreaks of bartonellosis in Peru *(Payne and Fitchett, 2010).*

5. Ecosystem-Mediated Impacts of Climate Change on Health Outcomes (5)

5.1.5. Other Vector-Borne Diseases (Contd.)

- Cutaneous leishmaniasis (CL): Highest incidence in Bolivia, where it increases (decreases) during La Niña (El Niño) *(Gomez et al., 2006; García et al., 2009).*
- CL is affected in Costa Rica by temperature, forest cover, and ENSO (*Chaves and Pascual, 2006; Chaves et al., 2008).*
- Land use, altitude, and climate - Increasing trends of CL in Colombia (*Valderrama-Ardila et al., 2010*), which also increases (decreases) during El Niño (La Niña) (*Cárdenas et al., 2006; 2007; 2008)*.
- In Venezuela, CL increases during La Niña (*Cabaniel et al., 2005).*
- CL is a seasonal climate-driven disease in Suriname and in French Guiana.

- Visceral Leishmaniasis (VL) has increased in Brazil (highest in LA) owing to deforestation and El Niño (*Cascio et al., 2011; Sortino-Rachou et al., 2011; Ready, 2008*), as in Argentina, Paraguay, and Uruguay (*Bern et al., 2008; Dupnik et al., 2011; Salomón et al., 2011; Fernández et al., 2012*).
- VL transmission in western Venezuela is seasonally climate-driven (*Rodríguez-Morales et al., 2007)*.

5. Ecosystem-Mediated Impacts of Climate Change on Health Outcomes (6)

5.1.5. Other Vector-Borne Diseases (Contd.)

- Onchocerciasis (river blindness) is another climate-related disease (*Botto et al., 2005*), whose vector exhibits clear-cut wet-dry seasonal biting rates (*Rodríguez-Pérez et al., 2011*).

- Leptospirosis is particularly prevalent in warm and humid tropical regions of CA (*Valverde et al., 2008*).

- Other climate-driven infectious diseases are ascariasis and gram-positive cocci in Venezuela (*Benítez et al., 2004; Rodríguez-Morales et al., 2010), and Carrion's disease in Peru (Huarcaya et al., 2004)*

5. Ecosystem-Mediated Impacts of Climate Change on Health Outcomes (7)

5.2. Food and Water-Borne Infections

- Sea water temperature affects the abundance of the cholera-responsible bacteria (*Koelle, 2009; Jutla et al., 2010; Marcheggiani et al., 2010; Hofstra, 2011)*.

- High correlations exist between El Niño and cholera in Peru, Ecuador, Colombia, Mexico and Venezuela (*Cerda Lorca et al., 2008; Martínez-Urtaza et al., 2008; Salazar-Lindo et al., 2008; Holmner et al., 2010; Gavilán and Martínez-Urtaza, 2011; Murugaiah, 2011*).

- Extreme temperatures and changes in rainfall may also increase food safety hazards along the food chain *(Sivakumar et al., 2005; Tirado et al., 2010)*.

5. Ecosystem-Mediated Impacts of Climate Change on Health Outcomes (8)

5.3. Air Quality

- The worsening of air quality in large cities is increasing allergic respiratory diseases, and morbidity from asthma and rhinitis (*Grass and Cane, 2008; Martins and Andrade, 2008; Gurjar et al., 2010; Jasinski et al., 2011; Rodriguez et al., 2011).*

5.4 Mental Health

- Extreme weather and climate events affect it by exposure to psychological trauma (*Higginbotham et al., 2006; Berry et al., 2010*).
- Drought-prone areas in NEB are vulnerable to lower socioeconomic and educational levels, in turn associated with depression, psychological distress, and anxiety (*Coêlho et al., 2004*).
- Hospital admissions for mania and bipolar disorder are associated with climate seasonality in Brazil.
- Extreme weather, meager crop yields, and low GDP are also linked with increased violence (*McMichael et al., 2006*). Likely exacerbated by climate change (*Schulte and Chun, 2009).*

7. Adaptation to Protect Health

7.1 Improving Basic Public Health and Health Care Service

- Enhancing disease surveillance, monitoring risky exposures, and facilitating coordination between health and other sectors to address shifts in the incidence and geographic range of diseases.
- Health care interventions may reduce harm caused by climate and other environmental stressors.
- Post-disaster initiatives also are important.

7.2 Health Adaptation Policies and Measures

- Maintaining and improving food safety amid rising temperatures and rainfall extremes.
- Indicators of community functioning and connectedness. Dissemination of health and related messages, ensuring compliance with behavioral norms and providing support to those in need.
- Vulnerability Mapping through Remote Sensing to guide interventions to reduce exposures and/or impacts. E.g. surface temperatures and urban heat island effects for risk of heat waves. Useful to modify surveillance programs before disease outbreaks occur.

7.3 Early Warning Systems

- Aiming at alerting public health authorities to climate-related health risks. Must take into consideration the wide range of factors that can drive risk.
- Heatwave and health warning systems (HHWS) are designed to prevent negative health impacts.
- Components: Forecasting weather conditions associated with increased morbidity or mortality, predicting possible health outcomes, identifying triggers of effective and timely response plans that target vulnerable populations, communicating heatwave and prevention responses, and evaluating and revising the system to increase effectiveness in a changing climate.
- Predictive models for vector-borne and food-borne infections.
- Effectiveness must be assessed.
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Adaptation

- Some initial steps in adaptation to climate change in Latin America with regard to human health are being given in Colombia. A pilot adaptation strategy is starting to being implemented by the Ministry of Health and National Institute of Health in such a way that the Epidemiological Surveillance System (SIVIGILA) responses to changes in the dynamics of malaria transmission and exposure brought about by climate variability and climate change.

7.4 Role of Other Sectors in Health Adaptation (2)

- A rapid response to the risk of child under-nutrition, targeted to those in greatest need, with flexible financing and the capacity to rapidly scale-up depending on need, may reduce damaging health consequences (Alderman, 2010).
- Community programs designed for other purposes can facilitate adaptation.
- Migration as a coping strategy in the face of adverse changes in climate, and may itself have significant effects on health, positive and negative. Last resort!

8. Co-Benefits

Reduction of Co-Pollutants

- Outdoor Sources
- Household Sources
- Primary Co-Pollutants
- Secondary Co-Pollutants

Access to Reproductive Health Services

- Birth and Pregnancy Intervals
- Maternal Age at Birth

Vulnerability to Disease and Injury due to Climate Variability and Climate Change

- Many factors contribute to exacerbate vulnerability: urbanization patterns; poverty; institutional and cultural aspects; poor sanitation, lack of access to clean water, etc.
- Besides, ecosystem degradation and decline of life support systems will affect human health and wellbeing.

Vulnerability

- Human Health vulnerabilities are not homogeneously distributed across the spectrum of the LA population, with distinctive outcomes depending on geography, age, gender, race, ethnicity, and socio-economic status.
- The inhabitants of the Caribbean and Central America, Colombia and Venezuela, are subject to higher vulnerability from tropical storms and to more intense hurricanes.

Vulnerability (2)

- Intra-Adean valleys are more vulnerable to intense storms triggering landslides, and large floods.
- Inhabitants of the low, hot and humid regions of the tropical Americas are more vulnerable to climate-sensitive diseases including malaria, dengue, yellow fever, and leishmaniasis. Climate change favors the transmission of those diseases at higher altitudes.
- Climate change and its effect on sea level rise can contaminate fresh water reservoirs, and the salinization of soil, with important health effects.
- In the tropical Americas, human populations are often living with temperatures that are close to tolerable thresholds.

Projections (1)

Kistin et al. (2010): Ranges of relative health risks attributable to climate change in 2030, under alternative scenarios: Under the scenario of unmitigated emissions those ranges are: Diarrhoea (0.92 to1.08), Malnutrition (1.0 to 1.0), Inland floods (1.0 to 4.24), Coastal floods (1.8 to 4.20), and Malaria (1.0 to 1.28).

Whereas a rapid emissions reduction scenario indicates: Diarrhoea (0.95 to 1.05), Malnutrition (1.0 to 1.1), Inland floods (1.0 to 3.74), Coastal floods (1.57 to 3.28), and Malaria (1.0 to 1.15), thus showing the need for the second scenario.

Projections (2)

- Kjellstrom et al. (2009) used physiological evidence on the effects of heat, climate guidelines for safe work environments, climate modeling, and global distributions of working populations to estimate the impact of two climate scenarios on future labor productivity. By the 2080s, the greatest absolute losses of population-based labor work capacity (in the range 11% to 27%) are seen under the A2 scenario in Southeast Asia, Andean and Central America, and the Caribbean.

Summary

- **Climate variability and climate change (CV/CC) are negatively affecting human health in CA and SA, either by increasing morbidity, mortality, and disabilities (high confidence).**
- **Human health impacts have been exacerbated by variations and changes in climate extremes (*high confidence*).**
- **Climate-related diseases emerged in previously non-endemic regions (malaria in the Andes, dengue in CA and Southern SA) (*high confidence*).**
- **Climate variability also affected the incidence of respiratory and cardiovascular, vector- and water-borne and chronic kidney diseases, viruses and pregnancy-related outcomes (*high confidence*).**
- **Health vulnerabilities vary with geography, age, gender, ethnicity, and socio-economic status, and are rising in large cities (*high confidence*).**
- **Without adaptation measures (e.g. extending basic public health services), climate change will exacerbate future health risks, owing to current vulnerabilities in water, sanitation and waste collection systems, nutrition, pollution and food production in poor regions (*medium confidence*).**

On Human Health and Climate Change

"I have noted the dismal under-recognition of the importance, role and connectedness of human health to other goals/objectives. I live in hope that we can impress on other sectors and policy-makers that population health is not a side-show to the main event. In the long run, it is the main event. Why else do we want an economy, security, social cohesion and material comfort?"

Tony McMichael