Science of the Total Environment 574 (2017) 837–846

Contents lists available at ScienceDirect

Science of the Total Environment

journal homepage: www.elsevier.com/locate/scitotenv

Sensitivity of health sector indicators' response to climate change in Ghana

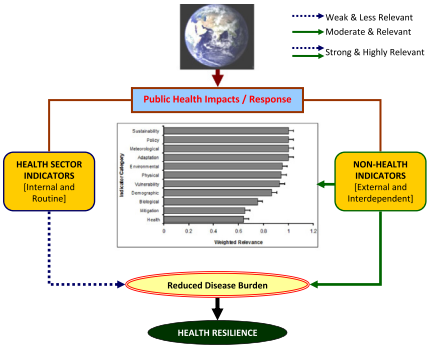
Delali B.K. Dovie [a,b,*], Mawuli Dzodzomenyo [c], Oladele A. Ogunseitan [d]

[a] Regional Institute for Population Studies, and Department of Geography and Resource Development, University of Ghana, Legon, Ghana
[b] School of Animal, Plant and Environmental Sciences, University of the Witwatersrand, South Africa
[c] Department of Biological, Environmental and Occupational Health Sciences, School of Public Health, University of Ghana, Legon, Ghana
[d] Department of Population Health and Disease Prevention, Program in Public Health, and School of Social Ecology, University of California at Irvine, USA

HIGHLIGHTS

- Existing health indicators are limited in scope to build resilience to climate change.
- Indicators of socio-ecological origins of the coupled human – environment system established.
- Multivariate statistics with systematic reviews and expert consultations generated new insights.
- Resilience of climate-sensitive diseases is multidimensional, and driven by external factors.
- Non-health indicators have synergistic effect on health resilience to climate change.

GRAPHICAL ABSTRACT



ARTICLE INFO

Article history:
Received 22 June 2016
Received in revised form 8 September 2016
Accepted 9 September 2016
Available online xxxx

Editor: D. Barcelo

Keywords:
Adaptation
Disease burden
Ecohealth
Epidemiology
Health surveillance
Vulnerability

ABSTRACT

There is accumulating evidence that the emerging burden of global climate change threatens the fidelity of routine indicators for disease detection and management of risks to public health. The threat partially reflects the conservative character of the health sector and the reluctance to adopt new indicators, despite the growing awareness that existing environmental health indicators were developed to respond to risks that may no longer be relevant, and are too simplistic to also act as indicators for newer global-scale risk factors. This study sought to understand the scope of existing health indicators, while aiming to discover new indicators for building resilience against three climate sensitive diseases (cerebro spinal meningitis, malaria and diarrhea). Therefore, new potential indicators derived from human and biophysical origins were developed to complement existing health indicators, thereby creating climate-sensitive battery of robust composite indices of resilience in health planning. Using Ghana's health sector as a case study systematic international literature review, national expert consultation, and focus group outcomes yielded insights into the relevance, sensitivity and impacts of 45 indicators in 11 categories in responding to climate change. In total, 65% of the indicators were sensitive to health impacts of climate change; 24% acted directly; 31% synergistically; and 45% indirectly, with indicator relevance strongly associated with type of health response. Epidemiological indicators (e.g. morbidity) and health demographic indicators (e.g. population structure) require adjustments with external indicators (e.g. biophysical, policy) to be resilient to climate change. Therefore, selective integration of social and ecological indicators with existing public health indicators improves the fidelity of the health sector to adopt more robust planning of

* Corresponding author at: Regional Institute for Population Studies, University of Ghana, LG96 Legon, Ghana.
E-mail address: dbdovie@ug.edu.gh (D.B.K. Dovie).

http://dx.doi.org/10.1016/j.scitotenv.2016.09.066

interdependent systems to build resilience. The study highlights growing uncertainties in translating research into protective policies when new indicators associated with non-health sources are needed to complement existing health indicators that are expected to respond to climate change.

1. Introduction

The fifth assessment report (AR5) of the Inter-governmental Panel on Climate Change (IPCC) has affirmed high confidence in the link between climate change and human health (Smith et al., 2014). The report emphasized that, despite the advances in understanding the influence of climate change on health, uncertainties and knowledge gaps must be addressed to improve decision support systems. There have been difficulties in introducing new climate–sensitive indicators to the health sector beyond the traditional environmental public health indicators (EPHI). Health indicators are measurable quantitative and qualitative parameters that represent phenomena such as disease outbreaks, complex risk factors, hazards, exposures, health effects, health resources interventions, disease-preventive activities, and communication elements to support decision making (English et al., 2009). Subsequently, there is a need to expand and prioritize indicators of social and biophysical origins that are relevant for integrating climate response into public health planning and resilience building (Ebi and Burton, 2008; Haines et al., 2006). Adverse health outcomes such as changing global patterns of disease incidence and mortality, shortage of food, water, and shelter, and inadequate sanitation, have emerged to challenge routine public health practices that focus exclusively on local stressors. The well-recognized local stressors exacerbate human exposure to additional harm from climate change, thereby providing new challenges for health planning (Costello et al., 2009, Houghton and English, 2014, McMichael et al., 2006). However, there is a severe shortage of experiences within the National Adaptation Programs of Action (NAPAs) of the United Nations Framework Convention on Climate Change (UNFCCC), which are relevant to moving the health sector beyond traditional coping mechanisms at national levels (IPCC, 2001; UNFCCC, 2007).

Ghana was selected as a case study for the current analysis, because the country relies on internationally mandated action plans such as the National Climate Change Adaptation Strategies (NCCAS). Further, the health sector received little attention in Ghana's National Communications to respond to the impacts of climate change (Government of Ghana, 2015; Government of Ghana, 2010). Similarly, the adaptation plans of some developed countries fail to recognize the vulnerability of the health sector to climate change with only 15% having an explicit human health component of their adaptation plans (e.g. Annex I parties) (Lesnikowski et al., 2011). The Annex I parties were the industrialized countries that were members of the OECD (Organization for Economic Co-operation and Development) in 1992, and countries with economies in transition as one of the three major groups of parties to the UNFCCC (UN, 1992). Major gaps remain in understanding the sensitivities of predictors of climate change and related risks to match existing public health indicators (Houghton and English, 2014; Mishra et al., 2015). Globally, the health-climate change nexus is still evolving in health policy and planning. The nexus is characterized mostly by perception and conjectures rather than empirical evidence (Clarke and Berry, 2012; Linnenluecke and Griffiths, 2012; Uittenbroek et al., 2013). The impacts of climate change on public health are expected to manifest through three pathways: (i) the direct emergency impacts relating primarily to extreme weather conditions, including heat, drought, and storms, (ii) the sub-acute effects mediated through natural systems, and (iii) effects heavily mediated by human systems such as malnutrition (Costello et al., 2009; IPCC, 2014; Jankowska et al., 2012). Therefore, it is prudent that health sector indicators are expanded and adjusted to reflect these pathways.

Climate change acts to exacerbate existing patterns of ill health by acting on the underlying environmental and socio-demographic vulnerabilities (McMichael et al., 2006; Nguendo-Yongsi and Dovie, 2007; Sheridan and Allen, 2015; Smith et al., 2014; Xu et al., 2013). The highly regulated health sector depends mostly on the EPHI to integrate environment-based issues, but the sector is confronted with organizational difficulties to integrate additional climatic risk indicators which are external to EPHI. This is because climatic risk indicators represent a mix of drivers mostly dictated strongly from effects of non-health sector interactions as EPHIs were not designed to respond to climatic risks. Climate change related large-scale ecological changes and losses impinge on human well-being concurrently (Haines, 2012; Houghton and English, 2014). Whilst the convergent effect of social and ecological change have been felt in recent times in conventional public health practice (Costello et al., 2009), loss of momentum to sustain such practices could undermine the potential co-benefits of effectively managing the climate change – human health interactions defined as planetary health or Ecohealth. Ecohealth practices generally leverage and engage human health issues concurrently with the coupled human - environment system defined by ecosystem services to regulate disease origins (Butler and Friel, 2006). This approach considers the dynamic interplay among ecosystem determinants, and between them and health outcomes. Examples are managing waste to generate electricity and diesel fuel, whilst reducing health hazards, and also using recycled wastewater from hospitals to manage landscapes and reducing costs associated with disposal, creating green jobs and minimizing greenhouse gases from health facilities. Therefore this study aimed to assess the scope of sensitivities of existing health indicators, with the potential to broaden the scope to include indicators external to the health sector that may improve response to the burden of climate change and contribute to resilience of public health infrastructure.

2. Cross-scale interactions of health indicators

The readiness of public health systems to adapt to the impacts of climate change has been described as facing delays because of limitations on the inclusion of social-ecological concepts in the planning process (Deppisch and Hasibovic, 2013; Downes et al., 2013; Few, 2007; Folke, 2006; Gallopin, 2006). For example, large-scale environmental changes such as biochemical pollution, extreme temperature events, loss of biodiversity and ecosystem services occur simultaneously, and will have cumulative and interactive adverse impacts on population health (Houghton and English, 2014; Sheridan and Allen, 2015; Zell, 2004). However, it is important to acknowledge that there is no guarantee that the inclusion of indicators outside the traditional health sector would result in improvements to public health to respond to climate change. Thus there are vaguely understood linkages between environmental quality, health planning and equity in the distribution of disease burden and inadequate translation of evidence from health, ecological and social systems into policies towards improved health status. The national climate change impact study of Ghana's health sector serves as the context within which we explore these gaps to produce a refined process of developing climate-sensitive indicators of resilience. This study therefore was not intended to showcase Ghana's milestones on