Drought and Its Effect on Infectious Diseases

Kunal H. Doshi MPH [1], Sara Paull PhD [2]

[1]University of Colorado School of Medicine, Aurora, CO; [2]University of Colorado School of Public Health

School of Medicine
UNIVERSITY OF COLORADO
ANSCHUTZ MEDICAL CAMPUS

Introduction

Climate change is the **warming of the average global temperature**[1]. It is naturally caused as well as through human activities, particularly the burning of different fossil fuels[1].

This could wreak **havoc on different ecosystems**. It can also affect **individual and community health**. There is a risk involved with extreme heat, in which populations would suffer periods of **heat waves**[1]. There is also the risk of **natural disasters**, like hurricanes, flooding, increased periods of rainfall which could lead to the destruction of homes and crops, leading to issues like **malnutrition**[1].

Many studies have examined the relationship between **the increase in rainfall and infectious diseases**.

Studies have indicated an **increase in the range of infectious diseases with warming temperatures**[2]. With mosquito-borne diseases, the increasing temperatures have allowed for mosquitoes to spread, specifically the **geographical location and life spans**, resulting in the extension of infectious diseases, like malaria[2]. Global warming has led to changes in the temperature of water. It has been documented that water with increased temperatures has led to environments more suitable for bacterial growth[2]. This in turn has caused increases in water-borne infections[2].

There has been so much discussion about how precipitation has increased different vector borne diseases and not a lot of discussion on the **effects of decreased precipitation**, aka drought, **on vector borne diseases**.

Methods

Databases

- PubMed
- Google Scholar
- Web of Science

Inclusion Criteria

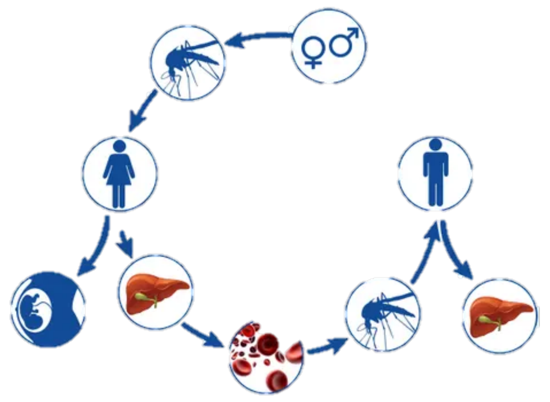
- Key terms "climate change" "drought" "infectious disease, disease specific terms
- Studies between 1988-2018
- ENSO, precipitation, drought index vs. vector

Final Inclusion

- 800 articles were retrieved
- 350 articles passed the abstract and title screening
- 300 articles were included after final screening (vector borne illnesses vs weather variables)

Results

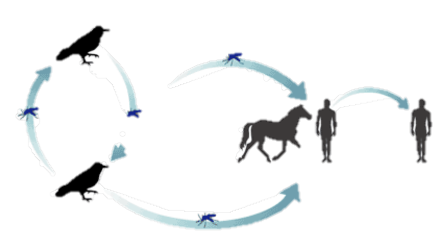
Infection/Virus	Findings

Malaria

	• Sahara, drought conditions reduced Anopheles mosquitoes and malarial risk[3]
	• South America, Southeast Asia malaria risk increased as drought severity increased[4]
	  • Increased due to decreased human immune response in stressful periods as well as increase in gametocytogenesis[4]
	  • Changes in mosquito behavior - increased in blood meals associated with reproductive success[5]
	  • Drought tolerance phenotypes were selected for in Anopheles Gambiae species[6]

Dengue, Zika, Chikungunya

	• Guangdong, China and Venezuela – periods of drought and El Nino were associated with increased dengue outbreaks
	  • Aedes species increased blood feeding frequency
	• Zika and Chikungunya – drought consistently associated with increased breakouts[7]
	  • mosquito feeding behavior - increased blood meals
	  • human behavior - shifted to have more open water containers

Eastern Equine Virus/ St. Louis Encephalitis	• Infections rates were the same during heavy precipitation periods and dry periods[8]
Japanese Encephalitis	• Infections rates were increased during dry periods[9] • Human behavior change - increased open water containers for storage
Ross River Virus	• Infections rates increased during dry periods • Female Aedes species were capable of vertical transmission (transmission from parent to child)[9]

West Nile Virus

	• Dry periods associated with increased WNV cases[10]
	  • Culex species increases blood feeding meals
	  • Periods of drought increase stress in primary host, birds, propagating WNV
	  • Human behavior – shifted to have more open water containers

Limitations

The studies in this paper were limited from 1993-2018. The researchers believed **that using studies that were more recent would be more beneficial to individuals using this paper**. The search criteria being specific to drought and to vector borne disease significantly limits the pool of studies.

The studies included in this review **varied in design and level of quality**.

With the **limited number of studies between drought and vector borne diseases** it is difficult to assess direct causation between the variables.

Conclusions

With a decrease in precipitation, **mosquitoes have adapted in multiple ways**. During periods of drought, their **feeding behaviors have increased**, some species have **adapted to vertical transmissio**n, and finally **some species have developed drought resistant eggs.**

Change in **human behavior has led to a closer proximity** between mosquitoes and humans.

Findings are important in **driving preventative responses to potential outbreaks** in periods of drought.

The routine **surveillance of mosquito borne diseases will play an important role in preventing future outbreaks** as they become more common due to climate change. With the proper surveillance methods set, the burden of these infectious diseases could potentially be alleviated.

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References

1. Climate change and health. (2017). World Health Organization from http://www.who.int/mediacentre/factsheets/fs266/en/
2. Rossati, A. (2017). Global Warming and Its Health Impact. The International Journal Of Occupational And Environmental Medicine, 8(1January),963-7-20.Retrievedfrom http://theijoem.com/ijoem/index.php/ijoem/article/view/963
3. Kent RJ, Thuma PE, Mharakurwa S, Norris DE. Seasonality, blood feeding behavior, and transmission of Plasmodium falciparum by Anopheles arabiensis after an extended drought in southern Zambia. Am J Trop Med Hyg. 2007 Feb;76(2):267-74. PMID: 17297034; PMCID: PMC4152308.
4. Kvit, A. (2017). The Effect of Drought Associated Indicators on Malaria in the Choma District of Zambia. from https://jscholarship.library.jhu.edu/handle/1774.2/40750
5. Dieter, K., Huestis, D., & Lehmann, T. (2012). The effects of oviposition-site deprivation on Anopheles gambiae reproduction. Parasites & Vectors, 5(1), 235. doi: 10.1186/1756-3305-5-235
6. Goltsev, Y., Rezende, G., Vranizan, K., Lanzaro, G., Valle, D., & Levine, M. (2009). Developmental and evolutionary basis for drought tolerance of the Anopheles gambiae embryo. Developmental Biology, 330(2), 462-470. doi: 10.1016/j.ydbio.2009.02.038
7. Muñoz, Á., Thomson, M., Goddard, L., & Aldighieri, S. (2016). Analyzing climate variations at multiple timescales can guide Zika virus response measures. Gigascience, 5(1). doi: 10.1186/s13742-016-0146-1
8. SHAMAN, J., DAY, J., & STIEGLITZ, M. (2004). THE SPATIAL-TEMPORAL DISTRIBUTION OF DROUGHT, WETTING, AND HUMAN CASES OF ST. LOUIS ENCEPHALITIS IN SOUTHCENTRAL FLORIDA. The American Journal Of Tropical Medicine And Hygiene, 71(3), 251-261. doi: 10.4269/ajtmh.2004.71.251
9. Lindsay, M., Mackenzie, J., Wright, A., Broom, A., & Johansen, C. (1993). Ross River Virus Isolations from Mosquitoes in Arid Regions of Western Australia: Implication of Vertical Transmission as a Means of Persistence of the Virus. The American Journal Of Tropical Medicine And Hygiene, 49(6), 686-696. doi: 10.4269/ajtmh.1993.49.686
10. Shaman, J., Harding, K., & Campbell, S. (2011). Meteorological and Hydrological Influences on the Spatial and Temporal Prevalence of West Nile Virus in <I>Culex</I> Mosquitoes, Suffolk County, New York. Journal Of Medical Entomology, 48(4), 867-875. doi: 10.1603/me10269

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