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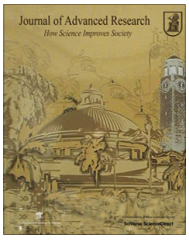

REVIEW

Climate change and epidemiology of human parasitosis in Egypt: A review

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ABSTRACT

Climate change is an emerging global issue. It is expected to have significant impacts both in Egypt and around the world. Thus, the country is in need for taking action to prepare for the unavoidable effects of climate change, including the increase in water stress, the rise in sea level, and the rapidly increasing gap between the limited water availability and the escalating demand for water in the country. Also, weather and climate play a significant role in people's health. Direct impacts of climate change on the Egyptians public health may include also increased prevalence of human parasitic diseases. Climate could strongly influence parasitic diseases transmitted through intermediate hosts. The present work reviews the future of such parasitic diseases in the view of the current available evidence and scenarios for climate change in the Egypt.

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Introduction

Climate change is now widely accepted as a fact. Evidence of such change includes the instrumental temperature record, rising sea levels, and decreased snow cover in the Northern Hemisphere. Scientists projected future changes in air and

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sea surface temperatures, as well as changes in precipitation, sea level, and ocean salinity and circulation patterns. These environmental changes are likely to have an impact on all the natural ecosystems and socioeconomic systems [1,2].

In 2000, the Intergovernmental Panel on Climate Change (IPCC) issued a Special Report on Emission Scenarios (SRES) that presented more than 40 scenarios based on different visions of how the world may develop in the 21st century, the sources of energy it will use, and how the communities will solve their problems. Based on the SRES, an array of serious threats is apparent to develop in Egypt with the climate change [3].

Egypt is generally an arid country that depends on the Nile River as its main and almost exclusive source of fresh water. At present, it is the largest consumer of the Nile water. It is one of the African countries that could be vulnerable to water stress under climate change [3]. The river is very sensitive to temperature and precipitation changes mainly because of its low runoff/rainfall ratio which is 4% [4]. Because of being at the bottom end of the river, Egypt is affected by the climate change impacts, not only within its borders, but also within the whole basin, which it shares with ten other countries. Egypt will be likely to experience an increase in water stress with a projected decline in precipitation [5]. At present, there is a rapidly increasing gap between the limited water availability and the escalating demand for water in the country. The rate of water utilization has already reached its maximum for Egypt, and climate change will exacerbate this vulnerability. The quantity of water used in 2000 was estimated at about 70 km^3 which is already far in excess of the available resources [6]. Temperature rise is expected to reduce the productivity of major crops and increase their water requirements, thereby directly decreasing crop water-use efficiency [7,8]. This situation may be complicated by a general increase in irrigation demand [9]. The ongoing expansion of irrigated areas will reduce the capacity of Egypt to cope with future fluctuation in flow [10].

In addition, climate change is likely to cause rise in sea level as a consequence of global warming. This could affect the Nile Delta and other coastal areas [11]. Coastal cities such as Alexandria (Egypt's second city) will probably be impacted and could be completely lost [12].

Direct impacts of climate change on Egypt may include also increased prevalence of many parasitic diseases, physiological disorders, skin cancer, eye cataracts, respiratory ailments, heat strokes, and heat related illnesses. The indirect impacts involve factors such as demographic dislocations and socioeconomic disruptions. However, comprehensive studies that contain detailed estimations and correlations between climate change and human health are still lacking for Egypt [13]. For the interest of the public health in the country, it becomes crucial to review how human parasites may respond to the climatic change expected in next decades, according to results obtained with forecasting climatic models.

Impacts of climate change on human parasitosis in Egypt

Climate change could strongly affect diseases transmitted through insects, snails, and other cold blooded animals

Table 1 Potential range of effects of climate on disease transmitted to man through other hosts. Adapted from McMichael and his coauthors in 2001 [19].

Climate Factor	Intermediate host	Pathogen	Vertebrate host and rodents
Increases in temperature	– Decreased survival (e.g., *Culex tarsalis*) – Change in susceptibility to some pathogens; seasonal effects – Increased population growth – Increased feeding rate to combat dehydration, therefore increased vector-human contact – Expanded distribution seasonally and spatially	– Increased rates of extrinsic incubation in vector – Extended transmission season – Expanded distribution	– Warmer winters favor rodent survival
Decreases in precipitation	– Increase in container-breeding mosquitoes because of increased water storage – Increased abundance for vectors that breed in dried-up river beds – Prolonged droughts could reduce or eliminate snail populations	– No effect	– Decreased food availability can reduce populations – Rodents may be more likely to move into housing areas, increasing human contact
Increases in precipitation	– Increased rain increases quality and quantity of larval habitat and vector population size – Excess rain can eliminate habitat by flooding – Increased humidity increases vector survival – Persistent flooding may increase potential snail habitats downstream	– Little evidence of direct effects – Some data on humidity effect on malarial parasite development in anopheline mosquito host	– Increased food availability and population size
Increase in precipitation extremes	– Heavy rainfall events can synchronize vector host-seeking and virus transmission	– No effect	– Risk of contamination of flood waters/runoff with pathogens from rodents or their excrement (e.g., *Leptospira* from rat urine)
Sea-level rise	– Coastal flooding affects vector abundance for mosquitoes that breed in brackish water (e.g., *Anopheles subpictus* and *Anopheles sundaicus* malaria vectors in Asia)	– No effect	– No effect