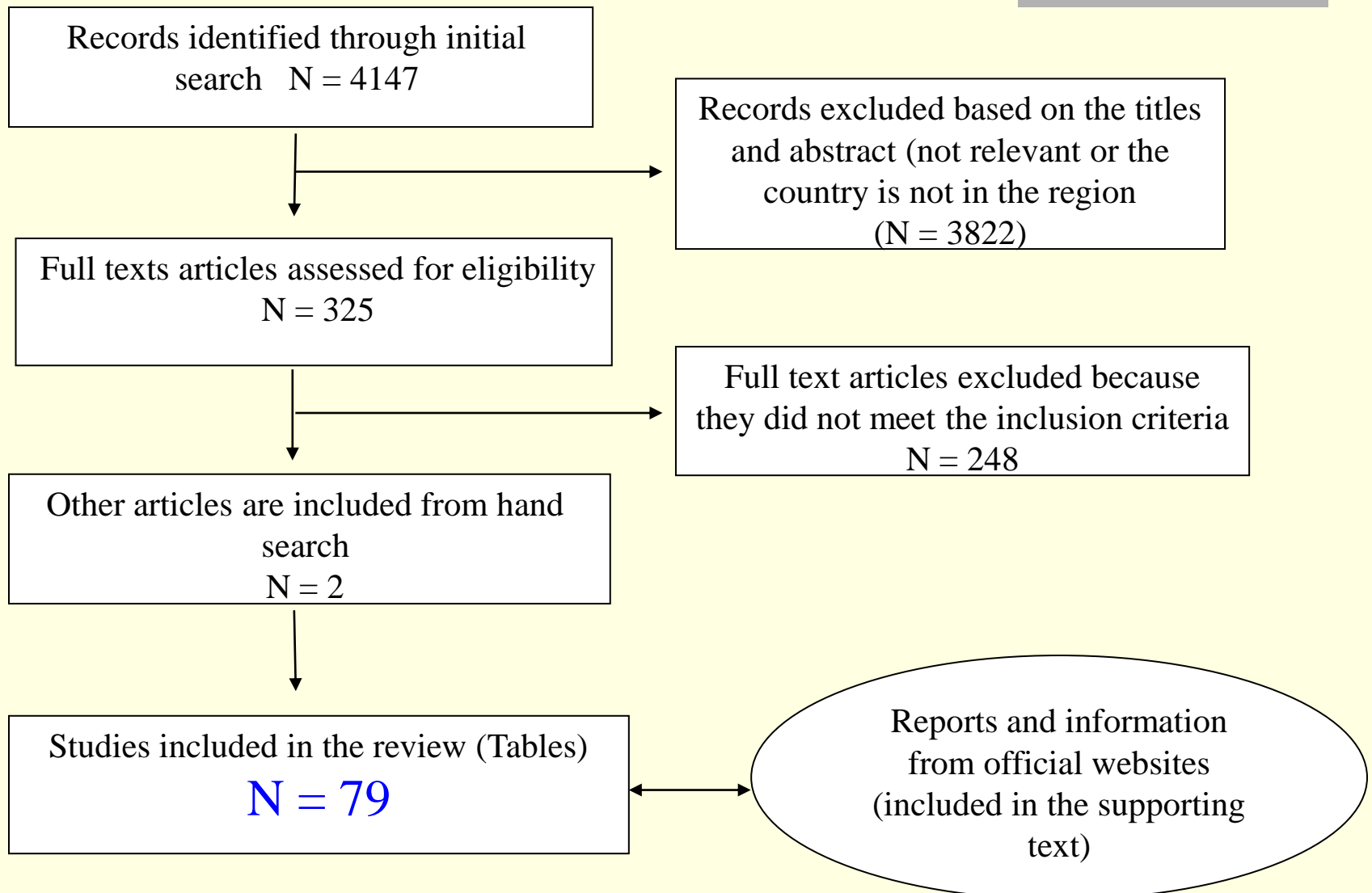# Climate Change and Health in the EMR Countries:

A Systematic Literature Review
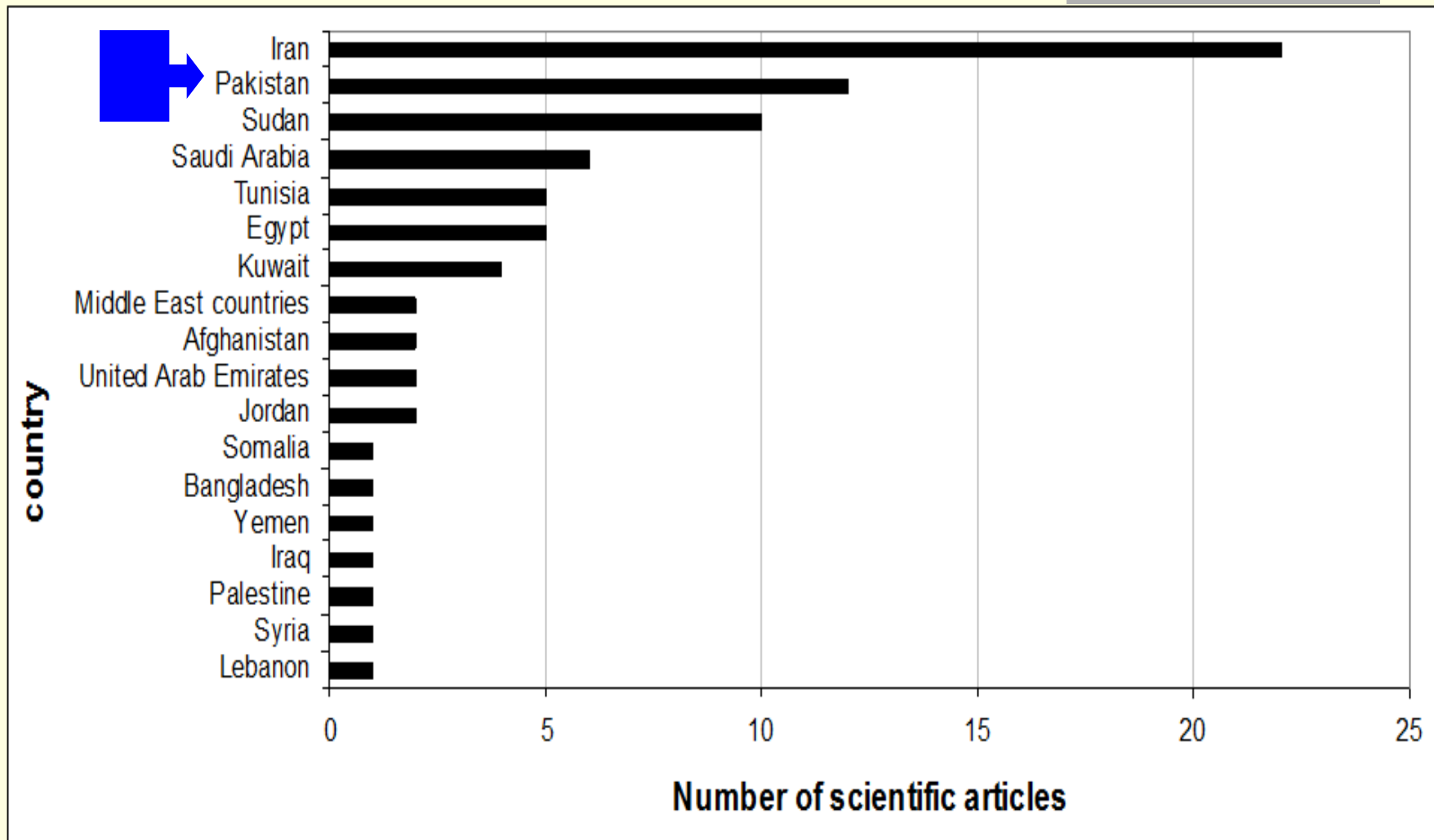
Objectives

➢ Systematically review published and unpublished literature **(2000-2014**) on the impact of climate change on human health in the EMR countries.

➢ Understand the specific pathways that link climate change to health as reported in the reviewed literature.

➢ Explore factors and population characteristics which contribute to different health outcomes that occur in response to climatic change.

➢ Identify gaps in knowledge and research gaps to support further research efforts.

➢ Identify the priority research and information needs that can better prepare managers, policymakers, and the public to reach informed decisions related to climate change and health.
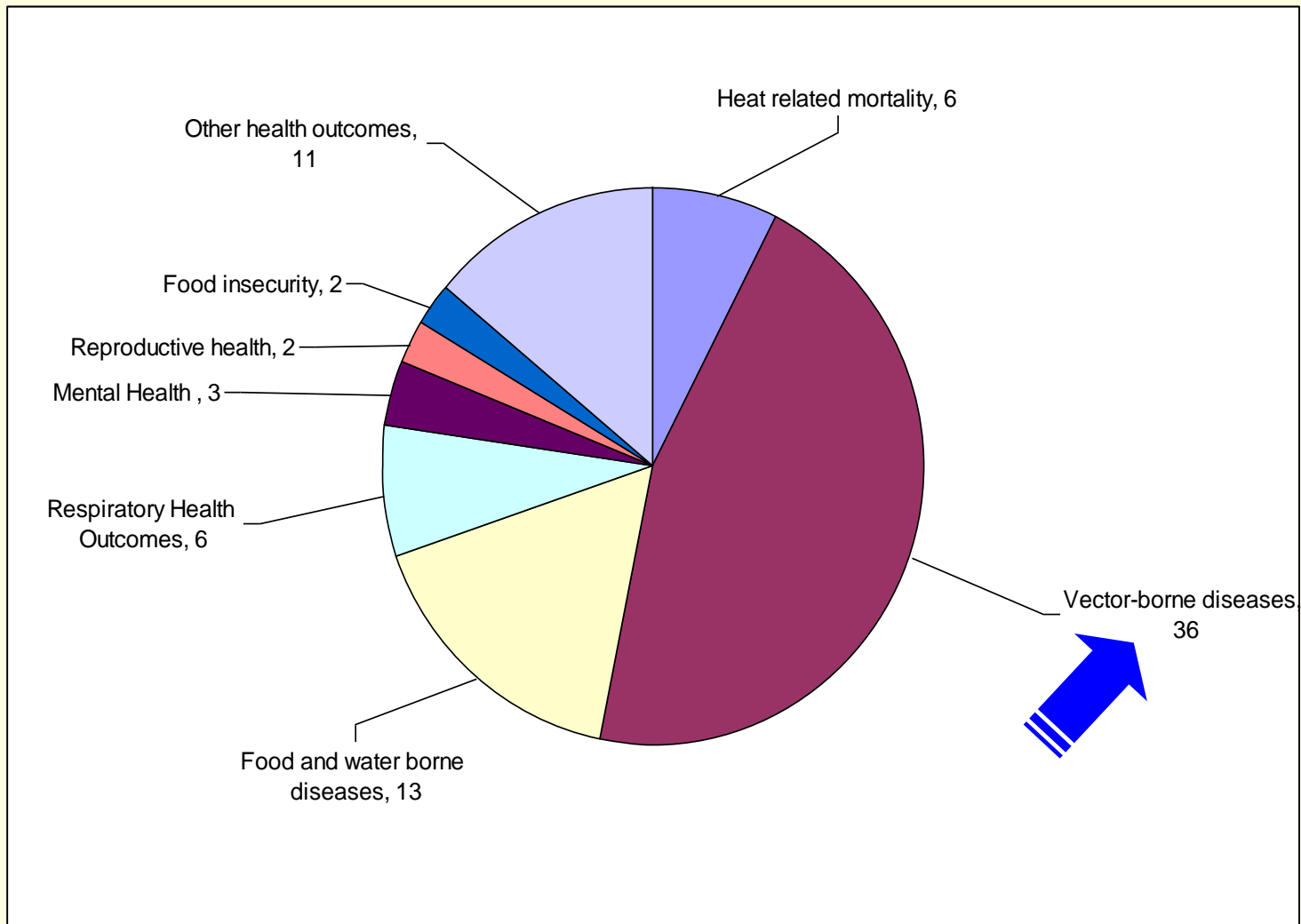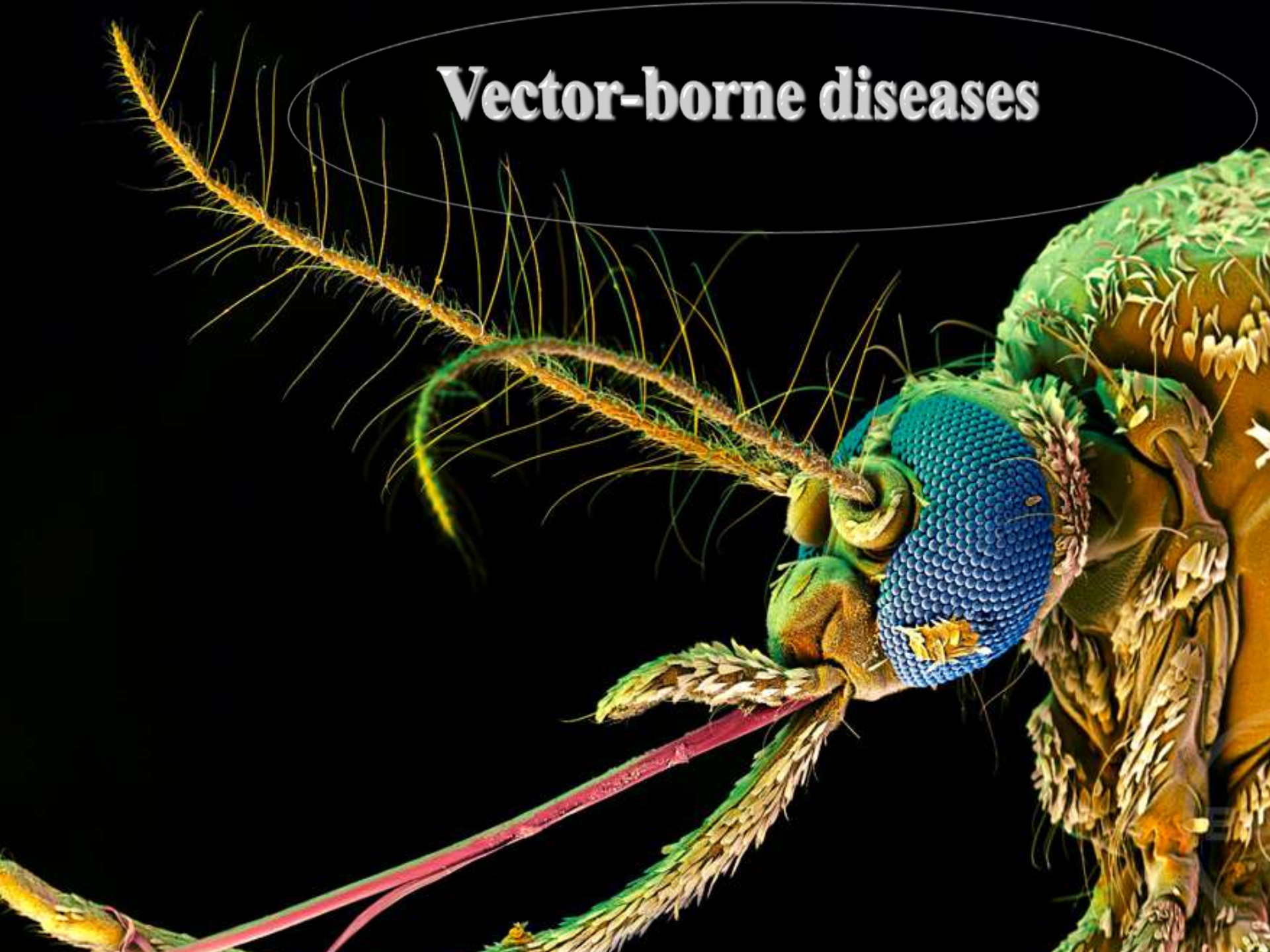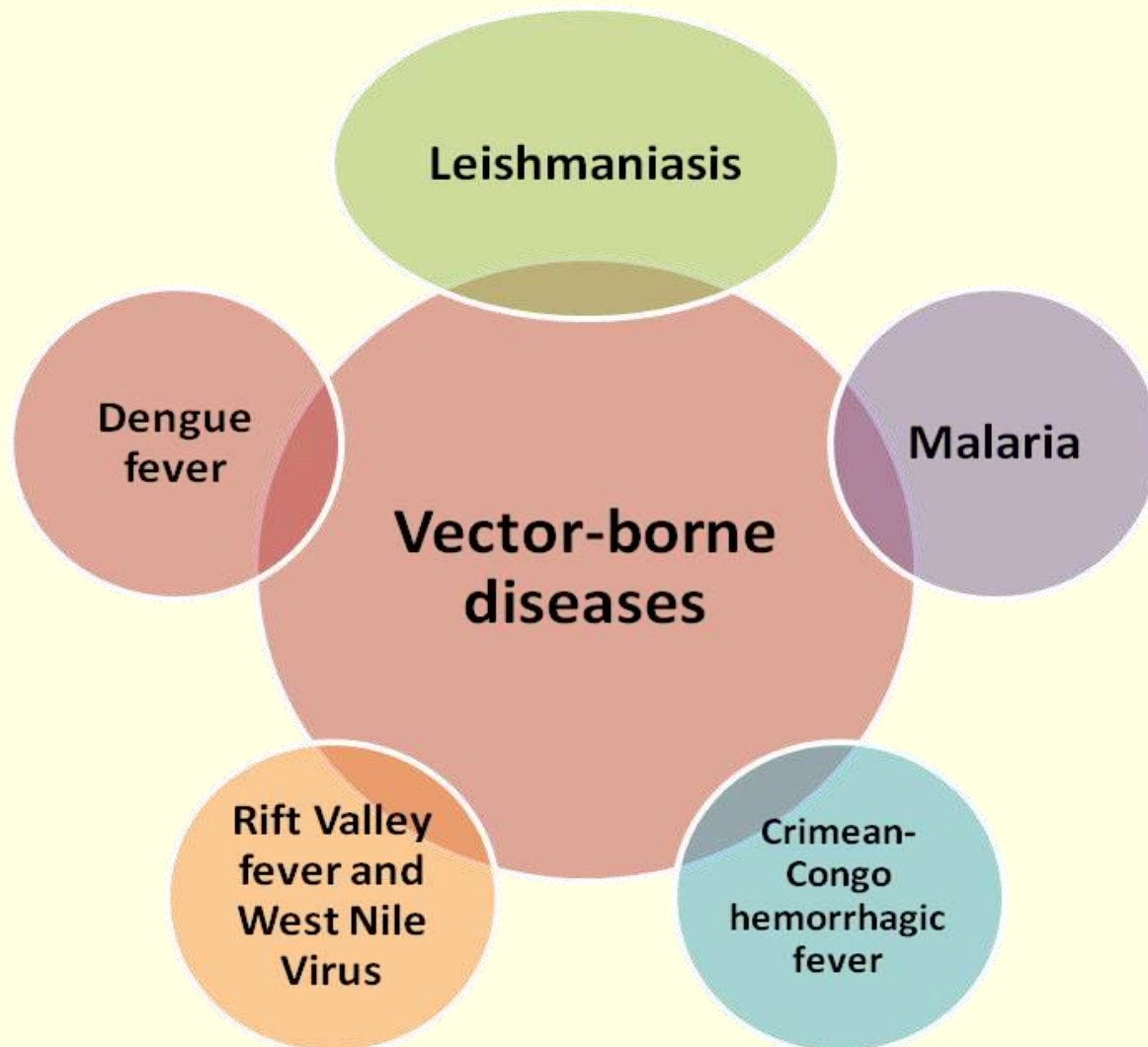
The literature search

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│ Records identified through initial   │
│ search   N = 4147                    │
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│ Full texts articles assessed for     │ └──────────────────────────────────────┘
│ eligibility                          │
│ N = 325                              │
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│ Other articles are included from     │
│ hand search                          │
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│ Studies included in the review       │       │  Reports and information  │
│ (Tables)                             │◀─────▶│  from official websites   │
│ N = 79                               │       │  (included in the supporting │
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Records identified through initial search   N = 4147

Records excluded based on the titles and abstract (not relevant or the country is not in the region (N = 3822)

Full texts articles assessed for eligibility N = 325

Full text articles excluded because they did not meet the inclusion criteria N = 248

Other articles are included from hand search N = 2

Studies included in the review (Tables) N = 79

Reports and information from official websites (included in the supporting text)

Studies' characteristics

Studies' characteristics

Heat related mortality, 6

Other health outcomes, 11

Food insecurity, 2

Reproductive health, 2

Mental Health , 3

Respiratory Health Outcomes, 6

Vector-borne diseases, 36

Food and water borne diseases, 13

Vector-borne diseases

Vector-borne diseases in the EMR research

Vector-borne diseases
Leishmaniasis

- In the Middle East and North Africa (MENA), cutaneous leishmaniasis is regarded as an **endemic disease**.

- Leishmaniasis has received little attention in the research.

Vector-borne diseases
Leishmaniasis

- Studies that investigated the association between climatic variables and leishmaniasis in the EMR are scarce.

- **11 studies** (5 in Iran, 2 in Tunisia, 2 in Sudan, 1 in Egypt, and 1 in some of the Middle East countries).

- 3 studies focused on cutaneous leishmaniasis, 3 on zoonotic cutaneous leishmaniasis (ZCL) and 5 on visceral Leishmaniasis.

- Most studies investigated the spatial and temporal patterns of leishmaniasis, their associations with climate and environmental factor, disease outbreaks, and risk mapping of leishmaniasis.

Vector-borne diseases
Leishmaniasis: *Main findings*

■ The presence of major hotspots of relatively high incidence rates covering some countries.

■ Three climatic factors could be used jointly as explanatory variables to explain part of the spatial variations of the CL incidence rates in these countries.

> **Precipitation** (the higher the precipitation, the higher the incidence rates)

> **Temperature** (the lower the temperature, the higher the incidence rates).

> **Humidity.**

Vector-borne diseases
Leishmaniasis: *Main findings*

- The importance of agriculture and irrigation projects (dams) as risk factors for the emergence of ZCL.

- Climate factors could affect both *Psammomys* obesus and the sand fly population densities.

- The *Phlebotomus* species presence was associated negatively with relative humidity and positively with both maximum temperature and elevation.

Vector-borne diseases
Leishmaniasis

Overall, the reviewed studies showed:

- ➢ There are **seasonal fluctuations** in the incidence of leishmaniasis.

- ➢ A significant relationship between leishmaniasis and climatic factors.

- ➢ Its spatial spread was linked to environmental changes, land use and water development projects such as development of dams and wells for agriculture projects.

Vector-borne diseases
Malaria

- Malaria is endemic in almost half of countries of the EMR, but with a low risk of transmission in the majority of the countries.

- In 2013, about 280 million people in eight countries in the region were at some risk of malaria, with 104 million at high risk.

- Six countries have areas of high malaria transmission (Afghanistan, Djibouti, Pakistan (27%), Somalia, Sudan (57%) and Yemen) and the transmission is focal in Iran and Saudi Arabia.

- Climate change is projected to influence the geographical distribution and intensity of transmission of malaria, due to changing patterns of rainfall, humidity and particularly seasonal variation of temperature.

Vector-borne diseases
Malaria

13 studies (6 in Sudan, 2 in Iran, and one in each of Yemen, Somalia, Pakistan, and Afghanistan).

Rainfall as well as temperature and humidity were the main meteorological variables studied in relation to malaria.

Studies have:

- described the overall malaria situation
- investigated the relationship between meteorological variables and malaria incidence
- plotted the transmission dynamics of falciparum malaria in relation to climatic variables
- developed malaria transmission maps at different geographic areas
- assessed epidemiological characteristics and predisposing factors of the malaria epidemics, and assessed the feasibility of malaria early warning systems,
- designed a spatial model of malaria incidence.

Vector-borne diseases
Malaria

Sudan:

- The bimodal annual peaks and the active transmission observed during the hot dry season
- Infectivity and transmission rates increased with proximity to the river following the peak of rainfall
- Heavy rainfall was found to initiate epidemics.
- seasonal transmission of malaria is increasing with onset of rainy season and high humidity

Yemen: significant associations between climatic factors such as temperature, relative humidity, rainfall volume and wind speed with incidence of malaria.

Egypt: favorable meteorological conditions (i.e., optimum temperature and relative humidity) led to the prolongation of the malaria transmission season.

Vector-borne diseases
Malaria

- **Somalia:** Both minimum and maximum temperatures exhibited non-linear relationships with PfPR.

- Precipitation, maximum and minimum temperature, distance to water and survey month all displayed a highly significant association with PfPR.

- The most prevalent malaria vector species in **Afghanistan** are *Anopheles stephensi, Anopheles culicifacies*, *Anopheles pulcherrimus* and *Anopheles superpictus*. These species breed in river pools, river edges, and irrigated rice fields. Melt snow in the spring and rainfall in the summer provide additional larval habitats and enhance malaria transmission.

Vector-borne diseases
Malaria: *Conclusion*

- Temperature, rainfall and humidity have specific roles in promoting malaria transmissions. These factors influence the propagation and survivorship of the malaria vectors.

- Rice fields, water bodies and other land cover types are associated with the larval habitats of certain malaria vector species.

- An issue that is not being raised is the political instability in the region that may limit the access to malaria treatment and prevention and make the region susceptible to higher malaria incidence and epidemics.

Vector-borne diseases
Malaria: *Conclusion*

- Findings of the reviewed studies have important implications for malaria control.

- Successful implementation of malaria control measures are needed in the countries of the region that are susceptible for malaria.

Vector-borne diseases
Dengue fever

Dengue is a mosquito-borne viral disease affecting humans.

Vector-borne diseases
Dengue fever

- Most countries in the Middle East experience very low annual rainfall and extremely dry weather throughout the year and are thus not favorable for efficient transmission of dengue.

- However, the existence of the dengue vector mosquito, A. aegypti, is reported in some countries in the Middle East and there is evidence that sporadic outbreaks and local transmission of dengue by A. aegypti is taking place.

Vector-borne diseases
Dengue fever: *Main findings*

- **3 studies in Pakistan and 2 studies in Saudia Arabia**.

- The three studies in Pakistan were descriptive studies based on a retrospective review of hospital records.

- The abnormal conditions prevailed in Pakistan during 2010–2011 due to heavy rains and flooding which caused the high rate of dengue spread

- Dengue virus is an endemic in Pakistan, circulating throughout the year with a peak incidence in the post monsoon period.

- Areas with abundant rainfall and high humidity and low elevation areas with calm winds and higher minimum temperatures were found to be favorable for the dengue transmission.

Vector-borne diseases
Dengue fever

- Most high and medium risk areas were mainly concentrated in the central districts of Jeddah-Saudi Arabia and the pattern changes considerably with time

- Most of these districts have limited access to water supply, which forces residents to use water storage containers.

Vector-borne diseases
Crimean-Congo hemorrhagic fever

- Crimean-Congo hemorrhagic fever (CCHF) is a a viral infection widely distributed fatal tick-borne disease in Africa, Asia, Eastern Europe, and the Middle East.

- CCHF is acquired via a tick bite or following contact with an infected vertebrate, its blood, or other secretions.

Vector-borne diseases

Crimean-Congo hemorrhagic fever: Main findings

- Rising temperatures, decreasing rainfall in late autumn, and rising humidity were significantly associated with increasing number of cases in the Sistan-va- Baluchistan province of Iran.

- The temporal modeling of CCHF revealed that the occurrence of the disease in Iran followed seasonal variations and was influenced by climatic factors

Vector-borne diseases

Crimean-Congo hemorrhagic fever: Main findings

- Generally, the results of such studies can be used as predictive indicator in early warning system and could help the health system to plan and have an efficient CCHF control program in the region.

- The results of these studies also may help to improve the methods to control the disease and its surveillance.

Vector-borne diseases
Rift Valley fever and West Nile Virus

- West Nile Virus (WNV) is a vector-borne zoonotic disease, belonging to the Japanese encephalitis serogroup of flaviviruses.

- These viruses are transferred by carriers, specially mosquitoes.

- The disease generally appears at the end of the summer and the beginning of autumn, with incubation period of 3 – 15 days.

- *Cox. pipiens* is a vector of both Rift Valley Fever virus and West Nile Virus

Vector-borne diseases
Rift Valley fever and West Nile Virus

- High temperatures speed up the replication of WNV in mosquitoes, this rapid amplification directly affects the likelihood of the mosquito reaching maturity and subsequently infecting other hosts

- Amplifications of WNV are thought to occur under the climatic conditions of warm winters followed by hot dry summers.

- In drought conditions, standing water pools may encourage birds to circulate around small water holes and thus increase interactions with mosquitoes.

Water- and food- borne diseases

Water- and food- borne diseases
Diarrhea

- 7 studies linked diarrheal diseases to climate change (3 in Pakistan, 2 in Egypt, 1 in Tunisia, and 1 in Jordan).

- Most studies were descriptive in nature.

- Two descriptive studies explored the impact of 2010 flooding on diarrheal diseases in Pakistan.

- Both studies showed that water in flood affected areas was contaminated by Escherichia coli and found to be microbiologically unfit.

Water- and food- borne diseases
Diarrhea

- Studies in other countries studies reported that the incidence rate of diarrhea was the highest in the summer period probably because hot weather encourages the growth of pathogenic organisms in contaminated food.

- Summer is also the breeding season for flies that act as mechanical vectors conveying enteropathogens to food and water.

Water- and food- borne diseases
Cholera

➤ Recent studies have associated higher temperatures and rainfall with diarrhea and cholera, and demonstrated the role of climate variability in cholera transmission.

■ The O139 serogroup co-exists with O1 V. cholerae, being responsible for continuous epidemics in some countries like Bangladesh.

■ In Iran, several epidemics have been registered with the last epidemic occurred in 2005, with 1133 cases and 12 deaths

Water- and food- borne diseases
Cholera

- In the region, **three studies** investigated cholera in the context of climate change

- The incidence of cholera was found to be significantly related to higher temperature and humidity and lower precipitation.

- Pakistan is particularly at risk for waterborne disease because it is an agricultural economy with one of the most expansive water distribution systems in the world.

Water- and food- borne diseases
Cryptosporidiosis

- Cryptosporidiosisis a parasitic disease caused by Cryptosporidium, a protozoan parasite

- It is spread through the fecal-oral route, often through contaminated water

- The main symptom is self-limiting diarrhea

- Cryptosporidium varied depending on the geographic locations of the studies, but it was generally most prevalent in the rainy season.

Research on climate change and health in EMR: Research gaps

Research on climate change and health in EMR: Research gaps

- Scarcity of research linking climate change and health in the most vulnerable countries of the region. The contribution of the research from the EMR to the global literature in this area is minimal.

- Knowledge in the area of climate change and heath is based on limited information and remains limited primarily due to weak technical capacity particularly in the area of modelling climate system dynamics and the lack of adequate availability of relevant data

Research on climate change and health in EMR: Research gaps

- Although that the burden of diseases of climate change is expected to be highest in the EMR, there were few studies addressing important topics such as water-borne and food-borne illness, malnutrition, respiratory and cardiovascular diseases, mental health, vector-borne diseases transmission, and the health risks of extreme weather events other than heat effects.

- Of course, this does not mean there is an absence of research in these areas, but rather that they did not specifically link climate change and health

Research on climate change and health in EMR: Research gaps

- There is limited information regarding how changes in temperature, precipitation and other weather variables might affect the geographic range and incidence of mortality and morbidity from various diseases.

- The impact of climate change on health is not recognized as a priority area by health researchers, health professionals, and policy makers in the EMR countries.

Lake of international research collaborations and partnerships and lack of multidisciplinary research to addresses public health challenges and risks associated with climate change.

Research on climate change and health in EMR: Research gaps

■ Available research has many limitations and shortcomings that arise from:

➢ inappropriate study designs

➢ poor assessment of exposure and outcomes

➢ questionable sources of data

➢ lack of standardized methods

➢ poor adjustment of confounders

➢ limited geographical area studies

➢ small sample sizes

➢ poor statistical modeling, and not testing for possible interactions between exposures.

■ Longitudinal studies over extended periods of time that investigate the link between climate change and health are almost missing in the region

Research on climate change and health in EMR: Recommendations

- Need for greater use of international research collaborations, as well as increased funding from international and global agencies. Thus, the research funding agencies may need to create dedicated funding pools for research in these vulnerable countries.

- There is a need to develop a comprehensive catalog of climate change and associated health outcomes across the range of environments and populations likely to be affected in the region

- Climate change and its impact on health need to be recognized as a priority area by health researchers, health professionals, and policy makers in the EMR countries.

Research on climate change and health in EMR: Recommendations

- More focused, well-designed and evidence based research is needed in the region to assess climatic changes and related health impacts, estimate the burden and cost of climate change, and test the efficacy and effectiveness of the relevant interventions.

- Improvement of predictive models supplemented by continuous prospective measurement and assessment of the key outcomes and exposures which determine the impact of climate change on health.

Research on climate change and health in EMR: Recommendations

- **Longitudinal studies** over extended periods of time for research on heat and health especially in countries with hot summers to determine the factors relating to the adaptive capacity of vulnerable populations and the role of socio-economic conditions should be investigated.

- **Development of long-term data sets on the incidence and prevalence of health outcomes** such as respiratory diseases, as well as of the environmental and social factors with which they are associated.

- Studies that project the future health impacts need to take into account the key factors that determine the geographic range and incidence of diseases, including effectiveness of treatment with respect to population, age and sex.

Research on climate change and health in EMR: Recommendations

- ❑ **Geographic information systems and spatial analysis** must be further developed; they are very useful tools when conducting vulnerability assessments, assessing environmental exposures, prioritizing research, and disseminating findings to decision makers and the public alike.

- ❑ **Remote sensing and environmental monitoring** are particularly useful to catalog variables such as air pollution and heat exposure.

- ■ **The clinical efficacy of interventions and treatments** to protect health from climate change, the development of early warning systems for populations, especially the vulnerable and those with a predisposition are needed and the methodology should be developed for warning systems and for the evaluation of their effectiveness.

Research on climate change and health in EMR: Recommendations

- Research among vulnerable populations and groups including children, elderly, and medically compromised patients.

- Establishing climate-sensitive exposure metrics, with appropriate temporal and spatial dimensions, that are most strongly associated with asthma, allergy, and airway diseases.

- Research on the complex synergistic effect of temperature, weather variability, long-term climate change, and environmental exposures.

- Health professionals should be educated about the climate change and its associated health risks.