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REVIEW ARTICLE

Climate change and health in Iran: a narrative review

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Abstract

Background The consequences of climate change are highly impeding the achievement of Sustainable Development Goals (SDGs) anywhere, especially in low and middle-income countries. While climate change scales up, its health-related risks increase, which in turn leads to cause new challenges for public health. As a second largest country of the Eastern Mediterranean Region of World Health Organization, Iran is highly vulnerable to the effects of climate change.

Purpose This study seeks the notion of health risks and challenges of climate change in Iran and provide potential evidence-based remedies to prevent and diminish such destructive effects.

Methods A comprehensive literature in various computerized databases was conducted, and numerous published original research and review articles about climate change status and evidences of adverse health consequences of climate change in Iran were reviewed.

Results The evidence suggests that the expected health challenges related to climate change in Iran are: rising temperatures; frequent extreme weather events; reduction of air quality; food-borne, water-borne, and vector-borne diseases; mental health and well-being consequences; and the increasing trend of natural disasters and deaths associated with climatological hazards.

Conclusions By considering the growing burden of diseases associated with climate variability in Iran as well as the interdisciplinary nature of climate change and health issues, an integrated, multi-sectoral, and comprehensive approach for identification, prioritization, and implementation of adaptation options is required by Ministry of Health and Medical Education as a custodian of public health in order to enhance the resiliency and adaption against adverse health effects of climate change.

Keywords Climate change · Waterborne diseases · Vector-borne diseases · Communicable diseases · Non-communicable diseases · Food safety · Food security

Background

Global warming is a consequence of the civilizations' development in all over the world. Since the industrial revolution in the nineteenth century, human activities have increased the carbon dioxide levels, up to now, the most abundant greenhouse gas emissions are in the atmosphere. The industrial revolution was a turning point in the interaction between

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human and the environment, which has brought a set of effects on environment as well [1]. According to the definition of the United Nations' Framework Convention on Climate Change)UNFCCC), climate change (CC) is '*the change that can be attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparabletime periods'* [2]. Therefore, climate change might influence the development of human beings via fossil fuels burning, deforestation, desertification, and other activities that increase the concentration ofgreenhouse gases in the atmosphere [2]. Climate change and its consequences are serious concerns for humanity that can impede the pathway towards Sustainable Development Goals (SDG) in all settings, particularly within low and middle-income countries [3].

Climate change is called '*the biggest global health threat of the twenty-first century'* [4]. Through various mechanisms and paths, CC can adversely affect the key requirements of life, i.e. water, food, agriculture, and health. Worse still, any influence on other criteria could also affect health consequently. For instance, by altering the pattern of diseases, especially in low-income and more vulnerable countries, CC is threatening the health of millions of people [4, 5]. Although all people are vulnerable to climate change and its consequences, some groups, i.e. elderly, people with disability, people with past medical history or in poverty, children, and women are more vulnerable to the burden of many climate-sensitive diseases [6]. Four paths have been identified in this regard.

First, CC may lead to inadequate water resources and lack of sanitary. Water availability would presumably reduce in areas where consuming water is supplied by melting ice from the mountain ranges [4]. Heavier rainfall would probably increase the risk of floods and subsequent death tolls. Greater precipitations with higher temperatures will make sanitary water supplies harder and costlier, which would surge the risk of infectious diseases such as diarrhea, typhoid, cholera, malaria, and dengue fever ultimately [7]. Sea level rise threatens the life of people who live in coastal areas, through harming the industries and river floodplains, and adverse effects on their physical and mental health.

The second path is the health effects caused by temperature rise [4]. In other words, higher temperature increases the risk of mortalities associated with cardiovascular and heat-related diseases [6]. For example, in 2003, a heat wave caused up to 70,000 premature deaths across Europe due to cardiovascular and respiratory diseases [8].

The third path is pertinent to the impact of climate change on agriculture and food supplies. Higher temperature would ultimately lead to the decrease of efficiency in desirable crops. Also, reducing food productions in dry and tropical regions increase the number of people exposed to famine and hunger, which would ultimately force the population to displace and migrate to other regions that could also create conflicts on scarce resources [4]. It may also have adverse effects on food security and creates malnutrition, especially in children.

As the fourth path, climate change may contribute to extreme weather events (e.g., drought, storms, and floods) as well as heat waves to occur more violently and more frequently. From 1960 to 2007, the number of affected people by droughts, floods, storms, and extreme temperatures has mounted up about ten times globally [7].

First of all, this study has introduced the status of climate change and some related indexes in Iran. Then it has investigated the various aspects of health issues associated with changing in climate variables such as temperature and rainfall in Iran's territory. Consequently, it has provided a comprehensive vision on the issue. In the following, this article has focused on the organizational and managerial structure of climate change health aspects for better understanding of existing challenges. These challenges would reveal more aspects for future studies on climate change and health field.

Climate change status in Iran

Located in West Asia and being 17th largest country in the world [9], Iran is an upper-middle-income economy [10], with over 80 million population in 2017 [11] . Population growth rate 1.1% in 2017 [12], population under five 8.8%, and population aged 65 or older 4.9% in 2015 accordingly [13]. Also, the Human Development Index (HDI) was 68 in 2014 [14]. Other indicators are shown in Table 1.

More than 80% of Iran is in the arid and semi-arid regions. Almost 11.2% of the country's land is agricultural, while forests, rangeland, deserts, and industrial/residential areas account for 8.7%, 52.1%, 19.7%, and 7.3% of the area, respectively. Enjoying its unique geographic location, Iran has a variety of climates with different types of terrestrial and marine species. However, the country has encountered rainfall decrease, drought, water scarcity, urban and industrial pollutions, desertification, soil erosion, and loss of biodiversity during recent past few years [15]. The average annual rainfall was about 240 mm in Iran [16], which is less than one-third of

Table 1 Some health indicators, demographic and economic estimates in Iranian population estimated in 2013

Health indicators, demographic and economic estimates	
Population living in urban areas (2013)	72.3%
Life expectancy at birth (2013)	74 years
Under-5 mortality per 1000 live births (2013)	17
GDP per capita (current US$, 2013)	6631 USD
Total expenditure on health as % of GDP (2013)	6.7%

Reference [13]

the world average precipitation [17]. The range of temperatures is −20 to +50 degrees Celsius in Iran [15, 17].

Climate change has been associated with some economic and social consequences, i.e. an increase in the urban migration due to drought, reduced agricultural production, and devastating environmental damage [15]. Proportion of people living in urban areas reached 72.3% in 2013, which was about four times higher than it was in 2007 [13].

It is estimated that temperature will rise around 4.5 degrees Celsius in most parts of Iran by 2100's [18], which will be more intense in the central and the southern areas due to their sensitivity to climate change [19]. Under a high emissions scenario, the mean annual temperature is projected to increase by about 6.2 degrees Celsius on average from 1990 to 2100 in Iran. If global emissions decrease rapidly, the temperature rise will be limited to about 1.7 degrees Celsius. It is projected that the number of heat spell days will be approximately 215 days on average in 2100, while it was ten days in 1990. This will be limited to about 50 days on average if global emissions decrease rapidly [13].

Iran is the eighth carbon dioxide emitter after China, the United States of America, the European Union, India, the Russian Federation, Japan, and Canada, and was the fifth consumer of natural gas in the world (5.5% share in natural gas consumption) in 2015 [20]. Iran's total emission of carbon dioxide was 630 million tones and about 8.0 metric tons per capita in 2015 [20].

Iran's performance regarding Climate Change Performance Index (CCPI) was 59 in 2018 [21], which is not promising. While the country is home to 1.07% of world's population [22], it has produced 1.72% of the world's carbon dioxide emissions [23], 34% of which associated with the energy sector. Iran's transport sector had the highest methane emissions among other sectors in 2010 [16].

The 21thConference on parties (COP21) in 2015 emphasized on countries' acceptance to reduce carbon dioxide emissions, where signatory countries agreed to modify their industrial and economic development processes to reduce greenhouse gases globally, aiming to limit the global range temperature to a maximum of 2 degrees Celsius. It was also agreed that high-income countries will donate 100 billion US dollars to reduce greenhouse gas emissions in low and middle-income countries through applying new and clean energy by 2030 [24]. During COP21, Iran announced that it would voluntarily try to reduce its greenhouse gas emissions by 4% until 2020 to reach 12%, subject to meaningful lift of unfair international sanctions and obtaining required funds [25].

IPCC classification on health effects of climate change

Intergovernmental Panel on Climate Change (IPCC) declared in successive reports that climate change contributes to the global burden of diseases and premature deaths [5] and classified two main categories for the health impacts of climate change. First, direct mortalities due to climate-sensitive natural disasters such as floods, heat waves, hurricanes, droughts, and landscape fires. Second, the indirect effects that are divided into two sub-categories: non-communicable diseases (NCD), infectious diseases, food and water contamination, plus changes in the life cycle of vector-borne diseases on one hand and social consequences like migration, food and water insecurity, conflicts, and mental stress on the other hand [26]. (See Table 2).

Overview of the pattern of diseases in Iran

West Asia, where Iran is located in, is strongly influenced by the health impacts of climate change [28]. Overall, NCDs are responsible for 82% of all deaths in 2018 [29], while the burden of communicable diseases was 9.7% in 2012 [30].

As a result of improved health standards, the establishment of national surveillance systems over the past two decades, urbanization, and changing lifestyle, the pattern of diseases has transformed from infectious towards non-communicable diseases, mainly cardiovascular diseases, cancers, and road traffic injuries (RTI) [31]. It is estimated that 79,200 deaths per year are the results of environmental factors with the proportion of disability-adjusted life years (DALY) of 19.0% in World Health Organization (WHO) report 2009 on environmental burden of disease. Also, 9100 deaths per year have been estimated as potential outcomes of outdoor air pollution in that year [32]. It is obvious that air pollution and other chemical pollutions have been increasingly behind the rising burden of NCDs in Iran [30], while malaria, leishmaniasis, Crimean-Congo haemorrhagic fever (CCHF), diarrhea, and cholera have been the most significant infectious diseases associated with climate change in Iran during recent decades [33].

Methods

We used the narrative review method for data collection. This narrative review is based on material derived from a comprehensive literature search conducted using various computerized databases (i.e. the PubMed, Web of Science, EMBASE, Cochrane Library, Scopus, Science Direct, and Google Scholar). The narrative review covered articles that have been published before 31 December 2017. There was no limitation with the date of studies, but the type of articles was only restricted to original research and review articles. Also, the study language was only English. The eight keywords were selected after consulting with experts. The experts were involved in climate change and health fields. In addition,

Table 2 Adverse health impacts of climate change

Effects	Categories	Example	Climatic factors
Direct	Climate-sensitive natural disasters	Floods, heat waves, hurricanes, droughts, and landscape fires	- Rainfall increased in some areas - Precipitation reduction in other areas
Indirect	Non-communicable diseases (NCD)	Cardiovascular diseases Respiratory diseases Cancers Diseases related to the heat wave	- Temperature increase - Increased concentrations of pollutants and allergens
	Food-borne diseases	Food safety (Diseases such as Diarrhea, intestinal infections)	- Precipitation increase - Temperature increase - Change in relative humidity
	Water-borne diseases	Diarrhea, Cholera, Typhoid, Intestinal infections	- Precipitation increase - Temperature increase - Change in relative humidity
	Vector-borne diseases	Malaria, Leishmaniasis, Dengue fever	- Changes in maximum and minimum temperatures, climatic and seasonal patterns - Changes in precipitation pattern - Changes in relative humidity
	Stresses on social processes	Food insecurity (Malnutrition, Hunger, Famine, Population displacement, Migration, and Conflict over limited resources)	- Temperature increase - Reduction of rainfall, increase in precipitation, and impact on agricultural crops

The table was designated by the authors: According to the classification of IPCC [5, 26, 27]

MeSH terms in PubMed were used. The research strategy was determined for searching the database as follows:

1. ((Climate Change) AND Health) AND Iran
2. ((Climate Change) AND Waterborne Disease*) AND Iran
3. ((Climate Change) AND Vector-Borne Disease*) AND Iran
4. ((Climate Change) AND Natural Disaster*) AND Iran
5. ((Climate Change) AND Non-Communicable Disease*) AND Iran
6. ((Climate Change) AND Communicable Disease*) AND Iran
7. ((Climate Change) AND Food Security) AND Iran
8. ((Climate Change) AND Food Safety) AND Iran

Inclusion and exclusion criteria

There was an attempt to identify authentic articles written in English that were published in English peer-reviewed journals. These articles had to been focused on evidence of adverse health effects of climate change in Iran directly. Moreover, they had to explain the influences of climate variables on sensitive diseases to climate change, the number of hospital admission, number of illness cases, the death toll in climatological disasters, quality and sanitation of water. The documents without full text or those which their full texts were not available were excluded. Figure 1 shows the PRISMA flow diagram for the selection process of articles for this review.

Data extraction and analysis

The researchers performed the screening of the titles and abstracts according to the inclusion and exclusion criteria. Then the full texts of the relevant articles were reviewed. Abstracts and articles were selected for review if they come across our research goal. Also, the references of selected articles were studied and other related articles were followed. Those articles which were not in line with the goals and objectives were excluded.

Also, in order to extract the current challenges and remedies of the Iranian health system for controlling and adapting to the adverse health consequences of climate change, an expert panel was held with 11 health experts that have been educated in climate change field from the Tehran University of Medical Sciences and the Ministry of Health.

Results

The full text of 68 articles from 278 original research and review articles published by the end of 2017 was reviewed. Selected articles have been published between 2003 and 2017.

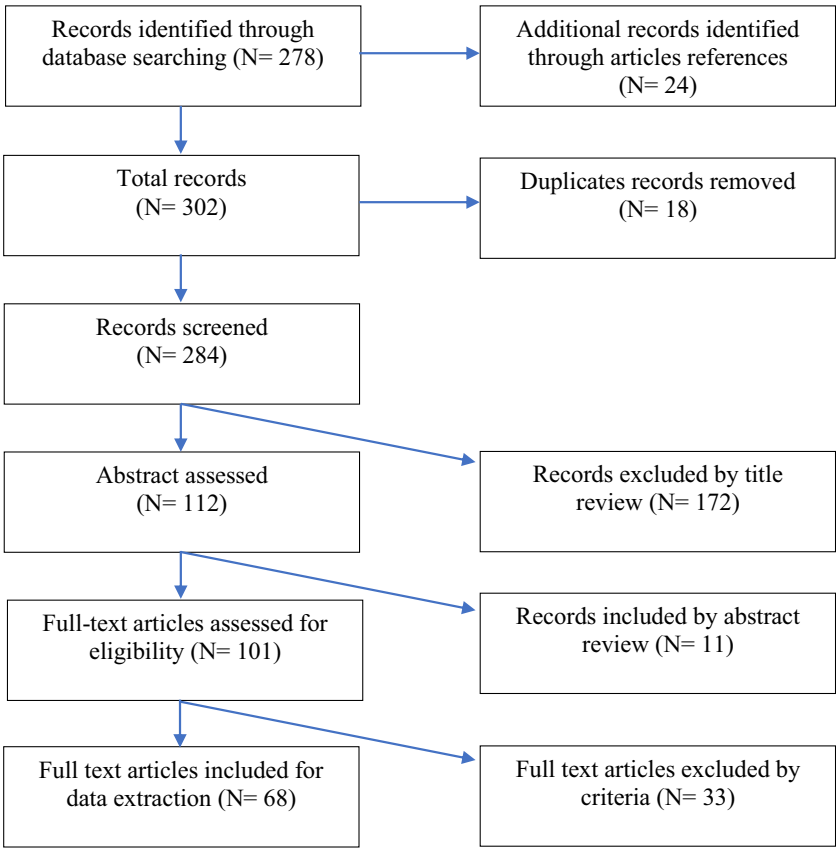

Fig. 1 Flow diagram of the search and selection of articles

As mentioned above, public health in the Islamic Republic of Iran is highly affected by extreme weather events and numerous natural disasters due to diverse climates and climate change. Therefore, the results of this study are presented below in five main groups based on the available evidence in Iran.

Sensitive diseases and injuries to climate change in Iran

Non-communicable diseases

Overall climate change has had an effect on people that have been exposed to heat stresses due to the global warming in Tehran [34]. A recent study on indirect health effects of climate change revealed a strong and positive association between cardiovascular mortality and maximum temperature, plus a negative and weak but significant association between minimum temperature and mortality [35]. It is expectable that increases and decreases in ambient temperature and the number of hot days in the next decades could intensify cardiovascular disease mortality, especially in vulnerable groups in Iran [35–37]. Some regression and linear correlation models also show that temperature reduction is associated with a rise in respiratory and cardiovascular mortality [35, 37].

Tehran, the capital city of Iran is one of the top ten polluted megacities in the world [17, 38]. About 4000–5000 of Tehran inhabitants die due to the air pollution every year [39]. One study showed that 14% of days throughout the year of 2004 were polluted in Tehran, and 26% of Chronic Obstructive Pulmonary Diseases (COPD) were recorded during those days [38]. Another study showed that air pollution with dust particles and SO2 contributed to death toll rises as a result of respiratory diseases in Iran [37, 40]. Regression models in an ecological study indicated that short-term exposure to an ambient concentration of air pollutants such as PM10 and CO, during cold weather, could increase hospital admissions and mortality risk due to CVDs [41–44]. Also, exposure to a high daily mean concentration of SO2, CO, PM10, and NO2 have been related to chronic obstructive pulmonary diseases (COPDs), hospitalizations due to respiratory diseases, and number of patients visiting the emergency departments, especially among the elderly groups [45, 46]. As well as the total mortality caused by trauma (injuries such as traffic accidents, falls, drowning and heat exhaustion) has been increased in the warm season. It has been attributed to the raising activity or traveling in the warm season [47, 48]. Finally, as one of the five common cancers in Iran [49], various types of skin cancer have been associated with climate change and environmental factors such as ultraviolet radiation [50].

Vector-borne diseases

Among various vector-borne diseases, malaria and leishmaniasis, are common health problems in the Eastern Mediterranean Region (EMR) of WHO that are related to climate change [51, 52]. These diseases follow seasonal patterns of incidence in Iran [53]; their epidemiology and transmission could be predicted by meteorological variables [54]. The climatic parameters such as maximum and minimum temperatures, humidity, and rainfall rate [51, 55, 56] are the most effective factors on the life cycle of plasmodium and their transmitters (anopheles mosquitoes) [51]. Population movement [55] and the previous number of malaria cases are other predisposing factors [57]. Although Iran is currently in the pre-elimination phase of malaria control based on the WHO classification, [52, 58] three provinces in south-east Iran have a tropical climate and are still endemic zone for malaria, containing 95% of all of the nation's malaria cases [52, 59, 60], especially among children [61]. The program of malaria control has become more difficult because of proximity with endemic countries such as Iraq, Afghanistan, and Pakistan as well [62–64]. More acute cases of malaria have been registered during the hot seasons in Iran. One-degree Celsius increase in the maximum temperature has increased the incidence of malaria by 15% and 19% during the same and subsequent months [52].

Two forms of leishmaniasis Cutaneous [65–67] and Visceral are more common in Iran [33]. Although in some studies [68, 69] average temperature did not play important role in the number of reported leishmaniasis Cutaneous (CL) cases in Iran, various studies approved that changes in climate variablea including higher maximum temperature, lower rainfall and lower relative humidity are trigger factors in geographic distribution of leishmaniasis, especially in central Iran [33, 70–73]. In addition, Crimean-Congo haemorrhagic fever (CCHF) that is endemic in south-east, central, south, north-east, and north Iran [33], follows a seasonal pattern [74], and the number of its reported cases in warmer and low rainfall seasons are normally higher than other seasons in Iran [75]. Maximum temperature, accumulated rainfalls, and maximum relative humidity have been significantly correlated with the monthly incidence of CCHF in Iran [74].

Water-borne diseases

Climate change brings new challenges to control infectious diseases, including water-borne diseases that are highly sensitive to climate conditions, especially temperature and rainfall [6]. For instance, Cholera that usually spreads through contaminated food and water [76], is still endemic in Iran [77], especially in the south-eastern districts with subtropical and tropical climate condition [77]. The number of registered cholera cases in Iran's health surveillance system has been significantly correlated with climatic factors such as higher temperature, heavy rainfall, and flood [33, 78–80], and humidity in particular [78]. One study showed that rainfall above 294 mm in the rainy seasons, the high temperature above 49.6 degrees Celsius in hot seasons, humidity around 50%, and moderate temperature of under 25 degrees Celsius were major factors related to the cholera epidemic in the country [81].

Furthermore, the incidence of diarrhea depends on climatic factors. Temperature and sea-level rise can influence the frequency and duration of diarrhea outbreaks [82]. For instance, Shigella has been considered as an essential agent of diarrhea among 2–5-year-old Iranian children, while a seasonal pattern of diarrhea was reported mostly in Iran's warmer months [83]. Other consequences of climate change that contribute to high incidence of diarrhea include limited accessible drinking water, warm weather, and extreme environmental pollution [84]. Also, the microbial quality of drinking water in terms of creating dysentery and typhoid diseases is important in hot seasons [85]. With the remaining constant of other factors that influence the incidence of typhoid fever, It has been projected that YLDs (Years Lived with Disability) will be increased by increasing temperature [86].

Food safety and security

Food security is among the greatest challenges of the twenty-firstcentury. The influence of climate change on crop yield has been proved [87]. Sea level and temperature rising increase the frequency and intensity of extreme weather events, which may bring adverse effects to farming [88]. Several regions are prone to drought in Iran, which will get worse in years to come [89]. Hence, strong measures need to be taken to prevent the effects of climate change on food security, especially for vulnerable groups, such as children under the age of five [30]. Whose life cycle of Shigella, Salmonella, and *Escherichia coli* relies on the climatic variables. These have been the most prevalent causes of food-borne diseases in Iran [90, 91]. A significant association was reported between the incidence of shigellosis and monthly temperature, humidity, and atmospheric dust in Iran [92], where the incidence rate of shigellosis showed peaks every summer, especially during August [92]. Finally, the epidemiological analysis of food-borne diseases indicated that the number of outbreaks was the highest during warm months, especially in August with 17.8% of total outbreaks [91]. For Instance, brucellosis and fascioliasis prevalence peaks were associated with accumulated summer rainfall [93, 94].

Climate-sensitive natural hazards

Iran is the sixth exposed nation to natural disasters and among top ten countries whose people are affected by natural disasters. One hundred and three natural disasters happened

between 1900 and 2012 in Iran, with the total of 155,878 deaths [95]. Iran's natural disasters risk class has been estimated as 8 out of 10 [96], and the trend of its natural disasters has been increasing in recent years [97]. Climatological disasters, i.e. flood, flash flood, drought, landslides, forest fire, heat wave, windstorm, and tropical cyclone have been considered as the most intensive and frequent climate-sensitive natural hazards in Iran [96, 98]. Golestan flash floods (2000–2005) and Gonu cyclone (2007) have been the deadliest climatological disasters of the last two decades in the country [99].

A comprehensive recent study to provide a natural disaster profile of Iran showed that out of all natural hazards, 72, 95.3, 14 and 45% of the occurrence, affected population, number of fatalities, and number of damaged buildings respectively were due to hydro-climatological hazards, and the trend was increasing over 1997–2010. Further, the flood has had the highest rate of occurrence with 96.9% and drought possesses the most rate of the affected people with 91.7% in total hydro-climatological disasters in Iran in the past four decades [100].

As a consequence of drought, dust storms have been common in arid and semi-arid regions, particularly in the Middle East [101], where the adverse health effects have been a major concern [102]. Of the 31, 18 provinces in Iran have experienced wind erosion [89]. Factors, such as persistent drought, high evaporation, high wind erosion, reduced rainfall, and lower relative humidity have exacerbated the generation of dust storms in Iran [89]. Worse still, due to anthropogenic impacts on the environment and the imposed war on Iran during 1980–1988, there are still traces of nuclear, chemical, microbial, and heavy metals contaminants in some areas of the country, which will enrich dust storms by sources of air pollutants [89], and will make dust particles more dangerous for people's health [103, 104].

The management structure of health and climate change in Iran

In the Islamic Republic of Iran, there are three organizations responsible for health impacts of climate change, including: Ministry of Health and Medical Education (MoHME), Department of Environment (DoE), and Institute for Environmental Research (IER). (See fig. 2).

Iran's health system lead by the Ministry of Health and Medical Education plays a vital role in responding and mitigating the health effects of climate change. At present, MoHME of the Islamic Republic of Iran is a member of the Regional Committee of WHO and committed to the World Health Assembly resolution on May 2008 for protecting direct and indirect health effects of climate change. Given the essential role of the health system in partnership with other involved sectors, the effective diplomatic reaction by this section would create a extensive approach for adaptation and mitigation of adverse health effects of climate change. The aim of this

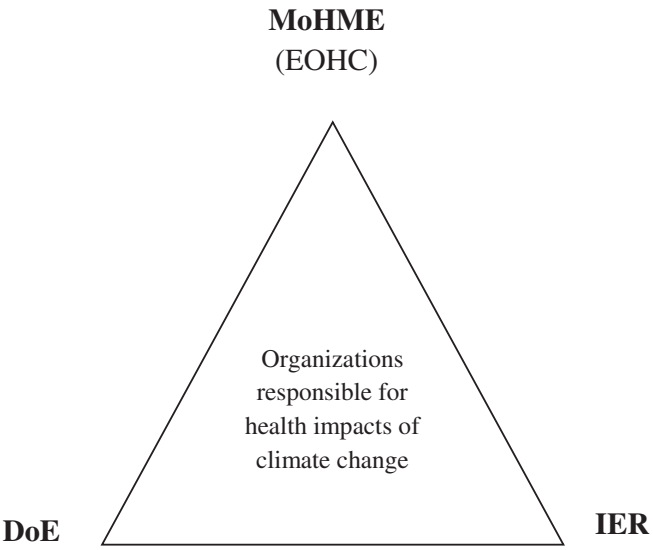

Fig. 2 Organizations responsible for health impacts of climate change in Iran

approach is eventually protecting the planet while promoting the health and well-being of its inhabitants. In this regard, MoHME began a National Adaptation Strategies and Plan of Action project (NASPA) to investigate the impact of climate change on human health. Several working groups, including experts, policy makers and planners in different fields of public health gathered to deliver their adaptation programs.

The working groups have focused on six main topics, including water resources, infectious diseases, occupational health, non-communicable diseases, nutrition, and food security and health management in natural disasters. As a result, National Adaptation Strategies and Plan of Action project (NASPA), was submitted to the relevant organizations in 2014. The main goal of NASPA was to identify related health risks and to suggest emergency programs for reducing injuries. In total, 85 operational projects have been extracted from NASPA. In addition to this project, concerning climate change and health, MoHME also launched other projects listed below:

- Establishment of a National Working Group on Health and Climate Change under the leadership of Center for Environmental and Occupational Health and in collaboration with Institute for Environmental Research at Tehran University of Medical Sciences
- Establishment of the Department of Climate Change and Health in the Institute for Environmental Research at Tehran University of Medical Sciences
- Implementation of six projects on health system vulnerability assessment against climate change (in collaboration with the World Health Organization and the Institute for Environmental Research) in the field of water-borne

diseases, vector-borne diseases, occupational health, nutrition, non-communicable diseases, and extreme events
- Participation in the drafting of a chapter on health and climate change in Iran National Communication to UNFCCC
- Taking part in WHO Conference on Health and Climate Change in Geneva, Switzerland in 2014 with the Department of Environment of Islamic Republic of Iran

Environmental and Occupational Health Center (EOHC) at the deputy of the Ministry of Health and Medical Education (MoHME) is responsible for policy making and providing public health strategies and adaptation programs related to climate change. Climate Change committee has been designed under the supervision of EOHC and has had a close collaboration with the Institute for Environmental Research (IER). EOHC has proposed preventive and curative approaches in order to perform its duties. This center tries to establish the leadership, guidance and supervision roles with external links in other sectors involved in health, for example, water and agriculture as well. It also needs to strengthen its technical and financial expertise also academic and executive research activities in order to be able to succeed.

On the other angle, at the Department of Environment (DoE), there are offices for legislation and health system monitoring. The duties of these offices include evaluating the performance of organizations related to weather and climate change, water and soil, environmental pollution and environmental impacts.

It should be noted that the provisions related to climate change in this organization have been minor. Consequently, fewer assessments have been done in this field. However, in the field of public health, provisions related to the human environment encompass broad dimensions which could be considered for the health effect of climate change.

In addition to the mentioned authorities, the Institute for Environmental Research (IER) at Tehran University of Medical Sciences has comprised to promote an academic level of the health system in the environment field, so some educational and research measures have been done in the national and international levels.

One of the most important of these measures is setting up adepartment on Climate Change and Health, which has been doing activities such as health system vulnerability assessment against climate change in partnership with the World Health Organization; provision of the textbook of health and climate change; investigation of health effects of water shortage in partnership with WHO; active membership in WHO climate change regional network; running workshops on climate change adaption in partnership with Oxford University in Hong Kong; partnership in the study on the estimation of the number of pre-hospital emergency bases in Tehran for dealing with the effects of air pollution and climate change; and partnership in the study on the cardiovascular effects of heat waves inthe Rashtcity.

Beyond that, one of the mechanisms for inter-sectoral collaboration is Secretariat of Supreme Council for Health and Food Security that has been in interaction with 12 ministries and government agencies at the National and province levels. This high-ranking entity provides a context for an integrated approach to health, food and public policies with direct and indirect impacts on public health.

Some challenges and limitations from the perspective of health and climate change in Iran

Despite the above-mentioned issues, there are still challenges to raise the level of social vulnerability to climate change in Iran. In spite of the importance of climate change and health issue, this subject is not a priority in the health system in our country. It needs notifications in policy making level and senior management of the health system. According to the people in charge and experts' opinions that have been given by discussion group meetings, the most important challenges of Iran's health system in dealing with the adverse effects of climate change include:

1) Lack of awareness of policy-makers and health officials towards adverse consequences of climate change
2) Lack of proper collaboration between related organizations to managing health impacts of climate change (nexus approach)
3) Poor stewardship and leadership roles of the health system in policy-making and management of issues related to climate change in the country
4) Lack of technical, organizational, financial and human resources capacities in order to manage these effects
5) Inadequate high-quality research, documentation, training, planning, and implementation of operational programs regarding risk management, reduction of vulnerability and response to the adverse health effects of climate change
6) Lack of budget for the development of climate change and health programs
7) Weak role of health systems in the process of regional and international negotiations on climate change

Conclusion

Considering the full range of problems, the burden of climate-sensitive diseases in Iran, and the growth of acute and chronic diseases and health problems in relation to climate change, the need for national planning to adapt and reduce health problematic effects caused by climate change is more than ever.

Reliable policy-making is needed to develop effective plans. Therefore, the Ministry of Health and Medical Education has not only the preventive and therapeutic approach, but should have a comprehensive and wide-ranging approach, leadership, guidance and observing other health - related sectors such as agriculture and water.

In short, strategies and measures to adapt and reduce the effects of climate change in different levels of society can be beneficial. Knowledge of risks associated with climate change; integration of health services, climate and environment; provision of long-term climate models to estimate the burden of disease; developing response plans and early warning systems; and finally, the development of risk assessment models can significantly reduce the risk of climate-sensitive-diseases, especially among vulnerable populations.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

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