



The environmental health catastrophe in Urmia Lake and asthma disease: a cohort study

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ABSTRACT

Background: Urmia Lake of Iran used to be the largest saltwater lake in the world. It has now disastrously shrunk to 10 percent of its previous size. This study aims to investigate the impact of this environmental catastrophe on the occurrence of asthma.

Methods: The whole population of ten districts in the area were investigated in this retrospective cohort study: "Exposed group" in the neighbouring areas of the lake, "Not exposed group 1" with medium distance (65 km) from the lake, and "Not exposed group 2" with more than 160 km from the lake. Clinical diagnosis of asthma was performed by the family physicians in the whole population.

Results: The occurrence risk of asthma in "Exposed group" was 1.85 times higher (CI95%: 1.1- 3.0) than of "Not exposed group 1". The risk of disease, similarly, in "Exposed group" was 1.44 times more (CI95%: 0.9-2.3) when compared to "Not exposed group 2".

Conclusion: The country and provincial authorities should consider this hazardous climate change in the region seriously before it becomes a harmful event for millions of people living in the area.

Keywords: asthma, incidence, occurrence, Urmia Lake, Iran

INTRODUCTION

Urmia Lake is located in the southwest of Caspian Sea, northwest of Iran. It was, at its greatest extent, the largest saltwater lake in the world, with a surface area of approximately 5,200 km², a length of 140 km, a width of 55 km, and a maximum depth of 16 m. Over the last 1-2 decades, Urmia Lake has disastrously shrunk to 10 percent of its previous size due to damming of the rivers that used to flow into it, and the pumping of groundwater from the surrounding areas (1,2). The dryness of this Lake has led to some harms and regional climate changes including salty dust exposure in inhabitants in the region. A similar environmental health disaster was previously reported from Aral Sea area bordering Kazakhstan and Uzbekistan in central Asia (3-5).

Over the past few decades, the prevalence of asthma has significantly increased in various places in the world with no clear reason. It is now estimated that more than 5 percent, on average, of the world population suffering of asthma. Some epidemiologists predict that by the year 2025, 100 million people will be added to the population of asthma patients worldwide (6-11).

Some studies show that prevalence of asthma in Iran is ranging from 3 to 35 percent in various places in the country (12-13).

This study aims to investigate the occurrence of asthma in the neighbouring areas of Urmia Lake to find whether the recent changes in this lake has had any effect on the pulmonary function (including asthma disease) of inhabitants in the area.

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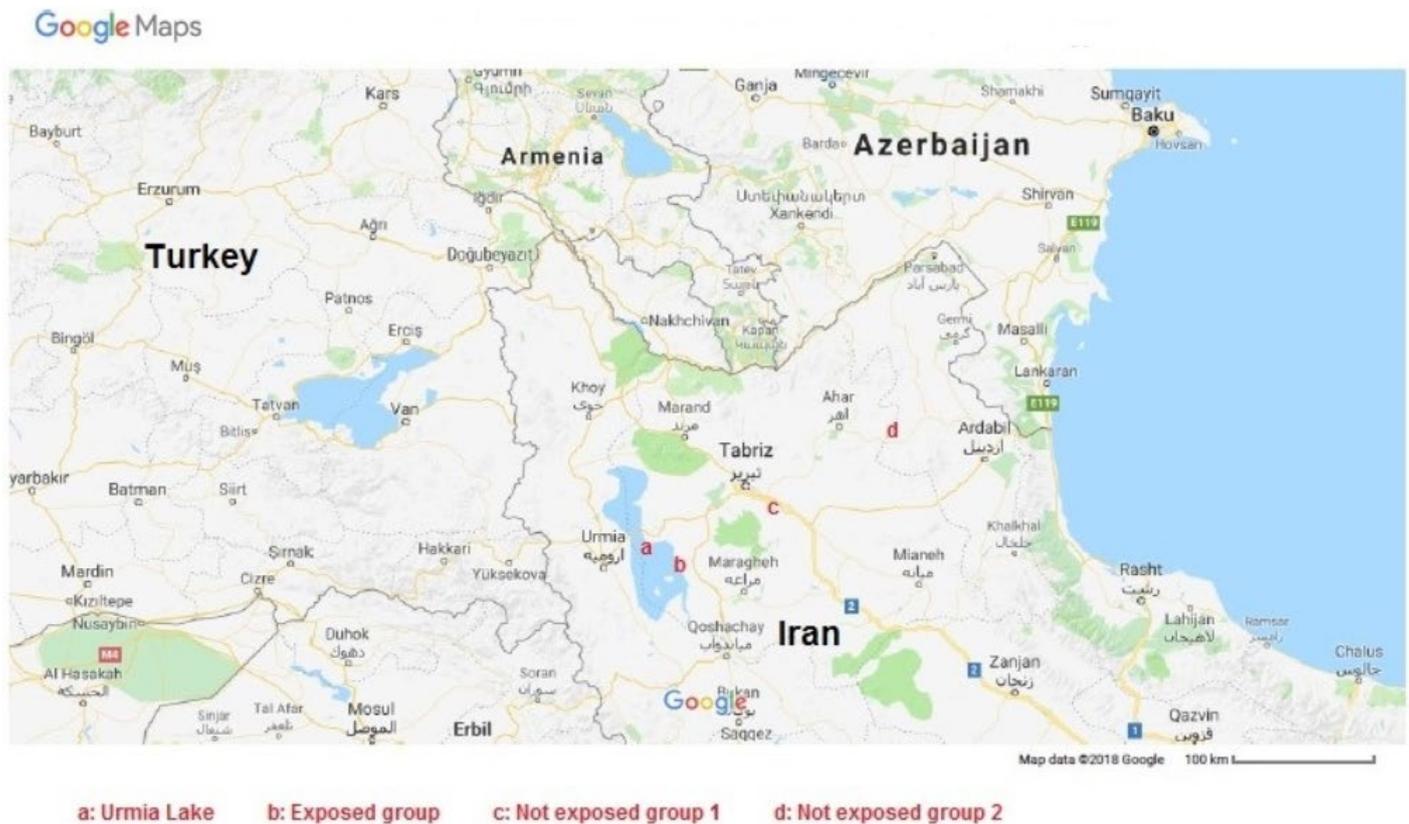


Figure 1: Urmia Lake and the Study Areas in the Northwest of Iran

METHODS

In this retrospective cohort study, the whole population of ten districts in three areas in the northwest of Iran were investigated: five districts in the neighbouring areas of Urmia Lake (with less than 30 km distance from the lake) were selected as "Exposed group" (Sarai, Ghezel Dizaj, Kojabad, Mayan Olya and Mayan Sofla). The district of Dizaj Lilikhani that located in the southeast of the Tabriz city was selected as "Not exposed group 1" with medium distance (65 km) from the lake. Four other areas that were far from the Lake (more than 160 km) were selected as "Not exposed group 2" including Reyhan, Kaqalaq, Kordlar and Naqarakoob districts. The geographical details of the study area are shown in **Figure 1**. The predominant direction of winds in the study population blows broadly from east to west areas. As indicated above, the "Exposed group" is in a very close distant from the lake while both "Not exposed" groups are located far away from the wind direction and the lake. It was then assumed that population in the "Exposed group" has the heaviest/strongest exposure to the salty dust induced by the changes in the lake over the past years compared to "Not exposed group 1,2".

We investigated a total population of 23787 individuals in three groups including: 17983 (male:9355, female:8628) in "Exposed group", 3107 (male:1600, female:1507) in "Not exposed group 1" and 2697 (male:1379, female:1318) in "Not exposed group 2". Clinical diagnosis of asthma was performed by the family physicians based on the official guidelines provided by the Ministry of Health and Medical Education. Information on the age, sex, occupation, smoking, family history of asthma, education, blood pressure, diabetes and duration of the disease were also collected. Those data were used (as confounding factors) in the analysis of data.

Incidence rate of asthma for a period of 10 years (2006 to 2016) was calculated in three levels of exposure in the study groups. We calculated the Relative Risk (RR) as the ratio of the probability of the occurrence of asthma in "Exposed group" to the probability of disease in "Not exposed" groups. Attributable Risk (AR) (similarly called Excess Risk and Risk Difference), was also calculated to show the attributable fraction of environmental pollution on the occurrence of asthma among "Exposed group". Confidence Intervals (CI95%) were calculated to estimate the statistical compatibility range of those epidemiological measures in the study population.

We obtained the ethics approval from the Ethics Committee of the Tabriz University of Medical Sciences for this study. Information was anonymised at source of data collection to keep personal information private.

Table 1: The Incidence Rates (per 1000), Relative Risk and Attributable Risk (%) of Asthma Disease (Urmia Lake Area, Iran, 2006-2016)

	Incidence	Relative Risk	Attributable Risk%	Relative Risk	Attributable Risk%	Relative Risk	Attributable Risk%
exposed	10.12 (8.6-11.5)	1.85 (1.1- 3.0)	45.94 (9.6-82.3)	1.44 (0.9-2.3)	30.39 (-8.8-69.6)	1.63 (1.1-2.3)	38.71 (10.9-66.6)
not exposed 2	5.47 (2.9-8.1)	reference	reference				
not exposed 3	7.04 (3.9-10.2)			reference	reference		
not exposed 2+3	6.20 (4.2-8.2)					reference	reference

Notes: numbers in Parentheses indicate 95 percent confidence intervals

Table 2: The Incidence Rates (per 1000), Relative Risk and Attributable Risk (%) of Asthma Disease by Gender (Urmia Lake Area, Iran, 2006-2016)

	Incidence	Relative Risk	Attributable Risk%	Relative Risk	Attributable Risk%	Relative Risk	Attributable Risk%
exposed							
male	8.01 (6.2-9.8)	1.83 (0.9-3.9)	45.43 (-11.6-102.4)	1.84 (0.8-4.2)	45.73 (-15.3-106.8)	1.84 (1.0-3.3)	45.56 (2.3-88.9)
female	12.40 (10.1-14.7)	1.86 (0.9-3.6)	46.49 (-0.6-93.6)	1.25 (0.7-2.2)	20.47 (-30.6-71.5)	1.52 (0.9-2.4)	34.35 (-1.9-70.6)
not exposed 2							
male	4.37 (1.1-7.6)	reference	reference				
female	6.63 (2.5-10.7)	reference	reference				
not exposed 3							
male	4.35 (0.9-7.8)			reference	reference		
female	9.86 (4.5-15.2)			reference	reference		
not exposed 2+3							
male	4.36 (1.9-6.7)					reference	reference
female	8.14 (4.8-11.6)					reference	reference

Notes: numbers in Parentheses indicate 95 percent confidence intervals

FINDINGS

A total of 218 cases of asthma patients were diagnosed by family doctors in the study population: 182 cases (male:75, female:107) in "Exposed group", 17 (male:7, female:10) in "Not exposed group 1", and 19 cases (male:6, female:13) in "Not exposed group 2" were identified/recruited for this study. The mean age of the patients was 53 years, and the average duration of illness was 5.7 years in asthmatic patients. The majority of the study subjects (53 percent) were housewives, and a very small proportion of them (0.5 percent) were employees of petrochemical and leather companies. Except age and sex, no confounder was found when compared three groups.

The annual incidence of disease was 10.12 (per 1000, CI95%: 8.6-11.5), 5.47 (per 1000, CI95%: 2.9-8.1) and 7.04 (per 1000, CI95%: 3.9-10.2) in "Exposed group", "Not exposed group 1" and "Not exposed group 2", respectively. The occurrence risk of asthma in "Exposed group" was 1.85 times higher (CI95%: 1.1- 3.0) than of "Not exposed group 1" (as reference group). The risk of disease, similarly, in "Exposed group" was 1.44 times more (CI95%: 0.9-2.3) when compared to "Not exposed group 2" (as reference group). It was found that the risk of asthma disease is 63 percent (CI95%: 1.1- 2.3) higher than both control groups (group1+group2). In the neighbouring population of the lake, the risk solely attributed to the exposure to this pollution for asthma disease was 38.7 percent (CI95%: 10.9-66.6) (**Table 1**).

Incidence rates, relative risk and attributable risk of the occurrence of asthma in three study cohorts (stratified by age and sex) are presented in **Tables 2,3**. Except for annual incidence of asthma, no major significant difference was found between males and females in the study population. The incidence rate of disease was always higher in females compared to males in all three exposure groups (**Table 2**).

As presented in **Table 3**, two age groups (<40 vs. >=40 years) showed statistically significant difference in all three exposure levels in terms of annual incidence of asthma. However, the relative risk and attributable risk of the incidence of asthma were not significantly different when compared two age groups.

Table 3: The Incidence Rates (per 1000), Relative Risk and Attributable Risk (%) of Asthma Disease by Age Groups (Urmia Lake Area, Iran, 2006-2016)

	Incidence	Relative Risk	Attributable Risk%	Relative Risk	Attributable Risk%	Relative Risk	Attributable Risk%
exposed							
<40	3.60 (2.6-4.6)	1.57 (0.6-3.9)	36.32 (-36.9-109.6)	—	—	2.82 (1.1-7.1)	64.55 (9.9-119.2)
>=40	33.47 (27.8-39.1)	2.54 (1.4-4.6)	60.56 (23.9-97.1)	1.49 (0.9-2.4)	33.18 (-3.9-70.2)	1.87 (1.3-2.7)	46.65 (19.2-74.1)
not exposed 2							
<40	2.29 (0.3-4.3)	reference	reference				
>=40	13.20 (5.8-20.1)	reference	reference				
not exposed 3							
<40	0			reference	reference		
>=40	22.36 (13.9-31.8)			reference	reference		
not exposed 2+3							
<40	1.28 (0.1-2.4)					reference	reference
>=40	17.86 (11.2-23.9)					reference	reference

Notes: numbers in Parentheses indicate 95 percent confidence intervals

DISCUSSION

In this study, the occurrence risk of asthma in the neighbouring areas of the Urmia salty lake was investigated. We found that the risk of disease is significantly higher in the population in the districts around the lake compared to the population in control areas. We studied the association between the harms of salty dust pollution (induced by dryness of Urmia Lake in the region) and asthma disease in the inhabitants of regional population. This is the first study, in its kind, in this area of the northwest of Iran. As in any epidemiological investigation, there might happen an ecological fallacy in the interpretation of association found in this study. However, some supporting data has similarly been reported from Aral Sea region in central Asia (3-5). Additionally, the time course and pathophysiological pattern of relation between asthma and environmental pollution (including salt pollution etc) is based on a similar physiological response of the body immune response to a particular foreign substance. This response would normally result in the proliferation of the body immunological productions (i.e., immunoglobulins or antibodies etc) to the identified foreign substance. Genetic predisposition of individuals determines the severity of response to those substances. As a result, some individuals may show asthmatic reaction to salt substances exist in the area. Therefore, the dryness of this salty lake over the last two decades might seemingly have played a role in the increasing risk of asthma in the region.

As indicated, similar health and social problems have been investigated in the population in the Aral Sea area, central Asia (4). Bennion and colleagues investigated the respiratory symptoms and lung function in children aged 7–10 years living in 18 communities in the Aral Sea region. They found no relation between the prevalence of asthma and dust exposure in this population in the area (3).

A systematic review of the literature by Crighton and colleagues studied the impacts of the Aral Sea disaster on children health. They found that anemia, diarrheal diseases, and high body burdens of toxic contaminants were the most important health problems for children in the area. They did not find, however, clear association between dust exposure and respiratory function (5).

We conclude that the disastrous situation of Urmia Lake might have an impact on the risk of asthma in the regional population. However, as the limitation of this study, the role of other factors and the possibility of some types of bias (i.e., ecological fallacy in the interpretation of data, underlying diseases in the study subjects, the role of other pollutions in the regional environment etc) on the onset and recurrence of asthma symptoms cannot be ruled out. There is, therefore, need for further studies in order to investigate all aspects comprehensively in large scale groups in the area, and to identify the effect of the salty dusts induces by Urmia Lake more specifically. For the time being, however, the country and provincial authorities should consider this hazardous climate change in the region seriously before it becomes a harmful event for millions of people living in the area.

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Conflicts of Interest

The authors have no conflicts of interest to declare.

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