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# Is Cholera Outbreak Related to Climate Factors? Report of Seven Year Study from 21th March 1998-to 21th March 2004 in Iran

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Cholera is a main food and water borne diseases world wide. This study was conducted to in order to find out is there any relation between Cholera outbreak and climate factors. The number of cholera infection during seven years (1998-2004) compared with the same year climate data. In addition the epidemiology of infection was surveyed in order to find out the possible link. The results of this study indicated that with decreasing or increasing from minimum or maximum range of temperature the outbreaks is dropped down sharply. The humidity around 50% is also prepared the best condition for the outbreak too. Cholera outbreaks could be related with many climate factors. Some factors including moderate temperature (25°C) and humidity increase the risk of epidemic conditions. However the rainfall above 294 mm in the rain seasons and high temperature above 49.6 in hot seasons are the major factors which could be related to cholera epidemic.

**Key word:** Cholera, outbreak, climate, Iran, normal

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## INTRODUCTION

Cholera has been recognized as a killer disease since earliest time. Since 1817, six pandemics have swept over the world and the seventh one is in progress. It was estimated that 12000 deaths reported world wide. Cholera is a highly contagious disease and is transmitted primarily by ingestion of faecally-contaminated water by susceptible persons. Besides water, foods have also been recognized as an important vehicle for transmission of cholera. Foods are likely to be faecally contaminated during preparation, particularly by infected food handlers in an unhygienic environment. Cholera still is a main problem in many countries including in Peru in 1991 (after an absence of cholera there for 100 years) and spread rapidly in Central and South America, with recurrent epidemics in 1992 and 1993 (Gil *et al*., 2004) in Bangladesh (Rowland, 1986) Mexico (Borroto *et al*., 2000) and former USSR (Lomov, 1994).

Little is known regarding the relation between cholera outbreaks and climate factors. However a few research showed strong relationship of rainfall and infectious diseases outbreaks (Venkateswaran, 1989; Lobitz *et al*., 2000; Shope 1991; Weiss *et al*., 2004 ). Also little is known the link of climate factors such as temperature (Shope, 1991; Speelmon *et al*., 2000; Lipp, 2002) too. The purpose of this study was to discover the relation between such weather conditions and daily temperature and other climate factors in Cholera outbreaks. Because of cholera outbreak in Iran which is occurred occasionally this study persuaded. In fact the aim of this study was to determine the relation of climate factors to cholera outbreaks during seven years (1998-2004). In the other hand this hypothesis was arised that is there any possibility between climates factors and cholera outbreak or not? Also we intent to find out which climate factors is the most effective on the outbreaks.

## MATERIALS AND METHODS

This study as cross-sectional study was designed in Iran between 1998-2004 in order to find out the possible link of climate factors and cholera outbreaks. In this regard the climate data was collected from Iran metrology organization based on daily collection of climate condition across the country. In addition the Cholera cases were registered and inserted in computer by co-operation of Iran Center of Diseases Control in Ministry of health during the same years of the study. The both data was inserted, analyzed and compared with SPSS version 11.5.

## RESULTS

The result of this study was shown in Table 1 and 2 in aspect of number of cases of Cholera and condition of weather during 1998-2004, respectively.

As it could be seen in Table 1 and 2 in 1998 the major Cholera epidemic occurred in the recent years in Iran with 9897 cases and 109 death when the minimum temperature in 1998 was -24.6°C in Feb in Aradebil (North west of Iran) and Maximum temperature in 1998 was 50°C in July in Ahvaz (in South of Iran). However all age group were infected and most cases were seen in age group 0-4. The previous report was supported the same finding as the most age group infected were under <5 year.

In 1999, totally 1245 cases were reported at the same years the minimum temperature was -19°C in November the maximum temperature was 50°C in August in Ahvaz (in South of Iran). In 2000, only 345 cases were reported and the minimum -25°C in Ardebil in November and 52.2°C in July in Ahvaz (in South of Iran). In addition, in 2001, only 105 cases of cholera were reported when the minimum degree of temperature was -27°C in January in Ardebil and maximum degree of temperature was 51.6°C in Ahvaz ( in South of Iran).

Table 1: The number of Cholera from 21th March 1998 to 21th March 2004

| | 1998 | | 1999 | | 2000 | | 2001 | | 2002 | | 2003 | | 2004 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Year/Age group | No. | Percent | No. | Percent | No. | Percent | No. | Percent | No. | Percent | No. | Percent | No. | Percent |
| 0-4 | 1327 | 13.5 | 314 | 25.0 | 101 | 29.0 | 35 | 33.0 | 54 | 46.0 | 46 | 47.9 | 34 | 36.0 |
| 5-9 | 774 | 8.0 | 233 | 19.0 | 51 | 15.0 | 14 | 13.0 | 21 | 18.0 | 14 | 14.6 | 14 | 14.9 |
| 10-14 | 842 | 8.5 | 130 | 10.0 | 34 | 10.0 | 10 | 9.5 | 13 | 11.0 | 11 | 11.5 | 18 | 19.0 |
| 15-19 | 1107 | 11.0 | 95 | 7.5 | 33 | 9.5 | 8 | 7.5 | 7 | 5.5 | 9 | 9.4 | 8 | 8.5 |
| 20-24 | 1176 | 12.0 | 137 | 19.0 | 34 | 10.0 | 10 | 9.5 | 2 | 1.5 | 5 | 5.2 | 6 | 6.4 |
| 25-29 | 969 | 10.0 | 86 | 7.0 | 16 | 4.5 | 7 | 6.5 | 7 | 5.5 | 3 | 3.1 | 5 | 5.3 |
| 30-34 | 664 | 7.0 | 52 | 4.0 | 13 | 3.5 | 6 | 6.0 | 3 | 2.5 | 2 | 2.1 | 3 | 3.2 |
| 35-39 | 572 | 6.0 | 37 | 3.0 | 15 | 4.0 | 5 | 5.0 | 2 | 1.5 | 2 | 2.1 | 1 | 1.1 |
| 40-44 | 417 | 4.0 | 31 | 2.5 | 7 | 2.0 | 2 | 2.0 | 2 | 1.5 | 1 | 1.1 | 2 | 2.1 |
| 45-49 | 371 | 4.0 | 20 | 1.5 | 10 | 3.0 | 1 | 1.0 | 3 | 2.5 | 0 | 0.0 | 0 | 0.0 |
| 50-54 | 335 | 3.0 | 27 | 2.0 | 8 | 3.0 | 3 | 2.5 | 0 | 0.0 | 0 | 0.0 | 1 | 1.1 |
| 55-59 | 264 | 2.5 | 16 | 1.0 | 4 | 1.0 | 1 | 1.0 | 0 | 0.0 | 0 | 0.0 | 0 | 0.0 |
| ≥60 | 1079 | 11.0 | 67 | 5.0 | 19 | 5.5 | 3 | 2.5 | 4 | 2.5 | 3 | 3.1 | 2 | 2.1 |
| Total cases | 9897 | 100.0 | 1245 | 100.0 | 345 | 100.0 | 105 | 100.0 | 116 | 100.0 | 96 | 100.0 | 94 | 100.0 |
| No. of death | 109 | | 17 | | 3 | | 1 | | 1 | | 0 | | 1 | |

Table 2: The situation of climate from 21th March 1998- to 21th March 2004

| | Temperature | | Relative Humidity | | Precipitation | |
|---|---|---|---|---|---|---|
| Year | Min. Month District | Max .Month District | Min. Month District | Max. Month District | Min. Month District | Max. Month District |
| 1998 | -24.6 Feb Ardebil | 50 July Ahvaz | 7 Sep Zahedan | 100 Nov Rasht | 0 Sep Ghazvin | 340 Jan Rasht |
| 1999 | -19 Nov Ardebil | 50 Aug Ahvaz | 6 June Yasoj | 99 Jan Rasht | 0 Sep Arak Zan<br>0 June Noshahr<br>0 Oct Yasoj | 350 Dec Rasht |
| 2000 | -25 Feb Ardebil | 52.2 July Ahvaz | 7 June Khoramabad Yasoj | 99 Feb Rasht | 0 Apr Kerman Shahrekord Semnan | |
| | | | | | 0 May Arak | 380 Oct Noshahr |
| 2001 | -27 Jan Ardebil | 51.6 Aug Ahvaz | 6 May Zahedan | 99 Oct Rasht | 0 Oct Kerman | 644.6 Dec Yasoj |
| 2002 | -26.8 Dec Ardebil | 50 July Ahvaz | 8 Sep Arak<br>8 Aug Khoramabad | 99 Nov Rasht | 0 Sep Bojnord Khoramabad Semnan | |
| | | | | | 0 Aug Tabriz | 294.2 Dec Rasht |
| 2003 | -19 Dec Ardebil | 49.6 Aug Arak | 7 Sep Shiraz | 99 Sep Rasht | 0 Sep Khoramabad Arak<br>0 Oct Ahvaz | |
| | | | | | 0 May Kerman | 357.8 Sep Noshahr |
| 2004 | -27.6 Mar Ardebil | 50 Aug Ahvaz | 6 Aug Zahedan | 99 Sep Rasht | 0 Sep Kermanshah | 310 Nov Noshahr |

In 2002, only 116 cases of cholera were reported when the minimum degree of temperature was -26.8°C in December in Ardebil in North West of Iran and maximum degree of temperature was 50°C in Ahvaz in South of Iran.

In 2003, only 96 cases of cholera were reported when the minimum degree of temperature in the same year was -19°C in Ardebil in December in North West of Iran and maximum temperature was 49.6°C in August in Arak in center of Iran.

In 2004, 94 cases of cholera were reported at the same year and the minimum temperature were -27.6°C in March in Ardebil in North west of Iran and the maximum degree of temperature was 50°C in August in Ahvaz in South of Iran.

It should be noted that the Min and Max relative humidity in 1998, 1999, 2000, 2001, 2002, 2003, 2004 were, 7(Zahedan-Sep) 100(Rasht-Nov), 6(Yasoj-June). 99(Rasth-Jan), 7(Yasoj), 9(Rasht-Feb), 6(Zahedan-May), 99(Rasht-Oct), 8(Arak-Sep; Khoramabd-Aug), 99(Rash-Nov), 7(Shiraz-Sep), 99(Rasht-Sep) and 6(Zahedan-Aug), 99(Rasht-Sep), respectively.

However, the minimum amount of rain fall in 1998 was 0 mm in Sep in Ghazvin and the maximum amount of rain fall was in Rasht (340 mm) in December in 1999 0 mm in Sep in Arak and ZanJan and 0 mm in June in Noshahr (North of Iran) and 0 mm in Oct Yasoj (South of Iran) and maximum rainfall in Dec 350 in Rasht (North of Iran). The minimum amount of rain fall in 2000 was 0 mm in Apr Kerman, Shahrekord and Semnan 0 mm in May in Arak. However the maximum rate of rainfall was 380 mm in Oct in Noshahr (North of Iran).

The minimum amount of rain fall in 2001 was 0 mm in Kerman in Oct. However the maximum rate of rainfall was 644.6 mm in Dec in Yasoj. The minimum amount of rain fall in 2002 was 0 mm in Sep in Bojnord, Khoramabad and Semnan, in addition 0 mm in Aug in Tabriz. However, the maximum rate of rainfall was 294.2 mm in Dec in Rasht. The minimum amount of rain fall in 2003 was 0 mm in Sep in Khoramabad and Arak. In addition 0 mm in Oct in Ahvaz and the same amount of rainfall in May in Kerman and finally the minimum amount of rain fall in 2004 was 0 mm in Sep in Kermanshah (West of Iran); however the maximum rate of rainfall was 310 mm in Nov in Noshahr (North of Iran).

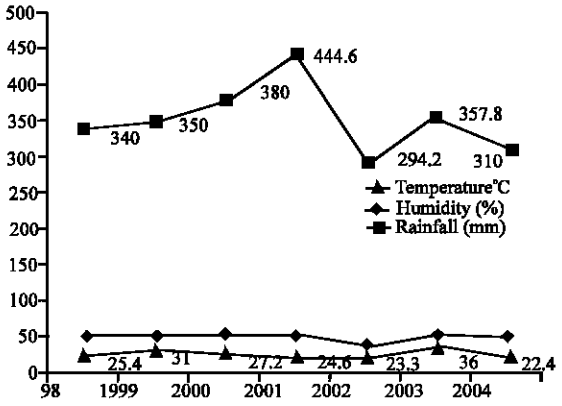


Fig. 1: The situation of a few climate factors including temperature, humidity and rainfall during 1998-2004

The situation of a few climate factors including temperature, humidity and rainfall during 1998-2004 was shown in Fig. 1.

## DISCUSSION

Cholera is endemic infectious diseases in Iran (Khazaei *et al*., 2005) the same as other countries either

developing or developed countries (Simanjuntak *et al*., 2001; Quick *et al*., 1995; Gil *et al*., 2004)). Cholera was reported from 21th March 1998- to 21th March 2004 in Iran as well as other countries including Afghanistan and Pakistan (Khazaei *et al*., 2005). Some studies indicated that such factors could be rolled as reservoir for *V. cholerae* regarding El Nino event (Gil *et al*., 2004; Speelmon *et al*., 2000) our findings support their studies.

A few researcher were shown the few amount of rainfall may related to sporadic form of Cholera however heavy rainfall may related to epidemic form of Cholera (Shope, 1991; Simanjuntak, 2001; Koelle, 2005). Our findings also support their study too. It should be noted that the diseases were reported when the rainfall in Iran was the highest amount during seven years of study in particular in 1998 with amount of 340 mm and high rate of morbidity and mortality during the years of studies.

Possible the rainfall above 294 mm in the rain seasons and high temperature above 49.6 in hot seasons are the major factors which could be related to cholera epidemic. However the minimum temperatures no cases of cholera was reported a cross the country during seven year of the study. In addition the humidity around 50% and moderate temperature under 25°C may have a role in particular in sporadic spreading of the diseases no published data were found to compare the results.

Therefore this study indicated that climate changes could be affected the rate of cholera prevalence, further studies requires finding out other aspect of the outbreaks which may be useful in epidemiology investigation or preparedness for controlling the infection.

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