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The relation between mortality from cardiovascular diseases and temperature in Shiraz, Iran, 2006-2012

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Original Article

Abstract

BACKGROUND: Several studies have suggested that temperature may have an effect on the number of cardiovascular deaths in societies. Global warming is a concern, and cardiovascular diseases are the top cause of death worldwide. This study investigated the relation between temperature and cardiovascular mortality in Shiraz City, Iran.

METHODS: In this ecological study, data about temperature and cardiovascular deaths (in age and gender groups) in Shiraz City were inquired from 2006 to 2012. The simultaneous and delayed relation between monthly temperature and cardiovascular deaths was examined using Spearman and Pearson correlation tests, and crude and adjusted negative binomial regression analysis with adjustment for confounding factors such as humidity, rainfall, wind direction, wind speed, and air pollutants. Analysis was done using MINITAB and STATA software.

RESULTS: During this period 17,167 deaths were reported in Shiraz. The lowest number of cardiovascular deaths was reported in 20 °C. No significant relation was observed between mean monthly temperature and cardiovascular deaths in the same month after adjusting for confounding factors. Although, cardiovascular death in 18- to 60-year-old people showed an inverse significant relation with minimum [Incidence rate ratio (IRR) = 0.98989, P = 0.020], maximum (IRR = 0.99046, P = 0.011), and mean temperature (IRR = 0.98913, P = 0.006) of the same month in the crude model, it was not significant in the adjusted model (IRR = 0.99848, P = 0.848, IRR = 0.99587, P = 0.584, and IRR = 0.99512, P = 0.506, respectively).

CONCLUSION: It seems that there is no significant relation between temperature and cardiovascular deaths in Shiraz, which is probably due to its moderate climate, and the fact that no major heat or cold wave occurred during this time.

Keywords: Temperature, Global Warming, Cardiovascular Diseases, Mortality, Iran

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Introduction

Dissemination of greenhouse gases and compounds such as chlorofluorocarbons (CFCs), can damage the ozone layer in the stratosphere, and has led to global warming and concerns over its effects on human health.[1] Global warming causes melting of glaciers, sea level rise, flooding, and destruction of valuable environmental areas, destruction of cities, and loss of humans, animals, and plants.[2] Generally, as temperature rises or drops from the human comfort zone, distress and mortality increases.[3] Deaths that are directly related to temperature, such as increase in body temperature, can result from cardiovascular disorders, respiratory disorders, or poorly functioning blood vessels.[4] Some evidences show the relation between respiratory mortality and temperature, and a great increase in the number of respiratory deaths in cold temperatures.[5]

Some studies have suggested that low temperature increases the incidence of heart attacks and possibly cardiovascular deaths.[6] Moghadamnia et al. conducted a systematic review based on studies that were mainly conducted in south east Asia, and concluded that both increase and decrease in ambient temperature related to cardiovascular mortality; but suggested that more studies from different geographical regions and climates should be conducted.[7] Jahanbakhsh et al. in Ahar, Iran,

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found a negative significant correlation ($r = -0.34$, $P = 0.01$) between temperature and number of deaths due to myocardial infarction.[6] Studies from England show that low temperatures increase the risk of ischemic heart disease mortality,[8] and cold weather is associated with higher death rates in all ages, and especially in older people.[9]

A study conducted in 12 cities in the United States showed that both cold and hot temperatures affect mortality from myocardial infarction (MI) and all cardiovascular diseases (CVDs); but the effects of these extreme temperatures are different. Cold temperature had a more homogeneous and continuous effect on both outcomes. Warm temperature had a more important effect on death due to MI compared to all CVDs, and death due to MI was higher in these temperatures. In hot cities, cold weather did not show any effect on cardiovascular mortality.[10]

A significant inverse relation was observed between cardiovascular deaths and temperature in a study in Iran, Kerman City, which has a desert climate.[11] Most epidemiologic studies on temperature and death were conducted in North America and Europe, most of which had temperature increase over the two last decades. Europe has been warming 0.3 °C per decade since 1970.[12] Death rates increased by 70 percent in Britain in some winters compared to summers. The increased death rate in winter was associated with the difference between low temperature and high temperature in winter and summer.[13]

Further studies are needed for better understanding the relation between temperature and human death rates. Although these deaths are probably also affected by ambient air pollutants and pre-existing health backgrounds, further research is required in regions with various climate conditions and different cultures to further clarify the effect of temperature on human death rates. This study investigated the relation between temperature and cardiovascular death in different age and gender groups in a city in the south west of Iran, Shiraz.

Materials and Methods

The current study was an ecological population-based study conducted in Shiraz. Shiraz is the fifth most populous city of Iran, and the capital of the Fars Province. In the 2011 census, the population of this city was 1,700,665. Shiraz is located in the southwest of Iran, on the Dry River which is seasonal river. It has a moderate climate, and is one of the oldest cities of ancient Persia.[14]

Initially, the number of deaths per day and their causes were inquired from 2006 until 2012 from the Health Deputy of Shiraz University of Medical Sciences, Shiraz, Iran. This information was anonymous. Only deaths due to cardiovascular diseases were selected, and other causes were excluded. Cardiovascular deaths were classified into the following groups: age at death below 18 years, 18-60 years, and above 60 years, and men and women deaths.

Cardiovascular deaths consisted of recorded deaths resulting from myocardial infarction, stroke, high blood pressure, pulmonary embolism, arterial embolism, thrombosis, aortic aneurysm, dissecting aneurysm, other vascular diseases, other heart diseases, other cardiovascular diseases, non-rheumatic mitral and aortic valve disorders, acute and subacute endocarditis, acute pericarditis, acute myocarditis, cardiomyopathy, heart failure, and cardiovascular congenital malformations.

The daily mean values of temperature (mean, minimum, and maximum), rainfall, relative humidity, and wind direction and speed were inquired from the meteorology department of Shiraz, and the recorded air pollutant levels were inquired from the Shiraz Environmental Protection Agency, and included carbon monoxide (CO), nitric oxide (NO), nitrogen dioxide (NO_2), nitrogen oxides (NO_x), sulfur dioxide (SO_2), ozone (O_3), particulate matter with aerodynamic diameter ≤ 10 µm (PM_{10}), methane (CH_4), total hydrocarbons (THC), and non-methane hydrocarbons (NMHC) for the same time period.

Later in this study, as the number of cardiovascular death counts per day was zero on many days; and also air pollution data was not available for every day of each month due to device malfunction, the overall monthly mortality, and the monthly average of meteorological variables (including temperature, humidity, rainfall, wind direction, and wind speed), and air pollution data were used.

In this study, the relation between mean monthly temperature and cardiovascular mortality, and the percent of change in cardiovascular mortality per degree Celsius change in temperature was computed. The best statistical model to predict the changes was selected by using the highest coefficient of determination (R^2). The minimum death temperature, which meant the temperature that the least number of death occurred, was calculated by taking the derivative of the equation and setting it equal to zero, and solving the equation for x.

Table 1. The number of cardiovascular mortality per month in Shiraz City, Iran, from March 2006 to March 2012

Month	Number of cardiovascular mortality*					
	Total	Sex		Age (year)		
		Men	Women	Under 18	18 to 60	Over 60
January	1696	910	786	14	309	1370
February	1193	658	535	12	263	918
March	1246	712	534	9	268	968
April	1487	835	655	13	224	1239
May	1374	774	600	8	232	1129
June	1365	732	633	18	256	1085
July	1423	780	643	13	214	1196
August	1398	781	617	10	240	1134
September	1267	706	561	9	222	1046
October	1405	767	638	15	242	1156
November	1504	828	676	12	276	1228
December	1809	994	812	21	285	1513
Total	17167	9477	7690	154	3031	13982

* Based on the International Statistical Classification of Diseases and Related Health Problems 10th Revision (ICD-10)

In order to determine the relation between the minimum, maximum, and mean temperatures and cardiovascular mortality the negative binomial regression was used and incidence rate ratio (IRR) was computed in univariate and multivariate models. Of course, various analyzes can be used.[15] Beforehand the fitting of Poisson regression analysis on cardiovascular mortality data was tested, and due to over-dispersion (variance greater than mean), negative binomial regression was used instead. The multivariable model included independent variables (minimum, maximum, or mean monthly temperature) and confounding variables (monthly relative humidity, monthly rainfall, wind speed and direction, and air pollutants including CO, NO_x, PM_{10}, SO_2, O_3, and THC). Some studies have shown a relation between air pollutants and cardiac deaths.[16] In this study, the base population size for each study group was acquired from the Statistical Center of Iran.

The correlations between temperature and cardiovascular mortality in the next month were calculated using the Pearson correlation coefficient or Spearman correlation coefficient. If the distribution of the data was normal, Pearson correlation coefficient was used, and if data distribution was not normal, Spearman correlation coefficient was used. All analyses were done on 6 groups of under 18 year old, 18-60 year old, above 60 year old, and men and women deaths. Data were analyzed using MINITAB (version 16, Minitab Inc., State College, PA, USA) and STATA (version 11, StataCorp LLC., College Station, TX, USA).

Results

Descriptive analyses of cardiovascular deaths during March 2006 to March 2012 are shown in table 1. The total number of cardiovascular deaths in Shiraz during March 2006 to March 2012 was 17167. The maximum number of cardiovascular deaths in the general population, and in other sub-categories, occurred in December and January with an average temperature of 11.90 and 6.1 °C, respectively, during these 6 years. The averages of meteorological variables from March 2006 to March 2012 in Shiraz are shown in table 2.

Table 2. The mean temperature, relative humidity, rainfall, and wind speed and direction per month and pollutants in Shiraz City, Iran, from March 2006 to March 2012

Month	Temperature (Celsius degree)			Rainfall (mm)	Relative humidity (%)	Wind direction (Degree)	Wind speed (m/s)
	Minimum	Maximum	Mean				
January	4.03	19.76	11.90	31.55		12.50	220
Febuary	0.96	14.33	7.65	34.95	26.25	10.66	250
March	8.73	23.11	15.92	33.84	45.73	11.16	250
April	13.50	30.28	21.89	31.15	2.28	12.83	255
May	17.65	35.98	26.81	27.69	0.11	11.33	257
June	20.56	38.88	29.72	29.99	0.00	10.50	245
July	20.43	37.93	29.18	29.55	1.66	9.16	248
August	16.76	35.28	26.02	30.20	0.43	12.33	253
September	11.58	30.71	21.15	28.86	0.01	9.16	268
October	6.51	23.35	14.93	32.02	11.63	9.33	248
November	0.43	15.73	8.08	33.03	50.40	7.83	218
December	-1.00	13.30	6.15	32.37	39.61	9.33	220

Table 3. The level of pollutants in Shiraz City, Iran, during the years 2006 to 2012

Pollutant	Mean	Median	Minimum	Maximum	SD
CO (ppb)	3034.758	2866.150	1205.630	5864.000	1290.237
PM_{10} (µg/m³ air)	86.143	80.372	28.341	212.007	35.751
NO (ppb)	57.598	48.105	22.790	181.430	30.336
NO_2 (ppb)	30.996	28.722	22.110	55.080	7.133
NO_x (ppb)	88.235	82.078	44.850	223.530	34.433
O_3 (ppb)	17.490	16.289	4.480	40.180	8.368
SO_2 (ppb)	101.531	82.734	3.100	292.740	94.238
CH_4 (ppmc)	2.416	2.506	0.832	4.449	0.753
NMHC (ppmc)	1.535	1.374	0.538	4.098	0.635
THC (ppmc)	3.989	3.950	1.663	7.887	1.149

SD: Standard deviation, ppb: Parts per billion; PM_{10}: Particulate matter with aerodynamic diameter ≤ 10 µm; ppmc: Parts per million carbon; CO: Carbon monoxide; NO: Nitric oxide; NO_2: Nitrogen dioxide; NO_x: Nitrogen oxides; SO_2: Sulfur dioxide; CH_4: Methane; O3: Ozone; NMHC: Non-methane hydrocarbons; THC: Total hydrocarbons

The level of pollutants is shown in table 3 as well.

Results of negative binomial regression between mean monthly temperature and cardiovascular mortality are shown in table 4. The multivariate analysis has been adjusted for humidity, rainfall, wind speed, wind direction, and air pollutants including CO, NOx, PM_{10}, SO_2, O_3, and THC.

The relation between temperature and cardiovascular death in total people, men, women, and people with age of fewer than 18 years and above 60 years was inverse and non-significant. An inverse significant relation was observed between cardiovascular deaths in 18- to 60-year- old people and minimum (P = 0.020), maximum (P = 0.011), and mean temperature (P = 0.006); but after adjusting for confounders, this relation disappeared (P = 0.848, P = 0.584, and P = 0.506, respectively).

To investigate the relation between cardiovascular mortalities and the temperature of the previous month, depending on normal or abnormal distribution of variables, Pearson or Spearman correlation tests were performed which are shown in table 5.

Correlation tests indicated that there was an inverse significant relation only between the number of cardiovascular deaths in 18- to 60-year-old and minimum (r = -0.268, P = 0.020), maximum (r = -0.238, P = 0.046), and mean temperature (r = -0.253, P = 0.034) in the previous month. This means as the minimum, maximum, and mean temperature decreased, the number of cardiovascular mortality that happened in the 18- to 60-year-old age group, in the next month, increased.

Table 4. The results of crude and adjusted negative binomial regression analysis

Group		Temperature	Crude IRR (95% CI)	P	Crude IRR (95% CI)	P
Total deaths		Minimum	0.99555 (0.98906-1.00209)	0.182	0.99645 (0.98445-1.00860)	0.566
		Maximum	0.99598 (0.99062-1.00137)	0.144	0.99410 (0.98441-1.00388)	0.236
		Mean	0.99534 (0.98966-1.00105)	0.110	0.99376 (0.98388-1.00375)	0.221
Sex	Men	Minimum	0.99574 (0.98938-1.00215)	0.193	0.99833 (0.98684-1.00995)	0.778
		Maximum	0.99626 (0.99098-1.00156)	0.167	0.99626 (0.98692-1.00569)	0.436
		Mean	0.99566 (0.99007-1.00128)	0.130	0.99634 (0.99606-1.00330)	0.870
	Women	Minimum	0.99535 (0.98779-1.00298)	0.332	0.99428 (0.97988-1.00890)	0.441
		Maximum	0.99567 (0.98943-1.00195)	0.176	0.99139 (0.97983-1.00309)	0.149
		Mean	0.99498 (0.98837-1.00164)	0.139	0.99060 (0.97805-1.00253)	0.123
Age (year)	Under 18	Minimum	0.98817 (0.96279-1.01422)	0.370	0.97078 (0.92391-1.02003)	0.240
		Maximum	0.99280 (0.97144-1.01463)	0.515	0.99116 (0.93829-1.04699)	0.751
		Mean	0.99276 (0.96989-1.01616)	0.541	0.98949 (0.94887-1.03184)	0.621
	18-60	Minimum	0.98989 (0.99895-0.98091)	0.020†	0.99848 (0.98309-1.01410)	0.848
		Maximum	0.99046 (0.98317-0.99780)	0.011†	0.99587 (0.98124-1.01072)	0.584
		Mean	0.98913 (0.98144-0.99688)	0.006†	0.99512 (0.98090-1.00955)	0.506
	Over 60	Minimum	0.99530 (0.97517-1.01585)	0.652	0.98354 (0.94756-1.02089)	0.383
		Maximum	0.99645 (0.97959-1.01361)	0.164	0.99280 (0.96135-1.02527)	0.660
		Mean	0.99480 (0.97711-1.01281)	0.569	0.99236 (0.96029-1.02550)	0.648

IRR: Incidence rate ratio; The calculated IRR was adjusted for humidity, rainfall, wind speed, wind direction, and air pollutants including CO, NO_x, particulate matter with aerodynamic diameter ≤ 10 µm (PM_{10}), SO_2, O_3, and total hydrocarbons (THC)

† Statistically significant; 95% CI: 95% Confidence interval; NO_x: Nitrogen oxides; CO: Carbon monoxide; SO_2: Sulfur dioxide; O_3: Ozone

The ratio shows increase in death in month per unit of increase in minimum, maximum, or mean temperature in the same month in different subgroups.

Table 5. The correlation between mean temperature and cardiovascular deaths happening one month later, in different population subgroups

Group		Temperature	Pearson correlation coefficient (r)	P
Total people		Minimum	-0.104	0.388
		Maximum	-0.048	0.694
		Mean	-0.073	0.543
Sex	Women	Minimum	-0.085	0.483
		Maximum	-0.034	0.777
		Mean	-0.057	0.635
	Men	Minimum	-0.106	0.377
		Maximum	-0.054	0.656
		Mean	-0.078	0.518
Age (year)	Under 18	Minimum	-0.073	0.547
		Maximum	-0.065	0.589
		Mean	-0.062	0.605
	18-60	Minimum	-0.268	0.024†
		Maximum	-0.238	0.046†
		Mean	- 0.253	0.034†
	Over 60	Minimum	-0.044	0.714
		Maximum	0.008	0.944
		Mean	-0.015	0.898

† Statistically significant

A second degree equation was a better fit for the data than a first degree equation. This equation showed that the lowest number of cardiovascular death (222 cases) was in the average temperature of 20 °C (Figure 1).

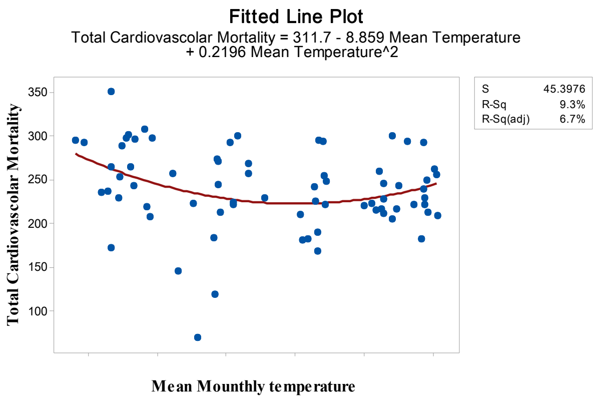

Figure 1. The scatter plot of deaths linked to cardiovascular and average temperature in Shiraz City, Iran, during the years 2006-2012

Discussion

Our study did not show a significant effect of temperature on cardiovascular deaths in Shiraz. This finding maybe due to the moderate climate of Shiraz. However, Studies have shown that temperature can affect human health.[17] There are various mechanisms for temperature to affect human death. Cold weather may have direct effects on the cardiovascular system due to changes in blood pressure, vasoconstriction, increased blood viscosity and increased levels of red blood cells, plasma cholesterol, and plasma fibrinogen.[18] The effect of environmental temperature on atherogenesis is not clear. Studies about ambient temperature and fat metabolism have led to controversial results. However, cold temperatures can probably harmfully change plasma lipid concentrations, and lead to abnormal thrombosis and chronic atherogenesis.[13]

Low temperatures can lead to thrombosis due to increased red blood cells.[19] In cold conditions, the concentration of some clotting factors and platelets, as well as platelet aggregation increase. The greater number of coronary events in cold weather may be related to blood clots. Plasma fibrinogen concentration is inversely related to environmental temperature; however, part of the increase in fibrinogen concentration during winter may be the result of seasonal respiratory infections.[20] Ambient temperature is inversely related to blood pressure and hypertension in a cold environment, has several side effects, and causes changes in the myocardial oxygen supply, particularly in patients with fixed stenosis. In this situation, the ventricular wall work load and oxygen demand increase. This additional load causes reduced mechanical efficiency of the heart; blood flow to coronary arteries might impair, and thus, cold weather can accelerate myocardial ischemia. Cold-induced peripheral vasoconstriction may cause acute pulmonary edema, which imposes an overload on the left ventricle, even in patients without coronary artery disease, and especially in those prone to high blood pressure. In patients with left ventricular dysfunction, the long-term effects of this high load induced by cold environments, may have adverse effects on survival.[13]

The effects of cold weather and air pollution following the inversion phenomenon in the cold seasons are very important in causing heart attacks. The inversion phenomenon happens in the cold season. In this phenomenon cold weather and air pollutants are trapped in layers close to earth, which can directly cause increased cardiovascular deaths. Moreover, activities such as snow plowing, installing tyre chains, and pushing cars stuck in snow increase in cold temperatures. Heavy activity on cold days imposes extra-pressure on the heart and the risk of heart attack increases. Reduced temperature also leads to a compensatory mechanism that increases body metabolism to produce heat. It also increases heart activity which increases the risk of heart attack.[6]

Results of a study from Ahar, Iran, showed an inverse, significant, and average correlation between temperature and death due to myocardial infarction. In that study, the number of deaths due to myocardial infarction increased with the start of cold weather (autumn season), and continued until the start of the warm season (around May).[6] The study by Khanjani and Bahrampour in Kerman, Iran, showed that cardiac death increased by 0.6 percent with every 1° C reduction in temperature. In that study, the relation between cardiac deaths and temperature was almost linear, and with temperature increase, the number of cardiac deaths decreased, which may be due to people getting accustom to desert climate over the years in this region.[11]

However, time series analysis in 12 United States (US) cities showed that the probability of death from MI is twice on warm days compared to cold days, while death due to cardiovascular diseases is five times less on warm days compared to cold days.[10] A study from the Netherlands showed that cardiovascular death increased 1.86 percent per 1 °C temperature increase over optimal temperature in the previous month.[21] In Ishigami et al. study in three cities from European countries, the strongest heat effect on death increase was seen in cardiovascular deaths; and death due to cardiac disease happened more on warm days than other causes of death in all cities except one.[12] Although the above-mentioned studies showed the effects of temperature on cardiac deaths, in the present study, this effect was not observed.

Seasonal and geographical data indicate that low ambient temperature has a significant impact on increased cardiovascular death.[13] Some researchers think mean blood pressure in cold climates is higher than warmer regions. Temperature difference between winter and summer in Britain has led to 5 ml mercury differences in blood pressure, and it is expected that such differences in blood pressure is the reason for at least 21 percent difference in the incidence of coronary events, and at least 34 percent difference in the incidence of stroke.[13] In a study in Tehran, Iran, the highest number of deaths due to myocardial infarction and stroke occurred in cold months, and the increase in total deaths that happened in low temperatures was due to increases in this type of death. They cocluded that the effect of temperature decrease on death increase is different depending on the type of disease (heart attacks and strokes), but its effect on heart attacks is more tangible.[22]

It was shown in another study in Oslo, Norway, that in temperatures lower than 10 °C, every 1 degree decrease in average temperature in the last seven days was associated with 1.7 percent increase in cardiovascular diseases, but no significant increase was observed in cardiac deaths in temperatures above 10 °C.[23] In Huynen et al. study in the Netherlands, cardiovascular death increased by 1.69 percent per one °C decrease below optimal temperature in the last month. Excessive mortality in cold weather is mostly related to increased cardiovascular deaths and mortality in old people.[21] These studies are consistent with the current study, since the highest cardiac death number in Shiraz in the total population and in all sub-groups was in cold months, and months with low temperature averages.

Results obtained from crude analysis indicated that there was an inverse significant relation between cardiovascular death in 18- to 60-year-old people and minimum, maximum, and mean temperature variables, and this group was more sensitive to temperature reduction. However, adjusted multivariate analysis in all sub-groups showed that there was no significant relation between temperature and cardiac death, and probably this finding was due to the fact that Shiraz has a moderate climate with an average annual temperature of 18 °C,[24] and without any heat or cold waves during this study period.

Temperature of minimum mortality (TMM) is the temperature in which the lowest mortality occurs, and if temperature goes higher or lower than this temperature, mortality increases. This temperature is obtained from studying the relation between number of deaths and average temperature, and varies by different cities.[22] The number of heart attacks increased in Ahar when temperature decreased beyond 15° C.[6] TMM was 19 °C in London, United Kingdom,[25] and in Huynen et al. study in the Netherlands, the TMM was 16.5 °C.[21] In the current study, the lowest number of cardiovascular deaths happened in the average temperature of 20 °C, and the relation was J shaped. In other studies, the temperature of 20 °C has been considered the optimal temperature in open space.[26] It seems that the adverse consequences of temperature are observed less in this temperature (TMM).[27] It has been shown that the dominant geographical climate may determine the optimal temperature of the region.[18] Generally in studies, most observed deaths occur in high or low temperatures, and the number of deaths is lower in average temperatures.[28]

The relation between cardiovascular deaths one-month later and temperature was also investigated in the current study. In the study by Braga et al. in 12 US cities, it was shown that moderate temperatures had no significant effect on death resulting from cardiovascular causes in warm cities. However, delayed effects of warm temperatures (after 4-6 days) were observed for MI deaths. But in cold cities, high and low temperatures were associated with increased mortality rate due to CVD. Generally the effect of cold temperature on these deaths lasted for several days, while the effect of higher temperatures was confined to the same day or a few days later.[10] In another study in the US, it was shown that heat is related to death on the same day or previous day, while cold temperature was related to deaths with longer delays and even up to 25 days after temperature drops.[29] In this current study, correlation results indicated that there was an inverse significant relation between cardiac death in 18- to 60-year-old people and minimum, maximum, and mean temperatures in the previous month.

One limitation of this study was that aggregated data were used, and therefore the results cannot directly be generalised to the individual-level. Moreover, we were not able to adjust for population dynamics or migration.[30] Meanwhile, we were not able to do calculations for joint age-gender groups, because the mortality data were inquired as de-identified information in separate age and gender groups. However, because the number of mortality cases would be low in these joint groups, due to low power, it is very unlikely that results would become significant.

Conclusion

Although cardiovascular deaths in 18- to 60-year-old people in Shiraz showed an inverse significant relation with minimum, maximum, and mean temperature of the same month, but the relation was not significant after adjusting. The lack of relation between cardiac deaths and temperature is probably due to the relatively moderate climate in Shiraz. Low and high temperatures may influence the number of cardiovascular deaths, but temperature-related cardiovascular deaths are lower in moderate temperatures.

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Conflict of Interests

Authors have no conflict of interests.

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