Original Article

A two-year survey on the effect of temperature changes on the incidence of myocardial infarction in patients referred to the Ali-ibn Abi Talib Hospital, Rafsanjan, Iran, in 2013-2014

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Abstract

Background: The role of temperature changes, as an environmental risk factor, in the human health status has been investigated in recent studies. Accordingly, the present two-year study was conducted to evaluate the incidence of myocardial infarction (MI) in warm and cold seasons in Ali-ibn Abi Talib Hospital, Rafsanjan, Iran.

Materials and Methods: In this descriptive and cross-sectional study, 264 patients hospitalized with MI during a two-year period (2013-2014) were included. Data on the participants were obtained from their electronic medical files and on the weather from the official Rafsanjan Weather Bureau station. The collected data was then analyzed using statistical tests including chi-squared test, Fisher's exact test, and logistic regression model in SPSS software.

Results: Data showed that 41.80% of MI occurred in hot weather, 14% in cold, and the remaining 37.12% in mild weather. According to the type of MI, 49.47% of non-ST elevation myocardial infarction (NSTEMI) and 44.44% of ST-segment elevation myocardial infarction (STEMI) occurred in very hot weather while 13.54% of NSTEMI and 18% of STEMI occurred in very cold weather. This difference was not significant.

Conclusions: Based on our data, MI had occurred mostly in hot weather and more than half of the cases were NSTEMI.

Keywords: Temperature, Heart Attack, Myocardial infarction

Introduction

In recent years, new geological models have been improved to determine the impact of climate changes on human health, especially in regions that experience heat waves. Most of the studies have been conducted in the Northern Hemisphere and have focused on death. Countries in the Southern Hemisphere have received less attention in this regard.

Determination of the socioeconomic risk factors that are potentially associated with mortality due to heat waves is required for the development or improvement of community health (1). The harmful effects of high and low temperature on cardiovascular diseases (CVDs) are clear. The

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known risk factors for CVD include smoking, excessive drinking of alcohol, poor diet, insufficient physical activity, high blood pressure and cholesterol, obesity and diabetes mellitus (DM). However, along with these risk factors, other factors such as temperature changes and air pollution also play a role in the incidence of CVDs. Changes in serum cholesterol levels and autonomic nervous system response has caused an increase in CVD events during temperature crises and this issue has become a concern among older people with heart problems (2).

According to some studies, increase in heart diseases varies in different seasons and in hot seasons it is higher than other seasons (3, 4). However, in most studies, the season that was associated with the highest rate of acute myocardial infarction (MI) was winter. With warming of the climate system, people develop tachycardia, cardiac contractility becomes low, but cardiac output per minute does not change (5, 6, 7).

Moreover, low temperature causes an increase in the heart's need for oxygen, vasoconstriction, high blood pressure, and blood platelet activation, which increases the risk of artery-blocking plaque formation in the heart and MI (8). As mentioned above, the harmful effects of hot and cold weather are associated with mortality due to CVD (9).

Previous studies have shown that in addition to MI, cerebrovascular accident (CVA), pulmonary embolism, and aortic dissection are also likely to be affected by climate changes during the year (10). The main causes of death in Iran are MI and cardiovascular problems (11). Temperature changes can also cause an increase or decrease in the death rate due to climate changes (9). Therefore, this study aimed to investigate the incidence of MI during periods of very low and high temperatures over a period of two years from 2013 to 2014 in Ali-ibn Abi Talib Hospital of Rafsanjan, Iran.

Material and Methods

This was a cross-sectional study conducted on patients admitted with MI to Ali-ibn Abi Talib Hospital in Rafsanjan from the beginning of 2013 until the end of 2014. The study population consisted of all patients with MI admitted and archived using electronic medical records. The number of admissions due to MI at Ali-ibn Abi Talib Hospital during the two years was 264.

Data regarding the type of MI and the risk factors of MI (age, gender, and smoking) were gathered from the patient records using checklists. The mentioned records were based on the codes of MI types. Data regarding temperature consisted of the average daily temperature of Rafsanjan and were obtained from the Meteorological Organization of Kerman Province, Iran. Based on meteorological indices, temperatures of 8 °C and lower were classification as very low, temperatures greater than 20 °C as very high, and temperatures between 8-20 °C as moderate temperatures (12).

After entering the data in SPSS software (version 18, SPSS Inc., Chicago, IL, USA), they were compared using descriptive statistics (frequency, percentage, and mean), analytical methods (chi-square), and logistic regression. These data included the specified items in the checklist, including MI type and MI risk factors (age, gender, and smoking) which were used as variables in this study. Another important data was the temperature status of each day, which was recorded in the software as the average temperature of Rafsanjan. In addition to daily comparisons, monthly and seasonal comparisons were also conducted.

Results

The mean and standard deviation of age of the participants was 61.7 ± 13.96 years (men: 59.37 ± 13.90 years, women: 65.21 ± 13.30 years). Among the participants, 187 (70.8%) were men and 77 (29.2%) were women. The age range of

men was 27 to 92 years and the age range of women was 35 to 90 years. Moreover, 75 (28.4%) participants were smokers and 71.6% were not. Smokers smoked an average of 11.6 cigarettes per day and these individuals had smoked for an average of 2.89 years. These values were different among men and women. Data showed that 68 (36.4%) men were smokers and they smoked an average of 10.59 cigarettes per day, and had been smoking for an average of 10 years. However, 7 women smoked an average of 21.43 cigarettes per day.

Table 1: distribution of variables based on myocardial infarction type

variables		NSTEMI/N	STEMI	Total	P- value
Gender	Man	72.2 / 135	27.8 /52	100.0 / 187	0.761
	Woman	74.0 / 57	26.0 / 20	100 / 77	
smoking	Yes	69.3 /52	30.7 /23	100 / 75	0.435
	No	74.1 / 140	25.9 / 49	100 / 189	
Treatment Outcome	Discharged	76.0 / 187	24.0 / 59	100 / 246	0.001
	Death	27.8 / 5	72.2 / 13	100 / 18	

* The used statistical tests were chi-square and Fisher's exact test and significance level was 0.05

The distribution of patients by type of MI showed that 135 (72.2%) men and 57 (74%) women had non-ST elevation myocardial infarction (NSTEMI) and the rest had ST-segment elevation myocardial infarction (STEMI) (P = 0.7). According to smoking status of patients, results showed that 69.3% and 30.7% of smokers had NSTEMI and STEMI, respectively. However, 74.1% and 25.9% of non-smokers had NSTEMI and STEMI, respectively. This difference was not statistically significant (P = 0.435). Recovery was observed in 76% of the discharged patients with NSTEMI and 24% of the discharged patients with STEMI. Deaths were reported in 27.8% of patients with NSTEMI diagnosis and in 72.2% of patients with STEMI, and this difference was statistically significant (P < 0.001) (Table 1).

Table 2: The relationship between the risk of myocardial infarction and temperatures in the logistic regression model

Variables	B	S.E	Wald	Sig	Exp(B)	95%C.I.for EXP(B)	
						Lower	Upper
Gender	0.209	0.359	0.34	0.56	1.2		
Age	0.009	0.011	0.702	0.4	1.009		
Job	6.662	0.0013	0.000	1	0		
disease	0.000	0.001	0.291	0.59	1	0.99	1.001
smoking	0.447	0.369	1.463	0.22	1.5	0.75	3.22
amount of smoking	0.017	0.017	0.993	0.31	1.01	0.98	1.05
duration of smoking	-.0.031	0.025	1.493	0.22	0.97	0.92	1.019

The results of the incidence of MI divided by year and season showed that maximum and minimum number of cases of MI had occurred during winter and fall of 2013 and 2014, respectively. Nevertheless, this difference was not statistically significant (P = 0.527 and P = 0.296, respectively). In this study, logistic regression was used to determine climate changes by considering risk factors such as age, gender, occupation, disease, and the amount and duration of smoking and the results were not statistically significant (Table 2).

The final finding of the present study was related to the prevalence of MI in cold (average annual temperature of lower than 8 °C), moderate (average annual temperature between 8-20 °C), and warm temperatures (average annual temperature of higher than 20 °C). The results showed a reduction of the percentage of NSTEMI incidence with the decreasing of temperature. However, the percentage of STEMI incidence had increased. Overall, the statistical test showed no significant difference (P = 0.600) (Table 3).

Table 3: Distribution of myocardial infarction with regards to high, moderate, and low temperature Discussion

Variables		Temperature Rang			P-Value
		high temperature > 20º	moderate temperature 8º -20º	low temperature < 8º	
myocardial infarction	NSTEMI	74/8%(n=95)	72/4%(n=71)	66/7%(n=26)	0.630
	STEMI	25/2%(n=32)	27/6%(n=27)	33/3%(n=13)	
	Total	100%(n=127)	100%(n=98)	100%(n=39)	

Discussion

The harmful effects of climate changes could increase the burden of diseases affecting public health (13-16). The World Health Organization (WHO) has estimated more than 150,000 deaths per year due to the impact of these changes in the last 3 decades (17). This increase in disease). The variations in the burden of major diseases such as CVDs are the result of climate change. This has been reported by many studies in different countries (9, 19, 20). However, different countries have different climates; therefore, the reported results were different and the studies were not homogeneous (21).

The results of this study showed that there was no correlation between temperature and the incidence of MI. This relationship was also not significant regarding the division of subjects based on gender. A study was conducted in 2011 in Copenhagen, Denmark, with the aim of

burden will encompass all spectrums of non-communicable and communicable diseases. This will certainly include CVDs and respiratory diseases that are the leading causes of illness and death in most countries. Changes in global temperature and its effects on public health have recently attracted much attention (18

reviewing hospital admissions data (21). It was observed that temperature was inversely related to hospitalization due to CVDs, meaning that the increase in temperature significantly reduced the rate of hospitalization (21). Another study conducted in Shanghai, China, obtained similar results (22). However, the results of a study conducted in the UK in 2012 were inconsistent with the results of the abovementioned studies (23). In this study, it was shown that with increase in temperature, hospitalization due to acute MI was significantly increased. In other words, there was is a direct relationship between

temperature and the number of hospitalizations (23). This heterogeneity in the results may be due to individuals' adaptation to the environment in each particular area (24).

By reviewing studies on the relationship between ambient temperature and hospitalization for CVD, it was found that the results reported for different research designs, countries, and cities were not homogeneous. This difference might be due to the fact that people in different areas have different tolerance levels and their bodies have adapted to the certain conditions of their living area (24). This particular adaption of the residents of different climates causes different responses towards temperatures above the thresholds of hot and cold temperatures. These reasons can be the cause of differences in the effects of weather variables on the people of the regions studied in this research.

The mechanism through which cold temperature causes an increase in the risk of CVDs is still not clear (25). However, several risk factors such as increased plasma cholesterol, fibrinogen, blood pressure, and white and red blood cell count can partly explain this mechanism (21). The main mechanism of the adverse effects of high temperatures may be the directing of blood by the blood circulatory system of the human body from the vital organs towards layers under the skin in order to regulate body temperature in high temperatures (26).

This study also showed that the prevalence of MI varies between seasons. Although this difference was not statistically significant, it was consistent with the results of other studies that have shown that lower temperatures increased the rate of CVD. The results of a study conducted in Denmark showed that temperature was inversely related to hospitalization due to CVD (21). Therefore, an increase in temperature significantly reduced cases of CVD, and thus, hospitalization for CVD. A study conducted in

Shanghai, China, also obtained the same results (27).

Conclusion

In this study, despite the apparent differences in the frequency and occurrence of MI, these differences were not statistically significant. One significant difference was the increase in the frequency of MI occurrence at lower temperatures which was also reported in other studies. The reviewing of studies on the relationship between environmental temperature and MI showed that the reported results in different studies designs, countries, and cities were not homogeneous. This matter requires broader researches and studies among different regions or countries. Moreover, a comprehensive review of a wider range of aspects of geographical areas and countries is necessary.

Acknowledgments

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