# Association of Climate with Acute Myocardial Infarction Hospitalizations

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## Original Article

## Abstract

**Introduction:** Regarding the association between climate, seasons and myocardial infarction, a cross-sectional study was carried out in Shiraz and Bandar Abbas in Iran.

**Methods:** All patients with diagnosis of acute myocardial infarction living in Shiraz and Bandar Abbas were included in the study during 2011-2013. Demographic data were extracted from the patients' hospital records. Data were analyzed using descriptive statistics, student's t-test, and Chi-square test with SPSS software.

**Results:** A total of 2626 patients were admitted with acute myocardial infarction of which 1546 were from Shiraz and 1080 from Bandar Abbas. Admission rate due to myocardial infarction was 0.12 in Shiraz and 0.24 in Bandar Abbas. In Shiraz, 35.2% of the patients were female and in Bandar Abbas 34% Mean age of female patients was 65.68 years in Shiraz and 62.46 in Bandar Abbas while mean age of male patients in Shiraz was 60.39 years and 57.22 years in Bandar Abbas. Difference in admissions rates in 4 seasons was statistically significant in Shiraz, but not significant in Bandar Abbas. Seasonal variation of myocardial infarction had no correlation with gender or age of the patients.

**Conclusion:** Incidence of myocardial infarction in Shiraz was half of the incidence rate in Bandar Abbas. During summer in low altitude humid areas, extra healthcare should be provided to high risk patients with coronary artery diseases, whereas this caution should be taken in high altitude areas with cold winter to minimize incident of myocardial infarction.

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## Introduction:

Coronary artery diseases (CAD) are the leading cause of mortality worldwide (1). Many factors are related to mortality of CAD, as well as demographics, humidity, altitude, seasonal variation, stress, physical activity, dietary habits, and air pollution (2-5).

The role of gender is well known in CAD (6-8), hormones and vasoactive agents such as vasopressin (AVP), norepinephrine (NE), epinephrine (E) and angiotensin II, aldosterone and catecholamine which tend to rise in the winter are suggested to play an important role in the seasonal change of CAD (9).

It has been well documented that hot and humid climate increases cardiac workload and induces stress (10,11). Strength of these factors in inducing Acute Myocardial Infarction (AMI) has been documented to some extent, but the role of humidity, air pollution, and meteorological changes on human health and physiology needs to be more explored. Although the impact of humidity and temperature on AMI has been described as peaks of this condition in winter and decline in summer while atmospheric pressure and humidity are inconsistently associated with AMI (12,13) which is observed in US and Europe (14).

There are well known risk factors for coronary diseases such as hypertension (HTN), diabetes mellitus (DM), dyslipidemia, cigarette smoking, obesity and stress. Controlling these factors decline 50% of AMI occurrence, while seasonal variations and temperature account for the remaining causes of AMI (14).

Multiple studies have focused on the effect of meteorological factors on incidence of AMI and found out that exposure to cold increased the risk of AMI (15), monthly variations of incidence of AMI are seen significantly in females and younger patients (16), cool temperatures and higher nitrous oxide (NO) levels increase the risk of AMI in normally warm-climate areas (17). It is notable that high incidence of AMI has been described in summer or no seasonal variation of this condition has also been reported (18).

According to this background, this study was designed to compare the admissions due to AMI in two different cities with different population, altitude and climate which are different in geographical location, and climate

## Methods:

All admitted patients with diagnosis of AMI confirmed by cardiologist (ECG, cardiac enzymes, compatible clinical symptoms) in central hospitals of Shiraz and Bandar Abbas during 2011-2013 were enrolled in this cross-sectional study. The patients were residents of either Shiraz or Bandar Abbas.

Shiraz is located in the southwest of Iran with an altitude of 1500 m above the sea level with distinct seasons and a steppe climate, with a relative humidity of about 40.9%. Estimated population of Shiraz is 1,227,331 (in 2006 AD) (19).

Bandar Abbas is a seaport located on southern coast of Iran with an altitude of 9m above the sea level and an estimated population of 450,000 (in 2011 AD). Climate is hot and humid, but dry hot as desert climate. Maximum temperature in summers can reach up to 49 C (120F) while in winters the minimum temperature may drop to 5 C (41F).

Relative humidity is about 65%. The details on climate of these two cities are shown in tables 3 and 4 respectively (20)

Data including gender, age and date of admission were obtained from the patients' hospital records data center. Data were gathered by a general physician. The seasons were defined by their calendar notion (21 Mar-21 June: Spring; 22 June-22 Sep: Summer; 23 Sep-22 Nov: Autumn and 23 Nov-20 Mar: Winter).

The patients were grouped in to 6 age groups (younger than 30 years, 30-39 years, 40-49 years, 50-59 years, 60-69 years, 70 years or older than 70 years).

Data (age, gender and location) were analyzed using descriptive statistics, student's t-test, and chi square (for testing a hypothesis on the basis of a difference between sample means and to investigate whether distributions of categorical variables differ from one another) with SPSS 16 Softwar.

## Results:

Overall 1546 patients form Shiraz and 1080 patients from Bandar Abbas were admitted during this 3 year period with AMI (Table 1).

The humidity of Shiraz in winter is much alike the humidity of Bandar Abbas in winter (mean humidity in November-December and January in Shiraz is 61.6% vs. 65% in Bandar Abbas), while the humidity in Bandar Abbas is more in comparison with Shiraz (mean humidity in June, July and August in Shiraz is 23.5% vs. 67% in Bandar Abbas).

Mean winter temperature in Shiraz: 7.93°C and BA: 20.7°C, and mean summer temperature is 28.7°C in Shiraz and 34.03°C in Bandar Abbas. (Tables 3 and 4) (19,20).

**Table 1. Distribution of frequency of myocardial infarction in two hospitals differentiated by age**

| | Namazi hospital (Shiraz) | Shahid Mohammadi hospital (Bandar Abbas) | Total |
|---|---|---|---|
| **<30** | 9 (0.6%) | 6(0.6%) | 15(0.6%) |
| **30-39** | 51(3.3%) | 39(3.6%) | 90(3.4%) |
| **40-49** | 228(14.7%) | 218(20.2%) | 446(17%) |
| **50-59** | 323(20.9%) | 252(23.3%) | 575(21.9%) |
| **60-69** | 377(24.4%) | 272(25.2%) | 649(24.7%) |
| **≥70** | 558(36.1%) | 293(27.1%) | 851(32.4%) |
| **Total** | **1546(100%)** | **1080(100%)** | **2626(100%)** |

* (P<0.0001) considered significant

**Table 2. Frequency of myocardial infarction distributed by season and age compared in two hospitals**

| | Spring | | Summer | | Autumn | | Winter | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Shahid Mohammadi hospital (Bandar | Namazi hopsital (Shiraz) | Shahid Mohammadi hospital (Bandar | Namazi hopsital (Shiraz) | Shahid Mohammadi hospital (Bandar | Namazi hopsital (Shiraz) | Shahid Mohammadi hospital (Bandar | Namazi hopsital (Shiraz) | Shahid Mohammadi hospital (Bandar Abbas) | Namazi hopsital (Shiraz) |
| **<30 yrs** | 0 (0%) | 3(0.7%) | 3(1%) | 3(0.9%) | 2(0.8%) | 2(0.5%) | 1(0.4%) | 1(0.2%) | 6(0.6%) | 9(0.6%) |
| **30-39** | 8(3.2%) | 15(3.7%) | 18(6%) | 7(2.1%) | 7(2.6%) | 13(3.4%) | 6(2.3%) | 16(3.7%) | 39(3.6%) | 51(3.3%) |
| **40-49** | 45(17.9%) | 52(12.7%) | 61(20.2%) | 53(16.2%) | 61(23%/) | 63(16.6%) | 51(19.5%) | 60(14%) | 218(20.2%) | 228(14.7%) |
| **50-59** | 68(27%) | 83(20.3%) | 58(19.2%) | 83(25.3%) | 64(24.2%) | 78(20.5%) | 62(23.8%) | 79(18.4%) | 252(23.3%) | 323(20.9%) |
| **60-69** | 64(25.4%) | 97(23.8%) | 76(25.2%) | 83(25.3%) | 62(23.4%) | 90(23.7%) | 70(26.8%) | 107(24.9%) | 272(25.2%) | 377(24.4%) |
| **≥70** | 67(26.6%) | 158(38.7%) | 86(28.5%) | 99(30.2%) | 69(26%) | 134(35.3%) | 71(27.2%) | 167(38.8%) | 293(27.1%) | 558(36.1%) |
| **Total** | 252(100%) | 408(100%) | 302(100%) | 328(100%) | 265(100%) | 380(100%) | 261(100%) | 430(100%) | 1080(100%) | 1546(100%) |

* (P<0.0001) considered significant

**Table 3. Climate data for Shiraz (Source: Wikipedia) (19)**

| Climate data for Shiraz | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Month | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Year |
| Record high °C (°F) | 22.0 (71.6) | 24.0 (75.2) | 28.5 (83.3) | 34.0 (93.2) | | | | | | 36.2 (97.2) | 28.0 (82.4) | 23.0 (73.4) | |
| **Average high °C (°F)** | 12.1 (53.8) | 14.7 (58.5) | 18.9 (66) | 23.8 (74.8) | 30.6 (87.1) | 36.1 (97) | | | | 30.8 (87.4) | 20.5 (68.9) | 14.4 (57.9) | 26.45 (79.61) |
| **Daily mean °C (°F)** | 5.3 (41.5) | 7.7 (45.9) | 11.8 (53.2) | 16.2 (61.2) | 22.5 (72.5) | 27.7 (81.9) | 29.8 (85.6) | 28.7 (83.7) | 24.5 (76.1) | 18.4 (65.1) | 11.7 (53.1) | 6.8 (44.2) | 17.59 (63.67) |
| **Average low °C (°F)** | −0.4 (31.3) | 1.2 (34.2) | 4.8 (40.6) | 8.5 (47.3) | 13.2 (55.8) | 17.1 (62.8) | 19.9 (67.8) | 18.8 (65.8) | 14.1 (57.4) | 8.8 (47.8) | 3.8 (38.8) | 0.5 (32.9) | 9.19 (48.54) |
| **Record low °C (°F)** | −14 (7) | −8 (18) | −4 (25) | −1 (30) | 3.0 (37.4) | 9.0 (48.2) | 14.0 (57.2) | 12.0 (53.6) | 1.0 (33.8) | 1.6 (34.9) | −8.0 (17.6) | −11 (12) | −14 (7) |
| **Precipitation mm (inches)** | 59.8 (2.354) | 49.8 (1.961) | 38.4 (1.512) | 30.6 (1.205) | 6.6 (0.26) | 0.2 (0.008) | 1.0 (0.039) | 0.0 (0) | 0.0 (0) | 5.2 (0.205) | 20.7 (0.815) | 53.2 (2.094) | 265.5 (10.453) |
| **Avg. rainy days** | 8.7 | 7.9 | 7.9 | 6.4 | 2.1 | 0.2 | 0.8 | 0.0 | 0.0 | 1.2 | 3.7 | 7.2 | 46.1 |
| **Avg. snowy days** | 1.5 | 0.6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0.6 | 2.7 |
| **% humidity** | | | | | 32 | 22 | 24 | 24 | 26 | 34 | | | |
| **Mean monthly sunshine hours** | 217.0 | 218.5 | 236.2 | 247.7 | 324.1 | 357.8 | 344.6 | 329.7 | 318.0 | 297.7 | 238.3 | 216.2 | 3,345.8 |

Source: NOAA (1961-1990)(33)

**Table 4. Climate Data for Bandar Abbas (source: Wikipedia)(20)**

| Climate data for Bandar Abbas | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Month | **Jan** | **Feb** | **Mar** | **Apr** | **May** | **Jun** | **Jul** | **Aug** | **Sep** | **Oct** | **Nov** | **Dec** | **Year** |
| **Record high °C** | 32.0 | 33.0 | | | | | | | | | | 32.0 | |
| **(°F)** | (89.6) | (91.4) | | | | | | | | | | (89.6) | |
| **Average high °C** | 23.5 | 24.4 | 27.7 | 31.6 | 36.3 | | | 37.7 | 36.8 | 35 | 30.4 | 25.5 | 32.13 |
| **(°F)** | (74.3) | (75.9) | (81.9) | (88.9) | (97.3) | | | (99.9) | (98.2) | (95) | (86.7) | (77.9) | (89.83) |
| **Daily mean °C** | 18.1 | 19.4 | 23.1 | 26.8 | 31.2 | 33.7 | 34.4 | 34.0 | 32.5 | 29.6 | 24.3 | 19.7 | 27.23 |
| **(°F)** | (64.6) | (66.9) | (73.6) | (80.2) | (88.2) | (92.7) | (93.9) | (93.2) | (90.5) | (85.3) | (75.7) | (67.5) | (81.03) |
| **Average low °C** | 12.1 | 14 | 17.5 | 20.9 | 24.7 | 28 | 30.3 | 30.1 | 27.7 | 23.5 | 18 | 13.5 | 21.69 |
| **(°F)** | (53.8) | (57) | (63.5) | (69.6) | (76.5) | (82) | (86.5) | (86.2) | (81.9) | (74.3) | (64) | (56.3) | (71.04) |
| **Record low °C** | 3.0 | 5.4 | 7.6 | 11.5 | 17.0 | 20.0 | 25.2 | 25.0 | 21.0 | 12.0 | 6.0 | 2.0 | 2 |
| **(°F)** | (37.4) | (41.7) | (45.7) | (52.7) | (62.6) | (68) | (77.4) | (77) | (69.8) | (53.6) | (42.8) | (35.6) | (35.6) |
| **Precipitation mm** | 39.7 | 47.5 | 34.8 | 10.7 | 4.8 | 0.0 | 0.6 | 2.2 | 0.8 | 1.3 | 5.0 | 24.0 | 171.4 |
| **(inches)** | (1.563) | (1.87) | (1.37) | (0.421) | (0.189) | (0) | (0.024) | (0.087) | (0.031) | (0.051) | (0.197) | (0.945) | (6.748) |
| **Avg. precipitation days (≥ 1.0 mm)** | 3.3 | 3.1 | 2.6 | 1.3 | 0.2 | 0 | 0.1 | 0.2 | 0.1 | 0.1 | 0.4 | 2.3 | 13.7 |
| **% humidity** | | | | | | | | | | | | | |
| **Mean monthly sunshine hours** | 220.1 | 211.9 | 224.9 | 242.4 | 312.7 | 302.2 | 264.6 | 270.1 | 270.1 | 283.4 | 251.2 | 228.8 | 3,082.4 |

Source: NOAA (1961-1990) (6)

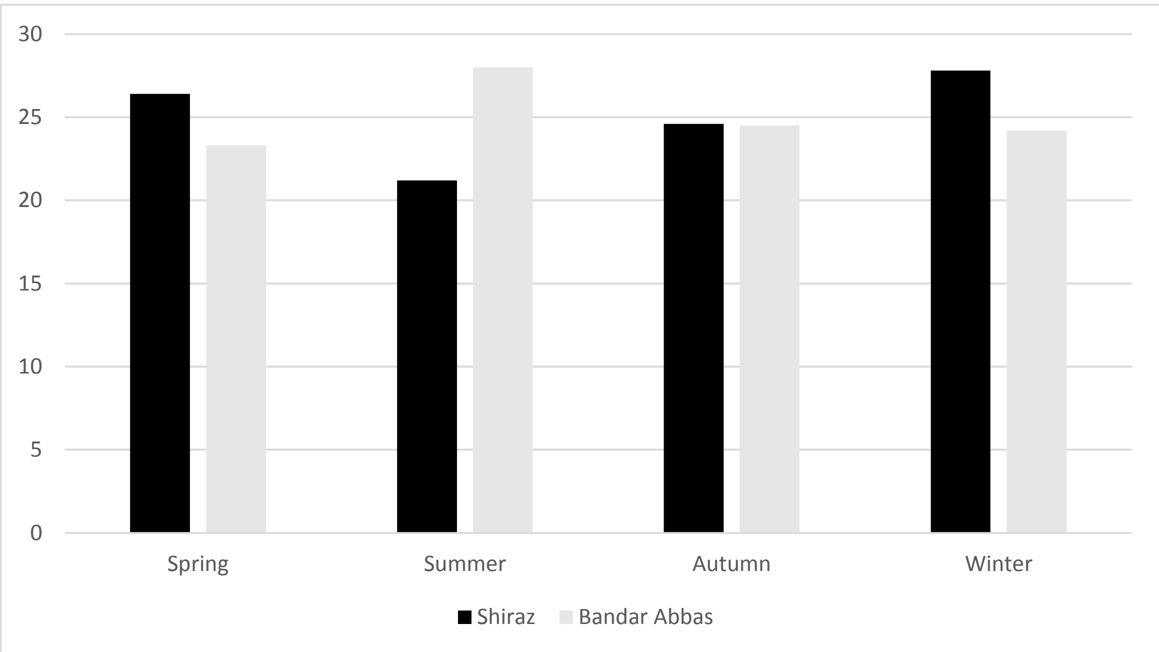


**Figure 1. Seasonal Variation of AMI in Bandar Abbas and Shiraz referral hospital**

In Shiraz 35.2% of the patients were female and 34% in Bandar Abbas. In Shiraz mean age of female patients was 65.68 years, and 60.39 years in male patients with a statistically significant difference of incidence in male and female patients ($P<0.0001$). In Bandar Abbas mean age of female patients was 62.46 years, and 57.22 years in male patients with a statistically significant difference ($P<0.0001$). Mean age of studied population in Shiraz was 62.25 years and 59 years in Bandar

Abbas and this difference is also statistically significant ($P<0.0001$). In both cities age and gender had a statistically significant correlation with incidence of AMI ($P<0.0001$).

Admissions in spring, summer, autumn and winter were 26.4%, 21.2%, 24.6% and 27.8% respectively in Shiraz; and 23.3%, 28%, 24.5% and 24.2% respectively in Bandar Abbas (Table 2).

Difference of admissions during the 4 seasons in Shiraz was statistically significant ($P<0.005$), while this difference was not significant in Bandar Abbas ($P>0.05$). The seasonal variation had no correlation with gender of the patients ($P>0.05$) or with the age of the patients ($P>0.05$). The seasonal variation of the AMI in two cities is displayed in Figure 1.

The results can be summarized as below:

- Men were mostly sufferers from AMI
- People younger than 30 years suffered the least and most of the patients were older than 70 years in both cities
- Average age of affected men is less than the age of women in both cities
- Average age of patients in Bandar Abbas is less than the age of patients in Shiraz
- Rate of AMI was correlated with seasonal variation in Shiraz but not in Bandar Abbas (i.e. seasonal variation of AMI differs with altitude)
- Rate of AMI correlates with humidity.
- No correlation was found between the gender of the patients and the seasonal occurrence of the AMI

Incidence rate of AMI in Bandar Abbas is twice as Shiraz referral hospitals.

## Conclusion:

There has been well known association of increased CAD in men and in advanced age. Men with CAD tend to be more diagnosed than women suffering from this disease, and perhaps this may be a cause of high diagnosed CAD in men (21). In our study the percentage of male patients in both cities was higher than female patients.

Difference of incidence rate of AMI can be related to the climate and geographic location of the two cities. A city like Bandar Abbas has a moderate climate (mostly spring and summer) with no cold climate, while Shiraz has four distinct seasons with a cold winter. Difference in altitude of these two cities should also be considered. Misalidou et al. found from their study that for a 1 degree Celsius decrease in temperature there was a 1.6% increase in admissions, which was more pronounced in the elderly (22) and in Panagiatakos et al.'s study the admission rate for each Celsius degree increased about 5%, which affected females and elderly more. The latter study's finding was that humidity was also associated with increased rate of AMI admissions (23). Several studies have been performed to assess the association of seasonal variation with incidence of AMI, which are described in brief.

In a 10 year study in Iran during 1990-2000, 1174 admitted patients in Babol located in north of Iran were followed up as the day of the week, month and the season the patients were admitted. In this follow up 26.2% were admitted in spring, 23.1% in summer, 26.8% in autumn and 23.9% in winter with a $P>0.05$. In this city, seasonal temperature changes are not obvious and this city has a humid environment (24). These findings are also consistent with our findings in Bandar Abbas.

In another study on 8400 patients with myocardial infarction admitted in 12 cardiology departments in PRIMVAC since January 1995 till December 1999, number of admitted patients increased in winter (2183 patients, with 742 patients admitted in February, age group ≥ 65years were the most admitted group) and decreased in summer ($P=0.006$ ) (25). Lin et al found association of low winter temperature with high myocardial infarction admissions, especially in male patients and in elderly groups in those living in warmer areas (26), although association of female gender and young age has also been proposed regarding to the results of Korean registry of AMI (16), but this is not in line with our findings.

Rivero and coworkers conducted a 12 year study to define the effects of climate variability on myocardial infarction. Strong association was present between myocardial infarction and climate variability, as to say that highest mortality rate occurred during dry months (winter months in Cuba), with lowest mortality in rainy season, with a downward trend in total number of deaths seen in change point. died the association of non-fatal acute coronary syndromes and bioclimate in a 3 year period (2004-2007) and in their study the frequency of ACS was high in august and in May, while relatively high frequencies of ACS existed in winter, but these correlations, were not statistically significant (27). Lashari and coworkers also found out that that AMI admissions increased in winter and in summer (i.e. with sudden changes in temperature) (28). Nastos and coworkers studied on effect of bio climate in nonfatal acute coronary syndromes. In their study in Lerapetra (which is the sunniest city in Greek (29)) it was observed that high occurrence of ACS was seen in August and with less common incidence in May, and relative high ACS frequencies occur in early winter but no statistical significance was observed between the months of year and occurrence of ACS (30).

In our study the incidence of AMI was increased in summer in Bandar Abbas, and in winter in Shiraz. Only the occurrence in Shiraz was statistically significant. Shiraz climate is somewhat similar to Lerapetra's climate and this may be a cause for significant presence of AMI in winter.

Bandar Abbas being a humid and hot area has increased AMI in summer where the estimated temperature in summer ranges from 36-42 degrees Celsius (20). Because of inability of the body to cool by perspiration with is altered in humid areas, resulting in a forced blood flow in peripheral areas and extremities to ease heat loss leads to elevated central blood pressure and vasoconstriction in core of body (i.e. reduced blood flow and oxygen supply to heart resulting in myocardial ischemia in high risk patients). The same can be interpreted for higher rate of AMI in winter in Shiraz, where the climate change is more pronounced with an estimated average recorded temperature of (6.6 degrees Celsius) in winter (19); this decrease of temperature causes vasoconstriction which in turn results cardiac overload and ischemia in susceptible and high risk patients (31) compared to mean winter temperature in Bandar Abbas (19.07 degrees Celcius). As it is observed in the results, summertime admissions in Bandar Abbas are more than any admissions in other seasons. While in Shiraz, admissions are more seen in cold seasons and the difference in Shiraz admissions is statistically significant, but not seen in Bandar Abbas (perhaps the results are similar to Lerapetra's temperature (29)). As observed, in these seasons the humidity levels is increased in comparison to other months in year, which show the effect of humidity on incidence of AMI. In Bandar Abbas, summer is the most humid season of the year and also the temperature is very hot. Incidence rate of AMI increase in this season but unfortunately no significant association was observed between the incidence of nonfatal cardiac events with the humidity and temperature.

Abrignani and co-workers studied the effect of seasonal variation and weather on hospital admissions of AMI, and concluded that environmental temperature, and also humidity, may play an important role in the pathogenesis of AMI (32), which is in line with our findings.

According to definition of International Society for Mountain Medicine, altitudes above 1500 meters start to affect humans (33). Increase in altitude results a decrease in atmospheric pressure thus the partial pressure of oxygen is reduced and so the workload of heart increases. Increased workload of heart, decreased partial pressure of oxygen and vasoconstriction lead to cardiac ischemia in vulnerable individuals (i.e. hypertensive, diabetic and smokers) (16) which explains the high incidence of AMI in winter of Shiraz.

Curran et al's study indicates that there's a positive correlation between temperature and STEMI, while season and humidity did not effect this condition (13). These findings support myocardial infarctions in Bandar Abbas as this area is a hot and humid.

Although the role of air pollution is known to contribute to incidence of AMI, and Shiraz is a more polluted city than Bandar Abbas.

This study shows that high risk individuals such as old people, diabetics, smokers, obese people, or hypertensive individuals living in high altitudes, humid areas, hot climate or very cold areas should protect themselves in a suitable way so that these alterations would minimally affect their cardiovascular system. Also these high risk people should be given extra and appropriate care and by healthcare providers to minimize the possible cardiovascular events including AMI and stroke.

**Limitations:**

As the records were only from Namazi hospital in Shiraz and Shahid Mohammadi hospital from Bandar Abbas which are both referral hospitals in these two cities, only AMI admissions in these hospitals were considered and other cases of AMI in other hospitals of the Shiraz and Bandar Abbas were not recruited.

## Conflict of interest:

Authors declare no conflict of interest.

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# ارتباط آب و هوا با بستری شدن متعاقب سکته قلبی

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## چکیده

***مقدمه***: *برای بررسی ارتباط بین آب و هوا، فصول و بستری شدن متعاقب سکته حاد قلبی، مطالعه مقطعی در شیراز و بندرعباس طراحی شد.*

***روش کار:*** *تمام بیماران بستری شده متعاقب سکته قلبی در طی سال‌های ۱۳۹۰-۱۳۹۲ وارد مطالعه شدند. اطلاعات دموگرافیک از پرونده‌های بیماران استخزاج شد. داده‌ها توسط SPSS با استفاده از روشهای توصیفی و آزمونهای t و کای اسکوئر مورد تجزیه و تحلیل قرار گرفتند.*

***نتایج***: *در کل، ۲۶۲۶ بیمار با سکته حاد قلبی وارد مطالعه شدند که ۱۰۸۰ بیمار از بندرعباس بودند و مابقی از شیراز. میزان بستری به دلیل سکته قلبی ۱۲ درصد در شیراز بود و ۲۴ درصد در بندرعباس. اختلاف بستری شدن بر اساس فصول سال در شیراز از لحاظ آماری معنی‌دار بود ولی در بندر عباس ارتباطی معنی‌دار نداشت ($P > ۰/۰۵$). متوسط سن بیماران مونث در شیراز ۶۸/۶۵ سال و ۲/۳۵ درصد بیماران مونث بودند. در بندرعباس ۳۴ درصد بیماران مونث و میانگین سنی آنها ۴۶/۶۲ سال بود. در حالی که بیماران مذکر در شیراز ۳۹/۶۰ سال و در بندرعباس ۲۲/۵۷ سال سن داشتند. در این مطالعه تفاوت معنی داری بین سن بیماران و چهار فصل سال دیده نشد.*

***نتیجه‌گیری***: بروز سکته قلبی در بندرعباس دو برابر بروز سکته در شیراز بود. در مناطق کم ارتفاع با تابستان های مرطوب باید مراقبت بیشتری برای بیمازان با ریسک فاکتور قلبی صورت بگیرد و در مناطق مرتفع با زمستان‌های سرد این اقدامات برای کاهش عوارض قلبی عروقی در بیماران پر ریسک صورت گیرد.

***کلیدواژه‌ها:*** *سکته حاد قلبی، رطوبت، ارتفاع جغرافیایی، فصل های سال*

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