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Research Article

**MYOCARDIAL INFARCTION MORTALITY AND MORBIDITY:  
A RETROSPECTIVE COMPARISON OF COMPLICATIONS  
BETWEEN HIGH AND SEA LEVEL ALTITUDES**Nawaf N. Alzahrani<sup>1</sup>, Sultan M. Alzahrani<sup>2</sup>, Nouf M. Althobaiti<sup>3</sup>, Mutaz H. Althobaiti<sup>4</sup>,  
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**Abstract:**

**Background:** The leading cause of mortality in myocardial infarction is cardiogenic shock as a complication in the absence of appropriate care with a mortality rate of 70-90%. **Objectives:** Our aim is to compare complications between high and sea level altitude and to study its relation to risk factors of myocardial infarction. **Materials and Methods:** a retrospective comparison study. We recruited a data of 190 samples from mortality records from both Jeddah (sea level altitude) and Taif (high altitude). **Results:** Jeddah was significantly lower in mean age ( $64.4 \pm 13.5$  vs  $71.9 \pm 15.1$ ,  $p$  value < 0.05). ST- elevation myocardial infarction was the highest among ECG changes in both cities (71.8% in Jeddah and 92% in Taif) which were mostly in the anterior side (45.1% in Jeddah and 40.9% in Taif). In complications, arrhythmia was significantly higher in Taif, however, Cardiogenic shock was significantly higher in Jeddah with a significant relation to diabetes only and to diabetes with hypertension as risk factors. **Conclusion:** The mean age was significantly higher in Taif (high altitude). Cardiogenic shock was higher in Jeddah as a complication of MI with a significant relation to DM only and to DM with HTN, however, arrhythmia was significantly higher in Taif.

**Keywords:** comparison, mortality, myocardial infarction, complications, altitude.**Corresponding author:**

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## INTRODUCTION:

Myocardial infarction is the damaging or death of an area of the heart muscle (myocardium) resulting from a blocked blood supply to that area. [1] It is a very serious condition and considered as one of the leading causes of mortality and disability in developing and developed countries. [2]

The leading cause of death in myocardial infarction is cardiogenic shock which is a decrease in output with evidence of tissue hypoxia. The mortality rate of cardiogenic shock is as high as 70-90% in the absence of appropriate care. [3]

Another complication of myocardial infarction is cardiac arrhythmia which can develop in 90% of patients during or after the event. The incidence of this complication is higher in ST elevation myocardial infarction compared to non- ST elevation myocardial infarction. [4]

The prevalence of CAD in Saudi Arabia is estimated to be 5.5%, and 1.1% for myocardial infarction. [5]

A study was reported from southern Saudi Arabia. They studied retrospectively 124 patients admitted to Asir Central Hospital, Abha, with proved acute myocardial infarction. There were 116 men (94%) and 98 patients were Saudi (79%). The majority of non-Saudi patients were Egyptians and Pakistanis. The mean age was 57 (SD = 13) years. Diabetes mellitus, cigarette smoking, and hypercholesterolemia were the most common risk factors. Most of the patients had anterior acute myocardial infarction and, remarkably, both the incidence of complications and the mortality rate were lower than those reported from the rest of Saudi Arabia and the western world. The study revealed that there is a possible explanation for this trend, among others, could be due to prolonged residence at high altitude, which may have acted as a protective factor to the myocardium. [6]

The objective of our study is to show the effect of altitude on complications including arrhythmia and cardiogenic shock in patients diagnosed with myocardial infarction and determine the leading risk factors.

## MATERIALS AND METHODS:

**Study design and time frame:** a retrospectively study was done in the time from January to May 2019.

**Study setting:** the study was done in at King Faisal Hospital (KFH), King Abdulaziz Specialized

Hospital (KASH) in Taif City, King Abdulaziz University Hospital (KAUH) in Jeddah City, Saudi Arabia.

**Sampling and data collection:** Data were selected from the medical records of patients admitted to the three hospitals. Medical record for the patients was considered eligible if the patients died as a result of myocardial infarction at age of  $\geq 18$  years regardless of sex and ethnicity, if they died either in Taif or Jeddah as their city of residence, and if the MI diagnosis confirmed as the cause of death by abnormal ECG and/or cardiac markers. The record was excluded if childbearing and pregnant women died as a result of myocardial infarction.

The data were collected from the patient's files by using a specific check list (data sheet) with no contact with their relatives, and the data were anonymous therefore, there was no need for taking consent. The check list used in this research was including the date of death, age, sex, nationality, residency, site of ECG change, complications (arrhythmia and cardiogenic shock), risk factors (diabetes, hypertension, smoking, hyperlipidemia, and family history of MI) and past surgical history (PCI and CABG).

After applying the exclusion criteria, the total number was 190 medical record. Of the records, 102 were from Jeddah City, and 88 of were from Taif City.

**Ethical considerations:** This study was approved by Research Ethics Center at Directorate of Health Affairs in Taif City, Research Center at King Faisal Hospital (KFH), Research Center at King Abdulaziz Specialist Hospital (KASH), and Research Center at King Abdulaziz University Hospital (KAUH).

**Data analysis:** The statistical package for the social sciences (SPSS) was used for data analysis. Qualitative data were expressed as numbers and percentages (No. (%)), and the Chi-square ( $\chi^2$ ) test was used to test the relationship between variables. A p-value of less than 0.05 was considered as statistically significant.

## RESULT:

A total of 102 and 88 patients who died from acute myocardial infarction were enrolled in this study from Jeddah and Taif city, respectively. In both cities, males were more than females (66.7% and 68.2%) (Figure1).

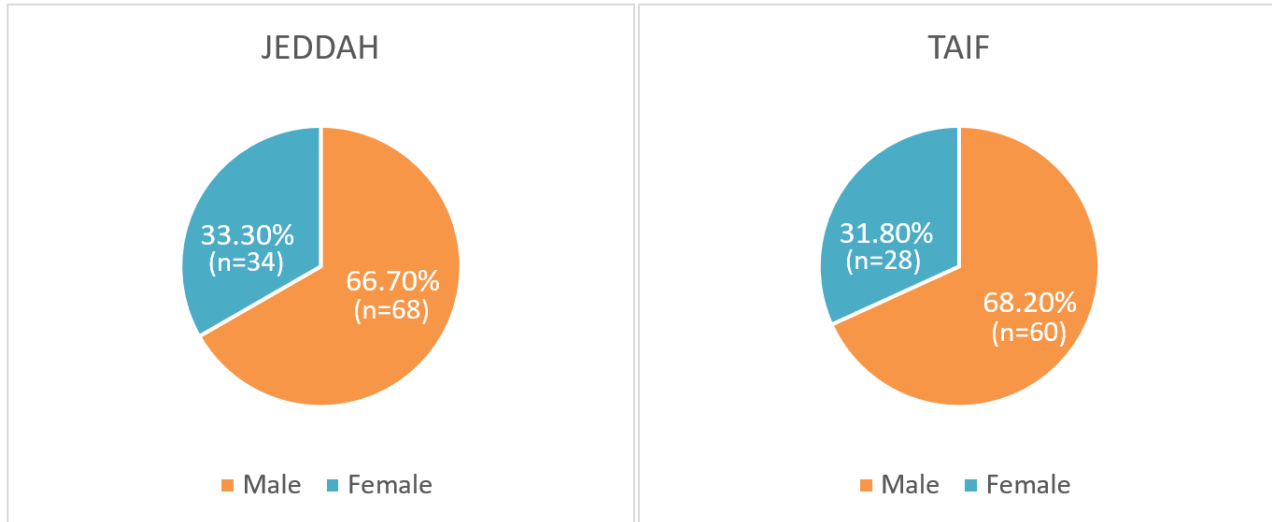


Figure (1): Distribution of gender in both cities.

In Jeddah most of them were Saudis (27.5%) followed by Yemenis (24.5%) while in Taif most of them were Saudis (84.1%) followed by Pakistanis (5.7%). (Figure 2). Regarding mean age, it was significantly higher in Taif compared to Jeddah ( $71.9 \pm 15.1$  vs  $64.4 \pm 13.5$ ,  $p$  value  $< 0.05$ ). (Figure 3)

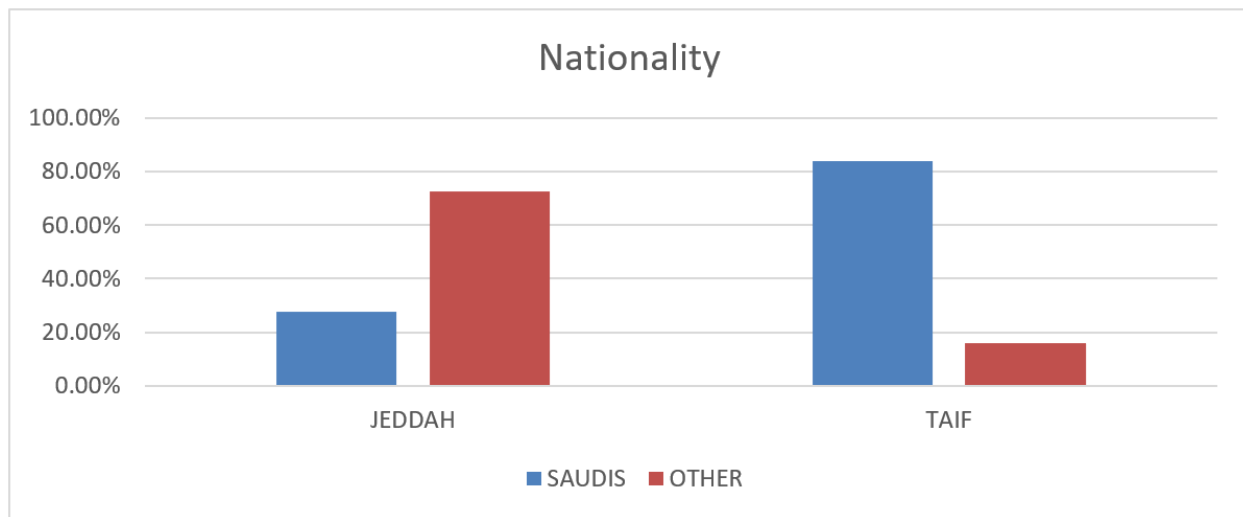


Figure (2): Distribution of nationalities in both cities.

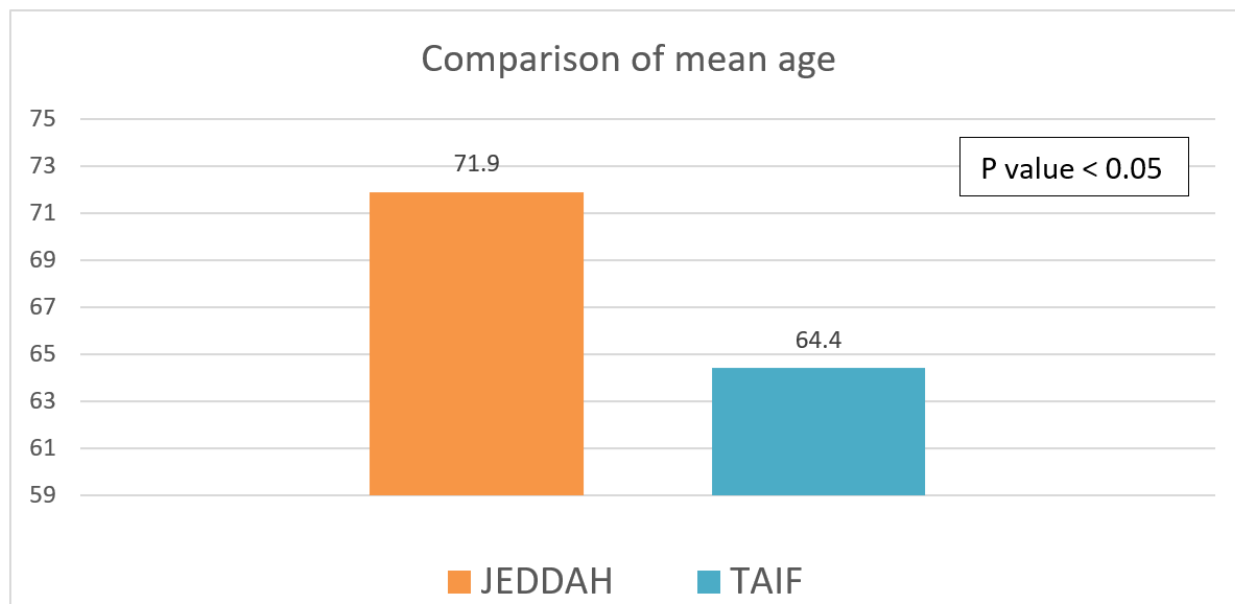


Figure (3): Comparison of age between Taif and Jeddah cities with a significant difference.

While reviewing the files, STEMI (ST elevation myocardial infarction) was the highest among the other ECG changes (71.8% in Jeddah and 92% in Taif) and mostly it was observed to be in the anterior leads (45.1% in Jeddah and 40.9% in taif) followed by inferior leads (11.8%) in Jeddah and anterolateral leads (22.7%) in Taif.

In Jeddah, 16.9% of patients had type II DM, while 57.7% had both type II DM and HTN as a risk factors for myocardial infarction. Also, (14%) and (7%) were a known cases of heart disease and hyperlipidemia, respectively. 14.6% of Taif residents had type II DM but type II DM and HTN together also represent (52.9%) of the risk factors, (14.3%) had a previous heart disease while only (1.1%) was diagnosed with hyperlipidemia. Smoking was slightly higher in taif compared to Jeddah (7.7% vs 7%).

Collectively in both cities, 48.4% of the patient didn't suffer from any complications while cardiogenic shock complicated most of the other cases in this study (48% in Jeddah and 22.7% in Taif).

Regarding previous cardiac intervention, (38%) and (3.4%) had CABG (coronary artery bypass graft) while (38%) and (12.5%) had PCI (percutaneous coronary intervention) in Jeddah and Taif, respectively. When the relation of complication was seen with residency, it was found that arrhythmia is higher in Taif whereas cardiogenic shock is higher in Jeddah as a complication of myocardial infarction with a statistical significance for both complications ( $p < 0.05$ ). (Table 1).

Table (1): Relationship between complications and residency.

Residence	Complications				Chi-Square test	p value
	Arrhythmia	Cardiogenic shock	Both Cardiogenic shock & Arrhythmia	None		
Jeddah	6(5.9%)	45(44.1%)	5(4.9%)	46(45.1%)	13.307	0.004*
Taif	9(10.2%)	20(22.7%)	1(1.1%)	58(65.9%)		
<b>Total</b>	15	65	6	104		

In Jeddah, it was found that Type II DM was strongly related to occurrence of cardiogenic shock as a complication of acute myocardial infarction ( $p = 0.018$ ) vs ( $p$  value 0.216) in Taif. (Table 2)

**Table (2): Relationship between complications and risk factors.**

Residency	Risk factor	Arrhythmia	Cardiogenic shock	None	P value
Jeddah	DM	1	7	3	0.018*
	HTN, DM	2	13	14	
Taif	DM	0	1	7	0.216
	HTN, DM	2	7	23	

In the other hand there is no significant relationship between the patient's age or the ECG changes (STEMI or NSTEMI) and the possibility of having a complicated MI neither in Jeddah nor in Taif. (Tables 3,4)

**Table (3): Relation between complications and age.**

Residence	Age range	Complications			p-value
		Arrhythmia	Cardiogenic shock	None	
Jeddah	<50 years	0	3	4	0.128
	50-75 years	3	23	16	
	>75 years	0	5	12	
Taif	<50 years	0	1	4	0.913
	50-75 years	3	8	28	
	>75 years	6	7	26	

**Table (4): Relation between complications and ECG changes, no relation was found.**

Residence	ECG change	Complications			p-value
		Arrhythmia	Cardiogenic shock	None	
Jeddah	STEMI*	3	23	21	0.747
	NSTEMI**	0	8	11	
Taif	STEMI*	8	15	53	0.999
	NSTEMI**	1	1	5	

N.B. \*STEMI: ST elevation myocardial infarction

N.B. \*\*NSTEMI: Non-ST elevation myocardial infarction

### DISCUSSION:

In our study there was 102 patients who died from acute myocardial infarction in Jeddah, which represent the sea level altitude area and 88 patients in Taif which represent the high-altitude area. The main findings were that the high-altitude patients had a significant decrease in mortality ( $p < 0.05$ ), and higher incidence of arrhythmia as a complication of acute myocardial infarction. On the other hand, sea level altitude patients had a higher incidence of cardiogenic shock which is significantly related to having type II diabetes mellitus.

Among Taif residents, the mean age in Taif was

(71.9±15.1), while in Jeddah it was (64.4±13.5), this result is totally different than the results of a research conducted by Al-Huthi MA et al. (2006), where the mean age was significantly lower in high altitude vs. sea level altitude area (55.3 years ± 8.2 vs. 56.8 years ± 7.1). [7] In addition, the mean age in Taif was much higher when compared to another high-altitude areas such as Asir region in south Saudi Arabia and ski resorts in the French Alps (57±13 and 57±11). [6,8]

Most of the patients either from Jeddah or Taif had an ECG changes consistent with STEMI (ST elevation myocardial infarction), and it was mostly in the

anterior leads (V3, V4). This result is similar to another research that was done in Asir region. [6]

Type II Diabetes Mellitus, hypertension and hyperlipidemia were the most pronounced risk factors that led to the acute attack of myocardial infarction, a result that is similar to studies done by Ashouri K et al. (1994) and Chacornac M et al. [6,8]

All of the previously mentioned risk factors were higher in patients who died at a sea level Altitude (Jeddah). This finding is in contrary to the result of a study done in Yemen [7], where they were higher in high altitude or borderline significant. Also, smoking and history of previous heart disease were among the other reported risk factors that increase the risk of having myocardial infarction and they were both higher in Taif compared to Jeddah. This result is similar to what Al-Huthi MA et al. (2006) found in their study. Regarding complications, there was no sufficient researches that studied the effect of altitude on their occurrence. In this study cardiogenic shock and cardiac arrhythmia were the two most common complications. Cardiogenic shock was significantly higher in Jeddah, where arrhythmia was significantly higher in Taif. In contrast, arrhythmia was insignificantly higher in high altitude in Yemen. [7]

It was found that there was a significant relationship between having type II DM and suffering from cardiogenic shock as a complication of acute myocardial infarction. This result is supported by a study done by Marianne et al. (2004), which showed that patient who suffered from cardiogenic shock had an impaired fasting glucose compared to those who don't have cardiogenic shock. [9] However, in Lindholm et al. (Aug 2005) study a higher incidence of diabetes in patients with cardiogenic shock but the overall 30-days and 5-years mortality rate was equally poor in diabetic and nondiabetic. [10]

#### Limitations:

A limitation of this work was the small sample size selected, and carrying out the study of mortality and morbidity from a hospital setting.

#### CONCLUSION:

In Jeddah, the mean age was significantly lower compared to Taif. There was a significant relation between diabetes mellitus type II and cardiogenic shock in Jeddah, with no relation in Taif. In complications, arrhythmia was significantly higher in Taif whereas cardiogenic shock was higher in Jeddah. Our recommendation is to apply this study on a larger sample with comparing laboratory values of MI patients between high and sea level altitude.

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