ORIGINAL ARTICLE

Variation in Admission Rates of Acute Coronary Syndrome Patients in Coronary Care Unit According to Different Seasons

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Abstract

Objective: Environmental stresses, especially extreme cold and hot weathers, have tendency to have more admissions for acute coronary syndromes. Due to scarcity of local data, we studied the variation in patient admission rates with acute coronary syndrome according to different seasons.

Study Design: Descriptive study.

Place and Duration of Study: Coronary Care Unit, Civil Hospital and Pakistan Steel Hospital, Karachi, from January 2011 to December 2011.

Methodology: The study group comprised consecutive patients with acute coronary syndrome (unstable angina, Non ST-Elevation Myocardial Infarction (NSTEMI), ST-Elevation Myocardial Infarction (STEMI) admitted to the coronary care unit. Patients with stable angina and valvular heart disease were excluded. Data was analyzed for admission according to different seasons, (winter, spring, summer and autumn).

Results: The mean age of the 428 cases was 48.5 ± 10.4 years (range 27 to 73 years). Among the study group, 261 (61%) and 167 (39%) cases were male and female respectively. ST-elevation myocardial infarction, non ST-elevation myocardial infarction and unstable angina were present in 206 (48%), 128 (30%) and 94 (22%) respectively. Among the 428 patients, 184 (43%) cases had hypertension, 133 (31%) cases were smokers, 103 (24%) cases had dyslipidemia and diabetes mellitus and 08 (2%) cases had history of premature coronary artery disease. The number of patients admissions with acute coronary syndrome tended to change with sudden change in season. It increased in Winter 158 (36.9%) and Summer 130 (30.3%) in comparison to Spring 80 (18.69%) and Autumn 60 (14.02%) season.

Conclusion: It was found variation in admission rates of acute coronary syndrome patients according to different seasons. The number of admissions not only increased in the cold season (winter) but also in hot season (summer) with sudden changes in temperature.

Key Words: *Variation. Admission. Acute coronary syndrome patients. CCU. Seasons.*

INTRODUCTION

The effect of climate change on human health has received much attention in response to projected scenarios of both increasing and more variable global temperature. Karachi is located on the coast and as a result has a relatively mild climate. Karachi has two main seasons summer and winter, while spring and autumn are very short. Summer season persists for longest period during the year. The level of precipitation is low for most of the year. Less precipitation during summer is due to inversion layer. Karachi also receives the manson rains from July to September. The city enjoys a tropical climate encompassing mild winters and warm summers. The humidity levels usually remain high from March to November, while very low in winter as the wind direction in winter is North Easterly. Since summer temperatures (from the end of April till the end of August) are approximately 30°C (86°F) to 36°C (97°F), the winter months (from November till the end of March) are the best time of Karachi.[1] Global warming is affecting the Earth. The Intergovernmental Panel on Climate Change (IPCC) has projected that global mean surface temperature will increase by 1.8 - 4.0°C (best estimate) by 2100 relative to 1980 - 1999 (IPCC 2007a). Therefore, efforts to understand how climate change will affect health are urgently needed.[2] To-date, only a few studies have concentrated on hospital and/or emergency department admissions data, collected from either hospital or health department information systems.[3,4] In 1937, Masters *et al*. have described an increase in mortality from acute myocardial infarction in winter seasons.[5] Since then larger studies have confirmed these findings.[3,4] Hernandez *et al*.[6] on behalf of the Proyecto de Registro del Infarto de Miocardio en Valencia, Alicante y Castellón (PRIMVAC) study research team have reported the presence of a seasonal pattern in the admissions for acute myocardial infarction in the cardiology intensive care units of the Community of Valencia, Spain, with an increase in the number of

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cases in winter in comparison to summer season. In that report, age of patients have been shown to influence the effect of environmental factors on acute ischemic heart disease, especially in cases over 65 years of age. We do not have much data on the effect of weather on cardiovascular diseases. It is important to examine these effects as not only will it increase the knowledge of correlation between temperature and human health, but this information will also inform the public health policy that seeks to minimize the adverse impacts of climate change on the population, particularly in terms of major chronic conditions, such as cardiovascular.[7]

METHODOLOGY

The study group comprised of 428 consecutive patients with acute coronary syndrome admitted to the coronary care unit of Civil Hospital and Pakistan Steel Hospital, Karachi, Pakistan, from January 2011 to December 2011. Patients with stable angina and valvular heart disease were excluded. We analyzed the data of patients by gathering the data of temperature (Table I), resting electrocardiogram, biochemical markers, serum enzyme levels, serum lipid levels, and prior history of cardiac disease and coronary risk factors. At the time of admission and during the coronary care unit stay, in all patients, troponin and creatine kinase MB isoenzyme levels were measured at least once a day. Patients were identified as hypertensive on the basis of clinical history or if they required antihypertensive therapy. Diabetes mellitus was defined by history of the diagnosis or by regular use of insulin or oral hypoglycemic agents. Family history of premature coronary artery disease mortality was defined as death due to coronary artery disease, myocardial infarction, or sudden death (defined as death associated with an unexplained and sudden collapse) before 55 years of age (for men) and 65 years of age (for women) in any first-degree relative or grandparents.

The data were analyzed with Statistical Package for the Social Sciences (SPSS) 16.0 XP window. Frequency of patients' admissions calculated in percentage according to different seasons while mean ± standard deviation (SD) was calculated for numerical variables.

RESULTS

The mean age of the 428 cases was 48.5 ± 10.4 years, (range 27 to 73 years). Among the study group, 261 (61%) and 167 (39%) cases were male and female respectively. ST-elevation myocardial infarction, non-ST elevation myocardial infarction and unstable angina were present in 206 (48%), 128 (30%) and 94 (22%) respectively. Among the 428 patients, 184 (43%) cases had hypertension, 133 (31%) cases were smokers, 103 (24%) cases had dyslipidemia and diabetes mellitus and 08 (2%) cases had history of premature coronary artery disease. The average temperatures for Karachi, Pakistan, in 2011 are given in Figure 1. In cold and hot seasons, 158 (36.9%) and 130 (30.3%) patients were admitted respectively. Frequency of patients admissions were different across different seasons (Table II). The monthly temperatures and frequency of patients' admissions are given in Figures 1 and 2 respectively. In cold season, 56 (13%) patients were admitted in the month of January while in hot season, 53 (12%) patients were admitted in June as shown in Figure 2.

Table II: Frequency (%) of patients admissions according to different seasons (temperature).

Seasons	Total number of patients (428) Number (%)	Temperature (°C) average high
Winter (cold season)	158 (36.9%)	25.6
Spring	80 (18.69%)	30.6
Summer (hot season)	130 (30.3%)	33.3
Autumn	60 (14.02%)	30.5

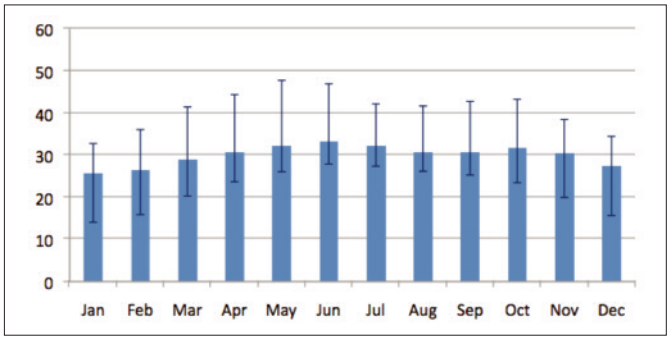

Figure 1: Average, low and high temperature (°C) of Karachi Pakistan according to months during year 2011.

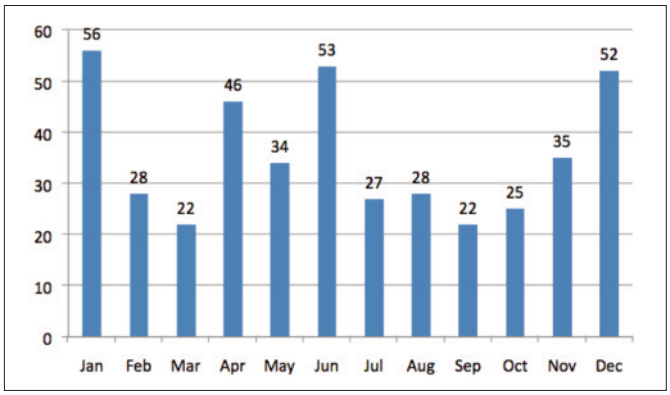

Figure 2: Frequency of acute coronary syndrome patients admission according to months of year 2011.

Table I: Temperature variations of Karachi, Pakistan, during year 2011.

Month	January	February	March	April	May	June	July	August	September	October	November	December	Year
Record high °C (°F)	32.8 (91)	36.1 (97)	41.5 (106.7)	44.4 (111.9)	47.8 (118)	47.0 (116.6)	42.2 (108)	41.7 (107.1)	42.8 (109)	43.3 (109.9)	38.5 (101.3)	34.5 (94.1)	47.8 (118)
Average high °C (°F)	25.6 (78.1)	26.4 (79.5)	28.8 (83.8)	30.6 (87.1)	32.3 (90.1)	33.3 (91.9)	32.2 (90)	30.8 (87.4)	30.7 (87.3)	31.6 (88.9)	30.5 (86.9)	27.3 (81.1)	30.0 (86)
Average low °C (°F)	14.1 (57.4)	15.9 (60.6)	20.3 (68.5)	23.7 (74.7)	26.1 (79)	27.9 (82.2)	27.4 (81.3)	26.2 (79.2)	25.3 (77.5)	23.5 (74.3)	20.0 (68)	15.7 (60.3)	22.2 (72)

Climatological information for Karachi, Pakistan". Hong Kong Observatory. Retrieved 2011-05-02[1]

DISCUSSION

The study group comprised of acute coronary syndrome patients admitted to coronary care unit. Our findings that admissions were more frequent, 158 (36.9%) with decreasing temperature is in accordance with the findings of Panagiotakos *et al*.[8] Seasonal changes have been shown in the pattern of cardiac deaths in New South Wales and Western Sydney area health service by Weerasinghe *et al*.[9] They found that there were higher death ratios from cardiac events during the winter months. Fifty five percent of the cases have been admitted in autumn and winter in that study also comparable in this study (51.01%). Auliciems *et al*. has analyzed mortality rates for a decade in Brisbane for dependence upon atmospheric factors.[10] They showed that deaths were observed to increase with colder and less humid weather. Also in Auckland, New Zealand daily myocardial infarct deaths showed an increase in mortality rate with decreasing temperatures over the entire thermal range.[11] Colder weather has been shown to alter hemodynamic and hematological factors in favor of arterial thrombosis.[12] The coronary artery disease has classical risk factors. The acute coronary syndromes are believed to have triggers like heavy exercise, cold weather, mental stress, sexual activity, exposures to cocaine, marijuana and particulate air pollution.[13]

In addition to winter season, this study also showed increase in admissions in summer and sudden change in hot season, as in some other studies that suggested an increase in cardiac events during the summer.[14-16] The effect of ambient temperature on morbidity is a significant public health issue. Every year, a large number of hospitalizations are associated with exposure to extreme ambient temperatures, especially during heat waves and cold spells.[17,18] Urban residents may be exposed to higher temperatures than residents of surrounding suburban and rural areas because of the "heat island effect" resulting from high thermal absorption by dark paved surfaces and buildings, heat emitted from vehicles and air conditioners, lack of vegetation and trees, and poor ventilation.[19,20] Besides heat wave intensity, heat wave duration is also an important risk factor in estimating the health effect of heat episodes. Vulnerability to heat stress depends on many factors, such as age, pre-existing diseases, environmental humidity and adaptative response. A long heat wave could lead to accumulated heat stress on the body when heat produced and obtained from the environment overwhelms the heat loss by thermo-regulation. Over consecutive hot days without cooler nights, individuals may suffer from thermoregulatory failure, increasing the risk of illnesses. There is also an evidence that the effect of extreme cold might increase with increasing duration, as low temperature can lead to cardiovascular stress by increasing platelet counts, red cells, blood viscosity, plasma cholesterol, fibrinogen and blood pressure. Some studies explored temporal patterns (lag structure) of the correlation between exposure to temperature over previous days and health risk on a particular day. Various lag days were reported for correlation of temperature with morbidity, ranging from the same day to one month, with shorter lags during warmer seasons and longer lags during cooler seasons.[21,22] Several studies also found U- or V-shaped exposure-response relationships as in this study (Figure 2), with morbidity increasing at both ends of the temperature scale like in this study. The majority of studies reported detrimental effects of heat on the same day or upto the following 3 days, and longer cold effects upto a 2 - 3 weeks lag, with no substantial effects after more than one month. Seasonal changes in hemo-dynamic might contribute to seasonal variation in acute myocardial infarction. The reason for the number of admissions is because of having acute coronary syndrome being high in cold days may be caused by the increased cardiac workload during the winter, higher coronary and vascular resistance induced by cold, higher blood pressure during the winter, and higher fibrinogen levels reported in winter. These all may account for the increased rate of admission. It may be wise to advice coronary patients to avoid environmental stresses, especially extreme cold and hot weathers.[23-25] The average temperatures will probably raise and the tendency to have more admissions for acute coronary syndromes in cold weathers may change to some extent by involving very hot summer days. This is a small study; needs large local studies. Such studies will provide valuable information for designing and implementing intervention strategies to alleviate the public health impacts of climate change.

CONCLUSION

This study showed variation in the admission rate of acute coronary syndrome patients in coronary care unit across the different seasons. The number of admissions not only increases in the cold and hot season but also with sudden change in season.

REFERENCES

1. Where is your weather? [Internet]. 2007. Available from: http://www.wunderground.com/
2. Intergovernmental Panel on Climate Change. Climate change 2001: the scientific basis. Contribution of working group-I to the third assessment report of the Intergovernmental Panel on Climate Change. Cambridge: *Cambridge University Press;* 2001.
3. Liang WM, Liu WP, Chou SY. Ambient temperature and emergency room admissions for acute coronary syndrome in Taiwan. *Int J Biometeorol* 2008; **52**:223-9.
4. Knowlton K, Rotkin-Ellman M, King G. The 2006 California heat wave: impacts on hospitalizations and emergency department visits. *Environ Health Perspect* 2009; **117**:61-7.
5. Masters AM, Dack S, Jaffe HL. Factors and events associated with onset of coronary artery thrombosis. *JAMA* 1937; **109**: 546-9.

6. Hernández EG, O'Callaghan AC, Doménech JC. On behalf of the PRIMVAC study (Proyecto de Registro del Infarto de Miocardio en Valencia, Alicante y Castellón) research team. Seasonal variations in admissions for acute myocardial infarction. *Rev Esp Cardiol* 2004; **57**:12-9.
7. Lin S, Luo M, Walker RJ. Extreme high temperatures and hospital admissions for respiratory and cardiovascular diseases. *Epidemiology* 2009; **20**:738-46.
8. Panagiotakos DB, Chrysohoou C, Pitsavos C. Climatological variations in daily hospital admissions for acute coronary syndromes *Int J Cardiol* 2004; **94**:229-33.
9. Weerasinghe DP, MacIntyre CR, Rubin GL. Seasonality of coronary artery deaths in New South Wales, Australia. *Heart* 2002; **88**:30-4.
10. Auliciems A, Frost D, Siskind V. The time factor in mortality: weather associations in a subtropical environment. *Int J Biometeorol* 1997; **40**:183-91.
11. Frost DB, Auliciems A, de Freitas C. Myocardial infarct death and temperature in Auckland, New Zealand. *Int J Biometeorol* 1992; **36**:14-7.
12. Woodhouse PR, Khaw KT, Plummer M, Foley A, Meade TW. Seasonal variations of plasma fibrinogen and factor VII activity in the elderly: winter infections and death from cardiovascular disease. *Lancet* 1994; **343**:435-9.
13. Servoss SJ, Januzzi JL, Muller JE. Triggers of acute coronary syndromes. *Progr Cardiovasc Dis* 2002; **44**:369-80.
14. Heyer HE, Teng HC, Barris W. The increased frequency of acute myocardial infarction during summer months in a warm climate. *Am Heart J* 1953; **45**:741-6.
15. Revich B, Shaposhnikov D. Excess mortality during heat waves and cold spells in Moscow, Russia. *Occup Environ Med* 2008; **65**:691-6.
16. O' Neill MS, Ebi KL. Temperature extremes and health: impacts of climate variability and change in the United States. *J Occup Environ Med* 2009; **51**:13-25.
17. Schwartz J, Samet JM, Patz JA. Hospital admissions for heart disease: the effects of temperature and humidity. *Epidemiology* 2004; **15**:755-61.
18. Ye X, Wolff R, Yu W. Ambient temperature and morbidity: a review of epidemiological evidence. *Environ Health Perspect* 2012; **120**:19-28.
19. Hajat S, Kosatky T. Heat-related mortality: a review and exploration of heterogeneity. *J Epidemiol Community Health* 2010; **64**:753-60.
20. Yu W, Vaneckova P, Mengersen K. Is the association between temperature and mortality modified by age, gender and socio-economic status? *Sci Total Environ* 2010; **408**:3513-8.
21. Yu W, Mengersen K, Hu W. Assessing the relationship between global warming and mortality: lag effects of temperature fluctuations by age and mortality categories. *Environ Pollut* 2011; **159**:1789-93.
22. Martiello MA, Giacchi MV. High temperatures and health outcomes: a review of the literature. *Scand J Public Health* 2010; **38**:826-37.
23. Nitschke M, Tucker GR, Hansen AL. Impact of two recent extreme heat episodes on morbidity and mortality in Adelaide, South Australia: a case-series analysis. *Environ Health* 2011; **10**:42-5.
24. Alessandrini E, Zauli Sajani S, Scotto F. Emergency ambulance dispatches and apparent temperature: a time series analysis in Emilia-Romagna, Italy. *Environ Res* 2011; **111**:192-200.
25. Li Y, Du T, Lewin MR. The seasonality of acute coronary syndrome and its relations with climatic parameters. *Am J Emerg Med* 2011; **29**:768-74.