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Title Page

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Irfan FB, Castren M, Bhutta ZA, George P, Qureshi I, Thomas SH, Pathan SA, Alinier G, Shaikh LA, Suwaidi JA, Singh R, Shuaib A, Tariq T, Mckenna WJ, Cameron PA, Djarv T
Furqan B Irfan
Department of Clinical Science and Education, Södersjukhuset, Karolinska Institutet, SE-118 83 Stockholm, Sweden
College of Osteopathic Medicine, Michigan State University, West Fee Hall, 909 Fee Road, East Lansing, MI 48824

Maaret Castren
Helsinki University and Department of Emergency Medicine and Services, Helsinki University Hospital, Haartmaninkatu 4, 00029 HUS, Finland

Zain A Bhutta
Department of Emergency Medicine, Hamad General Hospital, Hamad Medical Corporation, PO Box 3050, Doha, Qatar

Pooja George
Department of Emergency Medicine, Hamad General Hospital, Hamad Medical Corporation, PO Box 3050, Doha, Qatar

Isma Qureshi
Department of Emergency Medicine, Hamad General Hospital, Hamad Medical Corporation, PO Box 3050, Doha, Qatar

Sameer A. Pathan
Department of Emergency Medicine, Hamad General Hospital, Hamad Medical Corporation, PO Box 3050, Doha, Qatar

Stephen H. Thomas
Department of Emergency Medicine, Hamad General Hospital, Hamad Medical Corporation, PO Box 3050, Doha, Qatar

Guillaume Alinier
Hamad Medical Corporation Ambulance Service, Medical City. Doha
PO Box 3050, Qatar
School of Health and Social Work, Paramedic Division, University of Hertfordshire, Hatfield, AL10 9AB, HERTS, UK

Loua A Shaikh
Hamad Medical Corporation Ambulance Service, Medical City. Doha
PO Box 3050, Qatar

Jassim A Suwaidi
Adult Cardiology, Heart Hospital, Hamad Medical Corporation, Doha, PO Box 3050, Qatar

Rajvir Singh
Cardiology Research, Heart Hospital, Hamad Medical Corporation, Doha, PO Box 3050, Qatar

Ashfaq Shuaib
Neuroscience Institute, Hamad Medical Corporation, PO Box 3050, Doha, Qatar

Tooba Tariq
Western Michigan University Homer Stryker M.D. School of Medicine, 1000 Oakland Drive, Kalamazoo, MI 49008, US

William J. McKenna
Heart Hospital, Hamad Medical Corporation, Doha, PO Box 3050, Qatar

Peter A. Cameron
The Alfred Hospital, Emergency and Trauma Centre, School of Public Health and Preventive Medicine, Monash University, 99 Commercial Road, Melbourne VIC 3004

Therese Djarv
Department of Medicine Solna, 171 00 Karolinska Institutet, Sweden

Corresponding author:

Furqan B. IRFAN
Department of Clinical Science and Education, Södersjukhuset, Karolinska Institutet, SE-118 83 Stockholm, Sweden
Department of Emergency Medicine, Hamad General Hospital, Hamad Medical Corporation, PO Box 3050, Doha, Qatar
Correspondence to: furqan.irfan@gmail.com

Ethnic differences in out-of-hospital cardiac arrest among Middle Eastern Arabs and North African populations living in Qatar

Abstract

Aims:
There are very few studies comparing epidemiology and outcomes of out-of-hospital cardiac arrest (OHCA) in different ethnic groups. Previous ethnicity studies have mostly determined OHCA differences between African American and Caucasian populations. The aim of this study was to compare epidemiology, clinical presentation and outcomes of OHCA between the local Middle Eastern Gulf Cooperation Council (GCC) Arab and the migrant North African populations living in Qatar.

Methods:
This was a retrospective cohort study of Middle Eastern GCC Arabs and migrant North African patients with presumed cardiac origin OHCA resuscitated by Emergency Medical Services (EMS) in Qatar, between June 2012 and May 2015.

Results:
There were 285 Middle Eastern GCC Arabs and 112 North African OHCA patients enrolled during the study period. Compared with the local GCC Arabs, univariate analysis showed that the migrant North African OHCA patients were younger and had higher odds of initial shockable rhythm, pre-hospital interventions (defibrillation and amioderone), pre-hospital scene time, and decreased odds of risk factors (hypertension, respiratory disease and diabetes) and pre-hospital response time. The survival to hospital discharge had greater odds for North African OHCA patients which did not persist after adjustment. Multivariable logistic regression showed that North Africans were associated with lower odds of diabetes (OR 0.48, 95% CI 0.25- 0.91, p=0.03), and higher odds of initial shockable rhythm (OR 2.86, 95% CI 1.30-6.33, p=0.01) and greater scene time (OR 1.02 95% CI 1.0-1.04, p=0.02).

Conclusions:

North African migrant OHCA patients were younger, had decreased risk factors and favorable OHCA rhythm, and received greater ACLS interventions with shorter pre-hospital response times and longer scene times leading to better survival.

Keywords:
Cardiac arrest
Ethnic
Cardiopulmonary resuscitation
Epidemiology
North Africa
Middle East

Introduction

Out of hospital cardiac arrest (OHCA) is a leading cause of mortality. In the US alone, 359 800 people suffered OHCA annually with a survival rate of 10.6%. (1) There is considerable variation in incidence and survival rates among countries and region. (2)(3) Improved survival has been shown to be dependent on various factors such as younger age, initial shockable rhythm, witnessed arrest, bystander cardiopulmonary resuscitation (CPR), and short emergency medical services (EMS) response times. (4)(5)

The relationship between race and OHCA have mostly compared African Americans to Caucasian racial groups, with few studies also including other ethnic groups; Hispanics, Asians, and South Asians. (5) (6) (4) (7) South Asians have been reported to have a higher incidence of OHCA at a relatively younger age compared to Caucasians. (4) Many studies have shown that African Americans have a higher incidence of OHCA compared to Caucasians. (7) Studies have showed that African Americans have lower survival rates and are less likely to have a witnessed cardiac arrest, receive bystander CPR and have a shockable rhythm. (5) Some studies have attributed these differences to lower socio-economic status rather than ethnic differences. (8) (9) The explanation for these differences based on ethnicity are inconclusive and could be due to many factors including cardiovascular anatomy and pathophysiology of OHCA, varying standards of EMS and healthcare access, health education and prevention strategies. (7)

The few studies that have looked at ethnic differences in OHCA have mostly been carried out in Western countries. (10) There are no studies investigating the effect of Asian and African ethnic groups on OHCA characteristics and outcomes. (5) Qatar being an Arab country with a majority of expatriate (over eighty percent) population provides a fertile ground to study OHCA according to different African and Asian ethnicities. (2) We have previously described Qatar's population, health system and emergency care services. (2) In this study, the hypothesis was that there is a difference in epidemiology, clinical presentation and outcomes between Middle Eastern Gulf Cooperation Council (GCC) Arab (local) and North African (expatriate) populations living in Qatar. Given the hypothesis, the aim of the study was to compare and determine association of OHCA epidemiology, peri-cardiac arrest characteristics, emergency

management and survival with Middle Eastern Gulf Cooperation Council (GCC) Arab and North African ethnicities living in Qatar.

Methods

This was a retrospective cohort study of prospectively enrolled OHCA patients in Qatar, as part of the national OHCA registry according to Utstein style guidelines, assessed by Hamad Medical Corporation Ambulance Service (HMCAS) from 1 June, 2012 to 31 May, 2015. (2) Data were obtained from HMCAS incident, dispatch, and pre-hospital patient records, Emergency Department (ED) and inpatient medical records of Hamad Medical Corporation (HMC), the public (government) healthcare provider for Qatar. (2) A brief overview of the EMS in Qatar and emergency cardiac care protocols according to advanced cardiac life support (ACLS) guidelines have been described in a previous publication. (2) The Institutional Review Board (IRB) of HMC gave ethics approval for the study and granted waiver of informed consent (JIRB# 13-00071).

OHCA was defined as arrest due to presumed cardiac etiology determined by EMS in the absence of any non-cardiac cause of the arrest. (2) Inclusion criteria included adult (greater than 18 years of age) Middle Eastern GCC Arabs and North African patients with presumed cardiac origin OHCA resuscitated by EMS in Qatar. Exclusion criteria were OHCA patients with origin other than Middle Eastern GCC Arabs and North African, OHCA patients with clear evidence of death, patients less than 18 years of age, and arrest during EMS inter-hospital transfer or arrest in nursing facility or intermediate/long-term healthcare facility.

Patients were categorized into Middle Eastern GCC Arab or North African ethnic groups based on nationality which was obtained from the patient medical records. OHCA patients were classified as Middle Eastern GCC Arabs if they were nationals from the following Gulf Cooperation Council (GCC) countries in Middle East; Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates. (11) OHCA patients were classified as North Africans if they were nationals from the following countries according to United Nations classification; Algeria, Egypt, Libya, Morocco, Sudan, Tunisia, and the Western Sahara. (12) (Figure1)

Covariate variables collected included demographic variables, peri-cardiac arrest characteristics (location, witnessed arrest, bystander CPR, CPR quality, initial shockable rhythm, and defibrillation), advanced cardiac life support (ACLS) interventions (airway management and/or medications), and time-related indicators of EMS processes (response, scene and transport times). Association of covariate variables with ethnic origin was the primary outcome and secondary outcomes were covariate variable predictors of ‘survival to hospital discharge’, and ‘survival to hospital admission’ defined as ‘return of spontaneous circulation (ROSC) achieved and sustained on ED arrival.’ (2) Detailed methodology and data collection methods have been previously published. (2)

Statistical analysis

Descriptive analyses of categorical variables were reported as frequencies and percentages. Continuous variables with normal distribution were described using means with standard deviations and variables with non-normal distribution were described using medians with interquartile ranges (IQR) according to Tukey's Hinges. Normality of continuous variables was assessed by the Shapiro-Wilk test. Chi-square and Fisher's exact test were used for comparison of categorical variables, as appropriate. Independent t-test and Mann-Whitney test were used for comparison of continuous variables with normal and non-normal distribution, respectively. Binomial logistic regression modelling was performed to measure the association of covariate variables with ethnic origin and overall outcomes; survival to hospital discharge and survival to hospital admission. Multivariable analysis was performed using step-wise forward logistic regression modelling. Multivariable analysis included potentially significant variables if p-value < 0.1 and missing observations were less than 10% in univariate analysis. Age (natural log) and gender were included in multivariable analysis as potential confounders. Before performing multivariable analysis, a correlation matrix was used to assess collinearity in independent variables. Statistical analysis was performed using SPSS (IBM SPSS Statistics version 22.0).

Results

The EMS in Qatar attempted to resuscitate a total of 1,917 OHCA patients between June 2012 and May 2015. After exclusion a total of 397 OHCA patients were Middle Eastern GCC Arabs (n=285, 21%) and North Africans (n=112, 8%), during the study period and were included in the analysis. (Figure 1) The sex ratio was 1.5 for GCC OHCA patients and 5.6 for North African OHCA patients. The median age for GCC OHCA patients was 71 years (IQR = 56.5 – 79.0) and mean age was 66.9 (SD=17). The median age for North African OHCA patients was 52 years (IQR = 40.0 – 63.3) and mean age was 52.3 (SD=15).
The remaining OHCA patients were mainly from South Asian and Far Eastern origin.
North African OHCA patients were predominantly male and younger compared to GCC Arabs ($p<0.001$) (Table 1). Although the majority of the cardiac arrests occurred at home (n=334, 85.4%) in both ethnic groups, North Africans had relatively lesser proportion of OHCA at home and consequently greater proportion of OHCA in public places and street/road in comparison to GCC Arabs ($p<0.001$) (Table 1). GCC Arabs had a greater history of hypertension ($p=0.03$), respiratory disease ($p=0.05$), and diabetes ($p<0.001$) compared to North Africans (Table 1). Witnessed cardiac arrest, bystander CPR, mechanical chest compression device, ACLS interventions, airway, and adrenaline utilization were comparable between the two ethnic groups. North African OHCA patients had a greater proportion of initial shockable rhythm ($p=0.002$), defibrillation ($p=0.005$), and amioderone utilization ($p<0.001$) compared to GCC Arabs. EMS median response time was higher for GCC Arabs ($p=0.03$) while the inverse was true for scene time ($p=0.005$) compared to North Africans (Table 1). The overall survival rate was 6.5%. Survival to hospital admission (ROSC) was comparable between both ethnic groups while survival to hospital discharge was greater for North Africans compared to GCC Arabs ($p=0.04$).

Survival of patients without ROSC at ED, was greater for North Africans (n=8, 8.0%) compared to GCC Arabs (n=7, 2.8%) (p=0.04). In the multivariable analysis after adjustment for age and gender; North Africans were associated with lesser odds of diabetes (OR 0.48, 95% CI 0.25-0.91, p=0.03), and higher odds of initial shockable rhythm (OR 2.86, 95% CI 1.30-6.33, p=0.01) and greater scene time (OR 1.02 95% CI 1.0-1.04, p=0.02). (Table 1)
Overall univariate analysis for ROSC or survival to hospital admission; respiratory disease, witnessed OHCA, initial shockable rhythm, and defibrillation were associated with higher odds of ROSC while increased transport time was associated with lower odds of ROSC. (Table 2) In multivariable analysis after adjustment for age, gender, and ethnicity; respiratory disease (OR 5.8, 95% CI, 1.7- 20.4, p=0.005) and witnessed OHCA (OR 2.6, 95% CI, 1.1- 6.0, p=0.03) were associated with higher odds of ROSC, while increased transport time (OR 0.94, CI 95% 0.90 - 0.99, p= 0.009) was associated with lower odds of ROSC. (Table 2)
In the overall univariate analysis for survival to hospital discharge; ethnicity, initial shockable rhythm, defibrillation, and ROSC were associated with higher odds of survival to hospital discharge while diabetes was associated with lower odds of survival to hospital discharge. (Table 1) In multivariable analysis after adjustment for age, gender and ethnicity; initial shockable rhythm (OR 4.36, 95% CI 1.55 – 12.3, p=0.005) and ROSC (OR 5.02, 95% CI 1.68- 15.02, p= 0.004) were associated with higher odds of survival to hospital discharge while diabetes (OR 0.24, 95% CI 0.07 – 0.84, p=0.03) was associated with lower odds of survival to hospital discharge. (Table 2)

Discussion

This is the first study exploring ethnic differences associated with OHCA in Middle Eastern Arabs and North Africans. Middle Eastern GCC Arab patients are mostly Qataris and have a normally distributed population including elderly (allowing Middle Eastern GCC Arab results generalized) while North Africans were mostly actively working male expatriates living in Qatar. North African OHCA patients were younger and predominantly male with lesser history of hypertension, respiratory disease, and diabetes. North Africans had proportionally greater arrests outside their homes, greater shockable rhythm, and received more ACLS interventions (defibrillation and amioderone). The median response time was lower whereas scene time was higher in North Africans. There was evidence of ethnic differences in survival with North African ethnicity associated with higher survival than GCC Arabs which was not statistically significant in the adjusted model. In multivariable analysis Middle Eastern GCC Arabs were associated with greater odds of diabetes and North Africans were associated with higher odds of initial shockable rhythm and greater scene time. We accepted the hypothesis that North African (expatriate) OHCA patients differed from Middle Eastern GCC Arab (local) OHCA patients in terms of epidemiology, management and outcomes.
Most of the literature on comparison of OHCA patients according to ethnicity reported blacks, whites, and Asians as ethnic minorities compared to whites. Blacks and Hispanics had been

reported to have OHCA at a younger age compared to whites which corresponds with the younger age of North African OHCA patients in our study. (5) (13) (14) (15) (16) (17) (4) (18) Blacks and Asians OHCA patients were reported to have a larger proportion of hypertension and diabetes compared to whites with no difference in proportion of coronary artery disease between different ethnicities. (7) Association of diabetes with GCC Arabs persisted after adjustment for age and gender which is consistent with previous studies. (19) Arrest witnessed and bystander CPR were comparable in both ethnicities unlike some previous studies including a meta-analysis that reported blacks were less likely to receive bystander CPR or have a witnessed cardiac arrest when compared to whites. (5) (20) (14) (13) (16) Some studies have reported that initial shockable rhythm was less likely in blacks when compared to the majority white population. Our study however showed that North African ethnicity was found to be independently associated with initial shockable rhythm after adjustment, compared to the native Arab GCC population. (5) (20) (14) (16) ACLS interventions; defibrillatory shocks, and Amioderone were associated with North African ethnicity in univariate analysis which was explained by the association of initial shockable rhythm and greater scene time for North Africans in the adjusted model. This was in contrast to results of a recent study by Ghobrial et al. that reported no statistical difference in ACLS interventions between different ethnicities. (7) To our knowledge, this is the first study on OHCA ethnic differences to look at scene time and transport time. Most studies look only at response time and we emphasize the importance of including all EMS time intervals, since scene time was the only EMS time interval that was significant in North Africans in the adjusted model. The overall median response time was 8.2 minutes which is within the recommended 8-minute response time for ACLS provision. (21) Median response time was shorter for North Africans in univariate analysis which could be due to their OHCA proportionally occurred more in a public place which might be easier and quicker to reach than a private property. (7) (14) A recent study explained shorter response times for blacks and Asians by closer medic unit location to these communities in Seattle. (7) However, the hub and spoke model of ambulance geographical locations of Qatar's EMS excludes closer location of expatriate communities to ambulance stations as the reason for shorter response times. Majority of the studies have reported that whites were more likely to survive compared to blacks. (5) (20) (18) (16) There was no difference in ROSC while North African OHCA patients had better odds of survival compared to GCC Arabs which did not persist after adjustment. North African patients had far better conversion from ROSC to survival (36.4% vs 24.1%). Shorter response times coupled with longer scene times and greater ACLS interventions and better survival for North Africans compared to GCC Arabs provide evidence of relatively better emergency healthcare services for North African expatriates in Qatar.

There were limitations which merit consideration. Categorizing patients into ethnic groups based on nationality restricts selection bias in ethnically homogenous populations and allowed us to explore closely related ethnic groups in this study, since the majority of North Africans are also considered Arabs. However, such a selection method would not be generalizable to ethnically heterogeneous nationalities in most western countries and would be limited to developing

countries. Sample size of ethnic groups was comparable to earlier studies but was still limited. We could not collect socioeconomic data like marital status, income, and education level for individual OHCA patients which could have influenced outcomes. In absence of autopsy for OHCA patients in Qatar, we presumed OHCA patients included in this study to be of cardiac origin in absence of any other signs indicating non-cardiac origin OHCA.

Conclusions

Better health status and younger age translated to North Africans having a greater proportion of shockable rhythms and receiving more ACLS interventions (defibrillation and amioderone) with increased median scene time by paramedics and increased survival odds (univariate analysis) compared to GCC Arabs. GCC Arabs were associated with greater odds of diabetes and North Africans were associated with greater odds of initial shockable rhythm and greater median scene time after adjustment.

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'Conflict of interest: none declared'

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Table 1: Comparison of OHCA patients according to Origin

Variable	Total N=397 (100%)	GCC 285 (71.8%)	North Africa N=112(28.2 %)	Unadjusted Odds Ratio (95% CI) p-value	Adjusted Odds Ratio (95% CI) p-value
Age (Mean ±SD) (Independent t-test)	62.8±17.5	66.9±17	52.3±15	**0.95 (0.94-0.96) P=0.001**	**0.11 (0.04 - 0.29) p= 0.001**
Gender N (%)					
Male	266 (67.0)	171 (60.0)	95 (84.8)	Reference	
Female	131 (33.0)	114 (40.0)	17 (15.2)	**0.27 (0.15-0.47) P=0.001**	**0.42 (0.21 - 0.87) p= 0.02**
Location N (%)					
Public Place	19 (4.8)	7 (2.5)	12 (10.7)	Reference	
Home	334 (84.1)	253 (88.8)	81 (72.3)	**0.19 (0.07-0.49) p=0.001**	-
Street/Road	17 (4.3)	11 (3.9)	6 (5.4)	0.32 (0.08-1.24) p=0.10	-
Other location	21 (5.3)	10 (3.5)	11 (9.8)	0.64 (0.18-2.28) p=0.50	-
History Coronary Artery Disease N (%)	100 (25.1)	77 (27.0)	23 (20.5)	0.77 (0.45-1.32) p=0.34	-
History Hypertension N (%)	143 (36.0)	114 (40.0)	29 (25.8)	**0.57 (0.35-0.94) p=0.03**	-
History Respiratory Disease N (%)	21 (5.3)	20 (7.0)	1 (1.0)	**0.13 (0.02-0.97) p=0.05**	-
History Diabetes N (%)	136 (34.2)	118 (41.4)	18 (16.07)	**0.29 (0.16-0.51) p=0.001**	**0.48 (0.25 - 0.91) p=0.03**
Arrest Witnessed N	131 (33.0)	97 (34.0)	34 (30.3)	0.85 (0.53-1.37)	-

(%)				p=0.51	
Shockable Rhythm N (%)	49 (12.3)	26 (9.1)	23 (20.5)	**2.6 (1.41-4.80) p=0.002**	**2.86 (1.30 - 6.33) p = 0.01**
By Stander CPR N (%)	67 (16.9)	49 (17.2)	18 (16.1)	0.92 (0.51-1.67) p=0.79	-
Defibrillation N (%)	101 (25.4)	61 (21.4)	40 (35.7)	**1.99 (1.23-3.22) p=0.005**	-
Mechanical chest compression device N (%)	329 (82.9)	231 (81.1)	98 (87.5)	1.64 (0.87-3.08) p=0.13	-
Airway N (%)	381 (96.0)	273 (95.8)	108 (96.4)	1.19 (0.38-3.76) p=0.77	-
Adrenaline N (%)	365 (91.9)	262 (91.9)	103 (92.0)	1.01 (0.45-2.24) p=0.99	-
Amioderone N (%)	62 (15.6)	32 (11.2)	30 (26.8)	**2.89 (1.66-5.05) p=0.001**	-
ROSC N (%)	40 (10.2)	29 (10.2)	11 (9.9)	0.96 (0.46-2.0) p=0.92	-
Survival N (%)	26 (6.5)	14 (4.9)	12 (10.7)	**2.30 (1.03-5.12) p=0.04**	-
EMS Time interval, in minutes (Median, IQR)					
Response Time	8.2 (6.4-10.4)	8.4 (6.6-10.8)	7.7 (6.1-9.5)	**0.94 (0.88-0.99) p=0.03**	-
Scene Time	39.1 (30.0-47.9)	37.1 (29.7-45.0)	43.4 (33.2-54.6)	**1.02 (1.01-1.03) p=0.005**	**1.02 (1.0 - 1.04) p= 0.02**
Transport Time	22.3 (14.7-32.1)	22.6 (14.7-31.9)	21.4 (14.6-34.2)	1.01 (0.99-1.02) p=0.4	-

Table 2: Predictors of ROSC and Survival to hospital discharge at Multivariate Logistic Regression analysis.

Variable	**ROSC**	**Survival**
	Adjusted Odds Ratio (95% CI),p-value	**Adjusted Odds Ratio (95% CI), p-value**
History Respiratory Disease	5.8(1.7 – 20.4), 0.005	--
History Diabetes	--	0.24(0.07 – 0.84), 0.03
Arrest Witnessed	2.6(1.1 – 6.6), 0.03	--
Shockable Rhythm	--	4.36(1.55 – 12.3), 0.005
Transport Time	0.94(0.90 – 0.99), 0.009	--
ROSC	--	5.02(1.68 – 15.02),0.004

Figure 1: Middle Eastern and North African OHCA patients in Qatar