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WJC covers topics concerning arrhythmia, heart failure, vascular disease, stroke, hypertension, prevention and epidemiology, dyslipidemia and metabolic disorders, cardiac imaging, pediatrics, nursing, and health promotion. Priority publication will be given to articles concerning diagnosis and treatment of cardiology diseases. The following aspects are covered: Clinical diagnosis, laboratory diagnosis, differential diagnosis, imaging tests, pathological diagnosis, molecular biological diagnosis, immunological diagnosis, genetic diagnosis, functional diagnostics, and physical diagnosis; and comprehensive therapy, drug therapy, surgical therapy, interventional treatment, minimally invasive therapy, and robot-assisted therapy.

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Observational Study

Inter-ethnic marriages and severity of coronary artery disease: A multicenter study of Arabian Gulf States

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Abstract

AIM

To assess the association of inter-ethnic vs intra-ethnic marriage with severity of coronary artery disease (CAD) in men undergoing angiography.

METHODS

We conducted a prospective multicenter, multi-ethnic, cross sectional observational study at five hospitals in Saudi Arabia and the United Arab Emirates, in which we used logistic regression analysis with and without adjustment for baseline differences.

RESULTS

Data were collected for 1068 enrolled patients undergoing coronary angiography for clinical indications during the period of April 1st, 2013 to March 30th, 2014. Ethnicities of spouses were available only for male patients. Of those enrolled, 687 were married men and constituted the cohort for the present analysis. Intra-ethnic marriages were reported in 70% and inter-ethnic marriages in 30%. After adjusting for baseline differences, inter-ethnic marriage was associated with lower odds of having significant CAD [adjusted odds ratio 0.52 (95%CI: 0.33, 0.81)] or multi-vessel disease (MVD) [adjusted odds ratio 0.57 (95%CI: 0.37, 0.86)]. The adjusted association with left main disease showed a similar trend, but was not statistically significant [adjusted odds ratio 0.74 (95%CI: 0.41, 1.32)]. The association between inter-ethnic marriage and the presence of significant CAD and MVD was not modified by number of concurrent wives (*P* interaction > 0.05 for both).

CONCLUSION

Among married men undergoing coronary angiography, inter-ethnic, as compared to intra-ethnic, marriage is associated with lower odds of significant CAD and MVD.

Key words: Arabian Gulf; Inter-ethnic marriage; Coronary artery disease; Cardiac epidemiology; Coronary angiography

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Core tip: One thousand and sixty-eight enrolled patients underwent coronary angiography for clinical indications. Ethnicities of spouses were available for only male patients. Of the 771 males, 687 were married. Seventy percent of them were in intra-ethnic marriages and 30% in inter-ethnic marriages. After adjusting for baseline differences, inter-ethnic marriage was associated with lower odds of having significant coronary artery disease (CAD) or multi-vessel disease (MVD). The adjusted association with left main disease showed a similar trend, but was not statistically significant. The association between inter-ethnic marriage and the presence of significant CAD and MVD was not modified by number of concurrent wives.

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INTRODUCTION

Coronary artery disease (CAD) is a major cause of death throughout the world. The high prevalence and mortality have led to great importance in understanding the risk factors associated with CAD^[1-3]. Traditional risk factors comprise the majority of the increase for cardiovascular events^[4]. Additional factors such as physiological, psychological, emotional, social, and stress, both acute and chronic, have been studied^[5-23]. The interactions between risk factors also have great consequences^[24]. Studies investigating the association between marital status and CAD have predominantly been performed in developed countries, and none examined the role of spousal ethnicities and CAD^[25-32]. Selecting a spouse is often influenced by social norms, and cultural practices typically prefer marriages between persons of the same ethnic background. However, inter-ethnic marriages are increasingly common as societal attitudes and demographic patterns change. Studies from Western societies demonstrated that such marriages are associated with increased stress and lower relationship quality^[33-35]. Due to these findings, we examined the relationship between inter-ethnic marriages and severity of CAD in two Gulf States.

MATERIALS AND METHODS

Study population and data collection

The details regarding the design, methods, and end-points of this multicenter, observational study came from the Polygamy and Risk of Coronary Artery Disease

in Men Undergoing Angiography^[36]. In the current study the data were collected prospectively from five hospitals in two Gulf Regions (the Kingdom of Saudi Arabia and the United Arab Emirates), during the period of April 1st, 2013 to March 30th, 2014. The study was approved by King Faisal Specialist Hospital and Research Center Institutional Review Board, and an invitation letter was given to all participants who affirmed verbal consent prior to their enrollment. For each patient undergoing coronary angiography for clinical indication, two separate data forms, one general and one angiographic, were filled out by the research assistant and assigned cardiologist, respectively. Both forms were completed before the patients were discharged from hospital. All data forms were reviewed by the assigned cardiologist then sent online to the principle investigator, who also checked the forms prior to submission for analysis. All patients undergoing coronary angiography were recruited for the study. There was no exclusion criteria.

Contents of personal data form

Demographic data: Age, ethnic background; Physiologic status: Hypertension, diabetes, dyslipidemia, BMI; Life style: Smoking history; Past medical history: CAD, percutaneous coronary intervention, coronary artery bypass surgery, cerebral vascular disease, peripheral arterial disease, congestive heart failure, atrial fibrillation, chronic kidney disease. Socioeconomic data: Occupation (unemployed, private sector, government sector, self-employed), living in rural or urban area, highest level of education completed (illiterate, secondary school, university, masters, PhD), monthly income (< 1300, 1300 to 2600, 2600 to 5300, 5300 to 7900, 7900 to 10600, > 10600 USD); Number of wives: Single or multiple concurrent wives; Ethnicity of spouse (Arabic Gulf region, Arabs non-Gulf region, non-Arabic).

Contents of angiographic data form

Reason for coronary angiography: Elective or urgent/emergent; Number of vessels involved (severity); Treatment: Medical or revascularization.

Definitions

Significant CAD was defined as $\geq 70\%$ luminal stenosis in a major epicardial vessel or $\geq 50\%$ stenosis in the left main coronary artery. Multi-vessel disease (MVD) was defined as having more than one significant CAD; Inter-ethnic marriage was defined as Arab men from the Gulf region marrying Arab women from a non-Gulf region or non-Arab women; Intra-ethnic marriage was defined as Arab men from the Gulf region marrying Arab women from the same region.

Statistical analysis

Standard summary statistics were used to describe the cohort. Continuous variables are presented as mean \pm SD and were compared across multiple groups using the analysis of variance test. Categorical variables are

presented as percentages and compared using the χ^2 test. The associations between inter-ethnic or intra-ethnic marriage and CAD, MVD and left main disease (LMD) were assessed using logistic regression models and quantified with odds ratios. Adjusted regression models included the following explanatory variables: Age, community setting (urban vs rural), employment, income level, education level, number of concurrent wives, and additional variables that differed by ethnicity of spouse in univariate comparisons ($P < 0.1$). All statistical tests were two-tailed and significance was defined as $P < 0.05$. No adjustments for multiple comparisons were made.

RESULTS

Overall characteristics of patients and coronary angiogram findings

A detailed description can be found in Polygamy and Risk of Coronary Artery Disease in Men Undergoing Angiography^[36].

Patients characteristics stratified by ethnicity of spouse

We enrolled 1068 patients in the current study. Ethnicities of spouses were available for only male patients, so the analysis excludes female patients. Of the 771 males, 685 were married; however, spouse ethnicity was not available for two of these men. Married men were categorized according to number of wives: The majority had one wife (68%), while some had a history of two wives (19%), three wives (10%) or four wives (3%). Most were in intra-ethnic marriages 481 (70%), as opposed to inter-ethnic marriages 204 (30%), Table 1. The majority of inter-ethnic marriages were between Gulf nationals and non-Gulf Arab women (65%). Men in inter-ethnic marriages were more likely to have a history of hypertension and CABG, to live in rural communities, and to be in polygamous marriages. In univariate analyses, there was a significant association between inter-ethnic marriage and presence of LMD therefore the rate of CABG was higher in these subjects when compared with those in intra-ethnic marriages, who had undergone more PCI (Table 1). In multivariate logistic regressions adjusting for baseline differences, inter-ethnic marriage was associated with lower odds of having significant CAD [adjusted odds ratio 0.52 (95%CI: 0.33, 0.81)] or MVD [adjusted odds ratio 0.57 (95%CI: 0.37, 0.86)]. The adjusted association with LMD showed a similar trend, but was not statistically significant [adjusted odds ratio 0.74 (95%CI: 0.41, 1.32)] (Figure 1). The association between inter-ethnic marriage and the presence of significant CAD or MVD was not modified by number of concurrent wives (P interaction > 0.05 for both) (Figure 2).

DISCUSSION

Previous literature from non-Gulf regions demonstrated that inter-ethnic marriages were found to have lower income and education level and poor level of family

Table 1 Overall patient characteristic stratified by by ethnicity of spouse

	All (n = 685)	Intra-ethnic (n = 481)	Inter-ethnic (n = 204)	P value
Age (yr)	59 ± 12	58 ± 13	60 ± 12	0.0879
BMI (kg/m ²)	28 ± 6	28 ± 6	27 ± 5	0.4009
Rural, n (%)	27	25	34	0.0148
DM, n (%)	56	57	54	0.5226
Hypertension, n (%)	57	54	64	0.0209
Smoking, n (%)	54	53	57	0.1428
Dyslipidemia, n (%)	66	65	68	0.4734
Past history, n (%)				
CAD	45	45	45	0.9468
PCI	24	23	26	0.3263
CABG	6	5	9	0.0329
Atrial fibrillation	5	4	5	0.3990
CHF	13	13	11	0.5102
CVA	4	4	5	0.4388
CKD	14	14	13	0.7020
Depression	8	8	8	0.8363
PAD	2	2	3	0.1453
Ethnicity, n (%)				0.3597
Arabic gulf region	87	87	88	
Arabic non-gulf	6	7	4	
Non Arabic	7	6	8	
No. of wives, n (%)				< 0.0001
1	68	81	38	
2	19	13	32	
3	10	5	22	
4	3	1	8	
Monthly income, n (%)				0.1760
\$ < 1300	50	50	52	
\$ 1300-2600	29	30	27	
\$ 2600-5300	13	14	10	
\$ 5300 to 7900	4	4	5	
\$ 7900 to 10600	2	1	3	
\$ > 10600	2	1	3	
Job category, n (%)				0.6824
Jobless	21	21	23	
Private sector	18	18	16	
Government sector	43	42	45	
Self employs	18	19	16	
Education level, n (%)				0.0403
Illiterate	42	42	40	
Secondary school	38	37	40	
Post graduate	16	18	12	
Master	3	2	7	
PhD	1	1	1	
Indication for CAG, n (%)				0.1483
Elective	48	48	47	
NSTEMI	46	44	50	
STEMI	6	8	3	
Findings on CAG, n (%)				< 0.001
No CAD	28	29	27	
Single vessel	24	25	21	
Double vessel	26	29	19	
Triple vessel	22	17	34	
Multi-vessel	48	46	53	0.1020
Left main	12	10	17	0.0175
Intervention, n (%)				< 0.0001
Medical therapy	36	33	43	
PCI	47	54	31	
CABG	17	13	26	

DM: Diabetes mellitus; CAD: Coronary artery disease; CHF: Congestive heart failure; CVA: Cerebrovascular accident; CKD: Chronic kidney disease; PAD: Peripheral arterial disease; \$: United States dollars; PhD: A doctor of philosophy; STEMI: ST segment elevation myocardial infarction; NSTEMI: Non-ST-segment elevation acute coronary syndromes; CAG: Coronary angiography; PCI: Percutaneous coronary intervention; CABG: Coronary artery bypass grafting.

acceptance and support when compared to intra-ethnic marriages. In addition, inter-ethnic couples reported lower

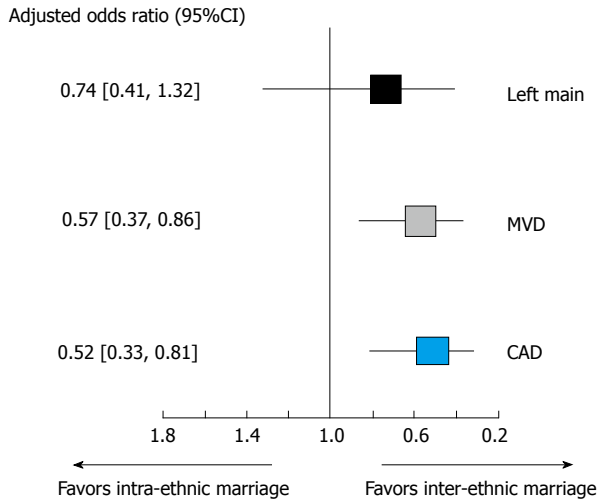


Figure 1 Adjusted association between type of marriage (inter-ethnic vs intra ethnic) and presence of any coronary artery disease, multi-vessel disease and left main disease. CAD: Coronary artery disease; MVD: Multi-vessel disease.

relationship satisfaction, and increased conflict within the relationship over such issues as money and spending time together. These factors are associated with increased stress and lower relationship quality^[33-35]. Furthermore, it is known that acute and chronic stress is associated with the development of CAD^[17,18]. However, the impact of inter-ethnic marriage on the severity of CAD is unknown. Our study is the first to analyze the association between inter-ethnic vs intra-ethnic marriage and severity of CAD among men using coronary angiography, the gold standard for identifying CAD. After adjusting for baseline characteristics, we observed that inter-ethnic marriage was associated with lower odds of having significant CAD or MVD. The adjusted association with LMD showed a similar trend, but was not statistically significant. Studies from western societies reported an increase in stress within inter-ethnic marriages; however, our study found lower odds of CAD in inter-ethnic vs intra-ethnic marriage, which may suggest lower levels of stress in these marriages. A number of factors may contribute to our results. First, in the current study, 80% of the patients reported income levels of 32000 USD or less annually. Although there is family and societal pressure to marry within the same region, the overall cost of getting married and maintaining the relationship within the Gulf region is high, which may impact men from this region leading them to select a spouse from elsewhere. The high cost of marriage in the Gulf is associated with complex family interactions, which possibly creates unrealistic expectations when anticipating a marital lifestyle. This may be a source of significant stress in and of itself. Second, almost 80% of the patients in our study had low level of education. In the Gulf region, there are increased opportunities for educated men to marry, which may necessitate less educated men to select a spouse from outside the region. Additionally, the conservative social and cultural practices in the Gulf region may play a role in stress levels when compared to non-Gulf regions. Men from Gulf region who marry women

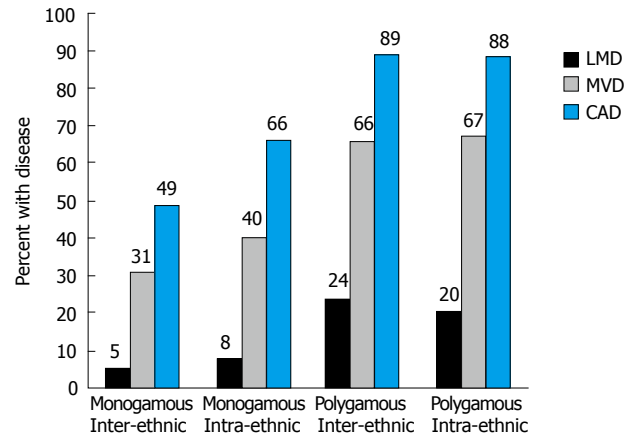


Figure 2 The proportion of patients with any coronary artery disease, multi-vessel disease or left main disease stratified by type of marriage (inter- or intra-ethnic and polygamous vs monogamous). CAD: Coronary artery disease; MVD: Multi-vessel disease; LMD: Left main disease.

from outside the region may be more health conscious than men who marry women from inside the Gulf. Classically, women from the Gulf region tend to prepare dishes rich in fat, which are atherogenic, whereas wives from elsewhere may favor dishes that are more healthy, notably those from the Arab Mediterranean region^[37-39]. Non-Gulf wives may encourage their husbands to be healthy and maintain fitness, as their literacy and health awareness may be superior to that of Gulf-native women.

Strengths of this study

This study is the first to look at the association between inter-ethnic vs intra-ethnic marriages and severity of CAD using coronary angiography in men from Arabian Gulf States.

Contributions of the study

The study provides additional knowledge on the risks associated with inter-ethnic vs intra-ethnic marriages. This information will be useful for personalizing care and preventing CAD. Not only will it provide patients information concerning social risk factors, it will also help providers identify and treat adults who are at increased risk of CAD. Further studies are required to confirm our findings and to investigate the mechanism underlying these findings in order to identify possible interventions to reduce these risks. In future studies, assessment of the local culture, social and medical practices, and attitudes toward inter-ethnic marriage should be performed.

Study limitations

Limitations of the study include a small sample size and the lack of documentation of the length of marriages prior to cardiac catheterization; this interval may influence the findings. Our study population was selected to undergo coronary angiography if clinically indicated, and as such, cannot be generalized to all married men in the Gulf region. Additionally, 42% of the patients were illiterate and 80% reported income levels of 32000 USD or less

annually; indicating that the results may not be applicable to those with higher incomes or higher levels of education. We did not look at unmeasured confounding variables such as dietary habits, physical activity, inflammatory or stress markers, or additional variables that may have played a role.

ACKNOWLEDGMENTS

We would like to sincerely thank all patients who agreed to participate in this study.

COMMENTS

Background

Selecting a spouse is often influenced by social norms, and societies typically prefer marriages of the same ethnic background. However, inter-ethnic marriages are increasingly common as societal attitudes and demographic patterns change. Studies from Western societies have demonstrated that inter-ethnic marriages are associated with increased stress and lower relationship quality. The majority of these studies examine the association between marital status and coronary artery disease (CAD), but none have examined the role of spousal ethnicity and CAD.

Research frontiers

It is unknown whether such marriages have an impact on the severity of CAD.

Innovations and breakthroughs

This study is the first to look at the association between inter-ethnic vs intra-ethnic marriages and severity of CAD using coronary angiography in men from Arabian Gulf States.

Applications

The data in this study suggest that among married men undergoing coronary angiography, inter-ethnic marriage is associated with lower odds of significant CAD and multi-vessel disease (MVD). Further studies are required to confirm these findings and to investigate the mechanism underlying these findings in order to identify possible interventions to reduce these risks. In future studies, assessment of the local culture, social and medical practices, and attitudes toward inter-ethnic marriage should be performed.

Terminology

Significant coronary artery disease (CAD) was defined as $\geq 70\%$ luminal stenosis in a major epicardial vessel or $\geq 50\%$ stenosis in the left main coronary artery. MVD was defined as having more than one significant CAD. Inter-ethnic marriage was defined as Arab men from the Gulf region marrying Arab women from a non-Gulf region or non-Arab women. Intra-ethnic marriage was defined as Arab men from the Gulf region marrying Arab women from the same region.

Peer-review

The data is interesting.

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