Original Research Article

High prevalence of hypertension and myocardial infarctions in Saudi adult female population with blood type A

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ABSTRACT

Background: There is high prevalence of obesity and smoking in Saudi population. Both are major risk factors for developing hypertension (HT) and myocardial infarctions (MI). Associations between hypertension, MI and ABO blood groups have been shown but they are inconsistent. To date no such studies have been done in Saudi Arabia to determine association between ABO blood groups and prevalence of smoking, hypertension and MI in Saudi female patients.

Methods: 432 control females were randomly selected and distribution of ABO and Rh antigens was statistically analyzed and compared with 78 smokers, 219 hypertensive and 311 MI female patients admitted to King Khalid hospital between the periods of August 2017 to May 2018.

Results: Among controls 3.2% were smokers, 7.6% hypertensive and 13.2% diabetics. Among hypertensive 7.8% were smokers and 46.6% were diabetics. Likewise we also found statistically significant increase in prevalence of smoking (9.9%) and diabetes (48.2%) in MI female patients. Additionally about half of MI patients (49.8%) were hypertensive. 85.9% controls were Rh⁺ and 14.1% were Rh⁻. Rh⁺ subjects were significantly higher in hypertensive and MI patients also. O⁺ was most prevalent and AB⁺ was least prevalent in all groups.

Conclusions: Statistically there was no difference between distributions of, B⁻, B⁺, AB⁻, AB⁺ blood groups, however there was high prevalence of A blood group in hypertensive (31.4%) and female MI patients (31.2%) as compared to A blood group among controls (24.8%). Distribution of O blood group was significantly lower in hypertensive (42%) and MI patients (41.5%) as compared to controls (53.1%).

Keywords: ABO and Rh blood groups, Coronary artery disease, Cardio vascular disease, Heart disease, Hypertension, Myocardial infarction, Diabetes, Obesity, Smoking, von Willebrand factor, World health organization

INTRODUCTION

Hypertension or high blood pressure occurs due to narrowing of blood vessels; as a result, blood exerts an increased pressure against the blood vessel walls. High stress environment, kidney disease, poor diet selection, and smoking are some of the major causes for developing

hypertension. It is considered a silent killer. According to the WHO report on "Global Health Risks" high blood pressure was lead cause of global mortality followed by the tobacco use related deaths.¹

According to American Heart association (AHA) and American College of Cardiology (ACC), new blood

pressure guidelines normal blood pressure is less than 120/80 mm Hg, and systolic between 120-129 mm of Hg is elevated blood pressure. Systolic between 130-139 mm of Hg and diastolic between 80-89 mm Hg is considered stage 1. The systolic at 140 and the diastolic pressure of at least 90 mm of Hg or higher is stage 2 of high blood pressure (New High blood pressure guidelines AHA 2017). A systolic of higher than 180 and diastolic of more than 120 is considered a hypertensive crisis and a physician should be immediately seen.

According to the WHO 2016 “Diabetes country profile” Saudi Arabia has a population of 31.54 million. According to the WHO noncommunicable disease country profile survey, in Saudi Arabia there were about 90,000 total deaths out of which 78% deaths (both sexes and all age groups) occurred due to the noncommunicable diseases and among them cardiovascular disease (CVD) was the number one killer at 46% of the total mortality rates in Saudi Arabia.²

Another WHO, world health ranking survey in 2014 ranked Saudi Arabia 27th in the prevalence of coronary heart disease (CHD) related deaths.³ The same survey suggested that CHD was also the leading cause of deaths in Saudi Arabia followed by stroke.

Several studies have suggested an association between inheritance of ABO blood groups with hypertension and myocardial infarctions (MI); however results have not been consistent.⁴⁻⁷ The current study was initiated because there is high prevalence of obesity and smoking in Saudi population, and since obesity and smoking are known major risk factors for developing hypertension and incidences of MI and since many studies have shown association between hypertension and the inheritance of ABO blood groups and MI for other global populations however results have been very inconsistent.⁸⁻¹¹

Aim of the study

In this cross sectional study we decided to look at the prevalence of hypertension and cases of MI in Saudi adult female population of Hail region and analyzed its association with the distribution of ABO blood group. This study was important because to the best of our knowledge, to date no such gender specific studies have been done to determine the possible association between ABO blood groups and prevalence of hypertension and the myocardial infarctions in Saudi adult female patients.

METHODS

Current study was designed to investigate the possible association between the distribution of ABO and the Rh blood group antigens in hypertensive Saudi adult female population and among MI female patients. This study was performed during the period of August 2017 to May 2018. We randomly selected 432 control adult female subjects (18-65 years) and analyzed the distribution of ABO and Rh blood group antigens and compared it with

the blood group distribution in 219 female hypertensive and 311 MI female patients registered at King Khalid hospital in Hail Saudi Arabia between 2012 through 2017. Patient files with incomplete test results or ABO blood group information were not included for data collection.

We also analyzed and compared the ABO and Rh blood group distribution among the female smokers with randomly selected controls. In addition to analyzing individual blood group distributions (A, B, AB or O) in control and the hypertensive and the MI female patients, the association of O blood groups versus non-O blood groups (A, B, and AB) with hypertension was also investigated. The data was statistically analyzed using Z calculator for the two population fractions.

RESULTS

Comparative prevalence of smoking, and diabetes mellitus (T2DM) between the control and hypertensive female patients

Among controls, 3.2% were smokers, 7.6% were hypertensive and 13.2% were diabetics (no distinction was made between type 1 and type II diabetic patients). In comparison among 100% hypertensive female group (age ranging from 20-87 years) (mean age 55.54 years), 7.8% were smokers and 46.6% were diabetics. Although we found a very small percentage of female smokers, however the number of smokers was more than doubled and was significantly higher ($p < 0.0104$) among the hypertensive female population. Likewise, we also saw more than threefold increase in the cases of prevalence of diabetes among the hypertensive ($p < 0.01$) females; we also found a dramatic and statistically significant increase in number of smokers (9.9%) and prevalence of diabetes (48.2%) among the female MI patients (Figure 1).

Figure 1: Percent female smokers and diabetics in control, hypertensive and the MI female patients: A comparative analysis. As we were expecting 49.8% of the female MI patients were also hypertensive.

Smoker's teeth and the ABO blood group distribution

We found high prevalence of teeth staining, gingival pigmentation and severe cases of gingivitis among female

smokers as compared to nonsmokers (Figure 2). When we analyzed the blood group distribution among female smokers we found 25.64% had A blood group, 8.96% had B blood group, 11.53% were AB blood group and 53.84% were of O blood type (Table 1).

Figure 2: (A) Oral hygiene among the female smokers. Non-smoker female with superficial carries; (B) female smoker with gingivitis and the gingival pigmentation; (C) a 22-year female smoker showing pigmentation on her gingiva; (D) a 25-year-old smoker with gingival over growth and the gingivitis.

Table 1: Percent distribution of ABO and Rh blood groups in female smokers.

Blood group antigen	Number of subjects	Percent expression (%)
A ⁻ Blood group antigen	10/78	12.82
A ⁺ Blood group antigen	10/78	12.82
B ⁻ Blood group antigen	3/78	3.84
B ⁺ Blood group antigen	4/78	5.12*
AB ⁻ Blood group antigen	1/78	1.28
AB ⁺ Blood group antigen	8/78	10.25
O ⁻ Blood group antigen	12/78	15.38#
O ⁺ Blood group antigen	30/78	38.46
Rh ⁻ subjects	26/78	33.3 #
Rh ⁺ subjects	52/78	66.66*

*Indicates a significantly low distribution and # indicates a significantly high distribution as compared to the non smokers (Table 2).

Like female control population O blood group was the most prevalent blood type among female smokers but unlike control population B blood type was the least prevalent blood group among female smokers while among control subjects AB was the least prevalent blood group. Majority of female smokers were Rh⁺ (66.6%) and 33.33% were Rh⁻. Proportion of Rh⁻ among smokers was statistically significantly higher and the proportion of Rh⁺

individuals was significantly lower in female smokers as compared to the controls and as compared to our previously reported findings. Although we did not have many female smokers however our data shows Rh⁻ especially O⁻ blood group to be most prevalent among female smokers and Rh⁺ especially B⁺ blood type to be statistically significantly reduced as compared to non smokers (Table 2). Large scale studies are needed to confirm these results. There is high prevalence of diabetes in Saudi male and female adult population. Our oral hygiene community survey of diabetic female patients showed a very high prevalence of carries, root fragments, gingivitis, severe periodontitis and the tooth loss as compared to the randomly selected controls (Figure 3).

Figure 3: Oral hygiene in female diabetic patients. A 25-year-old control non-smoker and a non-diabetic female. A 55-year-old diabetic with periodontitis. She has carries and two root fragments # 23 and 24. She is missing teeth #s 17, 18, 25, 27, 28, 34, 35, 36, 37, 38, 44, 45, 46, 47 and 48.

Figure 4: (A) Comparative distributions of O and non-O blood groups in the control and the hypertensive female subjects; (B) comparison of O blood group versus non-O blood groups in control and the hypertensive female subjects.

Distribution of O versus non-O blood groups in controls and the hypertensive female patients

Next we analyzed our control and hypertensive patient data as O versus non-O blood group (A, B, AB) distribution. We found statistically significant increase in distribution of non-O blood groups (58%) in the hypertensive females as compared to their distribution in control (46.5%) group (Figure 4 A). While O blood group distribution is significantly higher in controls (53.5%), it is significantly lower in hypertensive females (42%) patients ($p < 0.05$). In summary distribution of O blood groups is significantly higher in controls (53.5%) as compared to combine distribution of Non-O blood groups (46.5%) in controls while in hypertensive females distribution of Non-O blood groups is significantly higher (58%) as compared to the O blood group distribution (42%) among the hypertensive group (Figure 4 B). Therefore, our results show a statistically significant increase in the distribution of Non-O blood groups (58%) and a significant reduction in the distribution of O blood group in hypertensive females as compared to their distribution in the female control population (Figure 4A, 4B).

Distribution of ABO and Rh antigens in control and hypertensive females

Figure 5: Significantly high expression of A blood groups in hypertensive females (red bars, 33.3%) as compared to the control females (blue bars) (24.8%). However, in the hypertensive female patients the results are completely reversed and O blood groups (red bars) show a significantly reduced expression (42%) as compared to the control (53.5%) subjects (blue bars). In summary in hypertensive females (red bars) we see a dramatic increase in the A blood group expression (red arrow head) and statistically significant reduction in the prevalence of O blood groups (green arrowhead) as compared to the control population (blue bars). In hypertensive females expression of O blood group (42%) is dramatically reduced as compared to the distribution in the control group.

Since we saw a dramatic increase in the distribution of non-O blood groups in hypertensive females (Figures 4 A and B), next we compared the distribution of individual

blood groups among controls and the hypertensive females. In controls, we found 85.9% to be Rh⁺ and 14.1% were Rh⁻ (Table 2). Notice Rh⁻ distribution is statistically significantly higher and Rh⁺ distribution is statistically significantly lower in female smoker's (Table 1). As expected the combined Rh⁺ individuals were significantly higher in control, hypertensive and the MI female patients (Tables 2, 3 and 4). Further analysis of ABO and Rh blood group distributions among hypertensive female patients showed that like control group O⁺ was most prevalent and AB⁺ was the least prevalent blood group (Figure 5). However, among smokers B blood group was the least prevalent blood group (Table 1).

Table 2: Percent distribution of ABO and Rh blood group antigens in female controls.

Blood group antigen	Number of subjects	Percent expression (%)
A ⁻ Blood group antigen	15/432	3.5
A ⁺ Blood group antigen	92/432	21.3
B ⁻ Blood group antigen	10/432	2.3
B ⁺ Blood group antigen	53/432	12.5
AB ⁻ Blood group antigen	1/432	0.2
AB ⁺ Blood group antigen	30/432	7
O ⁻ Blood group antigen	35/432	8.1
O ⁺ Blood group antigen	196/432	45.4
Rh ⁻ subjects	61/432	14.1
Rh ⁺ subjects	371/432	85.9

Table 3: Percent distribution of ABO and Rh blood group antigens in hypertensive females.

Blood group antigen	Number of subjects	Percent expression (%)
A ⁻ Blood group antigen	12/219	5.5
A ⁺ Blood group antigen	61/219	27.8
B ⁻ Blood group antigen	8/219	3.6
B ⁺ Blood group antigen	29/219	13.2
AB ⁻ Blood group antigen	2/219	0.9
AB ⁺ Blood group antigen	15/219	6.8
O ⁻ Blood group antigen	13/219	5.9
O ⁺ Blood group antigen	79/219	36.1
Rh ⁻ subjects	35/219	13.7
Rh ⁺ subjects	184/219	86.2

Although we found no statistical difference in distributions of B and AB blood groups between the control and the hypertensive female subjects the prevalence of A blood group was statistically significantly higher (red arrow head Figure 5) in the hypertensive females ($p < 0.020$) and the expression of O blood group was statistically significantly lower (green arrow head, Figure 5) in female hypertensive patients ($p < 0.0232$) as compared to the randomly selected female controls (Figures 5).

Table 4: Percent distribution of ABO and Rh blood group antigens in MI female patients.

Blood group antigen	Number of subjects	Percent expression (%)
A ⁻ Blood group antigen	15/311	4.8
A ⁺ Blood group antigen	15/311	27.7
B ⁻ Blood group antigen	15/311	3.5
B ⁺ Blood group antigen	15/311	13.2
AB ⁻ Blood group antigen	15/311	0.65
AB ⁺ Blood group antigen	15/311	8.7
O ⁻ Blood group antigen	15/311	2.6
O ⁺ Blood group antigen	15/311	38.9
Rh ⁻ subjects	15/311	11.6
Rh ⁺ subjects	15/311	88.4

Distribution ABO and Rh antigens in control and the MI female patients

Among MI female patients ABO blood group distribution patterns were similar to hypertensive females. We saw a significant increase in the expression of A, blood group among MI female patients (Figure 6, red bars) as compared to the controls (Figure 6, blue bars). However, in hypertensive and MI patients we saw a statistically significant reduction in the expression of O blood group as compared to controls. In summary, MI female patients show statistically significant increase in the expression of A blood group and a significant reduction in the distribution of O blood groups as compared to female controls (red bars).

Figure 6: Percent ABO distribution in control and myocardial infarction female patients.

Statistically significant increase in expression of A blood groups in MI female patients (red bars, 32.5%) as compared to the control females (blue bars) (24.8%). However, in the MI female patients the results are completely reversed in the distribution of O blood groups (red bars). MI female patients show a statistically significant reduction in the expression of O blood group (41.5%) as compared to the control (53.5%) population (blue bars). In summary in MI female patients (red bars) we see a dramatic and statistically significant increase in the A blood group expression and a statistically significant

reduction in the prevalence of O blood groups as compared to the control population (blue bars).

Figure 7: Individual blood group distributions in control (blue bars), hypertensive (red bars) and the MI female patients (green bars).

To summarize, we compared individual blood group distributions in control, hypertensive and MI female patients (Figure 7). Our results show statistically significant increases in the expressions of A blood groups in hypertensive (red bars) and MI patients (green bars) as compared to controls (blue bars) and statistically significant reduction in the distribution of O blood groups in hypertensive and MI female patients as compared to controls (Figures 5-7).

DISCUSSION

According to WHO, every 6.2 seconds a current or an ex-smoker die (approximately more than 5 million deaths each year). WHO estimates that there are more than one billion smokers globally, tobacco use kills about five million people a year additionally about 600,000 of the non-smokers also die as a result of second-hand smoke.¹² Smoking or tobacco use is known to cause tooth staining, smoking related enhanced gingival melanin pigmentation and gum disease which can affect the bone structure around teeth and can cause tooth loss and many types of cancers. There is a high prevalence of smoking among Saudi male population.¹³⁻¹⁶ However, low prevalence of smoking in Saudi female population has been reported as compared to male population.^{16,17} Smoking is one of the major risk factor for developing hypertension and coronary heart disease (CHD).

Hypertension is a serious medical condition in which a person may have raised blood pressure in arteries that can put him or her at high risk of hemorrhagic stroke, heart attack or myocardial infarction and kidney failure. Smoking, high stress levels in life, poor diet selection (which is high in salt and saturated fats and low in fiber content), a sedentary life style (leading to the problem of overweight and obesity) are known to cause diabetes, atherosclerosis, and the hypertension which may eventually lead to heart disease and MI.

We and others have previously reported alarmingly high rates of obesity in Saudi adult male and female population.^{8,18-19} In our recently reported eye-opening community survey we found 9.9% Saudi adults to be overweight, 58% were obese while 15.84% were severely obese. Overall, we found about 84% of adult Saudi population to be overweight or obese.⁸ According to a recent WHO 2016 survey 67.5% Saudi male population was overweight and 29.5% were obese. According to same survey 69.2% of Saudi females were also overweight and that 52.1% of the Saudi adult males and 67.7% of the females were physical inactive.² Obesity along with smoking is considered as one of the major risk factors for hypertension, coronary artery disease (CAD) and increased probability of myocardial infarctions.

Saudi Arabia has high prevalence of hypertension.²⁰ In a recent study on cardio vascular risk factors hypertension was reported to be second most prevalent risk factor at 47.5%.²¹ Although many studies have shown some association between the blood groups and the development of hypertension and or incidences of MI however the results are inconsistent. For example, according to few studies the B blood group is more susceptible to hypertension while according to the other studies O blood group was more predominant among the hypertensive patients.^{5,6,22,23} Yet another recently published study reported highest systolic pressure among the A⁺ blood group subjects.⁴ While according to yet another study there was no correlation between ABO blood groups and the tendency of developing hypertension or no major difference between systolic or diastolic blood pressure were found among any blood group subjects.^{24,25} Since these results have been so very inconsistent and since distribution of ABO blood group patterns differ in different geographical regions of the world we decided to analyze distributions of ABO and Rh blood groups in hypertensive and MI adult female patients who were admitted to King Khaled hospital in Hail region of Saudi Arabia.^{4-6,22-25}

Although according to many recently published findings people with O blood groups are at increased risk of coronary artery diseases as compared to subjects who have inherited non-O blood groups (A, B, and AB).^{26,27} According to few other studies individuals with blood groups other than the O blood group (A, B, or AB) may be at higher risk of dying from MI and the other cardiovascular disease (CVD) related complications however the exact biological mechanisms that are involved for causing this increased heart disease risks remains unclear. In an earlier study, mortality associated with the ischemic heart disease was more common among non-O blood groups (A, B, AB).²⁸ Yet another study found an association between A blood group and elevated levels of total cholesterol and low-density lipoproteins (LDL) as compared to the non-A blood groups.²⁹ In our previously published studies on male MI patient, and the current study we also found significantly higher expressions of A blood group and significantly reduced expressions of O blood groups among the

hypertensive (Figure 5) and MI female patients (Figure 6 and 7).¹¹ Therefore, our results are in agreement with many other studies; however they are in disagreement with some other previously published reports.^{4-7,9,10,22,23,26-28,30,31}

As reported by us and others, there is high prevalence of diabetes in Saudi Arabia and it is associated with high economic burden on the government.³²⁻³⁵ Our oral hygiene community survey of diabetic female patients showed a very high prevalence of carries, root fragments, gingivitis, severe periodontitis and the tooth loss. In addition to prevalence of obesity and diabetes, Saudi Arabia is also ranked high in prevalence of smoking. In Saudi adult females although there was low prevalence of smoking, however those who smoked did show stained teeth, gingival pigmentation and cases of gingivitis. Like our recently published report, our oral hygiene survey of female diabetic patients showed high prevalence of gingivitis and periodontitis along with severe tooth decay and tooth loss (Figure 3).³⁶ According to the American dental association mouth healthy website smoking and tobacco use can cause bad breath and stained teeth.¹³ Smoking is also known to cause tooth decay, teeth discoloration and several types of cancers.¹⁵

In summary our results show that compared to control groups in hypertensive females and MI female patient's the non-O blood group distribution (A, AB, and B blood group) increases and the O blood group distribution decreases significantly (Figures 4-7). Further analysis of our results shows that in hypertensive females and the MI female patients the distribution of A blood group significantly increases ($p < 0.05$) and the distribution of O blood group significantly decreases ($p < 0.01$) as compared to control population (Figures 5 and 6). These results are in agreement with our previously published findings that among MI male patients, blood group A was more prevalent and with other findings that Non-O blood groups are associated with increased risk of MI and hypertension.^{10,11,30} However, our results are in disagreement with other studies in that there is no correlation between ABO blood group and myocardial infarctions.^{5,6,9,24,25}

Limitations of this study

Due to social and cultural restrictions in Middle East, it is hard to find more female subjects for the study. These are results of a small-scale cross sectional study (n, 219 for hypertension study and 311 for MI female patients) due to the difficulty of finding large number of patients in a small town; however our results are in agreement with many previously published studies. Larger studies need to be done to confirm these results.

CONCLUSION

Results of this study show that the hypertensive and the MI female patients with blood type A show high prevalence of hypertension and significantly higher

incidences of myocardial infarction as compared to the randomly selected control female population. In contrast the O blood group subjects showed low prevalence of hypertension and a significant reduction in the incidences of MI as compared to the O blood group distribution in the female control population. Although people cannot change their inherited blood groups however they can change their diet and their life style such as regular exercising and quit smoking to reduce the risks of heart disease. Based on results from many previously published studies and in light of our results the physicians may advise their patients to quit smoking and to try to reduce their blood cholesterol levels (LDL) and to be more physically active, lose weight and make a low saturated fat and low salt high fiber diet selection so as to raise their good cholesterol levels (HDL).

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