Effect of Smoking, Alcohol and Exercise on the Prevalence of Metabolic Syndrome in a Cohort of Royal Jordanian Air Pilots

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ABSTRACT

Objectives: To assess whether smoking, alcohol intake and exercise cofounders have an impact on the development of metabolic syndrome in a Jordanian cohort of air pilots.

Methods: A random sample of 111 subjects serving at Royal Jordanian Air Force were recruited at the routine annual examination. Complete history and physical exam was done. The criteria of the National Cholesterol Education Program-Adult Treatment Panel III were used to define features of metabolic syndrome. Waist and hip circumference and height were measured to nearest centimeter, body weight to the nearest kilogram. Blood pressure was taken after 10 minutes of rest. Blood was drawn in fasting state for complete kidney function test, liver function test, lipid profile and fasting blood sugar. The cohort was divided into groups according to exercise, alcohol intake and smoking habit and comparison among groups was performed. Metabolic syndrome in Jordan ranges from 19-36% in different studies. The prevalence of metabolic syndrome in air pilots was 15.3%.

Result: Mean age was 32.5 ± 7.2 years. There were 72 smokers of 17.3± 5.4 cigarettes/day for a duration of 10.3± 6.7 years. Thirteen subjects consume alcohol on social basis and 58 subjects who do regular excises of a mean of 3 sessions per week. There was no difference in the prevalence of metabolic syndrome among all groups studied as well as for components of metabolic syndrome. Smokers were having a statistically significant higher rates of low HDL-C *vs.* non smokers (47.2% *vs.* 23.1%, p=0.0012; OR=2.98(95% CI : 1.15-7.9)RR =2.05 (95% CI :1.1-3.81) and their mean HDL-C level was lower (42.3±10.1 *vs.* 48.1± 12.5) for non smokers (p= 0.0041).The systolic blood pressure and body weight were significantly lower in the smoker group.

Conclusion: Smoking, alcohol intake and exercise as confounders did not affect the prevalence of metabolic syndrome in this cohort. Smoking has a significant impact on low HDL-C rates and levels in smokers. Further, larger studies are needed to elicit differences and significant results of these confounders.

Key word: Air pilots, Alcohol, Confounders, Metabolic syndrome, Smoking

JRMS March 2011; 18(1): 34-38

Introduction

The metabolic syndrome (MS), characterized by a clustering of abdominal obesity, hypertriglyceridaemia, low high-density lipoprotein (HDL) cholesterol, elevated blood pressure (BP), and high fasting glucose, has been associated with an increased risk for the development of diabetes and CVD as well as an increased mortality from CVD and from all other causes.[1]

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Manuscript received April 12, 2009. Accepted August 29, 2009

The age-adjusted prevalence of the Metabolic Syndrome in West Bank of Jordan as defined by the WHO was 17%.[2] The estimated prevalence of MS in a small military cohort in Jordan using the ATP III is 15.3 % and increases with age being 26.7% in subjects >40 years.[3] In a cross-sectional study in North of Jordan that included a random sample of 1121 aged ≥25 years to estimate the prevalence of metabolic syndrome using the ATPIII criteria, the prevalence was 36.3%; the prevalence being higher in females (40.9%) than males (28.7%) the study also showed that the prevalence increased significantly with age.[4]

In a previous study by our group we showed an increased prevalence of cardiovascular disease in a cohort of patients with MS; this prevalence being higher in the diabetic subgroup.[5,6] A Chinese study in men showed that physical activity was associated with a lower prevalence of metabolic syndrome, whereas drinking more than three drinks per day was associated with a higher risk of metabolic syndrome regardless of the criteria employed. The association between smoking and the prevalence of metabolic syndrome in this population failed to reach significance.[7]

In a Swedish cross sectional study, authors showed that education, physical activity at leisure time, moderate intensity of physical activity at work, alcohol intake and smoking had strong association with MS.[8]

In a study from Taiwan, the higher risk of development of metabolic syndrome, high triglyceride level, and low HDL-C level was insignificant in former smokers. In the same study, current smokers who smoke ≥ 20 pack-years have a significantly increased risk of developing metabolic syndrome, high triglyceride level, and low HDL-C level.[9] The study concluded that this community-based study supports the view that smoking is associated with metabolic syndrome and its individual components. Smoking cessation is beneficial to metabolic syndrome and its individual components.[9]

The crude prevalence of metabolic syndrome in the sedentary, low active, active and very active groups was 9.7%, 6.9%, 5.6% and 4.9% respectively.[10] After adjusting for the effect of other risk factors, the higher the physical activity level, the lower the relative risk of metabolic syndrome as well as the individual metabolic abnormalities.[10,11]

In the NCEP III report,[12] the relationship between current smoking and ex-smoking and metabolic syndrome was statistically significant while there was no correlation between non-smokers and the metabolic syndrome.[12]

In this study we aim to see the effect of smoking, alcohol intake and exercise on the prevalence of metabolic syndrome defined according to NCEP ATP III and the biochemical profiles among a group of air pilots at one of the air bases of the Royal Jordanian Air Force.

Methods

In a routine annual medical checkup of military air pilots of Jordan armed forces, we assessed the presence of three or more of the following components of the metabolic syndrome according to National Cholesterol Education Program (NCEP); Adult Treatment Panel III (ATPIII) criteria: waist circumference of 102 cm or higher in men and 88 cm or higher in women, SBP/DBP of 130/85 mm Hg or higher, HDL-C levels less than 40mg/dl in men and less than 45 mg/dl in women, triglyceride levels of 150 mg/dl or higher, and blood glucose level of 110mg/dl or higher.[12]

The study took place at the Air Force Medical Center- Aviation Medicine, Royal Medical Services between January and December 2006; all pilots who presented on Sunday and Tuesday of the first week of the month were randomized and assessed.

Medical history of diabetes (DM) hypertension (HTN), smoking, alcohol and exercise habits were assessed by direct questioning and completion of predefined questionnaire. A total of 111 pilots who completed the questionnaires and had their blood test were assessed for the components. The type, duration and frequency of exercise per week were also stated. Complete physical examination including the waist circumference, hip circumference and height were assessed by a non-stretchable tape meter to nearest centimeter (cm) and body weight was measured bare feet in fatigue suit to nearest kilogram (kg). Blood pressure was assessed in a sitting position after 10 minutes of rest from right arm by standard sphygmomanometer. Blood was withdrawn after 12 hours of fast for lipid profile; high density lipoprotein (HDL-C), low density lipoprotein (LDL-C), triglyceride (TG), total cholesterol (TC) and fasting blood sugar (FBS), kidney function tests (KFT), liver function tests (LFT), and uric acid. Blood was separated and analysed immediately at the RJAF medical center using automated Hitachi 927 device for lipid profile, KFT, LFT as well as

Table I. Rates of metabolic syndrome and its components in each subgroup studied

Confounders	Smoking		Exercise		Alcohol	
MS components	Yes n=72	No n=39	Yes n=59	No n=52	Yes n=13	No n= 98
Metabolic Syndrome	11(15.3%)	8(20.5%)	13(22%)	6(11.5%)	3(23.7%)	16(16.3%)
Hypertriglyceridemia	36(50%)	22(56.4%)	33(56%)	25(48%)	8(61.5%)	50(51%)
Hyperglycemia(>110mg/dl)	5(6.9%)	5(12.8%)	7(11.8%)	3(5.8%)	1(7.7%)	9(9.2%)
Hypertension(>130/85)	15(20.8%)	10(25.6%)	13(22%)	12(23%)	2(15.4%)	23(23.5%)
Low HDL(<40 mg/dl)	34(47.2%)*	9(23%)*	22(37.3%)	21(40%)	3(23%)	40(40.8%)
High waist circumference (>102)	6(8.3%)	5(12.8%)	5(8.5%)	6(11.5%)	2(15.4%)	9(9.2%)

*p=0.0012; OR=2.98(95% CI: 1.15-7.9).RR =2.05 (95% CI: 1.1-3.81)

Table II. Showing the demographic and biochemical profile of all group studied with statistical significance

	Smoking			Exercise			Alcohol		
mean ±SD	**Yes n=72**	**No n=39**	**p value**	**Yes n=59**	**No n=52**	**P value**	**Yes n=13**	**No n=98**	**p value**
Age (yr)	33.2 (7.6)	32.9 (6.4)	0.35	33.7 (8.04)	31.2 (5.8)	0.033	36.7 (8.1)	31.9 (6.9)	0.01
Waist circumference	92.4 (7.04)	95.5 (5,8)	0.012	92.9 (7)	92.2 (6.3)	0.15	94.1 (8.3)	93.4 (6.6)	0.37
SBP(mmHg)	122.2 (9.2)	126.7 (9.2)	0.009	122.3 (9.1)	125.5 (9.6)	0.039	122.7 (10.1)	123.8 (9.4)	0.35
DBP(mmHg)	80.2 (6.3)	81.4 (6.7)	0.18	80.2 (6.6)	81.1 (6.3)	0.25	80.4 (6.5)	80.6 (6.5)	0.46
FBS (mg/dl)	97.2 (9.8)	99.6 (11.2)	0.12	99.2 (11.8)	96.7 (8.2)	0.104	98.1 (8.2)	98 (10.6)	0.48
TG (mg/dl)	155.4 (78)	167.7 (105.7)	0.24	161.2 (85.2)	158 (92.8)	0.42	177.5 (92.9)	157.3 (88)	0.22
Cholesterol (mg/dl)	182.5 (34.1)	194.3 (56.6)	0.08	190.4 (49.8)	182.4 (34.9)	0.16	202 (35.3)	184.6 (44.2)	0.08
HDL-C (mg/dl)	42.3 (10.1)	48.1 (12.5)	0.004	44.4 (11.1)	44.2 (11.6)	0.47	48.8 (12.6)	43.7 (11.1)	0.065
LDL-C (mg/dl)	109.5 (33.4)	124.5 (68.8)	0.06	115.8 (47.7)	113.8 (51.3)	0.41	123.8 (43)	113.6 (50.1)	0.24
T4 ng/ml	1.36 (0.29)	1.26 (0.22)	0.028	1.4 (0.27)	1.3 (0.3)	0.019	1.34 (0.3)	1.33 (0.27)	0.38
T3 ng/ml	3.3 (0.77)	3.07 (0.66)	0.044	3.2 (0.74)	3.2 (0.75)	0.4	3.2 (0.6)	3.2 (0.76)	0.39
TSH mIU/ml	1.86(1.03)	1.98 (0.97)	0.27	1.8 (1.1)	1.97 (0.87)	0.25	1.67 (1)	1.93 (1)	0.19

free thyroxin level (T4) and thyroid stimulating hormone (TSH) to rule out secondary causes of hyperlipidemia.

This study was approved by the Directorate of Study and Research of the RJAF and informed consent of the subjects involved in the study was taken.

The cohort was divided into smokers *vs.* non-smokers, alcohol intake *vs.* none and subject doing exercise *vs.* none. These groups were compared among each other with regards to prevalence of MS components and differences between rates of each MS component in each group. The RR and OD were calculated, the anthropometric and the biochemical profile of each group expressed as mean (±SD) were reported for each group.

Statistical analyses using descriptive statistics, Student's t-test to compare means using XP excel program and Epinfo 6 program.

Results

A total of 111 male pilots were assessed, none of them were known to have diabetes or hypertension. The mean age was 32.3±7.2 years. The mean height was 177.7±4.5 cm and weight 81.5±9.2 kg. Sixty five percent of the cohort were smokers of 17.3±5.4 cigarettes per day for a duration of 10.3±6.7 years, 52.2% of the cohort were doing regular exercise of 3.1±2 sessions per week, the mean duration of each session was 46.4±17.8 minutes. Alcohol consumption on social irregular basis was reported in 11.7% of the cohort.

The overall prevalence of MS was shown in previous study to be 15.3%.[3] There were no statistically significant differences in the prevalence of metabolic syndrome in smokers (Yes *vs.* No:15.3% vs. 20.5%, p=0.3), exercise (22% *vs.*11.5% p=0.14) or alcohol subgroups (23.7% *vs.*16.3% p=0.39) (Table I).

There were no statistically significant differences in the prevalence of MS components between all groups studied. Smokers were having a statistically higher rate of low HDL-C than non smokers (47.2% *vs.* 23%; p=0.0012) giving an Odds Ratio of 2.98 (95% CI: 1.15-7.9), the Relative Risk was 2.05 (95% CI: 1.1-3.81) (Table I).

The demographic and biochemical profile of all groups are shown in Table II. Smokers were having lower body weight and lower systolic blood pressure (122.2 (9.2) *vs.* 126.7 (9.2) p= 0.009). The HDL-C level was significantly lower than non-smokers and the levels of thyroxin and triiodtyronine were higher in the non smokers (Table II).

The exercising group was older and had lower body weight, the systolic blood pressure being again lower than the non exercising group (122.3(9.1) *vs.* 126.5(9 .6); p=0.039).

The alcohol consumers were older, consumed less than 14 units per week on social bases. Their HDL-C level was not significantly higher than non consumers; (48.8(12.6) vs. 43.7(11.1) p=0.065) (Table II).

The kidney function test, liver function tests and electrolytes were normal in all studied groups; the free T3 and T4 were significantly higher in the smoker group (Table II)

Discussion

This study looked into MS in a small cohort of air pilots; in a previous study of same cohort we showed the prevalence to be 15.3%,[3] here we tried to analyze the effect of some important confounders that were showing conflicting effects on MS prevalence.

Many studies have shown high prevalence of MS in smokers than non smokers,[9] in this study we failed to show any effect neither on MS prevalence nor on any of its components except on rates and levels of low HDL-C in smokers (Table I).

Fisher *et al.* found that current smokers have higher thyroxin levels and lower thyroid stimulating hormone levels than never smokers and former smokers. They also found that heavy smokers had a smaller increase in thyroxin levels than did light smokers, when compared to non-smokers.[13]

Leisure-time physical activity was inversely related to the metabolic syndrome. Smoking more than 20 cigarettes per day was associated with an increased risk compared to non-smokers. The hazard ratios (95% confidence intervals) were 1.27 (1.04-1.54) and 1.40 (1.02-1.92) in men and women, respectively. Alcohol intake and education were inversely associated with metabolic syndrome in women but not in men. Physical inactivity and heavy smoking increased the metabolic syndrome incidence in men and women. Low or no intake of alcohol was also associated with increased risk, but in women only.[6,14]

In a study by Santos *et al.* from Brazil[15] on the effect of certain confounders and their effect on metabolic syndrome prevalence revealed that, after adjustment, higher total physical activity and work activity levels in females were significantly associated with lower prevalence of the metabolic syndrome. More sleeping hours were positively associated with metabolic syndrome. Regarding smoking, the only statistically significant association was found in women that smoked less than 10 cigarettes per day. No statistically significant association was found between ethanol intake and metabolic syndrome. The study concluded that there is an association between decreased physical activity, increased sleeping hours and metabolic syndrome but no association was found between cigarette smoking, alcohol intake and the metabolic syndrome. This was further supported by an Irish study.[15,16]

This study did not show any difference in the prevalence of MS, rather there were more subjects with MS in the exercise group than non- exercise group but this did not reach statistical significance (Table I). The presence of multiple components in metabolic syndrome made most of the studied subject exercise more to keep fit and to obtain licensure for flying.

Studies have shown that alcohol intake increases the HDL level and reduce the rates of MS.[15,16] In this study there was no difference in the prevalence of MS, the mean level of HDL-C was not statistically significantly higher in the group that consumed some alcohol than non consumers and less subjects with low HDL-C were found in this group but the difference did not reach statistical significance. (23% vs. 40%; p=0.09 Table II).

However, the number of subjects that consume alcohol is small enough to draw a significant impact on the components of metabolic syndrome. No protective effect of alcohol on the occurrence of metabolic syndrome was found supporting the study by Kawada *et al*.[10]

Limitation of the Study

This study has some limitations that might have exerted an effect on the results as a whole. There were under reported rates of smoking habits and alcohol consumption due to the fear that this might affect the pilots' career and the social and religious prohibition of alcohol intake.

Conclusions

This study concludes that smoking, alcohol intake and exercise as confounders did not exert any deleterious or beneficial effects on the prevalence of metabolic syndrome or its components. The most prevalent components of MS are dyslipidemia in all groups. Smoking has a significant impact on low HDL-C rates and levels in smokers. The total number of subjects studied is small so further larger studies are needed to elicit differences and significant results of these confounders.

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