Original Article

Correlation Between Fasting Blood Sugar and Resting Blood Pressure in Teachers Residing in Shiraz, Iran 2009

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Background: Coronary Artery Disease (CAD) is the major cause of morbidity and mortality**.** The knowledge about correlation between the different risk factors of CAD provides valuable information for prediction and prevention of the disease in a specific population.The aim of this study was to evaluate the correlation between fasting blood sugar (FBS) and resting blood pressure in teachers residing in Shiraz, Iran

Methods: A total of 3115 teachers from different educational centers of Shiraz, Iran were interviewed in this cross sectional study. The data obtained comprised demographic information including age, sex, and history of hypertension (HTN), diabetes mellitus (DM), and current use of medications. Other parameters measured were height, weight, fasting blood sugar (FBS) and resting blood pressure (BP) as well as calculating the body mass index (BMI).

Results: Out of all the cases studied, undiagnosed and/or untreated cases of diabetes and hypertension were 1.5% and 15.2% respectively. FBS was higher in the elderly and in cases with higher BMI, but without any significant difference in relation to sex. The prevalence of HTN was higher in males, in older cases and in those with higher BMI. A significant relationship was observed between FBS and resting BP in hypertensive and pre-hypertensive groups ($P < 0.001$) as compared to normotensive subjects.

Conclusion: There was a significant correlation between FBS and resting BP in hypertensive and prehypertensive teachers residing in Shiraz,Iran. But this correlation was not present in the vast majority of the population with normal resting blood pressure. The prevalence of neglected DM and HTN in this population was high enough to warrant regular screening.

Key Words: Diabetes mellitus, Hypertension, Cardiovascular risk factors

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Introduction

Chronic non-communicable diseases such as cardiovascular disorders are rapidly growing worldwide and are the leading cause of death around the world. There is some evidence that the prevalence of these diseases in developing and Middle eastern countries is increasing because of the emerging high-risk lifestyles.[1,2] Nowadays, Coronary Artery Disease (CAD) which is the most common form of cardiovascular disease is the major cause of morbidity and mortality in Iran with around 50% of deaths per year.[3] There is a complex set of risk factors interacting for presence and severity of CAD. The difference in incidence of CAD in a single population reveals the impact of environmental factors and lifestyle on the prevalence of CAD.[2] The most important risk factors for CAD are Diabetes Mellitus (DM), hypertension (HTN), dyslipidemia and obesity especially central obesity.[4-6]

DM is one of the leading risk factors of CAD and is growing in developing countries because of the changes in lifestyles, increasing high-calorie diet and physical inactivity.[7]The association between the glucose status and cardiovascular disease can be detected in the early stages of the disease before diagnosis. All stages of glucose abnormalities are associated with CAD and detection of these abnormalities is of great value in early screening of cardiovascular diseases.[8,9] HTN is another common risk predictor of CAD as it has been reported that about 10 mmHg rise in systolic blood pres-

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sure would increase the risk of CAD by a factor of 22%.[10]The incidence of HTN is growing significantly because of the tremendous changes in the lifestyles especially in the developing countries. A study on prevalence of HTN among Iranians has shown that 26.6% of adults were hypertensive and an additional 38.2% were in prehypertension stage.[1]

Obesity is one of the challenging problems of public health in modern time and one of the potential risk factors of CAD which can also increase the prevalence of other risk factors such as DM and hyperlipidemia.[11-12] Body Mass Index (BMI) which is defined by weight (kg) /height (meter),[2] is one of the anthropometric indices of obesity that provides predictive value for diagnosis of CAD.[13-14] Clustering of risk factors, central obesity, hypertension, hyperglycemia, and dyslipidemia, along with an insulin-resistant state which is called metabolic syndrome (MetS) is an important risk factor for cardiovascular disease.[15-16]Among diverse descriptions of MetS in different references, the definition adopted by the National Cholesterol Education Program Adult Treatment Panel requires at least three of the following five criteria: (1) waist circumference larger than 102cm in men and 88cm in women; (2) serum triglyceride levels of at least 150 mg/dl; (3) HDL cholesterol less than 40 mg/dl in men and less than 50 mg/dl in women; (4) blood pressure of at least 130/85 mmHg; and (5) minimum serum glucose concentration of 110 mg/dl.[17]

Certain studies have shown some degree of correlation between insulin resistance and increased resting blood pressure but this relationship is different in relation to the ethnic group studied.[16]It is thought that insulin resistance syndrome leads to impaired glucose tolerance, dyslipidemia, impaired fibrinolytic activity, and HTN. Insulin sensitivity is lower in patients with essential HTN compared with normotensive patients. DM and HTN often occur together and this combination amplifies the morphological changes seen in diabetic cardiomyopathy.[18]The aim of the present study was to evaluate the correlation between fasting blood sugar (FBS) and resting blood pressure in teachers residing in Shiraz, Iran.

Patients and Methods

The present cross-sectional study carried out from February to December 2009 comprised a total of 3115 teachers, aged from 21 – 80 years, from different educational centers of Shiraz, Iran. Among participants, 1842 (%59.1) were females and 1273 (%40.9) males. A trained nursing staff using standard questionnaires interviewed all participants after obtaining informed verbal consent. Collected data consisted of demographic information including age, sex, and history of HTN, DM, and current use of prescribed medicines for these two conditions. In regard to the disturbing effects of medications, 267 cases with HTN and/or DM who received treatment for these two abnormalities were excluded from the study. Anthropometric characteristics studied included weight, height and BMI. Weight was determined shoeless with light clothing using a portable scale. Height was measured using inflexible bar. BMI was calculated as weight (Kg)/height (meter) ^{2}. Blood pressure (BP) was taken after 5 min acclimatization to the environment and blood samples were then collected. BP was determined by a trained staff with a digital micro life sphygmanometer and recorded as an average of three measurements obtained at 5 min intervals. Blood samples (5ml) for FBS determination were withdrawn in sitting and resting position and kept at 5º C and transferred to specific reference laboratories for analysis. FBS analysis was performed by enzymatic methods using glucose oxidize kit.

The whole study process was approved by the Ethical Committee of Shiraz University of Medical Sciences and was performed under the supervision of a cardiology resident.

Variables and measurements

Participants with systolic BP (SBP)≥ 140 mmHg and/or diastolic BP (DBP)≥ 90 mmHg were considered as hypertensive. The SBP between 120-139 mmHg and /or DBP between 80-89 mmHg were regarded as prehypertension, and lower values for SBP and DBP were considered normal.[20]According to American Diabetes Association report on diagnosis and classification of diabetes mellitus, [21]FBS < 100 mg/dl was considered normal and between 100–125 mg/dl was marked as impaired fasting glucose or prediabetes. FBS≥ 126 mg/dl was defined as DM. BMI between 25-30 kg/m^2 and higher than 30 kg/m^2 were defined as overweight and obesityrespectively.[22]

Statistical analysis

Statistical analysis was performed by SPSS software. Descriptive statistics was used for describing the mean and frequency of the data obtained. The correlation between parameters was tested using Chi-square test. P-values less than 0.05 were considered significant.

Table 1. The prevalence estimates of HTN and DM based on sex, age and BMI.

Risk factor		BP Number (%)				FBS Number (%)			
		Normal	Pre-HTN	HTN	P value	Normal	Prediabetes	DM	P value
Sex	Female	787 (47.0)	659 (39.3)	230 (13.7)	<0.001	1508 (90.2)	141 (8.4)	22 (1.3)	0.127
	Male	370 (32.2)	578 (50.3)	202 (17.6)		1011 (87.8)	121 (10.5)	19 (1.7)	
Age (Year)	≤ 40	581 (49.5)	465 (39.6)	127 (10.8)	<0.001	1077 (91.7)	88 (7.5)	9 (0.8)	0.001
	> 40	575 (34.9)	771 (46.8)	303 (18.4)		1437 (87.5)	174 (10.6)	32 (1.9)	
BMI (Kg/m^2)	< 25	603 (48.9)	499 (40.5)	131 (10.6)		1134 (92.3)	85 (6.9)	10 (0.8)	
	25-30	465 (36.9)	582 (46.2)	212 (16.8)	<0.001	1110 (88.2)	127 (10.1)	22 (1.7)	< 0.001
	> 30	86 (26.4)	154 (47.2)	86 (26.4)		265 (82.0)	49 (15.2)	9 (2.8)	
BP (mmHg)	Normal	-	-	-		1063 (92.7)	75 (6.5)	9 (0.8)	
	Pre-HTN	-	-	-	-	1078 (87.9)	126 (10.3)	22 (1.8)	<0.001
	HTN	-	-	-		361 (84.0)	61 (14.2)	8 (1.9)	

Results

Out of all the 2848 cases studied, 15.2% had undiagnosed and/or untreated hypertension and the rate of hypertension was significantly higher in men than women (17.6 % versus 13.7%, P<0.001). BP was higher in subjects older than 40 years than younger age individuals (18.4% versus 10.8%, P<0.001).

Furthermore, 1.5% of cases were undiagnosed and/or untreated diabetic. Also 9.3% were in prediabetes stage. The prevalence of DM and prediabetes was not different between men and women. The prevalence of DM was dependent on age (1.9% of cases aged more than 40 versus 0.8% of those aged ≤ 40 years, P < 0.001). As shown in Table 1 there was direct correlation of both resting BP and FBS with BMI (P < 0.001).

The rate of DM was higher (P < 0.001) in compared with normotensive subjects (Table 1). A significant correlation (P < 0.001) was found between FBS with resting BP in these two groups (Table 1). But this correlation was not in persons whit normal blood pressure.

Discussion

Identification of patients at risk of cardiovascular disease is one of the major challenges in clinical cardiology. Prevalence of CAD in general population is unknown, because the diagnostic angiography is often indicated in people with clinical symptoms. People, involved in demanding and stressful occupations are at higher risk of CAD.[23]Therefore, screening of specific populations for risk factors of CAD and estimating the correlation of risk factors with demographic features seems imperative. The identification of risk factors provides the opportunity of decreasing CAD through controlling the modifiable risk factors and reducing the associated morbidity and mortality.[24] To elucidate the interaction between CAD risk factors, based on sex, age and BMI, we performed a cross-sectional study to evaluate the relationship between Hypertension and DM, two important risk factors of CAD.

The prevalence of DM in our study was lower than previous studies performed in Iran (1.5% versus 6.3%[5], 8.7%[1] and 3.6%[25]).This is due to the fact that we excluded known cases of diabetes that were on drug therapy for DM. Also we noted that the prevalence of DM was age-dependent but not sex-related, while in a similar study DM was shown to be more prevalent in the elderly[1] and in women, maybe because of higher predisposition of females to this disease and higher rate of unhealthy lifestyles in females than males.[7] The prevalence of HTN was lower in our subjects compared with previous studies(15.2%versus 26.6%[1] and 37.4%[25]). This is also attributed to the exclusion of known cases of HTN that were receiving medications. HTN was more prevalent in elderly and men in contrast to the study of Esteghamatiet al.[1] which showed that hypertension was more prevalent in women than men. We also found that BMI had a significant effect on FBS and restingBP. This finding allows us to conclude that obese individuals were at higher risk of DM and HTN compared to their younger counterparts with normal BMI. There is also some epidemiological evidence for this conclusion.[26]

The presence of HTN in patients with DM is pernicious because of the strong effects of these two entities on risk of CAD, stroke, renal disease, and diabetic retinopathy.[27] There are some previous reports on the correlation between HTN and

DM in Iranian population[7] and other communities like Americans, [28] AfricanAmericans[29] and the Saudi inhabitants.[30]

In the present study we found a significant correlation between FBS and resting BP in hypertensive and prehypertensive cases. This finding may support the theory of insulin resistance as an etiologic factor for increased resting blood pressure.[31] However the results are controversial in regard to different studies of the relationship between DM and HTN. A study of evaluation of glucose tolerance in essential HTN[24] showed that compared to control group, HTN duration was longer in patients with diabetes and prediabetes, but the prevalence of HTN was not significantly higher. In another study, absolute values of systolic BP at rest and the change from resting values during exertion ,at all workloads, did not differ significantly between diabetic and nondiabetic men. However, in patients with type 2 diabetes who were normotensive at rest, diastolic blood pressure increased during exercise more than in nondiabetic control subjects.[32] Another study showed that there was no correlation between DM with resting systolic or diastolic BP.However, significant correlation was shown to exist between DM with systolic BP measured during submaximal exercise.[33] Thus, it may be recommended to check for post-exercise BP elevation in diabetic patients with normal resting BP.

In conclusion, our study showed a direct interaction between FBS and resting BP in hypertensive and prehypertensive teachers residing in Shiraz but elucidation of the exact mechanism needs further investigations. However in the vast majority of population with normal resting blood pressure as a correlation was not found. Also we noted that despite high degree of education of the subjects under study, there are still many undiagnosed and/or untreated cases of HTN and DM in this population, which highlights the need for regular screening for coronary risk factors.

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