# Clustering of coronary artery disease risk factors in Jordanian hypertensive patients

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## ABSTRACT

**Objective:** To assess the coronary artery disease risk factors in hypertensive Jordanian patients in various hospitals in Jordan.

**Methods:** Two hundred and seven patients were assessed by physicians in various hospitals in Jordan including King Hussein Medical Center , Prince Rashid Medical Hospital and King Abdullah University Hospital Primary Health Care Internal Medicine Clinic from March 2003 to October 2003. Clinical assessment included blood pressure (BP), anthropometric data, metabolic and chemical profile were collected.

**Results:** The average age of sample was 58.9 ± 11.28 years old. The mean body mass index was 29.4 ± 6.4 kg/m$^2$, 77 patients (37.2%) were overweight and 83 patients (40.1%) were obese. Smoking habit was prevalent in 78 patients (37.7%). Analysis of data showed that female had a higher systolic BP than male, while male had a higher diastolic BP than female. The mean serum cholesterol level was 205.7 ± 65.7 mg/dl, while the mean fasting blood glucose was 150.1 ± 63.9 mg/dl. The sample was staged according to the Joint National Committee on Prevention, Detection, Evaluation and Treatment of High BP classification, 87 patients (42%) showed optimal and normal BP (<130/85 mm Hg), 40 patients (19.3%) showed high normal BP (130-139/85-89 mm Hg), 47 patients (22.7%) with stage 1 hypertension (140-159/90-99 mm Hg), 15 patients (7.2%) with stage 2 hypertension (160-179/100-109 mm Hg) and 18 patients (8.7%) with stage 3 hypertension (≥180/110 mm Hg). The high prevalence of risk factors in hypertensive patients is alarming, particularly the high prevalence of poor control of BP, smoking in men, hypercholesterolemia and obesity in women.

**Conclusion:** The BP control is inadequate in large percentage of this sample and a number of risk factors cluster in both adequately and inadequately controlled hypertensive patients.

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Various conditions including hypertension, hypercholesterolemia, diabetes mellitus, obesity and smoking are well-established atherogenic risk factors for coronary heart disease (CHD).[1] In developed countries, those CHD risk factors tend to cluster together,[2] with marked differences in risk factor distribution across countries and ethnic groups.[3-5] Hypertension is a major risk factor for cardiovascular mortality and morbidity. It doubles the risk for CHD and triples the risk for stroke and congestive heart failure (CHF).[6,7] The burden of CHD is considerable, representing 30% of all deaths worldwide that is approximately 15 million deaths a year, of which two thirds fatalities were in developing or transitional countries.[8,9] In Jordan, cardiovascular diseases (CVD) alone are now responsible for more than 35% of death cases[10] while in 1961, 1970, 1979 and 1985 the mortality rate was 5%, 12.6%, 22.2% and 39.1% for males and 2.9%, 13%, 18.5% and 27.2% for females[11] respectively, which is similar to other developing countries.[12] This rapid increase in prevalence of CVD can be attributed to increase in population, economic, social and cultural changes. Another

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factor, which plays a role in prevalence of CVD is the epidemiological transition. This is an evolutional increase in average life expectancy as a result of improvements in malnutrition, maternal and infant death, public health and medical services that reduce the rate of communicable diseases.[13] The American Heart Association (AHA) and American College of Cardiology (ACA) states that risk assessment of CVD is to identify high risk patients, motivate patient to adhere risk reduction therapy and to modify intensity of risk reduction effort based on the total risk estimate.[14] Cardiovascular disease is one area in which there is a significant gender variation; women less often have classical symptoms of angina, instead they presented with more subtle complaints of fatigue, breathlessness, nausea and neck pain. Treating women with CVD had been extrapolated from male data and efforts to correct this misstep is under way for the past decade, but it seems that prevention, diagnosis and treatment of CVD in women may never be completely gender blind.[15]

The aim of this study is to assess the control of blood pressure (BP), metabolic parameters and CHD risk factors in Jordanian hypertensive patients in primary health care clinics.

Methods. Two hundred and seven (124 males and 83 females) known hypertensive patients appointed at the Internal Medicine Clinics of King Hussein Medical Center (n=78), King Abdullah University Hospital (n=54) and Prince Rashed Military Hospital (n=75) for routine evaluation and monitoring of their hypertension. Data were collected from March 2003 to October 2003. The following data were collected: date of birth, gender, body weight, height, and family history of early CHD, smoking habit, fasting blood glucose on 2 occasions, BP, triglycerides and total cholesterol.

Smoking habit was considered positive for those who smoke a single cigarette or more until the day of the interview. Weight and height were used to calculate body mass index (BMI) based on the formula weight expressed in kilograms, divided by the square height expressed in meters. Patients with 25 kg/m$^2$ to <30 kg/m$^2$ BMI were classified as overweight and obese for those ≥30 kg/m$^2$. Each BP value was the mean of 2 successive measurements taken by a physician, or a skilled nurse after the patient had been seated for at least 5 minutes. Pulse pressure was calculated as systolic blood pressure (SBP) minus diastolic blood pressure (DBP). The degree of BP control was classified according to the sixth report of the Joint National Committee on Prevention, Detection, Evaluation and Treatment of High BP.[16] Both optimal and normal BP were considered as normal BP, for statistical purposes.

The various risk factors (BP, age, smoking habit, family history of CVDs, abnormal FBG, total cholesterol) were assessed on the basis of the recommendations of the World Health Organization-International Society of Hypertension Joint Committee.[17]

Statistical analysis was performed using the statistical program SPSS version 11. The gender difference was analyzed by Z-independent sample test, while the association between other categorized risk factors and gender was analyzed by chi-square test. Descriptive statistics with mean and standard deviation were computed to describe continuous variables, and the data were expressed as mean±SD. The null value hypothesis was rejected for $p<0.05$. Person's correlation coefficient and multiple analysis of variance (MANOVA) were used to test for the association of SBP, DBP, with other variables.

Results. The average age of sample was 58.9 ± 11.28 years old with mean BMI of 29.4 ± 6.4 kg/m$^2$ of height, 160 patients (77.3%) were overweight and 83 patients (40.1%) were obese. A total of 78 patients (37.7%) were smokers, of which 61 patients were male (49.2%) and 17 patients were female (20.5%). The mean SBP was 131.8 ± 23.2 mm Hg, and the mean DBP was 82.0 ± 13.6 mm Hg, while the mean pulse pressure was 49.8 ± 18.0 mm Hg. The mean fasting blood glucose was 150.1 ± 63.9 mg/dl, the mean cholesterol levels were 205.7 ± 65.7 mg/dl, and the mean triglyceride level was 190 ± 123.1 mg/dl. Positive family history of ischemic heart disease (IHD) or premature death of first-degree relatives was recorded in 89 patient (43%), 46 male and 43 female patients ($p<0.05$). The mean number of risk factors was 2.82 ± 1.28 (3.3 ± 1.2 in females vesus 2.5 ± 1 .2 in males). When dividing the sample on the basis for gender (**Table 1**), it can be noticed that female were significantly more obese, had higher fasting blood and positive family history with significantly lower incidence of smoking.

***Blood pressure control and staging of BP.*** The sample mean SBP was 131.8 ± 23.2 mm Hg and DBP was 82.0 ± 13.6 mm Hg. Pulse pressure was lower in males (49.1 ± 18.3) than females (50.9 ± 17.6 mm Hg). The sample was staged according to Joint National Committee on Prevention, Detection, Evaluation and Treatment of High BP classification, 87 (42%) patients showed optimal and normal BP of <130/85 mm Hg , 40 (19.3%) showed high normal BP of 130-139/85-89 mm Hg, 47 (22.7%) with stage 1 hypertension (140-159/90-99 mm Hg), 15 (7.2%) with stage 2 hypertension (160-179/100-109 mm Hg) and 18 (8.7%) with stage 3 hypertension of >180/110 mm Hg. Therefore, 123 patients (59.4%) showed adequate

control and 84 patients (40.6%) with inadequate control of hypertension despite medical therapy. When the sample was divided according to age group, prevalence of adequate BP control was progressively increasing until the age of 70 years. (**Table 2**).

The most prevalent risk factor other than hypertension is hypercholesterolemia (62.3%) followed by diabetes mellitus (54.1%), family history of CVD (43%), obesity (40.1%), smoking (37.7%) and age (26.42%). Regarding the prevalence of CVD clustering risk factors other than hypertension, more than 96% of patients had more than one risk factor other than hypertension. Out of 110 patients with 3-4 risk factors, 70 patients (63.6%) had an adequate control of BP (**Table 3**).

Triglyceride levels are significantly directly correlated with SBP (r=0.137, p=0.049). After adjusting for other risk factors using MANOVA, triglycerides are significantly associated with increased SBP. Both increased triglycerides and BMI are significantly associated with increased DBP. Both increased age and triglycerides are associated with increased pulse pressure, and male gender was associated with non-significant lower SBP and higher DBP than females. Increase in cholesterol and BMI was associated with decreased pulse pressure.

Discussion. This study although performed on a limited number of patients, but it stresses the need for screening for the whole hypertensive population for CAD risk factors as it will guide the treatment options. This sample is characterized by a major prevalence of male gender, hypercholesterolemia and glucose intolerance. As a single measurement of FBG >126 is not a clue for diabetes mellitus and further investigations are required. The clustering of risk factors in hypertensive patients had been reported in many industrialized countries.[18] This study demonstrates that a significant proportion of Jordanian hypertensive patients with optimal control for hypertension, about one third of patients (38.7%) were still on stage 1-3 of hypertension despite medical therapy. Despite medical therapy for hypertension, 40.6% of patients in the sample were with poor control of BP which is a higher percent than Saudi hypertensive patients on medical therapy attending a primary health care (33.3%).[12] Sustained differences of 10 mm Hg in SBP and 5 mm Hg DBP were each associated with a 28% difference in the risk of death from CHD.[19] In the United States of America, the proportion of hypertensive patients on antihypertensive therapy with adequate control of BP was 47% in the health examination survey (1960-1991)[20] and 45% in the health and nutrition examination surveys (1988-1991).[21] Females had non-significant higher SBP and lower DBP than males compared with significant similar variation in a study on hypertensive Egyptian population.[2] Non-significant difference of BP measurements may be attributed to

Table 1 - Population characteristics according to gender.

| Variables | Males (N=124) Mean ± SD | Females (N=83) Mean ± SD | Total (N=207) Mean ± SD | *p*-value |
|---|---|---|---|---|
| Age (years) | 58.39 ± 11.48 | 59.81 ± 11.00 | 58.96 ± 11.28 | Not significant |
| Body mass index | 28.61 ± 5.34 | 30.64 ± 7.98 | 29.42 ± 6.39 | Not significant |
| Systolic blood pressure | 131.46 ± 25.36 | 132.04 ± 21.73 | 131.81 ± 23.20 | Not significant |
| Diastolic blood pressure | 82.95 ± 13.00 | 80.63 ± 14.38 | 82.02 ± 13.59 | Not significant |
| Pulse pressure | 49.09 ± 18.32 | 50.83 ± 17.59 | 49.78 ± 18.01 | Not significant |
| Fasting blood sugar | 142.32 ± 63.36 | 161.81 ± 63.17 | 150.13 ± 63.86 | 0.031 |
| Cholesterol level | 200.44 ± 54.17 | 213.57 ± 79.54 | 205.70 ± 65.67 | Not significant |
| Triglycerides | 189.25 ± 112.08 | 191.44 ± 38.73 | 190.13 ± 123.14 | Not significant |
| Positive family history (%) | 46 (37.1) | 43 (51.8) | 89 (43) | 0.036 |
| Smokers (%) | 61 (49.2) | 17 (20.5) | 78 (37.7) | <0.0001 |
| Obese patients (%) | 42 (33.9) | 41 (49.4) | 83 (40.1) | 0.025 |
| Overweight patients (%) | 49 (39.5) | 69 (83.1) | 77 (37.2) | Not significant |
| Number of risk factors | 2.47 ± 1.20 | 3.34 ± 1.22 | 2.82 ± 1.28 | <0.0001 |

Table 2 - Prevalence of blood pressure (BP) control in accordance to age.

| Age (years) | N | Adequate BP control | | Inadequate BP control | |
|---|---|---|---|---|---|
| | | n | (%) | n | (%) |
| ≤50 | 40 | 21 | (52.5) | 19 | (47.5) |
| 51-58 | 52 | 28 | (53.8) | 24 | (56.2) |
| 59-64 | 59 | 37 | (62.7) | 22 | (37.3) |
| 65-70 | 39 | 26 | (66.7) | 13 | (33.3) |
| >70 | 17 | 11 | (64.7) | 6 | (35.3) |

Table 3 - Clustering of cardiovascular risk factors other than hypertension.

| Status | Number of risk factors | | | |
|---|---|---|---|---|
| | 0 | 1-2 | 3-4 | >4 |
| Normal | 2 | 31 | 50 | 4 |
| High normal | 3 | 13 | 20 | 4 |
| Stage 1 | 1 | 17 | 25 | 4 |
| Stage 2 | 1 | 5 | 8 | 1 |
| Stage 3 | 1 | 5 | 7 | 5 |
| **Total (%)** | **8 (3.9)** | **71 (34.3)** | **110 (53.1)** | **18 (8.7)** |

highly prevalent obesity of our sample and the lack of large cuff size in our hospitals. The high prevalence of inadequate control of BP emphasizes the importance of BP reduction as a measure to reduce mortality and morbidity in this patient group via life style modification and medications. The high prevalence of risk factors in hypertensive patients who are by definition had a single risk factor is alarming, particularly the high prevalence of poor control of BP, smoking in men, obesity in women and hypercholesterolemia. Pulse pressure which is considered as a major predictable of coronary mortality even in the presence of acceptable mean BP affecting the coronary but not the cerebrovascular circulation[22] was lower in males than females and these results are similar to other[2] and can be explained by higher level of DBP. More than half of the patients in the sample had fasting blood glucose of >126 mg/dl on 2 different occasions indicating the presence of diabetes mellitus and this is consistent with some studies.[23] Diabetes mellitus was significantly more prevalent in females taking into account that glucose intolerance is reported to be the strongest risk factor for CAD.[24]

Obesity was common in females more than males (49.4% versus 33.9%) and similar data were reported previously.[2] Obesity can explain the high prevalence of cholesterol and blood glucose abnormalities, by causing insulin resistance irrespective of the location.[6,18,25] Hypercholesterolemia was significantly high (61.8%) with higher prevalence in women (65.1% versus 59.6%). These results can be explained partly by high prevalence of obesity in women, high intake of lipid in diet and low physical activity. Total cholesterol levels increase significantly with increasing SBP or DBP in both sexes.[26,27] In Sweden hypercholesterolemia was prevalent in 41% of treated hypertensive and was also more prevalent in females (45.3 % versus 36.7%).[28] Obesity and weight gain are the most important determinants of hypertension. Thus, a 10% rise in body weight explains a 7 mm Hg rise in SBP in the whole population and every 1 kg excess weight lost is associated with a decrease of 0.33 mm Hg in SBP and 0.43 mm Hg in DBP.[29] The pathogenesis of hypertension in obese individuals is a complex of genetic, metabolic and endocrine abnormalities with environmental and psychosocial determinants.[29] Common finding in obese individuals is hypertriglyceridemia, insulin resistance and unfavorable cholesterol profile.[30] Smoking prevalence (37.7% of total sample 49.2% male and 20.5% female) is similar to that of Egyptian hypertensive population (35.5% for male and 2.3% for female)[2] while smoking prevalence among hypertensive patients on antihypertensive medication is much lower in developed countries such as Italy (15.7%)[31] and Sweden (9.7%).[28] Smoking prevalence in our sample might be underdetermined as female smoking status may be less reported for social unacceptance in both Jordanian and Egyptian societies. A multicenter study in developing countries showed that smoking prevalence varied from 16-78%.[32]

Our sample was burdened by the coexistence of high number of risk factors other than hypertension, only 3.9% free from other CVD risk factors compared with 10% of patients included in the Pandora project.[31] Adequate control of BP was prevalent in patients with 3-4 risk factors may suggest that this group of patients adhere more to therapy than those with a lower number of risk factors. The number of risk factors in this study is alarming, Hypertensive patients presented with risk factors for CAD at stratification of hypertension

should be fully followed up by careful and thorough diagnostic evaluation with respect to those risk factors and treated according to guidelines established by health authorities that take into account the effect of antihypertensive therapy on those risk factors.

The role of the clinical pharmacist on patient counseling regarding life style modification and optimization of therapeutic outcomes is crucial and should be authorized to maximize health care and patient quality of life.

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