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HAEMATOLOGICAL, LIPID PROFILE AND OTHER BIOCHEMICAL PARAMETERS IN NORMAL AND HYPERTENSIVE SUBJECTS AMONG THE POPULATION OF THE EASTERN PROVINCE OF SAUDI ARABIA
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ABSTRACT

Objective: **To determine the lipid profile complete blood count and other biochemical parameters in normotensive and hypertensive individuals.**
Design: **Cross-sectional population-based epidemiological household survey.**
Setting: **Population sample of the Eastern Province of Saudi Arabia.**
Results: **Hypertensive individuals had significantly higher mean levels of glucose, Tc, LDL-c, HDL-c, triglycerides and HBAIc, compared to normotensive individuals while there were no significant difference in the mean levels of Apo AI and Apo B. Within the same group there were variations in the levels of certain parameters between male and female. While the mean levels of haemoglobin, WBC and platelets were significantly higher in the hypertensive group compared to normotensive, there were no significant differences between these two groups in the levels of RBC, MCV, HCT, MCH and MCHC. However, the mean levels haemoglobin, RBC count and HCT were significantly higher in male compared to female within the same group with no significant difference in levels of WBC, MCV, MCH and MCHC. Furthermore, the mean concentration of platelets was significantly higher in females compared to male within the same group. Hypertensive individuals had significantly higher serum sodium, chloride and calcium levels but a significantly lower potassium level when compared to normotensive with no siginificant differences between male and female within the same group.**
Conclusion: **The lipid and electrolyte profile of hypertensive individuals differ from that of normotensive individuals in this population. This study has contributed towards establishing the normal values for a number of parameters involved in the aetiology of cardiovascular diseases in the population of Eastern province.**

INTRODUCTION

Cardiovascular disease (CVD) is the leading cause of illness in the industrial world and its incidence is progressively increasing in the developing countries(1). Hypertension is the most important risk factor of CVD which increases the risk of stroke, myocardial infarction, heart and renal failure. Coronary atherosclerosis is the result of complex processes which include inflammatory processes, low density lipoprotein (LDL) accumulation and smooth muscle cell migration (2). These processes at different degrees are modulated by many factors including hypertension, diabetes and smoking (3). It has well been established that high blood LDL cholesterol (LDL-c) among others, is associated with the early development of atheroselerotic plaques. An increase of one standard deviation for every LDL cholesterol concentration has been shown to be associated with 5.4% more atherosclerotic lesions (4). Additionally, biochemical research has provided evidence that LDL cholesterol promotes atherosclerotic calcification of vascular cells due to products of lipid oxidation (5).

A number of studies have reported a progressive increase in the incidence of CVDs in the Mediterranean region including Saudi Arabia (6,7). This has been attributed to the tremendous changes in socio-economic factors and the life style of these populations. This changing life style and technology of the modern environment which brings with them diminished physical activity, abundance of high energy and dense food in combination with social stresses and deleterious habits in populations unaccustoned to such exposure are leading to increasing occurence of CVDs. Yet, clinical trials have provided compelling evidence that coronary heart disease is largely preventable (8). However the efficiency and success of the above

measures depend on previous identification of the population risk factors.

There have been many studies in the kingdom of Saudi Arabia concerning hypertension and other risk factors, with varied results and conclusion (9-14). This may reflect the non uniformity of the study design populations surveyed and different laboratory procedures. In addition many of the studies are hospital based (15).

The present study was carried out to establish the local norms and identify the risk factors in the communities of the Eastern Province as part of a comprehensive population based study of hypertension.

MATERIALS AND METHODS

During a household screening programme of hypertension in the Eastern province of Saudi Arabia, 250 hypertensive Saudi males and females aged 18-60 and similar numbers of controls were randomly selected. The section was from a sample of 6000 representing the population of Eastern Province with all its socio-economical and genetic variabilities. A written informed consent was obtained from each subject. Extreme care was taken in the random selection of hypertensive and control groups to ensure that they represented a broad cross sectional coverage of all population in the Eastern Province. The control group consisted of healthy volunteers who were not taking hormones or drugs known to affect plasma lipid levels. Hypertension was considered to be present if subjects met the following criteria: Systolic pressure of 140mmHg and above and diastolic pressure of 90mmHg and above on two occasions by the same interviewer (1). Blood samples were obtained at the local primary health centre after an overnight fast. Blood pressure measurements were obtained using a mercury sphygmomanometer on three occations during the interview. Blood collected in red top vacutainer tubes was allowed to stand for 30 minutes at room temperature to allow complete clotting and clot retraction. Samples were centrifuged at 2000 x g for 15 min, divided into aliquots and stored at -20° celsius. Three millilitres of blood was collected in EDTA coated tubes and 4ml of blood was collected in plain tubes. Haematological indices were determined for all samples using a haematological analyzer (ACT-8 coulter Electronies). Glucose, creatinine, BUN, uric acid, Tc, HDL-c and triglycerides were determined as previously described (17-19). LDL-c was calculated using the Friedwald formula (20). Apo A-I and Apo B were determined by ELIZA methods while HBAI-c was determined by affinity chromatography (Bio Merieux Sa, Immunoturbidimetric assay of Apo A-I and Apo B, Helena GLYCO-TEK Affinity Column). Serum sodium, potassium, chloride and calcium were determined using electrolyte analyzer (AVL 9180 Electrolyte analyzer). Mean values in lipid lipoproteins and other parameters between subgroups were compared using the independent sample t-test. All statistical analyses were perfomed using the SPSS package (version 10). A p-value of <0.05 was considered to be statistically significant. Quality control procedures included the re-analysis of 5% of frozen specimens randomly selected either within assay or between assays.

RESULTS

The mean values of blood indices are presented in Table 1. Within the hypertensive and normotensive groups, the mean levels of haemoglobin, HCT and RBC were significantly higher in male compared to females ($p<0.05$). However, the platelet level was higher in female than in male ($p<0.05$). There were no significant differences in the levels of WBC, MCV, MCH and MCHC between males and female ($p>0.05$). While the mean levels of haemoglobin, WBC and platelets were significantly higher in the hypertensive group compared to normotensive ($p<0.05$), there were no significant differences between these two groups in the levels of RBC, MCV, HCT, MCH and MCHC ($p>0.05$). Hypertensive individuals had significantly higher mean levels of glucose, Tc, LDL-c, HDL-c, triglycerides and HbAIc compared to normotensive individuals, while there were no significant differences in the mean levels of Apo AI and Apo B. However, there were variations in the levels of certain parameters between male and female within the hypertensive and the normotensive groups. The most striking difference was in the level of Tg where the male had a signicantly higher mean Tg level compared to female in both groups.

Table 1

CBC (Mean ± SD) of normotensive controls and hypertensive groups

Gender	WBC (10^9/L)	RBC (10^{12}/L)	Haemoglobin (g/dl)	HCT (%)	MCV (fl)	MCH (pg)	MCHC (g/dl)	PLT (10^9/L)
Controls								
Male	5.64±1.53	5.08±0.59	13.74±1.44	39.99±3.57	79.20±7.36	27.16±3.30	34.18±1.23	237.8±57.7
Female	5.64±1.55	4.49±0.55	11.77±1.30	34.78±3.18	77.66±8.39	26.63±3.82	33.99±1.31	275.90±69.1
Total	5.64±1.54	4.82±0.65	12.84±1.69	37.70±4.27	78.52±7.85	26.93±3.54	34.10±1.27	254.6±65.7
Hypertensives								
Male	6.41±1.17	5.04±0.48	14.26±1.38	41.91±3.50	83.55±6.53	28.43±2.70	34.10±1.04	264.53±64.8
Female	6.42±1.44	4.59±0.49	12.18±1.27	36.43±3.66	79.40±7.74	26.58±3.16	33.45±0.99	288.0±75.4
Total	6.42±1.45	4.79±0.53	13.11±1.67	38.83±4.50	81.23±7.51	27.40±3.04	33.73±1.05	277.7±71.7

Table 2

Serum lipid profile, glucose and HbAIc of the two study groups (Mean ± SD)

Test Parameters	Controls			Hypertensives		
	Male	Female	Total	Male	Female	Total
Glucose (mg/dL)	93.84±47.8	89.1±42.7	91.15±45.3	136.5±60.5	122.5±52.0	128.8±56.3
TC (mg/dL)	168.8±30.64	176.4±38.63	172.7±34.88	196.7±33.46	195.7±40.18	196.1±37.24
LDL-c (mg/dL)	105.8±25.6	114.1±30.5	109.8±28.3	126.7±33.4	131.4±36.7	129.2±35.2
Tg (mg/dL)	104.8±67.2	89.4±55.3	97.4±62.2	145.2±76.9	119.4±68.2	131.0±73.2
HDL-g (mg/dL)	40.7±8.5	44.6±9.1	42.6±9.0	44.1±8.7	46.6±9.0	45.7±8.9
Apo Al (g/L)	1.53±0.35	1.63±0.36	1.58±0.36	1.45±0.31	1.60±0.55	1.52±0.44
Apo B (g/L)	1.05±0.33	1.00±0.32	1.03±0.32	1.06±0.24	0.93±0.32	1.0±0.29
HbAlc (%)	7.48±2.24	7.45±2.4	7.47±2.31	8.99±2.98	8.93±2.3	8.96±2.3

Table 3

Serum Electrolyte, BUN, creatinine and uric acid levels of the two study groups (Mean ± SD)

Test parameters	Normotensive Controls			Hypertensives		
	Male	Female	Total	Male	Female	Total
Sodium (meq/L)	132.8±13.5	131.5±12.1	132.1±12.8	138.3±6.1	137.80±8.5	138.00±7.5
Potassium (meq/L)	4.75±0.63	4.61±0.53	4.68±0.59	4.34±0.47	4.13±0.44	4.22±0.47
Chloride (meq/L)	98.2±8.2	97.1±7.6	97.7±7.9	101.6±5.0	102.4±4.6	102.0±4.8
Calcium (mg/dL)	9.15±1.11	9.28±0.97	9.21±1.05	9.61±0.82	9.42±1.02	9.51±0.92
BUN (mg/dL)	26.58±8.15	24.29±7.43	25.44±7.90	21.03±11.62	14.50±7.29	17.50±10.05
Creatinine (mg/dL)	0.84±0.167	0.711±0.153	0.781±0.174	1.059±0.349	0.757±0.219	0.90±0.349
Uric acid (mg/dL)	5.85±1.48	4.61±1.21	5.26±1.49	5.65±1.23	4.66±1.48	5.12±1.45

Within the hypertensive and normotensive groups, the mean levels of creatinine, BUN, uric acid and potassium were significantly higher in male compared to female ($P<0.05$). However, there were no significant differences in the levels of sodium, calcium and chloride ($p>0.05$) between male and female within these two groups. While the mean levels of chloride, sodium, calcium and creatinine were significantly higher in the hypertensive group compared to normotensive ($p<0.05$), there was no significant difference between these two groups in the levels of uric acid ($p>0.05$). Hypertensive individuals however had significantly lower mean levels of potassium and BUN ($p<0.05$).

DISCUSSION

Abnormal lipid and lipoprotein levels are all positively associated with an increased risk in the incidence of CVD(21-23). In western Europe and the USA, CVD is the leading cause of morbidity and mortality with hypertension being the most common cause with a prevalence above 20% in the general population (24,25). In many developing countries, serum lipid levels are low and the incidence of CVD is less frequent when compared to western countries (26). However, these populations are increasingly exposed to urbanisation and associated changes in diet, physical activity and life styles. As a consequence, a CVD epidemic may be emerging due to an increase in risk factors. In the past four decades, the kingdom of Saudi Arabia has undergone profound socio-economic changes due to rapid urbanisation and a large increase in per capita income. This background suggests an increased prevalence of CVD which prompted this study (27). Information on CVD risk factors and hypertension in the population of the Eastern Province of Saudi Arabia is limited. Such information would allow us to improve control of hypertension which may contribute to a decrease in common causes of morbidity and mortality. The procedure by which a cohort is selected for any study is of fundamental importance for the interpretation of the results obtained and their accuracy. In the present study, which was part of a population based cross-sectional household survey, utmost care was taken to ensure the randomness of the sample selected and that all criteria were strictly adhered to. This broad coverage was needed for variables of genetic identity, physical environment and social and economical factors which were expected to affect the results. Thus the design of the study was

similar to those perfomed in the U.S and European countries and therefore allows for meaningful comparison.

Although a number of studies have shown significant differences in the levels of haemoglobin, RBC, MCV, HCT and MCH between hypertensive and normotensive individuals, other studies have shown no significant differences between these groups (28-32). Our data do not show any significant differences in the levels of these parameters between hypertensive and the normotensive control group. However, the mean levels of haemoglobin, WBC and platelets were significantly higher in the hypertensive group compared to the normotensive. Furthermore, it has to be emphasised that there is a significant difference in the parameters between the gender within each group. This is in agreement with previous population based studies (33).

The present study shows that serum concentrations of Tc, LDL-c, HDL-C, Tg, glucose and HbAI-c were significantly higher in the hypertensive group compared to controls. This was true not only among men but also among women and is in close agreement with previous reported data (6). High glucose and HbAIc levels are a reflection of higher prevalence of diabetes mellitus among hypertensives as compared to normotensives (34). There is a relatively small but significant increase in the level of HDL-c, which is an important measure to compare across populations in hypertensive individuals compared to normotensive counterparts and in female compared to male. This conclusion is at variance with an earlier study of HDL-c in Saudi male and female (7). However, the observed higher levels of HDL-c in women modifies the coronary heart disease risk factors in this population. On comparison of lipid profile results obtained with the results of the European or American cohort, it is clear that Saudi populations in the Eastern Province have on average a lower lipid concentration. This can be reflected by the lower prevalence of CVD (10%) (unpublised data) seen in the region compared to European or American populations (>20%)(35).

It has been well established that an increased level of sodium and a decreased level of potassium is associated with hypertension (36,37). Our data clearly indicate that the hypertensive group has a higher level of sodium and a lower level of potassium compared with the control normotensive group. This is true in other populations with a high prevalence of hypertension which may be due to hypertensive medication (38). In addition the data clearly indicate that hypertensive individuals have a higher mean creatinine level compared to normotensive individuals. This agrees with previous published data for other populations. This suggests some degree of renal impairment in this population. In this regard, it is unusual that the blood urea nitrogen was lower in hypertensives than in normotensives.

In conclusion, the present data have made an important contribution in establishing base line values of serum lipids in normal and hypertensive populations in the Eastern Province. In addition, these data address the feasibility of reducing the serum lipids of hypertensives in order to reduce the prevalence of CVD.

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