Effect of salt intake on blood pressure in diabetic hypertensive patients in Saudi Arabia

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ABSTRACT

Objectives: To understand the impact of salt intake on blood pressure and to assess the application of international management guidelines in Saudi diabetic hypertensive patients.

Methods: We recruited 112 consecutive diabetic hypertensive patients visiting the diabetic and nephrology clinic at the King Khalid University Hospital between July 2005 and January 2006. Participants received complete medical assessment and their 24 hours urine sodium was measured. Patients on diuretics were excluded from the study.

Results: A significant correlation between 24 hours urine sodium and diastolic blood pressure concentration was observed (r = 0.25, *p*=0.04) but not with systolic blood pressure (r =0.06, *p*=0.6) or 24 hours urine protein (r =0.06, *p*=0.63). Approximately 15% of the patients had an glycosylated hemoglobin (A1C) of between 7-8% while 41.2% had an A1C of >8 (suboptimal group for glycemic control). Low-density lipoprotein (LDL) cholesterol in only 37.5% of the patients was within the desired goal (<2.4 mmol/l). Whereas only 24.8% of the patients achieved the goal of systolic and diastolic BP of <130/80 mm Hg.

Conclusion: Modest salt restriction has possible adjuvant effect to pharmacologic treatment to enhance blood pressure control. However, a majority of the Saudi diabetic patients with hypertension and hyperlipidemia are inadequately treated.

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Hypertension and diabetes mellitus are common diseases and their incidence is escalating in Saudi Arabia.[1,2] The coexistence of diabetes mellitus and hypertension has devastating consequences on the cardiovascular system.[3] The risk of stroke or other cardiovascular events double in patients with diabetes mellitus at comparable blood pressure (BP) levels in hypertensives.[4] While many patient and health system related factors contribute to poor BP control, it is not clear if high salt intake plays a role in BP of diabetic patients. The primary objectives of the present study were to understand the impact of salt intake and to assess the application of international management guidelines in Saudi diabetic hypertensive patients.

Methods. The study population consisted of 112 type II diabetic patients with hypertension, visiting the diabetic and nephrology clinic at the King Khalid University Hospital. An average sitting BP of 140/90 or higher based on 2 sets of 3 BP readings measured one week apart was defined as hypertension according to the International Hypertension Society Guidelines.[5] The patients were ≥30 years of age at the onset of diabetes without a history of diabetic ketoacidosis to minimize recruitment of patients with type I diabetes. Exclusion criteria included, patients not able to participate completely in the study components, non-diabetic renal disease (including renal-artery stenosis), self-identified substance abuse, pregnancy, and refusal to sign the consent form. The Ethics Committee of the King Khalid University Hospital approved the study protocol. A complete medical history and physical examination were performed on all participants. A trained nurse using Actuator Plus Datascope measured the blood pressure (BP). Three measurements to the nearest 2 mm Hg were obtained in 2 minutes interval and the average BP was used. Uncontrolled BP was defined as >130/80 mm Hg. Demographic and medical

information was collected on all study subjects upon enrollment into the study. Laboratory data obtained during clinic visits included routine serum chemistry and 24-hours urine collection to measure the sodium, protein and creatinine.

Statistical analyses were conducted by SAS software. Initially, univariate analyses were performed to determine the distribution of the variables and presence of outliers. Data were presented as the mean ± standards deviation. A probability value of <0.05 was accepted as statistically significant. To analyze the association of salt intake and BP, Pearson correlation coefficient analyses were applied. For discrete variables, Pearson's 2 tests were used to compare baseline characteristics (such as gender and smoking status) for patients in controlled and uncontrolled blood pressure groups. The t test and Wilcoxon's rank-sum test for testing of continuous data were used to compare baseline differences between the 2 groups for continuous measurements (such as baseline serum creatinine levels and age).

Results. Of the total 112 participants, 63.4% were females, 25% smokers, 60.7% had diabetic nephropathy and the average age was 58 years (**Table 1**). The correlation analysis between the 24-hours urine sodium, SBP and DBP are shown in **Figures 1 and 2**. There was a significant correlation between 24-hours urinary sodium and DBP (r = 0.25, p=0.04) but not with SBP (r =0.06, p=0.6) or 24-hours urinary protein (r =0.06 , p=0.63). The proportion of diabetic patients on whom target levels of various cardiovascular risk factors were achieved is shown in **Table 2**. A large percentage of patients fell in the suboptimal group of glycemic control (A1C of 7-8% in 15% and >8 in 41.2%). The LDL cholesterol lipid levels reached the goal of <2.4 mmol/l in 37.5% of the patients. The BP control profiles in diabetics showed that 31.3% had a systolic BP <130 mm Hg and 75% had a diastolic BP <80 mm Hg (**Table 2**). However, the data show that only 24.8 % of the patients achieved the goal of BP of <130/80 mm Hg. This although that the median number of anti-hypertensive been used were 3. Proportion of participants using essential BP medications in the cohort included, angiotensin converting enzyme inhibitor or angiotensin receptor blocker (98%), lipid lowering medications (85%) and aspirin (45%). The prevalence of obesity (BMI ≥30) was as high as 65.2% of patients. Women (76%) were more likely to be obese than men (46%). Compliance was assessed by self-reporting questionnaire. Forty-five percent of patients failed to take their medications more than once per week.

Discussion. Despite the enormous observational and controlled clinical trials over the last 3 decades, there is still little agreement as to the efficacy and safety of salt restriction. In the present study, we examined the relationship between salt intake and blood pressure in type 2 diabetic hypertensive patients who were more resistant to BP treatment. Our results show that high salt intake to be associated with higher diastolic but not with higher systolic BP. The INTERSALT, a large observational trial examined the relationship between BP and salt intake in approximately 11,000 male and female in 52 centers around the world.[6] This study found no significant relationship between 24-hour sodium urine excretion and systolic BP in 48 centers.[6] Recent meta-analyses examining the impact of salt

Table 1 - Demographic characteristics.

Demographic characteristics	Data
Age (years)	58 ± 10.3*
Gender (%)	
Female	71 (63.4)
Male	41 (36.6)
Smoking (%)	28 (25)
24-hour urine protein (gm/l)	1.2 ± 1.8*
24-hour urine sodium (mmol/day)	129 ± 59*
Creatinine clearance (ml/min)	
Diabetics complications	59.0 ± 39*
Retinopathy (%)	52 (64)
Peripheral vascular disease (%)	54 (48.2)
Neuropathy (%)	68 (60.7)
Mean systolic blood pressure (mm Hg)	141± 18*
Mean diastolic blood pressure (mm Hg)	74 ± 12*
Fasting blood sugar (mmol/l)	9.8 ± 6.7*
Body mass index, kg/m^2	32.5 ± 5.4*
Diabetes duration (years)	14.2 ± 7.7*
HTN duration (years)	10.3 ± 6.3*

*Mean ± SD

Table 2 - Goal attainment rate among participants for glycemic, lipid and blood pressure control.

Parameters and their target levels	Percentage of patients who attained the goal
Systolic blood pressure <130 mm Hg	32
Diastolic blood pressure<80 mm Hg	74
Systolic blood pressure <130 mm Hg and Diastolic blood pressure <80 mm Hg	24
Low-density lipoprotein <2.4 mmol/L	60
Hemoglobin A1c <7%	43

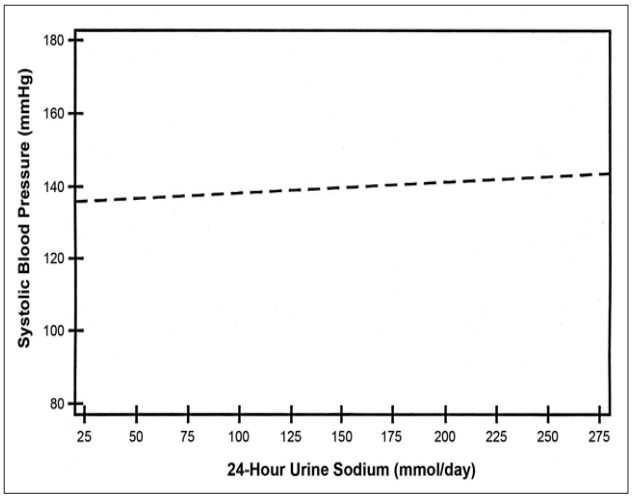

Figure 1 - Relationship between 24-hours urine sodium and systolic blood pressure.

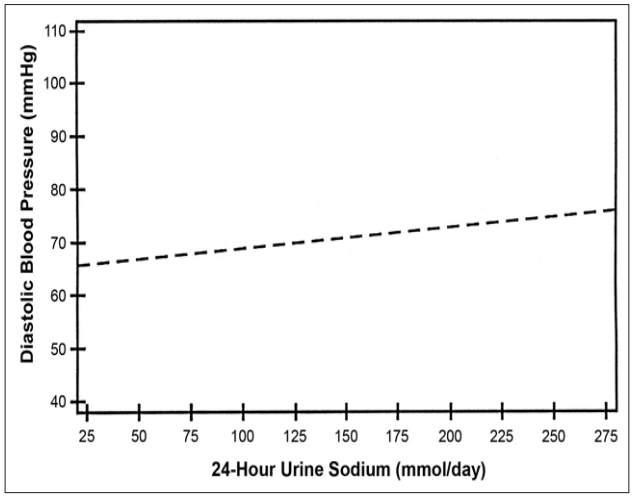

Figure 2 - Relationship between 24-hours urine sodium and diastolic blood pressure.

intake on BP show small but consistent reduction in blood pressure of hypertensive individuals with low salt intake.[7] The average urinary sodium is approximately 124 mmol/day in Saudi patients comparable to patients in most of industrialized countries. A dietary intake of 2.5 grams/day table salt corresponds to 1 gram sodium and 43.5 mmol of urinary sodium/day, the remaining (1.5 grams) is chlorine. Typical dietary salt intake is 8.5 grams/day and corresponds to 150 mmol/day urinary sodium. The Joint National Committee report and the World Health Organization-International Society of Hypertensive (WHO/ISH) guidelines recommend moderate sodium restriction as part of the non-pharmacologic hypertension therapy.[8,9] Recently, the Institute of Medicine Committee recommended 65 mmol/l sodium to be an adequate intake level.[10] However, due to available foods with high levels of sodium a reduction in sodium intake to 65 mmol/l is not readily achievable and thus long-term compliance is often poor. A major challenge in managing diabetics patients is not whether to initiate treatment or to use a specific therapeutic agent, but rather the failure to adequately treat patients to achieve the desired BP, blood sugar and lipid levels. Community-based epidemiological studies have repeatedly found poor BP control in treated diabetic hypertensive patients.[11,12] In the present study, although all patients were treated in specialized clinics, the rate for both systolic and diastolic BP control was only 24%. These discouraging results may be due to patient-related factors, such as non-compliance, difficulties in accessing care, financial barriers, failure to understand the consequences of the disease and adverse events during therapy.[13-17] However, physician-related factors are equally important[13-14] in BP control. Physicians are often not aggressive enough in managing diabetic patients and may fail to follow recommended guidelines in initiating therapy in patients who could benefit from increasing the dose and types of BP lowering agents until desired BP, lipid and blood sugar were achieved. Several studies have shown that physicians fail to intensify therapy in as much as 2/3 of the patients with BP values above the goal.[13,14,16] Diabetes is a rapidly growing health problem in Saudi Arabia, related in part to improved living conditions and increasing rates of obesity.[1,2,18,19] Al-Nozha et al,[20] reported an age-adjusted prevalence of obesity in 35.5% and overweight in 36.9% of the general population. In our study, 65% of diabetic patients were obese and females were more likely to be obese than men. The prevalence of obesity among female Saudi subjects is among the highest rate in the world. There are important limitations in the present study. The results are applicable only to a highly selected group of hypertensive patients with type 2 diabetes treated with antihypertensive medications. This study did not examine the use of salt restriction on BP of diabetic patients, which should be carried out in a randomized control trial.

In conclusion, salt intake in Saudi diabetic patients is equivalent to most industrialized countries. Modest salt restriction has possible adjuvant effect to pharmacologic treatment to enhance blood pressure control. The majority of diabetic patients with hypertension, or hyperlipidemia are inadequately treated. Good management of these conditions requires physicians to respond, in a timely fashion, to indicators of inadequate or ineffective treatment, particularly in the absence of symptoms. Most importantly, patients need to take more active role in managing their personal health care.

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