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Hypertension among 1000 patients with type 2 diabetes attending a national diabetes center in Jordan

Fayzeh M. Mubarak,[a] Erika S. Froelicher,[b] Hashem Y. Jaddou,[c] Kamel M. Ajlouni[a]

From the [a]Department of Endocrinology and Genetics, The National Center for Diabetes, Amman, Jordan, [b]School of Nursing, University of California San Francisco, California, USA, and [c]Department of Community Medicine, Jordan University of Science & Technology, Irbid, Jordan,

Correspondence and reprints: Prof. Hashem Y. Jaddou · Department of Community Medicine, Jordan University of Science & Technology · PO Box 462, Irbid 22110, Jordan · jaddou@just.edu.jo · Accepted for publication July 2008

BACKGROUND AND OBJECTIVES: In Jordan, there is a paucity of research on hypertension and its risk factors among patients with type 2 diabetes mellitus. This study was designed to assess the prevalence of hypertension, risk factors, and the level of awareness and control of hypertension among outpatients with type 2 diabetes.

SUBJECTS AND METHODS: A cross-sectional study was carried out on a sample of 1000 patients with type 2 diabetes who were attending the National Center for Diabetes, Endocrine and Genetic Diseases for follow-up during the period of June to December 2006. Data were collected from medical records and through a structured interview questionnaire. Logistic regression analysis was used to assess the independent effect of variables on hypertension.

RESULTS: The prevalence of hypertension (BP >130/80 or on medication for high blood pressure) was 72.4% (70.9% of males and 73.9% of females). The logistic regression indicated that hypertension was positively associated with age (P=.001), body mass index (P=.001), and duration of diabetes (P=.001). About one-half of patients who were aware of having hypertension failed to keep their blood pressure under control.

CONCLUSION: Hypertension is a common co-morbidity among diabetic patients. Despite a high rate of awareness of hypertension among study subjects (93%), hypertension was not controlled to the recommended levels of blood pressure in about one-half (50.4%) of patients.

Type 2 diabetes mellitus is associated with an increased risk of premature death from cardiovascular disease (CVD), stroke, and end-stage renal disease.[1] Hypertension is a major risk factor for cardiovascular disease, stroke and ischemic heart disease, and as such is one of the most important preventable causes of premature morbidity and mortality in developed and developing countries.[2]

Hypertension is a common co-morbidity in patients with type 2 diabetes. The prevalence rate of hypertension among type 2 diabetics is higher than that of age- and sex-matched patients without diabetes,[3] ranging between 32% to 82%.[4-9] The coexistence of hypertension in patients with type 2 diabetes is a major contributor to the development and progression of macrovascular and microvascular complications in people with diabetes compared to the general population.[2,10-12] Moreover, hypertension exacerbates diabetic cardiomyopathy, enhancing the progression of renal[13] and cardiovascular disease.[14] In one study, Hypertensive diabetics demonstrated a significant excess risk of cerebrovascular accident-related mortality compared to diabetic patients without hypertension.[15]

In Jordan there is a paucity of research on hypertension and its associated risk factors among patients with type 2 diabetes. Community-based surveys have examined the magnitude of hypertension and its associated risk factors among groups of adults and adolescents of the general population,[16-18] but no studies have been conducted on a population of diabetic patients. This study was designed to assess the frequency of co-existing hypertension and its associated risk factors among a population group of patients with type 2 diabetes and to examine the level of awareness and control of hypertension.

SUBJECTS AND METHODS

A cross-sectional study design was used to estimate the prevalence rates of hypertension among a population of diabetic patients receiving health care at the National

Center for Diabetes, Endocrine and Genetic Diseases (NCDEG) during the period from June to December 2006. NCDEG was established in Amman, the capitol of Jordan, by a royal decree, for the provision of a comprehensive state-of-the-art preventive and clinical ambulatory services in the fields of diabetes, endocrine and genetic disorders. The center receives patients from all over the country who are either physician-referred or self-referred. The policies at the center require that each diabetic patient received at the center be subjected to a routine battery of tests including measurements of glycated hemoglobin (HbA_{1c}), blood sugar, blood pressure, lipid profile, weight and height, abdominal circumference, urine examination for microalbuminurea, foot examination and fundoscopy on each visit the patient makes to the center every 2 to 3 months. A quota sample of 1000 patients with type 2 diabetes was drawn from the population of type 2 diabetic patients attending the ambulatory outpatient clinic at the NCDEG during the period of June to December 2006. All patients who had reported to the center during the study period for at least his/her second follow-up appointment and consented to participate were included in the study. Pregnant women and patients on hemodialysis were excluded from the study.

The sources of data used in this study were medical record abstraction and a structured and pilot-tested interview questionnaire. The structured interview questionnaire was used to gather information on sociodemographic variables (gender, age, family income, level of education and smoking status), as well as clinical information about history of hypertension, use of antihypertensive medications and duration of diabetes.

Anthropometric measurements including weight and height were measured by trained nursing staff. Weight was measured to the nearest 0.5 kg and height was measured to the nearest 0.5 cm. Body mass index (BMI) was obtained by dividing the weight in kilograms by the square of the height in meters. BMI was categorized as normal if <25 kg/m², overweight if 25-29.9 kg/m² and obese if >30 kg/m². Blood pressure was measured using standardized sphygmomanometers (EN 1060, Rudolf Reister GmbH and Company, Germany; www.reister. de) with a cuff circumference of 24-32 cm to cover 80% of the upper arm (for obese patients a larger cuff circumference of 42-50 cm was used). A trained nurse performed the procedures while the subject was in a sitting position with the arm at the level of the heart and after 5 minutes rest. The cuff was deflated at a rate of 2-3 mm Hg per second. Systolic blood pressure was taken upon hearing the first sound and diastolic blood pressure was taken upon complete disappearance of Korotkof

sounds (phase V). Two blood pressure readings were taken on each patient and the mean of these readings was used in the study. The patient was labeled as having hypertension if SBP ≥130 mm Hg or DBP ≥80 mm Hg, or if the patient was on antihypertensive medications. The most recent biochemical data on HbA_{1c} were obtained from medical records of participants that included an analysis of HbA_{1c} by high-performance liquid chromatography (Bio-Rad Laboratories, Hercules, California, USA; www.bio-rad.com). Glycemic control was considered good if HbA_{1c} <7%, and poor glycemic control if HbA_{1c} >7 %.

Data analysis was performed using the Statistical Package for Social Sciences (SPSS) version 11.5. Frequency distributions and chi-square statistics were used for categorical variables and mean±standard deviations were obtained on continuous variables. Logistic regression analyses were performed to assess the independent effect of gender, age, education, BMI, smoking, HbA_{1c} and duration of diabetes on hypertension. The odds ratio was the antilogarithm of the regression coefficient of an indicator term that corresponded to a certain level of the independent variable. The 95% confidence interval was calculated using the standard error of the regression coefficient.

RESULTS

As shown in Table 1, 49.5% of the study participants were males, 48.3% were >60 years old, 45.1% held college degrees and 35.6% were within the low income group. The majority of the sample (41.8%) had been suffering from overt diabetes for a period of 10 years or more, 58.6% of the sample were obese, 15% were smokers, 24.2% had HbA_{1c} values of <7%, and 44.8% were on insulin alone or in combination with other treatment regimens.

The prevalence rate of hypertension was 72.4% (Table 2). The prevalence among men was similar to that among women (*P*=.3). The rate of hypertension increased with age, a trend that was statistically significant (*P*=.001). Illiterate people were found to be at higher risk of hypertension compared to those with a high school or college education (*P*=.01). Obese subjects had a significantly (*P*=.001) higher rate of hypertension (76.6%) than both the overweight (69.9%) and normal weight (55.7%) groups. Contrary to our expectations, nonsmokers in this study had a higher rate of hypertension than smokers (*P*=.001). Level of HbA_{1c} was not significantly associated with hypertension, but a direct and significant relationship was found between duration of diabetes and hypertension.

In the multivariate analysis, there was a positive and

Table 1. Sociodemographic and health characteristics of study population (n=1000).

Variables	n (%)
Sex	
Male	495 (49.5)
Female	505 (50.5)
Age (years)	
<50	180 (18.0)
50-59	337 (33.7)
≥60	483 (48.3)
Education	
Uneducated	98 (9.8)
Secondary education	370 (45.1)
College education	370 (45.1)
Income (US $, monthly)	
<450	254 (35.6)
450-699	303 (42.5)
>700	156 (21.9)
Body mass index	
<25	79 (8.1)
25.0-29.9	326 (33.3)
≥30	573 (58.6)
Current smoking	
Yes	145 (15)
No	821 (85)
HbA$_{1c}$ (% total Hb)	
<7	242 (24.2)
7-8	324 (32.4)
>8	434 (43.4)

Values are number of patients and percentage. Categories of some variables do not add to 1000 because of missing values.

Table 2. Frequency distribution of hypertension by sociodemographic and health variables (n=1000).

Variable	Hypertensives	Normotensives	P value
Sex			
Male	351 (70.9)	144 (29.1)	
Female	373 (73.9)	132 (26.1)	
Total	724 (72.4)	276 (27.6)	.3
Age (years)			
<50	82 (45.6)	98 (54.4)	
50-59	235 (69.7)	102 (30.3)	
≥60	407 (84.3)	76 (15.7)	
Total	724 (72.4)	276 (27.6)	.001
Education			
Uneducated	71 (88.8)	9 (11.2)	
Secondary education	266 (71.9)	104 (28.1)	
College education	259 (70.0)	111 (30.0)	
Total	596 (72.7)	224 (27.3)	.001
Income (US $, monthly)			
<450	193 (76.0)	61 (24.0)	
450-699	219 (72.3)	84 (27.7)	
>700	111 (71.2)	45 (28.8)	
Total	523 (73.4)	190 (26.6)	.21
Body mass index			
<25	47 (55.3)	38 (44.7)	
25.0-29.9	232 (69.9)	100 (30.1)	
>30.0	439 (76.6)	439 (76.6)	
Total	709 (72.5)	269 (27.5)	.001
Current smoking			
Yes	92 (63.4)	53 (36.6)	
No	608 (74.1)	213 (25.9)	
Total	700 (72.5)	266 (27.5)	.01
HbA$_{1c}$ (% total Hb)			
<7	163 (67.4)	79 (32.6)	
7-8	242 (74.7)	82 (25.3)	
>8	319 (73.5)	115 (26.5)	.12
Duration of DM (years)			
<5	172 (56.8)	131 (43.2)	
5-9	209 (74.9)	70 (25.1)	
>10	343 (82.1)	75 (17.9)	
Total	724 (72.4)	276 (27.6)	.001

Values are number of patients and percentage. Categories of some variables do not add to 1000 because of missing values

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statistically significant association between hypertension and the variables of age, BMI and duration of Diabetes, but no significant association was found with gender, level of education, smoking and HbA_{1c} (Table 3). Compared to the <50 years of age group, the risk of hypertension increased by 2.9 times among the 50-59 age group (P=.001), and by 6.4 times among the age group 60 years and older (P=.001). Relative to the normal BMI group, the risk of hypertension increased 1.6 times among the overweight patients (P=.13), and by 2.9 times among the obese group (P=.001). The risk of developing hypertension increased by more than 2 times among patients suffering from diabetes for more than 5 years (P=.001).

Fifty-one (7%) of 724 hypertensive patients were not aware of having hypertension at the time of study. About one-half (50.4%) of patients who were aware of having hypertension had failed to keep their blood pressure levels under control. As indicated in Table 4, no significant association was found between the rate of uncontrolled hypertension and the variables of gender, age, level of education, and BMI.

DISCUSSION

This study reports three salient findings: 1) the high proportion of patients with diabetes who also have hypertension; 2) the positive association of hypertension with age, BMI and duration of overt diabetes; and 3) the lack of adequately controlled blood pressure in our sample of 1000 type 2 diabetic patients. In agreement with the findings reported in several studies,[3-9] our data indicated that hypertension is a very common co-morbidity among patients with type 2 diabetes using the Joint National Commission VII[19] definition of hypertension. The 72.4% prevalence rate of hypertension reported in this study among patients with type 2 diabetes is lower than the 82% prevalence rate reported in Afro-Caribbean individuals living in the UK,[9] and much higher than the 32% and 39% rates reported among diabetics in the Turkish[4] and Taiwanese[5] populations, respectively, but comparable to the 74%, 74.4% and 73% rates of systolic hypertension reported in UK Caucasians,[6] Italian[7] and Spanish[8] populations, respectively. The explanation for differences in frequency by country could be due to different surveillance methods, ethnic variations, population characteristics and differences in definitions of hypertension. Baskar et al[9] evaluated the independent contribution of ethnicity on the frequency of hypertension and vascular complications among three ethnic subgroups (Afro-Caribbean, Caucasian and Indo-Asian) in the UK and found that the frequency of hypertension was 82%, 74% and 68% in Afro-Caribbean, Caucasian and Indo-Asian, respectively. Ethnicity was found to have a

Table 3. Adjusted odds ratio (OR) for prevalence of hypertension by selected variables (n=1000) in multivariate analysis.

Variable	OR	*P* value
Sex		
Male	1.0	
Female	.97	.6
Age (years)		
<50	1.0	
50-59	2.9	.001
>60	6.4	.001
Education		
Uneducated	1.0	
High school education	.61	.24
College education	.65	.28
Body mass index		
<25	1.0	
25.0-29.9	1.6	.13
≥30.0	2.9	.001
Current smoking		
Yes	1.0	
No	1.3	.19
HbA$_{1c}$ (% of total Hb)		
<7	1.0	
>7	1.1	.97
Duration of diabetes (years)		
<5	1.0	
5-9	2.2	.001
>10	2.5	.001

Categories of some variables do not add to 1000 because of missing values

statistically significant effect on hypertension. Only a few studies were found that reported the frequency of hypertension in subjects with diabetes in the Arab world; these studies showed a frequency that ranged from 21.5 % in Omani,[20] 53% in Saudi diabetics[21] and 38% in Bahraini diabetics.[22] The relatively higher rate of hypertension reported among our study sample is perhaps related to the fact that most diabetic patients have long-standing diabetes of more than 10 years. The high rate of hypertension could also be explained on the basis that the majority of diabetic patients treated in the NCDEG center are referred not only for their diabetic state, but rather for

Table 4. Chi-square distribution of controlled and uncontrolled hypertension among previously diagnosed hypertensives by selected variables (n=698).

Variable	Controlled hypertension n (%)	Uncontrolled hypertension n (%)	*P* value
Sex			
Male	163 (48.1)	176 (51.9)	
Female	189 (52.6)	170 (47.4)	.23
Age (years)			
<50	42 (59.2)	29 (40.8)	
50-59	122 (53.5)	106 (46.5)	
>60	188 (47.1)	211 (52.9)	.1
Education			
Uneducated	28 (39.4)	43 (60.6)	
High school education	137 (53.5)	119 (46.5)	
College education	130 (52.4)	118 (47.6)	.1
Body mass index			
<25	22 (55)	18 (45)	
25.0-29.9	112 (50.2)	111 (49.8)	
≥30	212 (50.5)	208 (49.5)	.85

Categories of some variables do not add to 1000 because of missing values

being more complicated cases of diabetes, including the complication of hypertension.

Hypertension among type 2 diabetics appeared to be age-related. This age-related trend of hypertension is consistent with that reported in the research literature.[23-26] Consistent with the findings of other studies,[25-27] our study also showed that obese patients have a higher risk of hypertension than patients with normal BMI. Contrary to our expectations, our data failed to show any significant association between hypertension and smoking. This finding is in contradiction with findings reported in the research literature.[28] The possible explanation is that non-smokers were comprised of never smokers and ex-smokers. It is possible that the ex-smokers had quit smoking after being diagnosed with hypertension, thus shifting from the hypertensive group to the normotensive group, which contributed to the higher rate of smoking among the latter. Research on "addictive behavior" strongly suggests that a health concern is the primary motive for attempts to quit smoking.[29-31]

Our data indicated that hypertension is positively as-

sociated with the duration of diabetes, after adjusting for the confounding effects of age, HbA_{1c} and other relevant variables. Duration of diabetes is positively associated with the severity of macro- and micro-vascular complications, both of which contribute positively to the development of renal and/or atherosclerotic hypertension. Our study showed an inadequate level of control of hypertension among previously diagnosed hypertensives. Despite the regular attendance of patients to NCDEG and the close medical supervision granted to those patients, close to one-half of patients with previously diagnosed hypertension still had uncontrolled hypertension. This may be due to the patient's misperception of the potential complications of hypertension, non-compliance, absence of effective health education programs, and/or to physicians not treating hypertension aggressively to reach target blood pressure. This finding is comparable to findings reported in other studies.[16-18,32,33] In their study of level of control of hypertension among US adults with diabetes, Geiss et al[32] reported that 71% of hypertensives were aware of their high blood pressure and 57% were on treatment, but only 12% had achieved a blood pressure <140/90 mm Hg. The findings from a study[16] on prevalence, awareness and control of hypertension among Jordanian adults had shown that 51.4% were aware of having hypertension and yet 36.5% failed to achieve levels of control <160/95 mm Hg.

Effective management strategies for hypertension need a three-pronged approach that focuses on the system of delivery of care, the provider and the patients.[34] The focus must be on patients and family education, counseling and behavioral interventions designed to modify lifestyle such as increasing physical activity and adopting recommended dietary changes, as well as compliance with medications.

In conclusion, the prevalence of hypertension among Jordanian patients with type 2 diabetes was 72.4% and about one-half of patients with previously diagnosed hypertension were uncontrolled, which requires all health care professionals (physicians, nurses and dietitians) to be committed to policies of enhancing blood pressure control through reinforcing messages about the risk of hypertension, and the importance of managing and achieving goals for systolic and diastolic blood pressure. Education about effective lifestyle modifications (increasing physical activity, maintaining a healthy weight and salt restriction) and the importance of adherence to treatment would be of great benefit in controlling high blood pressure and preventing its complications.

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