Prevalence of known diabetes and hypertension in the Republic of Yemen

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معدل الانتشار المعروف للسكّري وفرط ضغط الدم في جمهورية اليمن

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الخلاصة: لقد تم إجراء الدراسة الحالية لتحديد انتشار الحالات المعروفة للسكّري وفرط ضغط الدم بين البالغين في مدينة صنعاء. وقد أجريت مقابلات مع 1080 شخصاً تراوحت أعمارهم بين 20-85 سنوات بعد أن تم تحديدهم باستعمال أسلوب العينة العشوائية المتعددة المراحل. كان معدل الانتشار الخام للسكّري المعروف 6.57٪ (95 ٪ CI: 5.2 - 8.2) ولفرط ضغط الدم المعروف 13.5٪ (وبفاصلة ثقة 95٪ وتراوحت بين 15.6 - 11.5). وكان معدل الانتشار المصحّح ليوافق العمر المعياري بالنسبة للفترة العمرية 30 - 64 سنة كان 9.75٪ (وبفاصلة ثقة 95٪ وتراوحت بين 11.95 - 7.55) لمرض السكّر و17.1٪ (وبفاصلة ثقة 95 ٪ وتراوحت بين 19.2 - 15.0) ولفرط ضغط الدم. تقدّم هذه النتائج تقديراً للانتشار المعروف للسكّري وفرط ضغط الدم والحوادث الوعائية التي ترتبط بهما في مجتمع المدينة الواضح المعالم.

ABSTRACT The present study was undertaken to determine the prevalence of known cases of diabetes and hypertension among adults in Sana'a city. Thus 1080 persons aged 20–85 years were selected for interview using a multistage random sampling technique. The crude prevalence of known diabetes was 6.57% (95% CI: 5.2–8.2) and of known hypertension 13.5% (95% CI: 11.5–15.6). The age-standardized prevalence for the age range 30–64 years was 9.75% (95% CI: 7.55–11.95) for diabetes and 17.1% (95% CI: 15.0–19.2) for hypertension. These results provide an estimate of the prevalence of known diabetes, hypertension and related vascular events in a well-defined urban community.

Prévalence du diabète et de l'hypertension connus en République du Yémen

RESUME La présente étude a été réalisée pour déterminer la prévalence des cas connus de diabète et d'hypertension chez des adultes dans la ville de Sanaa. Ainsi, 1080 personnes âgées de 20 à 85 ans ont été sélectionnées pour un entretien en utilisant la technique de l'échantillonnage aléatoire à plusieurs degrés. La prévalence brute du diabète connu s'élevait à 6,57 % (IC 95 % : 5,2-8,2) et de l'hypertension connue à 13,5 % (IC 95 % : 11,5-15,6). La prévalence standardisée pour l'âge dans la tranche d'âge 30-64 ans était de 9,75 % (IC 95 % : 7,55-11,95) pour le diabète et de 17,1 % (IC 95 % : 15,0-19,2) pour l'hypertension. Ces résultats fournissent une estimation de la prévalence du diabète, de l'hypertension connus et des événements vasculaires qui y sont liés dans une communauté urbaine bien définie.

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Introduction

An epidemic of diabetes appears to be taking place in adults throughout the world. This trend appears strongly related to lifestyle and socioeconomic changes [1]. Much of the international variation in the prevalence of type 2 diabetes in adults may be attributed to differences in environmental factors and genetic susceptibility [2,3]. In developing countries, diabetes is gaining prominence as infectious and nutritional causes of sickness and death have become less significant [4]. Data on the epidemiology of type 2 diabetes in the Arab population indicate a prevalence rate of 10%–20%, reflecting a moderate genetic susceptibility [3].

In the Republic of Yemen, the population is homogeneous and ethnically uniform. Our knowledge of diabetes epidemiology among Yemenis remains poor and no relevant publications have yet appeared in the international literature. The present study was undertaken to determine the prevalence of "known" cases of diabetes and hypertension among adult subjects aged 20 years or over within the community of the capital city, Sana'a. This was an initial survey, to be followed by a second phase to study the prevalence of symptomatic and asymptomatic cases of glucose intolerance and hypertension and other cardiovascular risk factors in the same community.

Methods

This was a cross-sectional, population-based study conducted in the capital city, Sana'a, over a 4-month period from March to May 2000.

The sample size was calculated using *Epi-Info*, version 6.02 taking into consideration the following criteria: total target population (i.e. adult population aged ≥20 years living in Sana'a city): 464 000 people; desired precision: 2.5%; expected frequency: 3.5% for known diabetes and hypertension, estimated since no previous study has been conducted in the country; sample size with 95% confidence interval (CI): 1294 people.

The sampling procedure was based on a multistage random technique. In the first stage, Sana'a city was divided into four geographic zones; one-fourth of the sample was drawn from each zone. The second stage involved the random selection of one "election circle" from each geographic zone. In the third stage each selected election circle was divided into streets. The fourth stage included the random selection of four streets within each election circle: it was planned to interview 80 participants from each street (40 males and 40 females). The fifth stage was the systematic random selection of houses from each street and one participant (≥20 years old) from each household. The survey team included 16 volunteers in each geographic zone (a total of 64 volunteers), who were final-year students in the Department of Sociology, University of Sana'a. These future social researchers were chosen because they were trained in fieldwork and were able to sensitize people to the aims of the study and to encourage their participation. They visited the randomly selected households in groups of four volunteers and inquired about diabetes, hypertension, heart attack and stroke, using standard terms. The volunteers were taught how to administer a predesigned questionnaire. Details taken included the participant's name, age, sex, place of birth, current residence, standard of education reached, presence of diabetes mellitus (and age at which diabetes was diagnosed), presence of hypertension, ischaemic heart disease or

stroke, and any family history of diabetes, hypertension, ischaemic heart disease or stroke in the parents, siblings, spouse or offspring. The questionnaire format was verified by validity and reliability testing. Reliability was ensured by pretesting a subsample of 100 subjects. The survey team was provided with a list of specific drugs used in the management of diabetes mellitus, hypertension, ischaemic heart diseases and stroke.

"Known diabetes mellitus" was defined as a person with documented, physician-diagnosed diabetes mellitus, or a person taking oral hypoglycaemic agents or insulin as confirmed by the survey team. Early onset type 2 diabetes mellitus (EODM) was defined as diabetes with age at diagnosis of 25–39 years, and late onset diabetes mellitus (LODM) as diabetes diagnosed at the age of 40 years or more. "Known hypertension" was defined as a person with physician-diagnosed hypertension, who was taking anti-hypertensive medication as confirmed by the survey team. "Known ischaemic heart disease" (IHD) was defined as a person with history of heart attack requiring hospitalization, or a person with physician-diagnosed IHD who was taking medication as confirmed by the survey team. "Known stroke" was defined as a person with a history of abrupt-onset weakness or paralysis of one side of the body, with or without a history of hospitalization, or a person with physician-diagnosed stroke and currently experiencing weakness or paralysis of one side of the body.

Urbanization status was categorized as urban (has lived in the city since childhood) or urbanizing (has moved from a rural to an urban setting).

Data were analysed with *SPSS*, version 6.02 and the *Confidence interval analysis* (CIA) software package, version 1.0 [5].

The prevalence rates and 95% CI of known diabetes mellitus and hypertension for the Yemeni population between the ages of 30 and 64 years were calculated using the world population as the standard [6,7]. According to this method, the prevalence rates were standardized for age within a truncated age range of 30–64 years using 10-year age groups and the Yemeni population in the year 2000. Continuous variables were expressed as means ± standard deviation and a two-tailed *t*-test was used to calculate the statistical significance. The chi-squared test was used to analyse categorical variables. Two by two tables were used to calculate relative risk. 95% s were computed to indicate the precision of sample estimate, the variability of the characteristics being studied, and the degree of confidence required. A P-value < 0.05 was taken as statistically significant.

Results

A total of 1294 persons aged ≥20 years were invited for interview. Women represented 54% of the total sample. Of those invited, 1080 persons responded, giving an overall participation rate of 83.5%. Table 1 gives the sample size, the number of people interviewed by age and sex, and the participation rate by sex.

The median age of the study population was 33 years (range 20–85 years). Mean age was 35.4 ± 11.0 years (males: 37.5 ± 12.0 years; females: 33 ± 10.0 years). Table 2 shows that 88% of the study population were literate and 38% had university education. About 56.5% of this population were urbanizing (had moved from a rural to an urban setting), with an urbanizing:urban ratio of 1.3.

The prevalence rates and 95% CI of known diabetes mellitus and hypertension

Table 1 **Distribution of participants interviewed by age and sex**

Age (years)	Male		Female		Total	
	No.	%	No.	%	No.	%
20–24	47	8.0	95	13.6	142	11.0
25–29	112	18.9	140	20.0	252	19.5
30–34	93	15.7	113	16.2	206	16.0
35–39	75	12.6	79	11.3	154	12.0
40–44	52	8.7	61	8.7	113	8.7
45–49	47	8.0	47	6.7	94	7.2
50–54	50	8.4	46	6.6	96	7.4
55–59	48	8.0	45	6.4	93	7.2
60–64	40	6.7	45	6.4	85	6.5
65+	30	5.0	29	4.1	59	4.5
Total invited	594		700		1294	
Total sampled	514		566		1080	
Participation rate (%)		86.5		81.0		83.5

in the study population are given in Table 3. The crude prevalence rate of known diabetes mellitus was 6.57% (95% CI: 5.2–8.2), with a slightly higher rate in males than in females (7.8% versus 5.5%). Using the world population as the standard [6,7], the age-standardized prevalence rate of known diabetes mellitus in a truncated age range of 30–64 years for the Yemeni standard population for the year 2000 was 9.75% (95% CI: 7.55–11.95) with a slightly lower rate in males (9.4%, 95% CI: 7.9–10.9) compared to females (11.8%, 95% CI: 9.9–13.7).

The crude prevalence rate of known hypertension was 13.5% (95% CI: 11.5–15.6) with a slightly higher rate in females compared to males (14.3% versus 12.6%). Again using the world population as the standard, the age-standardized prevalence rate of known hypertension for the age range 30–64 years in the Yemeni population was 17.1% (95% CI: 15–19.2) with relatively lower rate in males (12%, 95% CI: 9.8–14) compared to females (21.8%, 95% CI: 20–23.6).

The coexistence of known cases of diabetes mellitus, hypertension, ischaemic heart disease or stroke in the study population is shown in Figure 1. It indicates that hypertension was more frequent than diabetes mellitus (14% versus 7%) and that both had co-morbidity with each other (3%) and with ischaemic heart disease (2%) and stroke (1%).

This population-based survey in the capital city has elicited important information about the prevalence of known cases of diabetes mellitus, hypertension and vascular events of the heart and brain among the study population and their relatives. Table 4 indicates that a history of known diabetes was present in 507 subjects and their relatives with a peak prevalence in fathers (33.4%), then mothers (18%), and to a lesser extent in the index subjects (14%) and their brothers (12.4%) and spouses

Table 2 **Basic characteristics of the study population (*n* = 1080)**

Characteristics	Male (*n* = 514)	Female (*n* = 566)	Total (*n* = 1080)
Age (years)			
Mean ± *s*[a]	37.5 ± 12.0	33 ± 10.0	35.4 ± 11.0
95% CI of mean	36.5–38.6	32.6–34.0	34.7–36.0
Median (range)	35 (20–85)	31 (20–80)	33 (20–85)
Standard of education			
Illiterate	57 (11.0%)	67 (12.0%)	124 (12.0%)
Basic education	138 (27.0%)	199 (35.0%)	337 (31.0%)
Secondary school	105 (20.0%)	102 (18.0%)	207 (19.0%)
University education	214 (42.0%)	198 (35.0%)	412 (38.0%)
Urbanization status			
Urbanizing	316 (61.5%)	294 (52.0%)	610 (56.5%)
Urban	198 (38.5%)	272 (48.0%)	470 (43.5%)
Urbanizing/urban ratio	1.6	1.0	1.3
Age at diagnosis of diabetes			
EOMD (<40 years)	28 (70.0%)	18 (58.0%)	46 (65.0%)
LODM (≥40 years)	12 (30.0%)	13 (42.0%)	25 (35.0%)
Total	40 (100%)	31 (100%)	71 (100%)

[a]*Significant difference males versus females (P < 0.05).*
s = standard deviation.
EOMD = early onset diabetes mellitus.
LODM = late onset diabetes mellitus.

(12%). A history of known hypertension was reported in 711 subjects and relatives with nearly equal frequency in mothers (24.3%) and fathers (23.8%), then index subjects (20%) followed by their spouses (13.4%). A history of known ischaemic heart disease was reported by 246 participants with a peak prevalence in fathers (36.2%), followed by mothers and brothers (18.3% each), then in the index subjects themselves (11%). A history of known stroke was reported by 81 subjects and relatives with a peak prevalence in fathers (34.6%), followed by mothers (17.3%), brothers (16%) and spouses (12.3%). The prevalence among index subjects was lower (9.9%).

Of the diabetic participants, 35 had diabetic parents and 36 did not (Figure 2). Of the 35 diabetic parents, 25 (71.4%) had late onset diabetes (onset ≥40 years), while 29 (83%) of their diabetic offspring had early onset diabetes (onset <40 years). The diabetic offspring of non-diabetic parents had an approximately equal opportunity of having either early onset diabetes mellitus (*n* = 17, 47%) or late onset diabetes mellitus (*n* = 19, 53%).

An analysis of the familial aggregation of diabetes among first-degree relatives is given in Table 5. Most of the higher observed than expected (Ob-Ex) frequencies (+9.7) in patients with diabetes came from the presence of diabetes in one or both parents and one or more siblings, and to a lesser extent from diabetic parents only (+5). Conversely, the only higher observed than expected (Ob-Ex) frequencies (+16) in

Table 3 **Crude and age-standardized prevalence rates of known (previously diagnosed) diabetes mellitus and hypertension in the adult population in Sana'a, Republic of Yemen**

Condition	Crude prevalence (20–65 years) (n = 1080) %	95% CI	Age-standardized prevalence[a] (30–64 years) (n = 664) %	95% CI
Diabetes mellitus				
Male	7.8	5.6–10.4	9.4	7.9–10.9
Female	5.5	3.75–7.7	11.8	9.9–13.7
Total (M+F)	6.57	5.2–8.2	9.75	7.55–11.95
Hypertension				
Male	12.6	9.8–15.5	12.0	9.8–14.2
Female	14.3	11.4–17.2	21.8	20.0–23.6
Total (M+F)	13.5	11.5–15.6	17.1	15.0–19.2

[a]*Using the world population as the standard.*

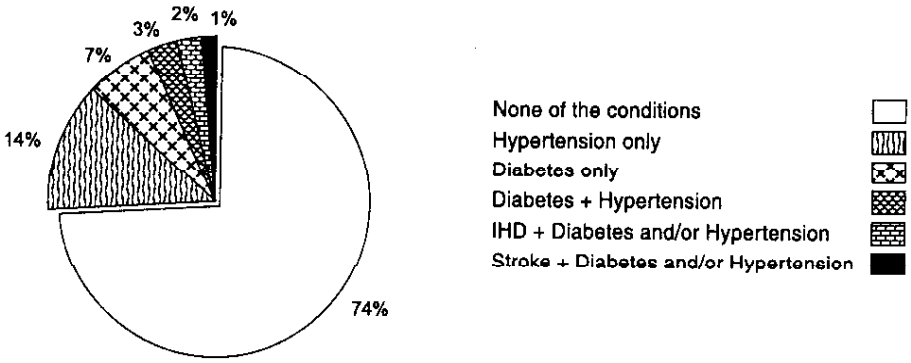

Figure 1 **Prevalence (%) of known diabetes, hypertension, ischaemic heart disease (IHD) and stroke among the adult population aged 20 years and older in Sana'a, Republic of Yemen (n = 1080)**

non-diabetic subjects came from the non-diabetic parent(s) and sibling(s). This contribution of family history of diabetes among first-degree relatives to the occurrence of diabetes in index subjects was statistically significant ($\chi^2 = 51.4$, df = 3, $P < 0.0001$).

In order to study the genetic dose-response effect, the relative risk (RR) and 95% confidence interval for diabetes were calculated based on the prevalence of diabetes among first-degree relatives. The relative risk (RR) of diabetes in persons with non-diabetic family members was significantly negative (RR = 0.38, 95% CI: 0.24–0.59, P = 0.00001). In persons with one diabetic family member, the risk was low (RR = 1.36, 95% CI: 0.82 2.25, P = 0.3),

Table 4 **Prevalence of known cases of diabetes, hypertension, ischaemic heart disease and stroke among the relatives of index subjects (n = 1080)**

Participant	Diabetes	Hypertension	Ischaemic heart disease	Stroke
Index subjects	71 (14.0)	146 (20.0)	27 (11.0)	8 (9.9)
Father	169 (33.4)	169 (23.8)	89 (36.2)	28 (34.6)
Mother	92 (18.0)	173 (24.3)	45 (18.3)	14 (17.3)
Brother	63 (12.4)	58 (8.1)	45 (18.3)	13 (16.0)
Sister	35 (7.0)	51 (7.2)	15 (6.1)	6 (7.4)
Spouse	61 (12.0)	95 (13.4)	23 (9.3)	10 (12.3)
Offspring	16 (3.2)	19 (2.7)	2 (0.8)	2 (2.5)
Total	507 (100)	711 (100)	246 (100)	81 (100)

Values given are no. (%).

but still 3.6 times higher than the risk for persons with no diabetic family members. The relative risk of diabetes in persons with two or more diabetic family members was high (RR = 4.95, 95% CI: 3.0–8.0, P = 0.00001). There was 13-fold increase in the risk compared to persons with no diabetic family members, and 4.4-fold increase in the risk compared to persons with only one diabetic family member.

Discussion

This population-based survey was conducted in adults aged ≥20 years living in an urban community. The crude prevalence rates of known cases of diabetes mellitus and hypertension were 6.6% and 13.5% respectively. With age-standardization for the age range 30–64 years in the Yemeni population, the prevalence of known diabetes and hypertension rose to 9.75% and 17.1% respectively.

In population-based studies of the prevalence rates of diabetes mellitus in adults, previously diagnosed (known) cases of diabetes have been found to account for 64% of the total estimated by measuring fasting capillary blood glucose, and 55% of the total estimated by measuring capillary blood glucose 2 hours after an oral glucose load [8]. Based on these observations, we might assume that the previously mentioned age-standardized prevalence of diabetes would be doubled if the estimate were based on measuring blood glucose 2 hours after oral glucose load.

Several studies have recently been published indicating the prevalence of known diabetes and hypertension in the Eastern Mediterranean Region (EMR). In Egypt, the crude prevalence of previously diagnosed (known) diabetes in low socioeconomic urban areas among adults aged ≥20 years was found to be 8.4% versus 5.1% newly diagnosed cases. In high socioeconomic urban areas, the prevalence of known diabetes was equal to that of newly diagnosed diabetes (each 10%) [9]. The prevalence of known diabetes in low socioeconomic urban areas of Lebanon was found to be 13.9% in the age group 30–64 years and 30.2% in the group aged 65 years and over. In high socioeconomic urban ar-

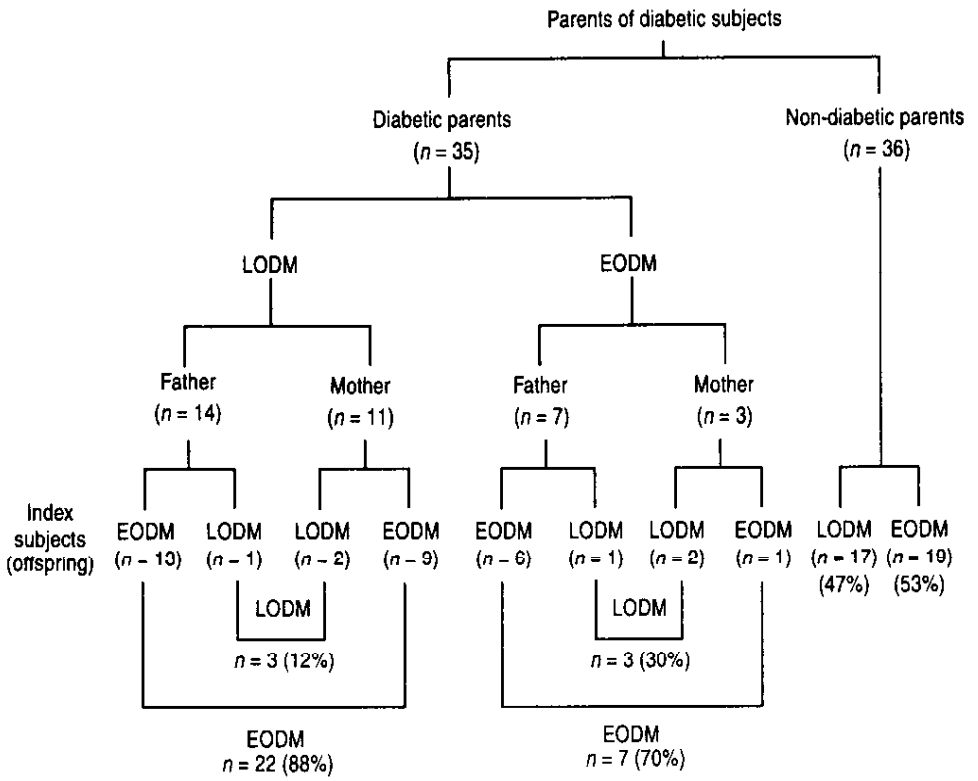

Figure 2 **Age at diagnosis of diabetes (early onset <40 years versus late onset ≥40 years) in index subjects and their parents (*n* = 71)**
EODM = early onset diabetes mellitus; LODM = late onset diabetes mellitus

eas, the prevalence of known diabetes was 3.0% in the age group 30–64 years and 14.3% in the age group ≥65 years. Within each socioeconomic class and each age group, the prevalence of newly diagnosed diabetes was lower than that of known diabetes [*10*].

The overall prevalence of self-reported (known) diabetes in urban communities in males aged ≥15 years in Saudi Arabia was 6.6% versus 5.1% for newly diagnosed cases, while for females the respective frequencies were 7.0% and 6.8%. Rates for known diabetes increased with age, from 1.6% for males and 1.4% for females in the age group <30 years to 11.2% for males and 14.8% for females in the age group 30–60 years to 21% for males and 24.4% for females in the age group >60 years [*11*]. The prevalence of previously diagnosed (known) diabetes in the Bahraini population aged ≥20 years attending primary health care centres was 17.3% (males 18.4%, females 16.7%). By contrast, the rate of newly diagnosed diabetes was 8.2% (males 8.0%, females 8.3%) [*12*]. In the urban

Table 5 **Familial aggregation of diabetes among first-degree relatives of diabetic and non-diabetic index subjects**

Subject	First-degree relatives					χ^2				
	X1	X2	X3	X4	Total	X1	X2	X3	X4	Total
Diabetic index subjects										
Observed frequency	18	5	12	36	71					
Expected frequency	13	3.8	2.3	52	71					
Ob-Ex	+5	+1.2	+9.7	−16		2.0	0.4	41	4.9	48
Non-diabetic index subjects										
Observed frequency	178	53	23	755	1009					
Expected frequency	183	54	33	739	1009					
Ob-Ex	−5	−1	−10	+16		0.1	0.0	2.9	0.3	3.4

Total χ^2 = 51.4, df = 3, P < 0.0001.
X1 = ≥ 1 diabetic parent(s)
X2 = ≥ 1 diabetic sibling(s)
X3 = ≥ 1 diabetic parent(s) + ≥ 1 diabetic sibling(s)
X4 = non-diabetic parent(s) or sibling(s)
Ob-Ex = observed–expected.

population aged ≥20 years in Sousse, Tunisia, the prevalence of known diabetes was 10.2% (males 7.2%, females 11.5%) [*13*]. A much lower prevalence of known diabetes was reported in an urban community in northern Sudan, where the crude prevalence in adults aged ≥25 years was found to be only 1.45% which was about 60% of the new cases [*14*]. A summary of reports from different Arab countries in the region is given in Table 6. The conclusion derived from these reports is that the prevalence rate of known diabetes in the urban adult population aged ≥20 years is similar in many countries in the EMR, with a few exceptions. However, if the age-standardized prevalence for the age range 30–64 years in each country were calculated, the results would probably be easier to compare. One further observation is that the prevalence rate of known diabetes in the majority of these reports is either equal to or greater than the prevalence of newly diagnosed cases. In other populations, such as the population in the United States aged 20–74 years [*15*] or an Iranian population in Isfahan aged ≥40 years [*16*], the prevalence rate of known diabetes was almost equal to that of newly diagnosed diabetes.

The crude and age-standardized prevalence rates of hypertension observed in this study were even higher than those of diabetes. Data on hypertension reported from many countries in the EMR have indicated that at least 20% of the population aged 20 years or older suffers from hypertension [*17*]. According to a recent survey, about 30.4% of the adult population in Egypt are hypertensive [*18*]. Similarly, the prevalence of hypertension based on new WHO criteria in the urban population in Tunisia aged ≥20 years was found to be 28.9% [*13*].

Data presented in this study on the prevalence of known diabetes, hypertension and related vascular events of the heart and brain point to a substantial degree of familial clustering of these diseases among the index subjects and their relatives. This clustering might reflect the magnitude of the population distribution of diabetes and

Table 6 **Prevalence of previously diagnosed (known) diabetes in the adult urban population in some Arab countries**

Country	Investigator(s)	Age range (years)	Prevalence (%)		
			Male	Female	Both
Egypt	Herman et al., 1995 [*9*]	≥ 20, high urban	–	–	10.0
		≥ 20, low urban	–	–	8.4
Lebanon	Sati et al., 1997 [*10*]	30–64, high urban	–	–	3.0
		≥ 65, high urban	–	–	14.3
		30–64, low urban	–	–	13.9
		≥ 65, low urban	–	–	30.2
Saudi Arabia	Al-Nuaim et al., 1995 [*11*]	< 30	1.6	1.4	–
		30–60	11.2	14.8	–
		> 60	21.0	24.4	–
Bahrain	Al Zurba, Al Garf, 1996 [*12*]	≥ 20	18.4	16.7	17.3
Tunisia	Ghannem, Fredj, 1997 [*13*]	> 20	7.2	11.5	10.2
Northern Sudan	Elbagir et al., 1996 [*14*]	≥ 25	–	–	1.45
Republic of Yemen	Gunaid, 2000 [Present study]	≥ 20	7.8	5.5	6.57
		Age-standardized ages 30–64	9.4	11.8	9.75

High urban = high socioeconomic status in an urban community; low urban = low socioeconomic status in an urban community.

cardiovascular diseases as a result of the rapid socioeconomic development in the Republic of Yemen over the last three decades. These advances have been accompanied by a change to a modern lifestyle and the emergence of noncommunicable diseases as a dominant feature of community health [*19,20*].

Information on the age at which diabetes was diagnosed in adults in this study indicates that about 65% of the index subjects developed the disease below the age of 40 years. In a previous diabetic clinic population study, we found that only 16% of adult onset diabetes was diagnosed under the age of 40 years [*20*]. The occurrence of early onset diabetes mellitus among the majority of the diabetic offspring of parents with late onset diabetes mellitus might be attributed to the effect of environmental factors that unmask the disease in genetically susceptible persons at an earlier age. The contribution of diabetic parents to the occurrence of diabetes in the offspring was evident in this study and it was strengthened by the number of diabetic sibling(s). We have previously demonstrated the role of familial clustering in the development of early onset diabetes mellitus in Yemeni patients, with increasing risk of type 2 diabetes in a person as the number of diabetic family members increases [*21*].

A recognized difficulty in studies of this type is variability in the recall of events in the family history of diabetes, hypertension and related cardiovascular and cerebrovascular events. To overcome this difficulty, we taught the survey team individually how

to administer the questionnaire. It should also be noted that this study did not search for undiagnosed cases of diabetes mellitus and hypertension, as this initial survey was conducted to determine the prevalence of known diabetes and hypertension in the community.

In conclusion, determining the prevalence of known (previously diagnosed) diabetes and hypertension in the community represents an inexpensive and noninvasive method for the identification of the magnitude of the problem with reasonable sensitivity, especially when the participation rate is high and therefore selection bias is unlikely. Given the characteristics of the method used, the results obtained provide the national health system in the Republic of Yemen with an estimate of the prevalence and population distribution of diabetes mellitus, hypertension and related cardiovascular and cerebrovascular events in a well-defined urban community. In order to quantify exactly the magnitude of the problem in the community, further population-based studies are recommended, including investigation of diagnosed and undiagnosed cases of diabetes and hypertension and screening for population distribution of other cardiovascular risk factors.

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