

Risk factors for hypertension among the adult Moroccan population

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عوامل اختطار فرط ضغط الدم بين البالغين في المملكة المغربية

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الخلاصة: استمد الباحثون في هذه الدراسة المعطيات من المسح الوطني المغربي لعام 2000 للتعرف على عوامل الاختطار الرئيسية لفرط ضغط الدم في عينة ممثلة من السكان الذين يزيد عمرهم عن 20 عاماً. وقد وجد الباحثون أن اختطار فرط الضغط يزداد بمعدل ثابت مع تقدم العمر ليصبح على أعلى مستوى له بين القرويين (نسبة الأرجحية 1.42) والسكريين (نسبة الأرجحية 1.72). ويزداد الاختطار مع ازدياد منسوب كتلة الجسم وقياس محيط الخصر وفرط كولسترول الدم. كما ينقص اختطار فرط ضغط الدم بمقدار 36% لدى من يمشي لمدة 30 – 60 دقيقة يومياً وبمقدار 46% لدى من يمشي لمدة تزيد عن 60 دقيقة يومياً. كما ترافق استهلاك السمك والفواكة الطازجة أكثر من مرة أسبوعياً باختطار أقل. ومن بين المصابين بفرط ضغط الدم لم يشخص إلا 21.9% منهم، ولم يحظ بالمعالجة الدوائية إلا 8.8% منهم.

ABSTRACT This study used data from the Moroccan national survey in 2000 to identify the principle risk factors for hypertension in a representative sample of the population age 20+ years. The risk of hypertension increased steadily with age and was higher among rural residents (OR = 1.42) and those with diabetes (OR = 1.72). The risk increased with increased body mass index, waist size and hypercholesterolaemia. The risk of hypertension decreased by 36% and 46% respectively for those who walked 30–60 min and > 60 min daily. Consumption of fish and fresh fruits 1+ times per week was associated with a lower risk. Among those with hypertension, only 21.9% were previously diagnosed and 8.8% were under medical treatment.

Facteurs de risque d'hypertension dans la population adulte marocaine

RÉSUMÉ Cette étude a exploité les données de l'enquête nationale marocaine de 2000 afin de recenser les principaux facteurs de risque d'hypertension dans un échantillon représentatif de la population âgée de 20 ans et plus. Le risque d'hypertension augmentait régulièrement avec l'âge et il était plus élevé chez les personnes vivant en milieu rural (OR = 1,42) et les diabétiques (OR = 1,72). Il augmentait également si l'indice de masse corporelle, le tour de taille et l'hypercholestérolémie étaient élevés. Le risque d'hypertension diminuait de 36 % chez les personnes qui marchaient entre 30 et 60 minutes par jour et de 46 % chez celles qui marchaient plus de 60 minutes par jour. La consommation de poisson et de fruits frais au moins une fois par semaine était associée à un risque plus faible. Parmi les sujets hypertendus, seuls 21,9 % avaient été diagnostiqués auparavant et 8,8 % étaient sous traitement médical.

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Introduction

It is well established that hypertension is prevalent not only among developed nations but also in developing countries [1–3]. The available data for several countries in the Eastern Mediterranean Region indicates that hypertension and its associated complications constitute an important cause of morbidity and mortality [4,5]. It has also been reported that well-established risk factors for cardiovascular diseases such as obesity, high serum cholesterol, diabetes and smoking pose a greater risk in those with hypertension than in those with normal blood pressure (BP) levels [6].

In Morocco, the high prevalence of hypertension is a serious public health problem. The results of the 2000 national survey on cardiovascular disease risk factors showed that 33% of individuals aged 20 years and over had hypertension [3]. With knowledge of the principle risk factors of hypertension, the segments of the population most exposed, as well as the rate of its increase in Morocco, an effective strategy to combat hypertension and its associated complications can be initiated.

The objective of this study was to identify the principal risk factors for hypertension and to determine the rate of detection, treatment and control of hypertension in a representative sample of the Moroccan population.

Methods

Population and sample

The survey conducted in 2000 used a representative sample of the Moroccan population aged 20+ years. The sample selection was conducted through a multi-stage clustering technique. A total of 2000 people were selected from 100 communes, in clusters of 20 persons per commune. Morocco

is divided into 68 administrative provinces and prefectures, each of which is composed of several communes. The number of clusters selected at random in a province or prefecture was proportional to the number of its inhabitants. Likewise, the number of clusters selected at random in urban and rural areas was proportional to the distribution of the Moroccan population in urban and rural areas, i.e. 53% and 47% respectively. Twenty (20) households were selected at random from each commune included in the survey, and 1 person aged 20+ years from each household was selected at random to take part in the survey. Pregnant women and bed-ridden terminally-ill people were excluded.

Data collection

Data collection took place at the participants' place of residence. On the first day of the survey the investigator filled in the questionnaire and took the BP and anthropometric measurements of the respondent. A blood sample was taken the next day in order to determine serum glucose, total cholesterol and high-density lipoprotein (HDL) cholesterol levels. The blood sample was centrifuged within the following hour and sent to the laboratory at the Moroccan League for the Prevention of Cardiovascular Disease at the Ibn Sina Hospital in Rabat. The methodology of this survey was reported in detail in a previous article [3].

The survey questionnaire included questions on demographic data (age, sex, place of residence, level of education), socioeconomic status (monthly income, occupation), personal and family history of hypertension, diabetes and hypercholesterolaemia, as well as questions regarding smoking habits, alcohol consumption, physical exercise and dietary habits.

Socioeconomic status was classified based on type of residence and monthly

income as: satisfactory (residence in a villa and/or monthly income > US\$ 500), low (residence in an apartment/traditional house and/or monthly income US\$ 300–500) or very low (residence in a shantytown/rural house and/or monthly income < US\$ 300).

Smoking and alcohol use were defined as: non-smoker (never smoked cigarettes), smoker (current smoker) or ex-smoker (quit smoking) and non-drinker (never drank alcohol), drinker (current drinker of alcohol) or ex-drinker (quit drinking).

Body mass index (BMI) was defined as: normal (< 25 kg/m²), overweight (≥ 25 to < 30 kg/m²) or obese (≥ 30 kg/m²). Waist size and hip size were measured at the beginning of the great trochanter and the beginning of the umbilicus respectively. Waist size was defined as: normal (men < 88 cm; women < 80 cm), high (men ≥ 88 to < 102 cm; women ≥ 80 to < 88 cm) or very high (men ≥ 102 cm; women ≥ 88 cm). The waist-hip ratio (WHR) as a measure of abdominal obesity was defined as: normal (men < 1; women < 0.85) or high (men ≥ 1; women ≥ 0.85).

Physical activity was defined as: vigorous (accelerated breathing), moderate (rhythmic breathing) or walking. Only physical activity that lasted > 10 minutes was considered. Each activity was measured in terms of average time spent/day (minutes).

Data about diet was based on the frequency of consumption of the main foods habitually consumed by the Moroccan population: frequently (1+ times per week), moderately (< 1 time per week) or rarely (< 1 time per month).

If one of the parents of the participant was known to have hypertension, the person was considered to have a family history of hypertension. A person was considered diabetic if his/her fasting blood sugar was ≥ 1.26 g/L and/or s/he took medication for diabetes. Hypercholesterolaemia was

defined as cholesterol level ≥ 2.00 g/L and low HDL cholesterol as ≤ 0.29 g/L for men and ≤ 0.35 g/L for women.

Measurement of hypertension

Hypertension was measured using a Vaquez-type sphygmomanometer. BP measurements were taken from both arms with the subject in a sitting position after a 10 min rest, after which a 3rd BP measurement was taken from the arm with the highest BP. The systolic BP and the diastolic BP values were averaged and done on the same side. A large armband was used when the width of the arm was > 33 cm. A person was considered hypertensive with systolic BP ≥ 140 mmHg and/or diastolic BP ≥ 90 mmHg and/or under treatment with antihypertensive medication. In our survey, 63 people were taking medication for hypertension.

Statistical analysis

The chi-squared test was used for the comparison of the given categories and the *t*-test for the comparison of the given means and standard deviation (SD) within groups. A non-conditional logistic regression model was utilized to analyse the association between the risk of hypertension (dependent variable) and the different risk factors of interest (independent variables). During the first analysis, a univariate analysis was conducted in order to select the covariates significantly associated with the risk of hypertension, with an alpha error less than 10%. During the second analysis, a multivariate logistic regression (stepwise logistic model) was utilized in order to study the association between hypertension and the significant risk factors identified in the univariate analysis. Only those variables with a *P*-value < 0.05 were retained in the final model.

We also examined the interactions between the different risk factors retained in

the final model. The estimated odds ratios (OR) are presented along with the 95% confidence intervals (CI). The analysis was conducted using *SPSS*, version 10.

Results

In total, 1802 people (90.1%) participated in the questionnaire survey and blood pressure/anthropometric measures (755 men and 1047 women); 1662 of these (92.2%) gave blood samples the next day for serum glucose, total cholesterol and HDL cholesterol levels. The blood sample was insufficient to test HDL cholesterol in 21 people.

Prevalence of hypertension

The prevalence of hypertension was 39.6% and 33.6% after standardizing for the Moroccan population by age and by sex (men 30.2%; women 37.0%) [3]. The prevalence of hypertension increased significantly with age in both sexes (Figure 1) from 17.5%

among those aged 20–29 years (men 17.5%; women 17.4%) up to 73.9% among those 70+ years (men 71.4%; women 77.2%).

Women had significantly higher mean systolic and diastolic BP levels than men (systolic 134.0 versus 131.3 mmHg, $P = 0.017$; diastolic 78.7 versus 76.0 mmHg, $P = 0.0002$). Systolic and diastolic BP increased with age in both sexes. For men, mean BP was 123.2/72.2 mmHg in those aged 20–29 years and 148.3/81.6 mmHg in those 70+ years, reflecting an increase in systolic BP of 20% and an increase in diastolic BP of 13%. Among women, the mean values were 120.6/72.0 mmHg and 157.0/87.3 mmHg respectively in those 20–29 years and 70+ years, reflecting a 30% increase in systolic BP and 21% increase in diastolic BP.

The distribution of hypertensives and non-hypertensives in the population according to the measured variables is presented in Tables 1 and 2. Mean age was 50.6 years

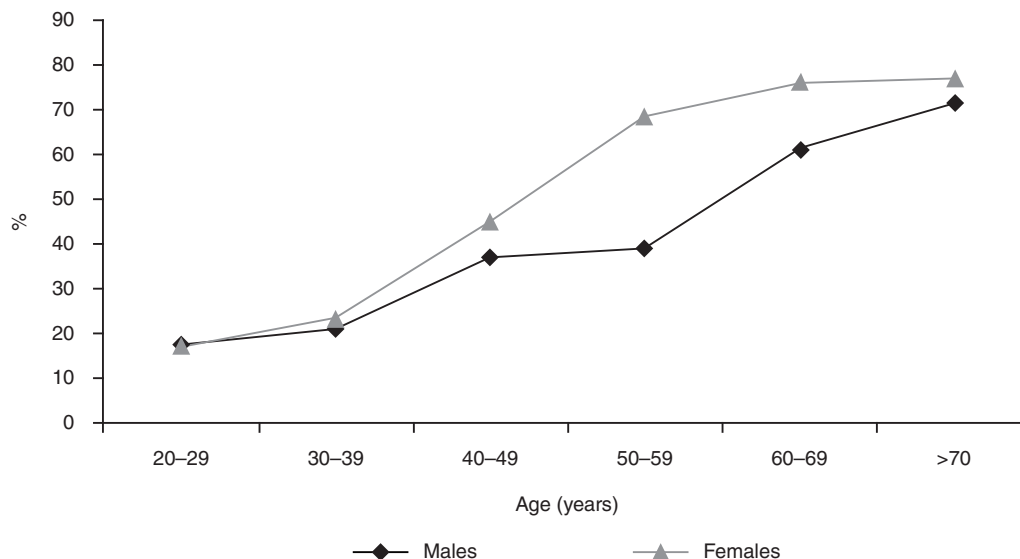


Figure 1 Prevalence of hypertension by age and sex: national health survey, Morocco 2000

Table 1 Hypertension risk factors of participants ≥ 20 years according to hypertension status and prevalence of hypertension: national health survey, Morocco 2000

Variable	Non-hypertensives		Hypertensives		Prevalence of hypertension	P-value
	No.	%	No.	%	%	
<i>Age (years)</i>						< 0.001
20–34	460	42.2	109	15.3	19.2	
35–44	313	28.7	134	18.8	30.0	
45–54	175	16.1	183	25.7	51.1	
55–64	81	7.4	140	19.6	63.3	
≥ 65	60	5.5	147	20.6	71.0	
Mean (SD)	38.7 (13.3)		50.6 (15.1)*			
<i>Sex</i>						0.082
Male	474	43.5	281	39.4	37.2	
Female	615	56.5	432	60.6	41.3	
<i>Place of residence</i>						0.046
Urban	566	52.0	336	47.1	37.3	
Rural	523	48.0	377	52.9	41.9	
<i>Marital status^a</i>						< 0.001
Single	211	19.4	51	7.2	19.5	
Married	785	72.1	528	74.1	40.2	
Widow	59	5.4	117	16.4	66.5	
Divorced	30	2.8	16	2.2	34.8	
<i>Education level^b</i>						< 0.001
None	607	55.7	509	71.4	45.6	
Koranic school	69	6.3	47	6.6	40.5	
Primary	185	17.0	86	12.1	31.7	
Secondary	175	16.1	52	7.3	22.9	
University	51	4.7	18	2.5	26.1	
<i>Socioeconomic status</i>						0.677
Satisfactory	26	2.4	17	2.4	39.5	
Low	473	43.4	296	41.5	38.5	
Very low	590	54.2	400	56.1	40.4	
<i>Family history of hypertension</i>						0.988
No	961	88.2	630	88.4	39.6	
Yes	128	11.8	83	11.6	39.3	
<i>Cigarette smoking</i>						< 0.001
Never smoked	826	75.8	576	80.8	41.1	
Current smoker	179	16.4	65	9.1	26.6	
Ex-smoker	84	7.7	72	10.1	46.2	

Table 1 Hypertension risk factors of participants aged 20 years and over according to hypertension status and prevalence of hypertension: national health survey, Morocco 2000 (continued)

Variable	Non-hypertensives		Hypertensives		Prevalence of hypertension	P-value
	No.	%	No.	%	%	
<i>Alcohol drinking</i>						0.066
Never drank	958	88.0	650	91.2	40.4	
Current drinker	36	3.3	14	2.0	28.0	
Ex-drinker	95	8.7	49	6.9	34.0	
<i>Moderate physical activity (min/day)</i>						0.004
≤ 120	477	43.8	365	51.2	43.3	
121–240	300	27.5	184	25.8	38.0	
> 240	312	28.7	164	23.0	34.5	
Mean (SD)	187.6 (161.5)*		159.9 (157.0)			
<i>Intense physical activity (min/day)</i>						< 0.001
≤ 60	860	79.0	607	85.1	41.4	
> 60	229	21.0	106	14.9	31.6	
Mean (SD)	62.5(135.9)*		39.2(105.3)			
<i>Walking (min/day)</i>						< 0.001
≤ 30	313	28.8	298	41.8	48.8	
31–60	301	27.6	175	24.5	36.8	
61–120	261	24.0	137	19.2	34.4	
> 120	214	19.7	103	14.4	32.5	
Mean (SD)	88.5 (97.5)*		69.1 (86.8)			
<i>BMI^a (kg/m²)</i>						< 0.001
< 25	697	64.0	308	43.2	30.6	
25–29	269	24.7	234	32.8	46.5	
≥ 30	121	11.1	168	23.6	58.1	
Mean (SD)	24.2 (4.4)		26.7 (5.3)*			
<i>Waist size^b(cm)</i>						< 0.001
Normal	737	67.7	296	41.5	28.7	
High	171	15.7	151	21.2	46.9	
Very high	177	16.3	266	37.3	60.0	
Mean (SD)	80.8 (11.1)		88.6 (12.2)*			
<i>Waist–hip ratio^c</i>						< 0.001
Normal	880	81.1	468	65.6	34.7	
High	205	18.9	245	34.4	54.4	
Mean (SD)	0.84 (0.08)		0.88 (0.08)*			

Table 1 Hypertension risk factors of participants aged 20 years and over according to hypertension status and prevalence of hypertension: national health survey, Morocco 2000 (concluded)

Variable	Non-hypertensives		Hypertensives		Prevalence of hypertension	P-value
	No.	%	No.	%		
<i>Fasting blood sugar^a(g/L)</i>						< 0.001
< 1.26	957	87.9	565	79.2	37.1	
≥ 1.26	48	4.4	91	12.8	65.5	
Missing data	84	7.7	57	8.0	40.4	
Mean (SD)	0.94 (0.34)		1.06 (0.48)*			
<i>Cholesterol^d (g/L)</i>						< 0.001
< 2.0	750	68.9	349	48.9	31.8	
2.0–2.2	122	11.2	113	15.8	48.1	
> 2.2	133	12.2	195	27.3	59.5	
Mean (SD)	1.76 (0.39)		2.00 (0.46)*			
Missing data	84	7.7	56	7.9	40.0	
<i>HDL cholesterol^e (g/L)</i>						0.462
Normal	955	87.7	610	85.6	39.0	
Low	42	3.9	34	4.8	44.7	
Mean (SD)	0.50 (0.15)		0.51 (0.14)			
Missing data	92	8.4	69	9.7	42.9	

* $P < 0.001$.

^aUnknown for 5 people; ^bunknown for 3 people; ^cunknown for 4 people.

^d1662 people consented to give a blood sample.

^eBlood sample was insufficient to test high-density lipoprotein cholesterol in 21 people.

Mean (SD) systolic/diastolic blood pressure was 118.5 (10.8)/69.4 (8.7) mmHg in the non-hypertensive group and 154.9 (22.0)/90.1 (14.1) mmHg in the hypertensive group ($P < 0.01$).

SD = standard deviation; HDL= high-density lipoprotein.

and 38.7 years respectively among those with and without hypertension ($P < 0.001$). The mean systolic and diastolic BP levels were 154.9 (SD 43.1)/90.1 (SD 27.6) mmHg and 118.5 (SD 21.2)/69.4 (SD 17.4) mmHg respectively among those with and without hypertension.

Risk factors for hypertension

The univariate analysis indicated an increased risk of hypertension among rural residents, widowers and individuals with low levels of education. The risk of hypertension was positively associated with age, BMI, waist size and WHR. Hypertension

was also positively associated with diabetes, high cholesterol and lowered levels of HDL cholesterol. Those without hypertension more frequently consumed fish, lamb, chicken, eggs, beans and dried fruits. The risk of hypertension was lower among those who smoked cigarettes, drank alcohol and participated in more physical activity or walking, and was not based on socioeconomic status or family history of hypertension.

The multivariate analysis indicated that age, place of residence, BMI, waist size, diabetes, high cholesterol, walking, the consumption of fish and fresh fruits were all independent risk factors associated with

Table 2 Dietary habits of participants aged 20 years and over according to hypertension status and prevalence of hypertension: national health survey, Morocco 2000

Frequency of food consumption	Non-hypertensives		Hypertensives		Prevalence of hypertension	P-value
	No.	%	No.	%		
<i>Beef</i>						0.644
Rarely	286	26.3	203	28.5	41.5	
Moderately	181	16.6	117	16.4	39.3	
Frequently	622	57.1	393	55.1	38.7	
<i>Lamb</i>						0.002
Rarely	474	43.5	370	51.9	43.8	
Moderately	231	21.2	134	18.8	36.7	
Frequently	384	35.3	209	29.3	35.2	
<i>Chicken</i>						0.004
Rarely	197	18.1	159	22.3	44.7	
Moderately	246	22.6	187	26.2	43.2	
Frequently	646	59.3	367	51.5	36.2	
<i>Fish</i>						<0.001
Rarely	237	21.8	232	32.5	49.5	
Moderately	228	20.9	160	22.4	41.2	
Frequently	624	57.3	321	45.0	34.0	
<i>Eggs</i>						<0.001
Rarely	188	17.3	178	25.0	48.6	
Moderately	166	15.2	100	14.0	37.6	
Frequently	735	67.5	435	61.0	37.2	
<i>Fresh vegetables</i>						0.348
Rarely	10	0.9	12	1.7	54.5	
Moderately	19	1.7	11	1.5	36.7	
Frequently	1060	97.3	690	96.8	39.4	
<i>Beans</i>						<0.001
Rarely	351	32.2	295	41.4	45.7	
Moderately	307	28.2	164	23.0	34.8	
Frequently	431	39.6	254	35.6	37.1	
<i>Fresh fruits</i>						0.015
Rarely	91	8.4	81	11.4	47.1	
Moderately	132	12.1	108	15.1	45.0	
Frequently	866	79.5	524	73.5	37.7	
<i>Dried fruits</i>						0.014
Rarely	719	66.0	515	72.2	41.7	
Moderately	196	18.0	112	15.7	36.4	
Frequently	174	16.0	86	12.1	33.1	

Table 2 Dietary habits of participants aged 20 years and over according to hypertension status and prevalence of hypertension: national health survey, Morocco 2000 (concluded)

Frequency of food consumption	Non-hypertensives		Hypertensives		Prevalence of hypertension	P-value
	No.	%	No.	%		
<i>Olive oil</i>						0.982
Rarely	279	25.6	184	25.8	39.7	
Moderately	83	7.6	53	7.4	39.0	
Frequently	727	66.8	476	66.8	39.6	
<i>Vegetable oil</i>						0.338
Rarely	54	5.0	40	5.6	42.6	
Moderately	14	1.3	14	2.0	50.0	
Frequently	1021	93.8	659	92.4	39.2	
<i>Butter</i>						0.526
Rarely	438	40.2	306	42.9	41.1	
Moderately	145	13.3	95	13.3	39.6	
Frequently	506	46.5	312	43.8	38.1	
<i>Dairy</i>						0.674
Rarely	223	20.5	155	21.7	41.0	
Moderately	144	13.2	102	14.3	41.5	
Frequently	722	66.3	456	64.0	38.7	
<i>Tea</i>						0.757
Rarely	40	3.7	31	4.3	43.7	
Moderately	12	1.1	9	1.3	42.9	
Frequently	1037	95.2	673	94.4	39.4	
<i>Coffee</i>						0.877
Rarely	642	59.0	423	59.3	39.7	
Moderately	98	9.0	67	9.4	40.6	
Frequently	349	32.0	223	31.3	39.0	

hypertension (Table 3). The risk of hypertension increased with age. Hypertension was 8 times more likely among those age 65+ years compared with those 20–34 years old ($P < 0.001$). The risk of hypertension increased among rural residents (OR = 1.42). The risk of hypertension increased by 36% among overweight individuals and 79% among obese individuals, compared with those of a normal weight. Similarly, the risk of hypertension increased by 77% and 130% respectively when waist size was high and very high. The risk of hypertension was 1.7 times higher among diabetics and

1.4 times and 1.9 times higher respectively when cholesterol levels were 2.0–2.2 g/L or > 2.2 g/L.

Individuals who consumed fish and fresh fruits at least once per week were at low risk for hypertension (43% and 31%, respectively) than those who consumed these items less than once per month (the reference category).

Walking was also associated with a low risk of hypertension. The decrease in risk was 36% for those who walked 30–60 min/day and 46% for those who walked more than 60 min daily.

Table 3 **Association between hypertension and potential risk factors: national health survey, Morocco 2000**

Variable	Multivariate analysis		Odds ratio (95% CI)
	P-value step 0	P-value final	
<i>Age (years)</i>	< 0.001	< 0.001	
20–34			1
35–44			1.41 (1.03–1.93)
45–54			3.21 (2.33–4.43)
55–64			5.53 (3.79–8.06)
≥ 65			8.00 (5.37–11.9)
<i>Place of residence</i>	0.017	0.005	
Urban			1
Rural			1.42 (1.11–1.81)
<i>Sex</i>	0.210	0.526	
<i>Marital status</i>	0.355	0.417	
<i>Education level</i>	0.849	0.912	
<i>Cigarette smoking</i>	0.337	0.473	
<i>Alcohol drinking</i>	0.745	0.763	
<i>Walking (min/day)</i>	< 0.001	0.001	
≤ 30			1
31–60			0.64 (0.48–0.85)
61–120			0.53 (0.39–0.71)
> 120			0.54 (0.39–0.75)
<i>Moderate physical activity</i>	0.913	0.600	
<i>Intense physical activity</i>	0.991	1.000	
<i>BMI (kg/m²)</i>	0.021	0.023	
< 25			1
25–29			1.36 (1.00–1.83)
≥ 30			1.79 (1.17–2.74)
<i>Waist size (cm)</i>	0.001	< 0.001	
Normal			1
High			1.77 (1.28–2.44)
Very high			2.30 (1.59–3.31)
<i>Waist-hip-ratio</i>	0.991	0.955	
<i>Diabetes</i>	0.024	0.011	
No			1
Yes			1.72 (1.12–2.63)
<i>Cholesterol (g/L)</i>	0.001	0.0003	
< 2.0			1
2.0–2.19			1.39 (1.00–1.93)
≥ 2.20			1.88 (1.39–2.55)

Table 3 Association between hypertension and potential risk factors: national health survey, Morocco 2000 (concluded)

Variable	Multivariate analysis		Odds ratio (95% CI)
	P-value step 0	P-value final	
Consumption of:			
Fish	0.005	< 0.001	1
Rarely			0.85 (0.62–1.17)
Moderately			0.57 (0.43–0.76)
Frequently			
Fresh fruits	0.065	0.015	
Rarely			1
Moderately			1.07 (0.67–1.68)
Frequently			0.69 (0.48–1.01)
Lamb	0.190	0.129	
Chicken	0.200	0.130	
Eggs	0.225	0.176	
Beans	0.272	0.186	
Dried fruits	0.990	0.856	

CI = confidence interval; BMI = body mass index; HDL = high-density lipoprotein.

Sex, level of education, marital status, drinking alcohol, smoking and moderate or intense physical activity were not significantly associated with the risk of hypertension.

Treatment of hypertension

In our survey, 156 (21.9%) of those with hypertension had been diagnosed beforehand (men 13.5%; women 27.3%) and 63 of those (40.4%) were taking antihypertension medication (men 26.3%; women 44.9%). Only 8/63 (12.7%) cases with hypertension and under antihypertension treatment were controlled (i.e. BP < 140/90 mmHg) (men 20.0%; women 11.3%). Thus of those with hypertension, only 8.8% were under medical treatment (men 3.6%; women 12.3%) and only 1.1% were controlled (men 0.7%; women 1.4%).

Discussion

Our study has the advantage of using a representative sample of the Moroccan popula-

tion and including a number of potential important risk factors of hypertension.

Similar to other studies, the risk of hypertension increased with age [7–12]. This progressive increase is linked with rising systolic BP, increasing with age to an average value close to 140 mmHg in the 7th decade [13].

The rural population was more at risk of hypertension. In the first report we suggested a possible link between stress and rural residence, the majority of such residents work in agriculture, due to the drought in Morocco over the past 2 decades [3]. Stress is known to be a risk factor of hypertension, but other studies are necessary to confirm or refute this [14].

The prevalence of hypertension in our survey was slightly higher among women [3]. However, multivariate analysis indicated that women did not have a higher risk of hypertension than men. Similarly, marital status, level of education and socioeconomic

status, as defined in our study, were not significant risk factors for hypertension in the multivariate analysis. But in other studies a high risk of hypertension has been associated with low education level [10] and with a higher socioeconomic status [15].

Many studies have examined the effect of smoking on the prevalence of hypertension. In our study, smoking was not a significant risk factor for hypertension. A similar result was found in the study of Mohsen Ibrahim in Egypt [16]. Certain studies indicate that smokers and ex-smokers are more at risk [17–19]. It has also been suggested that BP among ex-smokers is higher than that of smokers as well as those who have never smoked [20]. The increased risk of hypertension among ex-smokers has been attributed to the number of cigarettes smoked daily prior to cessation of smoking and not to the duration of smoking [21]. Recently, it was suggested that smoking was associated with an increase in systolic BP among older men and not among women [22] and an increase in the incidence of hypertension [23]. Other studies have indicated an inverse relationship between smoking and BP and the risk of hypertension [7,14,20]. These contradictory results indicate that the relationship between smoking and hypertension is complicated. This is further complicated by the finding that those who smoke may consume a different diet from those who do not smoke [24]. However, it is important to note that the relationship between other factors may contribute to the risk of hypertension, such as the age at which one starts smoking and the time elapsed since smoking cessation.

The positive association between obesity and hypertension observed in our study has been reported in numerous studies [8,10–12,14,16,19,25,26]. The Framingham study indicated that 70% of new-onset hypertension may be attributed to obesity or

weight gain [25]. The mechanism through which obesity and BP are related has yet to be fully elucidated. Resistance to insulin and peripheral hyperinsulinaemia due to overweight and obesity play a role in the development of hypertension [27].

Waist size reflects abdominal obesity and is considered a good indicator of obesity. The positive association observed in our study between waist size and hypertension has been reported in other studies [12,15,16,28]. Some of those studies indicated that abdominal obesity was a risk factor for hypertension independently of BMI [12,15,28]. Ledoux reported that obesity (BMI) and the abdominal distribution of fat (waist size or WHR) are equally associated with the presence of hypertension [29]. Similar to the study by Perez [14], physical activity was not associated with the risk of hypertension in our study. However, walking did seem to have a protective role against hypertension. In the study of Singh et al. in India, lower physical activity was weakly but significantly associated with hypertension [15].

The results of our study confirm those of similar studies which indicate that there is an increased risk of hypertension among diabetics [14,16,26] and those with hypercholesterolaemia [16]. The association between hypercholesterolaemia and the risk of hypertension may explain some of the mechanisms: first, hypertension and hypercholesterolaemia are linked to atherosclerosis which is associated with reduced vascular compliance [30]; secondly, high cholesterol is associated with vascular diseases, which are linked to changes in the endothelium [31,32]; thirdly, food rich in fat and cholesterol may cause a disturbance in the metabolism of prostaglandins [33]; and fourthly, hypertension and hypercholesterolemia are present in familial dyslipidaemia and hypertension [34].

In our study, drinking alcohol was not significantly associated with hypertension, similar to the results of Perez et al. [14], although other studies have found an association [7,25,35]. A Japanese study found not only a dose–effect relationship between the quantity of alcohol consumed and the level of BP but also a higher prevalence of hypertension among heavy drinkers of alcohol [35]. Another study showed that BMI and the consumption of alcohol are strong predictors of hypertension [25].

The frequent consumption of fresh fruit and fish seems to have a protective role against hypertension. Sacks et al. suggested that consumption of fresh fruits and vegetables are associated with a low risk of hypertension [36]. A number of studies indicate that fish has a protective effect against coronary artery disease [37–39] but there are few available data concerning the relationship between the consumption of fish and BP. Similar to the study conducted by Perez et al [14], the consumption of animal products high in fat were not found to be associated with an increased risk of hypertension. Concerning the relationship between the risk of hypertension and the other foods, few data are available in the international literature.

In this study, family history of hypertension was not found to be associated with hypertension. This contrasts with a number of other studies indicating a positive association suggesting a hereditary component to hypertension [14,19,26].

The detection rate for hypertension (1 in 5 patients) and the proportion under treatment for hypertension (26% for men and 45% for women) remains very low in Morocco. This situation is of further concern because only 1 in 8 patients under medical treatment had a normal level of BP. According to our study, of 100 people with hypertension only 1 had their BP controlled. The

reduction in the prevalence of hypertension and its associated complications requires the reduction of the known risk factors and early and adequate assistance for hypertensive patients. It is important to educate the population, in particular those at high risk (obese, diabetic, sedentary lifestyle, etc), who must be identified and assisted.

Our study had certain limitations. The measures of BP were only taken during 1 visit, thus it was not possible to confirm with complete certainty the presence of hypertension among those with elevated BP [18]. The number of cigarettes smoked per day, the quantity of alcohol consumed and the duration of smoking and drinking alcohol were not measured. The food consumption evaluation, which measured the frequency of consumption of certain foods, was an imprecise measure and may have introduced bias, as people in the survey may not have remembered or may not have wanted to declare what they ate and because the quantity of the different foods consumed and nutrient content (carbohydrates, fats, etc.) were not taken into account.

Conclusions

The study results suggest that to reduce the prevalence of hypertension among the Moroccan population necessitates a reduction of certain risk factors, notably obesity and high serum cholesterol, but also the promotion of a healthy lifestyle with regular walking and a balanced diet rich in fresh fruits and fish.

The percentage of individuals with hypertension who are diagnosed and treated is low in Morocco and greater efforts are needed to improve the situation in order to reduce the complications associated with hypertension, most notably stroke.

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