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CARDIOVASCULAR RISK FACTORS ASSESSMENT AMONG DIABETIC AND HYPERTENSIVE SUBJECTS IN MOROCCO

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Contribution

RE conceived the idea and designed the study. AMS and ZS helped in data collection and analysis. While HH did final review and manuscript writing. All authors contributed equally to the submitted manuscript.

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ABSTRACT

Objective: This study, the first field survey in one prefecture in the Eastern of Morocco contributes by description of the distribution and characteristics of CVD risk factors using multiple cardiovascular risk assessment among hypertensive and diabetics subjects.

Methodology: This cross-sectional study was done in over 11 localities from urban and rural areas in one prefecture from January to December 2017 screen CVD risk factors; obesity, blood pressure, smoking, physical activity, pharmacological treatment and others. Gaziano algorithms were used to calculate probabilities for the next 5-years of fatal and non-fatal cardiovascular events.

Results: The sample consisted of 244 patients with a mean age 60.64 ± 12.90 years and predominantly women (58.19%). Hypertensive subjects consisted of 105 with low level of education (15.23%) received their pharmacological treatment 90.48% but only 35.25 percent had optimal blood pressure. The frequency of obesity was 7.61% affecting more men than women and 36.19% of them had positive family history for diabetes and/or hypertension. Among all hypertensive subjects, 51.42% were considered at high cardiovascular risk for both fatal and non-fatal events. The group of diabetic participants consisted of 139 most of them illiterate (69.07%) and 21.58% had high blood pressure touching more men than women (25.86% vs 18.51%). The obesity (7.19%) was more frequent in rural areas than urban areas and only 30.21 % of them were found following physical activity. Examining the cardiac risk show that 55.39% of all diabetics were at high cardiovascular risk, exposing men more than women (63.63% vs 42.62%).

Conclusion: CVD risk factors assessment represent a strategic tool to prevent and face these epidemic, and although the kingdom of Morocco has launched national strategy to reduce and face chronic diseases, the results of our study indicate that diabetic and hypertensive patients have high prevalence of CVD risk factors which exposed them to high cardiovascular risk.

Key Words: Cardiovascular diseases, Risk factors, Hypertension, Diabetes, Morocco

INTRODUCTION

-In Morocco, the mortality rate caused by non-communicable diseases is 5.7 times higher than the death rate from infectious diseases characterizing the epidemiological transition. Cardiovascular disease (CVD) represents the leading cause of death (27.2% of all deaths in 2015) by a death rate of 214 deaths per 100,000 individuals.[1] Two major modifiable risk factors for CVD are hypertension and diabetes mellitus which affect globally almost 2 billion persons with 1.4 billion hypertensive persons , 425 million diabetics persons" and account directly for 7.5 million and 1.6 million deaths respectively (World Health Organization. 2017).[2,3] The proportion of Moroccan elder (≥60 years) having diabetes (20.0%) or hypertension (89.9%) have reached an alarming levels with all their socio-economic and pathological consequences.[4] These frequencies have different geographic distributions. Thus, and according to Ministry of health the Eastern of Morocco holds the first position in terms of subjects (≥18 years) who have at least one chronic disease, subjects with diabetes (8.5%) and subjects with hypertension (12.4%) overcoming the national frequencies.[4] In theory, all those diabetics and hypertensive patients benefit from pharmacological treatment, therapeutic education and periodic screening through-out the national strategy for facing non-communicable diseases launched by Ministry of health since 2012, and which focus primarily on reducing cardiovascular risk factors and the progression of fatal events. The progression of CVD in the history of hypertension and diabetes is accelerated by the presence of classical CVD- risk factors, particularly that many of them share the same biochemical pathways and thereby can have synergistic effects enhancing the process of atherogenisis.[5] In Morocco as many African countries there is paucity on CVD risk factors epidemiology among hypertensive and diabetics subjects. This study, the first field survey in one prefecture in the Eastern of Morocco contributes by description of the distribution and characteristics of CVD risk factors using multiple cardiovascular risk assessment among hypertensive and diabetics subjects.

METHODOLOGY

This study was conducted in the prefecture of Figuig in South-Eastern of Morocco. It has an areas of 55,990km² representing 7.92% of the Moroccan areas. According to the national census of Moroccan population (2014), the total population of the prefecture was 138, 325 inhabitants of which 50% live in rural areas and defining a density of 2.5 inhabitants/km².[7,8] The global multi-dimensional poverty is 13.1% while the rates if illiteracy and health privation rates were 52.8% and 9.6% respectively.[9]

This was a cross sectional study funded by Ministry of Health through a partnership with the university of Ibn-Tofail from January to December 2017. We followed the annual program of medical caravans and medical visits to investigate among diabetics and hypertensive subjects. Patients aged of 30 years and more, by order first coming first in, were registered then measure and prepared for general consultation. Patients with advanced symptoms were transferred to specialists. At the end those with prescription were oriented to the pharmacy for their treatment.

All procedures in this study were in accordance with the ethical standards of the national committee and the 1964 Helsinki declarations. Participants were asked to share their information for scientific researches purposes, those who refused were screened, have their medication and their data were not included. Participants were assured the confidentiality of their information. A special terminologies and words have been accepted to express medical meanings to ensure the effectiveness of the communication, because most subjects were illiterate speaking local languages. Pregnant women and subjects not able to communicate were not included in this work. Considering the local traditions wives were interviewed and screened in the presence of their husbands.

CVD risk factors are defined according to WHO criterions for diabetes (blood glucose ≥ 126 mg/dl), hypertension (the blood systolic pressure ≥140 mmHg and/or Diastolic pressure ≥90 mmHg). The anthropometric measurements were made according the WHO guidelines. Waist circumference (cm) and height (cm) were determined using a tape measure (cm). weight (Kg) is measured using electronic balance for medical use. The body mass index (BMI) was calculated as the subject's weight (Kg) divided by the square of its height (m). Subjects are considered obese if their BMI ≥30 Kg/m². Abdominal obesity is considered if: WC ≥ 102 cm among men and WC ≥88cm among women. Smoking status was defined by the current use of the cigarettes or any other tobacco products and former smoker as a subject who did smoked at least 100 cigarettes in his lifetime and quite smoking at the time of the interview. Patients were considered as active if they follow regular moderate or intense physical activity of at least 1 hour per week, being registered in sport clubs, or having active occupation (e.g. working in construction).

Gaziano algorithms were used to calculate probabilities of cardiovascular risks for the next 5 years.[6] These algorithms were based on age, smoking status, systolic blood pressures, diabetes, gender and BMI. Lipids and glycated hemoglobin testing was not feasible because of the logistic and economic reasons.

The data was transferred from questionnaire paper into electronic data base. We performed analysis using Epi-Info software, we realized unadjusted, uni-variate descriptive statistics to express the characteristics of patients, our results are expressed as means (±) standard deviation (SD), percentage (%) or in number of cases (n). We used t-test to compare means and X^2 - test to compare proportion.

RESULTS

-Over one year (2017), a total of 11 localities from urban and rural areas were covered. Our sample consists of 244 patients with a mean age of 60.64 (SD±12.90) years, [minimum 30, maximum 90 years] selected randomly (first coming, first in) from the prefecture. They were predominantly women (58.19% vs 41.80%) (p=0.03) and rural residents (59.01% vs 40.98%) where 13.52% (n=33) were nomads who came seeking consultations and medicines. Patients characteristics were summarized in table 1.

The official number of diabetic subjects recorded in the prefecture was 1316 subjects (788 women versus 528 men) and 1076 hypertensive subjects (699 women versus 377 men)

Table 1: Characteristics of Diabetic and Hypertensive Patients. (M: men, W: women):

	Diabetic Patients						Hypertensive Patients					
	Rural			Urban			Rural			Urban		
	M	W	Total	M	W	Total	M	W	Total	M	W	Total
n (%)	(38) 36.53%	(45) 31.90%	(83) 59.71%	(20) 19.23%	(36) 25.35%	(56) 40.28 %	(25) 24.03 %	(36) 25.35%	(61) 58.09%	(19) 43.18%	(25) 17.6 %	(44) 41.90%
Age (years)	60.24 ±15.17	56.18± 13.49	58.04 ±14.34	58.15 ±8.96	54.58 ±8.68	55.86 ±8.98	63.8 ±10.69	62.4 ±13.95	63.31 ±12.63	66.31 ±11.20	69.20 ±10.46	67.95 ±10.75
Disease Duration (years)	8.21± 6.48	6.22±3. 64	7.0±4. 99	9.5± 6.07	6.51 ±6.0	7.71± 6.14	5.50± 3.55	6.60 ±4.88	6.15 ±4.39	7.73 ±5.16	5.68 ±3.95	6.56± 4.57
Hyperglycaemia (mg/dl)	193.80 ±50.66	183.51 ±50.66	188.22 ±64.30	158.06 ±43.74	181.93 ±64.44	173.4 ±58.62	105.30 ±19.39	104.84 ±16.12	105.03 ±17.38	109.18 ±14.64	107.01 ±15.5	108.02 ±14.8
Systolic Blood pressure (mmHg)	135.5 ±17.5	132.4± 15.8	133.8 ±16.5	127.5 ±14.0	130.8 ±15.5	129.6 ±15.0	149.2 ±10.7	147.2 ±17.0	148.0 ±14.7	147.8 ±17.5	107.01 ±15.5	108.02 ±14.8
BMI kg.m^{-2}	24.76 ±3.73	25.81± 2.51	25.33 ±3.18	24.62 ±3.18	24.48 ±3.25	24.53 ±3.2	25.67 ±4.48	23.98 ±2.71	24.67 ±3.61	23.75 ±3.10	23.23 ±2.02	23.54 ±2.54
Education	(12) 31.57%	(10) 22.22%	(22) 26.5%	(13) 65.0%	(8) 22.22%	(21) 37.5%	(8) 32.0%	(4) 11.11%	(12) 19.67%	(3) 15.78%	(1) 4.0 %	(4) 9.09%
Medical insurance	(31) 81.57%	(43) 95.55%	(74) 89.15%	(20) 100 %	(34) 94.44%	(54) 96.42%	(23) 92.0%	(35) 97.22%	(58) 95.08%	(18) 94.73%	(22) 88.0%	(40) 90.90%
Periodic Monitoring Health Programs Participation	(34) 89.47%	(40) 88.88%	(74) 89.15%	(18) 90.0%	(36) 100%	(54) 96.42%	(18) 72.0%	(32) 88.88%	(50) 81.96%	(19) 100%	(25) 100%	(44) 100%
Other chronical condition (Epilepsy, rheumatism)	(1) 2.63%	(5) 11.11%	(6) 7.22%	(0)	(2) 5.55%	(2) 3.57%	(3) 12.0%	(2) 5.55%	(5) 8.19%	(3) 15.78%	(1) 4.0%	(4) 9.09%
Pharmacological Treatment respected	(37) 97.36%	(40) 88.88%	(77) 92.77%	(20) 100%	(36) 100%	(56) 100%	(22) 88.0%	(30) 83.33%	(52) 85.24%	(19) 100%	(24) 96.0%	(43) 97.72%

Our sample consists of 105hypertensive participants with an average age of 65.25 (SD±12.04)years, an average systolic blood pressure of 147.7 (SD±15.3) mm Hg and an average disease duration of 6.33 (SD±4.45)years. They were predominantly women (58.09%)($p<0.001$).

Regarding their characteristics, only 15.23% had an education but most of them had a medical coverage (93.33%) and participated in health programs for managing their chronic condition (89.52%) where women participated more than men (93.44% vs 84.09%) ($p<0.03$). They had another chronic condition such as epilepsy, rheumatism, asthma and depression with a frequency of 8.57% and only9.52% of those with prescriptions do not follow any pharmacological treatment against 90.48% (women were more touched than men 11.47% vs 6.87%)($p<0.02$).

Considering our measurements, 8.57% of hypertensive subjects had hyperglycemia affecting more women than men (9.83% vs 6.81%) ($p<0.02$) and 64.76% have high blood pressure touching more men than women (68.18% vs 62.29%). Rural residents were more exposed than their urban counterparts (68.85% vs59.09%) ($p<0.001$). The frequency of obesity among hypertensive subjects was 7.61% observed in men more than women (15.90 % vs 1.63%) ($p<0.03$) and impacting rural residents more than urban residents (11.47% vs 2.27%). The frequency of abdominal obesity was 15.23%, more frequent in rural than urban areas (22.95% vs 4.54%) and 36.19% of all participants had positive family history for hypertension and/or diabetes, more common in rural areas than urban areas (37.70% vs 34.09%).

Only 28.57% confirmed following regular physical activity making women more active than men (45.90% vs 22.72%) ($p<0.001$) and interestingly, rural residents were found to be more physically active than urban residents (37.70% vs 34.09%) ($p<0.03$). In this study, only one hypertensive participant was found to be current smoking.

We screened 139 diabetics patients predominantly women (58.27%) and rural residents (59.71%). They had an average age of 57.15 ±12.47 years, an average glycaemia of 182.25 ±62.28 mg/dl, and an average systolic blood pressure of 132.1 ±15.0 mmHg. The average diabetes duration was 7.3 ±5.5 years.

-In terms of their characteristics, only 30.93% of them had an education, 92.08% had medical insurance and most of them participate in health programs for diabetes monitoring where women participated more than men (93.82% vs 89.65%) ($p<0.02$) and rural residents participated less than their urban counterparts (96.42% vs 89.15%) ($p<0.001$). The vast majority of them follow their pharmacological treatment (95.69%) and all those who were missing their medication were from rural areas (7.22%) mostly women (6.17% vs 1.72%) ($p<0.001$).

-Integrating our measurements, 87.05% of participants had their blood glucose exceeding 126 mg/dl and 21.58% had high blood pressure where men were more exposed than women (25.86% vs 18.51%) ($p<0.001$) and rural residents were more impacted than their urban counterparts (26.50% vs 14.28%). The frequency of obesity among diabetic patients is 7.19% abundant in women (7.4% vs 6.8%) ($p<0.001$) and in urban residents (8.92% vs 6.02%) whereas the frequency of abdominal obesity is 16.54% touching remarkably women (24.69% vs 5.17% ($p<0.001$) and rural residents (18.07% vs 14.28%). Considering the physical activity, only 30.21% of them were following regular physical activity commonly, from urban areas (50.0% vs 16.86%). Among all diabetics, 9.35% of them were current smocking, more frequent among urban residents then their rural counterparts (10.71% vs 8.43%). The interrogatory of family history of first degree relatives shows a frequency of 52.51% of diabetic participants who have positive family history for diabetes and/or hypertension more frequent in rural than urban areas (55.42% vs 48.21%) (Table 2).

We enumerate a subgroup of n=35 subjects who have confirmed diagnosis of diabetes and hypertension simultaneously translated into 25.17% of diabetic patients who had hypertension with an average age of 61.03 (SD±12.30) years. They had an average glycaemia of 182.12 (SD±70.12) mg/dl and an average systolic blood pressure as 143.1 (SD±1.64) mmHg. The association of the dual [diabetes-hypertension] and other chronical conditions such as psychiatric disorders (depression, anxiety) rheumatism, epilepsy and gout diseases had a frequency of 14.28%. Most of them were without education (71.42%) and only 11.42% who have no medical coverage. The frequency of high blood pressure in this sub-group was 60.0% and only 22.85% of them follow regular physical activity (men more active than women 25.0% vs 21.05%). The frequencies of obesity and abdominal obesity were 17.14% and 54.28% respectively, while 11.42% were found current smoking.

Table 2: Physiologic and Anthropometric Measurements among the Patients; (M: men, W: women).

	DIABETES						HYPERTENSION					
	Rural			Urban			Rural			Urban		
	M	W	Total	M	W	Total	M	W	Total	M	W	Total
Hyperglycemia	(32) 84.21%	(42) 93.33%	(74) 89.11%	(15) 75.0%	(32) 88.88%	(47) 83.92%	(1) 4.0%	(3) 8.33%	(4) 6.55%	(2) 10.52%	(3) 12.0%	(5) 11.36%
High Blood pressure	(12) 31.57%	(10) 22.22%	(22) 26.5%	(3) 15.0%	(5) 13.88%	(8) 14.28%	(17) 68.0%	(25) 69.44%	(42) 68.85%	(13) 68.42%	(13) 52.0%	(26) 59.09%
Obesity	(3) 7.89%	(2) 4.44%	(5) 6.02%	(1) 5.0%	(4) 11.11%	(5) 8.92%	(6) 24.0%	(1) 1.63%	(7) 11.47%	(1) 5.26%	(0)	(1) 2.27%
Abdominal Obesity	(3) 7.89%	(12) 26.66%	(15) 18.07%	(0)	(8) 22.22%	(8) 14.28%	(7) 28.0%	(7) 11.47%	(14) 22.95%	(0)	(2) 8.0%	(2) 4.54%
Current Smoking	(7) 21.87%	(0)	(7) 8.43%	(6) 30.0%	(0)	(6) 10.71%	(0)	(0)	(0)	(1) 5.26%	(0)	(1) 2.27%
Positive Physical Activity	(4) 12.5%	(10) 22.22%	(14) 18.91%	(13) 65.0%	(15) 41.66%	(28) 50.0%	(8) 32.0%	(4) 6.55%	(12) 19.67%	(8) 42.10%	(10) 40.0%	(18) 40.90%
Positive Family History	(23) 71.87%	(23) 51.11%	(46) 55.42%	(8) 40.0%	(19) 52.77%	(27) 48.21%	(8) 32.0%	(15) 24.59%	(23) 37.70%	(2) 10.52%	(13) 52.0%	(15) 34.09%

Using Gaziano algorithms, we calculate probabilities for developingbothfatal and non-fatalcardiacevents among all patients. Thus, 53.68% of all patients were at high cardiovascular risk for the next 5 years, men were more exposed than women (68.62% vs 42.95%). In terms of diseases, 55.39% of all diabetic participants and 51.42% of all hypertensive subjects were considered at high cardiovascular risk (Table 3).

Table 3: Global Cardiovascular Risk Assessment.

Risk levels	Women	Men	Total
High Cardiovascular risk	(61) 42.95%	(70) 68.62	(131) 53.68
Moderate Cardiovascular risk	(41) 28.87	(23) 22.54	(64) 26.22
Low Cardiovascular risk	(40)28.16%	(9) 8.82%	(49) 20.08

DISCUSSION

In this investigation, 90.47% of patients receive their anti hypertensive medication but only 35.26% had better control of their BP, similar results were described in other studies, in Tunisia where 93.5% received their treatment and only 37.1% had optimal control, in Spain where 88.3% received their treatment and only 26.6% had positive control.[10,11] Countries like Brazil hold an intermediate range of control (51.1%) while high income countries like US and Canada hold the first level with an average of [67% -69%].[12]

The universal health insurance (93.33%) or the presence of the pharmacological treatment does not guaranty positive clinical outcomes in hypertensive patients which call for the adopting new measurements that focus not only on providing medicine but also on the education and increasing the awareness toward the exposure to risk factors.[13] In Africa, it seems that awareness is highly related to literacy which is in correlation with our finding; the rate of education among elder population in this areas is very low. The low frequency of smoking among participants compared to frequencies in Africa and Middle-East countries (25.0%) and the national prevalence (18.0%) could be explained by the negative social image of this habit.[14,15]

Lack of hypertension control would act by destroying endothelium cells throughout atherogenesis and degenerative changes, reducing the Luminal diameter and stimulating the left ventricular to work more (hypertrophies) which evolve with time to congestive heart failure, dysrhythmias and coronary artery diseases.[16] This condition coupled with lack of physical activity would affect the cardiac output, ejection fraction and left ventricle contractility by reducing end-systolic volume.[17] The presence of obesity (7.61%) acts by increasing blood volume, oxygen needs and cardiac stroke volume which reduce the peripheral resistance trigging more raise in blood pressure.[18]

In this study, 51.42% of the patients having hypertension were considered at high 5-years cardiovascular risk for both fatal and non-fatal events, 30.47% were at intermediate risk and the rest (18.09%) at low risk.Interestingly, men are exposed to be at high risk more than women (63.63% vs 42.62%) and we do not know yet the exact reason behind that, we can advance smoking as an exclusive risk factor since in this areas, only men who smock which expose them to more risks but further investigations are needed to confirm. In a study conducted in Spain, it has been established that 12.0% of hypertensive patients are at high cardiovascular risk.[11]

In Morocco, the prevalence of diabetes estimated by ministry of health is 6.6%''' and the estimated frequencies for Africa and Middle-East countries is 25%. Diabetic patients showed high awareness toward their condition because 92.08% of them have confirmed their effective participation in health programs for chronic diseases management and 95.68% of them have answered following their anti-diabetic treatment. We believe that the reason behind the high participation of women in health programs is due to their regular connection to the health care centres throughout various activities such as; vaccination or pregnancy controls.

The measurements indicate that 21.58% of diabetic patients have high blood pressure affecting more men than women.[19,20] Measuring blood pressure of diabetic patients in another cross-sectional study over three different regions in Morocco showed that 70.4% of patients have high blood pressure impacting more women than men. Other studies in different countries show the rates of high blood pressure among diabetic patients; Tunisia (45.0%), Spain (79.4%) and China (83.1%).[11,23]

The association diabetes with obesity and central obesity was extensively described in many studies.[24] Thus, 65.1% of diabetic patients were considered obese and/or overweight in Bangladesh, 52.4% in Tunisia and 39.9% in Spain.[22,24,25] In Morocco, a cross-sectional study, showed that 77.4% of diabetic patients were having obesity.[26] The high frequencies of obesity in urban areas can be explained by the modern diet habits and the high consumption of red meat considering the large economic activity of sheep livestock (annual red meat production in the eastern of Morocco: 65.000Tonnes).[27] The accumulation of fatty tissue increases the cardiac output inducing the activation of sympathetic system and the inflammatory state (caused by Interleukin 6, C-protein) which lead to insulin-resistance stimulating diabetes.[18] The relative cardiac risk of diabetes in males with BMI of 35kgm^{-2} is 40 times higher than those with BMI of 23 kgm^{-2}.[28]

The frequency of tobacco use among diabetic participants is (9.35%) concern only men was much less than the national prevalence (18.0%) among general population can be approached by the social view of smocking synonymous of risk factor.[15] In Tunisia the tobacco use among diabetic patients is 28%.Only 30.21% of the participants followed regular physical activity which bring back into question the effectiveness of the health programs for chronic diseases management, especially among illiterate patients and rural residents with focus on the dialogue adopted by health professional to show and teach them risk factors management as the main goal of these programs.[22]

Analysing the cardiovascular risk for the next 5 years show that 55.39% of diabetic participants are at high cardiovascular risk, 23.02% are at moderate risk and 21.58% are at low level. Regarding the gender, diabetic men were at high cardiovascular risk than women (72.41% vs 43.2%). More analyses are required to study this differences.

Having diabetes and hypertension simultaneously increase the cardiovascular risk because those conditions affect the same vital organs and vasculatures. The presence of other chronic condition (14.28%)can cause medication interactions or lack of treatment adherence coupled with other risk factors (obesity, smoking, physical inactivity...) would accelerate the atherogenesis and left ventricular hypertrophy.[29]

Noticeable the high frequency of positive family for diabetes and/or hypertension among this sub-group of participants (65.70%)show the genetic dimensions of these conditions, especially in this areas where consanguineous marriage is often.[30]

Finally, our sample is representative of the population of the prefecture in terms of gender, age, location (urban/rural) but we did not consider the ethnic differentiation (Arab versus Berber) that characterise this area and may impact lifestyles, calling for further investigations. The cardiovascular risk was a tool for estimation and further comparative studies with other risk scores are required to defines the exact risk magnitude.

CONCLUSION

-CVD risk factors assessment represent a strategic tool to prevent and face these epidemic, and although the kingdom of Morocco has launched national strategy to reduce and face chronic diseases, the results of our study indicate that diabetic and hypertensive patients have high prevalence of CVD risk factors which exposed them to high cardiovascular risk. The findings of this study are very important not only in terms of epidemiological studies in the world but also for health policy makers who are required to adopt new health measurements that converge all specializations and identify individual at high risk in order to specify interventions for them

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