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Study of Modifiable Risk Factors of Chronic Diseases (hypertension and diabetes type 2) in the Province of Berkane: Eastern Region of Morocco

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Abstract

Background: The prevalence of mortality due to chronic diseases is quite high in Morocco (80%), where hypertension and type 2 diabetes are the tip of the iceberg.
Aims: This study aimed to estimate the prevalence of chronic disease: Type 2 Diabetes Mellitus (T2DM), hypertension, and the profile of modifiable risk factors in the eastern region of Morocco (Berkane).
Methods: This was a cross-sectional study of adults (≥ 18 years) consulting at health centers in primary care facilities. It involved a total of 404 participants. The questionnaire used includes socio-demographic, clinical and biological information of the consultants, Multiple logistic regression was used to estimate the factors associated with chronic disease (CD).
Results: The prevalence of T2DM was 21% and that of hypertension was16.58%, undiagnosed T2DM constituted 12.12% and unknown hypertension 5.44%.The risk factors (RF) detected in the overall population were physical inactivity 74%, abdominal obesity 61%, sedentary lifestyle 57.42%, overweight 40%, peripheral obesity 31%, stress 47.27%, smoking 7% and alcohol use 3%. While the common RF incriminated in the pathogenesis of T2DM and hypertension were general overweight (p= 0.014) vs (p= 0.014), or visceral overweight (p= 0.016) vs (p= 0.0001).
Conclusion: In the long term, diabetics and hypertensives are at risk of developing several complications that are detrimental to their health status and costly to the health system.
Keywords: Chronic diseases, eastern region, hypertension, risk factors, Type 2 Diabetes.

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INTRODUCTION

Over the past 30 years, chronic diseases (including cardiovascular disease, cancer, chronic respiratory disease, and diabetes) have become a growing global burden, accounting for seven out of ten deaths worldwide[1]. They are responsible for 41 million of the 57 million deaths worldwide, or 71%, of which 15 million are premature deaths occurring between the ages of 30 and 69 years old, and over 85% of these "premature" deaths occur in low- and middle-income countries[2].

A recent study showed that low- and middle-income countries have the highest risk of dying from Non-Communicable Disease (NCD), particularly in sub-Saharan Africa, Central Asia and Eastern Europe[3];

They all share key behavioral risk factors that can be modified, including smoking, poor diet, lack of exercise, and harmful alcohol use[4]. These factors contribute to 4 metabolic changes that increase the risk of NCD: hypertension; overweight/obesity; hyperglycemia; and hyperlipidemia[5]. In terms of deaths, hypertension is the main metabolic risk factor worldwide (responsible for 19% of deaths worldwide), followed by overweight and obesity, then hyperglycemia[5].

The Eastern Mediterranean region (MENA) is particularly affected by the invasion of CD especially in hypertension and type 2 diabetes. According to Abboud et al 2021, the prevalence of hypertension ranged from 15.2% in Saudi Arabia to 39.5% in Palestine[6].

As a result, this region has a very large number of diabetics with one in six people living with diabetes (73 million) and this figure is expected to reach 95 million by 2030[7]. As everywhere in the world, Morocco does not escape this alarming situation, Morocco is among the first countries with a high prevalence of NCD mortality (80%) in the Eastern Mediterranean region[8]. This exceeds the global average of 70% of deaths[8]. The epidemiological, demographic and nutritional transition that Morocco is undergoing are the factors favoring this expansive increase in NCD, in particular cancers, diabetes and cardiovascular diseases[2]. The cost of treating these diseases is very high, and the situation is all the more worrying since medical coverage only covers 62% of the population[2].

At the level of the eastern region of Morocco, it was found that the age of people with T2DM has started to decline, attacking the population in active phase is younger between 30 to 49 years with 19.74%[9].

To this end, our objective was to determine the prevalence of hypertension and T2DM as well as the risk factors related to lifestyle that are specific to the eastern region (Berkane province) and to highlight the links between these two variables (RF and chronic pathology).

MATERIAL AND METHOD

a. **Region and population concerned**

The province of Berkane: is located North-East of the Morocco and the region of the Oriental. Covering a total area of 1985 Km^2 (2.2% of the total area of the region). The province has 289137 inhabitants, (12.5% of the total population of the region with a density of 145.7 inhabitants / km^2). The urbanization rate in the province of Berkane is located at 63.2%[10].

b. **Ethical considerations:**

This research was approved by the Moroccan Ministry of health and social protection, obtaining the authorization of the regional director (representative of the Minister of Health in the eastern region of Morocco) to conduct this survey.

However, all ethical principles were respected in accordance with the principles stated in the Declaration of Helsinki: an informed consent written in Arabic and French was signed by each participant, the anonymity of the participants was guaranteed as no name or identifier was recorded, the questionnaires were then stored in a safe place, accessible only to the researcher, and the data extracted from the questionnaire were saved in a password protected computer.

c. **Study Design:**

The survey is a prospective cross-sectional study, to be carried out between late 2019 and early 2020. The sample size is 404. A random recruitment technique will be used to obtain 40 respondents in each health centre. The subjects interviewed were 18 years of age or older.

d. **Data collection instrument:** comprised of two sections: Section A assessed sociodemographic and clinical data, while Section B assessed modifiable risk factors.

The researcher to ensure compliance of the data collected administered all questionnaires.

DEFINING RISK FACTORS:

Operating definition of variables:

Epidemiological data: age, gender, educational level, occupation, and basic medical coverage.

Anthropometric data: weight (kg), height (m), waist circumference (cm), BMI by formula: weight/ height ^{2} (kg/m ^{2}).

Biological data: fasting or postprandial blood glucose and glycated hemoglobin using a glucose meter and a validated Hb1ac meter.

Diabetic status was self-reported, and patients who were newly diagnosed were referred to the physician for follow-up and confirmation and were included in the study only after two hb1ac tests were performed at 3-month intervals. The criterion of blood glucose ≥ 7.0 mmol/L was used to assess the prevalence of diabetes[11].

Abdominal obesity, defined according to the International Diabetes Federation (IDF) harmonized criteria, as a waist circumference (WC) ≥ 94 cm in men and ≥ 80 cm in women[12].

Blood pressure measurement: after five minutes of rest, twice at three-minute intervals, using an OMRON electronic blood pressure monitor. The value taken was the average of the two measurements. Hypertension (HT) was defined as systolic blood pressure (SBP) ≥ 140 mmHg or diastolic blood pressure (DBP) ≥ 90 mmHg, or in patients on antihypertensive therapy at inclusion[13].

With respect to **smoking** and **alcoholism**, responses were divided into three categories: daily alcoholic/daily smoker, former smoker/former alcoholic, non-smoker/ non-alcoholic.

Sedentary behavior is defined as being awake in a sitting or lying position, associated with a very low energy expenditure, less than or equal to 1.5 MET (metabolic equivalent units)[14].

Physical activity (PA) is defined as "any bodily movement produced by skeletal muscle contraction resulting in an increase in energy expenditure relative to resting energy expenditure[14]. The PA covers all activities that can be carried out in a variety of settings, including work, transportation, domestic and recreational activities; recreational activities include sports, so sport is only one component.

Level of stress: The Perceived Stress Scale (Cohen's PSS) consists of self-reported indicators of stress, which aim to quantify one's feelings according to a scale of perceived stress ranging from low, medium, high, very high (0 to 4)[15].

f. Statistical analysis:

Initially, descriptive analyses were used to determine the crude prevalence of hypertension and T2DM, characteristic of the study population, the frequency of environmental risk factors in the overall sample. X^2 test, correlation, and binary regression statistical analyses were performed using SPSS software (version 22.0). The significance level was set at 0.05.

RESULTS

A. **Sociodemographic characteristics of the study population:**

The characteristics of the study population are presented in the **Table: 1.**

Four hundred and four subjects were enrolled, 296 in urban and 108 in rural areas. The mean age of the participants was 41.1 ± 11.1 years, and the majority (72%) was younger than 50 years. The female gender was the most dominant among our respondents, representing 71% of the participants. (**Table 1**)

B. **Prevalence of T2DM and hypertension: (Table 2)**

According to the data in Table 2, the overall prevalence of all types of diabetes was estimated at 23.5%, T2DM represented 21% of which 11.38% were known diabetics under treatment and 12.2% of diabetics newly diagnosed at the time of the survey were from urban 14% more than rural 8% (**Figure 1**). One person in ten reported having a family history of diabetes. The prevalence of T2DM increased significantly with age (p=0.0001) ranging from 20% for [18-33] year olds, to 43.52% for [50-65] year olds.

The overall prevalence of hypertension was 16.58%, 11% of whom reported being hypertensive compared to 5.44% who did not know they were hypertensive. Almost half (41%) of the hypertensive were from rural areas and only 8.2% were from urban areas (**Figure 1**). A significant proportion of men were hypertensive, 8.41% versus only 2.72%. This prevalence increased significantly with age in both sexes, from 4.4% in [18-33] year olds to 17.8% in [34-49] year olds and 77% over 50 years of age (66.7% in [50-65] year olds and 11% in over 66-year-olds) ($p < 0.0001$).

For systolic blood pressure (SBP) values, they were greater than 14 in one-third of the participants, and 33.4% had a DBP value greater than 9.

C. **Risk factors in the total population: (Table 3)**

The risk factors detected in our sample were physical inactivity 74%, abdominal obesity 60.89%, sedentary lifestyle 57.42, overweight 40%, stress 52.72%, general obesity 31%, and smoking 7% and alcohol use 2.47% (**Figure 2**).

Table 1 : Sociodemographic data of consultants

Variables	Total number (%) (n=404)	urban (n=296) 73%	Rural (n=108)27%	P value IC95
Gender				
M	116 (28.71%)	88(29.72%)	28 (25.92%)	0.456 NS
W	288(71.28%)	208(70.27%)	80 (74.07%)	
Age (years)>18 years				
18-33 (1)	134 (33.16%)	95 (32.3%)	39 (36.11%)	0.537 NS
34-49 (2)	155 (38.36)	112 (37.83%)	43 (39.81%)	
50-65 (3)	103 (25.49%)	77 (26.01%)	26 (24.07%)	
> 66 (4)	12(3%)	12 (4.05%)	0 (0%)	
School level				
Illiteracy	78 (19.30%)	56 (18.91%)	22(20.37%)	0.235 NS
Coranic school/ Primary	122(30.19%)	82(27.70%)	40(37.03%)	
Secondary level	117(29%)	93(31.41%)	24(22.22%)	
Superior level	87(21.53%)	65(22%)	22(20.37%)	
Occupation				
Without	53 (13.11%)	37(12.5%)	16(14.81%)	NS 0.23
Student	26(6.43%)	15(5.06%)	11(10.18%)	
Liberal profession	51(12.62%)	40(13.51%)	11(10.18%)	
Public profession	85(21.03%)	60(20.27%)	25(23.14%)	
Retired	15(3.71%)	13(4.39%)	2(1.85%)	
Homemaker	148(36.63%)	112(37.83%)	36(33.33%)	
Medical Cover				
Without	56(13.86%)	43(16%)	13(12.03%)	**NS**
AMO	98(24.25%	73(24.66%)	25(23.14%)	
RAMED	248(61.38%)	178(60.13%	70(64.81%)	
Other	2(0.49%)	2(0.67%)		
AMO :obligatory health insurance, RAMED:Medical insurance for the poor				

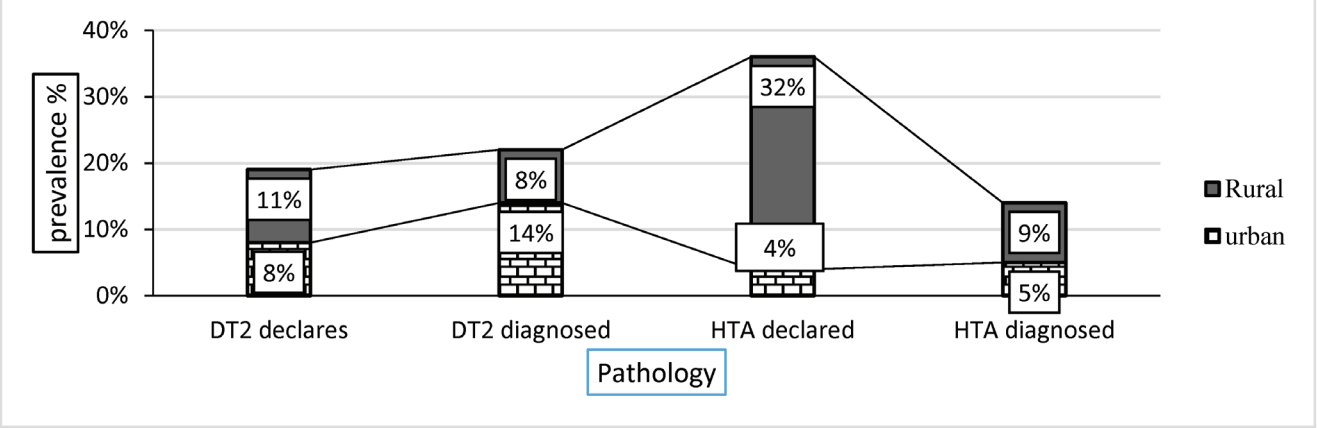

Figure 1. Prevalence of T2DM and hypertension in the province of Berkane between urban and rural areas.

Table 2: Clinical data of consultants

Variables	total Number (%)(n=404)	Urban (n=296)	Rural(n=108)	P value
Self-reported medical history				
DT1	10(2.47%)	8(2.70%)	2(1.85%)	
DT2	36(8.91%)	24(8.10%)	12(11.11%)	0.052*
HT	45(11.13%)	11(3.71%)	34(31.48%)	
Newly diagnosed disease				
DT2	49(12.12%)	41(13.85%)	8(7.40%)	0.052*
HT	22(5.44%)	12(4.46%)	10(9.25%)	
Family history				
Yes	39(9.65%)	28(9.45%	11(10.18%	NS
Fasting Glycemia (404)				
Normal	318(78.71%)	244(82.43%)	74(68.51%)	0.002*
Abnormal >1.26g	85(21.28%)	50(16.89%)	36(33.33%)	
Hb1ac (86)				
<7	21(24.41%)	09(10.46%)	13(15.11%)	0.012*
>7	64(74.41%)	47(54.65%)	17(19.76%	
BMI				
< 25	117(29%)	84(28.37%)	33(30.55%)	0.818 NS
Between [25-29,9]	161(39.85%)	123(41.55%)	38(35.18%)	
>30	126(31.18%)	89(30.06%)	37(34.25%)	
Report TT/TH				
Normal	158(39.10%)	112(37.83%)	46(42.59%)	0.387 NS
Abnormal	246(60.89%)	184(62.16%)	62(57.40%)	
SBP (Systolic pressure)				
<14	282(69.80%)	213(79.18%)	69(63.88%)	0.118 NS
>14	122(30.2%)	83(30.85%)	39(36.11%)	
DBP (Diastolic pressure)				
<9	269 (66.85%)	206 (76.57%)	63(58.33%)	0.034*
>9	135(33.41%)	90(33.45%)	45(41.66%)	

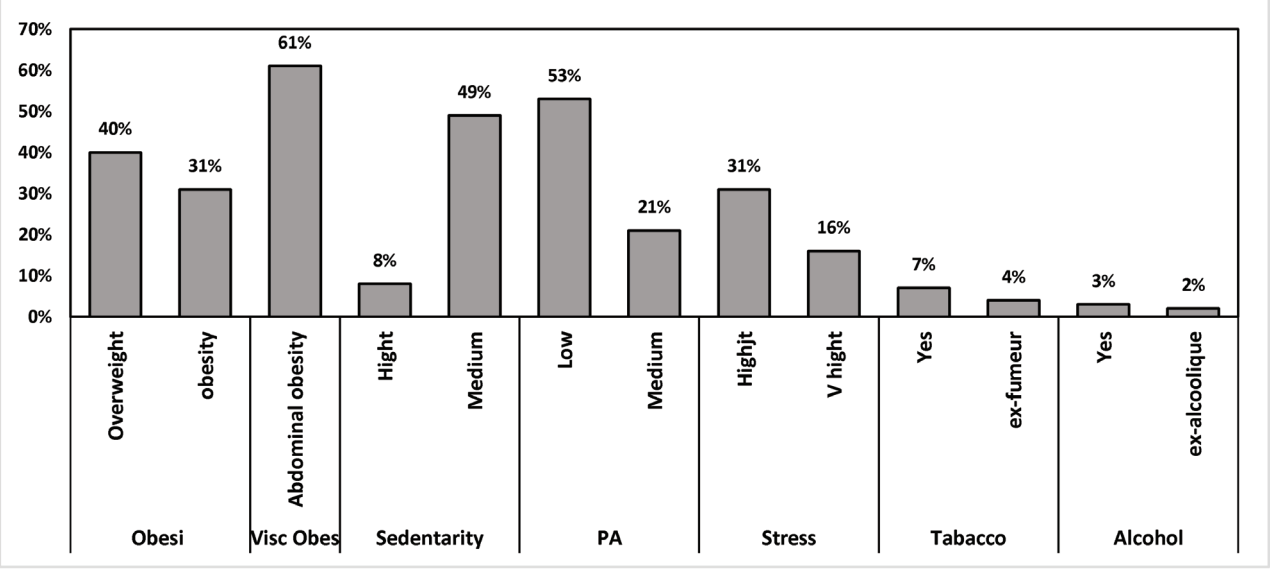

Figure 2. Prevalence of risk factors province of Berkane.

Table 3: Distribution of RDF by gender, age, residence, education and occupation

Risque factors	Gender			Years					Residence			Scholar level					Profession					
	M	F	P	1	2	3	4	P	U	R	P	NS	Pri	Sec	Sup	P	SS	FF	Fonct	Retr	Etud	P
Overweight (161) **Obesity** (126)31.%	61 19	100 107	0.0001**	54 45	65 48	37 32	5 2	0.022	123 89	38 37	NS	25 33	44 38	50 35	42 12	0.0001**	16 15	56 56	74 50	8 2	5 2	NS
AbdominalObesity (246)	66	180	0.048*	89	95	60	6	NS	184	62	NS	48	74	73	51	NS	26	96	101	8	0	NS
Sédentarity High (33) Medium (199) Low (150) Active (22)	05 82 53 07	28 117 97 15	0.0015*	27 75 21 11	13 76 57 09	07 57 37 02	02 01 09 00	NS	24 143 111 18	09 56 39 04	NS	07 37 32 04	12 62 44 04	07 57 45 08	07 45 29 00	NS	05 23 14 06	16 85 42 05	08 68 59 05	03 05 06 01	01 09 12 04	NS
PA Low (217) Medium (82) High (89) Very high (16)	47 31 27 11	170 51 62 05	0.0001**	78 30 20 06	102 24 25 04	65 19 13 06		NS	229 32 25 10	86 08 12 02	NS	46 17 14 01	83 21 13 05	67 27 17 06	37 19 23 05	0.0001**	27 08 11 01	113 19 13 02	84 47 19 12	07 04 03 01	15 03 08 00	NS
Stress (psycho) Little (95) Medium (118) High (127) Very high (64)	33 36 33 14	62 82 94 50	0.052*	35 39 44 23	34 49 48 24	27 29 34 13	06 02 04 00	NS	114 91 90 01	45 27 36 00	NS	23 33 10 12	25 39 39 19	21 42 41 13	27 18 27 15	NS	20 19 10 04	30 52 34 32	37 43 63 19	04 03 07 01	03 05 12 06	NS
Tabacco Yes (28) No Ex smoker (21)	27 74 15	01 281 06	0.0001**	06 124 04	10 135 10	05 91 07	07 05 00	NS	19 262 15	02 100 06	NS	01 69 08	03 112 07	13 101 03	03 73 11	0.0001**	03 46 04		12 140 10	02 06 07	07	NS
Alcohol Yes (10) No Ex alcoholic (10)	10 97 09	0 287 01	0.0001**	04 127 03	01 152 02	05 98 05	0 12 00	NS	02 07	08 03	NS	04 78 0	01 118 2	03 08	02 82 00	0.058*	0 52 01	08 0	02 09	0 13 00	0	NS

Physical inactivity was the first factor that prevailed, it represented 74% of our surveys with a female predominance (78.34%) whose relationship was highly significant p=0.0001. According to the level, between 20.3% and 53.71% of the consultants exercised a moderate to low intensity PA, while only between 4% and 22% pursued a very high-to-highintensity PA (**Figure 3**). The multivariate analyses show that these results do not seem to be modified by age, place of residence, or occupation, while a significant association was found between this parameter and the level of education with a p value=0.0001.

Abdominal obesity was in second place in the cohort as a whole with a higher prevalence of 61%, with a small difference between male and female, 62.5% vs. 57% (p=0.048), and with no difference for other sociodemographic parameters.

Sedentary lifestyle: A hight sedentary lifestyle was detected in 8.16% of our population, while about half (49.25%) had a medium level of sedentary lifestyle, against 5.44% to 37.12% their level of sedentary lifestyle oscillates between very low and low (**Figure 3**).

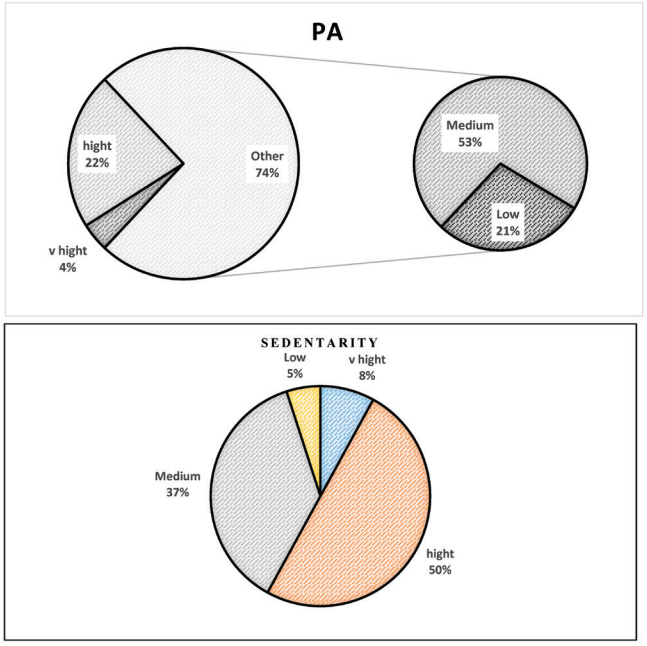

Figure 3. Prevalence of PA and sedentarity in province of Berkane

The female sex was more concerned by this event than the male sex with a p-value=0.015, the large proportion of unemployed homemakers (96 women) in our population can explain this result.

Weight status: The average BMI of the participants was 28.1 ± 3.7 kg/m ^{2}, about 40% were overweight and 31% were obese according to the World Health Organization classification. In contrast to the other RFs, weight status correlated with all parameters except residence; sex p=0.0001, age p=0.022, school level p=0.0001, and occupation 0.0001.

Stress (psychological): According to the data in **Table 3**, between 31.43% and 15.84% of our population stated that they had been exposed to stress ranging from high to very high levels, however, more than half 53% experienced little or moderate stress in their daily lives. This factor does not seem to have any relationship with the different sociodemographic parameters.

Smoking: Participants who reported smoking were approximately about 7% and 3.46% were former smokers. Smoking status was highly correlated with gender and occupation, with p=0.0001.

Alcohol use: For alcohol status, only 2.47% reported current alcohol use and 2.47% were former drinkers.

D. **Risk factors by disease type:**

Binary regression between the presence of T2D/HT and risk factors showed the following results: (**Table 4**).

On the one hand, T2DM was significantly associated with certain non-modifiable risk factors, such as age (0.0001) and place of residence (p=0.003). On the other hand, no association was found between this pathology and gender, family history, level of education, and occupation. A diabetic has a five times risk of being hypertensive with p=0.0001 and an (Relative Risk) RR 5.654 [2.962-10.792].

On the other hand, type 2 diabetes is associated with modifiable risk factors such as: BMI>30 p=0.014 with a risk ratio of 2.464 [1.251-2.857] and a highly significant association with abdominal obesity with p=0.0001, risk ratio of 2.136 [2.046-3.290].

Regarding hypertension, the modifiable risk factors with which it is significantly associated are: overweight p=0.004 and odds ratio 1.280 [1.116-1.673], and obesity p=0.006 OR 1.327 [1.148-3.723], also waist circumference and highly significant with hypertension p=0.0001 odds ratio 2.136 [2.046-4.290].

On the other hand, hypertension was not associated with sex, place of residence, and occupation, whereas it was significantly associated with age p=0.0001, family history 0.004, and educational level p=0.027.

DISCUSSION

Few studies have focused on the study of environmental RF in the eastern region, to our knowledge; our study is the first of its kind conducted in the province of Berkane.

A. **Risk factors in the general population:**

Our results indicate that physical inactivity was the dominant risk factor in our cohort with 74%, female gender was the most concerned with 78.34%, but no significant relationship between residence, age, or educational level was detected. This result is close to those announced by the (World Health Organisation) WHO, which states that 60% of the world's population does not manage to maintain an activity at the recommended level[16]. However, these results are higher than the data reported in the (National Institute of food safety) INCA3 study, which showed that 45% of men and 55% of women were inactive[17]. According to *Loyen*and al, if objective measurements of PA are taken (accelerometers) it is more like 70% of adults are inactive[18].

The first result of physical inactivity is excess weight, particularly visceral adiposity, it represents 61% of our sample, and i.e. six adults out of 10 have abdominal obesity, of which the majority is attributed to the female sex (64%). This prevalence is lower than that found in women in the region of Meknes and the eastern region (Oujda) in Morocco with respectively 98% and 79.1% of patients with abdominal obesity[19,20].

In addition, several studies have reported a high prevalence of obesity in women compared to men in both urban and rural areas[21] , this can be explained in large part by certain events in women's lives (childbirth, menopause) that could promote the development of obesity[21]. Indeed, our population was composed of more at-risk subjects such as women (71.28%), unemployed and therefore often sedentary subjects (13.61%).

Sedentary times were also high, as about 57.42% had between high and medium sedentary times. The latter would be responsible for 8% of premature death per hour spent in a sitting position beyond 8 hours/day. It is associated with all causes of mortality and specific morbidity: cardiovascular mortality with an incidence of between 1.95 and 5.32; incidence of cancer between

Table 4: risk factors according to each pathology T2DM and hypertension.

Modifiable risque factor	DT 2 (n=85)			HT (n=67)		
	Yes	P value	OR IC95%	Yes	P value	OR IC95%
Gender M W	31(36.47%) 54(63.5%)	0.17 NS	2.416[1.858-2.336]	45(67.16%) 22(32.83%)	0.502 NS	0.783[0.382-1.603]
Years 18-33 34-49 50-65 >66	17(20% 28(32.94% 37(43.52% 7(8.23%	0.000**	Chi2 32.661	4(5.98%) 11(16.41%) 34 (50.74%) 18(26.86%)	0.0001**	X^2 63.980
Residence Urbain Rural	50(58.82%) 35(41.17%)	0.003*	NA	45(67.16%) 22(32.83%)	0.71 NS	0.874[0.426-1.793]
Family History Yes	25(29.41%)	NS 0.185	1.732[0.766-3.913]	15(22.38%)	0.004*	
Level school Illiteracy/primary Secondary /superior	46(54.11% 39(45.88%	NS	X^2 5.048	42(62.68% 25(37.31%	0.027*	X^2 9.173
BMI Normal overweight obesity	22(25.88% 23(27.05% 40(47.05%	1 0.207 0.014*	1 1.650 [1.334-2.268] 2.464 [1.251-2.857]	11(16.41% 17(25.37% 25(37.31%	1 0.004* 0.006*	1.280[1.116-1.673] 1.327[1.148-3.723]
TT/TH Normal Abnormal	45(52.94% 40(47.05%	1 0.0001**	2.136[2.046-3.290]	45(67.16%) 22(32.83%)	1 0.0001**	2.136 [2.046-4.290]
HT Yes	65(76.47%	0.0001**	RR 5.654[2.962-10.792]	25(32.83%	0.0001**	RR 5.654[2.962-10.792]
PA Never/Sometimes Often/Always	76(89.41%) 9(10.58%)	NS	[0.122-0.103]	52(77.61% 15(22.38%	0.165 NS	X^2 5.091
Sedentarily V high/High Medium/ Low	54(63.52) 31(36.47)	NS	NA	39(58.20 28(41.79)	NS	
Tabacco No Yes ex	74(87.05% 5(5.88% 6(7.05%	NS 0.836	1.173 [0.351-3.618]	53(79.10% 0 14(20.89%	NS 0.803	0.609 [0.141-2.640]
Alcohol No Yes ex	77(90.85% 2(2.35% 6(7.05%	NS 0.202	0.336[0.089-1.273]	55(82.08% 0 12(17.9%)	NS 0.635	1.792[0.161-19.915]

1.33 and 3.67; incidence of death from type 2 diabetes between 1.77 and 2.87[22].

The most recent meta-analysis included six cohort studies that used accelerometers (33 386 subjects). It showed that mortality increased gradually from 9 hours of sedentary time per day, with an increased risk of overall mortality of 48% for 10 h/d (IC95%: 1,22–1,79) and multiplied by 2.92 (95% CI: 2.24-3.83) for 12 h/d sitting (multivariate analysis)[17].

Overweight and general obesity represent respectively 40% and 31% in our study population, similar results to some recent surveys that revealed that in Kuwait, 48% of women and 36% of men were obese, while 77% of women and 74% of men were overweight. In Saudi Arabia, 44% of the female and 28% of the male were obese. However, 71% of women and 66% of men are reported to be overweight[23]. With regard to gender distribution, women have been disproportionately affected by extreme obesity compared with men, a fending that has been supported by another research[23]. Therefore, the increase in age was clearly significantly associated with overweight, obesity p=0.022, large population studies indicate that BMI increases progressively during adult life, peaking at [50-59] years of age in men as well as women, showing a decreasing trend in BMI after age 60 years[23].

Education level was identified as a significant predictor of obesity, which is likely to be the case in Greek and American populations where the risk of being obese was lower in educated women than in illiterate ones[23] unlike the Japanese and Lebanese, where less educated people had a high BMI[23].

Similarly, our study showed that the prevalence of stress was 47%. This (psychological) factor is responsible for biological changes related to the alteration of health status as it has been documented in scientific research worksc[24].

These risk factors are responsible for the increased prevalence of hypertension and T2D:

The first investigations of the study (**Table 2**) showed, first, a prevalence of T2DM of 21%, which far exceeds the estimates recorded at the national level of 10.6%[2]. and at the regional level of 6.6% in the prefecture of Oujda and 6.7% in the city of Rabat[20].

Among these diabetics, there was a rate of undiagnosed diabetes equivalent to 12.12%, a result similar to that of the survey conducted in the two regions of Grand Casa and Rabat 12.8%[25]. In contrast, it was 4.3% among U.S. adults in a survey conducted between 2013-2016[26].

Also, the prevalence of hypertension in our sample was 16.57% of which 5.44% was undiagnosed. This value is lower than the rates collected in some regions of Morocco; in Rabat, it is 25%, in the prefecture of Oujda it was 35%[20], then in Maghreb countries, such as Algeria 36.2% and Tunisia 31%[20]. Despite these high values, the rates recorded in developing countries remain lower compared to developed countries (38% in Italy, 45% in Spain, 31% in France)[20].

When diabetics and hypertensive patients were crossed with modifiable RF (**Table 4**), we found that the proportion of diabetic individuals was positively and significantly associated with overweight: either general or visceral, so that an obese person has twice the risk of being diabetic than a person with a normal weight (Odds Ratio) OR=2.464 [1.251-2.857]. This relationship has been widely documented in the literature, highlighting the role of BMI in the etiology of cardiovascular disease (CVD)[23]. It is a modifiable and preventable risk factor for insulin resistance resulting in impaired glucose tolerance that favors the development of diabetes with a BMI ≥35Kg/m^2. [23]

In addition, abdominal obesity was found to be associated with diabetes status (50%) **Table 4**. The results showed a highly significant relationship at 1% P <0.0001, an OR: 2.136 [2.046-3.290] the relative risk of having diabetes was 2 times higher in people with visceral obesity. Pathophysiological, T2DM is a disease intimately associated with abdominal adiposity that aggravates insulin resistance and low-grade inflammation[27].

Also, the prevalence of hypertension increases with weight gain in our study using the WHO cutoff value. In previous studies, increased blood pressure has been shown to be associated with weight gain, and an estimated 60% to 70% of adults with hypertension are related to adiposity[28].

CONCLUSION:

In conclusion, our results show an alarming prevalence of T2DM and hypertension. The risk factors were similarly present in urban and rural areas, suggesting a possible transition that will become more pronounced in the coming years.

In general, physical inactivity, obesity and overweight appear to be the main determinants and modifiable factors in the province of Berkane in eastern Morocco, particularly among women. There is there-

fore an urgent need to introduce prevention programs based on awareness-raising, health education and early diagnosis in order to reduce the burden of these diseases.

Perspectives and limits:

In this article, we have only presented some risk factors, planning to publish other articles later on that detail the nutritional status, the adherence to the Mediterranean diet.

Declaration of interest

The authors declare that they have no ties of interest. They are solely responsible for the writing and content of this article.

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