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Epidemiology of Hypertension in the Prefecture of Figuig, Morocco

Authors: E. Rida[1,*]; A. Soulaymani[1]; H. Hami[1]; M. Abdelrhani[1]

Affiliations: *[1]Laboratory of Genetics and Biometry, Faculty of Science, Ibn Tofail University, Kenitra, Morocco*

ABSTRACT

BACKGROUND: Hypertension continues to be a public health problem with devastating consequences globally, particularly in developing countries where there is an acute paucity of hypertension data.
The aim of this study was to describe the epidemiological, clinical, and treatment characteristics of hypertensive patients in the prefecture of Figuig, Morocco.
METHODS: Retrospective analysis of hypertensive patients' medical records from 2010 to 2020. The diagnosis, treatments, and complications were reported by physicians and cardiologists. Data analysis was made according to epidemiological, clinical complications, and treatments.
RESULTS: Hypertension progressed from 871 cases in 2010 to 1785 cases in 2020 with an average annual incidence rate of 105.56/100,000 person-year, affecting more women than men (68% vs 32%). Hypertension was higher among rural residents compared to urban residents (54.0%vs 46%). Hypertension was noted in 65.4 % of patients aged 60+, and in 30.49% of patients aged 40-59. The incidence proportion of clinical complications is $I^{p}_{complications}$=18.35/1000 person-year, principally cardiovascular diseases (45.42%), stroke (25.55%), retinopathy (17.98%) and nephropathy (10.41%). The most antihypertensive drugs used were Calcium channel blockers (33.39%), Angiotensin-converting enzyme inhibitors (21.13%), Angiotensin receptors blockers (21.21%), diuretics (19.4%), beta-blockers (5.38%) and central antihypertensive (10.46%) with an average coverage needs of treatments in the prefecture as (47.29%).
CONCLUSION: Hypertension progresses gradually in the prefecture, higher among older individuals, women and rural residents. Large proportion of patients cannot find their treatments in health care structures which lead to poor blood pressure control, accelerating the appearance of complications.

Keywords: Hypertension, Antihypertensive, Complications, Incidence, Morocco

INTRODUCTION

Hypertension is the leading risk factor for cardiovascular diseases and a major cause of premature death [1]. Chronic hypertension is associated with stroke, ischemic heart diseases, retinopathy, and end-stage renal disease. A small portion of hypertensive patients [5-10%] has renal or adrenal pathologies as the underlying cause ("secondary hypertension"), while the vast majority (90%) of cases have "essential hypertension" in which no clear biochemical

***Corresponding author:** Elyamani Rida, Email: rida.elyamani@uit.ac.ma, Laboratory of Genetics and Biometry. Faculty of Science. Ibn Tofail University. Kenitra. Morocco;
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mechanisms are identified [2]. Blood pressure is in part determined by cardiac output and peripheral resistance, with most cases of essential hypertension having normal cardiac output but an elevated peripheral resistance. The vasculature structure is dominated by small muscular arteries and arterioles, which are regulated by nerves, hormones (e.g., Adrenaline and Nor-Adrenaline), circulating factors (e.g., Angiotensin II) and local regulators (e.g., Nitric oxide and Endothelin) [3]. In order to explain this phenomenon, many risk factors have been explored intensively in various cohort studies, which show that slate intake, obesity, insulin resistance, renin-angiotensin system and sympathetic nervous system are the most important actors.

According to the world health organization (WHO), approximately 1,13 billion individuals have high blood pressure (1 in 4 men, and 1 in 5 women), translated into a global prevalence of 31.1% (95% CI: 30-32.2%) (2010). The numbers are higher in low- and middle-income countries (LIMIC) compared to high-income countries (HIC) (31,5% versus 28.5%) [4].

According to the WHO, Morocco has one of the highest prevalence in the Euro-Mediterranean Region (EMR), estimated in 2000 by the ministry of health as 33.7%. In 2017, the results of STEPS showed a prevalence of 29.3% with no difference in gender or residence status. Another study conducted in Eastern Morocco estimated a regional prevalence of hypertension of 31.7% with no gender difference but with higher frequency among rural residents than urban residents (39.9% vs 29.0% p<0.001).

In Morocco, as in many other developing countries, there is paucity of hypertension data, and the majority of data comes from international studies (peer-reviewed). This scarcity of data affects the distribution of hypertension in various regions in Morocco, and is due in part to a lack of scientific resources and medical records in the health care system.

The main objective of this study is to describe the epidemiological, clinical and treatment characteristics of hypertension in the prefecture of Figuig, Morocco.

METHODS

Study design and data sources: This research is a retrospective study analyzing hypertension data of registered patients between 2010 and 2020 in the prefecture of Figuig. Located in Eastern Morocco, this province has an area of 55,990 Km^2 and a total population of 139,631 inhabitants (2020), half (50%) of which live in rural areas.

The data source is medical records of all hypertensive patients, collected from all prefecture health care structures, which were updated every 3 months by the epidemiologist for both old and new cases. All new cases of hypertension with confirmed medical diagnosis, are identified, registered and followed. Under the program of non-communicable diseases management, patients with hypertension were followed, and benefited from periodic consultations, and pharmacological treatment delivery.

The diagnosis of hypertension was made according to the WHO criterion (systolic blood pressure (SBP) ≥140 mmHg and/or diastolic blood pressure (DBP) ≥ 90 mmHg), and signed by a physician or cardiologist. All clinical complications were diagnosed by physicians or other specialists (e.g., ophthalmologists, cardiologists) and reported in the medical records. The pharmacological prescriptions were signed by physicians, and used by all health structures for medicine delivery, and physicians signed any change in treatment. In this study, only hypertension treatment was considered.

Our data reports cases of loss to follow-up, without specification of the cause; death, emigration from the prefecture, or simply due to lack of compliance.

In order to calculate the epidemiological characteristics of hypertension, we have referred to the demographic projections from the National High Commission for Planning (HCP) [5], and the prefecture's population was considered a closed society.

This study was a part of research project investigating cardiovascular diseases in the prefecture and was approved by the university of Ibn-Tofail and the Ministry of health through written consent of partnership (PARTNERSHIP 01/ December/2016/Kenitra). No external funding was used to support this work.

Statistical analysis: Data extraction and the transfer were made from hypertensive patients' records into electronic data, and the quality of this operation was controlled by different researchers to check for any possible errors. Our analysis was made according to gender, age, areas of

residence, the type of clinical complication and the pharmacological treatment.

We performed statistical analysis using Epi-Info™ Software version 7.1.5. continuous variables were presented as mean and standard deviation (SD) or percentages (%) and categorical variables were expressed as frequencies or percentages. Appropriate statistical tests (t-test, Fischer t-test and x^2-test) were used to compare proportions and groups.

RESULTS

By the end of 2010, the total number of hypertension cases was 871 cases, of which 72.45% were females. And by the end of 2020, the total number of hypertensive subjects was 1786 cases, of which 68.36% were females (Figure 1).
Globally, the sex-ratio (m/f) was 0.46 with 68.0% females. Patients from urban areas represented 54% versus 46% from rural areas. Patients aged 60 years or older were the largest proportion, by 65%. Over 10 years, the number of hypertensive subjects has almost doubled, following the demographic growth in the prefecture, from 134,632 inhabitants in 2010 to 139,631 in 2020.
The average prevalence of hypertension in the prefecture between 2010 and 2020 was; 830.72/10^{-5} PY (95% [669.35-1070.91]) (Figure 2). Considering the demographic structure by areas of residence, the average prevalence in urban areas is 770.57/10^{-5} PY (95%, [506.65-1356.55]) and in the rural areas is 931.3/10^{-5} PY (95%, [506.05-1356.55]) (Figure 3). When comparing the prevalence by residence, the difference is insignificant (p=0.21).

In terms of gender, the average prevalence among males is 538.25/10^{-5} PY (95%, [420.67-655.85]) and among females is 1108.14 (95%, [903.73-1312.56]) (p<0.001).
Regarding the age groups, we have calculated the

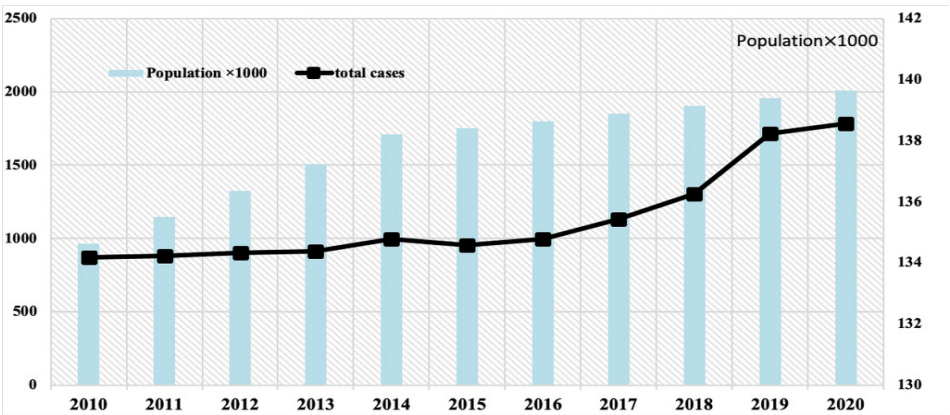

Figure 1: Evolution of total cases of hypertension and the total population in the period between 2010 and 2020.

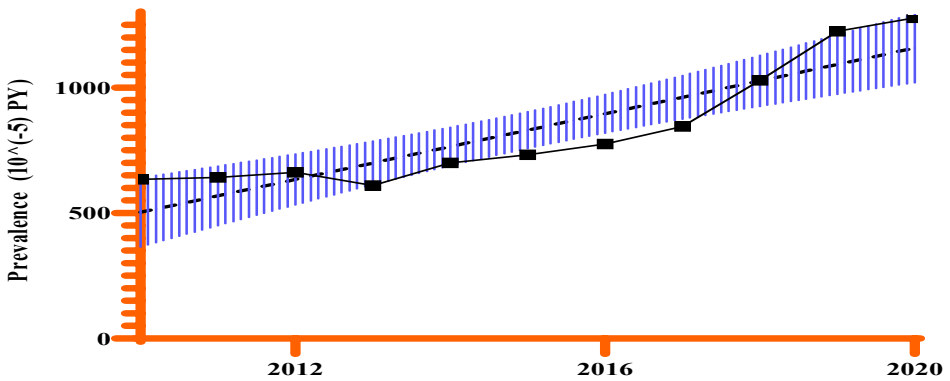

Figure 2: Evolution of hypertension prevalence

prevalence for 4 groups as follows:
-[0-19years]; 0.68/10^{-5} PY (95%, [0-5.56])
-[20-39years]; 124.15/10^{-5} PY (95%, [95.75-152.54]).
-[40-59years]; 1316.97/10^{-5} PY (95%, [990.96-1642.27]).
-[60years and older; 5613.63/10^{-5} PY (95%, [5155.18-6072.06]).

The prevalence of hypertension increases with age.
When studying the distribution of prevalence in terms of; "age, gender" and "age, areas of residence," we concluded that the population aged between 40 to 59 years from rural areas was the portion of the people who developed hypertension rapidly (Table 1).

The average of new cases of hypertension recorded each year is 146.28 cases, translated into 30.19 cases in urban areas and 116.10 cases in rural areas.
The average annual incidence of hypertension between 2010 and 2020 is; 105.56/10^{-5} PY (95%, [67.83-161.73]) (Figure 4). The average incidence in rural areas is 173.01/10^{-5} PY (95%, [92.66-253.36]) and in urban areas is 43.57/10^{-5} PY (95%, [92.66-253.35]). The difference between the residential areas is significant (p=0.04) (Figure 5).
The incidence increases with age groups; from 0.34/10^{-5} PY (95%, [0- 1.46]) for the group [0-19years], 11.52/10^{-5} PY (95%, [0.32-22.72]) for the group [20-39years], 78.28/10^{-5} PY (95%, [17.99-138.57]) for the group [40-59years] and 276.63/10^{-5} PY (95%, [77.68-457.58]) (p<0.05).

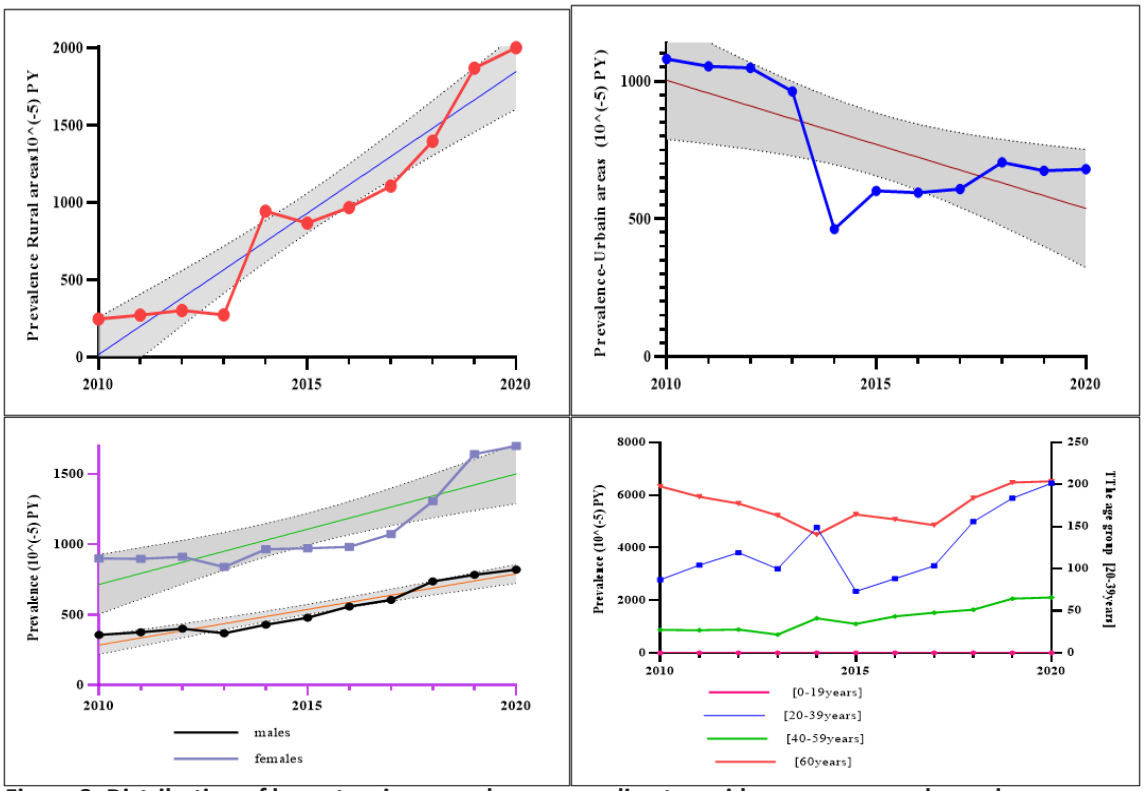

Figure 3: Distribution of hypertension prevalence according to residence areas, gender and age groups.

Table 1: Comparison between the age groups and residence areas, in terms of prevalence

Comparison between age groups of urban and rural areas	p-value
20-39 years	0.07
40-59 years	0.001
60 years and older	0.7

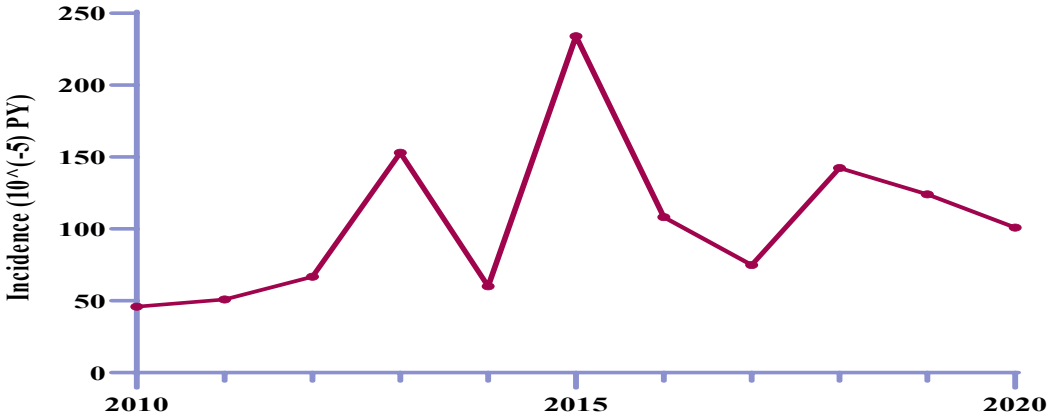

Figure 4: Evolution of annual incidence in the prefecture of Figuig between 2010 and 2020

In terms of gender, the incidence of hypertension among males was; 32.47/10^{-5} PY (95%, [19.19-45.74]) and among females; 56.86 (95%, [25.81-87.92]). The difference is not significant (p=0.27).
The prevalence of hypertension increases steady over years, while the incidence fluctuates with major pick; in 2015 (234.07/100,000PY).
Our data recorded the number of patients lost to follow up (without specification of the cause) by an average of 153.7 patients/year.

Globally, and over 10 years, the percentage of followed hypertensive patients who developed clinical complication is 2.5%, with an average of 0.25% each year, with 21.5 recorded cases per year.
The clinical complications are classified into five major classes:

- Stroke: 25.56%
- Cardiovascular diseases: 17.99%
- Nephrology complications: 10.42%
- Ophthalmologic complications: 17.99%
- Other complications: 0.64%

The prevalence total of clinical complications is 2.36% (95% [1.41-3.76]). The annual incidence of stroke and cardiovascular is 0.42% and 0.76% respectively (Figure 6).
When comparing the prevalence of each complication class; the difference between the stoke and the cardiovascular is no significant (p=0.1) and the difference between the cardiovascular and the other manifestations is significant; p=0.03, p=0.02 (Table 2).

The new cases of clinical complications were reported to the general population, in order to estimate the global risk of developing clinical complications from hypertension for a random individual living in the prefecture during the period of the study (Table 3)
The global risk of developing the clinical complication is: R_{global}=18.39 ×10^{-3}/year

Under the national program of non-communicable prevention by the Ministry of Health, six pharmacological classes delivered by all public health structures are:

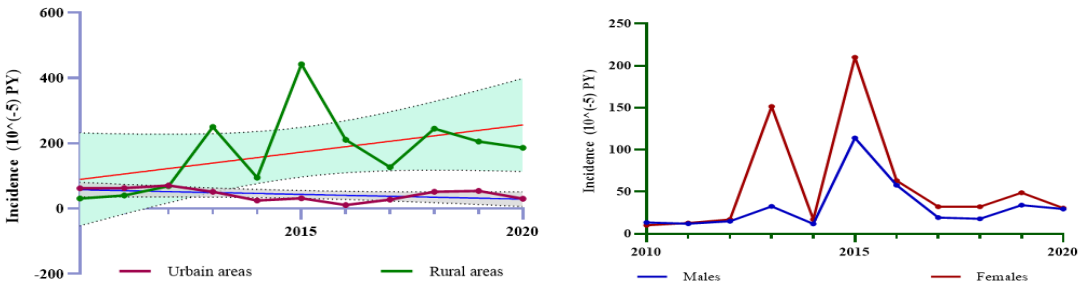

Figure 5: Distribution of annual incidence according to residence areas and gender

Calcium channel blockers (CCB): Amlodipine (5mg, 10mg), Nicardipine (10mg, 50mg)
Converting Enzyme inhibitors (CEI): Captopril (25mg), Ramipril (10mg, 5mg, 2.5mg)
Angiotensin Renin Blockers (ARB): Losartan (50mg, 100mg)
Diuretics (D): Furosemide (injection, 40mg Tablets), Hydrochlorothiazide (25mg), Indapamide (1.5mg), Spironolactone (50mg)
Beta-Blockers (ß (-)): Atenolol (100mg), Propranolol (40mg)
Central Antihypertensive (CA): Methyldopa (250mg)
The general prescription trends of these medications were evaluated through the expressed needs by the health care structures to be delivered to their registered patients. Thus, the average use of these pharmacological classes was: CCB; 33.39%, CEI; 21.13%, ARB; 21.21%, D; 19.4%, ß (-); 5.38%, CA; 10.46%, and the average coverage of these needs were calculated through the quantity of medication delivered to the patients; CTN (%) = 47.29%. The variation of medical prescriptions through the study period is presented in Figure 7.

To study the correlation (rs) between the CTN (%) and the incidence of clinical complications (Figure 8), we have considered values of CTN (%) <40% as poor performance of the pharmacological treatment availability and values of clinical complications incidence >1% as an increasing case; (rs)=-0.21 with (RR)=0.7 and (OR)=0.4.

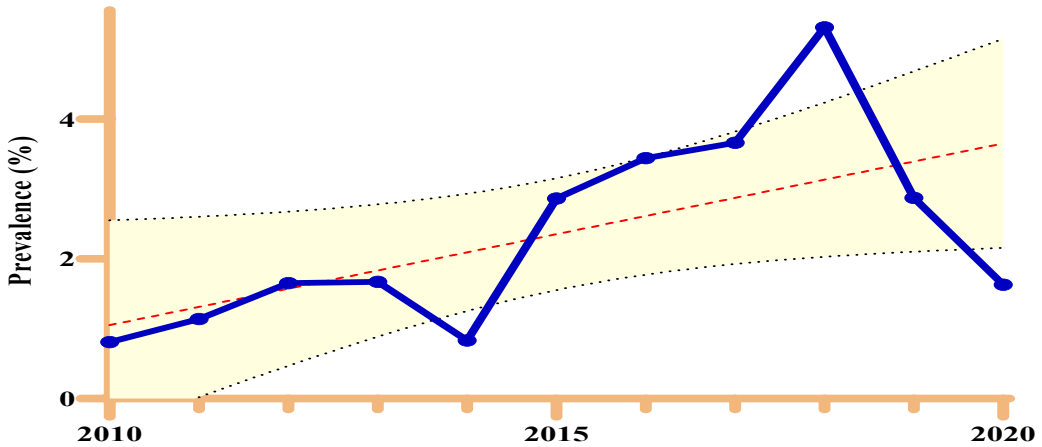

Figure 6: Evolution of the prevalence of hypertension clinical complications

Table 2: Characteristics of hypertension clinical complications

Complication class	Symptomatology	Percentages (%)	Prevalence (%)	Incidence (%)
Cardiovascular diseases	Stroke	25.56%	0.63% (95%, [0.34-1.04])	0.42% (95% [0.21-0.71])
	Myocardial Infarction, heart failure, ischemic heart disease,	45.43%	1.06% (95%, [0.57-1.54])	0.76% (95%, [0.29-1.23])
Nephrology complications	Kidney damage, kidney failure including renal end-stage	10.42%	0.24% (95%, [0.08-0.38])	0.16% (95%, [0.05-0.28])
Ophthalmologic complications	Retinopathy	17.99%	0.44% (95%, [0.22-0.65])	0.22% (95% [0.1-0.35])
Other complications	Dementia	0.64%	0.03% (95% [0-0.07])	0.01% {95% [0-0.04])

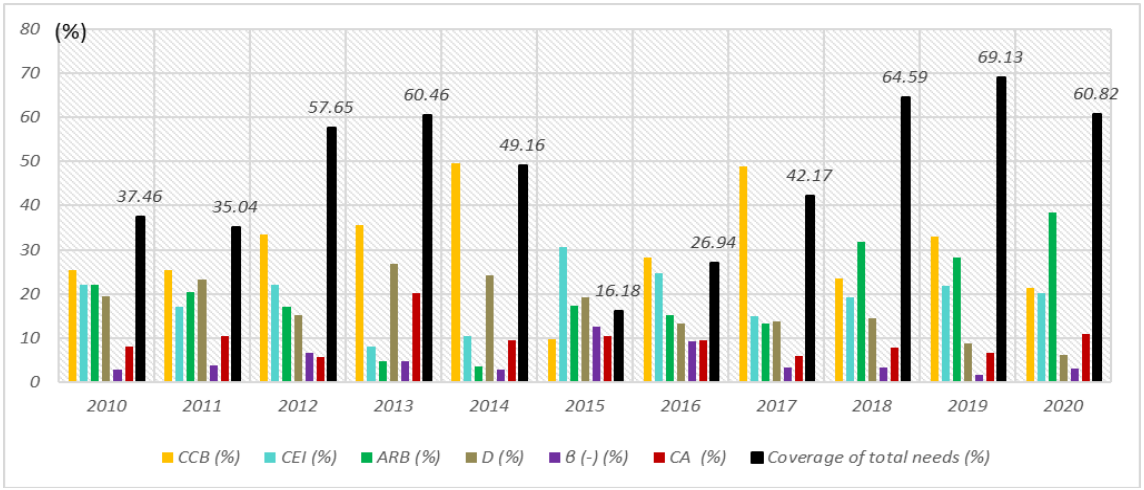

Figure 7: Variation of prescription trends of antihypertensive drugs and the percentage of prescriptions coverage

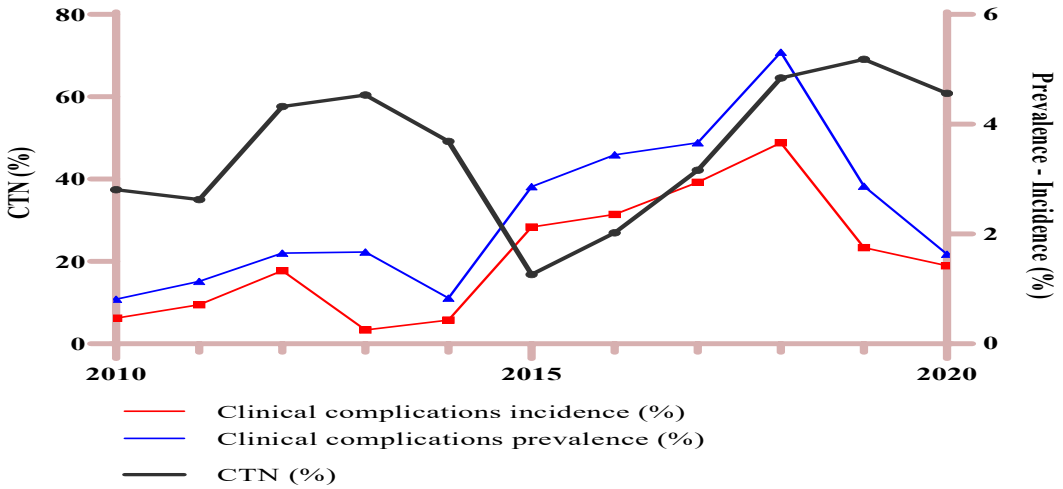

Figure 8: Correlation between CTN (%) and clinical complication incidence (%)

DISCUSSION

Hypertension is ubiquitous, and almost everyone knows someone with this condition. From 1975 to 2015, the global mean of age-standardized systolic blood pressure has remained nearly constant in men (126.6 to 127.0 mmHg) and slightly decreased in women (123.9 to 122.3 mmHg) with a global age-standardized systolic blood pressure of 127 mmHg in men and 122.3 mmHg in women (2015). During the same period, the mean blood pressure decreased in HIC and increased in LIMIC. The global prevalence of hypertension in 2010 was 31.1% (95% CI [30.0-32.2%]) with a general prevalence in HIC of 28.5% (95% IC [27.3-29.3%]) and in LIMIC of 31.5% (95% IC [29.7-33.6%]) translated to 1.04 billion individuals with hypertension. The burden of hypertension is shouldered in HIC by older subjects aged 60+ years, and in LIMIC by individuals aged 40-59 years old [6].

Morocco belongs to the Euro-Mediterranean region displaying a high frequency of hypertension, with an estimated prevalence of [30-31.9%] for women and <28% for men. In 2000, a survey [7] conducted by the ministry of health to assess cardiovascular risk factors amongst the Moroccan population estimated a national prevalence of hypertension of 33.7%, affecting more rural residents than urban residents (43.3% vs 32.6%). Another large cross-

Table 3: the incidence proportion of the clinical complications and their corresponding risk

Clinical complication	Incidence proportion /1000PY	Corresponding Risk per person
Stroke	4.68 /1000PY	$4.68x10^{-3}$
Cardiovascular	9.16 /1000PY	$9.16x10^{-3}$
Nephrologic	1.87 /1000PY	$1.87x10^{-3}$
Ophthalmologic	2.56 /1000PY	$2.56x10^{-3}$
Other complications	0.12 /1000PY	$0.12x10^{-3}$

sectional study [8] (n=10.714) conducted between 2008 and 2009 estimated a global prevalence of 39.8% and an age-standardized prevalence of 26.6%, affecting more women than men (28.0% vs 26.3%, p=0.01) and more rural residents than urban residents (26.4% vs 22.9%, p<0.005). In 2017, the results of STEPTS [9] estimated a national prevalence of hypertension of 29.3%, with no difference in gender or residence areas. In 2012, cross-sectional study [10] in Eastern Morocco, including the prefecture of Figuig (n=1628) among individuals aged 40+ years, estimated a regional prevalence of 31.7%, slightly higher among women than men (32.5% vs 30.2%) and among rural residents compared to urban residents (39.9% vs 29.0%, p<0.001). The same study showed that hypertension increased with age and switched from 23.4% in the age period [40-49 years] to 52.6% amongst those aged 70+ years, and 9.7% in the age period [40-49 years] to 51.5% among those aged of 70+ years, in women and men respectively.

Our study pointed out the evolution of hypertension over 10 years in the prefecture of Figuig. The absolute number of registered hypertensive patients has progressed from 871 cases in 2010 to 1785 cases in 2020, with a growth rate of 105%, with incidence rate and prevalence both rising. This progression could be explained by two major phenomena: population growth and aging.

The total prefecture population grew from 134,632 in 2010 to 139,631 in 2020, with a total demographic growth of 3.71%. In Morocco, this population growth was promoted by economic progress and healthcare improvements, particularly the generalization of basic health care insurance and the national program of immunization, where the childhood mortality rate dropped from 150‰ in 1960 to 47.9‰ in 2004 [11].

The life expectancy of Moroccans has progressed from an average of 43 years in 1962 to 71 years in 2004, which has increased the prevalence and the incidence of hypertension, marking the epidemiological transition to non-communicable diseases (NCD) as the leading causes of mortality and disabilities [12].

The international trends of hypertension incidence have shown fluctuations, where after the first period of rate decreasing from 47.0% in 2000 to 41.7% in 2013, the global incidence of hypertension increased to reach 45.4% in 2018. And following the global tendencies [13], our findings showed that hypertension is more prevalent among rural residents than urban residents, increases with age, and affects more women than men. As LIMIC trends [14], the great burden of hypertension is among patients aged 60 years or older by 65.4% and patients aged between [40-59 years] by 30.49%, while young individuals aged between [0-19 years] hold the lowest rate by 0.04%. In Morocco, and since 2010, especially with the launch of the national strategy of NCD in 2012, a group of actions were taken to improve health among rural residents. These actions included:

The establishment of mobile units composed of physicians and nurses and directed to remote areas to screen nomads, register new cases and provide follow-up for chronic cases.
The annual program of medical campaigns composed of a large group of physicians, pharmacists, and various specialists, working together to screen a large proportion of the population.
The launch of new primary health care centers in rural areas with health professionals (physicians and nurses).
The improvement of rural health care was associated with an increase in hypertension detection. However, our data contains only cases with confirmed diagnoses by physicians

or cardiologists, while a large proportion of the general population may be unaware of their clinical condition. Large data analysis of 200 countries, including Morocco, from 1990 to 2019 has indicated that globally, 59% of women and 49% of men with hypertension have reported having been previously diagnosed. Almost 47% of women and 38% of men with hypertension were treated and only 23% (95%, IC [20-27%]) of females and 18% (95%, [16-21%]) of males have controlled clinical condition. In the EMR, approximately 36% (95%, CI [31-41%]) of women and 53% (95%, CI [48-57%]) of men are still undiagnosed, 10% of women and men are diagnosed but without pharmacological treatment, 29% of hypertensive women and 21% of hypertensive men are treated but not controlled, and only 24% (95%, CI [20-30%]) and 16% (95%, [13-20%]) have controlled hypertension. The countries with high hypertension control rates are South Korea, Canada, the United States of America, and Iceland, where the rate of treatment is more than 70%, and the control rate is more than 50%. In 2019, a large study [15], the "may-measurement month campaign" involving more than 1.5 million individuals screened from 92 countries, indicated that 58.7% of all individuals were aware of their condition and 54.7% were on monotherapy antihypertensive. In Morocco, the multi-centric study [8] estimated that 85.9% of hypertensive patients were under pharmacological treatment or lifestyle changes, and only 17.1% had controlled hypertension. In Morocco, the main determinants of hypertension control are; age, urbanization, education and obesity.

In 2017, a cross-sectional study [16] amongst hypertensive patients in the prefecture of Figuig showed that only 35.3% of patients had controlled hypertension, affecting more women than men (37.71% vs 31.82%) and more urban residents than rural residents (40.91% vs 31.15%). The same study showed that most patients had high frequencies of CVD risk factors, and estimated the cardiovascular risk, using the Gaziano algorithm, that 51.42% of hypertensive subjects were at increased risk of developing both fatal and non-fatal cardiac events. Another Moroccan hospital study [17] found that 52.5% of hypertensive patients were at high cardiovascular risk, using the SCORE scale, with 46.8% of patients with controlled blood pressure. After 3 months of patients' follow-up, this study suggested that uncontrolled blood pressure is due to poor compliance with pharmacological agents (17.1%) and lack of treatment efficacy (16.9%). Generally, in developing countries [18], approximately 47.34% of hypertensive patients were non-adherent to their medications, inducing clinical complications, with an estimated 30-days of drug discontinuation in hypertension treatment associated with a 3-fold risk of death by clinical complications.

Lack of blood pressure control acts by trigging various clinical complications, with CVD being the most common, followed by stroke and retinopathy. The incidence of clinical complications increases following the incidence of hypertension. A cross-sectional study [19] in south Asia (Indonesia) estimated the prevalence rate of clinical complications to be 33.9% from a general prevalence of hypertension of 37.8%, more frequent among rural residents than their urban counterparts. In Africa (Ethiopia), a hospital study [20] indicated that stroke was the leading clinical complication amongst hypertensive patients at 63.2%, followed by heart diseases at 24.7%. Age and poor pharmacological treatment adherence were the main determinants of the risk of developing complications. It was estimated that the risk of death from hypertension complications increases 3 times after 1 month of pharmacological treatment discontinuation. Another hospital study [21] in Nigeria has estimated that 90% of hypertension complications were CVD. In 2015, the estimated number [22] of all-cause mortality associated with hypertension was 10.7 million deaths with attributed risk of mortality to IHD of 4.9 million deaths (54% of all IHD deaths), 1.5 million deaths with ischemic stroke (50% of all ischemic stroke deaths) and hemorrhagic stroke (42.5% of all hemorrhagic stroke mortality).

Hypertension induces endothelial dysfunction, exacerbates the atherosclerotic process by destabilizing atherosclerotic plaques, and provokes left ventricular hypertrophy. The increasing mechanical pressure directly affects the endothelial permeability of coronary arteries, decreasing the reserve and increasing the myocardial oxygen demand (myocardial ischemia) with two terms of complications [23]:

Short-term cardiac complications, such as stroke, coronary heart diseases, heart failure and cardiac arrest.

Long term cardiac complications, such as

hypertensive cardiomyopathies, heart failure with preserved ejection fraction, atrial fibrillation, aortic syndrome, peripheral arterial diseases and dementias.

The PREVER prevention trials [24] demonstrated that administering low-dose diuretics in adults with a systolic blood pressure of 120-139 mmHg or diastolic blood pressure of 80-89 mmHg prevents the incidence of left ventricular hypertrophy. The result of MRFIT study [25] (Multiple Risk Factor Intervention Trials) (n=347,978) show that a 10-mmHg reduction in SBP would reduce the following cardiac events by reducing 20% of all cardiac events (OR=0.80 (95%, CI [0.78-0.88])), 17% of IHD (RR=0.83, (95%, CI [0.78-0.88])), 27% of stroke (RR=0.73, (95%, CI [0.68- 0.78])), 29% of heart failure (RR=0.72, (95%, CI [0.67-0.78])).

Chronically elevated blood pressure also affects retinal circulation, producing a group of clinical symptoms generally known as hypertensive retinopathy. In South Asia, the prevalence of hypertensive retinopathy varies between [30.6% - 33.9%] in Bangladesh [26], 39.9% in Iran [27] to more than 60% in India. In Africa, (Malawi) [28], the estimated prevalence was 75.0% (95%, CI [66.7% - 83.3%]) including all types of retinopathies, while the prevalence [29] of mild hypertensive retinopathy in Germany was 6.7% (95%, CI [6.3%-7.2%]). Data analysis of the general population (≥ 40 years) showed that the general prevalence of hypertensive retinopathy is 3%-14% of adults.

It was considered that the presence of hypertensive retinopathy is a predictor of stroke, congestive heart failure and CVD mortality. There are three grades of retinopathy (classification of Mitchel-Wong);

Mild: Generalized arteriolar narrowing, focal arteriolar narrowing, arteriovenous nicking, arteriolar wall opacification, or a combination of all these signs.

Moderate: hemorrhages (blot, dot, flame-shaped), micro-aneurysms, cotton-wood spots, hard exudates, or a combination of all these signs.

Malignant: signs of moderate retinopathy in combination with optic disc swelling in the presence of severely elevated BP [180/120 mmHg] appearance of macular edema.

Because the retinal and cerebral small vessels share similar embryological paths, the generalized microvascular dysfunction seen in the retinal precedes the onset of stroke. Studies estimated an arteriolar caliber decrease of 3.07 µm for every 10 mmHg increase in BP [30]. Other clinical complications are represented mainly by chronic kidney diseases and end-stage renal disease, where hypertension is the second leading cause after diabetes. Different biochemical pathways were involved in the development of hypertensive nephropathy; the interaction between the renin-angiotensin-aldosterone system (reduction of renal blood flow, increasing of inflammation and collagen synthesis), oxidative stress and endothelial dysfunction inducing renal vasoconstriction and vascular damage producing tubule-interstitial fibrosis, additionally to direct effect of elevated blood pressure on glomerular function producing; increasing in glomerular capillary stretching and medial wall thickness which rises protein filtration and leads to podocytes injury (glomerulosclerosis) [31]. Studies [32] estimated 20% of American hypertensive patients have chronic renal insufficiency, and 21% of hypertensive patients (≥60 years) have idiopathic glomerulonephritis.

Regarding hypertension pharmacotherapy [33,34], the national list of antihypertensive drugs contains essential molecules based on WHO definition, and most protocols used, suggest treatment initiation using a single antihypertensive molecule (monotherapy) and combinations are used to control BP. Our findings indicated that the CCB class was the highest prescribed. This class has a universal acceptance and long pharmacological action; until 24 hours with possible use in monotherapy or combination. The second highest class was CEI which is used widely, providing between 60% and 70% of BP control among patients with uncomplicated hypertension. They can be used in congestive heart failure as monotherapy or combined with diuretics, and among diabetics, because they increase insulin sensitivity. The third highest class was ARB, used in monotherapy or combination with diuretics because of their protective renal action (decrease of proteinuria). They provide effective action in congestive heart failure because of their positive action in left ventricular hypertrophy.

Less prescribed; the class of Alpha-adrenoreceptor agonists (methyl-dopa) are particularly used among pregnant women, the class of β-blockers, used as second-line antihypertensive, especially after myocardial infarction, and the class of diuretics (19.4%); commonly used in combination, providing protection against myocardial infarction,

stroke and heart failure. In 2017, a cross-sectional study [35] indicated similar results by studying antihypertensive medication among hypertensive patients in the prefecture; CCB in monotherapy (27.36%) followed by CEI in monotherapy (21.05%), followed by ARB in monotherapy (16.84%), diuretics (7.35%) and β-blockers by 3.15%.

Under the national program of non-communicable diseases, pharmacological treatments are delivered for free in all primary health care centers in the prefecture to all registered patients. The availability of the medicine in primary health care is depending on the supply chain from the national central pharmacy which periodically delivers medication to all prefectures. With a prescriptions coverage rate of (≈48%), many patients have no chance to follow correctly their treatment, especially those among low socioeconomic level, which push patients to seek traditional treatments usually based of plants medicine or "spiritual" treatments, such as the practice of sorcery or visiting religion workers, and which may accelerate the appearance of clinical complications and increase their cardiovascular risk.

CONCLUSION

In this study, we studied hypertension in the prefecture of Figuig, from 2010 to 2020 by studying medical health records. Our findings highlight the progression of hypertension over 10 years in the prefecture, where the total recorded cases increased as the total population grew. Women and rural residents were more affected by hypertension, compared to men and urban residents. Cardiovascular diseases were the leading clinical complications, followed by stroke and hypertensive retinopathy. Various antihypertensive classes were prescribed to treat hypertension and delivered for free in all health care structures. More than half of pharmacological prescriptions were not covered, which may affect the quality of the blood control, accelerating the development of the clinical complications, calling for further studies.

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