Cardiovascular Topics

Paying more attention to arterial hypertension, dyslipidaemia, women and the rural environment in our ongoing fight against cardiovascular diseases and their risk factors

Pêngd-Wendé Habib Boussé Traore, Jean Augustin Diégane Tine, Oumar Bassoum, Abdoul Kane, Adama Faye

Abstract

Background: The diagnostic and therapeutic efforts instituted by the state of Senegal since the results of the STEPwise survey in 2015 could and should be reinforced with an effective and targeted preventative approach against cardiovascular accidents. This study aimed to (1) identify the pathological population that contains the most incidents of stroke in Senegal, (2) identify the prevalence, and geographical and gender distribution of biological co-morbidities with hypertension, stroke and advice for a change in behaviour, and (3) research the factors associated with the occurrence of cardiovascular accidents specific to the Senegalese context.

Methods: This was a secondary analysis of the STEPwise WHO Senegal 2015 survey: a descriptive quantitative epidemiological study with an analytical aim.

Results: Biological co-morbidities with arterial hypertension as well as cardiovascular accidents affected more women than men. Biological co-morbidities with arterial hypertension predominated in urban areas, while cardiovascular accidents were more common in rural areas. The population with arterial hypertension and total hypercholesterolaemia simultaneously was at the top of a list of 25 pathological populations in terms of the proportion of cardiovascular accidents within them. In addition, total hypercholesterolaemia was found in the first three populations with the most cardiovascular accidents. Regarding advice for behavioural change, advice for smoking cessation was the most widespread. All advice was given mostly to the gender most affected by the health problem, but some advice was mostly addressed to the environment least affected by the problem. Therefore, despite being the most affected, the rural environment received the least advice for a change in behaviour with regard to the practice of any of the forms of the physical activities described, the consumption of oil of palm, the consumption of cubed sugar or sugary drinks, smoked and non-smoked tobacco and attempted smoking cessation. In multivariate analysis, it was found that arterial hypertension produced a 2.74 times greater risk of having a cardiovascular accident (adjusted odds ratio = 2.74; 95% confidence interval = 1.88–3.99; $p < 0.001$).

Conclusion: In Senegal, we need to pay more attention to arterial hypertension, dyslipidaemia, women and the rural environment in our ongoing fight against cardiovascular diseases and their risk factors.

Keywords: arterial hypertension, dyslipidaemia, co-morbidity, cardiovascular accidents, counselling for behavioural change, woman, rural, associated factors, STEPwise WHO, Senegal

Submitted 11/2/23, accepted 14/6/23

Cardiovasc J Afr 2023; online publication www.cvja.co.za

DOI: 10.5830/CVJA-2023-033

Institute of Health and Development, Public Health Service, Faculty of Medicine, Pharmacy and Dentistry, Cheikh Anta Diop University, Dakar, Senegal

Pêngd-Wendé Habib Boussé Traore, MD, MPH, traore.habib1990@gmail.com
Jean Augustin Diégane Tine, MD, MPH, PhD
Oumar Bassoum, MD, MPH
Adama Faye, MD, MPH, PhD

Cardiology Department, Dalal Jamm Hospital, Faculty of Medicine, Pharmacy and Dentistry, Cheikh Anta Diop University, Dakar, Senegal

Pêngd-Wendé Habib Boussé Traore, MD, MPH
Abdoul Kane, MD, MPH, PhD

In 2015, the Paris Climate Agreement[1] and the 2015–2030 agenda of the Sustainable Development Goals (SDGs) were adopted by the General Assembly of the United Nations (UN).[2-4] The objective of wellbeing and health for all is in third position (SDG3) and has 13 targets.[5] Through its fourth target, SDG3 aims to reduce the premature mortality rate due to non-communicable diseases (NCDs) by one-third by 2030 through prevention and treatment.[5] This is how the state of Senegal, even before the end of 2015, carried out its first study at the national level according to the WHO STEPwise approach in order to know the prevalence of NCDs and their risk factors (RF) within its population.[6]

Less than 10 years from the expiry of the SDGs, all the diagnostic and therapeutic efforts instituted by the state of Senegal since the results of the STEPwise survey could and should be reinforced with an effective and targeted preventative

approach against cardiovascular accidents (CVA). This is why we set ourselves the objectives of (1) identifying the pathological population that contains the most incidents of stroke in Senegal; (2) exploring the prevalence and geographical distribution according to gender of biological co-morbidities with hypertension, stroke and advice for behavioural change, and (3) determining the associated factors with occurrence of CVA specific to the Senegalese context.

Methods

This was a secondary analysis of the STEPwise WHO Senegal 2015 survey. Our study was descriptive, quantitative epidemiology for analytical purposes. Data collection was done from 1 August to 15 December 2015.

The target population was the STEPwise population, aged from 18 to 70 years, during the year of the survey, living in Senegal for at least six months before the start of the survey, not pregnant, having no mental and/or physical disability, not being ill in bed, not being an absent household member whose return was not expected within two and a half days of the presence of the team in the census district and finally having given their consent to participate in the study.

The calculation of the size of the representative sample to be drawn in the population source was done according to the STEP methodology with the following formula:

$$N = Z^2 \times \frac{p\,(1-p)}{e^2} \times \text{dtsa}$$

where Z is the level of confidence = 1.96; p is the initial level of indicators; e is the margin of error = 5%; d is the effect of sampling plan = 2; t is the non-response rate (20%) = 1.2; s is stratum by gender = 2; a is stratum by age = 6. The size of the representative sample was calculated at 6 306 individuals.

The sampling technique was done by stratification in three stages of sampling. The first stage consisted of a systematic selection with probability proportional to the size of the census districts based on RGPHAE 2013. The second stage of sampling involved a systematic selection with equal probability of households in the selected census districts. The third and last stage of sampling concerned individuals with a draw by the Kish method of individuals in each selected household.

The sampling unit was therefore initially the census district, then the household and finally the individual. The statistical unit of the study was the individual aged 18 to 70 years on Senegalese territory in 2015 and having been chosen to be in the survey.

The data collection used as collection tools was the WHO STEPwise basic and expanded modules survey form. It included a questionnaire section devoted to step 1 and a form section dedicated to collecting data relating to step 2 and step 3.

The support for the data-collection tool was electronic. The final version of the survey form had been implemented in personal digital assistant (PDA) configured with the appropriate STEP application. However, paper media were also available.

The variables collected at the level of step 1 were first, the sociodemographic and economic characteristics, then the behavioural characteristics (consumption of tobacco, alcohol, fruit and vegetables, salt, fast sugars, fat, physical activity, sedentary behaviour), and finally the history (hypertension, diabetes mellitus, high cholesterol level, cardiovascular accident, therapy, advice received for lifestyle change).

The variables collected at step 2 level were physical measurements (weight, height, waist circumference, hip circumference, three blood pressure measurements and three heart rate measurements). The variables collected at step 3 level were biochemical measurements with fasting capillary glycaemia, total cholesterolaemia and high-density lipoprotein (HDL) cholesterolaemia.

The mode of data collection for step 1 was done during a face-to-face interview with each individual. Step 2 required direct contact with the participant. All physical measurements were taken in an isolated location to ensure privacy. Physical measurements were taken on the participant in the following order: blood pressure and heart rate, weight, height, waist circumference and then hip circumference.

Current tobacco use was defined as any tobacco use in the last three years preceding the survey.[7,8] The consumption of smokeless tobacco consists of the consumption of a tobacco product without burning it. Here the product is chewed. The consumption of smoked tobacco consists of burning the product containing tobacco and inhaling the smoke that emerges.

Depending on the voluntary or involuntary nature of smoking, a distinction was made between active and passive smoking. Passive smoking at home is exposure to tobacco smoke from others in the last 30 days at home (according to the STEPwise survey definitions). Passive smoking at work is exposure to second-hand tobacco smoke in the last 30 days in an enclosed place at work (according to the STEPwise survey definitions). Smoking cessation is the set of strategies and methods to get rid of addiction.[8,9,10]

Consumption of foods high in salt is the consumption of foods such as pre-packaged salty snacks, canned food and fast food (according to the STEPwise survey definitions).

The practice of none of the forms of physical activity described is the absence of the practice of intense activity at work, moderate activity at work, walking or cycling, intense activity during leisure and moderate activity during leisure. The practice of all the forms of physical activity described is the fact of practicing simultaneously, an intense activity at work, a moderate activity at work, moving on foot or by bicycle, an intense activity during leisure time and moderate activity during leisure time.

Hypertension is defined by consensus, except in emergencies, for any subject aged 18 years and over, as being an abnormal elevation of systolic (SBP) ≥ 140 mmHg and/or diastolic (DBP) ≥ 90 mmHg, which remain high at two separate consultations carried out one or two weeks apart, in a subject lying down or sitting, with relaxed muscles for at least five minutes, far from a meal, alcohol or cigarette intake.[11-14]

Isolated systolic hypertension was defined for any SBP ≥ 140 mmHg and DBP < 90 mmHg in the office that matched SBP ≥ 135 mmHg and DBP < 85 mmHg at self-measurement.[11,15-17] Isolated diastolic hypertension was defined for any DBP ≥ 90 mmHg and SBP < 140 mmHg in the office that matched with DBP ≥ 85 mmHg and SBP < 135 mmHg at self-measurement.[11,15-17] Systolic/diastolic hypertension corresponded to any SBP ≥ 140 mmHg and DBP ≥ 90 mmHg in the office that agreed with SBP ≥ 135 mmHg and DBP > 85 mmHg at self-measurement.[11,15-17]

A high pulse pressure was defined for a value of the differential between SBP and DBP ≥ 60 mmHg.[18] The history of known arterial hypertension was obtained from the participant's declarations or specific treatment for arterial hypertension.

Diabetes was considered if one or more of the following criteria were met: fasting blood glucose ≥ 7.0 mmol/l (126 mg/dl) or blood glucose two hours after ingestion of 75 g oral glucose [oral glucose tolerance test ≥ 11.1 mmol/l (200 mg/dl) or random blood glucose > 11.1 mmol/l (200 mg/dl) or HbA_{1c} ≥ 48 mmol/mol (equivalent to 6.5%)].[19-25] The history of known diabetes was obtained from the participant's declarations or the specific treatment for diabetes.

Dyslipidaemia is a persistent elevation of triglyceride levels (TG), low-density lipoprotein cholesterol (LDL-C), and decrease in HDL-C, occurring alone or in combination.[26-28] Dyslipidaemia is defined on an empty stomach as follows:[28] total hypercholesterolaemia: > 5.17 mmol/l (> 200 mg/dl); hyper-LDL cholesterolaemia: > 3.36 mmol/l (> 130 mg/dl); hyper-triglyceridaemia: > 1.7 mmmol/l (> 150 mg/dl); hypo-HDL cholesterolaemia: < 1.03 mmol/l (< 40 mg/dl) for men, < 1.3 mmol/l (< 50 mg/dl) for women. The history of known dyslipidaemia was retained from the participant's declarations or the specific treatment for dyslipidaemia.

The history of CVA included patients who had suffered a heart attack and/or cerebrovascular accident (ischaemic and haemorrhagic stroke). The data were obtained from the declaration of the participant or specific treatment or in the presence of a neurological deficit associated with scannographic images of cerebrovascular accidents, or the specific treatment of ischaemic heart disease.

The heart rate at cardiovascular risk was defined for an individual average of the three resting heart rate measurements as > 80 beats per minute.[29,30] It is an independent factor of cardiovascular risk and higher mortality rate, demonstrated in several studies such as the Framingham study,[31] Cordis[32] and MATISS.[33]

Abdominal obesity was defined as a waist circumference threshold > 102 cm for men and > 88 cm for women according to the 2001 NCEP-ATP III criteria for detecting high-risk abdominal obesity.[34] Overall obesity was defined using body mass index (BMI). The BMI was calculated by the ratio of weight (kg) to height² (m^2).[9,35] A BMI ≥ 30 kg/m^2 is the threshold that defines overall obesity.[9,35] The prevalence of a pathology was obtained by combining its known history and the new cases diagnosed during the survey.

Data entry was done directly in the field with the PDAs, which served as a collection support. In case of failure of the PDAs, paper questionnaires were used, to be entered immediately after repairing the device.

Regarding the ethical framework, the STEPwise survey complied with law no. 2009-17 of 9 March 2009 on the Code of Ethics for Health Research in Senegal.[36,37] The STEPwise survey had obtained the favourable scientific opinion of the National Ethics Committee for Health Research (CNERS) and an administrative authorisation issued by the Health Authority.

Notices of passage for the STEPwise survey were distributed beforehand to the households selected in the census districts. In each household, the interviewer provided the respondent with the information form on the study and offered to go through it with him/her, highlighting the various elements mentioned. All this was with a view to free and informed participation. This form clearly explained the objectives of the study, what each step involved, the benefits of the study and the rights of the participant. If the respondent was illiterate or unable to read alone, the information form was read and explained to him/her. In cases where the interviewee was dissuaded from or coerced into participating in the survey by a third party, such as the spouse, relative or other member of the local population, the interviewer clearly indicated that it was up to the interviewee alone to decide whether he/she wished to be interviewed or not.

The interviewer checked that the interviewee had read and understood the information form, and after that, the consent was written. The interviewee was asked to sign two informed consent forms before proceeding with the interview. One of the two was given to the participant after acceptance and signature and the investigator kept the other.

All physical measurements were taken in an isolated location. Intimacy was ensured for waist circumference and hip circumference measurements in accordance with the degree of privacy desired by the participant. In the event of an anomaly during the medical tests or during the collection of information, the participant was informed with a sheet bearing the results of his/her measurements. If necessary, the respondent was referred to the nearest health centre. A respondent's identification number ensured anonymity, thanks to a coding associating the census district, the interviewer, the date and time of the interview.

Statistical analysis

Statistical analysis was done with the statistical analysis software Rstudio version 4.0.2. It initially consisted of expressing the modalities of the qualitative variables in the form of absolute and relative frequencies. To take into account fluctuations due to sampling, all proportions and means have been given with their 95% confidence interval (CI).

In bivariate analysis, we then made comparisons of unpaired proportions. We crossed the binary dependent variable (cardiovascular accident) with individually explanatory variables. Before each crossing, we had made two hypotheses. H0: hypothesis of the absence of a statistical link between the crossed elements (hypothesis of equality or null); H1: alternative hypothesis or presence of statistical link between the crossed elements. The risk α had been set at 5% (the risk of wrongly asserting that there is a link). The objective was to find the existence of a statistically significant link between the two variables. This link was retained as statistically significant for a p-value < 0.05. This link was sought with the appropriate statistical test according to its conditions of applicability, so we used Pearson's chi-squared parametric test if all the theoretical values were ≥ 5; Yates' corrected chi-squared parametric test if at least one of the theoretical values was between 3 and 5; and Fischer's non-parametric test if at least one of the theoretical values was < 3. Only the explanatory variables, having obtained a p-value ≤ 0.25 in bivariate analysis, were retained for the multivariate analysis.

Finally, in multivariate analysis, the first step was to determine a base made up of all the observations without missing data with regard to our explanatory variables and our variable of interest. We defined two sub-bases in the base without missing data: a base on which the construction of a parsimonious model was made (70% of the observations of the base without missing data) and a base on which the measurement of the intrinsic characteristics of the parsimonious model built was made (30% of the observations of the base with no missing data). Automatic random drawing made the choice of observations that constituted the sub-base for the construction of a parsimonious model.

The determination of a parsimonious model was done by modelling according to the binomial logistic regression for explanatory purposes. We proceeded in two different ways to determine the parsimonious model: the automatic stepwise ascending method and the automatic stepwise method. After having obtained the two parsimonious models according to the two methods described above, we compared these models with each other in order to retain the most plausible model.

This comparison of the likelihoods of the models used the AIC, BIC and blorr tests. The model that obtained the smallest AIC, BIC and blorr was retained as being the parsimonious model and the most plausible of the two. With the parsimonious and most plausible model, we were looking for multicollinearity between the explanatory variables of the selected model. A VIF < 2.5 allowed us to conclude that there was no collinearity for a given explanatory variable compared to the others in the model. The selected model was declared well calibrated if $p > 0.05$ in the Hosmer–Lemeshow adequacy or calibration test. The discrimination capacity of the selected model was determined graphically with receiver operating characteristic (ROC) curves and the area under the curve (AUC) (AUC = 0.5, so-called zero discrimination capacity; AUC = 0.5–0.8, so-called acceptable discrimination capacity; AUC = 0.8–0.9, so-called excellent discrimination ability; AUC > 0.9, so-called exceptional model discrimination ability).

Then we looked for the sensitivity–specificity measures of the selected model. We ended with the interpretation of the results of the selected model according to the adjusted odds ratio (aOR). An aOR < 1 means that the modality presents a lower risk for the dependent variable of interest compared to the reference modality. An aOR > 1 means that the modality presents a greater risk for the dependent variable of interest compared to the reference modality. We were only interested in explanatory variables that showed a statistically significant link with the dependent variable of interest ($p < 0.05$).

Results

A total of 5 343 individuals were surveyed throughout Senegal during the STEPwise WHO 2015 survey. Women were in the majority at 63.4%, with a gender ratio (M/F) of 0.57 (Table 1).

The current consumption of smoked tobacco involved 5.9% (313/5321) of the sample with 95.8% (300/313) being males and 58.8% (184/313) living in rural areas (Table 1). Current consumption of smokeless tobacco involved 0.5% (24/5303) of participants, with men being in the majority at 54.2% (13/24). Rural participants were at 70.8% (17/24).

Passive smoking at home involved 19.7% (1043/5305) with females representing 53.8% (561/1043), and an almost equal distribution between rural (50.6%) and urban (49.4%) environments. Passive smoking at work represented 10.2% (345/3371) with males representing 61.2% (211/345) and the urban environment 60.3% (208/345). Passive smoking both at home and at work represented 4.5% (237/5305) with males being at 61.2% (145/237) and participants living in an urban environment at 56.5% (134/237).

The proportion of smoking cessation attempts among current smokers was 60.5% (188/311). This weaning attempt was made more by males, at 96.8% (182/188) and rural participants, at 55.8% (105/188).

Among those who had had a drink in the last 12 months (108), 14.0% (15/107) reported daily alcohol consumption. Urban (66.7%) males (93.3%) were the primary consumers.

Consumption of dishes high in salt according to the 'always' modality was at 3.86% (204/5290). This proportion was mainly females at 62.8% (128/204) and rural respondents at 57.8% (86/204). The statement that high salt consumption cannot be a source of health problems was found in 8.4% (445/5295) of respondents, predominantly females, at 55.3% (246/445) and rural respondents, at 67.4% (300/445).

The large consumption of fast sugar concerned 17.6% (775/4394), with rural (63.0%) females predominating (58.1%). Consumption of bacon or fat involved 1.5% (77/5295) of respondents. Palm oil consumption accounted for 79.2% (4192/5295), with females at 64.5% (2705/4192) and rural participants at 54.2% (2271/4192).

The total absence of any physical activity described in the STEPwise survey sheet involved 6.6% (352/5299) of the respondents. These were mostly female, at 75.3% (265/352) and rural, at 57.1% (201/352). The practice of all the physical activities described in the STEPwise survey sheet was found in 1.23% (65/5299) of participants, with males predominating at 92.3% (60/65) and a slight rural predominance of 50.8% (33/65) (Table 1).

Arterial hypertension was found in 24.5% (787/3208) of participants who were known hypertensives and diagnosed by a health professional. This proportion was largely female (625/787) at 79.4% and rural at 56.4% (444/787) (Table 2).

Diabetes was known in 9.5% (104/1095) of participants, diagnosed by a healthcare professional. This proportion was largely female at 67.3% (70/104) and urban at 70.2% (73/104) (Table 2). Knowledge of a state of dyslipidaemia, diagnosed by a health professional was found in 31.6% (72/228). This proportion was largely female at 79.2% (57/72) and urban at 80.6% (58/72).

A history of CVA was found in 3.8% (203/5298), mostly females, at 71.9% (146/203) and rural participants, at 61.6% (125/203) (Table 2). A heart rate at risk was found in 51.0% (2658/5208), and mostly females, at 74.9% (1991/2658) and rural participants, at 58.3% (1550/2658) (Table 3).

Abdominal obesity in men was 6.02% (113/1878), with 71.7% (81/113) being urban dwellers. Abdominal obesity in women was 41.8% (1378/3295) with 57.8% (797/1378) being urban dwellers. General obesity accounted for 7.7% (400/5180), with females predominating at 88.0% (352/400) and urban dwellers at 67.0% (268/400) (Table 3).

The prevalence of hypertension in Senegal was 23.5% (1254/5343) with females predominating at 71.9% (902/1254) and slightly more rural than urban dwellers (51.5%) (646/1254). The prevalence of diabetes in Senegal was 2.2% (116/5343) with females predominating at 67.2% (78/116) and urban dwellers at 73.3% (85/116). The prevalence of total hypercholesterolaemia in Senegal was 1.9% (99/5343) with females at 71.7% (71/99) and urban dwellers at 85.9% (85/99) (Table 3).

Subjects with hypertension and diabetes at the same time comprised 71 out of 5 343 or 1.3%. This proportion was largely female at 70.4% (50/71) and urban at 76.1% (54/71) (Table 4). Subjects with hypertension and total hypercholesterolaemia at the same time were 53 out of 5 343 or 1.0%. This proportion was largely female at 77.4% (41/53) and urban at 86.8% (46/53).

Subjects with hypertension, diabetes and total hypercholesterolaemia at the same time comprised 11 out of 5 343 or

Table 1. Distribution of sociodemographic and behavioural characteristics. National WHO STEPwise survey, Senegal 2015

Variables	n	*Percentage*	*95% CI*	*Total n*
Environment				5343
Rural	3103	58.1	56.73–59.40	
Urban	2240	41.9	40.59–43.26	
Gender				5343
Men	1958	36.6	35.35–37.95	
Women	3385	63.4	62.04–64.64	
Current consumption of smoked active smoking				5321
No	5008	94.1	93.44–94.72	
Yes	313	5.9	5.27–6.55	
Yes according to gender				313
Men	300	95.8	–	
Women	13	4.2	–	
Yes depending on the environment				313
Rural	184	58.8	–	
Urban	129	41.2	–	
Current use of smokeless tobacco				5303
No	5279	99.5	99.31–99.70	
Yes	24	0.5	0.29–0.68	
Yes according to gender				24
Men	13	54.2	–	
Women	11	45.8	–	
Yes depending on the environment				24
Rural	17	70.8	–	
Urban	7	29.2	–	
Passive smoking at home				5305
No	4262	80.3	79.23–81.39	
Yes	1043	19.7	18.60–20.76	
Yes according to gender				1043
Men	482	46.2	–	
Women	561	53.8	–	
Yes depending on the environment				1043
Rural	528	50.6	–	
Urban	515	49.4	–	
Passive smoking at work				5304
Do not work in a closed environment	1933	36.4	35.14–37.75	
No	3026	57.1	55.70–58.38	
Yes	345	6.5	5.86–7.21	
Yes according to gender				345
Men	211	61.2	–	
Women	134	38.8	–	
Yes depending on the environment				345
Rural	137	39.8	–	
Urban	208	60.3	–	
Passive smoking both at home and at work				5305
No	5068	95.5	94.93–96.06	
Yes	237	4.5	3.93–5.06	
Yes according to gender				237
Men	145	61.2	–	
Women	92	38.8	–	
Yes depending on the environment				237
Rural	103	43.5	–	
Urban	134	56.5	–	
Smoking cessation attempt				311
No	123	39.5	34.11–45.24	
Yes	188	60.5	54.75–65.88	
Yes according to gender				188
Men	182	96.8	–	
Women	6	3.2	–	
Yes depending on the environment				188
Rural	105	55.8	–	
Urban	83	44.2	–	
Alcohol consumption				175
No	67	38.3	31.13–45.95	
Yes	108	61.7	54.04–68.86	
Frequency of alcohol consumption				107
Less than once a month	50	46.7	37.10–56.58	
1–3 days per month	20	18.7	12.05–27.63	
1–2 days a week	15	14.0	8.31–22.38	
3–4 days a week	3	2.80	0.72–8.57	
5–6 days a week	4	3.74	1.20–9.85	
Daily	15	14.0	8.31–22.38	
Daily by gender				15
Men	14	93.3	–	
Women	1	6.7	–	

Table 1 continued.

Variables	n	*Percentage*	*95% CI*	*Total n*
Daily depending on the environment				15
Rural	5	33.3	–	
Urban	10	66.7	–	
Frequency of eating foods high in salt				5290
Do not know	140	2.65	2.23–3.12	
Never	2433	46.0	44.64–47.34	
Rarely	1320	25.0	23.79–26.14	
Occasionally	640	12.1	11.23–13.01	
Often	553	10.5	9.64–11.31	
Always	204	3.86	3.36–4.41	
Always by gender				204
Men	76	37.2	–	
Women	128	62.8	–	
Always depending on the environment				204
Rural	118	57.8	–	
Urban	86	42.2	–	
Knowledge that high salt consumption can cause health problems				5295
Yes	4696	88.7		
No	445	8.40		
Do not know	154	2.91		
No by gender				445
Men	199	44.7	–	
Women	246	55.3	–	
No according to the environment				445
Rural	300	67.4	–	
Urban	145	32.6	–	
Amount of sugar blocks consumed at breakfast				4394
1 block	368	8.38	7.58–9.24	
2 blocks	2231	50.8	49.28–52.26	
3 blocks	1020	23.2	21.97–24.49	
4 or more blocks	775	17.6	16.52–18.80	
4 blocks or more according to gender				775
Men	325	41.9	–	
Women	450	58.1	–	
4 blocks or more depending on the environment				755
Rural	488	63.0	–	
Urban	287	37.0	–	
Type of fat used most often for preparing meals at home				5295
None used	8	0.2	0.07–0.31	
None in particular	22	0.4	0.26–0.63	
Vegetable oil	5113	96.6	96.02–97.02	
Bacon or fat	77	1.5	1.15–1.82	
Butter or light butter	7	0.1	0.05–0.28	
Margarine	4	0.1	0.02–0.20	
Other	1	0.02	9.85×10^{-6}–1.22×10^{-3}	
Do not know	63	1.2	0.92–1.52	
Palm oil consumption				5295
No	1103	20.8	19.74–21.95	
Yes	4192	79.2	78.04–80.25	
Yes according to gender				4192
Men	1487	35.5	–	
Women	2705	64.5	–	
Yes depending on the environment				4192
Rural	2271	54.2	–	
Urban	1921	45.8	–	
Practice of none of the forms of physical activity described				5299
No	4947	93.4	92.64–94.00	
Yes	352	6.64	5.99–7.35	
Yes according to gender				352
Men	87	24.7	–	
Women	265	75.3	–	
Yes depending on the environment				352
Rural	201	57.1	–	
Urban	151	42.9	–	
Participation in all forms of physical activity described				5299
No	5234	98.8	98.42–99.04	
Yes	65	1.23	0.95–1.57	
Yes according to gender				65
Men	60	92.3	–	
Women	5	7.69	–	
Yes depending on the environment				65
Rural	33	50.8	–	
Urban	32	49.2	–	

Table 2. Distribution of personal history. National WHO STEPwise survey, Senegal 2015

Description	n	*Percentage*	*95% CI*	*Total* n
Knowledge of a hypertensive condition diagnosed by a healthcare professional				3208
No	2421	75.5	73.93–76.94	
Yes	787	24.5	23.05–26.06	
Yes according to gender				787
Men	162	20.6	–	
Women	625	79.4	–	
Yes depending on the environment				787
Rural	444	56.4	–	
Urban	343	43.6	–	
Knowledge of a diabetic condition diagnosed by a healthcare professional				1095
No	991	90.5	88.57–92.14	
Yes	104	9.5	7.85–11.42	
Yes according to gender				104
Men	34	32.7	–	
Women	70	67.3	–	
Yes depending on the environment				104
Rural	31	29.8	–	
Urban	73	70.2	–	
Knowledge of a state of dyslipidaemia diagnosed by a health professional				228
No	156	68.4	61.89–74.31	
Yes	72	31.6	25.68–38.10	
Yes according to gender				72
Men	15	20.8	–	
Women	57	79.2	–	
Yes depending on the environment				72
Rural	14	19.4	–	
Urban	58	80.6	–	
History of cardiovascular accident				5298
No	5095	96.2	95.60–96.66	
Yes	203	3.8	3.33–4.39	
Yes according to gender				203
Men	57	28.1	–	
Women	146	71.9	–	
Yes depending on the environment				203
Rural	125	61.6	–	
Urban	78	38.4	–	

Table 3. Distribution of anthropometric and biochemical measurements. National WHO STEPwise survey, Senegal 2015

Measurements	n	*Percentage*	*95% CI*	*Total* n
Heart rate at risk				5208
No	2550	49.0	47.59–50.33	
Yes	2658	51.0	49.66–52.40	
Yes according to gender				2658
Men	667	25.1	–	
Women	1991	74.9	–	
Yes depending on the environment				2658
Rural	1550	58.3	–	
Urban	1108	41.7	–	
Abdominal obesity in men				1878
No	1765	94.0	92.78–94.99	
Yes	113	6.0	5.00–7.21	
Yes depending on the environment				113
Rural	32	28.3	–	
Urban	81	71.7	–	
Abdominal obesity in women				3295
No	1917	58.2	56.47–59.86	
Yes	1378	41.8	40.13–43.52	
Yes depending on the environment				1378
Rural	581	42.2	–	
Urban	797	57.8	–	
General obesity				5180
No	4780	92.3	91.50–92.98	
Yes	400	7.7	7.01–8.49	
Yes according to gender				400
Men	48	12.0	–	
Women	352	88.0	–	
Yes depending on the environment				400
Rural	132	33.0	–	
Urban	268	67.0	–	
Isolated systolic hypertension				5207
No	4974	95.5	94.91–96.06	
Yes	233	4.5	3.93–5,08	
Isolated diastolic hypertension				5208
No	4727	90.8	89.93–91.53	
Yes	481	9.2	8.46–10.06	
High pulse pressure				5207
No	4727	90.8	89.95–91.54	
Yes	480	9.2	8.45–10.04	
High blood pressure				5343
No	4089	76.5	75.36–77.65	
Yes	1254	23.5	22.34–24.63	
Yes according to gender				1254
Men	352	28.1	–	
Women	902	71.9	–	
Yes depending on the environment				1254
Rural	646	51.5	–	
Urban	608	48.5	–	
Diabetes				5343
No	5227	97.8	97.39–98.19	
Yes	116	2.2	1.80–2.60	
Yes according to gender				116
Men	38	32.8	–	
Women	78	67.2	–	
Yes depending on the environment				116
Rural	31	26.7	–	
Urban	85	73.3	–	
Total hypercholesterolaemia				5343
No	5244	98.1	97.73–98.48	
Yes	99	1.9	1.51–2.26	
Yes according to gender				99
Men	28	28.3	–	
Women	71	71.7	–	
Yes depending on the environment				99
Rural	14	14.1	–	
Urban	85	85.9	–	

0.2%. This proportion was largely female at 72.7% (8/11) and urban at 90.9% (10/11) (Table 4). There were more hypertensives among the diabetics (61.2%; 71/116) than diabetics among the hypertensives (5.7%; 71/1254) (Fig. 1).

Out of 25 defined pathological populations, the first five in descending order in terms of the proportion of CVA within them were: the hypertensive and total hypercholesterolaemia populations, with 9.4% CVA (5/48); the hypertensive, diabetic and total hypercholesterolaemia populations simultaneously, with 9.1% CVA (1/11); the total hypercholesterolaemia population with 8.1% CVA (8/99); the population of hypertensives with 6.0% stroke (75/1250); and the population of hypertensives and diabetics, with 5.6% stroke (4/71) (Table 5).

Those having already had their blood pressure taken by a health professional at least once in their life was found in 60.6% (3208/5298) of participants, largely females, at 73.1% (2345/3208) and almost equal rural and urban participants (50.8 and 49.2%, respectively). Those having already had their blood sugar taken by a health professional at least once in their life was found in 20.7% (1095/5298), largely females at 72.5% (794/1095) and urban dwellers at 61.2% (670/1095) (Table 6). Those having already had their cholesterol levels taken by a health professional

Table 4. Distribution of co-morbidities according to hypertension, diabetes and total hypercholesterolaemia. National WHO STEPwise survey, Senegal 2015

Co-morbidities	n	*Percentage*	*95% CI*	*Total* n
High blood pressure and diabetes at the same time				5343
No	5272	98.7	98.31–98.95	
Yes	71	1.3	1.04–1.68	
Yes according to gender				71
Men	21	29.6	–	
Women	50	70.4	–	
Yes depending on the environment				71
Rural	17	23.9	–	
Urban	54	76.1	–	
High blood pressure and total hypercholesterolaemia at the same time				5343
No	5290	99.0	98.69–99.24	
Yes	53	1.0	0.75–1.30	
Yes according to gender				53
Men	12	22.6	–	
Women	41	77.4	–	
Yes depending on the environment				53
Rural	7	13.2	–	
Urban	46	86.8	–	
High blood pressure, diabetes and total hypercholesterolaemia at the same time				5343
No	5332	99.8	99.61–99.89	
Yes	11	0.2	0.11–0.38	
Yes according to gender				11
Men	3	27.3	–	
Women	8	72.7	–	
Yes depending on the environment				11
Rural	1	9.1	–	
Urban	10	90.9	–	

at least once in their life was found in 4.3% (228/5298), with females predominating at 71.1% (162/228) and urban dwellers at 75.4% (172/228) (Table 6).

Among the 787 who knew they were hypertensive, 31.6% (249/787) claimed to have taken a medication prescribed by a health professional in the last two weeks for hypertension. These were largely female at 75.9% (189/249) and urban at 51.0% (127/249) (Table 7). Among the 104 who knew they had diabetes, 39.4% (41/104) claimed to have taken antidiabetic treatment prescribed by a health professional in the last two weeks. This proportion was largely female at 58.5% (24/41) and urban at 82.9% (34/41) (Table 7). Of the 72 who were known to have dyslipidaemia, the proportion taking anti-lipid medication in the past two weeks as prescribed by a healthcare professional was 13.9% (10/72). These were 70.0% female and urban (7/10) (Table 7).

The sample who had received advice over the past three years to stop or not to start smoking was 2.8% (149/5299), mostly male at 84.6% (126/149) and urban at 60.4% (90/149) (Table 8). Those who had received advice in the last 12 months on smoking cessation were 17.4% (54/5305) of the sample. This proportion was exclusively male at 100.0% (54/54) and urban at 51.9% (28/54).

Those who had received advice over the past three years to reduce salt consumption were 13.0% (690/5299) and largely female at 77.8% (537/690) and rural at 55.1% (380/690) (Table 8). Those who had received advice during the last 12 months to reduce the amount of sugar in the diet were 7.6% (404/5296) of the sample and mostly female at 66.8% (270/404) and urban at 58.9% (238/404). Health personnel gave this advice in 71.2% of cases (287/403) .

Those who had received advice during the last three years to eat at least five portions of fruit and/or vegetables per day were 12.6% (667/5300) of the sample and largely female at 70.9% (473/667) and urban at 61.2% (408/667) (Table 8). Those who had received advice during the last three years to reduce fat consumption were 8.3% (439/5299) of the sample and largely female at 74.3% (326/439) and urban at 61.5% (270/439).

Those who had received advice during the last three years to start or do more physical activity were 10.3% (547/5299) of the sample and largely female at 64.5% (353/547) and urban at 66.5% (364/547). Those who had received advice during the last three years to maintain a healthy weight or lose weight were 5.1% (271/5299) of the sample and mostly females at 72.3% (196/271) and urban at 74.9% (203/271) (Table 8).

The variables that showed a statistically significant link with the CVA variables were: arterial hypertension ($p < 0.001$), gender ($p = 0.010$), number of sugar cubes consumed at breakfast ($p < 0.001$), knowledge that high salt consumption can be a source of health problems ($p < 0.001$), and all forms of physical activity practised ($p = 0.037$) (Table 9).

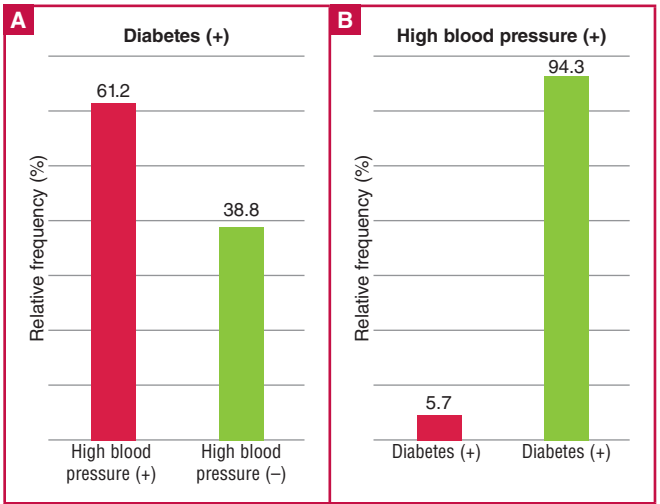

Fig. 1. Proportion of hypertensives among diabetics (A) and diabetics among hypertensives (B). National WHO STEPwise survey, Senegal 2015.

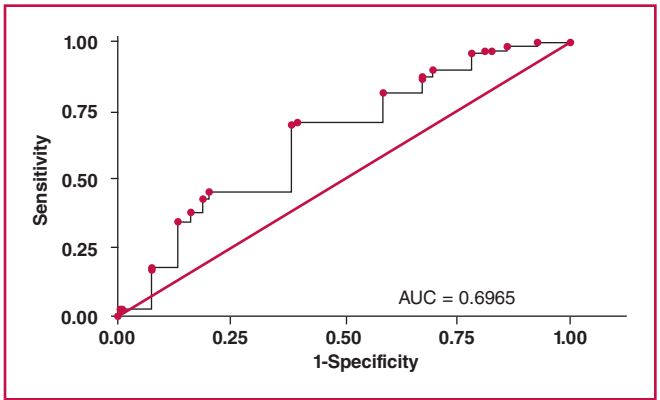

Fig. 2. Discrimination capacity by ROC curve and AUC of the parsimonious model retained with CVA as the dependent variable. WHO STEPwise survey, Senegal 2015.

Table 5. Distribution according to the proportion of CVA in descending order in 25 pathological populations. National WHO STEPwise survey, Senegal 2015

Cardiovascular accidents	n	*Percentage*	*95% CI*	*Total* n
Cardiovascular accidents among hypertensive and total hypercholesterolaemic people at the same time				53
No	48	90.6	–	
Yes	5	9.4	–	
Cardiovascular accidents among hypertensive, diabetic and total hypercholesterolaemic people at the same time				11
No	10	90.9	–	
Yes	1	9.1	–	
Cardiovascular accidents among hypercholesterolemic people				99
No	91	91.9	–	
Yes	8	8.1	–	
Cardiovascular accidents among hypertensives				1250
No	1175	94.0	–	
Yes	75	6.0	–	
Cardiovascular accidents among hypertensives and diabetics at the same time				71
No	67	94.4	–	
Yes	4	5.6	–	
Cardiovascular accidents among obese people				399
No	378	94.7	–	
Yes	21	5.3	–	
Cardiovascular accidents among passive smokers at work in an enclosed place				341
No	323	94.8	–	
Yes	18	5.2	–	
Cardiovascular accidents among people with isolated diastolic hypertension				479
No	455	95.0	–	
Yes	24	5.0	–	
Cardiovascular accidents among people with no physical activity				352
No	335	95.2	–	
Yes	17	4.8	–	
Cardiovascular accidents among passive smokers both at home and at work in a closed place				234
No	223	95.3	–	
Yes	11	4.7	–	
Cardiovascular accidents among passive smokers at home				1040
No	994	95.6	–	
Yes	46	4.4	–	
Cardiovascular accidents among diabetics				116
No	111	95.7	–	
Yes	5	4.3	–	
Cardiovascular accidents among people with isolated systolic hypertension				232
No	222	95.7	–	
Yes	10	4.3	–	
Cardiovascular accidents among people who know that high salt consumption is harmful				4695
No	4499	95.8	–	
Yes	196	4.2	–	
Cardiovascular accidents among women with abdominal obesity				1362
No	1305	95.8	–	
Yes	57	4.2	–	
Cardiovascular accidents among subjects with high pulse pressure				476
No	456	95.8	–	
Yes	20	4.2	–	
Cardiovascular accidents among people with a heart rate at risk				2640
No	2532	95.9	–	
Yes	108	4.1	–	
Cardiovascular accidents among people using palm oil				4192
No	4025	96.0	–	
Yes	167	4.00	–	

Table 5 continued.

Cardiovascular accidents	n	*Percentage*	*95% CI*	*Total* n
Cardiovascular accidents among men with abdominal obesity				113
No	109	96.5	–	
Yes	4	3.5	–	
Cardiovascular accidents among current active smokers				312
No	302	97.0	–	
Yes	10	3.2	–	
Cardiovascular accidents among people who always consume high-salt dishes				204
No	199	97.5	–	
Yes	5	2.5	–	
Cardiovascular accidents among people who claim that high salt consumption is not harmful				445
No	438	98.4	–	
Yes	7	1.6	–	
Cardiovascular accidents among people consuming four or more sugar blocks at breakfast				775
No	763	98.5	–	
Yes	12	1.5	–	
Cardiovascular accidents among people using fat and lard as fat				77
No	77	100.0	–	
Yes	0	00.0	–	
Cardiovascular accidents among daily alcohol consumers				15
No	15	100	–	
Yes	0	00.0	–	

We obtained the same parsimonious model with both methods. This model was well calibrated (p = 0.5298 with the Hosmer Lemeshow calibration test) with an absence of collinearity between its explanatory variables (Table 10) and with an acceptable ability to discriminate (AUC = 0.6965) (Fig. 2).

Two variables were factors associated with the occurrence of CVA in Senegal in 2015: high blood pressure and the practice of all forms of physical activity. Hypertensive subjects were 2.74 times more likely to have a CVA than non-hypertensives (aOR=2.74; 95% CI = 1.88–3.99; $p < 0.001$) (Fig. 3). Subjects who practiced all the forms of physical activity described in the WHO STEPwise survey were 4.29 times more likely to have a CVA than subjects who did not practice at least one form of exercise (ORa = 4.29; 95% CI = 1.42–10.55; p = 0.004) (Fig. 3).

Discussion

There were more hypertensives among the diabetics (61.2%) than diabetics among the hypertensive patients (5.7%). Diabetic patients were more prone to having concomitant hypertension than hypertensives to having diabetes. Choukem *et al.* in Cameroon found there were 66.7% hypertensive patients among the diabetics in their study.[38] Along the same lines, Nibouche *et al.* from Algeria found 66.7% arterial hypertension patients among the diabetics at the point of diagnosis of diabetes.[39] Ogola *et al.* in Kenya also found 76.6% hypertensives among the diabetics.[40]

These findings have a biological explanation. Premature neurovegetative imbalances, arterial hardening (arteriosclerosis) and endothelial dysfunction[41] occur with diabetes mellitus and are powerful generators of high blood pressure. Urban environments have the most subjects with biological co-morbidities with arterial hypertension.

In our study, one person in 100 was both hypertensive and diabetic (1.3%), one in 100 was both hypertensive and total

Table 6. Distribution according to monitoring of biological parameters and blood pressure. National WHO STEPwise survey, Senegal 2015

Monitoring	n	*Percentage*	*95% CI*	*Total* n
The fact of having already had your blood pressure taken by a doctor at least once in your life				5298
No	2090	39.4	38.13–40.78	
Yes	3208	60.6	59.21–61.86	
Yes according to gender				3208
Men	863	26.9	–	
Women	2345	73.1	–	
Yes depending on the environment				3208
Rural	1631	50.8	–	
Urban	1577	49.2	–	
The fact of having already had your blood sugar taken by a health professional at least once in your life				5298
No	4203	79.3	78.21–80.40	
Yes	1095	20.7	19.59–21.78	
Yes according to gender				1095
Men	301	27.5	–	
Women	794	72.5	–	
Yes depending on the environment				1095
Rural	425	38.8	–	
Urban	670	61.2	–	
The fact of having already had their cholesterol levels taken by a health professional at least once in their life				5298
No	5070	95.7	95.10–96.21	
Yes	228	4.3	3.78–4.89	
Yes according to gender				228
Men	66	28.9	–	
Women	162	71.1	–	
Yes depending on the environment				228
Rural	56	24.6	–	
Urban	172	75.4	–	

Table 7. Distribution of treatment history. National WHO STEPwise survey, Senegal 2015

Treatment history	n	*Percentage*	*95% CI*	*Total* n
Taking antihypertensive medication in the last two weeks on prescription by a health-care professional				787
No	538	68.4	64.96–71.57	
Yes	249	31.6	28.42–35.03	
Yes according to gender				249
Men	60	24.1	–	
Women	189	75.9	–	
Yes depending on the environment				249
Rural	122	49.0	–	
Urban	127	51.0	–	
Taking antidiabetic medication in the past two weeks as prescribed by a healthcare professional				104
No	63	60.6	50.48–69.87	
Yes	41	39.4	30.12–49.51	
Yes according to gender				41
Men	17	41.5	–	
Women	24	58.5	–	
Yes depending on the environment				41
Rural	7	17.1	–	
Urban	34	82.9	–	
Taking antilipid medication in the past two weeks as prescribed by a healthcare professional				72
No	62	86.1	75.47–92.78	
Yes	10	13.9	7.21–24.52	
Yes according to gender				10
Men	3	30.0	–	
Women	7	70.0	–	
Yes depending on the environment				10
Rural	3	30.0	–	
Urban	7	70.0	–	

hypercholesterolaemic (1%) and two out of 1 000 people were hypertensive, diabetic and total hypercholesterolaemic (0.2%). These three populations of co-morbidities were all predominantly urban (76.1% were hypertensive and diabetic simultaneously; 86.8% were hypertensive and total hypercholesterolaemic at the same time; and 90.9% were hypertensive, diabetic and total hypercholesterolaemic simultaneously).

In 2015, Senegal had 34 hospitals, including 10 level one public health establishments (PHEs), 13 level two PHEs, 11 level three PHEs, 99 health centres, 1 456 health posts and 708 health huts.[42] Most of the infrastructure was based in Dakar with the exception of the health huts and the level two PHEs. By way of illustration, 10 of the 11 level three PHEs were in Dakar.[42]

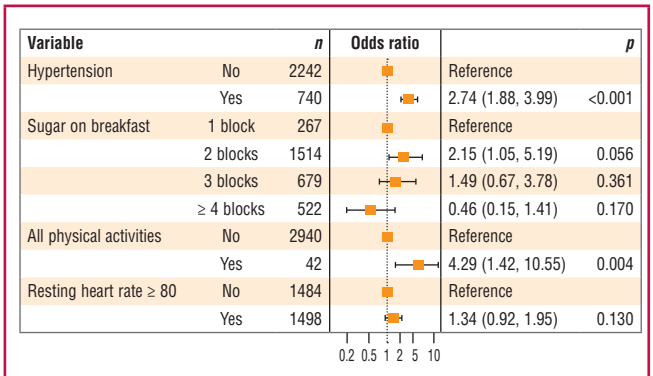

Fig. 3. Interpretation of the parsimonious model according to the aOR with CVA as the dependent variable. WHO STEPwise survey, Senegal 2015.

Rural areas have the most victims of CVA. Our study shows that two out of three strokes occurred in rural areas (61.6% of strokes). This suggests that investment in terms of state-of-the-art health infrastructure should not be made only in urban areas. This finding also suggests the importance and urgency of universal health coverage to allow these generally deprived rural populations to have access to care.

Our results show that Senegalese women were the most exposed to biological co-morbidities with arterial hypertension and CVA (77.4% arterial hypertension + total hypercholesterolaemia; 70.4% arterial hypertension + diabetes; 72.7% arterial hypertension + total hypercholesterolaemia + diabetes). In addition, they were also the most affected by strokes (71.9%).

This can be explained by genetic and hormonal differences between women and men,[43,44] accentuated by our socio-cultural realities, which are, among other things, the dependence of women on men. This confers on her a low decision-making power, even for her health,[44,45] her lack of financial autonomy, her low level of education and her continuous striving for overweight, which are criteria of beauty and well-being in our societies. Sougou *et al.* in their 2017 study highlighted a low rate (6.26%) of decision-making autonomy among Senegalese women with regard to their health.[46] The factors on which action should be taken to improve women's decision-making autonomy concerning their health were access to education for women and the promotion of income-generating activities among them.[46]

Table 8. Distribution according to the presence or absence of advice received in the last three years for a change in behaviour. National WHO STEPwise survey, Senegal 2015

Behavioural advice	n	*Percentage*	*95% CI*	*Total* n
Advice received over the past three years to stop or not start smoking				5299
No	5150	97.2	96.69–97.60	
Yes	149	2.8	2.39–3.30	
Yes according to gender				149
Men	126	84.6	–	
Women	23	15.4	–	
Yes depending on the environment				149
Rural	59	39.6	–	
Urban	90	60.4	–	
Advice received for smoking cessation in the last 12 months from a health professional				311
No	175	56.3	50.55–61.83	
Yes	54	17.4	13.41–22.13	
No visits in the last 12 months	82	26.4	21.62–31.69	
Yes according to gender				54
Men	54	100.0	–	
Women	0	0.0	–	
Yes depending on the environment				54
Rural	26	48.1	–	
Urban	28	51.9	–	
Advice received over the past three years to reduce your salt intake				5299
No	4609	87.0	86.03–87.86	
Yes	690	13.0	12.13–13.96	
Yes according to gender				690
Men	153	22.2	–	
Women	537	77.8	–	
Yes depending on the environment				690
Rural	380	55.1	–	
Urban	310	44.9	–	
Advice received during the last 12 months to reduce the amount of sugar in the diet				5296
No	4892	92.4	91.61–93.06	
Yes	404	7.6	6.93–8.38	
Yes according to gender				404
Men	134	33.2	–	
Women	270	66.8	–	
Yes depending on the environment				404
Rural	166	41.1	–	
Urban	238	58.9	–	
Yes depending on the nature of the advisor				403
Personal health	287	71.2	–	
Other	116	28.8		
Advice received over the last three years to eat at least five servings of fruit and/or vegetables a day				5300
No	4633	87.4	86.48–88.29	
Yes	667	12.6	11.70–13.51	
Yes according to gender				667
Men	194	29.1	–	
Women	473	70.9	–	
Yes depending on the environment				667
Rural	259	38.8	–	
Urban	408	61.2	–	
Advice received over the past three years to reduce your fat consumption				5299
No	4860	91.7	90.93–92.43	
Yes	439	8.3	7.56–9.06	
Yes according to gender				439
Men	113	25.7	–	
Women	326	74.3	–	
Yes depending on the environment				439
Rural	169	38.5	–	
Urban	270	61.5	–	
Advice received in the last three years to start or do more physical activity				5299
No	4752	89.7	88.81–90.47	
Yes	547	10.3	9.52–11.18	
Yes according to gender				547
Men	194	35.5	–	
Women	353	64.5	–	
Yes depending on the environment				547
Rural	183	33.5	–	
Urban	364	66.5	–	
Advice received in the last three years to maintain a healthy weight or lose weight				5299
No	5028	94.9	94.24–95.45	
Yes	271	5.1	4.54–5.75	
Yes according to gender				271
Men	75	27.7	–	
Women	196	72.3	–	
Yes depending on the environment				271
Rural	68	25.1	–	
Urban	203	74.9	–	

Total hypercholesterolaemia was found in the first three populations with the most strokes: simultaneous arterial hypertension + total hypercholesterolaemia; simultaneous arterial hypertension + total hypercholesterolaemia + diabetes; total hypercholesterolaemia only.

The prognosis of hypertension depends on the parameter relating to hypertension itself on the one hand (such as grade of blood pressure values, day–night profile, blood pressure variability, pulse pressure, blood pressure load, morning surge) and on the other hand on the presence of co-morbidities. More than 50% of hypertensives also have other cardiovascular risk factors.[47]

Any cardiovascular risk factor associated with hypertension increases the cardiovascular mortality rate. These are: male gender, age ≥ 55 years in men and 65 years in women, smoking, heavy alcohol consumption, physical inactivity, insufficient consumption of fruits and vegetables, obesity, abdominal obesity, dyslipidaemia, diabetes, and resting heart rate ≥ 80 beats per minute.[11, 15-17] Also a family history of diabetes, sudden death, or cardiovascular disease in a first-degree relative.[11,15-17]

This study reveals the great vulnerability that total hypercholesterolaemia inflicts on Senegalese people with regard to stroke. The Senegalese population of total hypercholesterolaemia constituted the third population with the most strokes in 2015 (8.1%). The population of hypertensives and total hypercholesterolaemics simultaneously was at the head of the pathological populations in terms of proportion of strokes (9.4 %). This was ahead of the hypertensive, diabetic and total hypercholesterolaemic population simultaneously (second position with 9.1%). The population of hypertensives came in fourth position in terms of the population recording the greatest number of strokes (6.0%).

Hypertension is one of the leading causes of premature death worldwide.[48,49] Complications of hypertension are more often ischaemic than haemorrhagic.[11,15-17] Hypertension initiates arteriosclerosis, which is a thickening of the arterial intima, with a fibrous thinning of the media.[11,15-17] This is made possible and maintained through three mechanisms: endothelial dysfunction, vascular remodelling and perivascular fibrosis.[11,15-17]

Table 9. Bivariate analyses with CVA as dependent variable. National WHO STEPwise survey, Senegal 2015

Variables	*Cardiovascular accident*		p-*value*
	No (n = *5 095*) n *(%)*	*Yes* (n = *203*) n *(%)*	
High blood pressure			< 0.001*
No	3 920 (97)	128 (3.2)	
Yes	1 175 (94)	75 (6.0)	
Diabetes			0.8
No	4 984 (96)	198 (3.8)	
Yes	111 (96)	5 (4.3)	
Total hypercholesterolaemia			0.055**
No	5 004 (96)	195 (3.8)	
Yes	91 (92)	8 (8.1)	
High blood pressure and total hypercholesterolaemia at the same time			0.051**
No	5 047 (96)	198 (3.8)	
Yes	48 (91)	5 (9.4)	
High blood pressure and diabetes at the same time			0.3
No	5 028 (96)	199 (3.8)	
Yes	67 (94)	4 (5.6)	
High blood pressure, diabetes and total hypercholesterolaemia at the same time			0.3
No	5 085 (96)	202 (3.8)	
Yes	10 (91)	1 (9.1)	
Environment			0.3
Urban	2 135 (96)	78 (3.5)	
Rural	2 960 (96)	125 (4.1)	
Gender			0.010*
Men	1 882 (97)	57 (2.9)	
Women	3 213 (96)	146 (4.3)	
Palm oil consumption			0.3
No	4 025 (96)	167 (4.0)	
Yes	1 066 (97)	36 (3.3)	
Most used fat for home preparation			0.3
None used	7 (88)	1 (12)	
None in particular	21 (95)	1 (4.5)	
Vegetable oil	4 913 (96)	199 (3.9)	
Bacon or fat	77 (100)	0 (0)	
Butter or light butter	7 (100)	0 (0)	
Margarine	4 (100)	0 (0)	
Other	1 (100)	0 (0)	
Do not know	61 (97)	2 (3.2)	
Number of sugar blocks consumed at breakfast			< 0.001*
1 block	359 (98)	9 (2.4)	
2 blocks	2 111 (95)	120 (5.4)	
3 blocks	984 (97)	35 (3.4)	
4 or more blocks	763 (98)	12 (1.5)	
Frequency of eating foods high in salt			0.093**
Never	2 323 (96)	109 (4.5)	
Do not know	137 (98)	3 (2.1)	
Rarely	1 265 (96)	54 (4.1)	
Occasionally	623 (97)	17 (2.7)	
Often	538 (97)	15 (2.7)	
Still	199 (98)	5 (2.5)	
Knowledge that high salt consumption can cause health problems			< 0.001*
Do not know	4 (100)	0 (0)	
Yes	4 499 (96)	196 (4.2)	
No	592 (99)	7 (1.2)	
Obesity			0.10**
No	4 580 (96)	173 (3.6)	
Yes	378 (95)	21 (5.3)	
Current active smoking			0.6
No	4 789 (96)	193 (3.9)	
Yes	302 (97)	10 (3.2)	

Table 9 continued.

Variables	*Cardiovascular accident*		p-*value*
	No (n = *5 095*) n *(%)*	*Yes* (n = *203*) n *(%)*	
Passive smoking at home			0.3
No	4 084 (96)	157 (3.7)	
Yes	994 (96)	46 (4.4)	
Passive smoking at work			0.3
Yes	323 (95)	18 (5.3)	
No	2 900 (96)	118 (3.9)	
Do not work in a closed environment	1 854 (97)	67 (3.5)	
Passive smoking both at home and at work			0.5
No	4 855 (96)	192 (3.8)	
Yes	223 (95)	11 (4.7)	
Isolated diastolic hypertension			0.14**
No	4 529 (96)	172 (3.7)	
Yes	455 (95)	24 (5.0)	
Isolated systolic hypertension			0.800
No	4761 (96.2)	186 (3.7)	
Yes	222 (96)	10 (4.3)	
High pulse pressure			0.708
No	4527 (96.2)	176 (3.7)	
Yes	456 (96)	20 (4.2)	
Practice of none of the forms of physical activity described			0.3
No	4 760 (96)	186 (3.8)	
Yes	335 (95)	17 (4.8)	
Participation in all forms of physical activity described			0.037*
No	5 036 (96)	197 (3.8)	
Yes	59 (91)	6 (9.2)	
Abdominal obesity in women			0.8
No	1 818 (96)	83 (4.4)	
Yes	1 305 (96)	57 (4.2)	
Abdominal obesity in men			0.6
No	1 694 (97)	51 (2.9)	
Yes	109 (96)	4 (3.5)	
Heart rate at risk			0.2**
No	2 452 (97)	88 (3.5)	
Yes	2 532 (96)	108 (4.1)	
Frequency of alcohol consumption			0.6
Less than once a month	45 (90)	5 (10)	
One to three days per month	19 (100)	0 (0)	
One to two days a week	14 (93)	1 (6.7)	
Three to four days a week	3 (100)	0 (0)	
Five to six days a week	4 (100)	0 (0)	
Daily	15 (100)	0 (0)	

*Variable having a statistically significant link in multivariate analysis with CVA.

In addition to arteriosclerosis, hypertension promotes atherosclerosis, which is an accumulation of macrophages overloaded with lipids in the sub-intima, leading to the formation of foam cells to which are added fibro-calcareous tissues.[11,15-17,50] Both, arteriosclerosis and atherosclerosis, lead to loss of vasomotor activity, disproportionate vascular contractility and stenosis of the arteries, which is both endoluminal and parietal.[11,15-17,50] These various abnormalities maintain elevation of the blood pressure and explain the onslaught of ischaemic heart disease and ischaemic stroke.[48-50]

However, total hypercholesterolaemia, more precisely hyper-LDL-cholesterolemia, also triggers atherogenesis by itself.[50] This is how the association of hypertension and hypercholesterolaemia sets up a self-sustaining vicious circle, which aggravates the development and progression of arteriosclerosis and atherosclerotic lesions. This increases the risk of ischaemic

Table 10. Multicollinearity between the explanatory variables of the parsimonious model with CVA as the dependent variable. National WHO STEPwise survey, Senegal 2015

Variables	*GVIF*	*Degrees of freedom*	$GVIF^{1/(2\times DF)}$
High blood pressure	1.011869	1	1.005917
Number of sugar blocks consumed at breakfast	1.002229	3	1.000371
Participation in all forms of physical activity described	1.015870	1	1.007904
Heart rate at risk	1.006050	1	1.003020

cardiovascular disease. The risk of having a stroke for a hypertensive patient with dyslipidaemia is four times higher than for those who have their parameters controlled.[51]

In the presence of hypertension, it is necessary to assess for the presence of other risk factors in order to assess the overall cardiovascular risk.[52] In practice, the association of hypertension and diabetes is sufficiently researched and feared because it corresponds from the outset, at least to a high risk of cardiovascular events, regardless of the grade of hypertension.[47,53]

It is time for us to research and consider with the same seriousness the association of hypertension and dyslipidaemia. As proof, the proportion of respondents having already had their cholesterol checked at least once in their life came last (4.3%), after blood sugar (20.7%) and blood pressure (60.6%) testing. The same was true for taking medication.

The proportion of known dyslipidaemics under treatment was the lowest at 14% behind known hypertensives (32%) and known diabetics (40%). Spannella *et al*., in their study of 1 219 hypertensive and dyslipidaemia patients simultaneously, found that dyslipidaemia was still too often neglected in hypertensives: LDL cholesterol was controlled in 28.5%, while blood pressure was controlled in 41.6% of patients and only 12.4% of patients had both 24-hour blood pressure and LDL cholesterol controlled.[54] They also found that the higher the cardiovascular risk, the lower the LDL cholesterol control rate ($p < 0.001$).[54] Hypertension and dyslipidaemia should therefore be detected and controlled simultaneously to provide better protection against stroke.[55-59]

Advice for any kind of behavioural change affected at least three people out of 100 and at most 17 out of 100. In descending order, according to the number of people affected in the whole sample, we found: patients have received smoking cessation advice (17.4%); have received advice to reduce salt consumption (13%); have received advice to eat at least five fruits and vegetables a day (12.6%); have received advice to start or do more physical activity (10.3%); have received advice to reduce fat consumption (8.3%); have received advice to reduce the amount of sugar (7.6%); have received advice to maintain a healthy weight or lose weight (5.1%); have received advice to stop or not to start smoking (2.8%).

The advice was most often given to women except for those related to tobacco consumption, which was given more often to men. The advice was most often given in the urban environment except for those relating to salt consumption, which was more often in rural areas. All advice was given mostly to the gender most affected by the health problem but some advice was mainly addressed to the environment least affected by the health problem.

The advice to start or do more physical activity was given predominantly in an urban environment, whereas those who did not practice any of the physical activities described were predominantly rural. The advice to reduce their fat consumption was given predominantly in urban environments, while palm oil consumption was predominantly rural.

The advice to reduce the amount of sugar in the diet was given predominantly in urban areas, while the vast majority who consumed sugar cubes or sugary drinks were predominantly in rural areas. The advice to stop or not to start tobacco consumption was given predominantly in urban environments, while the consumption of smoked and non-smoked tobacco was predominantly in rural environments. Counselling for smoking cessation was predominantly given in urban settings, while smoking cessation attempts were predominantly rural.

The rural environment was generally less well off when it came to awareness programmes for behavioural change. These results prove that the rural environment is often more affected by certain health problems than the urban environment. Therefore, for a greater impact of our health interventions (health structures, health personnel, health programmes), the rural environment deserves full consideration.

Subjects who practiced all the forms of physical activity described in the STEPwise WHO survey were 4.29 times more likely to have a CVA than subjects who did at least one of the forms of activity described (aOR = 4.29; 95% CI = 1.42–10.55; $p = 0.004$). This implies that very difficult living conditions requiring heavy and continuous physical effort at work, when travelling and even during supposed leisure time weakens the health and exposes people to CVA.

Hypertensive subjects were 2.74 times more likely to have a CVA than non-hypertensives (aOR = 2.74; 95% CI = 1.88–3.99; $p < 0.001$). This proves that hypertension is a major public health problem. It deserves the nickname 'silent and serial killer'. One in three adults suffer from hypertension in the world.[13] It causes 9.4 million deaths per year;[13,60] more than half of the deaths caused each year are from cardiovascular diseases,[13,60] and it represents 13% of all-cause mortality worldwide.[13] We need to pay more attention to the detection, treatment and control of high blood pressure in our country because high blood pressure is at the crossroads of the occurrence and severity of cardiovascular events.[61]

Conclusion

We in Senegal need to pay more attention to arterial hypertension, dyslipidaemia, women and the rural environment in our ongoing fight against cardiovascular diseases and their risk factors.

- In Senegal, we must work tirelessly for the primary prevention of arterial hypertension throughout the national territory.
- Public health specialists in Senegal must create an observatory of arterial hypertension for rigorous monitoring of morbidity and mortality indicators related to arterial hypertension throughout the national territory.
- Cardiologists in Senegal must above all be outstanding specialists in the diagnosis and management of arterial hypertension, and should cover the entire national territory.
- At a therapeutic level, there must be inclusion of healthcare providers, general practitioners, nurses and counsellors in the health centres, health posts and health huts. They are in contact with the larger population and have the opportunity for activities on screening, prevention, counselling and treatment.

- We must encourage pharmaceutical companies to provide populations with combined drugs (bi- or triple therapy) for better compliance in order to simultaneously and effectively control arterial hypertension and dyslipidaemia.
- On the socio-cultural level, we must support the empowerment of Senegalese women for their healthcare.

We acknowledge the Institute of Health and Development, Cardiology Department and Dalal Jamm Hospital.

References

1. Accord de Paris sur le climat — Wikipédia [Internet]. [cited 2020 Sep 11]. Available from: https://fr.wikipedia.org/wiki/Accord_de_Paris_sur_le_climat
2. Objectifs de développement durable [Internet]. [cited 2019 Apr 6]. Available from: https://www.un.org/sustainabledevelopment/fr/objectifs-de-developpement-durable/
3. 17 objectifs de développement durable | Agenda 2030 - Site des ODD [Internet]. [cited 2019 Apr 6]. Available from: https://www.agenda-2030.fr/odd/17-objectifs-de-developpement-durable-10
4. Les Objectifs de développement durable – Développement durable [Internet]. [cited 2020 Sep 11]. Available from: https://www.un.org/sustainabledevelopment/fr/objectifs-de-developpement-durable/
5. ODD3 - Donner aux individus les moyens de vivre une vie saine et promouvoir le bien-être à tous les âges | Agenda 2030 - Site des ODD [Internet]. [cited 2020 Sep 11]. Available from: https://www.agenda-2030.fr/odd/odd3-donner-aux-individus-les-moyens-de-vivre-une-vie-saine-et-promouvoir-le-bien-etre-tous-les
6. Ministère de la Santé et de l'Action sociale, Organisation Mondiale de la Santé, Agence Nationale des Statisque et du Dévéloppement. Enquête nationale sur les facteurs de risque des maladies non transmissibles STPHE 2015 <<Rapport préléminaire: les indicateurs clés>>. 2016 Juin p. 69.
7. Organisation mondiale de la Santé, Département des maladies chroniques et de la promotion de la Santé. Questionnaire STPHE de l'OMS pour la surveillance des facteurs de risque des maladies non transmissibles (Modules de Base et Elargis) [Internet]. Available from: www.who.int/chp/stPHE
8. World Health Organization. Regional Office for Africa. Report on the status of major health risk factors for noncommunicable diseases: WHO African Region, 2015 [Internet]. 2016. 88 p. Available from: http://www.afro.who.int/en/clusters-a-programmes/hpr/health-risk-factors.html
9. World Health Organization, Regional Office for Africa. Report on the status of major health risk factors for noncommunicable diseases: WHO African Region, 2015. 2015. 88 pp.
10. Guide pratique pour faire le point sur votre consommation d'alcool: 31.
11. Kane A. Hypertension arterielle de l'adulte: Du diagnostic à la prise en charge thérapeutique. Première édition. Presses Univversitaires de Dakar, 2015.
12. Hypertension artérielle – Wikipédia [Internet]. [cited 2020 Sep 11]. Available from: https://fr.wikipedia.org/wiki/Hypertension_art%C3%A9rielle
13. OMS | Questions-réponses l'hypertension artérielle [Internet]. [cited 2020 Sep 11]. Available from: https://www.who.int/features/qa/82/fr/
14. Les recommandations de l'ESC/ESH 2018 sur l'hypertension artérielle (HTA) [Internet]. [cited 2020 Sep 11]. Available from: https://www.cardio-online.fr/Actualites/A-la-une/recommandations-esc-2018-hypertension-arterielle
15. Kane A. Hypertension arterielle de l'adulte: Du diagnostic à la prise en charge thérapeutique. Deuxieme édition. Presses Universitaires de Dakar, 2021. 126 pp.
16. Asmar R. Pression artérielle. Régulation et épidémiologie. Mesures et valeurs normales. *Néphrologie Thérapeutique* 2007; **3**(4): 163–184.
17. Stergiou GS, Palatini P, Parati G, O'Brien E, Januszewicz A, Lurbe E, *et al*. 2021 European Society of Hypertension practice guidelines for office and out-of-office blood pressure measurement. *J Hypertens* 2021; **39**(7): 1293–1302.
18. Franklin SS, Larson MG, Khan SA, Wong ND, Leip EP, Kannel WB, *et al*. Does the relation of blood pressure to coronary heart disease risk change with aging? The Framingham Heart Study. *Circulation* 2001; **103**(9): 1245–1249.
19. Fédération Internationale du Diabète. *Atlas du Diabete de la Fid.* Septième édition 2015. 7e édition, 2015. 140 pp.
20. Fédération Internationale du Diabète. *Atlas du Diabete de la Fid*. 8e édition, 2017. 150 pp.
21. Fédération Internationale du Diabète. *Atlas du Diabete de la Fid.* 9ème édition, 2019. 176 pp.
22. Fédération Internationale du Diabète. Atlas du Diabete de la Fid. 10e edition, 2021. 141 pp.
23. Report of the Expert Committee on the diagnosis and classification of diabetes mellitus. *Diabetes Care* 1997; **20**(7): 1183–1197.
24. Monnier L, Colette C. Définitions et classifications des états diabétiques: 12.
25. American Diabetes Association. Diagnosis and classification of diabetes mellitus. *Diabetes Care* 2013; **36**(Suppl 1): S67–74.
26. Thiombiano LP, Mbaye A, Sarr SA, Ngaide AA, Kane Ab, Diao M, *et al*. Prévalence de la dyslipidémie dans la population rurale de Guéoul (Sénégal). *Ann Cardiol Angéiologie* 2016; **65**(2): 77–80.
27. Oguejiofor OC, Onwukwe CH, Odenigbo CU. Dyslipidemia in Nigeria: Prevalence and pattern. *Ann Afr Med* 2012; **11**(4): 197.
28. Expert Panel on Detection. Executive Summary of the Third Report of the National Cholesterol Education Program (NCEP) Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults (Adult Treatment Panel III). *J Am Med Assoc* 2001; **285**(19): 2486–2497.
29. Ambrosetti M, Scardina G, Favretto G, Temporelli PL, Faggiano PM, Greco C, *et al*. [Heart rate as a therapeutic target after acute coronary syndrome and in chronic coronary heart disease]. *G Ital Cardiol* 2017; **18**(3 Suppl 1): 3S–16S.
30. Cook S, Togni M, Schaub MC, Wenaweser P, Hess OM. High heart rate: a cardiovascular risk factor? *Eur Heart J* 2006; **27**(20): 2387–2393.
31. Kannel WB, Kannel C, Paffenbarger RS, Cupples LA. Heart rate and cardiovascular mortality: the Framingham Study. *Am Heart J* 1987; **113**(6): 1489–1494.
32. Kristal-Boneh E, Silber H, Harari G, Froom P. The association of resting heart rate with cardiovascular, cancer and all-cause mortality. Eight-year follow-up of 3527 male Israeli employees (the CORDIS Study). *Eur Heart J* 2000; **21**(2): 116–124.
33. Seccareccia F, Pannozzo F, Dima F, Minoprio A, Menditto A, Lo Noce C, *et al*. Heart rate as a predictor of mortality: the MATISS project. *Am J Public Health* 2001; **91**(8): 1258–1263.
34. Prévalence de l'obésité abdominale et évolution du tour de taille mesuré chez les adultes québécois :14.
35. Obésité et surpoids [Internet]. [cited 2022 Apr 26]. Available from: https://www.who.int/fr/news-room/fact-sheets/detail/obesity-and-overweight
36. Loi portant Code d'Éthique pour la Recherche en Santé. Loi n° 2009-17 p. 10.
37. *Journal Officiel de la Republique du Senegal* [Internet]. [cited 2021 Apr 4].

Available from: http://www.jo.gouv.sn/spip.php?article7557
38. Choukem SP, Kengne AP, Dehayem YM, Simo NL, Mbanya JC. Hypertension in people with diabetes in sub-Saharan Africa: revealing the hidden face of the iceberg. *Diabetes Res Clin Pract* 2007; **77**(2): 293–299.
39. Nibouche W, Biad A. Hypertension artérielle au moment du diagnostic du diabète de type 2 de l'adulte. *Annales de Cardiologie et d'Angéiologie* 2016; **65**(3): 152–158.
40. Ogola E. High prevalence and poor control of hypertension and associated cardiovascular risk factors in diabetic patients in a rural hospital in Kenya. *J Hypertens* 2016; **34**: e394.
41. Campbell NRC, Gilbert RE, Leiter LA, Larochelle P, Tobe S, Chockalingam A, *et al*. L'hypertension chez les diabétiques de type 2. *Can Fam Physician* 2011; **57**(9): e347–353.
42. Agence Nationale de la Statistique et de la Démographie. Situation économique et sociale du Sénégal en 2015. 2018 Jan p. 27.
43. Shufelt CL, Pacheco C, Tweet MS, Miller VM. Sex-specific physiology and cardiovascular disease. *Adv Exp Med Biol* 2018; **1065**: 433–454.
44. Santé des femmes [Internet]. [cited 2022 Oct 10]. Available from: https://www.who.int/fr/news-room/fact-sheets/detail/women-s-health
45. Lambert H, Kahindo Mbeva JB. Femmes et accès aux soins en République démocratique du Congo: des barrières liées au genre. *Santé Publique* 2019; **31**(5): 735–744.
46. Sougou NM, Sougou AS, Bassoum O, Lèye MMM, Faye A, Seck I. Facteurs associés à l'autonomie de décision des femmes pour leur santé au Sénégal. *Santé Publique* 2020; **32**(4): 381–388.
47. Unger T, Borghi C, Charchar F, Khan NA, Poulter NR, Prabhakaran D, *et al.* 2020 International Society of Hypertension Global Hypertension Practice Guidelines: 24.
48. OMS | Questions-réponses l'hypertension artérielle [Internet]. [cited 2020 Sep 11]. Available from: https://www.who.int/features/qa/82/fr/
49. Forouzanfar MH, Liu P, Roth GA, Ng M, Biryukov S, Marczak L, *et al.* global burden of hypertension and systolic blood pressure of at least 110 to 115 mmHg, 1990–2015. *J Am Med Assoc* 2017; **317**(2): 165.
50. Hurtubise J, McLellan K, Durr K, Onasanya O, Nwabuko D, Ndisang JF. The different facets of dyslipidemia and hypertension in atherosclerosis. *Curr Atheroscler Rep* 2016; **18**(12): 82.
51. Mach F, Baigent C, Catapano AL, Koskinas KC, Casula M, Badimon L, *et al*. 2019 ESC/EAS Guidelines for the management of dyslipidaemias: lipid modification to reduce cardiovascular risk. *Eur Heart J* 2020; **41**(1): 111–188.
52. Rudaz A, Rima A. Scores de risque cardiovasculaire : pourquoi, comment et quand les utiliser ? *Rev Médicale Suisse* 2010; **6**.
53. Mancia G, Rosei EA, Azizi M, Burnier M, Clement DL, Coca A, *et al*. 2018 ESC/ESH Guidelines for the management of arterial hypertension: 98.
54. Spannella F, Giulietti F, Di Pentima C, Sarzani R. Prevalence and control of dyslipidemia in patients referred for high blood pressure: the disregarded 'double-trouble' lipid profile in overweight/obese. *Adv Ther* 2019; **36**(6): 1426–1437.
55. Williams B, Mancia G, Spiering W, Agabiti Rosei E, Azizi M, Burnier M, *et al*. 2018 ESC/ESH Guidelines for the management of arterial hypertension: The Task Force for the management of arterial hypertension of the European Society of Cardiology (ESC) and the European Society of Hypertension (ESH). *Eur Heart J* 2018; **39**(33): 3021–3104.
56. Athyros VG, Mikhailidis DP, Papageorgiou AA, Bouloukos VI, Pehlivanidis AN, *et al*., for the GREACE Study Collaborative Group. Effect of statins and ACE inhibitors alone and in combination on clinical outcome in patients with coronary heart disease. *J Hum Hypertens* 2004; **18**(11): 781–788.
57. Sekizawa Y, Konishi Y, Kimura M. Are the effects of blood pressure lowering treatment diminishing? meta-regression analyses. *Clin Hypertens* 2018; **24**(1): 16.
58. Ference BA, Ginsberg HN, Graham I, Ray KK, Packard CJ, Bruckert E, *et al*. Low-density lipoproteins cause atherosclerotic cardiovascular disease. 1. Evidence from genetic, epidemiologic, and clinical studies. A consensus statement from the European Atherosclerosis Society Consensus Panel. *Eur Heart J* 2017; **38**(32): 2459–2472.
59. Sever PS, Poulter NR, Mastorantonakis S, Chang CL, Dahlof B, Wedel H, *et al*. Coronary heart disease benefits from blood pressure and lipid-lowering. *Int J Cardiol* 2009; **135**(2): 218–222.
60. Organisation Mondiale de la Santé, Ensemble venons à bout des mnt. Shake le sel : une habitude à perdre guide technique en vue de réduire l'apport en sel. 2017. 60 p.
61. Pan-African Society of Cardiology. Roadmap to achieve 25% hypertension control in Africa by 2025. *Cardiovasc J Afr* 2017; **28**(4): 262–273.