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A Cross-Sectional Survey on Non-Communicable Diseases and Risk Factors in the Senegalese Army

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Abstract

Background: The non-communicable diseases (NCDs) have become a public health priority. The objectives of this study were to measure the prevalence and to assess the risk factors of NCDs among the Senegalese military population to initiate an intervention program. **Methods:** A cross-sectional survey was conducted in 2014. Two-level stratification was used to sample participants. Data were collected following the protocol recommended by the World Health Organization. Data were managed using Epi-Info 6 software and analyzed using R software. **Results:** A total of 1224 participants were recruited, of whom 96.9% were men. Their ages ranged from 25 to 60 years with a mean of 39.7 ± 9.2 years. Of participants, 17.2% were active smokers. Average duration of active smoking was 19.9 ± 9 years. The prevalence of current alcohol consumption was 11.5%, with an average of 4 ± 2.7 glasses a day. 97.17% of participants consumed fewer than 5 servings of fruits and vegetables a day. 18.63% had insufficient physical activity. The overall prevalence of high blood pressure was 26.9%. The proportion of those who were overweight was 27.2%; 3.3% were obese. 3.0% of participants had diabetes and 44.1% had hypercholesterolemia. After adjusting for waist circumference, the risk of high cholesterol was 2.42 in the 35 - 44 age group and 2.86 in the 45 - 60 age group in comparison with the 25 - 34 age group. 32% were classified as having stage 2 chronic kidney. **Conclusions:** The findings of this study indicate the importance of risk factors for NCDs in the Senegalese military population. Intervention based on prevention and health promotion is needed.

Keywords

Risk Factors, NCDs, Military

1. Background

NCDs are a global public health priority [1] [2]. In developing countries, there exists a double epidemiological burden of both communicable and non-communicable diseases [3] [4]. Indeed, NCDs are responsible for 35 million of the 53 million deaths worldwide; three-quarters of these deaths occur in low-income or middle-income countries [2] [5] [6]. The epidemiological transition observed in industrialized countries seems to affect developing countries [7] [8]. Population growth, rapid urbanization and change in lifestyle are fueling the emergence of NCDs [7] [8] [9]. Furthermore, people who are in precarious socio-economic situations are the most vulnerable [2].

Despite the increase of NCDs, health prevention programs are still primarily focused on communicable diseases in developing countries [10]. For example, Millennium Development Goal 6 is dedicated to the fight against HIV/AIDS, malaria and tuberculosis, and to the mobilization of significant funding to fight these diseases [10]. However, the World Health Organization forecasts a global epidemic of non-communicable diseases in 2030 [11] and recommends that low and middle-income countries develop NCD maps, including their determinants, to implement appropriate control programs [12] [13] [14]. In addition, the United Nations passed a resolution to reduce premature mortality by 25% by 2025, an initiative that involves private entities and civil society [3] [10] [13] [15] [16].

In Senegal, several well-organized programs are dedicated to the fight against communicable diseases. However, there is no dedicated program for NCDs and case management is currently the main protocol. In coming years, the availability of epidemiological data and the development of a multi-sector approach will present challenges to NCD control.

To address these concerns, this study was carried out to assess NCD risk factors in the army to establish a sector-specific program for Senegalese military personnel.

2. Methods

We conducted a descriptive and analytical cross-sectional study on the key risk factors (behavioral, physical and biological) of non-communicable diseases.

The study population consisted of Senegalese military personnel. Sample size was calculated using a 25% estimated theoretical prevalence of high blood pressure, with 5% accuracy and 1.5% design effect [17]. For each stratum, 432 subjects were to be investigated, thus. The total estimated sample size was 1296 individuals. Two-level stratification was used to determine the number of individuals to be surveyed in each training unit and also in each age group. Statistical units were selected in the field using a simple random sampling approach.

Only military personnel aged 25 - 60 years who were in Senegal during the study period were included. Those who did not want to participate in the survey or were unable to answer questions were excluded from the study. Also, the military personnel under 25 years old were excluded. The enrolled population was divided into three age-based strata: 25 - 34; 35 - 44 and 45 - 60 years old.

A previously validated version of the STEPS questionnaire was used after adapting for context [18] [19]. The questionnaire included three sections including socio-demographic and behavioral information, anthropometric and cardiovascular measures, and biochemical parameters. Participation in the study was voluntary and free of charge. Data were entered using Epi Info 6 software and analyzed using R software.

Consumption of fruits and vegetables was considered insufficient below 5 daily servings. A serving was defined as 80 grams of fruits and/or vegetables, and estimation was performed using a validated chart. The WHO recommends a daily consumption of 400 grams or 5 servings of fruits and vegetables [18] [19]. The physical activity assessment took into account all activities related to leisure, work and daily trips. Physical activity was considered moderate when it was sustained for 30 minutes and resulted in a moderate heart rate increase. Physical activity was defined as high when it was a session of recreation or sports that was sustained for at least 30 minutes and resulted in a significant heart rate increase [18] [19] [20]. Participants who performed fewer than five intense physical activities weekly were considered inactive [18] [19] [20].

Current smokers were those who used cigarettes daily [20], while alcohol consumption was defined as the use of alcohol in the last 30 days [19].

Overweight was defined as a body mass index (BMI) between 25 and 30 kg/m^2, and obesity as a BMI greater than or equal to 30 kg/m^2 [18] [19] [20] [21].

Participants were classified as diabetic based on a fasting blood glucose level ≥126 mg/l or when the participant was under anti-diabetes treatment [20]. High blood pressure was indicated by systolic blood pressure ≥140 mm Hg and/or diastolic blood pressure ≥90 mm Hg or by regular use of antihypertensive therapy [18] [19] [20] [21]. Hypercholesterolemia was defined by a total cholesterol rate ≥250 mg/dl and/or a LDH cholesterol value below 40 mg/dl and/or triglyceride levels ≥150 mg/dl [20] [22] [23].

The glomerular filtration rate (GFR) was assessed using the Modification of Diet in Renal Disease (MDRD) formula [24] [25] [26] [27]. Chronic kidney disease was defined by a GFR below 60 ml/min/1.73 m^2. Two CKD stages were identified: Stage 1 represented a GFR greater than 90 ml/min/1.73 m^2; Stage 2 was represented a GFR between 60 and 90 ml/min/1.73 m^2 [24] [25] [26] [27].

Chi-square test was performed to compare proportions, with a significance level set at 5%. Odds ratios with 95% confidence interval were used to estimate the risk in simple and multiple logistic regression models. In this context, effects on the incidence of high blood pressure of age, BMI ≥25 kg/m^2, hypercholesterolemia, smoking and physical activity were verified. Similarly, effects on the occurrence of hyperlipidemia of age, physical activity, consumption of fruits and vegetables, alcohol consumption in the last thirty days and waist circumference were assessed. A likelihood test was used for this purpose.

Ethics statement: Each participant signed a consent letter before entering the study. Additionally, each participant was informed about his medical profile at the conclusion of data collection; appropriate advice was given and case management delivered according to identified health problems.

In compliance with national regulations, the Director of Senegalese military medical support approved the study among the military and its publication was authorized by Senegalese ethics national committee.

3. Results

The study was conducted over a period of ten months. A total of 1224 individuals participated. No cases of refusal were reported.

The mean and median ages were the same: both equaled 40 years (normal distribution of the sample). The average age at beginning of smoking was 20.8 ± 4 years and the average number of years of active smoking was 19.9 ± 9 years, with 9.5 ± 4 cigarettes smoked/day. The average alcohol intake was 2.7 ± 4 glasses per day. The mean BMI was 23.7 ± 3.1 kg/m^2 and the average waist circumference size was 85.6 ± 8 cm.

The average cholesterol level was 1.93 ± 0.42 g/l; the average HDL-cholesterol level was 0.52 ± 0.16 g/l, while the average triglycerides level was 0.82 ± 0.44 g/l. The average MDRD was 109 ± 31.2 ml/min/1.73 m^2.

Table 1 shows the behavioral determinants of NCDs among Senegalese soldiers. The prevalence of current active smokers was 17.2% (95% CI = 15 - 19) and did not vary significantly between the different age groups ($p = 0.73$). At the same time, the percentage of history of active smoking was higher among the over 45 age group.

The prevalence of alcohol consumption (11.5% overall, [95% CI = 9.8 - 13.4]), varied between strata ($p = 0.02$). It was significantly higher among 35 - 60 year olds (13%) and relatively low among 25 - 34 year olds (7.5%).

The proportion of participants who consumed insufficient amounts of fruits and vegetables was considerable; 9 out of 10 respondents consumed five or fewer servings of fruits and vegetables per day, 4 out 10 consumed fewer than three servings per day.

Among participants, 46% (95% CI = 43.3% - 49%) engaged in intense or moderate physical activity. This percentage decreased significantly with age ($p < 0.001$). Low physical activity was observed in one out of five participants and increased with age ($p < 0.001$). The prevalence of low physical activity was higher in the over 44 age group and observed less often among those under 35 years old.

Table 2 shows the distribution of respondents according to physical determinants. Overall prevalence of overweight participants was 27.2%. Obesity was rare; only 3.3% (95% CI = 2.4 - 4.5) of participants had a BMI above 30 kg/m^2. Overweight or obesity was more frequently observed among those aged 35 years and over. Prevalence of overweight was 3 and 4 times higher in the 35 - 44 and 45 - 60 age groups, respectively, compared to those under 35 years old.

The proportion of military staff with a waist circumference greater than 94 cm was 15%. It was more common in those over 44 years old.

The proportion of participants with high blood pressure that was detected for the first time during the study was 25%; 2% were already on antihypertensive therapy. Thus, the overall prevalence of hypertension was 27% (95% CI = 24.4 - 29.5). It was more common in the 45 - 60 age group ($p < 0.001$).

Table 1. Lifestyle risk factors for non-communicable diseases among Senegalese military personnel.

	All	25 - 34 years	35 - 44 years	45 - 60 years	*p* value
Tobacco consumption					
Current smoking	210	59	76	75	0.73
%	17.2	15.7	18.1	17.6	
$IC_{95\%}$	[15 - 19]	[12.2 - 19.8]	[14.5 - 22.0]	[14.1 - 21.6]	
History of smoking	303	43	110	150	<0.001
%	29.8	13.5	31.9	42.5	
$IC_{95\%}$	[27 - 32.7]	[10.0 - 17.8]	[27.0 - 37.1]	[37.8 - 47.8]	
Alcohol consumption					
In the last 12 months	190	43	72	75	0.031
%	15.5	11.4	17.1	17.6	
$IC_{95\%}$	[13.5 - 17.7]	[8.4 - 15.1]	[13.6 - 21.0]	[14.1 - 21.5]	
In the last 30 days	141	27	56	58	0.006
%	11.5	7.2	13.3	13.6	
$IC_{95\%}$	[9.8 - 13.4]	[4.8 - 10.3]	[10.2 - 16.9]	[10.5 - 17.2]	
Daily consumption of fruits and vegetables					
Five or fewer servings					
Number	1167	368	394	405	0.026
%	97.17%	98.90%	97.0%	95.74%	
$IC_{95\%}$	[96.1 - 98.0]	[97.3 - 99.7]	[94.9 - 98.5]	[93.3 - 97.5]	
Fewer than 3 servings					
Number	475	136	161	178	0.28
%	39.55%	36.56%	39.66%	42.08%	
$IC_{95\%}$	[36.8 - 42.4]	[31.6 - 41.7]	[34.8 - 44.6]	[37.3 - 46.9]	
Physical activity					
Intense or moderate	565	211	196	158	<0.001
%	46.16	56.12	46.56	37.00	
$IC_{95\%}$	[43.3 - 49.0]	[51.0 - 61.2]	[41.7 - 51.4]	[32.4 - 41.8]	
Low	228	66	63	99	0.007
%	18.63	17.55	14.96	23.19	
$IC_{95\%}$	[16.2 - 20.9]	[13.8 - 21.8]	[11.7 - 18.7]	[19.7 - 27.5]	

Table 2. Clinical characteristics of Senegalese military personnel with NCDs.

	All	25 - 34 years	35 - 44 years	45 - 60 years	*p* value
BMI(kg/m^2)					
Normal	850	339	274	237	<0.001
%	69.4	.2	65.1	55.5	
$IC_{95\%}$	[66.8 - 72]	[86.7 - 93]	[60.3 - 69.6]	[50.6 - 60.3]	
Overweight	333	34	129	170	<0.001
%	27.2	9.0	30.6	39.8	

Continued

$IC_{95\%}$	[24.7 - 29.8]	[6.3 - 12.4]	[26.3 - 35.3]	[35.1 - 44.6]	
Obesity	41	3	18	20	NV
%	3.3	0.8	4.3	4.7	
$IC_{95\%}$	[2.4 - 4.5]	[0.16 - 2.31]	[2.55 - 6.67]	[2.9 - 7.1]	
Overweight or obesity	374	37	147	190	<0.001
%	30.6	9.8	34.9	44.5	
$IC_{95\%}$	[28.0 - 33.2]	[7 - 13.3]	[30.3 - 39.7]	[39.7 - 49.4]	
Waist circumference >= 94 cm	185	25	63	97	<0.001
%	15.13	6.65	14.96	22.77	
$IC_{95\%}$	[13.2 - 17.3]	[4.3 - 9.7]	[11.7 - 18.7]	[18.9 - 27.1]	
Blood pressure					
Systolic	245	63	76	106	0.007
%	20.0	16.8	18.1	24.8	
$IC_{95\%}$	[17.8 - 22.4]	[13.1 - 20.9]	[14.5 - 22.1]	[20.8 - 29.3]	
Diastolic	239	59	78	102	0.011
%	19.5	15.7	18.5	23.9	
$IC_{95\%}$	[17.3 - 21.9]	[12.2 - 19.8]	[14.9 - 22.6]	[20 - 28.3]	
HSBP* or HDBP*	306	78	102	126	0.014
%	25.0	20.7	24.2	29.5	
$IC_{95\%}$	[22.6 - 27.5]	[16.8 - 25.2]	[20.2 - 28.6]	[25.3 - 34.2]	
Hypertension medication	23	0	5	18	NV
%	1.9	0.0	1.2	4.2	
$IC_{95\%}$	[1.2 - 2.8]		[0.39 - 2.75]	[2.51 - 6.58]	
Overall high blood pressure	329	78	107	144	<0.001
%	26.9	20.7	25.4	33.7	
$IC_{95\%}$	[24.4 - 29.5]	[16.8 - 25.2]	[21.3 - 29.9]	[29.4 - 38.6]	

HSBP*: High Systolic Blood Pressure; HDBP*: High Diastolic Blood Pressure.

Table 3 shows the biochemical parameters relevant to some non-communicable diseases. The prevalence of diabetes was low at 3% (95% CI = 2.1 - 4.1).

The prevalence of hypercholesterolemia was 44.07% (95% CI = 41.6 - 47). Hypercholesterolemia tended to increase with age ($p < 0.001$), increasing from 27.4% in the 25 - 34 age group to 49% in the 35 - 44 age group and 54.3% in the 45-60 age group. High total cholesterol level was often responsible for hyperlipidemia; 37.5% (95% CI = 34.7 - 40.3) of participants with hyperlipidemia had cholesterol levels above normal.

The prevalence of stage 1 chronic kidney disease was 68% in this study population (GFR > 90 ml/min/1.73 m^2); 32% were classified as having stage 2 chronic CKD (GFR value between 60 and 90 ml/min/1.73 m^2). The prevalence of stage 2 CKD was twice as high among those over 34 years old compared to those under 34 years old.

The results of the logistic regression are presented in Table 4. A simple model shows that age category, BMI ≥ 25 kg/m^2 and high cholesterol seemed to be risk factors for high blood pressure. Multiple regression controlling for the effect of overweight and

Table 3. Biochemical characteristics of NCDs among Senegalese military personnel.

	All	25 - 34 years	35 - 44 years	45 - 60 years	*p* value
Diabetes	37	2	7	28	NA
	3.03	0.53	1.66	6.57	
	[2.1 - 4.1]	[0.06 - 1.91]	[0.67 - 3.40]	[4.4 - 9.3]	
Hypercholesterolemia-total	446	86	167	193	<0.001
%	37.51	23.12	41.13	46.96	
$IC_{95\%}$	[34.7 - 40.3]	[18.9 - 27.7]	[36.3 - 46.1]	[42 - 51.9]	
Hypocholesterolemia-HDL	128	22	54	52	0.001
%	10.77	5.91	13.30	12.65	
$IC_{95\%}$	[9.1 - 12.7]	[3.7 - 8.8]	[10.2 - 17]	[9.6 - 16.3]	
Hypertriglyceridemia	50	5	23	22	0.004
%	4.21	1.34	5.67	5.35	
$IC_{95\%}$	[3.1 - 5.5]	[0.4 - 3.1]	[3.6 - 8.4]	[3.4 - 8.0]	
Hyperlipidemia	524	102	199	223	<0.001
%	44.07	27.42	49.01	54.26	
$IC_{95\%}$	[41.2 - 47.0]	[23.0 - 32.3]	[44.1 - 54.0]	[49.3 - 59.1]	
Chronic kidney disease					
Glomerular filtration rate					
60 - 90 ml/min/1.73 m^2	389	63	157	169	<0.001
%	31.86	16.76	37.38	39.76	
$IC_{95\%}$	[29.3 - 34.6]	[13.1 - 21.0]	[32.7 - 42.2]	[35.1 - 44.6]	
≥90 ml/min/1.73 m^2	832	313	263	256	0.001
%	68.14	83.24	62.62	60.24	
$IC_{95\%}$	[65.4 - 70.7]	[79.1 - 86.9]	[58.0 - 67.3]	[55.4 - 64.9]	

Table 4. Crude and adjusted odd ratios for high blood pressure and hypercholesterolemia risk among Senegalese military personnel.

	Crude OR	95% CI	Adjusted OR	95% CI
HBP risk				
Age group				
35 - 44 years	1.33	[0.95 - 1.86]	1.02	[0.72 - 1.45]
45 - 60 years	1.96	[1.42 - 2.71	1.41	[0.99 - 1.99]
BMI ≥25 kg/m^2	1.87	[1.43 - 2.44]	1.58	[1.18 - 2.10]
Hyperlipidemia	2.14	[1.65 - 2.77]	1.93	[1.48 - 2.52]
Hyperlipidemia risk				
Age group				
35 - 44 years	2.54	[1.88 - 3.43]	2.42	[1.79 - 3.28]
45 - 60 years	3.14	[2.33 - 4.24]	2.86	[1.1 - 3.87]
Waist circumference* ≥ 94 cm	2.31	[1.67 - 3.21]	1.93	[1.38 - 2.71]

*Waist circumference = waist − hip ratio.

hyperlipidemia showed that the risk of hypertension is not significantly different between age groups. However, BMI ≥25 kg/m^2 and hypercholesterolemia multiplied the risk of high blood pressure by 1.5 and 2, respectively. The risk of hyperlipidemia was found to increase with age and with waist circumference above 90 cm. When compared with the 25 - 34 age group, the risk of hyperlipidemia was 2.42 (95% CI = 1.79 - 3.28) and 2.86 (95% CI = 1.1 - 3.87) times higher among 35 - 44 and 45 - 60 year olds, respectively. Abdominal obesity multiplied the risk of hypercholesterolemia by 1.93 (95% CI = 1.38 -2.71).

4. Discussion

Despite WHO recommendations for the implementation of STEPS surveys in developing countries [12], few studies on the determinants of NCDs have been conducted in Sub-Saharan Africa [4]. In Senegal, only piecemeal studies on specific groups have been published [17] [28] [29] [30].

As a group, the military is considered to be a lower risk group for NCDs. Military members are selected between the ages of 18 - 22 on the basis of rigorous clinical and laboratory screening criteria. In addition, during their career, military members have regular follow-ups and have support in case of illness. Paradoxically, this study revealed the regularity of NCD risk factors among Senegalese military.

The presence of behavioral risk factors studied is one example. The prevalence of current tobacco smoking, 17.2%, is higher than that observed in studies by Seck *et al.* (7.5%) and Mbaye *et al.* (5.8%) [17] [28]. This finding confirms the conclusions of some authors that asserted that the army is an environment of freedom compared to the social restrictions that exist in civilian populations [31].

In contrast, the frequency of alcohol consumption (11.5%) was slightly higher in the study by Seck *et al.* (18%) [17]. In the military, this consumption was irregular, especially during the holidays.

Consumption of fruits and vegetables in sufficient quantity was not a common practice in the military; only 4% consumed an average of more than five servings per day. Some authors have shown that in developing countries, people eat what is available and cheap [7] [32] [33]. The food industry tends to bring to market energy-dense products that are nutritionally poor but attractively priced [7]. The frequency of dyslipidemia observed in our study correlates with this view; the prevalence of hyperlipidemia was significant (44%) in relation to total cholesterol (37%), hypo-HDL cholesterol (10.8%) and hypertriglyceridemia (4.2%). This indicates that hyperlipidemia was primarily attributable to total cholesterol. The high content of saturated fatty acid in foods may explain the role of total cholesterol in the occurrence of dyslipidemia observed in our study.

Compared to our study, Mbaye *et al.* observed a greater prevalence of hyperlipidemia (64.6%), the same total cholesterol (36.3%), a greater prevalence of hypo-HDL cholesterol (41.9%), and similarly low hypertriglyceridemia (1.2%) [28]. However, unlike our study, HDL cholesterol was responsible for dyslipidemia in a previous survey con-

ducted in Saint-Louis (northern Senegal) [28]. Physical activity is a very important aspect of the Army; military exams and courses assign a high coefficient to physical activity. Thus, in the average soldier's work schedule, two sessions of sports are scheduled every week. This rule is correlated with the median practice of intense physical activity observed in this study. Taking work activity into resulted in a median of 4 moderate or intense sessions a week. However, 38% were below the standard of 5 moderate or intense sessions a week. The same frequency was mentioned by Seck *et al.* [17]. This lack of practice was linked to organizational and informational problems within the army.

Overweight or obesity affected 3 out of 10 study participants, suggesting small amounts of exercise for some military staff, particularly those over 34 years old. This is in line with the practice of making physical activity non-compulsory for managers and elders, who have fewer physical training constraints during internship. The combination of poor diet rich in saturated fatty acid and insufficient physical activity may be the cause of this situation. However, previous studies in the Senegalese general population found a prevalence that was twice as high, approximately 66% [17] [28].

High blood pressure is both a risk factor for NCDs (heart disease, CKD) and also an NCD itself. The estimated prevalence of 26.9% in the military is identical to what was found by Seck *et al.* (24.1%) in Senegalese private sector workers [17]. Other authors have reported higher proportions, probably related to the study population [28] [29] [30]. This finding correlates with the results of the multivariate analysis which found that overweight, which is less common in the military, is a determinant of high blood pressure.

A study of the military in southern Tunisia reported a lower prevalence of hypertension (15.6%) [34]. The difference, compared with the prevalence observed in our study, could be explained by the high consumption of salt in Senegal, which is reinforced by the heavy use of food stocks due to the aggressive advertising of certain food processors [32].

The prevalence of hyperglycemia, estimated at 3.03% in our study, was three times lower than that observed in another Senegalese study (10.4%) [28]. In the latter study, the population was older, with a mean age of 58 years. In addition, physical inactivity and overweight were more frequent. A recent study in northern Senegal supports the work of Mbaye *et al.*, reporting a diabetes prevalence of 12.7% [30]. In contrast, a study conducted on the Tunisian military reported a prevalence almost identical to that found in our study (5.6%) [34].

In the rural Yoruba ethnic group (Nigeria), high blood pressure was found in 42.3% of men, diabetes in 1.9%, obesity in 3.6% and abdominal obesity 14.7%. The prevalence of hypertriglyceridemia and HDL-hypocholesterolemia were 1.9% and 43.1%, respectively. These results demonstrate the variability of NCD epidemiology based on geographic, socio-cultural and professional context [20].

Worldwide, the incidence of CKD is growing, with faster rates reported in developing countries [30] [35] [36]. However, CKD is not identified as a main target in the WHO strategy for the control of NCDs [37] even though it is a major risk factor closely

related to the incidence and the consequences of high blood pressure, diabetes and cardiovascular diseases [37]. CKD predisposes persons to high blood pressure and cardiovascular disease (CVD) while diabetes, high blood pressure and CVD are major causes or comorbidities of CKD [37]. The measurement of glomerular filtration performed in this study enabled assessment of the burden of chronic kidney disease in the army. Two-thirds of participants were classified as having good glomerular filtration. However, one-third of participants were found to have stage 2 CKD, indicating a slight alteration of renal function that would require early management. However, this apparently favorable situation is deceiving because of the high prevalence of CKD risk factors such as high blood pressure, diabetes and overweight which, in most of cases, were discovered during this survey. To better care for patients with CKD, an approach based on prevention and early detection is needed.

5. Limitations

This study was conducted among military personnel, who are a special group because of rigorous medical screening given upon entry into the army. Thus, these results are likely to be an underestimation of data concerning general population. The cross-sectional nature of the study excluded those who were absent during the period of survey, but no absence was related to NCDs risk factors. Finally, the mobility of the military extended the duration of data collection.

6. Conclusion

The military does not appear to be spared from the problem of NCDs, despite rigorous entry medical screenings, periodic medical check-ups and its lifestyle based on training and regular, often intense, physical activity. This study has highlighted the importance of NCD risk factors in the Senegalese army and supports the development of a sector-specific program for primary prevention focused on health promotion. Such a program would have the advantage of being inexpensive and available everywhere, even during operations. Additionally, military families, civilian staff in the military and some civilian populations will benefit. These results allow for the interests of military health to guide social policy to combat NCDs, particularly as policies relate to investment in health promotion.

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Competing Interests

The authors declare no competing interests.

Authors' Contributions

NDIAYE Abdoul Aziz: design, data collection, statistical analysis and manuscript re-

view. Other authors: design and manuscript review. All the authors have read and approved the final version of the manuscript.

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Abbreviations

NCDs: non-communicable diseases;

MDRD: modification of diet in renal disease;

BMI: body mass index;

GFR: glomerular filtration rate;

CKD: chronic kidney disease.