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Cardiac Abnormalities in an Agricultural Industry Population in Northern Cameroon

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Abstract

Background: Cardiovascular diseases are a public health problem worldwide and particularly in developing countries where they affect people in their most productive years. This study aimed to describe cardiovascular risk factors and cardiac abnormalities in a group of agricultural industry workers in North Cameroon.

Methods: This was a cross-sectional retrospective study. We analyzed the data of 1412 workers of an agricultural industry, screened in 2022 and 2023. We collected data on sociodemographic characteristics, lifestyle, anthropometric parameters, blood pressure, glycaemia, lipid profile, electrocardiography and transthoracic echocardiography. Electrocardiographic abnormalities included any arrhythmia, heart block or hypertrophy while echocardiographic abnormalities included any dilatation or hypertrophy of a heart ventricle, left ventricular ejection fraction less than 50%, abnormal mitral inflow pattern, mitral and aortic valvulopathy and aortic dilatation. Chi-square test and logistic regression were used to assess the association between electrocardiographic and echocardiographic abnormalities and cardiovascular risk factors.

Results: The majority of the participants were men (94%) and had a mean age of 45 ± 9 years. Men were older and had higher blood pressures than women. There was no difference in the mean glycaemia and lipid profile parameters. The three most frequent cardiovascular risk factors were hypertension (55.7%), dyslipidemia (32.4) and diabetes (21.8). Electrocardiographic and echocardiographic abnormalities were present in respectively 31.6% and 31.4% of the participants. They were associated with age ≥ 45 years, hypertension, dyslipidemia, low physical activity and tobacco smoking.

Conclusions: Electrocardiographic and echocardiographic abnormalities are frequent in agricultural industry workers in Northern Cameroon and are significantly associated with cardiovascular risk factors.

Keywords: Cardiovascular risk factors • Electrocardiography • Echocardiography • Agricultural industry.

Introduction

Cardio Vascular Diseases (CVDs) are the leading cause of mortality and morbidity worldwide. The 2019 Global Burden of Diseases and risk factors (GBD) studies showed that the prevalence of CVDs nearly doubled since 1990, reaching 523 million in 2019 and they were responsible of 18.6 million deaths and 34.4 years lived with disability [1]. Two thirds of this mortality and morbidity occur in Low and Middle Income Countries (LMICs) including Sub-Saharan Africa (SSA) [2,3]. CVDs have a distinct epidemiological pattern in SSA. In a review, Yuyun MF, et al. [3] reported the persistence of a high burden of rheumatic heart disease, which still represents one of the leading causes of heart failure, with hypertensive heart disease and cardiomyopathy. This high burden of CVDs in Africa is driven both by the high prevalence of atherosclerotic risk factors and the persistence of rheumatic heart disease [4,5]. High Blood Pressure (HBP) is the first modifiable risk factors responsible of prevalent CVDs. In 2021, HBP alone was responsible of 10.8 million deaths and 209 million disability adjusted life years [6]. The highest prevalence of HBP is found in Africa were Akpa OM, et al. [7] reported 42% in 2020. Moreover, awareness and treatment rates of HBP are lowest in Africa were only 10% of patients are well controlled [8]. The other cardiovascular risk factors such as smoking, diabetes, dyslipidemia, physical inactivity and obesity are present in Africa, but at a lower extent [3]. CVDs cause a high economic burden in LMICs, particularly in Sub-Saharan Africa where patients are affected during their most productive years [9–11]. In Cameroon, agricultural industry is one major employment sector and CVDs and risk factors have not yet been assessed in this milieu. In this study we aimed to describe cardiovascular risk factors and cardiac abnormalities in a group of agricultural industry workers in Northern Cameroon. We also assessed the association between cardiovascular risk factors and cardiac abnormalities.

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Methods

Study design and population

This was a cross-sectional retrospective study using data from the screening of 1412 workers of SODECOTON (Société de développement du coton), an agroindustry in North Cameroon. They were at least 18 years old. The screening occurred during August to September 2022 and April to August 2023.

Procedures

Using a predesigned data from, we collected data on sociodemographic characteristics, past-medical history and physical examination. Weight was measured using an electronic scale with a 100g precision. Height was either self-declared or measured using a health scale. The Body Mass Index (BMI) was calculated using the formula BMI=weight/heigh^2. Waist circumference was measured using a tape at midline between the inferior margin of the ribs and the superior border of the iliac crest. Blood pressure was measured with OMRON® automatic blood pressure machines. The participants were in sited position for at least five minutes. They had to avoid drinking alcohol and coffee or smoking 30 minutes before.

Afterword, a resting 12 leads electrocardiography was done in the lying position and a transthoracic echocardiogram according to the guidelines of the American Society of Echocardiography (ASE) [12]. Finally, a blood sample was taken for the dosage of glycaemia and lipid profile. The participants were not necessarily fasting at the time of the blood sample.

Definitions of study variables

- **Hypertension:** Systolic Blood Pressure (SBP) > 140 mmHg and/ or diastolic blood pressure (DBP) > 90 mmHg, or treatment with antihypertensive drugs [13].
- **Diabetes:** Fasting Blood Sugar (FBS) ≥ 1.26 g/L or random blood sugar (RBS) ≥ 2.0 g/L or treatment with antidiabetic drugs [14].
- **Dyslipidemia:** Total cholesterol level > 2.0 g/L or triglyceride level > 1.5 g/L or LDL-cholesterol level > 1.6 g/L or HDL-cholesterol<0.4 g/L or treatment with lipid lowering drugs [15].
- **Tobacco smoking:** current smoking.
- **Obesity:** BMI ≥ 30kg/m^2 [16].
- **Low physical activity:** Performing less than 150 minutes of a moderate intensity physical activity such as, but not limited to, walking, jogging, cycling, recreational football (self-declared) [17].
- **ECG abnormality:** Any arrhythmia, heart block or hypertrophy.
- **Echocardiographic abnormality:** Any dilatation or hypertrophy of a heart ventricle, Left Ventricular Ejection Fraction (LVEF) less than 50%, abnormal mitral inflow pattern, mitral and aortic stenosis or regurgitation, dilatation of the aorta or others (pericardial effusion, interatrial septum aneurysm).

Statistical analysis

The statistical analysis was performed using the Statistical Package for Social Sciences (SPSS) version 20.0. Categorical variables were presented as counts and frequencies. Quantitative variables were presented as mean ± standard deviation, minimum and maximum. The student test was used for the comparison of means. The Chi-square or Fisher test when appropriate, was used for the comparison of proportions. All variables presenting a significant association in univariate analysis, were included in multivariate analysis using logistic regression. All two-sided p values less than 0.05 were considered as statistically significant.

Results

We analyzed the data of all the 1412 participants. The majority of the participants were men (94%). We had a mean age of 45 ± 9 years. Two thirds (69.6%) of the participants lived in urban areas. The participants were married in 81.5% of cases, single in 16.9% of cases, widower in 1.1% of cases and divorced in 0.4% of cases. Their level of education we respectively none, primary, secondary and university in 3.1%, 7.6%, 60.0% and 29.3% of cases. Men were older and had higher blood pressures than women. There was no difference in the mean glycaemia and lipid profile parameters (Table 1).

The three most frequent cardiovascular risk factors were in descending order of frequency hypertension, dyslipidemia and diabetes (Table 2). The types of dyslipidemia were hypertriglyceridemia (18.2%), Low HDL cholesterol (6.7%) and high LDL cholesterol (3.3%). There was 6.6% of mixed hyperlipidemia. At least one ECG or echocardiographic abnormality was present in respectively 31.6% and 31.4% of participants. The most frequent ECG abnormality was left ventricular hypertrophy while the most frequent echocardiographic abnormality was abnormal mitral inflow pattern with delayed relaxation present in 27.0% of participants aged less than 50 years, followed by valvular heart disease (Table 3).

Table 4 present the univariate and multivariate analysis of the association between cardiovascular risk factors and ECG abnormalities in general. These abnormalities were significantly increased by age ≥ 45 years, hypertension and tobacco. We analyzed the ECG abnormalities in categories. Arrythmias were independently associated with age ≥ 45 years (ORa=2.17 [1.07–4.38]; p=0.031) and dyslipidemia (ORa=2.17 [1.12–3.98]; p=0.020). Hypertrophies were independently associated with age ≥ 45 years (ORa=1.59 [1.14–2.22]; p=0.006), hypertension (ORa=3.78 [2.58–5.53]; p<0.001), dyslipidemia (ORa=0.67 [0.48–0.93]; p=0.018) and tobacco smoking (ORa=2.01 [1.08–3.72]; p=0.027). Heart blocks were independently associated with age ≥ 45 years (ORa=2.30 [1.68–3.16]; p<0.001) and tobacco smoking (ORa=1.96 [1.09–3.52]; p=0.025). Abnormal repolarization was independently associated with age ≥ 45 years (ORa=1.60 [1.15–2.23]; p=0.005), hypertension (ORa=3.88 [2.66–5.66]; p<0.001), low physical activity (ORa=1.42 [1.02–1.99]; p=0.038) and tobacco smoking (ORa=2.12 [1.16–3.89]; p=0.014). Abnormal echocardiography frequency was independently increased by age ≥ 45 years and the presence of hypertension. It was negatively associated with low physical activity (Table 5).

Table 1. Clinical and laboratory data of the study population.

Variables	Men (Mean ± StD)	Women (Mean ± StD)	All (Mean ± StD)	p
Age (years)	45 ± 9	38 ± 10	45 ± 9	<0.001*
Weight (kg)	79 ± 15	72 ± 20	78 ± 15	<0.001*
Height (cm)	175 ± 8	164 ± 9	174 ± 8	<0.001*
Body mass index (kg/m^2)	25.9 ± 4.6	26.8 ± 6.3	25.9 ± 4.7	0.072
Waist circumference (cm)	95 ± 12	92 ± 16	95 ± 13	0.008*
Systolic blood pressure (mmHg)	140 ± 19	132 ± 23	140 ± 20	<0.001*
Diastolic blood pressure (mmHg)	90 ± 12	86 ± 14	90 ± 12	0.001*
Heart rate (bpm)	84 ± 14	90 ± 14	84 ± 14	<0.001*
Fasting blood sugar (g/l)	1.16 ± 0.39	1.21 ± 0.48	1.16 ± 0.40	0.262
Random blood sugar (g/l)	1.35 ± 0.49	1.22 ± 0.18	1.34 ± 0.48	0.197
Total cholesterol (g/l)	1.66 ± 0.44	1.74 ± 0.40	1.66 ± 0.43	0.106
Triglyceride (g/l)	1.04 ± 0.52	1.10 ± 0.52	1.04 ± 0.52	0.294
LDL-Cholesterol (g/l)	0.93 ± 0.36	0.99 ± 0.34	0.93 ± 0.36	0.170
HDL-Cholesterol (g/l)	0.52 ± 0.12	0.53 ± 11	0.52 ± 0.12	0.402

LDL: Low Density Lipoprotein; HDL: High Density Lipoprotein; StD: Standard Deviation; *Statistically significant

Table 2. Cardiovascular risk factors in the study population.

Variables	Count (N=1412)	Percentage (%)
Hypertension	787	55.7
Diabetes	308	21.8
Dyslipidemia	456	32.4
Tobacco	62	4.4
Obesity	266	18.8
Low physical activity	299	21.2

Table 3. ECG and echocardiographic abnormalities in the study population.

Variables		Count (N=1412)	Percentage (%)
ECG abnormalities	Atrial fibrillation	2	0.1
	Premature ventricular contractions	26	1.8
	Premature supraventricular contractions	13	0.9
	Atrio-ventricular block	23	1.6
	Bundle branch block	86	6.1
	Left ventricular hypertrophy	187	13.2
	Right ventricular hypertrophy	2	0.1
	Left atrial hypertrophy	22	1.5
	Right atrial hypertrophy	19	1.3
	Prolonged QT interval	53	3.7
	Total	446	31.6
Echocardiographic Abnormalities	Left ventricular hypertrophy	63	4.5
	Left ventricular dilatation	10	0.7
	LVEF <50%	11	0.8
	Abnormal mitral inflow pattern	399	28.3
	Mitral regurgitation	151	10.7
	Aortic regurgitation	84	5.9
	Mitral stenosis	1	0.1
	Aortic stenosis	1	0.1
	Dilatation of the aorta	7	0.5
	Pericardial effusion	10	0.7
	Interatrial septum aneurysm	4	0.3
	Total	444	31.4

LVEF: Left Ventricular Ejection Fraction

Table 4. Factors associated to ECG abnormalities in univariate and multivariate analysis.

		ECG Abnormalities		OR (95% CI)	P	ORa (95% CI)	Pa
		Yes (n=446)	No (n=966)				
Gender	Male	421(94.4)	904(93.6)	1.15(0.72-1.86)	0.624	-	-
	Female	25(5.6)	62(6.4)				
Age (years)	≥ 45	298(66.8)	479(49.6)	2.05(1.62-2.59)	<0.001*	1.64 (1.28-2.11)	<0.001*
	< 45	148(33.2)	487(50.4)				
Hypertension	Yes	311(69.7)	476(49.3)	2.37(1.87-3.01)	<0.001*	2.03 (1.58-2.62)	<0.001*
	No	135(30.3)	490(50.7)				
Diabetes	Yes	114(25.6)	194(20.1)	1.37 (1.05-1.78)	0.022*	1.05 (0.79-1.38)	0.745
	No	332(74.4)	772(79.9)				
Dyslipidemia	Yes	127(28.6)	329(34.1)	0.77 (0.60-0.99)	0.043*	0.74 (0.58-0.95)	0.020*
	No	317(71.4)	635(65.9)				
Obesity	Yes	101(22.6)	165(17.1)	1.42 (1.08-1.88)	0.016*	1.23 (0.92-1.65)	0.152
	No	345(77.4)	801(82.9)				
Low physical activity	Yes	95(21.3)	204(21.1)	1.01 (0.77-1.33)	0.944	-	-
	No	351(78.7)	762(78.9)				
Tobacco	Yes	30(6.7)	32(3.3)	2.10 (1.26-3.51)	0.005*	1.96 (1.16-3.33)	0.012*
	No	416(93.3)	934(96.7)				

OR: Odds Ratio; CI: Confidence Interval; P: P-Value; Pa: Adjusted P-Value; *Statistically significant

Table 5. Factors associated to echocardiographic abnormalities in univariate and multivariate analysis.

		ECG Abnormalities		OR (95% CI)	P	ORa (95% CI)	Pa
		Yes (n=444)	No (n=968)				
Gender	Male	419(94.4)	906(93.6)	1.15(0.71-1.85)	0.634	-	-
	Female	25(5.6)	62(6.4)				
Age (years)	≥ 45	287(64.6)	490(50.6)	1.78 (1.41-2.25)	<0.001*	1.46 (1.14-1.88)	0.003*
	< 45	157(35.4)	478(49.4)				
Hypertension	Yes	303(68.2)	484(50.0)	2.15 (1.70-2.72)	<0.001*	1.95 (1.51-2.51)	<0.001*
	No	141(31.8)	484(50.0)				
Diabetes	Yes	118(26.6)	190(19.6)	1.48 (1.14-1.93)	0.004*	1.15 (0.87-1.52)	0.314
	No	326(73.4)	778(80.4)				
Dyslipidemia	Yes	147(33.2)	309(32.1)	1.05 (0.83-1.34)	0.668	-	-
	No	296(66.8)	656(67.9)				
Obesity	Yes	98(22.1)	168(17.4)	1.35 (1.02-1.78)	0.040*	1.31 (0.97-1.75)	0.074
	No	346(77.9)	800(82.6)				
Low physical activity	Yes	70(15.8)	229(23.7)	0.60 (0.45-0.81)	0.001*	0.51 (0.38-0.70)	<0.001*
	No	374(84.2)	739(76.3)				
Tobacco	Yes	27(6.1)	35(3.6)	1.73 (1.03-2.89)	0.049*	1.65 (0.97-2.81)	0.064
	No	417(93.9)	933(96.4)				

OR: Odds Ratio; CI: Confidence Interval; P: P-Value; Pa: Adjusted P-Value; *Statistically significant

Discussion

This was to our knowledge the first study conducted in the industrial sector in our country. ECG and echocardiographic abnormalities were frequent and driven by the high prevalence of cardiovascular risk factors. Left ventricular hypertrophy was ultimately the most frequent ECG abnormality. Alongside this, the highest echocardiographic abnormality was abnormal mitral inflow pattern dominated by delayed relaxation in young participants. These two finding can be explained by the high prevalence of hypertension we found in our study population. It was almost twice the Cameroon national prevalence of hypertension which was estimated to be 32.1% in 2019 by Kuate Defo B, et al. [18]. This difference can be explained on one hand, by the very low proportion of women in our study sample. It is well demonstrated in epidemiological studies that men have higher prevalences of hypertension than women [19,20]. On the other hand, occupational stress is a great contributor to the incidence of hypertension. In a recent review, Khonde Kumbu R, et al. [21] found that working in the health, banking, education and industry sectors was associated with a two-fold increase in the risk of hypertension. Mitral and aortic regurgitation were the second and third most frequent echocardiographic abnormalities and may be secondary to degenerative or rheumatic valvular heart disease which is still endemic in our country. Similar trends of rheumatic heart disease was reported by Nkoke C, et al. [22] in their study in Buea, a town in South-West Cameroon. The prevalence of diabetes was nearly four times the Cameroon national prevalence of diabetes, estimated at 5.8% in 2018 by Bigna JJ, et al. [23]. This is due to differences in definitions of diabetes which have probably overestimated our prevalence. Indeed, in our attempt to include the largest number of participants, we did not exclude those who had only random blood sugar and considered them as diabetic if their RBS level was greater than 2.0 g/L, knowing that it was retrospectively impossible to determine whether signs of hyperglycemia were present or not. The percentages of lipid profile parameters in our study were lower than those found by Yangoua HCM, et al. [24] in Yaoundé in 2019. This difference may be explained that Yangoua HCM, et al. [24] in their study only included overweight and obese participants, meanwhile only 19% of our study participants were obese. The prevalence of active tobacco smoking in our sample was two times lower than the prevalence in two studies conducted in the Centre and West regions of Cameroon. Indeed, Pefura-Yone EW, et al. [25] found a prevalence of current smoking of 8.4% in adults in Yaoundé, while Balkissou AD, et al. [26] found a prevalence of 8.1% in Bandjoun. The extremely hot temperatures in the North of Cameroun may be an explanation for this lower prevalence of smoking.

Study Limitations

Some limitations of this study need to be pointed out. The first was the under-representativeness of women in our study sample, which was proportional to the workforce demographic of the studied agroindustry. For this reason, the result of this study cannot be extrapolated. The second limit was the fact that the participants were not necessarily fasting at the time of blood sample. Therefore, the lab results should be considered with precautions. The third limitation was the absence of some echocardiographic measurements such as the quantification of the atrial volumes, tissue Doppler and evaluation of the right ventricular systolic and diastolic function. The prevalence of echocardiographic abnormalities would have certainly been higher if these measurements were done.

Conclusion

ECG and echocardiographic abnormalities are frequent in agro-industry workers in North Cameroon. They are associated to cardiovascular risk factors. Longitudinal studies should be conducted to better understand the link between the cardiac abnormalities and risk factors in this population. Regular screening and management of cardiovascular risk factors should be implemented in this industrial sector. Occupational stress which is specifically found in this professional environment should not be overlooked.

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Authors Contributions

H.B, D.D and S.Y: Conceptualization, methodology, validation.

H.B, D.D, S.R, G.S.O and O.M: Investigation, data curation.

H.B and D.D: Resources, software, formal analysis.

H.B, N-G.C-N and K.F: Visualization, review and editing, supervision.

Conflict of Interest

The authors have no conflicts of interest to declare.

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Ethical Statement

The study was conducted in accordance with the Declaration of Helsinki and its subsequent amendments. The study was approved by the regional ethic board for health research of the North Region N° 00178/CERSH/NO/2023. Individual consent for this retrospective analysis was waived.

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