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RISK FACTORS ASSOCIATED WITH CARDIOVASCULAR DISEASES AMONG ADULTS ATTENDING NNAMDI AZIKIWE UNIVERSITY TEACHING HOSPITAL IN ANAMBRA STATE, NIGERIA

Akindele Emmanuel Oni[1], Emwinloghosa Kenneth Guobadia[2],

Emmanuel Okechukwu Ezunu[3], and Christogonus Ifeanyichukwu Ugoh[4]

[1]Department of Pharmacology, Faculty of Basic Medical Sciences, University of Port Harcourt, Nigeria

[2]Department of Administration, Federal Medical Centre, Asaba, Nigeria

[3]Department of Internal Medicine, Federal Medical Centre, Asaba, Nigeria

[4]Department of Statistics, Faculty of Physical Sciences, Nnamdi Azikiwe University, Awka, Nigeria

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ABSTRACT: *Cardiovascular disease (CVD) is one of the major cause of death in Anambra state. This study aims to examine the association between risk factors and CVD among adult patients in Anambra state between years 2015 and 2022. This is a cross-sectional study that utilizes the 2015 and 2022 data on patients admitted and examined at Nnamdi Azikiwe University Teaching Hospital. A total of 5267 and 4371 patients' records in 2015 and 2022 respectively were included. Over weight and obesity (BMI) were considered the most prevalent CVD risk factor, followed by hypertension. Compared to females, males were 1.48 times more likely to have CVD in 2015 which increased in 2022. Compared to non-alcohol consumers, those that take alcohol every day were 0.74 times more likely in 2015 and 0.35 times more likely in 2017 to have CVD. Compared to non-smokers, every day smokers were 1.87 times more likely in 2015 and 3.08 times more likely in 2022 to have CVD. Persons with high cholesterol compared to low cholesterol were 2.45 times more likely in 2015 and 1.54 times more likely in 2022 to have CVD. Furthermore, persons with hypertension compared to non-hypertensive persons were 3.61 times more likely in 2015 and 5.17 times more likely in 2022 to have CVD, and those with diabetes status compared with non-diabetic persons were 2.95 times more likely in 2015 and 2.01 times more likely in 2022 to have CVD. Preventable cardiovascular risk factor should be prime target of both public health and healthcare providers across the state and the entire nation.*

KEYWORDS: Risk Factors, Cardiovascular Disease, Multinomial Logistic Regression

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INTRODUCTION

Cardiovascular disease (CVD) is one of the leading cause of death in the globe. CVDs are a group of leading diseases that affect the heart and the arterial circulation that supplies the heart, brain, and the peripheral tissues. Stroke, ischemic heart disease, heart failure, peripheral arterial disease, including other cardiac and vascular diseases are the major causes of global death [1-3]. The most potentially modifiable risk factors associated with CVD are smoking, hypertension, regular alcohol consumption, lack of regular physical activity, inadequate intake of fruits and vegetables, obesity, diabetes [4] and in addition, some of the non- modifiable risk factors are age and gender [5-7].

A study on non-communicable diseases conducted in Qatar showed that CVD is one of the leading disease burden economically, and that the risk factors associated with CVD can be traced to the lifestyle pattern like smoking, fatty food and physical inactivity [8].

When the data registry of adult patients from age 18 years and above admitted in 2015 and in 2022 to the Coronary Care Unit at Nnamdi Azikiwe University (NAU) Teaching Hospital in Anambra state with the diagnosis of documented acute myocardial infarction (MI) is reviewed, the results showed that 41.05% of patients that attended NAU Teaching Hospital in 2015 were male compared to 58.95% of female, and in 2022, the proportion of male dropped down to 36.81% while that of female rose to 63.19%. The results also showed that overweight and obesity (BMI) were the most prevalent CVD risk factor, which was followed by hypertension. In addition to this, males were 1.48 times more likely to have CVD in 2015 which increased in 2022 compared to females. The results also showed that older patients have higher likelihood of having CVD. It is very important to explore the cardiovascular risk factors present among adult attending NAU teaching hospital and identify some of the changes over the last decade to encourage proper funding and prevention and intervention of CVD. This study aims to examine the modifiable and non-modifiable risk factors associated with CVD in the years 2015 and 2022.

MATERIALS AND METHODS

The study utilizes reviewed data registry of adult patients from age 18 years and above admitted in 2015 and in 2022 to the Coronary Care Unit at Nnamdi Azikiwe University Teaching Hospital in Anambra state with the diagnosis of documented acute myocardial infarction (MI). For 2015, we collected 5267 patients' recorded information, and in 2022, we collected 4371 patients' recorded information.

Two dichotomous variables are combined to develop the binary dependent variable. The independent variables used in this study are blocked in order to observe and understand their respective contributions to the demographic variables (age, gender, and income), comorbid variables (cholesterol, hypertension, diabetes mellitus, and body mass index), alcohol consumption, smoking altitude, and physical activity. The variables description are presented in Table 1.

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Methods

In this study, we applied frequency and proportions for the demographics to obtain the prevalence of the selected variables by subgroups. The multinomial logistic regression was used to model the association between the risk factors (independent variables) with CVD. We obtained the age adjusted odd ratios (AOR) and the 95% confidence intervals. However, we used age as a covariate in each multinomial logistic regression model, this was because of the strong association existing between age and CVD. All the analysis were conducted using R version 4.3.0.

RESULTS/DISCUSSION

Demographics

Table 2 presents the dataset for NAU Teaching Hospital which include a total of 5267 and 4371 with respect to 2015 and 2022 respectively. We divided gender evenly between male and female for each year. We went ahead and categorize age into four classes: 18-24 years, 25-44 years, 45-64 years, and 65 years and above. The highest number of patients recorded in 2015 is found within the age group 45-64 years (46.67%), with an income of ₦90,000 and above (43.88%), while in 2022, the highest number of patients is observed in the age group 65 years and above (43.24%) with an income of ₦90,000 (29.54%).

Gender, age, and cardiovascular risk factors outcome

The cardiovascular risk factors reported in both gender and age group differences for 2015 and 2022 are examined and reported in Table 3. Between male against female in both 2015 and 2022, hypertension, BMI, and CVD showed a statistical significant difference. Furthermore, females are observed to have higher risk factors in both year 2015 and 2022 compared to males, except in alcohol consumption and smoking habit.

The risk factors: Smoking habit, alcohol consumption, cholesterol, and BMI are higher in the age group 45-64 years for the year 2015, meanwhile cholesterol and BMI are higher in the age group 65+ years in 2022. Hypertension, CVD, and DM are higher in the age group 65+ years for both year 2015 and 2022 compared to other age groups, while the risk factors are minimal for both year 2015 and 2022 in the age group 18-24 years.

Table 1. Variable description

Variables	Description
Age	Age is categorized into four groups: 18-24 years, 25-44 years, 45-64 years, and 65 years and above. In the multinomial logistic regression modeling, age was categorized into three: 18-44 years, 45-64 years, and 65 years and above
Gender	Gender is categorized into male and female
Income	Income is categorized into five groups: below N30,000, N30,000-49,999, N50,000-69,999, N70,000-89,999, and N90,000 and above

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Cholesterol	Cholesterol is categorized into two: low and high
Hypertension	Hypertension is categorized into two groups: No (not hypertensive) and Yes (hypertensive)
Diabetes mellitus (DM)	DM is categorized into two groups: No (not diabetic) and Yes (diabetic)
Alcohol consumption	It is categorized into three groups: No(do not drink), drink sometimes, and drinks everyday
Smoking habit	It is categorized into four: smoke every day, smoke sometimes, former smoker, and No (do not smoke)
Physical activity (PA)	It is categorized into three groups: engages in PA, engages sometimes, and No (do not engage)
Body mass index (BMI)	BMI is categorized into four groups: underweight, normal weight, overweight, and obese

Table 2. Descriptive statistics and the relationship between modifiable and non-modifiable cardiovascular risk factors

	2015				**2022**			
	Observation	Proportion (%)	AOR	95% C.I.	Observation	Proportion (%)	AOR	95% C.I.
Gender								
Male	2162	41.05%	1.48	(1.07, 3.04)	1609	36.81%	1.89	(1.16, 3.15)
Female	3105	58.95%	1.00	(1.00, 1.00)	2762	63.19%	1.00	(1.00, 1.00)
Age								
18-24	248	4.71%	0.17	(0.08, 0.67)	203	4.64%	0.21	(0.08, 0.87)
25-44	1109	21.06%	0.21	(0.09, 0.47)	713	16.31%	0.26	(0.14, 0.51)
45-64	2458	46.67%	0.48	(0.22, 1.04)	1565	35.80%	0.51	(0.32, 1.18)
65+	1452	27.57%	1.00	(1.00, 1.00)	1890	43.24%	1.00	(1.00, 1.00)
Income								
<N30,000	189	3.59%	2.52	(0.99, 3.07)	613	14.02%	2.47	(1.11, 4.56)
₦30,000-49,999	779	14.79%	2.18	(1.10, 4.11)	881	20.16%	2.12	(1.15, 4.09)
₦50,000-69,999	1012	19.21%	2.03	(1.18, 4.21)	459	10.50%	2.01	(1.06, 3.88)
₦70,000-89,999	976	18.53%	1.88	(1.08, 3.17)	1127	25.78%	1.82	(1.21, 3.23)
₦90,000+	2311	43.88%	1.00	(1.00, 1.00)	1291	29.54%	1.00	(1.00, 1.00)
Total	**5267**				**4371**			

BMI (overweight and obese) is the most prevalent CVD risk factor for both year. In both year 2015 and 2022, the CVD was more prevalent in male compared to female.

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Associations between modifiable and non-modifiable cardiovascular risk factors

We performed the multinomial logistic regression in order to examine the relationship between demographic and risk factors with the presence of CVD in Anambra state by year (Table 2). We also computed the adjusted odd ratios. The male were 1.48 times more likely to have reported CVD in 2015 (AOR = 1.48; (1.07, 3.04)), which increased to 1.89 in 2022 (AOR = 1.89; (1.16, 3.15)). As compared to the age group 65 years and above, the age group 18-24 years were 0.17 times (AOR = 0.17; (0.08, 0.67)), 25-44 Years were 0.21 times (AOR = 0.21; (0.09, 0.47)), and 45-64 years were 0.48 times

Table 3. Behavioural risk factors gender and age outcome breakdown for Anambra state by year

2015	**Gender**		**p-value**	**Age (years)**				**p-value**	**Total**
	Males	**Females**		**18-24**	**25-44**	**45-64**	**65+**		
Smoking habit	231 (89.2%)	28 (10.8%)	0.012	34 (13.1%)	52 (20.1%)	108 (41.7%)	65 (25.1%)	0.012	259 (100.0%)
Alcohol consumption	1526 (69.2%)	679 (30.8%)	0.061	305 (13.8%)	661 (30.0%)	819 (37.1%)	420 (19.0%)	0.164	2205 (100.0%)
Cholesterol	807 (41.8%)	1125 (58.2%)	0.319	11 (0.6%)	301 (15.6%)	823 (42.6%)	797 (41.3%)	0.000	1932 (100.0%)
Hypertension	856 (39.3%)	1320 (60.7%)	0.004	19 (0.9%)	284 (13.1%)	871 (40.0%)	1002 (46.0%)	0.000	2176 (100.0%)
BMI	1608 (45.7%)	1914 (54.3%)	0.000	256 (7.3%)	750 (21.3%)	1404 (39.9%)	1112 (31.6%)	0.000	3522 (100.0%)
CVD	233 (51.7%)	218 (48.3%)	0.034	0 (0.0%)	24 (5.3%)	128 (28.4%)	299 (66.3%)	0.000	451 (100.0%)
DM	284 (47.8%)	310 (52.2%)	0.211	2 (0.3%)	26 (4.4%)	253 (42.6%)	313 (52.7%)	0.000	594 (100.0%)
2022	**Males**	**Females**	**p-value**	**18-24**	**25-44**	**45-64**	**65+**	**p-value**	**Overall**
Smoking habit	178 (96.7%)	6 (3.3%)	0.081	25 (13.6%)	38 (20.7%)	89 (48.4%)	32 (17.3%)	0.001	184 (100.0%)
Alcohol consumption	1209 (74.6%)	411 (25.4%)	0.228	279 (17.2%)	405 (25.0%)	678 (41.9%)	258 (15.9%)	0.078	1620 (100.0%)
Cholesterol	633 (41.2%)	902 (58.8%)	0.031	8 (0.5%)	242 (15.8%)	601 (39.2%)	684 (44.5%)	0.000	1535 (100.0%)
Hypertension	712 (44.6%)	883 (55.4%)	0.000	10 (0.6%)	200 (12.5%)	627 (39.4%)	758 (47.5%)	0.000	1595 (100.0%)
BMI	1235 (43.5%)	1602 (56.5%)	0.007	255 (9.0%)	558 (19.7%)	999 (35.2%)	1025 (36.1%)	0.003	2837 (100.0%)
CVD	170 (53.6%)	147 (46.4%)	0.017	1 (0.3%)	16 (5.0%)	109 (34.4%)	191 (60.3%)	0.000	317 (100.0%)
DM	244 (46.9%)	276 (53.1%)	0.413	0 (0.0%)	20 (3.8%)	219 (42.1%)	281 (54.1%)	0.000	520 (100.0%)

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(AOR = 0.48; (0.22, 1.04)) more likely to have CVD in 2015, which increased to 0.21 (AOR = 0.21; (0.08, 0.87)), 0.26 (AOR = 0.26; (0.14, 0.51)), and 0.51 (AOR = 0.51; (0.32, 1.18)) in 2022 respectively. Furthermore, as compared to the highest income level, those in the income level of less than ₦30,000 are 2.52 times (AOR = 2.52; (0.99, 3.07)), those in ₦30,000-49,999 are 2.18 times (AOR = 2.18; (1.10, 4.11)), those in ₦50,000-69,999 are 2.03 times (AOR = 2.03, (1.18, 4.21)), and those in ₦70,000-89,999 are 1.88 times (AOR = 1.88, (1.08, 3.17)) more likely to have CVD, which increased to 2.47 (AOR = 2.47, (1.11, 4.56)), 2.12 (AOR = 2.12, (1.15, 4.09)), 2.01 (AOR = 2.01, (1.06, 3.88)), and 1.82 (AOR = 1.82, (1.21, 3.23)).

Furthermore, we also examined the relationship between behavioural risk factors and CVD (Table 3). Under the alcohol consumption, when compared to those that do not consume alcohol, those that consume alcohol sometimes are 0.66 times (AOR = 0.66, (0.06, 1.15)), and those that consume alcohol everyday are 0.74 times (AOR = 0.74, (0.46, 1.43)) likely to have CVD in 2015, which reduced to 0.27 (AOR = 0.27, (0.07, 0.98)) and 0.35 (AOR = 0.35, (0.17, 1.21)) in 2022. Moreover, those that engage in physical activity as compared to those that do not engage in physical activity in 2015 are 0.82 times (AOR = 0.82, ((0.34, 1.48)) likely to have CVD, which in 2022, it decreased to 0.74 (AOR = 0.74, (0.26, 1.13)). Under the smoking status, those that smoke every day and those that smoke sometimes compared to those that do not smoke in 2015 are 1.87 times (AOR = 1.87, (1.07, 3.97)) and 1.42 times (AOR = 1.42, (0.97, 3.01)) more likely to have CVD respectively, which by 2022 increased to 3.08 (AOR = 3.08, (1.54, 4.98)) and 2.77 (AOR = 1.02, 4.40)) respectively.

We also examined the association between comorbid risk factors and CVD in Anambra state. Persons with higher cholesterol status as compared to those with low cholesterol in 2015 were 2.45 times (AOR = 2.45, (1.41, 4.65)) more likely to have CVD, which by 2022 decreased to 1.54 (AOR = 1.54, (0.87, 3.06)). Those with hypertension were 3.61 times (AOR = 3.61, (2.01, 5.98)) more likely to have CVD in 2015 compared to those without hypertension, which shows an increase in 2022 to 5.17 (AOR = 5.17, (3.11, 9.01)). Persons with diabetes mellitus in 2015 as compared to those without diabetes mellitus were 2.95 times (AOR = 2.95, (1.90, 4.77)) more likely to have CVD, and by 2022, it reduced to 2.01 (AOR = 2.01, (1.26, 3.19)). Compared to normal weight, those persons with underweight were 3.41 times (AOR = 3.41, (1.22, 5.73)), those with overweight were 0.88 times (AOR = 0.88, (0.61, 1.40)), and those with obesity were 0.69 times (AOR = 0.69, (0.37, 1.41)) more likely to have CVD in 2015, and in 2022, there was a reduction in those with underweight to 0.25 (AOR = 0.25, (0.09, 0.68)), and an increase in those with overweight and obesity to 1.22 (AOR = 1.22, (0.61, 2.24)) and 1.19 (AOR = 1.19, (0.66, 2.26)) respectively (Table 4).

Table 3. Behavioural risk factors associated with CVD by year

Variables	**2015**		**2022**	
	AOR	95% Confidence Interval	AOR	95% Confidence Interval
Alcohol consumption				
Do not drink*	1.00	(1.00, 1.00)	1.00	(1.00, 1.00)
Sometimes	0.66	(0.06, 1.15)	0.27	(0.07, 0.98)

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Everyday	0.74	(0.46, 1.43)	0.35	(0.17, 1.21)
Physical activity				
Engages in PA	0.82	(0.34, 1.48)	0.74	(0.26, 1.13)
Engages sometimes	0.66	(0.27, 1.47)	0.79	(0.31, 1.09)
Do not engage*	1.00	(1.00, 1.00)	1.00	(1.00, 1.00)
Smoking status				
Smoke everyday	1.87	(1.07, 3.97)	3.08	(1.54, 4.98)
Smoke sometimes	1.42	(0.97, 3.01)	2.77	(1.02, 4.40)
Former smoker	1.06	(0.46, 2.76)	0.95	(0.24, 2.85)
Do not smoke*	1.00	(1.00, 1.00)	1.00	(1.00, 1.00)
Age				
18-64 years	0.24	(0.09, 0.42)	0.27	(0.14, 0.44)
65 years and above*	1.00	(1.00, 1.00)	1.00	(1.00, 1.00)

Note: *Reference category

DISCUSSION

The main of this study was to find the association between cardiovascular risk factors and CVD among the adults in Anambra state in 2015 and 2022. Our study presents an overview of how the cardiovascular risk factors in Anambra state has change over 8 years. To actualize this, this study uses Nnamdi Azikiwe University Teaching Hospital, Nnewi as a case study. The results in this study showed that the males had higher odds of reporting CVD as compared to females, and it also increases between years. However, this finding is in line with the study of [9-11]. Furthermore, the findings of this study also showed that persons in the younger age groups 18-64 years are less likely to have CVD as compared to the older ones in the age group 65+ years for both year 2015 and 2022.

Again, this study has also shown that persons with lower income earnings are most likely to have CVD compared to those with higher income earnings in Anambra state in both year 2015 and 2022. In 2015, the persons with income level <N30,000 have higher likelihood of having CVD, but the increase in the odds of having CVD in the lowest income level in 2022 was not significant. This finding is consistent with the following studies [9, 12-13].

This study examined the relationship of different demographic factors and modifiable cardiovascular risk factors in Anambra state. We adjusted age in each multinomial logistic regression model because of the strong association existing between age and heart disease. However, this study provides interesting evidence which shows that there was no significant association between physical activity and CVD for both year 2015 and 2022. This finding does not support the study by [14], which shows that physical activity is very important to cardiovascular health. There was a non-significant association between patients who consumed alcohol every day and CVD in 2015, and in 2022, there was a significant association between them. This study also showed that in 2015 and 2022, persons that consumed alcohol every day likewise those that consume little (not always) have less likelihood of having CVD compared to those that do not consume alcohol. This study is in line with the studies from [9, 15] which

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indicates that moderate or no alcohol consumption is good for the cardiovascular health. Furthermore, this study showed that persons that smokes every day and those that smoke sometimes have higher odds for CVD in 2015 compared to those that does not smoke, which increased in 2022. However, smoking remains one of the cardiovascular risk factors, even though there have been a lot of efforts towards reducing smoking and CVD.

In Table 4, persons with higher cholesterol level have higher risk of having CVD compared to those with lower cholesterol level in 2015, however, by 2022, the odds reduced, though the association there was not significant. This study is consistent to the study by [9]. Those with hypertension had the highest odds of having CVD in 2015, and by 2022, the odds increased almost double that of 2015, however, this falls in line with the study from [16]. Our study showed that persons with diabetes mellitus have higher risks of having CVD, but in 2022 there was a decrease in the odds. However, this study shows that diabetes mellitus a significant risk factor associated with CVD, while obesity was not a significant factor. Again, one of the important findings of this study is that, persons who were underweight had a higher risk of having CVD as compared with normal weigh in 2015 and in 2022. Research from [17-18] showed that the increase in CVD risk with underweight is due to inadequate nutritional status, and that decrease in CVD risk is associated with underweight with lower cholesterol with lack of hypertension and diabetes mellitus.

Table 4. Comorbid risk factors associated with CVD by year

Variables	**2015**		**2022**	
	AOR	95% Confidence Interval	AOR	95% Confidence Interval
Cholesterol				
Low*	1.00	(1.00, 1.00)	1.00	(1.00, 1.00)
High	2.45	(1.41, 4.65)	1.54	(0.87, 3.06)
Hypertension				
No*	1.00	(1.00, 1.00)	1.00	(1.00, 1.00)
Yes	3.61	(2.01, 5.98)	5.17	(3.11, 9.01)
DM				
No*	1.00	(1.00, 1.00)	1.00	(1.00, 1.00)
Yes	2.95	(1.90, 4.77)	2.01	(1.26, 3.19)
Age				
18-64 years	0.37	(0.22, 0.66)	0.48	(0.23, 0.69)
65 years and above*	1.00	(1.00, 1.00)	1.00	(1.00, 1.00)
BMI				
Underweight	3.41	(1.22, 5.73)	0.25	(0.09, 0.68)
Normal weight*	1.00	(1.00, 1.00)	1.00	(1.00, 1.00)
Overweight	0.88	(0.61, 1.40)	1.22	(0.61, 2.24)
Obese	0.69	(0.37, 1.41)	1.19	(0.66, 2.26)

Note: **Reference category*

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CONCLUSION AND IMPLICATION

The aim of this study was to examine the risk factors associated with cardiovascular disease in Anambra state. The motive was to compare the cardiovascular risks for the period of 2015 and 2022. This study however identifies hypertension as the leading cardiovascular risk factor, and in addition, the study also revealed that persons at higher age groups 65 years and above with lowest income level have higher risk of having CVD disease. In order to reduce CVD, preventable cardiovascular risk factors need to be a focal target of public health and healthcare providers, in addition, there should be a profound examination and implementation of policy that will help in reducing the prevalence of CVD in Anambra state and in Nigeria as a whole.

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