Oil Pollution and Hypertension Prevalence in Rivers State, Nigeria: a comparative study

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Introduction

The World Health Organization (WHO) and all Member States (194 countries) agreed in 2013 on global mechanisms to reduce the avoidable non-communicable diseases (NCD) burden including a "Global action plan for the prevention and control of Non-Communicable Diseases (NCDs) 2013-2020" [1]. This plan aims to reduce the number of premature deaths from NCDs by 25% by 2025 through nine voluntary global targets. The sixth target in the Global NCD action plan calls for 25% reduction in the global prevalence of raised blood pressure. Raised blood pressure is the leading risk factor for cardiovascular disease. The global prevalence of raised blood pressure (defined as systolic and/or diastolic blood pressure more than or equal to 130/80 mmHg) [2] in adults aged 18 years and over was around 24.1% in men and 20.1% in women in 2015. The number of adults with raised blood pressure increased from 594 million in 1975 to 1.13 billion in 2015, with the increase largely in low- and middle-income countries. [3,4]

There is a speculation that residents of oil-polluted areas are more prone to having high prevalence of the non-communicable diseases probably due to oil exploration, spillage and gas flaring. [5] A community with oil exploration with at least one incidence of oil spillage or gas flaring is referred to as an oil polluted, while a community without any history oil exploration, spillage or gas flaring is referred to as a non-oil polluted. [5,6]

Worldwide, environmental air and water pollution has been linked to the development and exacerbation of a number of health problems including high blood pressure, lung cancer, and both chronic and acute respiratory diseases. [6] Hence, this study was done to compare the prevalence value of Hypertension in oil-polluted and non-oil polluted communities in Rivers State, Nigeria.

Methods

Study Area: Oil polluted communities: K-Dere and B-Dere in Gokana LGA of Ogoni ethnic group, while the non-oil polluted communities: Omelema and Emilaghan in Abua/Odua LGA.

Study Design: The study was a descriptive, cross-sectional, comparative, community-based survey

Study Population: All adults (≥18 years) irrespective of sex and previous diagnosis of hypertension) who reside in the area of study.

Sample size: 1000 participants using a test of difference in proportion between two groups with prevalence from past study and Design effect = 2n, 20% non-response (Egwurugwu & Nwafor, 2013).

Sampling technique: Multistage sampling technique, 3 stages (random and systematic sampling)

Study tool: Interviewer-administered questionnaire adapted from WHO-STEPS used for chronic diseases. Socio-demographics, systolic and diastolic blood pressures, Risk factors and anthropometric measurements.

Criteria for subject selection: Residence in an area with oil exploration or gas flaring for ≥10 years while, pregnant women, breastfeeding mothers, those on steroids, and non-consented adults were excluded.

Data Analysis: Statistical Package for Social Sciences (SPSS), version 25. Inferential statistics used for the analysis were the Chi-square test, for test of association for categorical/discrete data and student's t-test for continuous variables. Regression models were used to test for the association between hypertension and predictors of non-communicable diseases. BMI of ≥25 kg/m2 and WHiR of 0.85, the level of significance was $P \leq 0.05$.

Ethical Clearance: Research Ethics Committee of the University of Port Harcourt: UPH/CEREMAD/REC/MM69/024

Results

Table 1: Socio-demographic characteristics

Socio-demographic characteristic(s)	X^2 *(P - value)*
Marital status	49.650(P=0.001*)
Occupation	24.826(P=0.001*)
Age category	12.594(P=0.013*)

Table 2: Prevalence and risk factors of hypertension

Variable	Oil polluted communities		Non-Oil polluted communities		X^2 *(P - value)*
	Hypertension	Normal	Hypertension	Normal	
Hypertension Prevalence	299(59.8)	201(42.2)	233(46.6)	267(53.4)	16.974(0.001*)
Sex					
Males	140(63.1)	82(36.9)	102(43.4)	133(56.6)	17.709(0.001*)
Females	159(57.2)	119(42.8)	132(49.8)	133(50.2)	2.973(0.085)
Risk factors of HBP	Waist Hip Ratio		Waist Height Ratio		
	Source of drinking water		Body Mass Index		
	Smoking		Smoking		
Variables with Beneficial effects	Physical activity		Physical activity, Fruit & vegetable consumption		

***significance, X^2 =chi square value, p<0.05, HBP-Hypertension**

Table 3a: Multivariate regression model of Sociodemographic characteristics as Predictors of hypertension

Risk factor	**COR** 95% C.I. (Lower – Upper limit)	p-Value	**AOR** 95% C.I. (Lower – Upper limit)	p-Value
Marital status				
Single	Reference value		Reference value	
Married/Cohabiting	2.569(1.888 – 3.495)	0.001*	0.415(0.200 – 0.863)	0.018*
Separated/Divorced	2.351(1.052 – 5.253)	0.037*	0.568(0.301 – 1.072)	0.081
Widowed	4.411(2.651 – 7.337)	0.001*	0.408(0.115 – 1.444)	0.164
Occupation				
Unemployed/Students/ Pensioners	Reference value		Reference value	
Unskilled	0.734(0.476 – 1.133)	0.163	0.518(0.278 – 0.962)	0.037*
Skilled	1.863(1.379 – 2.518)	0.001*	1.197(0.766 – 1.871)	0.430
Professionals	1.249(0.877 – 1.779)	0.219	1.043(0.622 – 1.747)	0.874

Table 3b: Multivariate regression model for Predictors of hypertension

Risk factor	**COR** 95% C.I. (Lower – Upper limit)	p-Value	**AOR** 95% C.I. (Lower – Upper limit)	p-Value
Waist Hip Ratio				
Normal	Reference value		Reference value	
Overweight	1.699(1.209 – 2.386)	0.002*	0.562(0.335 – 0.941)	0.028*
Cigarette smoking				
No	Reference value		Reference value	
Yes	1.650(1.188 – 2.293)	0.003*	1.103(0.572 – 2.125)	0.770
Alcohol intake				
No	Reference value		Reference value	
Yes	1.424(1.065 – 1.905)	0.017*	0.796(0.443 – 1.433)	0.447
Residence				
Non-oil polluted	Reference value		Reference value	
Oil polluted	1.691(1.316 – 2.173)	0.001*	0.878(0.574 – 1.344)	0.550
Beneficial effects				
Physical activity				
Physically inactive	Reference value		Reference value	
Moderately physically active	0.053(0.035 - 0.079)	0.001*	0.058(0.038 – 0.087)	0.001*
Vigorously physically active	0.007(0.004 – 0.013)	0.001*	0.007(0.004 – 0.014)	0.001*

COR= Crude Odds Ratio, 95% C.I.= Confidence Interval, *Significance, $p<0.05$, only significant predictors

Discussion

This study compared hypertension status of people resident in oil polluted host communities with people resident in communities without any form of oil exploration. This study has revealed that the prevalence of hypertension was higher among participants resident in oil polluted host communities than among residents of non- oil polluted communities. This difference in prevalence was found to be significant at $p<0.05$. More than half the number of participants recruited for this study that are resident in the oil polluted communities were hypertensive, specifically two-third of the participants compared to less than half the number of participants who have hypertension and resident in the non-oil polluted communities. This to a large extent points to the fact that there are underlying factors at interplay in the oil polluted communities that are contributing to this high prevalence. Furthermore, two in three persons resident in the oil polluted communities have hypertension while, one in three persons resident in the non-oil polluted community have hypertension. This high prevalence is consistent with the reports on high prevalence in areas with high oil exploration and gas flaring. [5,7-11]

There abound enormous literatures on the ability of tiny particles from oil pollution in the air to course into the blood stream through the lungs to engineer damages within tiny blood vessels, thereby increasing the resistance of the vessels to blood flow. The long-term exposure to these particulate matter such as particulate matters ($PM_{1.5, 2.5}$) and many others in the air as pollutants have been reported to be associated with high blood pressure and an increased risk of cardiovascular diseases. [5, 12-15]This possibly could be the reason for the high prevalence of hypertension among residents of oil polluted communities [5] in the report of their study titled 'Is living in a gas-flaring host community associated with being hypertensive? Evidence from the Niger Delta region of Nigeria' showed that the prevalence of hypertension in the gas flaring region was 56.94% as at 2017, but this current study has shown a higher prevalence than what was reported in 2017.

Socio-demographic characteristics of participants with hypertension

Comparison of socio-demographic characteristics of participants with hypertension status among respondents showed that age group, marital status and occupation were significant with hypertension. This implies that the hypertension is more prevalent in certain age groups especially the elderly compared to the younger age groups. Although, recently there are reports of fast growing prevalence of hypertension in the younger age groups as documented.[2] In addition, Khosravi *et al*. [3] stated in their study that occupation and marital status were associated with the risk of hypertension in Iranian adults. This is consistent with the result of this study.

The regression model on crude analysis showed that the widowed participants were 4 times more likely to be hypertensive than the unmarried, the married/cohabiting participants had over twice the chance of being hypertensive than the unmarried and those who are separated/divorced had over twice chance of being hypertensive than the single. Speaking of the association between marital status and hypertension, Ramezankhani *et al.* [5] in their study motioned those participants with the status of divorced contributed 15.2% to the incidence of hypertension in the Iranian adult population. This current study showed prevalence greater than what was reported by Ramezankhani *et al.* [5] It therefore suggests that marital status is related to the hypertension status and this

finding is consistent with previous reports Ramezankhani *et al.* [5] Again, Ostchega *et al*. [24] reported the prevalence of hypertension to be 45.5% for 18yrs and over in their study. Also, Lee *et al*. [25] stated that young adults had high and increasing prevalence of hypertension and cardiovascular diseases. Again, Maduka *et al.*[2] reported a hypertension prevalence of 24.4% among young adults in tertiary institution. They all point to the fact that hypertension is fast growing in young adults. The result of this current study agrees with the various findings showing the fast rate of growth in the prevalence of hypertension in young adults.

Participants resident in the oil polluted communities were 1.6 times more likely to have hypertension than those that are resident in non-oil polluted communities, those with overweight waist-hip-ratio (WHiR) and smokers had 1.69 times chances of being hypertensive than the participants with normal weight and non-smokers. Participants who take alcohol regularly were 1.4 times more likely to have hypertension than those do not take alcohol. Conversely, participants who do moderate physical activity were 0.058 likely to be hypertensive, meaning that the chances of having hypertension have been reduced by 94.2%. Again, those who indulged in vigorous physical activity were 0.007 times likely to have hypertension which also means that they had reduced the chances of being hypertensive by 99.3%. This implies that moderate to vigorous physical activity having a protective effect greatly reduced the chances of being hypertensive. The findings from this study agrees with the previous reports of studies done on similar oil and gas company host communities in which they reported that residents in oil and gas flaring exploration host communities was a significant factor for high prevalence of hypertension. [13-16]

Overweight waist hip ratio, cigarette smoking, moderately and vigorously physically active and respectively; alcohol intake and residential status were related to being hypertensive. Although after adjusting for confounders using bivariate analysis model, overweight waist hip ratio, married/cohabiting, being moderately and vigorously physically active were the only predictors of hypertension as seen in table 6. These findings corroborate the results of reported in the past by other authors. Particularly, Jose *et al*. [28] who have reported that there is evidence that the risk of hypertension increases with waist hip ratio from their study on 'essential hypertension in young-association with waist and hip circumferences and BMI'.

Conclusions

A total of 532 persons among the adults in the study were found to be hypertensive, giving an overall prevalence of 53.2%. A total of 299(59.8%) hypertensive persons were residents of communities exposed to oil pollution activities, while 233(46.6%) hypertensive persons were residents of communities not exposed to oil pollution. These correspond to a prevalence of hypertension among persons resident in oil polluted communities of 59.8% compared with 46.6% prevalence of hypertension among persons living in communities not exposed to oil pollution. These two prevalence values were significantly different.

The study showed that residence, overweight waist hip ratio and smoking equally increased the chances by more than 1.5 times of being hypertensive; widowhood increased the chances of having hypertension by 4 times, married/cohabiting status increased the chance by over 2 times, being separated/divorced had over twice chance of being hypertensive. Although, moderate physical activity 0.058 (5.8%) reduced the

chances of being hypertensive by 94.2% and vigorous physical activity 0.007 (0.7%) reduced the chances of being hypertensive by 99.3%.

Recommendations

We recommend reduction in gas flaring & oil spillage, remediation and that findings from this study be used as reference for planning intervention and advocacy for efforts to reduce the oil pollution in host communities, exercise be taken more seriously as it reduces the chances of having hypertension.

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References

1. World Health Organization. The World Health Report: 2002: Reducing risks, promoting healthy life. Geneva: World Health Organization; 2003. pp. 1–71.
2. Maduka O, Tobin-West C. Is living in a gas-flaring host community associated with being hypertensive? Evidence from the Niger Delta region of Nigeria. BMJ global health. 2017;2(4):e000413.
3. Khosravi A, Arash Ramezani M, Toghianifar N, Rabiei K, Jahandideh M, Yousofi A. Association between hypertension and quality of life in a sample of Iranian adults. Acta cardiologica. 2010;65(4):425-30.
4. Ezejimofor MC, Uthman OA, Maduka O, Ezeabasili AC, Onwuchekwa AC, Ezejimofor BC, Asuquo E, Chen YF, Stranges S, Kandala NB. The burden of hypertension in an oil-and gas-polluted environment: a comparative cross-sectional study. Am J hypertension. 2016;29(8):925-33.
5.Ramezankhani A, Azizi F, Hadaegh F. Associations of marital status with diabetes, hypertension, cardiovascular disease and all-cause mortality: a long term follow-up study. PloS one. 2019;14(4):e0215593