Is There a Relationship Between Residence in Oil Bearing Communities and the Prevalence of Diabetes Mellitus?

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Introduction

Nigeria is blessed with huge deposits of natural gas and oil located mainly in the Niger Delta region of the country[1]. 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 [2].

Residences of oil and gas host communities are exposed 24 hours per day and 7 days per week to the oil-polluted surface and underground water. Chronic high-level and prolonged low-level exposure to these contaminants comes with huge cost not only to humans, the flora, and fauna but also to the environment comprising the air, soil, and water bodies[3]. Worldwide, pollution (air, land and water) have been linked to the development and exacerbation of a number of health problems including high blood pressure, diabetes, lung cancer, both chronic and acute respiratory diseases[4].

Diabetes is a chronic, metabolic disease characterized by elevated levels of blood glucose (or blood sugar), which leads over time to serious damage to the heart, blood vessels, eyes, kidneys, and nerves. The most common is type 2 diabetes, usually in adults, which occurs when the body becomes resistant to insulin or doesn't make enough insulin. In the past three decades the prevalence of type 2 diabetes has risen dramatically in countries of all income levels. Type 1 diabetes, once known as juvenile diabetes or insulin-dependent diabetes, is a chronic condition in which the pancreas produces little or no insulin by itself. For people living with diabetes, access to affordable treatment, including insulin, is critical to their survival.

The global burden of diabetes indicates that in 2014, 8.5% of adults aged 18 years and older had diabetes. In 2016, diabetes was the direct cause of 1.6 million deaths and in 2012 high blood glucose was the cause of another 2.2 million deaths[6]. The United Nations have set has a global target to halt the rise in diabetes and obesity by 2025[5]. This increasing prevalence of diabetes even in our society especially in the oil producing communities in Rivers State[4] is speculated to be a result of the oil and gas activities in the oil bearing communities in Rivers State. Hence, this study was done to investigate whether there is a relationship between residence in oil bearing communities and the prevalence of diabetes mellitus.

Methods

Study area: Oil polluted co mmunities: 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 diabetes) 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). Multistage sampling technique, 3 stages (random and systematic sampling)

Study tool: Interviewer-administered questionnaire adapted from WHO-STEPS used for chronic diseases. Socio-demographics, Blood glucose level, 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 diabetes 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 1a: Sociodemographics

Socio-demographic characteristic(s)	X^2 *(P - VALUE)*
Marital status	10.271 (P=0.016)*

Only significant sociodemographic

Table 1b: Comparison of prevalence, & risk factors of Diabetes Mellitus

Variable	Oil polluted communities		Non-Oil polluted communities		X^2 *(P - VALUE)*
	Diabetes	Normal	Diabetes	Normal	
Diabetes prevalence	87(17.4)	413(82.6)	33(6.6)	467(93.4)	27.614(0.001*)
Prevalence by Sex					
Males	37(16.7)	185(83.3)	18(7.7)	217(92.3)	8.748(0.003*)
Females	50(18.0)	228(82.0)	15(5.7)	250(94.3)	19.559(0.001*)
Risk factors of DM	Waist Hip Ratio Waist Height Ratio BMI Smoking		Waist Hip Ratio BMI Smoking		

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

Table 2: Multivariate regression model of predictors of diabetes mellitus

Predictors of Diabetes	COR(95% C.I.)	P-Value	AOR(95% C.I.)	P-Value
Overweight BMI	2.96(1.949 – 4.518)	0.001*	2.18(1.351 -3.546)	0.001*
Smoking	2.53(1.667 – 3.855)	0.001*	0.11(0.044 – 0.289)	0.001*
Alcohol	1.11(0.721 – 1.712)	0.001*	5.43(2.066 – 14.290)	0.001*
Residence	2.98(1.955 – 4.546)	0.001*	0.44(0.265 – 0.760)	0.003*
Variables with beneficial effects				
Moderate physical activity	0.05(0.026 – 0.136)	0.001*	7.10(3.418 – 14.782)	0.001*
Vigorous physical activity	0.13(0.064 – 0.262)	0.001*	0.43(0.150 – 1.284)	0.133

Only significant predictors

Discussion

The prevalence of diabetes was determined and compared among persons resident in oil and non-oil polluted host communities. This study revealed that the prevalence of diabetes was higher among participants resident in oil polluted host communities than among residents of non-oil polluted communities. This difference in prevalence was also found to be significant at $p<0.05$. This again shows that residence in oil polluted areas could be a risk factor to a high prevalence of diabetes. About one in five persons resident in the oil polluted community have diabetes; while one in fifteen persons resident in the non-oil polluted community have diabetes. It further shows that there are more chances of having diabetes residing in areas infested with oil exploration than areas without any known oil exploration. The high prevalence of diabetes in this current study confirms the findings of other authors who have in the past stated that in their studies that there were high prevalence of diabetes in regions with high oil exploration and gas flaring. [7, 21-24] Again, there are reports of association of exposure to oil exploration, air pollutants, fine particulate matters in the air, heavy metals, residential air pollution from oil and gas company activities with the prevalence of diabetes. [25 - 29] This could be the reason for the high prevalence of diabetes recorded in this current study.

The study in addition, showed that participants resident in oil polluted areas were approximately three times more likely to have diabetes than the residents of non-oil polluted areas, those who consume alcohol showed a risk of having diabetes 5 times more than those who do not take alcohol. This implies that alcohol intake had the highest contribution on the prevalence of diabetes on the participants. The participants with overweight waist hip ratio were approximately three times more likely to have diabetes than those with a normal weight, while cigarette smokers

were 2.5 times likely to have diabetes than non-smokers. The participants who were married/Cohabiting indicated a 1.9 times chance of being diabetic than the singles, the widowed had 2.6 chance of being diabetic than the singles. Interestingly, moderate physical activity reduced the chances of being diabetic by 95% and vigorous physical activity reduced the chances of being diabetic by 87%. Again, this emphasizes the protective role of physical activity to human health. Furthermore, after adjusting for confounding effect, the waist hip ratio (AOR 2.18), smoking (AOR 0.11), moderate physical activity (AOR 0.06), vigorously physically active (AOR 0.14), alcohol intake (AOR 5.43) and residential status AOR (0.44) were the only predictors of diabetes as seen table 2.

There are enormous reports on waist hip ratio as a risk factor for diabetes. Singh & Acharya [30] reported that waist hip ratio is a good predictor of post prandial hyperglycemia from their study on waist hip ratio as predictor of incident diabetes in young adults. In another study, Joshi & Shrestha [31] stated that waist hip ratio was higher in diabetic patients than the non-diabetic. Again, Jafari-Koshki *et al.* [32] reported that there was a significant relationship between the risk of diabetes and waist hip ratio. These previous findings cited above corroborates the result of this present study that shows waist hip ratio was a predictor of diabetes. Another variable related to diabetes from this study was smoking. Although was not a predictor after adjustment for confounding effect. Molla *et al.* [33] stated in their study that smoking was associated with multiple diabetes complications. Again, Burch *et al.* [34] in another study reported that smokers and those with low physical activity were more prone to having diabetes. The result of this present study that identified cigarette smoking to be related to diabetes agrees strongly with the reported results of previous studies smoking as associated with diabetes. This study again, identified waist hip ratio to be related to diabetes. Physical activity was also identified in this study to be a predictor of diabetes. It is not only in this study that physical activity has been mentioned as such, Arugu and Maduka [7] had reported the following as predictors of diabetes: physical activity, alcohol intake.

Residence in oil polluted environment was shown to be related to diabetes and after adjusting for confounding effect, residence remained as one of the predictors of diabetes. It means that there are factors at interplay which could be a result of the oil exploration in the environment or adoption of a negative lifestyle in this oil polluted environment contributing to the high prevalence of diabetes mellitus. Interestingly, Ordinioha and Brisibe [2] reported that an average of 240,000 barrels of crude oil is spilled in the Niger delta every year. The spills contaminated the surface water, ground water, ambient air, and crops with hydrocarbons, including known carcinogens like polycyclic aromatic hydrocarbon and benxo and that this oil spills in the Niger delta region have acute and long-term effects on human health.

Conclusion

The prevalence of diabetes among persons resident in oil polluted and non-oil polluted communities were 17.4% and 6.6% respectively. These two prevalence were also significantly different (x^2 =27.614, p=0.001). Residence in oil polluted environment was shown to be related to diabetes and after adjusting for confounding effect, residence remained as one of the predictors of diabetes ($p<0.05$). Those that were resident in oil polluted areas had a 44% chance of having diabetes over those in areas without oil pollution;

those who consume alcohol had 54.3% chance of having diabetes over those who don't consume alcohol. However, moderate and vigorous physical activity reduced the chances of having diabetes by 94%, and 86% respectively. It means that there are factors at interplay which could be a result of the oil exploration in the environment or adoption of a negative lifestyle in this oil polluted environment contributing to the high prevalence of diabetes mellitus.

Recommendations

We recommend reduction in gas flaring & oil spillage, remediation in areas with oil spillage, 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.

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