Original Research Article

PETROLEUM POLLUTION AND AGE-RELATED DECREASE NEUROPLASTICITY IN BRAIN DEVELOPMENT OF THE OGONI CHILDREN IN RIVERS STATE, NIGERIA

ABSTRACT

Background: A new challenge has emerged in the rural and undeveloped areas in Ogoniland where petroleum pollution is prevalent; and school children are no longer zealous about their academic activities. In these polluted areas, it has been reported that children suffered from several health and mental challenges. **Methods:** The study was conducted with 383 primary school teachers selected from four Local Government Areas that comprises Ogoniland in Rivers State where pollution has been reported. Structured questionnaires were used to collect the data from the teachers on the children's exposure to oil pollution; self rated mental illnesses and behavioural symptoms among the school children, perception to petroleum pollution and mental illnesses. **Results:** The results revealed that the signs of mental illnesses like anxiety disorder, attention-deficit disorder, autism spectrum disorder, mood disorder, schizophrenia and eating disorder were noticeable among the school children. The children also exhibited behavioural challenges such as extreme fear, difficulty in concentrating, self imposed injuries, aggressive behaviour, avoiding other classmates and poor academic performances. These mental and behavioural challenges were caused majorly by petroleum pollution of the communities. Other causes of these illnesses were revealed to be poverty and psychoactive substance use. **Conclusion:** It was concluded that constant exposures of the children to environmental pollution can gradually lead to decreasing neuroplasticity of the brain.

Keywords: brain, children, mental illnesses, petroleum, pollution

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1. INTRODUCTION

Pollution does not only destroy the ecosystem but it is also harmful to human health [1,3,6,7,11]. Previous studies have revealed that most mental illnesses and health related challenges are resulted from a polluted environment (19-28). It has also been reported that most cancerous terminal diseases are common in petroleum polluted environments [8]. The effects of pollution are even more prevalent among on the children because their defence system is not fully developed to adapt or survive in such a corrosive environment. The effect of the polluted environment often results in many illnesses and deaths among children [5,8]. Such consequences of a polluted environment could manifest in the form of poor academic, socio-economical and functional outcomes [4,9]; showing developmental, behavioural and emotional problems in young children. Thus, early detection is necessary for appropriate treatment and referrals to counteract the negative consequences.

One common consequence of pollution in the areas of petroleum exploration is air pollution; which has enormous influences on human health [8]. We all breathe air, and much of the world's population breathes air that hurts their health in so many ways [16] and causes an estimate of 7 million premature annual deaths [16]. Even the air we breathe as an adult may be mild and something our bodies could cope with; but our babies and children who are particularly more susceptible may not be that lucky [16]. In these young ones, air pollution can impair immune system development in utero and impede children's cognitive development [16]. World Health Organisation released in one of the weekly report that 93% of children under 15 currently alive on the planet breathe air that is polluted enough to jeopardized their health. Environmental pollution has also being linked with respiratory infections, cardiovascular diseases, throat inflammation, chest pain, ear infections and childhood obesity [16]. Bad air from petroleum exploitation activities can negatively affect neurodevelopment resulting in lower cognitive test outcomes and the development of behavioural disorders [8,16].

Aside from the polluted environment, poverty is common in the study area; as other studies have described the people of Ogoni, as living in abject poverty in a polluted environment [4,5]. Many parents cannot afford the cost of primary education, as they have to pay for books, admission fees, examination fees, sporting fees and every other chargeable fee. The Universal Basic Education (UBE) scheme that is supposed to cater for these poor children has failed in the aspect of ensuring that they get quality education for free. Most unfortunately, the teachers in this sector are the lowest paid in Nigeria, as they are placed on the poorest and specific scale, called Teachers Salary Scale (TSS). Thus, even when parents managed to put their children in schools, the available teachers are not motivated enough or are too hungry to inspire or impact on the children; leading to a greater number of the these poor children dropping out school due to poor motivation.

Developing countries are adjudged as having the highest population of children that are out of school due to the different prevailing environmental factors; which could be due to neuroplasticity of the brain development of the children. Recognising any possible challenges early enough in young children about their mental problems is important in improving developmental trajectories and reduces any likely outcome that would result into an emotional and behavioural disorder [9]. Some of these health challenges may start early in a child even immediately after birth, but may not be easily identified at a glance. In most cases, as the child grows, some of these health challenges may begin to manifest unseen or silently except when observed closely.

Parents normally should be the first to identify any possible health challenges in their children but their love for their children and their biased judgement may blindfold them from the truth that is starring them on the faces. The teachers on the other hand, spend even more time with the children and this exposes them to the basic essential information that can develop them mentally, emotionally and socially. The teachers do not only build skills in the children, but they can also cultivate the desired character into them. Thus, one can conclude that teacher play an important role in early problem detection [9]. Teachers can be more objective in observing children's development and measure their performance than their parents. The teachers have this broad knowledge about the children, because so many children must have passed through their tutelage and has given them experience over time in identifying health problems easily than the parents; as they are able to compare the behaviour of every child relative to the other.

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Some of the notable consequences of mental challenges are anxiety disorder (children who have anxiety disorders display attribute such as obsessive-compulsive disorder, post traumatic stress disorder, social phobia which normally interferes with their daily activities); attention deficit/hyperactivity disorder (these activities are identified easily in a child through the following signs like difficulty paying attention, hyperactivity and impulsive behaviour); autism spectrum disorder (the condition that affect the child's ability to communicate and interact with others); eating disorders (this can be seen when a child eat in a manner that is disgusting or different from the usual manner); mood disorder (depression and bipolar disorder-the persistent feeling of sadness or extreme mood swings than the usual); schizophrenia-psychosis (the chronic mental illness that causes one to lose touch with reality, though this kind normally appear in the late teen through the 20s) [15].

2. OBJECTIVE OF THE STUDY

The aim of this study is to examine how petroleum pollution is connected to the age-related decrease neuroplasticity in brain development of the Ogoni children. To achieve this aim, the following specific objectives will be considered:

i. Identify children with mental and behavioural challenges;
ii. Determine how petroleum pollution can influence brain development of children.

3. THE STUDY AREA

Ogoni is among the several ethnic minorities in River State Nigeria, which occupy a territory of approximately 404 square miles, which forms the part of the Eastern Niger Delta, between the Imo River on the East and North. The area lies between latitudes $4^0.05^1$ and $4^0.20^1$ North and longitudes $7^0.10^1$ and $7^0.30^1$ East [17]. Rivers State – in which Ogoniland, the study area for this report, is located – is situated in the coastal plain of the eastern Niger Delta. Its topography is mainly characterized by rivers, lakes, creeks, lagoons and swamps of varying dimensions. The land surface can be grouped into three main divisions from north to south: the freshwater zone, mangrove swamps and the coastal sand ridge zone. The riverside area, with a land surface between 2 and 5 meters above sea level, covers about 40 per cent of the state, while drier uplands occupy the remainder. Most water channels in the freshwater zone are bordered by natural levees that provide the basis for settlements and agriculture [18].

4. METHODOLOGY

The primary schools teachers that was selected as respondents for this study were given one week comprehensive training by psychologists (experts trained to evaluate and diagnosed mental illnesses but usually treat them through counselling or behavioural therapy) and psychiatrists (medical doctors who diagnose mental illnesses and write prescriptions for medications). The essence of the training was to enable the teachers identify signs of mental illnesses among the school children in their custody. Thus, this study was to focus on identifying possible mental and behavioural illnesses in school children between the ages of 6 to 13 years old, due to the pollution of the environment. Structured questionnaires were used to collect that data from the respondents (the selected teachers) on the children's exposure to oil pollution; self rated mental

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illnesses and behavioural symptoms among the children and the perception to petroleum pollution and mental illnesses.

Population and Sample Size

The population of Ogoni is 1,302,455 (comprising 298,986; 358,418; 460,766 and 184,290 for Eleme, Gokana, Khana and Tai respectively) according to Bodo [4] projected population data as shown on Table 1.

Table 1: Calculated Projected Population of Ogoni.

LGAs	Population (2006)	Projected Population (2016)
Eleme	218,200	298,986
Gokana	261,570	358,413
Khana	336,267	460,766
Tai	134,495	184,290
TOTAL	**950,532**	**1,302,455**

2018 projected population of Ogoni [18].

Out of the four Local Government Areas (LGAs) in Ogoni, two oil bearing or petroleum impacted communities were selected from each of the LGA and four primary schools were chosen from these communities as shown in Table 2.

Table 2: Selected communities

LGA	Chosen communities	No. of selected primary schools	Nature of primary school	
			Public	Private
Gokana	Bodo	4	3	1
	Bomu	4	2	2
Khana	Kpean	4	2	2
	Sii	4	2	2
Tai	Nonwa Tai	4	3	1
	Koroma	4	2	2
Eleme	Onne	4	3	1
	Akpajo	4	3	1

Source: Fieldwork, 2018

The sample size was subsequently determined through the use of TARO YAMANE sample size determination formula [4]. Subsequently, the 400 questionnaires were distributed equally among the chosen communities since the population sizes were fairly the same as discovered from the reconnaissance survey.

Table 3: Questionnaire distribution

LGA	Chosen communities	Questionnaire distribution	No. of retrieved questionnaires
Gokana	Bodo	50	48
	Bomu	50	46
Khana	Kpean	50	48

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	Sii	50	47
Tai	Nonwa Tai	50	49
	Koroma	50	48
Eleme	Onne	50	48
	Akpajo	50	49
TOTAL		400 (100%)	383 (95.75%)

Source: Fieldwork, 2018

5. RESULT AND DISCUSSIONS

Socio-economic Characteristic of Respondents

The data in Table 4 showed that the teachers that participated in this survey, cut across the four LGAs with 24.54% (94), 24.28% (93), 25.32% (97) and 25.32% (97) from Gokana, Khana, Tai and Eleme respectively. 51.95% (199) of the teachers were male while 48.04 (184) were female. Majority of the teachers are well educated 61.61% (236) and 37.59% (144) with NCE/ND and B.Ed/BSc respectively while only 0.78(3) had a master's degree. The majority of teachers (74.4%) are married, while the others are single (7.83%) and widows/widowers (17.75%). All the teachers claimed that their financial status was low as shown on Table 4.

Table 4: Socio-demographic characteristics of primary school teachers in Ogoni

Characteristics	Frequency (f)	Percentage (%)
Age		
21-30	50	13.05
31-40	150	39.16
41-50	103	26.89
51-60	80	20.88
LGA		
Gokana	94	24.54
Khana	93	24.28
Tai	97	25.32
Eleme	97	25.32
Sex		
Male	199	51.95
Female	184	48.04
Educational Qualification		
FSLC	0	0
SSCE(WAEC/NECO)	0	0
NCE/ND	236	61.61
B.Ed/BSc	144	37.59
MSc	3	0.78
PhD	0	0
Marital Status		
Single	30	7.83
Married	285	74.4
Divorced	0	0
Widow/widower	68	17.75
Perceived financial status		
High	0	0
Moderate	0	0
Low	383	100

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Source: Fieldwork, 2018

Children with mental and behavioural challenges

In the selected schools, the teachers through their wealth of knowledge about the children they have cared for in the past identified some children in their classes which they believe to be having mental and behavioural challenges as shown on Table 5.

Table 5: General survey of children with and without mental and behavioural challenges in the selected communities

LGA	No. of retrieved questionnaires	No. of pupils suspected to show signs of mental and behavioural challenges (frequency & Percentage)	No. of children free from mental and behavioural challenges (frequency & percentage)
Gokana	94	14 (14.89%)	80 (85.10%)
Khana	93	8 (8.60%)	85 (93.39%)
Tai	97	16 (16.49%)	81 (83.50%)
Eleme	97	10 (10.30%)	87 (89.69%)

Source: Fieldwork, 2018

The field data obtained in all Local Government Areas (LGAs) in Ogoni revealed that some of the children show signs of mental and behavioural challenges with 14.89%, 8.60%, 16.49%, and 10.30% for Gokana, Khana, Tai and Eleme respectively as shown on Table 5.

Table 6: Multiple responses on the identification of children with mental and illnesses and behavioural challenges

S/N	Variables	Frequency (f)	Percentage (%)
1.	**Mental illnesses:**		
	a. Anxiety disorder	8	2.08
	b. Attention-deficit/hyperactivity (ADHD)	319	83.28
	c. Autism spectrum disorder(ASD)	40	10.44
	d. Mood disorder	80	20.88
	e. Schizophrenia	5	1.30
	f. Eating disorder	111	28.98
2.	**Behavioural challenges:**		
	a. Showing less concern for one's own safety	111	28.98
	b. Poor school performance	300	78.32
	c. Noncompliant or aggressive behaviour	250	65.27
	d. Frequent complaints of physical symptoms such as headaches and stomach aches	10	2.61
	e. Self imposed injuries	5	1.03
	f. Difficulty concentrating	311	81.20
	g. Neglecting decent appearances	319	83.28
	h. Extreme fear	5	1.03
	i. Avoiding other classmates.	10	2.61

Source: Fieldwork, 2018.

Mental illnesses were found among primary school children in Ogoni, as some of the children were showing notable sign of these illnesses. The teachers in the selected schools believed that their children were suffering from mental illnesses such as anxiety disorder (2.08%), attention-deficit/hyperactivity (28.08%), autism spectrum disorder (10.44%), mood disorder (20.88%), schizophrenia (1.30%), and eating disorder (28.98%).

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Aside from the already noticed mental illnesses, the children were also exhibiting behavioural challenges like showing less concern for their safety (28.98%), poor school performance (78.32%), aggressive behaviour (65.27%), frequent complaints of headaches and stomach aches (2.61%), self imposed injuries (1.03%), difficulty concentrating (81.20%), neglecting decent appearances (83.28%), extreme fear (1.03%) and avoiding classmates (2.61%) as shown on Table 6.

Petroleum Pollution influences on brain development

Table 7: Multiple responses to petroleum pollution influences on the developing brain

Variable	Frequency (f)	Percentage (%)
Knowledge of the environment		
(a) Oil exploration is going on in the communities.		
YES	363	94.7
NO	20	5.22
(b) The community environment is polluted.		
YES	383	100
NO	0	0
(c) Illnesses in the communities are linked with petroleum pollution.		
YES	375	97.9
NO	8	2.08
Perceived causes of mental and behavioural illnesses		
(a) Polluted environment	363	94.7
(b) Poverty	45	11.74
(c) Heredity	0	0
(d) Psychoactive substance use	50	13.05
(e) Others, please specify	0	0
Common complaints from petroleum exposures		
(a) Headache	383	100
(b) Nausea	311	81.20
(c) Dizziness	343	89.55
(d) Respiratory diseases	111	28.98
(e) Skin rashes and irritations	311	81.20
(f) Others, please specify	0	0

Source: Fieldwork, 2018

The teachers in the study recognised the influences on petroleum pollution and other environmental factors on the developing brain of the children. The field data revealed that oil exploration is currently on-going in the chosen communities as 94% of the teachers agreed to this opinion, while 5.22% of the teachers believe that there are no current oil explorations in the communities. The results further revealed that the communities are massively polluted as a result of previous and current oil exploration activities with many associated mental illnesses. The field data revealed that root causes of the mental and behavioural challenges among primary school children in Ogoni are petroleum pollution (94.7%), poverty (11.74%) and psychoactive substance use (13.05%) as shown on Table 7. The exposures of the children to petroleum pollution, which is the major causative factor of the mental illnesses in the communities (94.7%)

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has resulted into common complaints like headaches (100%), nausea (81.20%), dizziness (89.55%), respiratory diseases (28.98) and skin rashes and irritations (81.20%).

6. CONCLUSION

There are links between petroleum pollution and decrease neuro-plasticity of the developing brain of children as some mental and behavioural behaviour exhibited in very young children are resultant from their environment which previous scholars have also acknowledged [2,8,14]. Most of these mental challenges are always overlooked or may not be identified without close attention and that is why teachers who built skills, knowledge and morals into these children play a key role in detection. In the case of Ogoni, there are reports of mental illnesses and behavioural challenges in all the Local Government Areas which have drastically affected the children's performance in school as many have showed signs like aggressive behaviour, poor hygiene, eating disorder, attention deficit and many other challenges. Though, poverty and psychoactive substance use were also mentioned as some of the contributors of mental illnesses in these school children, but the main causes were said to be petroleum pollution of the environment. Pervious scholars also confirm this assertion as psychoactive substance use, poverty and environmental pollution has been recognised as causative factors of mental illnesses in Ogoniland [5,8,13].

In this study, pollution has been recognised as the key causative factor of decrease neuro-plasticity of the developing brain of the primary school of Ogoni. Exposure to pollution has adverse effects on the pulmonary and cardiovascular systems which have been well established in series of major epidemiological and observational studies [1,10]. Constant exposures of the younger children to environmental pollution can gradually lead to decrease neuroplasticity of the brain.

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