Psychological Effects of Soot Pollution on Academic Functional Capacity

Larry O. Awo[1*], Enebi Y. Atanu[2], Anyahie A. Azunwo[3], and George Duru[4]

[1]*General Studies School, Federal Polytechnic of Oil and Gas, Rivers State, Nigeria*
[2]*Department of Statistics, Federal Polytechnic of Oil and Gas, Rivers State, Nigeria*
[3]*Department of Petroleum Marketing and Business Studies, Federal Polytechnic of Oil and Gas, Rivers State, Nigeria*
[4]*Department of Pension Services, Federal Polytechnic of Oil and Gas, Rivers State, Nigeria*
**Corresponding Author*

***Abstract:-*Empirical evidences on the psychological effects of sooth pollution due to gas flaring activities in the Niger-Delta region of Nigeria is hugely unknown. We examined the effects of exposure to soot pollution on academic functional capacity of staff and students of a Federal Polytechnic in Bonny Island, Rivers state, Nigeria. One hundred and sixty five (165) male and female participants aged 18-44 years (M= 29.36; SD = 8.14) took part in the study. Exposure to sooth pollution and academic functional capacity depletion were measured by means of questionnaires. Regression analysis results revealed that exposure to soot predicted academic functional capacity depletion, gender was also a predictor of academic functional capacity depletion, and academic functional capacity depletion was more among staff than students. Consistent exposure to soot disrupts teaching and learning activities in the Polytechnic. A call, is therefore made, for the minimization of gas flaring activities and soot pollution in academic towns in order to ensure a conducive environment for teaching and learning activities by staff and students.**

Keywords: **Functional Capacity Depletion; Psychological Effects; Niger-Delta Region; Soot Pollution.**

I. INTRODUCTION

Oil prospecting, exploration and extraction in has hugely boosted the growth of the Nigerian economy by contributing over 60% of the country's annual Gross Domestic Product (GDP) (Abali, Etebu & Leton, 2018), and the Kingdom of Bonny Island has been a major producer of both crude oil and natural gasin the last few decades. The location of the Nigerian Liquefied Natural Gas (NLNG) plant, Shell Petroleum Development Company (SPDC), and Exon-Mobil exploration stations in the Island has resulted in the proliferation and abundance of pipelines, oil wells, dredged swamps, flow stations and gas flaring facilities, that are most times located near residential houses and homes, schools, worship centers, farms and business premises within the communities (Nriagu, Udofia, Ekong & Ebuk, 2016). Observation has shown that, unlike other Niger Delta communities where oil spills are a common occurrence, the most dominant adverse effect of oil exploration in the Island of Bonny remains soot pollution which stems from erroneous or deliberate policy of either the government or the oil companies to flare gases as a bye-product of oil exploration processes (Yakubu, 2017).

Protracted exposure to soot particles has adverse effect on human health and other living organisms such as plant, as well as aesthetic outlook of the environment. Research show that long-term exposure to soot pollution increases the risk of coronary artery disease (Anyanime, 2016; Ite & Udoh, 2013; Nwogazi, Abali & Henshaw, 2016). It has been established that, on individual level, soot exposure is associated with lung disease (Akinfolarin, Obunwo & Boisa, 2018). Unfortunately, this appears the lot of the in habitants of Bonny Island who are constantly exposed to soot pollution in their homes and workplaces as their drinking water and foods are constantly contaminated by soot particles (Adeola, 2000). Ironically, the implications of such exposure on their mental and psychological health and well-being has remained largely unknown despite the general acknowledgement of soot pollution in the Island (Ibe, Njoku, Allinnor & Okpara, 2016).

Nwachukwu, Chukwuocha and Igbudu (2012) in their survey of a 5-year (2003-2007) epidemiological data discoveredthat the levels of all the criteria for air pollution in Rivers state was significantly higher than assumed, and that sootcontamination was associated with air related morbidities and mortalities in the state. Amongst the air-related morbidity assessed were Cerebro-Spinal Meningitis (CSM), chronic bronchitis, measles, pertussis, pulmonary tuberculosis, pneumonia, and upper respiratory tract infection. Pneumonia was the most prevalent for all of the years that were studied, and was responsible for the highest number of deaths in 2005. In another study to as certain the disease prevalence associated with industrial-related air pollution in Eleme and Ahaoda East areas of Rivers state, Godson, Sridhar and Bamgboye (2009) established strong a strong association between air pollution and morbidities like respiratory diseases, traumatic skin out growth, and child deformities. They conclude that these health risks are higher in highly industrialized communities than lowly industrialized settings. Similarly, Godson, Sridhar and Asuzu (2010) indicate that adverse health conditions like eye and skin disorders, occur among persons who spent about 8 hours per day in

environments with high soot contamination. Unfortunately, these studies focused solely on the physical health implications of air contamination, and neglecting the impacts of such pollution on the mental health and wellness of the presumed healthy individuals which will in essence determine their productiveness.

Nriagu et al's (2016) report on the effects of oil exploration in the Niger Delta have majorly focused on the caustic relationship between the oil pollution and poverty in the region. Interestingly, it found a mediating effect of psychological factors such as functional capacity depletion due to pollution on the relationship between environmental oil pollution and frosty interaction among host communities and oil firms. This suggest that the constant conflict between oil firms and their host communities is as a result of their perception that oil exploration related pollution has negatively affected their daily activities and functioning. Other studies (Ordinioha & Brisibe, 2013; Ovadia, 2013; Akinbobola & Njor, 2014; and Ehigie, 2005) highlight physical and psychological health problems associated with oil pollution in order to support the argument that concern for a clean environment is a reason for community-firm conflicts.

Increase in atmospheric concentration of soot just like any other air pollutant, is affected by emission rate, source strength and meteorological factors such as rain, sunlight, geography, cloud cover, moisture, and weather patterns. The huge levels of soot contamination in Bonny due to the oil and gas exploration activities of the Nigerian Liquefied Natural Gas (NLNG) and the Shell Petroleum Development Company (SPDC) is obviously observable. It is visibly seen dropping from the atmosphere or blown around to settle on any object and surface it comes in contact with. This influences the quality of human physical and psychological health. Wahid (2013) wrote that such pollution is related with respiratory problems, heart and lung diseases, and could in extreme cases cause death, especially among children who are generally more active outdoors, and whose lungs are still developing.

Ironically, and most unfortunately too, reliable information on the effects of soot exposure and pollution on the psychological health of workers in these firms and other organizations on the Island is elusive. Little or nothing is empirically known of how the continued soot contamination of the environment, offices and classrooms in the Federal Polytechnic of Oil and Gas, (FPOG-the only high institution on the Island) has impacted on the academic functioning capacity of the staff and student of the institution .Nriagu et al's (2016) observation that oil exploration related environmental pollution was strongly associated with an individual's daily and social functional capacity limitation does not consider academic functional capacity as the study population were predominantly farmer and traders. To this effect, the present study aims tofill this gap in knowledge by exploring the effects of soot exposure/pollution on the academic functional capacity of staff and students of the FPOG. This study will to a great extent provide insight into the psychological effect of soot pollution on learning activities in the Polytechnic. It will also aid the development of intervention models and packages to ameliorate the psychopathological ill-health in soot polluted areas across the globe. Thus, it was our prediction that exposure to soot pollution will negatively affect academic functional capacity of staff and students of the FPOG thereby hindering the academic growth of the institution.

II. METHOD

Participants

The study involved one hundred and sixty five(165) staff and students of the Federal Polytechnic of Oil and Gas, Bonny Island. They have lived in the Island for at least sixmonths. Their ages ranged from 18-44 years (mean = 29.36; SD = 8.14). Detailed observation showed that 98(26.1%) were males whereas 67(40.6%) were females. The participants were drawn from academic (43, 26.1%), administration (52, 31.5%), and students(70,42.4%).

Instrument

Soot Exposure Checklist (SEC).

A 7-item soot exposure questionnaire was adapted from Nriagu et al's (2016) oil pollution exposure scale and modified to measure participants' exposure to soot pollution in terms of residential, office, school and businesses' distance from soot emitting facilities, contact and perceived soot contamination of the environment in the past four (4) weeks. Sample items in the scale are "*Do you experience soot pollution in any of the following? Home, Business/workplace, Office, Market, School or Worship centers?" "In the past one month, how many times have you been exposed to or come in contact with soot pollution?"*The exposure measures covered different dimensions of soot exposure and were summed to get a composite measure of soot exposurefor each participant. Total score ranges from 0-30 with higher scores indicating higher levels of exposure to soot.A pilot study of the scale involving 60 male and female participants reported a high reliability alpha for the present study (alpha .60).

Academic Functional Capacity Depletion (AFCD).

For this study, one of the constructs in the General Health Questionnaire (GHQ) designed to measure limitations in one's activities during a typical day was used (Vie, Hufthammer, Holmen, Meland & Breidablik, 2014; Eriksson, Unden & Elofsson, 2001). Seven of the 11-item version of the GHQ for measures of functional capacity limitation were adopted from Nriagu et al (2016) and modified to address typical academic activities for the studypopulation. Examples of items in the questionnaire include; *"How has soot pollution affected your going to teach/learn in the class in the past 4 weeks?""How has soot pollution affected your reading in the office/classroom in the past 4 weeks?" "How much time during the past 4 weeks have you felt calm and peaceful*

despite contamination of your office/classroom by soot particles?", "How much time during the past 4 weeks have you felt down due to contamination of your office/classroom by soot particles?", Each item was scored on a four-pointscale ranging from *"Less than usual" (1) to "Much more than usual" (4)*. The sum of the scores of the 7 items was used as a subjective measure of academic functional capacity depletion for each participant. Total score for the scale (range, 7 to 28) was classified into 7-14 (low), 15-21 (medium) and 22-28 (high). A high reliability was reported by the scale for this study (alpha .75).

Procedure

The researchers employed the cross-sectional sampling technique to sample the staff members and students in their offices and classrooms respectively. This was after permission to conduct the study in the school was obtained from the school authorities. The questionnaires were filled and returned on the spot. However, those who are not free to do so on the spot were be allowed to return it after 2 days. In all, a total of 175 questionnaires were distributed, 169 were returned. Four questionnaire sets were not included in the final analysis because they were not completed. This amounts to a return rate of 94.3%.

Design and statistics

The study adopted a survey research design. Pearson correlation test(r) was performed to examine the correlations between psychographic factors, soot exposure, and academic functional capacity depletion. Hierarchical Multiple Regression analysis was used to explore the effects of soot exposure on staff and student academic functional capacity.

III. RESULT

Table 1: Correlation table showing relationship among academic functional capacity depletion, gender, job type and soot exposure

Factors	$\bar{x}$	SD	1	2	3	4
AFCD	15.88	3.46	-			
Gender	1.41	.49	.14*	-		
Job type	2.16	.81	-.02	.26***	-	
SE	14.75	4.52	.65***	.07	.00	-

Note: SE = Soot Exposure; AFCD = Academic Functional Capacity Depletion; * = p < .05; *** = .001.

The correlation table resultsshow that gender correlated with academic functional capacity depletion (r = .14, p < .05), soot exposure correlated with academic functional capacity depletion (r = .65, p <.001) and job type correlated with gender (r = .26, p < .001). This suggests that increase in the number of women staff in the polytechnic leads to increase in the academic functional capacity depletion among the staff members, an increase in soot exposure and pollution is associated with more depletion of staff and students academic functional capacity, and finally, increase in staff members is associated with increase in academic functional capacity depletion.

Table 3: Hierarchical multiple Regression (HMR)table showing effects of soot pollution on academic functional capacity depletion

Variables	B	SE	β	R	R^2	ΔR^2
Step 1				**.16**	**.02**	**.02**
Gender	1.12	.57	.16*			
Jobtype	-.28	.34	-.07			
Step 2				**.66**	**.43**	**.41**
Gender	.78	.44	.11			
Jobtype	-.22	.26	-.05			
SE	.49	.05	.64***			

Note: SE = Soot Exposure; * = p < .05; *** = .001.

The result on table 3 showed that among the demographic factors (gender and job type) entered in step 1, only gender significantly predicted academic functional capacity depletion (p < .05). It was also observed on the table that soot exposure significantly predicted academic functional capacity depletion(p <.001).

IV. DISCUSSION

Studies (Akinbobola & Njor, 2014; Luginaah, Taylor & Elliott, 2002; Kponee, Chiger, Kakulu, Vorhees & Heiger-Bernays, 2015; and Signorino, 2012, all cited in Nriagu et al, 2016)suggest that living near oil production and gas flaring sites constitute an environmental stressor that can have adverse effects on psychological health, well-being, quality of life and work productivity. Nriagu et al (2016) wrote that oil exploration related pollution can influence human health either through direct exposures to the inherently hazardous chemicals emitted oil exploration and gas flaring facilities such as para-phenols and soot particulates which can directly impair health through systemic toxicity, or through indirect pathways that work through the perceptions of risk, worry, annoyance, and chronic stress that moderatethe squeal of poor health outcomes.

This study examined the effects of soot exposure and contamination on academic functional capacity depletion. We found high correlation between soot exposure and academic functional capacity depletion among staff and students. The hypothesis that soot exposure will affect academic functional capacity was tested by means of Hierarchical Multiple Regression statistic and it was confirmed. The soot exposure was significantly correlatedwith academic functional capacity depletion (Table 2).This result suggest that the academic functional capacity depletion is indeed linked to soot exposure and direct contact soot particulates. The result also suggest that gender was associated with academic functional capacity depletion. That is, females reported more academic functional capacity depletion than males in the polytechnic.

The HMR result (table 3) revealed that soot exposure and gender are good predictors of academic functional capacity depletion ($\beta = .64$, $p < .001$), and ($\beta = .16$, $p < .05$) respectively. This implies that as soot exposure increases by a unit, academic functional capacity depletion also increases by.64 units. This study found that high level of soot exposure, contamination and pollution has high negative effects on academic activities such as classroom teaching and learning, reading and research, and academic and administrative engagements. It also shows that teachers and students barely felt calm and relaxed, have lost appreciable energy and mental strength, and have felt not going to scheduled academic meetings due to soot exposure, contamination and pollution related mental fatigue. The fact that soot exposure accounts for 49% of total variance in academic functional capacity depletion suggests that it is a strongfactor limiting optimal academic activities in the polytechnic.

The result also implies that females' academic functional capacities were more depleted than their male counterparts. The reason for this trends was not clear, but could stem from the position of Xu, Broster, Gu, Wu, van Dam, Jiang, Fan, and Luo (2013), that the unequal development of the right and left hemispheres in males and females has led to differences in how males and females interpret environmental stimuli and make decisions on them. Consequently, Soeck and Baily (2008), and Wing, Benner, Petersen, Newcomb and Scott, (2010) report that males are more likely to make thoughtful or calculated decisions while females tend to make decisions based on their emotional state when reacting to hazards in their environment.

V. LIMITATIONS

Despite the encouraging result of this study, generalizing this finding may hampered by certain drawbacks. Firstly, the sample size of 165 may not be an ideal representative of the population of the polytechnic. Secondly, we acknowledge that the study adopted a self-report measures of the variables, and this may present a highly biased responses (the tendency to under or over-report either soot exposure or academic functional capacity depletion runs high). Thirdly, the sampling procedure (survey) and cross-sectional approach is a limitation which might have led tosampling biases. They also do not establish cause-effect relationship between soot exposure and AFCD among the participants. We view that the use of experimentation and longitudinal designswould a clearer direction of the existing relationships found in the presentstudy.

VI. CONCLUSIONS

This study reports high magnitude of academic functional capacity depletion associated with soot exposure, contamination and pollution of Bonny Island in the Niger-Delta region of Nigeria due to gas flaring activities on the Island. Soot exposure disrupts classroom teaching and learning, reading and research, and academic and administrative engagements in high institutions. It was also found that women ranks higher on academic functional capacity than men. These findings suggest the multinational oil firms operating in the Niger-Delta part of Nigeria, through their gas flaring activities and emission of soot into the environment, are indirectly contributing to poor quality of education in the region despite their huge contribution to the annual GDP of the country. We therefore, call for measures and policies by the government through necessary regulating agencies, to curb gas flaring in the region by these firms, thereby ensuring a conducive teaching and learning environment in the region.

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