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Study Impact of Gas Flares Environment on Preschool Children Growth Profile in Yenagoa Bayelsa State, Nigeria

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

The aim of this study was to determine the growth profile of pre-school children in some gas flaring communities in yenagoa, Bayelsa state in relation to under nutrition (PEM), source of drinking water and others.

Methods: This study adopted a cross sectional design strategy to determine the anthropometric indices, parents occupational level effect on the children growth, source of drinking water and the prevalence of undernutrtion among age 1-5yrs using sampling method and well-structured questionnaires, bathroom scale for weight, meter rule for height and Gomez classification method to determine undernutrtion from the results obtained for this study.

Results: Results obtained from this study shows 110(45.83%) males and 130(54.17%) female as participants. Parent's demographic data shows that civil servants (40.42%) and trading (37.08%) was the major occupation of the fathers while the mothers were more engaged in business (50.42%) and farming (31.25%) compared with other occupations. The anthropometric indices of male children in Tombia compared with Obunagha were all statistically significant (<0.05) except for weight. However the weight among participants in Tombia (female subjects) was significant while other variables were non-significant. Regarding protein energy malnutrition among the male study population, 4.55%, 9.09%, 46.36%, suffers from 3rd ,2nd and 1st degrees malnutrition while 40% has normal weight with no indication of PEM compared with the prevalence of undernutrtion among the females of 1.54% severe, 1.54%moderate with stunted growth, 70% mild and 26.92% normal in the study population. The study also reveal that 6.67%, 1.67% and 12.91% of the children do sometimes drinks either river, pond, or untreated borehole water which could be a factor contributing to their being undernourished. With regards to the children's birth of origin, 17.08% and 44.17% were born in the study environment.

Conclusion: Gas flares into the studied environment affect the growth profile of age 1-5 yrs preschool children significantly with the manifestation of severe, moderate and mild undernutrtion observed compared with the percentage free from malnutrition. Hence proactive measures should be taking by the government to put an end to the indiscriminate flaring of gases that may hinder children ability to comprehend academically and growth retardation due to protein energy malnutrition, airborne diseases etc.

Keywords: Age; BMI children; flares gas; PEM; preschool.

1. INTRODUCTION

The issue of gas flaring is a public health concern, moreover studies have shown that the health implication associated with the inhalation of polluted ambient air by schoolchildren who spend about 80% of their active life in schools are exposed to this source of breathable air [1]. Studies have shown an increase incidence of stunting, wasting, underweight and other related diseases related to airborne diseases linked to gas flares in the Niger delta region [2], (WHO, 2023). Gas flaring has adverse effect on air quality as well as pre-school children putting individual life at risk, of which the flare gases causes eyes, nose and throat irritation, headaches, nausea, and damage to the, kidneys with significant increase in urea, creatinine and uric acid levels, cancerous diseases and central nervous system [3,4,5,6].

Growth and maturation improve when there are sufficient vital nutrients and steady interaction of genes that influence physical performance throughout the whole period of growth [7]. The height, weight or body-build of children are associated genetically with environmental forces combined [8,7].

Naturally sufficient calories intake are good influence of physiological growth of preschool children though developmental stages varies. To a greater extent, growth retardation is due to malnutrition during childhood characterize with underweight [9,10,11,12].

The effect of these gas has put school children into lack of concentration and snoring during school hours and there is a positive correlation between the flaring and community residents including pre-school children being the most vulnerable to having cough, airborne illness, along with high rate of stunting, wasting and underweight [13]. Studies have shown that flares has not only affected the micro-climate but also the physical properties of the soil (Alakpodia

2000; Adjugo, 2007). Many studies and standards have been provided in the developed world to help improve the level of indoor air quality (LAQ) in school since preschool children are vulnerable group of the population. The awareness for the comfort and wellbeing of users of school building is a process that requires flexibility and readiness in providing safe air space for both present and future generations (Adjugo, 2007). Little is known about this study area, but since there is no established document showing adverse effect of gas flares on the growth profile of preschool children this study becomes imperative to evaluate the growth profile of school children within the age group of 1-5years in Obunagha and Tombia. Recent studies conducted by Solomon et al. [14] on pregnant women in this present study area shows the presence of significant levels of heavy metals such as lead and cadmium in their blood and thus resulting in low birth weight babies being delivered since these chemicals can cross the placenta blood barriers to the unborn child.

The flaring of gases is the burning of natural gas generated in addition with crude oil during oil and gas extraction process with the release of unburned gases into the environment through venting [15,16,17,18-21]. Flaring was in the past globally common, but in more recent times, it has largely been limited to places like Algeria, Iran, Iraq, Nigeria and Russia [22]. Gas flaring hazardously impacts the environment through emission of methane and other chemicals resulting in stunted growth of plants, wild animals' disappearance and low production yield resulting in malnutrition (Anomohanran et al*.,* 2012; Hassan et al, 2013; Makuka et al*.,* 2017).

Lack of proper environmental regulation practices and conflict enforcement among various bodies or agencies saddled with the responsibility of controlling and monitoring petroleum extraction to regulate and enforce anti flaring policies due to the profit generated by government from oil industries has caused the government to neglect the infrastructural development of gas industry [23,24-31]. The number of children in a family exerts effect on the children's rate of growth. Children in large families have been shown to be usually smaller and lighter than children in small families because children from larger families tend to get less individual care and attention [32,33,34]. Gas flares contaminates water, crops, food and causes ill-health, environmental degradation and displacement of people from their ancestral homes and result in malnutrition [35,36-41].

2. MATERIALS AND METHODS

2.1 Research Design

Descriptive cross sectional study design was used for this study, this designed becomes paramount because it enables us to evaluate the growth profile of preschool children within the age group of 1-5years using simple sampling method in the study area.

2.2 Study Population

The target population for this study was 240 participants consisting of preschool children who are within the ages of 1-5years in Obunagha and Tombia Bayelsa State.

2.3 Sample Size and Sample Technique

The sample size for this study was determined using Cochran's formula.

$$n = \frac{Z\alpha^2 P(1-p}{d^2}$$

Where:

n= sample size
Z= normal standard deviation is $(1.96)^2$
At 95% confidence interval
P= prevalence of previous study by Omoniyi & John [2] reported 17% incidence of cough/underweight associated with gas flaring among children in Bayelsa state.

D= marginal error set as 5% or 0.05

$$n = \frac{(1.96)^2 \times 0.17(1-0.17)}{0.05^2}$$

$$n = \frac{3.8416 \times 0.83}{0.0025}$$

$$n = \frac{0.54204976}{0.0025}$$

$$n = 216.819$$

Adjusting for non- response rate of 10%

=10/ 100x216.819
=21.6819
n= 216.819+21.6819

N =239.5009

Sample size for this study will be 240 participants approximately.

2.4 Instrument for Data Collection

Camry bathroom scale for weight (China), meter rule for height determination, ruler, questionnaires and Oral viva was used for data collection.

2.5 Methods of Data Collection

During the period of data collection we distributed the questionnaires to get the required information and was thereafter retrieved immediately.

2.6 Data Analysis

SPSS version 23.0 was used for data analysis and results are presented in tables expressed in frequency, percentage and mean ± standard deviation.

2.7 Ethical Consideration

Before conducting this study, Permission was obtained from the Research and Ethnics Committee of the institution and was duly approved. Inform consent was also obtained from Community Development Chairman CDC) including verbal consent from school authorities before conducting this study. All information retrieved were kept confidential.

Inclusion criteria: Only preschool children within the ages of 1-5years that have persistently resided for at list one year in the gas flaring environment were considered for this study.

Exclusion criteria: Any child above five years was excluded from this study.

3. RESULTS AND DISCUSSION

Table 1 shows an increase percentage of female participants in this study compare with the males. Each age (yrs.) percentage was calculated using the number divided by the total number of study population and then multiply by 100.

Table 8 shows preschool children percentile in kg with 50th being the green normal zone for well-nourished male children and high proportion being malnourished.

Table 9 shows preschool children percentile in kg with 50th being the green normal zone for well-nourished female children. The Table 9 shows high prevalence of malnourished children in gas flares environment.

Table 1. Age and sex frequency distribution of the study population

Age(yrs.)	Male (No)	%	Female (No)	%	Both sex(No)	%
1	10	4.17	8	3.33	18	7.5
2	12	5	30	12.5	42	17.5
3	23	9.58	28	11.67	51	21.25
4	30	12.5	32	13.33	62	25.83
5	35	14.58	32	13.33	67	27.92
Total	110	45.83	130	54.17	240	100

Table 2. Parents demographic data of the study population

Occupation	Percentage			
	Fathers	%	Mothers	%
Civil servant	97	40.42	7	2.91
Carpentry	37	15.42	-	-
Trading	89	37.08	37	15.42
Farming	13	5.42	75	31.25
Business	4	1.66	121	50.42
Total	240	100	240	100

Table 3. Source of drinking water/birth of origin

Source of water	**N**	**%**
Tap water	189	78.75
Borehole	31	12.91
River	16	6.67
Pond	4	1.67
Total	240	100
Place of birth	**N**	**%**
Tombia	106	44.17
Obunagha	41	17.08
Outside	93	38.75
Total	240	100

Table 4. Male preschool children anthropometric indices

Variables	**Tombia**	**Obunagha**	**Diff.**	**p-value**
Wt(kg)	15.26±6.27	15.57±5.37	0.31	0.08
Ht(m)	1.01±5.65	0.89±6.66	-0.12	0.04
BMI (kg/m²)	14.91±1.37	19.66±4.96	4.7	0.02
Sleep Duration (hrs.)	10.96±4.23	9.98±2.43	-0.98	0.04

Source: Field source 2024

Table 5. Female preschool children anthropometric indices

Variables	Tombia	Obunagha	Diff.	p-value
Wt(kg)	15.08±9.23	14.38±9.18	-0.7	0.04
Ht(m)	0.89±1.52	0.86±4.54	-0.03	0.12
BMI (kg/m²)	19.04±3.30	19.45±3.24	0.41	0.14
Sleep Duration (hrs.)	9.41±3.04	9.24±3.24	-0.17	0.81

Source: Field source 2024

Table 6. PEM classification for age boys 1-5yrs in gas flares environment

Age (yrs.)	**<40% very severe**	**<60% Severe (3rd degree)**	**61-75% Moderate (2nd degree)**	**76-90% Mild (1st degree)**	**>90 Normal**	**>106**
1	-	-	2	1	7	-
2	-	-	2	10	-	-
3	-	1	2	20	-	-
4	-	1	2	20	7	-
5	-	3	2	-	30	-
Total N (%)	**-**	**5(4.55)**	**10(9.09)**	**51(46.36)**	**44(40)**	**-**

Classification Based on Gomez

Table 7. PEM classification for age girls 1-5yrs in gas flares environment

Age (yrs)	**<40% very severe**	**<60% Severe (3rd degree)**	**61-75% Moderate (2nd degree)**	**76-90% Mild (1st degree)**	**>90 Normal**	**>106**
1	-	-	-	6	2	-
2	-	-	1	25	4	-
3	-	-	-	26	2	-
4	-	-	1	30	1	-
5	-	2	-	4	26	-
Total N (%)	**-**	**2()**	**2()**	**92()**	**7()**	**-**

Classification Based on Gomez

Table 8. Combined percentile weight for age-1-5year in study population (males)

Age (yrs)	1st N(%)	3rd N(%)	5th N(%)	15th N(%)	25th N(%)	50th N (%)	75th N(%)	85th N(%)	95th N(%)	97th N(%)	99th N(%)
1	-	-	-	1 (0.91)	-	9 (8.18)	-	-	-	-	-
2	-	-	-	3 (2.73)	9 (8.18)	-	-	-	-	-	-
3	-	1 (0.91)	1 (0.91)	21 (19.09)	-	-	-	-	-	-	-
4	-	1 (0.91)	-	21 (19.09)	8 (7.27)	-	-	-	-	-	-
5	-	-	-	-	20 (18.18)	14 (12.73)	1 (0.91)	-	-	-	-

Table 9. Combined percentile weight for age 1-5year in study population (Females)

Age (yrs)	1st N(%)	3rd N(%)	5th N(%)	15th N(%)	25th N(%)	50th N (%)	75th N(%)	85th N(%)	95th N(%)	97th N(%)	99th N(%)
1	-	-	1 (0.77)	3 (2.31)	4 (3.07)	-	-	-	-	-	-
2	2 (1.54)	-	-	21 (16.16)	4 (3.07)	1 (0.77)	1 (0.77)	1 (0.77)	-	-	-
3	-	-	-	14 (10.77)	13 (10)	1 (0.77)	-	-	-	-	-
4	1 (0.77)	8 (6.15)	8 (6.15)	1 (0.77)	14 (10.77)	-	-	-	-	-	-
5	-	-	-	-	14 (10.77)	18 (13.85)	-	-	-	-	-

Age and sex frequency: The result from the present study shows a total of 110 males (45.83%) and 130 females (54.17%) that participated in this study. Participant within age 5 (14.58%) and 4yrs (12.5%) make up the highest percentage among males while age 4,5,2,3 has (13.33%), (13.33%), (12.5%) and (11.67%) among females respectively. Age 1 has the least number in both sex with 4.17% and 3.33%.

Parents data: The parent demographic data of the study population indicate 40.42%, 37.08%, 15.42%, and 5.42% are civil servants, traders, carpenters and farmers among the fathers while 50.42%, 31.25%, 15.42% and 2.91% among mothers engage in business, farming trading and civil service work as their dependent means of income to improve the nutritional wellbeing of the children in this study.

Anthropometric indices: This study shows a significant p-value increase between the height (1.01m; 0.89m), BMI (14.91kg/m²; 19.66kg/m²), and duration of sleep (10.96hrs; 9.98hrs) among male preschool children schooling in Tombia and Obunagha though with a non-significant p-value in weight. The distance between Obunagha and Tombia is between 2-3 kilometers with Obunagha being the epicenter of gas flares distribution to its environs. Affected school children suffering from underweight, stunting and thinness have been previously reported by Ayogu et al. [42] in the following prevalence rate of 18.2%, 41.6% and 20.0% in Nigeria. Regarding the female children anthropometric indices, significant p value increase was only observed in their weight while the other variables were non-significant statistically. Under nutrition is a public health challenge with serious consequences to the affected children and to the state. Nutrition issues are constraint to effective child growth development and reduced its ability to comprehend maximally at school [42].

Classification of PEM: The PEM for age classification among the male study population reveal 40% of the children are within the green zone of above 90% as normal using Gomez classification of identifying malnutrition. Cases of malnutrition among children between 2-3 years of age experiencing kwashiorkor (77.2%) and marasmus (22.8%) in Bayelsa state due to factors linked to under nutrition, malaria, worm infestation and diarrhea have been reported prior to this study [43]. Previous study carried out in India indicate 62.76% out of 239 children age 1-2years suffers from protein energy malnutrition [44]. This present study further reveal 46.36% of the children with mild malnutrition and 9.09% moderate while only 4.5% are experiencing severe malnutrition. Malnutrition was also observed among the female children as follows: 3rd degree malnutrition (1.54%), 2nd degree (1.54), 1st degree (70%) and normal (26.92%) respectively. This study is not in congruent with the findings of Solomon et al, (2015) who observed 93.5% of normal, 6.5% mild PEM with no moderate nor severe malnutrition among preschool children in sagbama local government area of Bayelsa state. Malnutrition is a major public health concern accounting for half of children death worldwide in both developing and underdeveloped countries [45-47].

The combined weight for age 1-5years male children shows a higher percentage among age 2 &3 yrs (26.36%) in the 25th percentile and 12.73% among age 5 in the green zone of normal children. However 22.73% and 1.82% are within the 15th and 3rd percentile age for weight. Regarding the combined female weight for age 1-5yrs, 15.89% are within the 50th green zone compared with 37.68%,30.01%, 6.92%, 6.15% and 2.31% that falls in the 25th,15th, 3rd, and 1st percentile respectively.

Source of Drinking water/birth origin: Results from the study also shows that the parents are doing their best by making use of tap treated water (78.75%) provision as their source of drinking water for the children. However 12.91%, 6.67%, and 1.67% still make use of untreated borehole, river and pond water during scarcity period. The consumption of untreated water could be a source of diarrhea due to water borne diseases associated with under nutrition among children [43,48-53]. More so, 44.17% and 17.08% were born and brought up in this gas flaring environment compared with 38.75% born outside this environment during this study. Study from World Bank published last two year ago shows the impact of gas flares on children between age 1-5years with respiratory symptoms, nutritional issues and underweight in the Niger delta region of Nigeria [2].

4. CONCLUSION

The prevalence of malnutrition among preschool children is high and should be treated as a matter of urgent concern by authorities in the health sector to protect the future wellbeing of these children within the ages of 1-5years in yenagoa, Bayelsa state. Undernutrtion can lead to mental retardation and decreased ability of children to comprehend and focus in their

studies. The occupational level of the parents and source of drinking water has an impact on the growth profile of the children as well due to gas flares component that may have been mixed up in water and crops consumed by these children.

5. RECOMMENDATIONS

This study did not treat all the factors associated with children growth profile. Meanwhile we hereby recommend for further detailed research that will include water, crops, fishes and blood sample test for heavy metals associated with gas flares in the study areas and their relationship with children growth profile. Also, subsequent studies regarding prevalence of undernutrtion among preschool children 1-5 years should include height for age, weight for height, the muac and dietary food intake that will serve as an index of cumulative effect of children undernutrtion.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

CONSENT

As per international standards, parental written consent has been collected and preserved by the author(s).

ETHICAL APPROVAL

As per international standards or university standards written ethical approval has been collected and preserved by the author(s).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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