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Health Consequences of Climate Change on Education and Sustainable Development

Track 2: ESG/ CSR and Sustainability of Public and Private Sector Institutions in Africa

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Abstract

Education is a catalyst for the development of every country hence the need for quality education of the youths who shall become leaders of tomorrow. When students' health is threatened by the immediate and long term impacts of climate change, their education is undermined, as such the sustainable development strides of the nation becomes compromised. Nations are vulnerable to climate change impacts given the vagaries of climate conditions they experience. The present study investigated the health consequences of climate change on secondary school students in Ebonyi State. Following a descriptive survey design, 400 Senior Secondary School two (SS11) students were randomly sampled out of 8,376 students in Onueke Educational Zone, Ebonyi State, South-Eastern Nigeria. An adapted instrument with a reliability coefficient of 0.87 was used for this study. Responses were tabulated and categorized using descriptive statistics while hypotheses were tested at $p < 0.05$ level of significance. Findings from the study revealed that changing rainfall patterns, drought and high temperature impact negatively on their health causing serious health challenges like lack of concentration in the class, sleeping disorder and sicknesses resulting from bacterial infection, etc. Based on the findings, it is recommended that school authorities should organize workshops on effective coping strategies to address climate change. Tree planting and other environmental programmes should be instituted to involve students in practical community-based response to climate change

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Keywords: Climate change, Climate impact, Ebonyi state, secondary school students, health consequences, coping strategies

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Introduction

The increase in industrial revolution has resulted to significant anthropogenic contribution towards climate change (Sulistyawati et al, 2018, Murshed et al. 2022). This includes activities such as fossil fuel burning, agricultural residues burning, deforestation and transportation among others (Haines, 2006; Huang et al. 2016). The changing climate is gradually becoming one of the most overwhelming threats in the environment (Pandve and Raut, 2011) with traceable effects such as flooding, deforestation, reduced crop yield, increased disease incidence and increased drought among others (Žurovec and Vedeld, 2019; Echendu, 2020).

Much concern is raised in the minds of people given the direct and indirect impacts of climate change on the environment and human health (Romanello, et al 2022; Sulistyawati et al, 2018; Crowley, 2016). Human health is adversely affected in a number of ways. Respiratory diseases like asthma become exacerbated as a result of rising global temperature. Agricultural production and food availability have been negatively impacted resulting to food insecurity and under-nutrition (Mank et al., 2021)

Adverse weather conditions impede smooth educational process for students across all age through its direct and indirect impacts. This is observed in countries which have experienced extreme climate disasters. In the face of climate disasters, stakeholders including teachers, students, parents and government are affected (UNICEF, 2019). It is reported that increase in the regularity and severity of climate-related disasters is common among low-income and developing countries (Leal et al., 2023). In Nigeria for instance, one of the prevalent threat of climate change is hydroelectric power generation (Ekpoh and Ekpoh, 2011). The country is experiencing seasonal reduction in her annual electricity generation due to drought conditions and this is getting worse. Above authors posited that electricity is major to a good studying environment thus its reduction has implications on the country's educational sector as students' health and comfort are affected especially the secondary school students.

Indirect impact of climate change on education could be seen in the form of migration by affected families, teachers inconsistency at school due to illness caused by climate disaster, teachers inadequate knowledge of how to educate school children who were absent as a result of climate disaster, absenteeism, impaired learning and relocation on the part of the students. Such displacement is reported to have instant impact on children's education. For instance, migration intensifies school dropout rates because of the involvement of those children in their families' recovery activities (Baez, 2021). The school buildings suffer reduced availability of safe water and meals, increased need for cooling or heating systems (UNICEF, 2019).

UNICEF (2023) defines education for sustainable development as the process of giving learners of all ages the knowledge, skills, values and agency to address interconnected global challenges including climate change, loss of biodiversity, unsustainable use of resources, and inequality. Secondary school students can be described as children between the ages of 12 years-16 years and specifically the

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senior secondary students range between 14 years – 16 years. They are early adolescents and part of the curricular processes which compliment learning in a school environment (Edikpa et al., 2016).

Unfortunately, climate change impacts have brought about increased frequency of heavy rainfall, strong winds, and storms. These constantly cause damage to school buildings and property posing possible harms to students' and teachers' health. Once the health of teachers and students are affected it will deprive them from attending school. Thus education for sustainable development will be undermined. Consequent upon these existing conditions, the present study was guided by the following research questions;

What is the impact of Rainfall Pattern on secondary school students' health in Ebonyi?

What is the impact of Drought on secondary school students' health in Ebonyi State?

What is the impact of High Temperature on secondary school students' health in Ebonyi State?

The following hypothesis were formulated and tested at $p < 0.05$ level of significance;

H_{01}: There is no significant difference in the mean response of male and female students on the impact of rainfall pattern on secondary school students' health in Ebonyi State

H_{02}: There is no significant difference in the mean response of male and female students on the impact of Drought on secondary school students' health in Ebonyi State.

H_{03}: There is no significant difference in the mean response of male and female students on the impact of High Temperature on secondary school students' health in Ebonyi State

Literature Review

Climate Change and Health

The single biggest global health challenge in this 21st century which affects the physical environment, ecosystem and their contacts with human beings has been identified as climate change (Vicedo-Cabrera et al, 2021; Romanello et al 2021). Thus, its adverse impact on human health is evidenced across literature (Hathaway and Maibach, 2018), ranging from untimely deaths resulting from natural hazards to transmissible ailments as a result of declined hygiene and excessive increase of pathogens (Lemery et al, 2021). This is more obvious among the vulnerable group; pregnant women, orphans, older adults and children. Their cases are worsened given their incapacitation for resiliency. For instance, children's more fluid intake, more air inhalation, greater food consumption coupled with involvement in several outdoor activities expose them to lately evolving environmental hazards (Zhiwei et al., 2012) The consequences of climate change on human health are clearly evident in various countries of the world. Recent reviews on the impacts of climate change on health for instance in Ethiopia reveal child under-nutrition as a result of climate change all through the three agro-ecologies of Ethiopia (Hagos et al, 2014). The authors argued that climate change also influence the prevalence of infectious diseases. Another study by Birhane et al., (2014) revealed an overall average occurrence rate of under-nutrition as unconquerable by stunting (55.2%), underweight (42.5%) and wasting (10.1%) in Ethiopia. Rieckmann et al., (2018) reported an increase in cholera outbreak during periods of drought. By implication, droughts are associated with greater risk of diseases such as diarrhea and cholera, as a result of declined water source for hygiene purposes.Research studies

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in few other countries have reported that very young children are particularly vulnerable to heat waves (Nitschke, et al., 2011) with associated related disasters like respiratory diseases, high rates of sleep disturbance, sadness, and other mental health impairments (Ahern, et al 2005). The report by Knowlton et al (2008) revealed an increase in heat-related illness among children between the ages of 0–4 years in California during the 2006 heat incident. Exposure to natural disasters has been reported to aggravate the situation of hopelessness, apprehension and pressure.

Omoruyi and Onafalujo, (2011) has reported some direct consequences of climate change in Nigeria as cerebra-spinal meningitis, cardiovascular respiratory disorder of the elderly people, skin cancer, high blood pressure, malaria, cholera and child and maternal health issues. From an empirical analysis of Brenda et al. (2018), 14,280 suspected meningitis cases were reported across 23 of the 36 states in Nigeria with 1145 deaths (8% case fatality rate) amid the suspected cases between December 2016 and May 2017. High temperature is a major cause of meningitis among children. In addition to above, other direct consequences of climate change can be found in the agricultural sector with severe negative consequences on agricultural production and food availability leading to food insecurity and under-nutrition (Belesova, et al., 2019). The high dependence of West African countries on rainfall for their agricultural practices are adversely affected as evidenced in low farm yields and hiked food prices (Saronga et al., 2016). This situation is reported to lead families into adjusting their food sources and diets. Under such family conditions, children within the age bracket of 0-5years, with particular need for sufficient nutrients and food for their development and growth would suffer some insufficiencies which would manifest in a complex risk for impeded cognitive development, stunted growth and followed by death (Belesova, et al., 2018). Infants and children among few others have been identified as populations at higher risk to climate change health impacts with reports of their susceptibility to heat stress, vector-borne diseases, air pollution, food-borne diseases and malnutrition and drought-related water-borne diseases (Ebi et al., 2012). Mortality occurs during floods and its recovery period as a result of drowning, non-fatal injuries like cuts and acute physical trauma (Clayton et al., 2014). Floods contaminate freshwater supplies, thus heightening the risk of water-borne diseases which creates safe breeding grounds for insects like mosquitoes with resultant effects of malaria and other water borne diseases (Factsheet, Climate Change and Health, 2016). With attendant increased risk of disease, more deaths of school children and reduced school attendance will occur because of their vulnerability to health hazards (BNRCC, 2011).

Climate change and Education

Adverse weather conditions impede smooth educational process for students across all age through its direct and indirect impacts. This is observed in countries which have experienced extreme climate disasters. In the face of climate disasters, stakeholders including teachers, students, parents and government are affected (UNICEF, 2019). It is reported that increase in the regularity and severity of climate-related disasters is common among low-income and developing countries (Leal et al., 2023). This has further denied the susceptible families and children access to education. In some cases school buildings and facilities like roads and bridges which connect rural communities have been ruined due to repeated climate-related events, ultimately affecting the quality of education and access to school

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premises (Kousky, 2016; Arndt et al., 2015). The inability of repairing or re-building destroyed school buildings results to further delay of access to education (Luetz, 2020). Direct impacts of climate change disasters like flood and cyclone include injury and mortality on the parents and inability to cover school expenses. In addition to afore-mentioned is inability to access the school premises by the teachers coupled with psychological stress on the students (UNICEF, 2019).

Indirect impact of climate change on education could be seen in the form of migration by affected families, teachers inconsistency at school due to illness caused by climate disaster, teachers inadequate knowledge of how to educate school children who were absent as a result of climate disaster, absenteeism, impaired learning and relocation on the part of the students. Such displacement is reported to have instant impact on children's education. For instance, migration intensifies school dropout rates because of the involvement of those children in their families' recovery activities (Baez, 2021). Save the children, (2015) reported of 351 schools which were sub-merged by flood and consequently closed for three to fourteen days in Indonesia. Similarly, 803 schools were reported to have shut down for fourteen days as a result of heavy damage after Typhoon Koppu in Philippines. One can easily conclude that such closure would have automatically affected even the curriculum coverage of different school subjects in the affected towns. This ultimately would affect the quality of education offered to the children

Methodology

Study Area and population

This study was conducted in Onueke Education Zone of Ebonyi State. Ebonyi State is located in the South of Eastern Nigeria. It is one out of the six states created in 1996 and is located on the latitudes 5°40′ and 6°45′ north of the Equator and longitudes 7°30′ and 8°46′ east of the Greenwich Meridian. Tropical rainforest and derived savannah describe the climate of the state which is favorable for rice cultivation as the inhabitants are mainly farmers. As at 2023, Ebonyi state has been estimated to have a population of 3,046,287 persons (Nigerian Investment Promotion Commission, 2024). It is been reported that approximately 80% of the inhabitants live in poverty (National Bureau of Statistics, 2012) thus, validating the susceptibility of the state is to climate risks (Onyeneke, 2020).

Sampling procedure and Data collection

A research instrument titled "climate change impact and students' health questionnaire (CCISHQ)" was adapted and used for data collection. The instrument was made up of four sections; A, B, C and D. Section A consists of questions requesting demographic information from each of the respondents, while section B, C and D were four point Likert scale items designed to elicit responses about impacts of rainfall, drought and high temperature on secondary school students health. The reliability of the instrument was determined using Cronbach Alpha after they were administered to another group of students different from the targeted sample. A reliability coefficient of 0.87 was realized which was suggestive of the instrument's reliability (Benson and Ttitlayo, 2016)

Sample and Procedure

The study population comprised of eight thousand, three hundred and seventy six (8,376) senior

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secondary 11 students of public secondary schools in Onueke Education Zone of Ebonyi State. The study employed descriptive survey design which adopted a multi-stage random sampling technique. The first stage involved the selection of 5 schools from each of the four local government areas of the education zone totaling 20 schools. The second stage involved a random selection of twenty senior secondary 11 students from each of the 20 selected schools. This gave a total of four hundred (400) students who participated in the study. The study followed the research ethical guideline of Alex-Ekwueme Federal University as contained in her research policy. Thus, the purpose of the study was explained to the students by the research team, and the re-assurance of treating their responses anonymously was given. In this way, their consents to participate in the study were obtained. The research instrument was administered on senior secondary 11 students by the researchers in the twenty sampled schools. The instruments were retrieved from them afterwards and data collected was analyzed using descriptive statistics and t-test

Results

Data Presentation and Analysis

Research Question 1

What is the impact of rainfall pattern on secondary school students' health in Ebonyi?

Hypothesis

H_{01}: There is no significant difference in the mean response of male and female students on the impact of rainfall pattern on secondary school students' health in Ebonyi.

The data that answered research question one is presented in the table below;

Table 1: Analysis of the responses of respondents on the impact of Rainfall Pattern on secondary school students' health in Ebonyi - n=400

S/N	Item statement	Mean	S	P-Value	Decision
1.	Heavy rains make my environment to become damp causing bacterial infections	2.65	.48	.13	Agreed, NS
2.	Flooding causes drowning of school children leading to death	2.54	.50	.55	Agreed, NS
3.	Excessive rains make me ill always due to prolonged cold	2.97	.85	.01	Agreed, NS
4.	Flooding contaminates our drinking water	2.60	.49	.38	Agreed, NS
5.	Heavy rains causes slippery roads leading to fall	2.62	.57	.07	Agreed, NS
6.	Heavy rains destroy our farms causing food shortage	3.20	.82	.26	Agreed, NS

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7.	More rainfall causes more mosquito bites leading to Malaria	3.16	.76	.22	Agreed, NS

Source: Field study, 2023.

Key*: SD-standard Deviation, N- Number of respondents, S= Significant, NS= Not Significant and Sig ≥.05*

The data presented in table 1 showed that the mean rating of the respondents on the 7 items had their range from 2.54 – 3.16 and were all above the cut-off value of 2.50 on a 4-point rating scale. These however indicated agreed. Therefore, the mean of 2.54 – 3.16 showed that the respondents agreed that rainfall pattern negatively affect secondary school students' health in Ebonyi. The standard deviation of all the 7 items ranged from .01 to .55 which showed that the respondents were not too far from the mean and the opinion of one another in their responses on the impact of rainfall pattern on secondary school students' health in the state. The p-values on all the items were all greater than the alpha-value of 0.05. With the forgoing, we therefore accept the null hypothesis for the items and reject the alternate hypothesis. This means there is no significant difference in the mean response of male and female students on the impact of rainfall pattern on secondary school students' health in Ebonyi state.

Research Question 2

What is the impact of Drought on secondary school students' health in Ebonyi State?

Hypothesis

H_{02}: There is no significant difference in the mean response of male and female students on the impact of Drought on secondary school students' health in Ebonyi State.

The data that answered research question one were presented on table below;

Table 2: Analysis of the responses of the respondents on the impact of Drought on secondary school students' health in Ebonyi State - n=400

S/N	Item statement	Mean	S	P-Value	Decision
1.	Drought leads to crop failures resulting to food shortage in our house	3.25	.82	.02	Agreed, NS
2.	I get sick sometimes due to poor water quality from drought	3.21	.82	.05	Agreed, NS
3.	Drought has resulted to higher food prices leading to my parents inability to provide a balance diet for me	3.21	.85	.22	Agreed, NS
4.	We suffer water shortage in the beginning of every year because of dried water wells	3.25	.82	.05	Agreed, NS

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5.	Drought impacts on the quality of air causing me respiratory allergies	3.12	.80	.07	Agreed, NS
6.	We suffer lack of water in the beginning of every year because of delayed rainfall	3.07	.81	.68	Agreed, NS
7.	A lot of children around my environment suffer Cholera as a result of delayed rainfall and drought	3.08	.82	.13	Agreed, NS
8.	Sometimes I have developed skin infections because I bath once a day since there is no water	2.99	.78	.88	Agreed, NS
9.	We suffer water-borne diseases within the first four months of the year due to drought	3.13	.77	.20	Agreed, NS

Source: Field study, 2023.

Key*: SD-standard Deviation, N- Number of respondents, S= Significant, NS= Not Significant and Sig ≥.05*

The data presented in table 2 showed the mean rating of students on the 9 items had their ranged from 2.99 – 3.25 and were all above the cut-off value of 2.50 on a 4-point rating scale. These however indicated agreed. Therefore, the mean of 2.99 – 3.25 showed that the respondents agreed that drought negatively affect secondary school students' health in Ebonyi. The standard deviation of all the 7 items ranged from .77 to .85 which showed that the respondents were not too far from the mean and the opinion of one another in their responses on the impact of drought on secondary school students' health in Ebonyi State. The p-values on all items were greater than the alpha-value of 0.05. With the forgoing, we therefore accept the null hypothesis for the items and reject the alternate hypothesis which means there is no significant difference in the mean response of male and female students on the impact of Drought on secondary school students' health in Ebonyi State

Research Question 3

What is the impact of High Temperature on secondary school students' health in Ebonyi State?

Hypothesis

H_{03}: There is no significant difference in the mean response of male and female students on the impact of High Temperature on secondary school students' health in Ebonyi State

The data that answered research question one were presented on table below;

Table 3: Analysis of the responses of the respondents on the impact of High Temperature on secondary school students' health in Ebonyi State n=400

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S/N	Item statement	Mean	S	P-Value	Decision
1.	Extreme heat causes me poor concentration in the class	3.07	.79	.01	Agreed, NS
2.	High temperature causes sleep disorder for me	3.17	.81	.39	Agreed, NS
3.	High temperature makes me sweat profusely	2.94	.79	.93	Agreed, NS
4.	High temperature has influenced my mental health resulting to issues such as stress	3.20	.83	.26	Agreed, NS
5.	I drink so much water due to dehydration caused by extreme heat	2.65	.48	.13	Agreed, NS
6.	The smoke from bush burning causes respiratory health problems for me	2.54	.50	.55	Agreed, NS

Source: Field study, 2023.

Key*: SD-standard Deviation, N- Number of respondents, S= Significant, NS= Not Significant and Sig ≥.05*

The data presented in table 3 showed the mean rating of students on the 6 items had their ranged from 2.54 – 3.17 and were all above the cut-off value of 2.50 on a 4-point rating scale. These however indicated agreed. Therefore, the mean of 2.54 – 3.17 showed that the respondents agreed that High temperature negatively affect secondary school students' health in Ebonyi. The standard deviation of the 6 items ranged from .48 to .83 which showed that the respondents were not too far from the mean and the opinion of one another in their responses on the impact of High temperature on secondary school students' health in Ebonyi State. The p-values on the items were all greater than the alpha-value of 0.05. Going forward, we therefore accept the null hypothesis for the items and reject the alternate hypothesis. This means there is no significant difference in the mean response of male and female students on the impact of High temperature on secondary school students' health in Ebonyi State

Discussion

Data presented in table 1 showed that rainfall pattern negatively affect secondary school students' health in Ebonyi State. The finding of this study is in tandem with Edikpa et al., (2016) who reported that rainfall/flooding exacerbate diseases like malaria, pneumonia, ashma, diarrhea etc. Dimitrova, et al., (2022) reported that wet conditions increase the risk of cough and fever in humid, subtropical regions. It can also cause an increased effect on transmission of infectious disease by affecting pathogen survival and transport. Similarly, Nübler et al., (2020), posited that the negative impacts of rainfall shocks on education are as a result of numerous basic mechanisms including persistent effects

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on the health of children and the wealth of their households. Floods pose threats to human health by exposing individuals to debris and toxic materials, vector-borne illnesses and water-borne diseases which occur as a result of flood water (Clayton et al., 2014; Factsheet, Climate Change and Health, 2016).

Respondents as presented in table 2 accepted that drought negatively affects the health of secondary school students in Ebonyi State. This is aligns with the findings of Singh, et al., (2006) who reported higher malnutrition and mortality rates among infants and young children when compared with the older children and adults as a result of drought. Similarly, Rieckmann et al. (2018) reported an increase in cholera outbreak during periods of drought and drought-related water-borne diseases (Pe'er *et al*. 2017). By implication, droughts are associated with greater risk of diseases such as diarrhea and cholera, as a result of declined water source for hygiene purposes. Similarly, Ojala and Lakew (2022) reported that the devastating impact of climate change are felt on school's materials and human resources especially secondary school students' health which are considered vital to the achievement of educational goals and objectives. Results on table 3 showed that the respondents agreed to negative impacts of high temperature on the health secondary school students in Ebonyi State. This is in agreement with Omoruyi and Onafalujo, (2011) who reported that high temperature is a major cause of cerebra-spinal meningitis among Nigerian children, skin cancer, high blood pressure, malaria, cholera and child and maternal health issues. In congruence with above, infants and children have been identified as the population at higher risk to climate change health impacts with reports of their susceptibility to heat stress, vector borne diseases, air pollution, food-borne diseases and malnutrition (Ebi et al., 2012). Research studies in few other countries have equally reported that very young children are particularly vulnerable to heat waves (Nitschke, et al., 2011) with associated related disasters like respiratory diseases, high rates of sleep disturbance, sadness, and other mental health impairments (Ahern, et al 2005). Knowlton et al (2008) revealed an increase in heat-related illness among children between the ages of 0–4 year in California during the 2006 heat incident.From the hypotheses results, no significant difference was found in the mean response of male and female students on the impact of rainfall pattern on secondary school students' health in Ebonyi State. There was no significant difference in the mean response of male and female students on the impact of drought on secondary school students' health in Ebonyi State. Finally, there was no significant difference in the mean response of male and female students on the impact of High temperature on secondary school students' health in Ebonyi State.

Conclusion, Implications & Recommendation

It is concluded that the health of secondary school students in Ebonyi State is adversely impacted by rainfall patterns, drought and high temperature. This study has educational implications in teaching and the general well- being of students. Climate change impacts cut across every sphere of life including the educational sector. Its ravaging effects are so enormous on students' health. If no action is taken by the government and schools to avert or mitigate these impacts, the future of our young children would be compromised as some may lose access to quality education due to poor health conditions. There is then the need to educate the schools and homes on simple coping strategies which could be

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adopted by children in and out of school.

The following are therefore recommended:

- Advance warning management systems should be provided for schools to monitor climate conditions and can support the disaster risk reduction process which will reduce the amount of drought effect on human health
- There should be more awareness creation and climate trainings for teachers and students on how best to manage the health challenges posed to them by climate change
- Cooling systems can be provided for schools by the government for use during intense heat periods
- Planting of trees in school premises should be revived by the government and school authorities. This would improve the ecosystem of such environments

Further Studies

Further studies should be conducted to find out the coping strategies developed and adopted by secondary school students in the face of climate change impact on their health. Such study would unravel how equipped these students are with the necessary skills and knowledge to tackle this monstrous challenge.

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