

Environmental and Hygiene Factors Affecting Diarrhea Occurrence in Enugu State, Nigeria.

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Abstract: Motivated by the high mortality and morbidity associated with diarrhea, and the increase in number of cases among children below five years, the paper analysed the environmental and hygiene factors affecting diarrhea occurrence in Enugu State and to fashion out some strategies that can be adopted to prevent and control the disease in the area. The study was to ascertain if there is a discernible pattern of environmental and hygiene factors affecting diarrhea occurrence in Enugu State from 2007 to 2016. A longitudinal survey was carried out. Data on diarrhea was collected from the seven District Hospitals in Enugu State which included Enugu Ezike District Hospital, Nsukka District Hospital, Isi-uzo District Hospital, Udi, Enugu, Agbani, and Agwu District Hospitals. A total of 1106 questionnaire on environmental and hygiene factors were administered to mothers. The paper tried to confirm if there is no significant discernible pattern of environmental and hygiene factors affecting diarrhea occurrence in Enugu State from January to December, 2016. The data was analysed using Principal Component Analysis PCA with varimax rotation. The findings showed that there is a significant discernible pattern of environmental and hygiene factors affecting diarrhea occurrence in the study area (total variance explained = 97.695% and communality extraction value ranges from 0.8 and above among all the environmental and hygiene factors variables studied). The paper showed that not practicing exclusive breast-feeding (0.999 extraction values), early introduction of complimentary feeding (0.999), picking dirt from the ground by babies (0.999) and not treating water from suspected sources (0.999) are the most crucial environmental and hygiene factors that affect diarrhea occurrence in the study area. Since there is a significant discernible pattern of environmental and hygiene factors affecting diarrhea occurrences in the State, it was recommended that, mothers in the area should be educated to maintain good environmental and personal hygiene of themselves and their children., through proper waste disposal, treating water from suspected sources, practicing exclusive breast-feeding up to four months, and ensure babies do not pick dirt and put in their mouth among others.

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I. Introduction

Diarrhea, according to ¹ is a condition that involves the frequent passing of loose or watery stools. It is opposite of constipation and can have many causes. It may be infectious or non-infectious. According to ², diarrhea is an abnormality that presents with frequent discharge of semi solid or fluid faecal matter from the bowel". This may be acute diarrhea, meaning diarrhea that is not long-term which is very common cause of death in developing nations, especially among young children and babies. It can also be chronic diarrhea, meaning long-term. Alternative names of diarrhea are; stool-water; frequent bowel movement, loose bowel movement, the runs, the trots. Causes of diarrhea include bacteria, viruses, parasites, certain medicines, food intolerances and disease that affect the stomach, small intestine or colon ³. In the early history of infectious diseases, Hippocrates (460-377 BCE) was among the first to record his theories on the occurrences of disease. In his treatise "Air, water and places", Hippocrates dismissed supernatural explanation of disease and instead attributed illness to characteristics of the weather, soil, water, mode of life and nutrition surrounding the patient ⁴. It is Hippocrates who coined the term endemic and epidemic disease to differentiate those diseases that are always present in a population (endemic), from those that are not always present but sometimes occurred in large number, (epidemic). He believed that people living in cities with different climate may suffer from different diseases. Hippocrates also observed that unusual weather conditions affect public health, especially the incidence and severity of various infectious diseases including gastro intestinal infections like diarrhea and also tuberculosis and nervous system infections ⁵. According to ⁶ several weather parameters affect diarrheal diseases from the level of infectious diseases (bacterial, parasites and viruses). A direct observation of the effects of rising temperature on these infectious agents shows increase in disease replication rates and survival duration.

There are other socio-demographic, environmental and hygiene factors associated with increased diarrhea in some areas. According to ⁷ they are factors such as low maternal education, poor hygiene of mothers, low economic status, and inferior quality of housing, diminished access to water and sanitation facilities, and crowding in the household. The breakdown in percentages of mortality and morbidity among children less than five years in Nigeria in 1999 revealed that 19% of death is due to diarrhea illness and dehydration from diarrhea is a major cause of death among young children ⁶. In Enugu State of Nigeria, diarrhea occurrence is a serious problem of public health and dehydration from diarrhea is also a major cause of death among young children ⁸. Between 2007 and 2011 diarrhea occurrence increased from 1212 cases to 1522 cases; and as at 2016 total of 1711 cases was recorded. Diarrhea has contributed to high infant mortality rate in Enugu State ⁹, thus the need to determine the environmental and hygiene factors affecting diarrhea occurrence in the State.

II. Material And Methods

This study was carried out among mothers whose children has suffered from diarrhea between January to December 2016 in Enugu State. Questionnaire was administered to a total of 1110 mothers aged from 15 to 50 years for the study.

Study design: Survey design.

Study Location: This was a study in Enugu State done at the Department of Environmental Management, Nnamdi Azikiwe University, Awka, Anambra State, Nigeria.

Study Duration: From January 2016 to December 2016.

Sample size: 1110 mothers.

Sample size calculation: The sample size was estimated using taro Yamane formula. The target population was 2083246 females in Enugu State. We assumed the limit of tolerance level of 0.03 and confidence interval of 95%.

Subjects and selection methods: The study population was drawn from the seven District Health Boards in Enugu State. The numbers of questionnaire in each district were calculated accordingly and administered to mothers whose children have suffered from diarrhea between January and December 2016. They were spotted out on immunization days in the district hospitals.

Inclusion criteria:

1. Mothers whose child or children have suffered from diarrhea from January 2016 to December 2016.
2. The child must be between 0-5 years.
3. The mother must be selected during immunization session.

Exclusion criteria:

1. Mothers who brought a child of another woman for immunization were not selected.

Procedure methodology:

Survey design was employed and data based on environmental and hygiene factors where the mothers were living were generated from the seven District Health Boards in Enugu State. A well structured questionnaire that contained information on sources of water supply, frequency of treating drinking water, excreta disposal methods, wash hand after visiting toilet, provision of waste bin, accessibility of domestic animal to the kitchen and baby picking dirt from the ground into the mouth among others was designed. Seven assistant researchers were trained to man the seven District Hospitals in each District Health Board. Their focus is on the mothers who come for weekly immunization in the district hospitals who met the inclusion criteria. Every immunization day mothers whose child or children have suffered from diarrhea were identified and requested to supply the needed information. The questionnaire was either completed by the mother herself or through the guidance of the assistance researcher.

Statistical analysis:

Data was analysed using principal component analysis PCA. The PCA included communalities, total variance explained, and Eigen value screen plot and rotated component matrix. Total variance explained entailed significant discernable pattern of characteristics of pertinent environmental and hygiene factors that affect diarrhea occurrence in the area. The pattern of pertinent environmental and hygiene factors affecting diarrhea occurrence in the area was validated with the extraction communality. The varimax rotation reduced the 21 environmental and hygiene factors used in the analysis into components 1, 2, and 3 from which a model of diarrhea control was developed.

III. Result

Table no. 1 shows diarrhea occurrence in different district of Enugu State from January to Dec., 2016. This table shows that highest cases of diarrhea was recorded in Nsukka District Health Board , followed by Isi-Uzo District Health Board.

Table no 1: Diarrhea occurrence in different district of Enugu State from January to Dec., 2016

Number of children infected with Diarrhea (under 5 year)								
year	Enugu Ezike District	Enugu District	Agbani District	Isi-Uzo District	Nsukka District	Udi District	Awgu District	Total
2016	108	62	137	169	213	102	423	1214

(Source: District Hospitals in Enugu State, 2016).

Table no. 2 showed 21 variables relating to Environmental and Hygiene factors within the environment where the children were brought up. The responses of the mothers were thus recorded accordingly for each of the seven District Health Board as shown in the table.

Table no 2: Environmental and Hygiene Factors Affecting Diarrhea Occurrence in the Districts

Variable Studied	Study Locations in Enugu State							Total
	Enugu Ezike District	Enugu	Agbani District	Isi-Uzo District	Nsukka District	Udi Distrit	Awgu District	
Major source of water supply								
Spring	0	2	0	3	15	1	12	33
Well water	35	200	70	10	80	36	7	438
Stream	2	10	2	39	70	0	90	213
Rain water	30	22	11	48	30	30	30	201
Water vendors	70	10	20	10	21	77	20	228
Rating of water treatment								
Very often	0	0	0	0	0	0	0	0
Often	0	0	0	0	0	0	0	0
Sometimes	0	24	1	1	7	2	2	38
Rarely	35	200	4	8	10	28	5	290
Never	102	20	98	101	119	107	151	778
Excreta Disposal Method								
Pit Latrine	62	80	22	18	71	42	31	326
Water system	14	150	10	9	30	10	10	233
Bush method	62	4	38	80	100	80	118	482
Ventilated improve pit larine	1	10	30	1	6	5	0	53
Other specify	0	0	3	2	9	0	0	14
Dust bin Type								
Carton	20	30	20	10	30	60	51	211
Standard dust bin	2	190	5	5	70	15	5	292
Basket	5	15	15	20	70	20	33	198
No Dust-Bin	110	5	60	70	40	40	70	395
Others specify	0	14	3	5	6	2	0	30
Accessibility of domestic animal to kitchen								
Very often	0	0	0	0	0	0	0	0
Often	20	0	0	5	27	7	70	129
Sometimes	114	7	76	80	154	100	51	582
Rarely	0	30	20	20	30	20	35	155
Never	3	207	7	5	5	10	3	250
Extent of baby exclusive breast feeding								
0-1 months	17	60	3	40	6	22	16	194
2 – 3 months	30	70	83	41	40	28	20	312
4- 5 months	20	54	3	0	10	51	20	158
6 months and above	10	50	4	9	20	6	3	102
Not at all	60	10	10	20	140	30	100	370
Age baby is introduced to complimentary feeding.								
0 -1 month	4	3	3	0	6	20	16	54
2 - 3 months	23	4	28	30	52	62	20	219
4 – 5 months	99	108	69	66	140	49	130	661
6 months to 1 yr	10	36	3	8	18	6	3	84
Above 1yr	1	3	0	6	0	0	0	10

Boiling drinking water for child								
0-1 months	0	50	3	2	11	44	16	126
2 – 3 months	103	80	93	70	102	47	128	623
4- 5 months	17	59	3	10	80	40	22	231
6 months and above	17	50	4	8	19	6	4	108
Not at all	0	5	0	20	4	0	0	29
Baby picking things and putting in the mouth								
Very often	0	10	0	10	0	0	0	20
Often	124	10	90	92	117	100	100	633
Sometimes	6	20	11	4	33	30	40	144
Rarely	5	147	2	4	4	7	14	183
Never	2	45	0	0	2	0	5	54
Wash hand after visiting toilet								
Very often	0	10	0	0	0	0	0	10
Often	10	200	3	50	111	10	0	384
Sometimes	103	28	90	50	90	122	24	507
Rarely	24	6	8	10	5	3	120	176
Never	0	0	2	0	10	1	15	28

(Source: Researcher’s Computation, 2017).

The Principal Component Analysis (PCA) was conducted to know if there is significant discernible patterns of environmental and hygiene factors affecting diarrhea occurrence in the study area. The PCA used survey data on environmental and hygiene factors that affects diarrhea occurrence in the study area (Table no 2).

The PCA included communalities, total variance explained, and Eigen value screen plot and rotated component matrix. The explained variance indicates 97.695% significant in characteristics of pertinent environmental and hygiene factors that affects diarrhea occurrence. Therefore, the complexity of data set on discernible pattern of pertinent environmental and hygiene factors information loss is 2.305 (ie 100 - 97.695%).

The total variance explained of 97.695% entailed significant discernible pattern of characteristics of environmental and hygiene factors that affects diarrhea occurrence in the area.

The discernible pattern of pertinent environmental and hygiene factors that affects diarrhea occurrence in the area was also validated with the extraction communality. The extraction communality is presented in table no 3 below.

Table no 3: Communality of Discernible Pattern of Environmental and Hygiene Factor

	Initial	Extraction
Sp	1.000	.969
Ww	1.000	.983
Sw	1.000	.987
Rw	1.000	.975
Wv	1.000	.990
Pl	1.000	.994
Ws	1.000	.865
Bm	1.000	.953
VIP	1.000	.977
Sw	1.000	.993
Sd	1.000	.987
Nd	1.000	.995
Cf	1.000	.991
Hw	1.000	.871
Ebf	1.000	.999 #
Bw	1.000	.999 #
Wt	1.000	.999 #
Cf	1.000	.999 #
Pd	1.000	.999 #
Ak	1.000	.998
Wb	1.000	.990

Extraction Method: Principal Component Analysis. # = Most crucial factors.

(Source: SPSS, PCA 2017).

Sp = spring water, Ww = Well water, Sw = Stream water, Rw = Rain water, Wv = water vendor, Pl = Pit latrine, Ws = Water system latrine, Bm = Bush method, VIP = Ventilated improved pit latrine, Sw = Solid waste disposal, Sd = Standard dust bin, Nd = No dust bin, Cf = Contaminated food, Hw = Hand washing, Ebf = Exclusive Breast feeding, Bw= Boiling drinking water, Wt = Water treatment, Cf = Complimentary feeding, Pd

= Picking dirt by babies, Ak = Animal having access to the kitchen, Wb = Washing of breast before feeding baby.

The result of communality in table no 3 indicates the amount of variance that is accountable for the discernible pattern of environmental and hygiene factor that affects diarrhea occurrence in the study area.

The PCA initial extraction is 1 in all cases. Hence, extraction communality are estimates of variance in each environmental and hygiene factor variables accountable for characteristics of pertinent environmental and hygiene factor by each components analysed. The communality of environmental and hygiene factors with extraction value of 0.5 and above indicates high value significant component score. Among the 21 variables analysed, 20 variables recorded 0.9 extraction values and 1 variable recorded 0.8 extraction value. The entire variables studied recorded 0.8 and above extraction value. The implication is that there is significant discernible pattern of environmental and hygiene factor that affect diarrhea occurrence in the area. This shows that all the environmental and hygiene factors are vital in the monitoring and management of diarrhea occurrence in the area. The study was able to show that exclusive breast-feeding (0.999), boiling water (0.999), complimentary feeding (0.999), picking dirt (0.999), and water treatment (0.999) were the most crucial environmental and hygiene factor variables that affects diarrhea occurrence in the study area.

The result of varimax rotated component matrix of discernible pattern of environmental and hygiene factor is shown in Table no 4. The table highlighted the pertinent environmental and hygiene factors that are accountable for 97.695% total variance explained in this work.

Table no 4: Rotated Component Matrix of Discernible Pattern of environmental and hygiene factor

Variables	Component		
	1	2	3
Sw	-.136	.954	.198
Ww	-.141	.964	.184
Sw	-.114	.972	.171
Rw	-.104	.964	.189
Wv	-.112	.973	.175
Pl	-.107	.977	.166
Ws	-.124	.917	.089
Bm	-.183	.194	.939
VIP	-.159	.166	.961
Sw	-.147	.164	.972
Sd	-.150	.143	.972
Nd	-.155	.140	.975
Cf	-.146	.133	.976
Hw	-.014	.238	.903
Ebf	.984	-.116	-.132
Bw	.983	-.119	-.135
Wt	.984	-.117	-.136
Cfe	.984	-.113	-.135
Pd	.982	-.119	-.144
Ak	.985	-.103	-.131
Wb	.976	-.151	-.122

Extraction Method: Principal Component Analysis; Rotation Method: Varimax with Kaiser Normalization.^a

a. Rotation converged in 5 iterations.

(Source: Author's SPSS PCA, 2017) .

Sp = spring water, Ww = Well water, Sw = Stream water, Rw = Rain water, Wv = water vendor, Pl = Pit latrine, Ws = Water system latrine, Bm = Bush method, VIP = Ventilated improved pit latrine, Sw = Solid waste disposal, Sd = Standard dust bin, Nd = No dust bin, Cf = Contaminated food, Hw = Hand washing, Ebf = Exclusive Breast feeding, Bw= Boiling drinking water, Wt = Water treatment, Cfe = Complimentary feeding, Pd = Picking dirt by babies, Ak = Animal having access to the kitchen, Wb = Washing of breast before feeding baby.

The varimax rotation reduced the 21 environmental and hygiene factors used in the analysis to 3 components of pertinent environmental and hygiene factors which included components 1, 2 and 3. The pertinent environmental and hygiene factor in component 1 are exclusive breast- feeding, boiling water, water treatment, complimentary feeding, picking dirty, animal in kitchen and washing of breast before feeding. These factors in component 1 have to do with hygiene of mothers and children. The pertinent environmental and hygiene factors in component 2 are spring water, well water, stream, rain, water vendor, pit latrine and water system. These factors in component 2 were tailored towards provision of water. While the pertinent

environmental and hygiene factors in component 3 are bush method, VIP Latrine, solid waste, standard dust bin, No dust bin, contaminated food and hand wash which are more of waste disposal factors.

The entire pertinent environmental and hygiene factor in component 1, 2 and 3 records 0.9 values. Hence these three high loading pertinent environmental and hygiene factor in component 1, 2 and 3 are known as derived parameter. The components of the derived parameter are related, consequently named Environmental and Hygiene Variables.

IV. Discussion

The findings showed that there is a significant discernible pattern of environmental and hygiene factors affecting diarrhea occurrence in the study area (total variance explained = 97.695% and communality extraction value ranges from 0.8 and above among all the environmental and hygiene factors variables studied). This implies that environmental and hygiene factors has a discernible pattern as measured by total variance explained (97.695%). The result of varimax rotation also shows the derived parameter that is responsible for the discernible pattern of environmental and hygiene factors in the study area. The study observed that the Environmental and Hygiene variables actually contribute to incidence and magnitude of diarrhea occurrence in the study area. The variables of environmental and hygiene factors affecting diarrhea occurrence studied includes: major source of water supply, rating of water treatment, excreta disposal method, dust bin type, accessibility of domestic animal to kitchen, extent of baby exclusive breast-feeding, age baby is fed with complimentary food, boiling drinking water for child, baby picking things from ground and putting in the mouth and hand washing before breast-feeding. The study was able to show that the most crucial among all the environmental and hygiene factor variables studied that contribute to occurrence of diarrhea are breast-feeding, boiling water, complimentary feeding, picking dirty things and putting in the mouth by babies and water treatment in the study area. The varimax rotation reduced the 21 environmental and hygiene factors used in the analysis to 3 components of pertinent environmental and hygiene factors which included components 1, 2 and 3. This shows that improvement in the Environmental and Hygiene Variables which can be achieved through personal hygiene of mother and child (component 1), adequate potable water supply (component 2), and proper waste management (component 3), are major ways to preventing diarrhea occurrence. This result is similar to ¹⁰ who worked on demographic and socio-economic factors associated with diarrhea morbidity in children under five in rural Malawi a study of Solola-Mzimba. An observational guide was used to gather more information regarding environmental factors. About 60% (182/302) of children were living in an environment of an overall poor sanitation /rubbish disposal; 72.1% 217/301 in that of poor food hygienic related practices; and 80.4% 242/251 in that of poor drinking water handling practices, low education and poor knowledge about diarrhea among others, inadequate breast-feeding, poor care of hands after defecating, shorter distance to latrine from house, sharing of latrines, unsafe disposal of feces /garbage, unsafe water source, sharing hand-washing water at meals, and unclean kitchen were significantly associated with diarrhea morbidity in the children. The unavailability of safe water, lack of knowledge and having been used to not treating water before use, laziness and not being used to using a rubbish pit and gender were the main reason among mothers for not using good practices regarding water and sanitation / rubbish disposal. Both studies were done in relation to diarrhea among children less than five years and pointed out some environmental and hygiene factors affecting diarrhea occurrence. In the present study, poor food hygiene related to contaminated food, lack of exclusive breast-feeding, unsafe disposal of feces and not treating water are all significant factors that affect diarrhea in Enugu State as in rural Malawi. ¹¹ commented that reduction in morbidity for diarrhea, trachoma, and *ascariasis* induced by water supplies and/or sanitation was 26%, 27%, and 29%, respectively. ¹² worked on the socio-economic and environmental determinant of diarrhea morbidity in Pakistan. The findings suggest mothers should be given awareness about personal hygiene, and specially of preparing complimentary food for children. This concurs with the findings of the present study where personal hygiene of mothers has been identified to be important factor in prevention of diarrhea in Enugu State. ¹³ carried a study on infant feeding practices, socio-economic conditions and diarrheal disease in a traditional area of urban Ilorin, Nigeria. Logistic regression analysis identified 5 variables that were significantly associated with diarrheal disease: child's age (P 0.01) Parity (P.0.05) Mother's education (P.0.05) household availability of a kitchen (P.0.01), and the feeding of semi solid foods (complimentary food) (P.0.05). The present study used Principal Component Analysis and showed that exclusive breast-feeding (0.999), boiling water (0.999), complimentary feeding (0.999), picking dirt (0.999), and water treatment (0.999) were the most crucial environmental and hygiene factor variables that affects diarrhea occurrence in Enugu State, Nigeria.

V. Conclusion

There is significant discernible pattern of environmental and hygiene factor that affect diarrhea occurrence in Enugu State. The communality of environmental and hygiene factors with extraction value of 0.5 and above indicates high value significant component score. The entire variables studied recorded 0.8 and above

extraction value. This shows that all the environmental and hygiene factors are vital in the monitoring and management of diarrhea occurrence in the area.

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