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Socio-economic Correlates of Intestinal Helminthiasis Infestation in Children with Human Immunodeficiency Virus Presenting in the University of Nigeria Teaching Hospital, Ituku-ozalla, Enugu

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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

Background: Children infected with Human Immunodeficiency virus (HIV) may be more prone to helminthic infestation and this may be modified by their socio-demographic and hygiene-related variables.

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Objectives: This study was aimed at eliciting the various socioeconomic correlates that affect helminth infections among children with HIV and comparing it with their normal counterparts who had no HIV.
Methods: A cross-sectional study where a total of 140 subjects including 70 HIV-infected children and 70 children without HIV infection. They were consecutively recruited from the Paediatric HIV clinic and matched for age and sex with**.**
Results: Socio-economic class, area of residence, hygienic practices such as method of feacal disposal, hand washing practices and footwear practices were significantly associated with helminthic infestation at the bivariate level of analysis ($p < 0.05$). Using bivariate analysis, of the independent variables that were significant at the bivariate analysis, only lower socioeconomic class was an independent predictor of helminthic infestation (AOR = 6.403, 95% CI: 1.303 to 31.469)
Conclusion: Socio-demographic and hygiene-related risk factors are similar in HIV-positive and negative children. However, lower socioeconomic status is an independent predictor of helminthic intestinal infestation after controlling for potential confounders such as age and gender.

Keywords: Enugu; helminthic intestinal infestation; HIV; socio-demographic.

1. INTRODUCTION

Intestinal helminthiasis [IH] affects all age groups, though children are predominantly affected [1]. Among these children, preschool and school-aged children are at the highest risk of severe morbidity from the disease [1]. Over 267 million preschool-age children and 600 million school-age children are infested with intestinal helminths worldwide [2]. Important determinants in epidemiology and transmission of IH are climatic factors, poverty, inadequate water supply, poor sanitation, and poor personal hygiene, especially shoe wearing and hand washing [3,4].

The World Health Organization has noted helminthiasis as one of the neglected tropical diseases with over 2 billion (24%) of the world's population and are endemic in the poor socioeconomic zones such as tropical and subtropical climatic regions across East Asia [2,3]. Several socioeconomic and geographical factors have been implicated in helminthiasis. These include poverty, unsanitary conditions, lack of clean water supply, and climatic changes [5]. More than 38 million people globally are infected with HIV, and most of them live in low and middle-income countries with poor socioeconomic status [6-8]. It is pertinent to note that both HIV and helminth infections are highly interwoven in terms of the manner of transmission. There is even a co-infection between them [5-8].

Okyay et al [9] have noted that improving mothers' education, a vital index of socioeconomic factors, has a positive impact on reducing helminth infestation in children. They noted this factor as the cause of a low prevalence of helminth infestation obtained in their various studies. It is interesting to note that helminth infestation is noted as a disease of poverty with poor hygiene and environment [10]. This work was therefore aimed at eliciting the various socioeconomic correlates that affect helminth infections among children with HIV and comparing it with their normal counterparts who had no HIV.

2. METHODS

2.1 Study Area

This study was carried out in Enugu, at the University of Nigeria Teaching Hospital (UNTH), Many health facilities (primary, secondary, tertiary) exist in the state of which UNTH is the largest and serves as a referral centre.

2.2 Study Sites

The study was conducted at the paediatric HIV clinic of UNTH. The clinic provides trained personnel for children infected with HIV. The Paediatric section of the clinic caters for both the HIV-exposed and HIV-infected children. Controls were recruited from apparently healthy children who attended the outpatient clinic for check-ups or minor illnesses.

2.3 Study Design

This was a comparative, cross-sectional study that involved consecutively enrolling children infected and uninfected with HIV.

2.4 Sample Size Determination

Using the formula;

$$n = \frac{[\, p1(1-p1) + p2(1-p2) \,] \times Cp\ power}{(p1 - p2)}$$

Where
n = number of subjects required in each group
p1 and p2 = prevalence proportions in the two groups from an existing study (28.6% and 20.2% respectively) [4,5].

Cp power = constant defined by the values chosen for the P value and power.

The minimum sample size for this study was calculated using the standard statistical formula for sample size calculation comparing differences in proportions (equal-sized groups) in a finite population. 70 subjects and 70 controls were enrolled into the study, giving a total sample size of 140.

2.5 Study Population

- **Subjects:** HIV-positive children aged 18 months to 18 years attending the Paediatric HIV clinic at the UNTH Ituku-Ozalla, Enugu.
- **Controls:** HIV-negative and healthy children attending the paediatrics outpatient clinic for routine follow-up.

2.6 Inclusion Criteria

- Children aged 18 months – 18 years.
- Confirmed HIV infection through HIV antibody or DNA polymerase chain reaction (PCR) tests.
- Not taken anti-helminthic medication in the past three months before the study.
- HIV-positive children who gave their assent or whose caregivers gave their consent for the study.

2.7 Exclusion Criteria

- Children aged less than 18 months.

Chronically ill children, such as those with malignancies.

Participation in the study was voluntary and participants had the right to withdraw at any time without repercussions. Subjects who met the inclusion criteria were enrolled consecutively on clinic days until the desired sample size was obtained. They were they approached while waiting for their clinic appointments.

HIV-negative children were selected from those who presented to the children's outpatient clinic for acute illnesses or medical examinations (such as a medical certificate of fitness). The participants were recruited consecutively by the researcher alone at a rate of ten per week till the required number for each group was filled. The parent's socio-economic classification of the subjects and controls were obtained using the social classification of Oyedeji [11]. In this classification, the educational level and the occupation of the caregivers were scored and the average of these scores, to the nearest whole number was noted. Each parent was scored separately by finding the average score of the two factors (occupational status and educational attainment) in the social classification. The mean of the scores for the father and mother approximated to the nearest whole number was chosen as the social class of the child.

2.8 Data Management and Analysis

Analysis of the results was done using the Statistical Package for the Social Sciences (IBM-SPSS), version 19. Descriptive analysis was used to compare the sociodemographic distribution of the subjects. Logistic regression was used to test for the strength of the relationship between socioeconomic variables and intestinal helminthiasis and HIV status. Chi-square and Fisher's exact were used to test for association between categorical variables.

3. RESULTS

3.1 Socio-demographic Characteristics of the Study Participants

The socio-demographic characteristics of the study participants are shown in Table I. The table shows that the two groups (i.e., HIV-infected, and HIV-negative children) were similar in age and gender ($p = 1.00$). Also, the distribution according to socio-economic status showed no significant difference ($p = 0.057$).

Hygiene-related and socio-demographic risk factors associated with intestinal helminthic infestation in HIV-positive and HIV-negative children: The hygiene-related and socio-demographic risk factors associated with intestinal helminthic infestation are shown in Table 2. Age, gender, social class and residential area distributions were similar between infested

HIV-positive and HIV-negative children ($p > 0.05$ in all cases, which is insignificant). Also, hygiene-related practices were similar among children infested with helminths irrespective of HIV status ($p > 0.05$ in all cases which is insignificant).

Socio-demographic and hygiene-related risk factors associated with intestinal helminthic infestation in HIV-positive and HIV-negative children: As already demonstrated in Table 3, the distribution of sociodemographic and hygiene-related variables among children with helminthic infestation was similar between HIV-infected and non-infected children. Thus, both groups were combined in Table 4 to test those variables as potential risk factors for infestation.

Table 1. Socio-demographic characteristics of the study participants

	HIV Status			
	Positive n (%)	Negative n (%)	χ^2	p-value
Median Age in mths (IQR)	*120.00 (123.00)*	*120.00 (123.00)*	*0.000**	*1.000*
Age group in mths				
18 – 59	17 (24.30)	17 (24.30)	0.000	1.000
60 – 119	17 (24.30)	17 (24.30)		
120 – 179	18 (25.70)	18 (25.70)		
180 – 216	18 (25.70)	18 (25.70)		
Sex				
Male	38 (54.30)	38 (54.30)	0.000	1.000
Female	32 (45.70)	32 (45.70)		
Socioeconomic class				
Lower	47 (67.10)	36 (51.40)	5.737	0.057
Middle	11 (15.70)	23 (32.90)		
Upper	12 (17.10)	11 (15.70)		

**=Mann-Whitney U-test. Mths=Months. IQR = Interquartile Range*

Table 2. Hygiene-related and socio-demographic factors associated with the presence of intestinal helminthic infestation in the participants

	HIV-Status		p-value
Variables	HIV-Positive n (%)	HIV-Negative n (%)	
Sociodemographic Age (months)			
18-59	1(5.30)	2(22.22)	0.595*
60-119	9(47.40)	3(33.33)	
120-179	6(31.60)	3(33.33)	
180-216	3(15.70)	1(11.11)	
Gender			
Female	10(52.6)	3(33.3)	0.435*
Male	9(47.4)	6(66.7)	
Social Class			
Upper/Middle	2(10.50)	0(0.00)	1.000*
Lower	17(89.50)	9(100.00)	
Area of Residence			
Rural	10(52.60)	6(66.70)	0.435*
Urban	9(47.40)	3(33.30)	
Hygiene-related Use of footwear			
Uses always	15(78.90)	7(77.80)	1.000*
None or rarely use	4(21.10)	2(22.20)	
Source of drinking water			
Underground water + Sachet water	8(42.10)	5(55.60)	0.846*
Shallow water	9(47.40)	3(33.30)	
Rain water	2(10.50)	1(11.10)	
Boil drinking water			
Always	0(0.00)	0(0.00)	NA
None or rarely	19(100.00)	9(100.00)	

**Fisher's Exact Test, NA=Not applicable, Underground water source include well, pipe-borne, sachet and bore-hole water, shallow water source include stream.*

Table 3. Socio-demographic and hygiene-related risk factors associated with intestinal helminthic infestation among the study participants

Variables	N	Intestinal Helminthiasis Infested n (%)	Not infested n (%)	Test stat	p-value
Median Age in months (IQR)	*140*	*108.0 (84.0)*	*120.0 (132.0)*	*U=1544.0*	*0.900*
Gender				χ^2=0.007	0.932
Male	76	15 (53.6)	61 (54.5)		
Female	64	13 (46.4)	51 (45.5)		
Socio-economic Status					<0.001*
Lower	83	26 (92.9)	57 (50.9)		
Middle /Upper	57	2 (7.1)	55 (49.1)		
Area of Residence				16.565	<0.001
Rural	27	13 (46.4)	14 (12.5)		
Urban	113	15 (53.6)	98 (87.5)		
Method of faecal waste disposal				6.069	0.014
Water cistern or pit)	113	18(64.3)	95(84.8)		
Bush	27	10(35.7)	17(15.2)		
Hand washing after toilet					0.025*
Always	136	25(89.3)	111(99.1)		
None or rarely	4	3(10.7)	1(0.9)		
Hand washing before food preparation					<0.001*
Always	112	15(53.6)	97(86.6)		
None or rarely	28	13(46.4)	15(13.4)		
Hand washing before eating				6.117	0.013
Always	97	14(50.0)	83(74.1)		
None or rarely	43	14(50.0)	29(25.9)		
Use of footwear					<0.001*
Always	133	22(78.6)	111(99.1)		
None or rarely use	7	6(21.4)	1(0.9)		
Boiling drinking water					0.600*
Always	6	0(0.0)	6(5.4)		
None or rarely	134	28(100.0)	106(94.6)		
Source of drinking water					0.058*
Underground water		13(46.4)	74(66.1)		
+ Sachet water	87	12(42.9)	35(31.2)		
Shallow water	47	3(|10.7)	3(2.7)		
Rainwater	6				

**=Fisher's Exact Test, IQR=Interquartile range, U=Mann-Whitney U-test, OR=Odd Ratio, CI=Confidence Intervals, Underground water source include well, pipe-borne, sachet and bore-hole water, shallow water source include streams*

Table 4. Logistic regression of the independent predictors of infestation among study participants

Variables	Wald	Adjusted Odds Ratio (AOR)	95% CI	p-value
Socio-economic Status				
Lower	5.223	6.403	1.303 – 31.469	0.022
Middle/Upper	Reference category			
Area of Residence				
Rural	0.966	1.894	0.530 – 6.765	0.326
Urban	Reference category			
Hand Washing After Using the Toilet				
None or rarely	2.641	7.924	0.653-96.160	0.104
Always	Reference category			
Hand Washing Before Meal Preparation				
None or rarely	3.694	3.079	0.978-9.693	0.055

Variables	Wald	Adjusted Odds Ratio	95% CI	p-value
Always	Reference category			
Hand Washing Before Feeding				
None or rarely	0.076	1.165	0.395-3.430	0.782
Always	Reference category			
Use of Footwear				
None or rarely	3.236	9.237	0.819-104.116	0.072
Always	Reference category			
Toilet Facility				
Bush	0.469	0.620	0.158-2.433	0.493
Water Cistern/Pit	Reference category			

Dependent variable = helminthic infestation, CI = Confidence Interval, AOR = Adjusted Odds Ratio

Socio-economic class, area of residence, hygienic practices such as method of faecal disposal, hand washing practices and footwear practices were significantly association with helminthic infestation at the bivariate level of analysis ($p < 0.05$).

Next, logistic regression analysis was applied to test the independence of risk factors identified on bivariate analysis. Table 4. Of the independent variables that were significant in the bivariate analysis, only lower socio-economic class was an independent predictor of helminthic infestation (AOR = 6.403, 95% CI: 1.303 to 31.469). $P < 0.05$ shows statistical significance.

4. DISCUSSION

4.1 Prevalence of Socio-demographic Characteristics

The prevalence of socio-demographic characteristics was largely similar between helminth-infected and helminth-uninfected groups. A lower frequency of food shortage within the previous month was reported by helminth-infected persons [12]. With regard to the risk factors for infestation, the present study found similar socio-demographic and hygiene-related risk factors in HIV-positive and negative children. In other words, the vulnerability factors to helminthic infestation are similar irrespective of the HIV status. The implication is that universal preventive strategies for helminthic infestation in the general population will suffice for HIV-positive children [12-14]. Interestingly, of all the socio-demographic and hygiene-related risk factors studied, only lower socioeconomic class independently predicted helminthic infestation after adjusting for potential variables. Similar findings were also observed by Boaitey et al. [15] who noted that no variables that measured personal hygiene, such as socioeconomic status such as income, employment, or housing conditions are predictive of helminth status [15].

4.2 Role of Socioeconomic Status

Using a Logistic regression analysis and odd ratios, a study has also shown no statistically significant findings on risk of infection and their educational levels, marital and employment statuses [16-18]. In the contrary, a reportage in Argentine and Brazilian studies had shown that subjects who had spent time in a rural area were at increased risk of having helminths in their stool [19-20]. They also noted that factors such as diminished food supply and illiteracy were risk factors for helminth infection. The differences observed in the reportage above and that of ours could be explained by the differences in study populations, methodologies, and geographic locations.

These results seen above negate findings seen in other studies where a negative correlation between measures of socioeconomic status and risk of helminth acquisition was postulated [20-23]. Some studies had however explained that it is possible that subjects of lower socioeconomic status were more likely to be subjected to routine mass deworming than those from richer homes and thus present with a low prevalence of helminthiasis.

This is understandable as socioeconomic class is a measure of parental education and occupation, which indirectly indicates economic advantage. In other words, individuals from lower economic classes are widely exposed to indices of social disadvantage such as living in rural or urban slums and having little or no access to pipe-borne water and adequate toilet facilities [17-20]. It is important to note that when our indices for the hygienic status of HIV infected and controls were subjected to bivariate analysis, only socioeconomic factors were seen as the only predictive value for risk factors.

This study has also shown that though socioeconomic status plays a major role in determining the risk of helminth infection in subjects and control, age, gender, and residential area distributions were similar between infested HIV-positive and HIV-negative children when hygiene-related practices are taken into consideration. It is noted in this study that hygienic practices such as method of fecal disposal, hand washing practices and footwear practices were significantly associated with helminthic infestation among children with HIV infection. Uhaegbu et al. [23]. also documented the same finding. Lack of sanitary facilities and lack of health education are notable factors that facilitate the transmission of intestinal parasites, especially among HIV patients.

5. CONCLUSION

Socio-demographic and hygiene-related risk factors are similar in HIV-positive and negative children. However, lower socioeconomic status is an independent predictor of helminthic intestinal infestation after controlling for potential confounders.

6. LIMITATIONS

Potential sources of bias or confounding factors such as language, culture and possibilities of a participant having more than 1 strain of retro-viral infection may have influenced the result.

CONSENT AND ETHICAL APPROVAL

Ethical clearance from the Health Research and Ethics Committee of UNTH, Enugu was obtained before the commencement of the study. Signed informed consent/assent was obtained from the parents/guardians/participant following an explanation both verbally and in writing, of the purpose of the study, the technique used, the benefits and risks and the steps to be taken if anything abnormal was found.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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