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Household socio-economic status and the risk of HIV infection among under five-year children in Muheza district, north-eastern Tanzania

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Abstract

Background: There are pieces of evidence of the association between socioeconomic factors and HIV prevalence in sub-Saharan Africa. However, there is a dearth of information on such a relationship in Tanzania.

Objective: To determine the relationship between household socioeconomic factors and HIV prevalence among under five-year children in Muheza district, Tanzania.

Methods: A facility-based study among HIV-exposed children with their respective mothers/guardians was conducted from June 2015 to June 2016. Information on the HIV status of the child and household socio-demographic characteristics were analyzed in the STATA version 13.0.

Results: A total of 576 child-mother/guardian pairs were interviewed. Sixty-one (10.6%) children were confirmed to be HIV positive. The odds of HIV infection were found to be lower among children belonging to the heads of households with secondary and high levels of education (AOR = 0.5, 95% CI 0.2-0.9); *P*=0.04, those living in wealthier households (AOR = 0.5, 95% CI 0.3-0.9; *P*=0.03) and those whose mothers/guardians had good knowledge of HIV (AOR = 0.2, 95% CI 0.1-0.3; *P*<0.001) compared to their counterparts.

Conclusion: Children with heads of households having high educational levels and those from wealthier households were associated with reduced odds of acquiring HIV infection in Muheza district.

Keywords: socioeconomic; household; under five-year children; HIV; Tanzania

Background

As of the end of 2016, an estimated 2.1 million children worldwide were living with HIV, and over 90% of them were in sub-Saharan Africa including Tanzania (UNAIDS, 2017). In 2016, an estimated 1.4 million people in Tanzania were living with HIV and 18% of these infections were due to mother-to-child transmission (MTCT) (WHO, 2017). Maternal immunological status with a CD4 cell count of fewer than 200 cells/mm^3 near delivery, high maternal viral load, and advanced stage of maternal HIV infection have been observed to increase the risk of MTCT (Leroy *et al.*, 2002, Mock *et al.*, 1999).

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These risk factors operate through several dimensions of socioeconomic status (SES) such as occupation, marital status, education, income, and wealth (Bwana *et al.*, 2016, Duncan *et al.*, 2002, Mosley and Chen, 2003). Studies of social determinants of health have demonstrated a relationship between SES and health (Chen, 2004, Hanson and Chen, 2007). People with lower SES tend to have poorer health and often succumb to a dangerous cycle of impoverishment than those with higher SES (Hajat *et al.*, 2011, Wagstaff 2002). More so, without economic resources, individuals living in impoverished communities are naturally unable to meet their basic needs including inadequate service utilization (Hajat *et al.*, 2011). Children living in these communities are most vulnerable because their biological, cognitive, emotional, and social development are affected across the life course (Jensen *et al.,* 2017). These children are at high risk of many poverty complications including communicable diseases, non-communicable diseases, health risk behaviours, and premature death (Levesque *et al.*, 2021, Yoshikawa *et al.,* 2012).

A study by Cohen and Syme (2013) reported that many years of education/schooling is the strongest SES predictor for good health, signifying a higher risk for contracting diseases with few years of education. Similarly, higher education level attainment is reported to be associated with improved income, wealth, better health care, and lifestyle (Hayward *et al.,* 2015, Marmot, 2002, Winkleby *et al.*, 1992). All these pieces of evidence suggest that schooling is the major means by which individuals acquire knowledge, skills, and capacities necessary for future performance in occupation as well as useful for the prevention of disease (Duncan *et al.*, 2002, Kawachi *et al.,* 2010). Though the above has been established in the literature, few studies reported conflicting results regarding the relationship between SES and HIV prevalence in sub-Saharan Africa including Tanzania (Bloom *et al.*, 2002, Kwesigabo *et al.*, 2005, Msamanga *et al.* 2006, Todd *et al.*, 2006). Studies in Tanzania demonstrated that HIV prevalence was higher among, urban residents than among rural residents (Mnyika *et al.,* 1994); men and women in professional jobs than among agricultural workers (Msisha *et al.*, 2008); individuals with lower educational levels, and those not married monogamously (Kwesigabo et al., 2005). Likewise, women with more than five members per household, and those who spent less on food had a significantly lower HIV prevalence (Msamanga *et al.,* 2006), which will ultimately influence MTCT.

It has been claimed that in the early years of the HIV epidemic, the disease primarily affected highly educated and wealthy individuals (UNAIDS, 1998, Piot *et al.,* 2001). Later, over the years, as the HIV epidemic matured, the burden of HIV has been reported to be greater among the poorer and least educated populations (Bunyasi and Coetzee 2017, De Walque *et al.,* 2005, Michelo *et al.,* 2006). Few countries in sub-Saharan Africa have documented an association between increased infection among poor groups, suggesting the need for urgent intervention UNAIDS, 2018). Higher education level attainment has been associated with decreased risk of HIV infection, especially among younger people in Ethiopia, Zambia, Uganda, and Tanzania (Bradley *et al.,* 2007, Fylkesnes *et al.,* 1997, Kilian et al., 1997, Mmbaga *et al.,* 2007). Evidence in support of the positive impact of education on better health outcomes is mounting (Choudhury, 2015, Fuchs *et al.,* 2010), most of which suggest that education attainment imparts similar influences on HIV burden, reduced child mortality, and increased survival. In addition, increased levels of HIV knowledge were found to be associated with a reduced risk of HIV infection (Barden-O'Fallon *et al.,* 2004), suggesting the need for strengthening health promotion campaigns in the fight against HIV/AIDS (Li *et al.,* 2004). Little is known about the association of the households' SES with the HIV prevalence of under five-year children in Tanzania. This relationship must be investigated to understand factors influencing pediatric HIV. This study was therefore carried out to determine the relationship between the households' SES and the likelihood of acquiring HIV infection among under five-year children in Muheza district, Tanzania.

Methods

Study area, design, and population

This facility-based study was carried out from June 2015 to June 2016 in Muheza district, north-eastern Tanzania (4°, 45'S; 39°00'E). The district has 116 primary schools and 31 secondary schools (MDC, 2017). It has a total of 46 health facilities, including one hospital, four health centres, and 41 dispensaries. More than 79% of households in the district are involved in agriculture as the main source of livelihood and income (MDC, 2017). The main crops produced include maize, cassava, banana, oranges, coconuts, black paper, cloves, cinnamon, and tea. The remaining proportions include small-scale traders, fishermen, and livestock keepers. The study populations were selected based on the following criteria: Mother/guardian with an under five-year child born to an HIV-positive mother and who agreed to participate, and under five-year child with a confirmed HIV test result. All HIV-exposed under five-year children who were not permanent residents of Muheza district were excluded from the study.

Sampling and sample size determination

The participants were selected by using multistage sampling. First, the district was chosen purposively for the entire study as being among the leading districts with high HIV prevalence among pregnant women in Tanga Region (MoHCDGEC, 2016). Secondly, a list of health facilities (N=46) that serve as Primary Sampling Units (PSUs) was obtained according to their geographical location from the district authority. All health facilities were listed by name and numbered from 1 to 46 (N), and 18 health facilities that provide EID services were randomly selected systematically from this list at regular intervals by applying a sampling interval determined in advance. At each health facility, a list of HIV-exposed under five-year children was obtained from the registers/database before the initiation of data collection. The list was numbered and all eligible under five-year children each with their respective mother/guardian were selected randomly by using the lottery method and enrolled based on the inclusion criteria.

The sample size was calculated based on the formula that accounted for simple random sampling and the design effect which account for between and within-cluster variation (Gorstein *et al.,* 2007). The average size for a cluster was estimated at 20 mother/guardian-child pairs and an intraclass correction was estimated at 0.05 (Finocchario-Kessler, 2015). With the number of clusters available, the design effect was adjusted by a factor of 2, at a 95% Confidence interval (CI) and the desired level of absolute precision was taken at 5%. Based on available statistics, transmission rates of HIV from mother to child range between 20 and 45% (De Cock *et al.,* 2000). We assumed the highest exposure of infection risk and a response rate of 90%, thus the estimated sample size was 830 children. Initially, each cluster's minimum number of mother/guardian-child pairs was set at 20. But, the proportion to size was employed based on the estimated total number of HIV-exposed under five-year children at a particular health facility. Details of this study have been described elsewhere (Bwana *et al.,* 2018).

Data collection

Socio-demographic characteristics of the mother/guardian-child pairs such as HIV knowledge, marital status, occupation as well as the size of the household, and proxy variables for household wealth were collected using a structured questionnaire. The household's wealth was measured based on the four key questions; the type of house roofing materials, the main source of fuel used for cooking, land ownership, and electricity availability. Mother/guardian's knowledge of HIV transmission including Prevention of mother-to-child transmission of HIV (PMTCT) and MTCT was measured based on the four key questions that addressed general MTCT knowledge; prevention of MTCT; timing of

post-exposure prophylaxis to HIV-exposed infants and factors affecting HIV transmission. Information on the HIV status of the children was extracted from the database available at the district hospital. Data on education level was based on the Tanzanian system of 7 years of primary education, 4 years of ordinary secondary education (ordinary level), and 2 years of high (advanced) secondary education. After ordinary/advanced secondary education, individuals meet the minimum requirements for college education or university education (MoEST, 2018).

Data management and analysis

Data were entered into the database developed in EpiData Software (version 3.1, EpiData Association, Odense, Denmark). Data checks and cleaning were done by taking a percentage of entered data and compared with the original data and any discrepancy observed was clarified by editing the data. The process continued until all data were compared. The cleaned dataset was exported into STATA version 13 statistical package (Stata Corporation College Station, Texas, USA) for analysis. Data were summarized using descriptive statistics and graphical summary, whereby, continuous variables were described using median and interquartile range (IQR), and categorical variables were described using frequencies and percentages. The child's HIV status was categorized into a binary outcome variable: 'HIV-positive' or 'HIV-negative'. Education level attainment (measured as the number of formal school years attended) was categorized into a binary outcome: 'low education' or 'high education. Low education level was recorded as ≤7 years of schooling and high education as >7 years of schooling. In this study, the size of the household was categorized into two: ≤7 people or >7 people living in the same household (MoFP, 2019).

A composite variable on a household's wealth was developed based on the four key questions by the use of recording and compute commands to form a single unit composite variable with a binary outcome of 'high' or 'low'. The four variables combined to form the high or low wealth variable were derived from the four key questions recorded as desirable/yes = 1 and undesirable/no = 0 as follows; (i) the main fuel used for cooking, charcoal/gas/electricity = 1; wood = 0; (ii) the roofing materials used for the house construction, iron sheets or tiles = 1; thatch or grass = 0; (iii) availability of electricity/solar energy for lighting in the house, present = 1; absent = 0; and (iv) ownership of land, yes = 1; no = 0. Similarly, a composite variable on knowledge of HIV was developed based on four key questions combined to yield a unit composite variable with a binary outcome 'good' or 'poor'. The four variables combined to form good or poor knowledge were derived from the four key questions recorded as desirable/yes = 1 and undesirable/no = 0 as follows; (i) MTCT can occur and can be prevented, yes = 1; no = 0; (ii) MTCT can be prevented by taking anti-retroviral (ARV) drugs during pregnancy, yes = 1; no = 0; (iii) HIV can be transmitted in utero, during delivery, and through breastfeeding, yes = 1; no = 0; (iv) post-exposure prophylaxis to HIV exposed infant should be given soon after birth within 6-12 hours postdelivery, yes = 1; no = 0. The development of a composite variable for high or low wealth and good or poor knowledge of HIV comprised all four data elements as described above. There were no variables that were left out during the selection of the key questions for the proxy variables for the household wealth and guardians' knowledge of HIV.

Binary logistic regression was done and all factors with p-values of ≤ 0.2 including Priori factors were considered for multiple variable logistic regression analysis. Multiple logistic regression analyses were used to examine the associations between various household socio-economic factors and the child's HIV infection status. The Backward Logistic Regression method was employed by removing non-significant variables with the highest *P*-value (one at a time) until the remaining variables in the final model have P-values of ≤ 0.05. The goodness of fit of the final model was tested using the likelihood ratio test. The final model was fitted for the household socio-economic factors associated with HIV infection among under five-year children. This modal consisted of statistically

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significant variables at a *P* value of ≤ 0.05. Adjusted odds ratios (AOR) with their corresponding 95% confidence interval (CI) and *P* value were estimated and presented.

Ethics statement

Ethical approval was obtained from the national review board of the National Institute for Medical Research in Tanzania with reference number NIMR/HQ/R.8a/Vol. IX/1978. Permission to conduct this study was granted by Muheza District Authority. Written informed consent was obtained from each mother/guardian before recruitment.

Results

Socio-demographic characteristics of the respondents

A total of 576 mothers/guardians each with HIV exposed under five-year child were interviewed. Of the 576 under five-year children, 281 (48.8%) were males. A total of 379 (65.8%) under five-year children were aged ≤ 24 months and 197 (34.2%) were aged 25 - 59 months. The median age of the 576 children was 15 months (IQR: 8.5 to 38.0 months). More than half (n=309) of under five-year children were living far (more than 30 minutes' walk on foot) from a health facility. Sixty-one (10.6%) of the under five-year children were confirmed to be HIV positive whereas 46 (75.4%) belonged to the heads of households who had completed primary (7 years) level of education. Few (n=5, 8.2%) of the HIV-infected children belonged to the heads of households who had completed more than 7 years of schooling (secondary and high level of education). The proportion of HIV-positive children was decreasing with increasing the number of years of education of the head of household (Figure 1). The majority (82.1%, n=473) of the head of households had completed primary (7 years) level education (Figure 1). A total of 445 (73%) heads of households were living in rural areas. Out of 576, 70.1% (n=404) of the heads of households were male and 98.8% (n=569) of the guardians were female. About two-thirds (67.5%) of the households were categorized to have a low wealth status while only a third (32.5%) were of high wealth status.

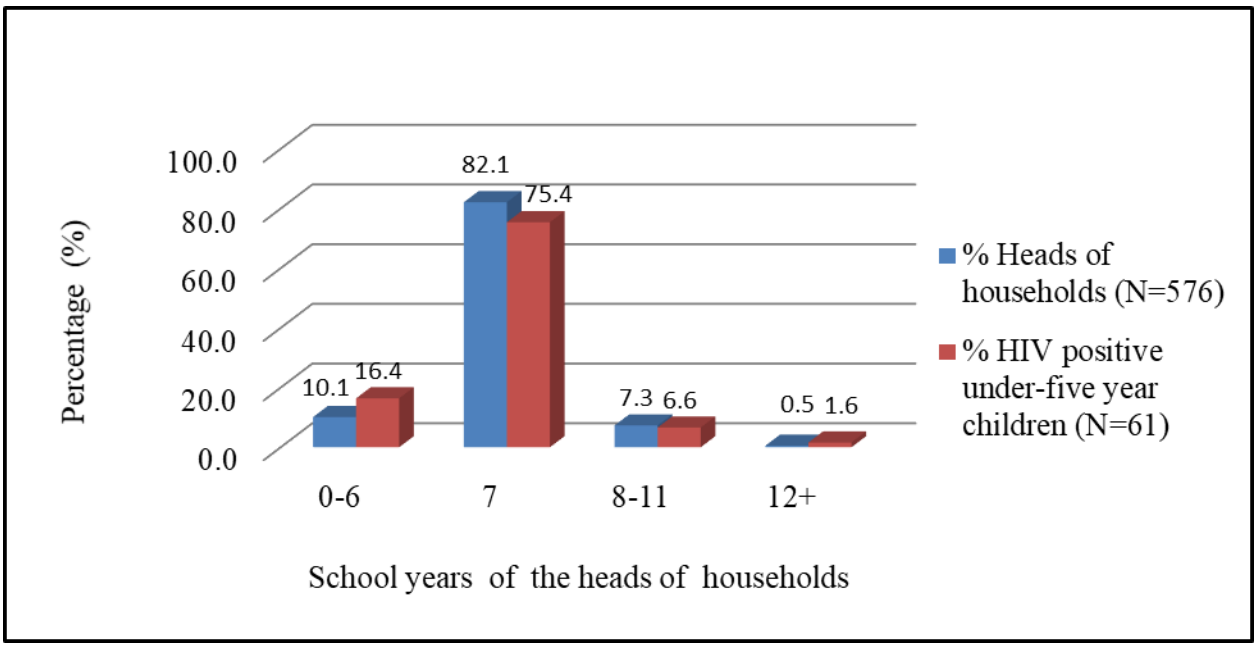

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Figure 1: Percentage of the heads of households and HIV-positive under five-year children by school year of the heads of households

Socio-economic factors associated with HIV infection among under-five year children

In multiple logistic regression, higher odds of HIV infection were observed among children aged more than two years (AOR = 4.5, 95% CI 2.4-8.5) than among the relatively younger children. The odds of HIV infection were 1.8 times higher among children living in rural (AOR = 1.8, 95% CI 1.0-3.5) than in urban areas. Likewise, the likelihood of HIV infection was three times higher among those who lived far from the health facility as compared to their counterparts who lived nearer (AOR = 3.3, 95% CI 1.7-6.6). The odds of HIV infection in children were lower (AOR = 0.5, 95% CI 0.2-0.9) among those with a head of household who had attained high education level and in those living in households with high wealth indices (AOR = 0.5, 95% CI 0.3-0.9). Children belonging to mothers/guardians with good knowledge of HIV had reduced odds of HIV infection (AOR = 0.2, 95% CI 0.1-0.3) compared to their counterparts who did not. The size of the household, mother/guardian's marital status, occupation, and education did not show a statistically significant association ($P>0.05$) with HIV infection among under five-year children (Table 1).

Table 1: Household's socio-economic factors associated with HIV infection among under five-year children

			Initial modal		Final modal	
	Unadjusted		Adjusted		Adjusted	
Characteristics	**OR (95% CI)**	**P value**	**OR (95% CI)**	**P value**	**OR (95% CI)**	**P value**
Child age (months)						
≤24	1.0		1.0		1.0	
25-59	5.1 (2.9-9.1)	<0.001	4.5 (2.4-8.7)	<0.001	4.5 (2.4-8.5)	<0.001
Child sex						
Female	1.0		1.0			
Male	1.2 (0.7-2.0)	0.5	1.3 (0.7-2.3)	0.4		
Residence						
Urban	1.0		1.0		1.0	
Rural	2.9 (1.2-6.9)	0.02	1.9 (1.1-3.6)	0.04	1.8 (1.0-3.5)	0.05
Distance to the health facility						
Near (≤30 minutes)	1.0		1.0		1.0	
Far (>30 minutes)	3.2 (1.7-6.0)	<0.001	3.2 (1.6-6.6)	0.001	3.3 (1.7-6.6)	0.001
Guardian knowledge of HIV						
Poor	1.0		1.0		1.0	
Good	0.1 (0.1-0.2)	<0.001	0.2 (0.1-0.3)	<0.001	0.2 (0.1-0.3)	<0.001
Guardian marital status						
Single/divorced/widow	1.0		1.0			
Married/living together	0.7 (0.3-1.5)	0.3	1.3 (0.5-3.2)	0.5		
Guardian education						
Low (≤7 school years)	1.0		1.0			
High (>7 school years)	1.8 (0.8-4.1)	0.3	1.2 (0.5-2.7)	0.5		
Guardian occupation						
Trading	1.0		1.0			
Formal employment	2.4 (0.5-10.3)	0.2	1.3 (0.2-6.2)	0.7		
Subsistence farmer	1.1 (0.5-2.4)	0.7	0.6 (0.2-1.3)	0.3		
Head of household education						
Low (≤7 school years)	1.0				1.0	
High (>7 school years)	0.5 (0.3-0.9)	0.02	0.4 (0.2-0.9)	0.03	0.5 (0.2-0.9)	0.04
Size of household						

https://dx.doi.org/10.4314/thrb.v24i1.10

≤7 people	1.0		1.0			
>7 people	1.2 (0.5-2.8)	0.6	0.7 (0.3-1.8)	0.4		
Household wealth						
Low	1.0		1.0		1.0	
High	0.6 (0.4-1.1)	0.1	0.5 (0.3-0.9)	0.03	0.5 (0.3-0.9)	0.03

Discussion

The findings of this study indicate that the odds of acquiring HIV infection among under five-year children in the district were low in children with heads of households having high educational levels, from wealthier households, and whose mothers/guardians had good knowledge of HIV. Also, it has been noted that children residing in rural areas and living far from the health facility were associated with increased odds of acquiring HIV infection than their counterparts.

Limited studies have shown the association between the SES of the household and the likelihood of HIV infection among children. However, education is one of the most important components of social and economic development (Wabiri, 2013). Education has positive spill-over effects where all people in the society benefit even if only a few of them have been educated (Hargreaves et al, 2008). The observed reduction in the likelihood of HIV infection among under five-year children in this study could be due to the adoption of preventive strategies for HIV/AIDS among highly educated members of the household (Hargreaves *et al,* 2008).

Studies in Uganda, Zambia, and Botswana have reported that the number of years one spends in school has an impact on the knowledge and ability to follow preventive strategies against HIV/AIDS transmission, and promotes better health outcomes and child survival in the community (De Neve *et al.,* 2015, De Walque *et al.,* 2005, Michelo et al., 2006). The effects of the household's SES on the risk of HIV infection of the under five-year children in this study are likely to be exerted through mediator factors which may influence their timely or untimely access to public health interventions (Boerma and Weir 2005, Hargreaves, 2002). It has been argued that a set of proximate determinants can be influenced by changes in socioeconomic determinants or by interventions that have a direct effect on biological mechanisms to influence the risk of morbidity and mortality among children (Mosley and Chen. 1984). This implies that educational attainment in itself cannot, however, be isolated from other socioeconomic factors on the grounds of HIV risk reduction.

Moreover, levels of knowledge, literacy, and education tend to be lower among the poor and individuals living in rural areas, and this has a considerable influence on the household's decisions concerning health-seeking behaviours (Filmer and Pritchett 1999). However, educational opportunities might be quite limited in rural areas with poor road infrastructures that make the formal school system difficult to enrol in. A previous study in Tanzania demonstrated increased HIV prevalence in a rural population with less-educated individuals being at increased risk of infection which can influence mother-to-child transmission of HIV (Currie, 2009). In addition, studies in Ethiopia, Tanzania, and Rwanda have reported that children living in rural areas are more prone to home deliveries that predispose them to HIV infection (Koye and Zeleke 2013, Mwendo *et al.,* 2014, Ruton et al., 2012). This could be attributed to the inaccessibility of health promotion messages regarding HIV/AIDS prevention in rural compared to urban settings or women's non-participation in household decision-making to access health-related information and services, particularly in male-headed households. Strategies to increase levels of HIV knowledge will play a vital role in the reduction of the risk of acquiring HIV infection in the community including children (Barden-O'Fallon *et al.,* 2004). Strengthening health promotion campaigns in the fight against HIV/AIDS particularly in rural areas is very crucial. The strategy will enhance awareness and increase access to PMTCT interventions to reduce the MTCT of HIV (Li *et al.,* 2004).

Studies have shown a strong association between education and health, which entails that the smaller the number of years of schooling the higher the risk of contracting diseases (Hayward *et al.,* 2015, Marmot, 2002, Winkleby et al., 1992). Similarly, the high education level achieved by individuals has been noted to be associated with high household wealth; improved income, health outcomes, and lifestyle behaviours (Wagstaff, 2002, Filmer and Pritchett 1999, Sianesi and Reenen 2003). In this study, the high education level of the heads of households and the high household wealth have been associated with reduced odds of acquiring HIV infection among under five-year children. In addition, the proportion of HIV-positive children was decreasing with increasing the number of years of schooling of the head of household.

More-educated individuals are most likely to have more income and thus more control over their living, which will have an impact on paediatric health outcomes (UNAIDS 1998). They are likely to place a higher value on future endeavours and thus be more motivated to adopt preventive measures, particularly against infectious disease risks, and safeguard their health-seeking behavioural patterns (Jukes *et al.,* 2008, Dinkelman *et al.,* 2007). This suggests that a convincing interaction does exist between education, wealth, and the risk of acquiring diseases among family members including children. Moreover, higher income at the household level is interrelated to higher educational attainment and better health outcomes which are attributed in part to frequent and more intensive use of health services in both private and public health sectors (Castro *et al.,* 2000). A recent study in South Africa reported a decreased risk of HIV infection among individuals living in less poor households and having tertiary education (Mabaso *et al.,* 2018). This indicates that strategies that enhance the provision of quality education to every individual are highly recommended to bring positive health outcomes to the whole society including the paediatric population.

The study had some limitations. These include the possibility that our results could have been affected by unmeasured confounders, which cannot be eliminated. Since some variables may not fully be adjusted during analysis, especially when dealing with proxy variables for household wealth which might be subjected to misclassification. The findings could also be affected by a shortfall of 30% of the estimated sample size of the study. This study was facility-based and hence did not include the entire community.

Conclusion

Children with heads of households having high educational levels, those from wealthier households, and belonging to mothers/guardians with good knowledge of HIV were associated with reduced odds of acquiring HIV infection among this paediatric population in Muheza district. Under five-year children located in rural areas had an increased likelihood of acquiring HIV infection than those living in urban areas. These findings emphasize the need for economic empowerment of the people as well as advocacy for continued education and optimizing sufficient knowledge of HIV at the household level as strategies for HIV prevention and control.

Competing interests

The authors declare that they have no competing interests.

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