

Prevalence and Factors Associated with Undernutrition Among HIV-Exposed Under Five Children in Two HIV Treatment Centers in Ngaoundere, Cameroon

Hidayatou Mohamadou¹, Tendongfor Nicholas^{1,*}, Kibu Odette Dzemo¹, Yenshu Emmanuel Vubo²

¹Department of Public Health and Hygiene, Faculty of Health Sciences, University of Buea, Buea, Cameroon

²Faculty of Social and Management Sciences, University of Buea, Buea, Cameroon

Email address:

Hidayahindou10@yahoo.fr (H. Mohamadou), ntendongfor@gmail.com (T. Nicholas), yayaodette@yahoo.com (K. O. Dzemo), emmanuel.yenshu@ubuea.cm (Y. E. Vubo)

*Corresponding author

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Abstract: *Background:* Human immunodeficiency virus (HIV) infection and undernutrition are still two major health issues in sub-Saharan Africa. Our study assessed the prevalence and associated factors of undernutrition among under-five children born to HIV-positive mothers. *Methods:* A hospital-based cross-sectional study was carried out in two HIV treatment centers in Ngaoundere (Regional and Protestant Hospitals), Cameroon. A structured questionnaire was used to collect data on socio-demographics of mothers infected with HIV and their children as well as clinical characteristics. Anthropometric measurements were collected from randomly selected 251 under-five HIV-exposed children. The data was analyzed in SPSS version 26. The prevalence of wasting, stunting and underweight were estimated and factors associated determined using a logistic regression analysis. The prevalence of undernutrition among under-five HIV-exposed children was 38% with 83 (33.4%) stunted, 35 (14.3%) underweight and 30 (12.1%) wasted. Wasting (15%) and underweight (11.6%) were high among girls compared to boys who had a high prevalence of stunting (35%). The odds of children from mothers with no education level developing undernutrition was 3.42 times higher (AOR 3.42; 95% CI: 1.21-10.27; $p=0.032$) than in those with secondary school level. The odds of children from Muslim (AOR= 0.12; 95% CI: 0.03-0.49; $p=0.004$) and Christians caregivers (AOR 0.12; 95% CI: 0.04-0.65; $p=0.012$) developing undernutrition were less compared to those from other religions. The odds of a child in the Protestant Hospital (AOR=0.33; 95% CI: 0.21-0.66; $P=0.001$) developing undernutrition were less compared to those in the Regional hospital of Ngaoundere. *Conclusion:* The prevalence of undernutrition was high among under-five HIV-exposed children in the two HIV treatment centers with wasting and underweight being more prevalent in females and stunting in males. Religion, education and health facility were independently associated with undernutrition among HIV-exposed children. This study highlight the need to take integrated actions in growth monitoring and feeding practices of under-five HIV-exposed children.

Keywords: Undernutrition, Prevalence, Associated Factors, HIV-Exposed Children, Ngaoundere, Cameroon

1. Introduction

Malnutrition, specifically undernutrition is the cause of children vulnerability to disease and death and it manifests in different forms including wasting, stunting, underweight, and deficiencies in vitamins and minerals. According to a report published by World Health Organization in 2016, it was

estimated that 155 million children under five years of age were suffering from stunting, and about 45% of deaths among children under-five years were related to undernutrition [1]. It is estimated that undernutrition underlies 60% of all infectious disease morbidity and

increases the incidence, and delays recovery [2]. Undernutrition, remains an issue of great concern in Cameroon. The national institute of statistics in Cameroon in 2018 reported that 29% of children under-five were stunted or chronically malnourished, 14% wasted and 11% underweight [3]. Children exposed to or infected with HIV are susceptible to child malnutrition. This is because HIV infection places a huge demand on energy. Nutrition among HIV exposed or infected children is affected by an increase in resting energy expenditure and a decline in food consumption, malabsorption and loss, as well as complex metabolic alterations [4]. It has been reported that HIV-exposed infants, born of HIV-positive mothers may start life with impaired nutrition [5] due to the high incidence of preterm and low birth weight deliveries. The infants may also, experience slower growth and severe malnutrition [6]. Treatment, care and support of HIV infected women and their family is one of the four pillar of Prevention of Mothers to Child Transmission (PMTCT) where clinical and biological follow-up based on national recommendations should be ensured [7]. Management of HIV-exposed children emphasizes ARV prophylaxis, monitoring, feeding and HIV testing in HIV-exposed children [8]. HIV-exposed children are also at risk for growth failure and the monitoring of height and weight and early identification of high-risk children should be given a special importance [9]. This study was carried out to assess the prevalence and associated factors of undernutrition among under-five HIV-exposed children.

2. Materials and Methods

2.1. Study Area

The study was conducted in two HIV treatment centers (the Regional and Protestant Hospital of Ngaoundere) in the Adamaoua region of Cameroon. The Regional Hospital of Ngaoundere is located in the Sub-Division of Ngaoundere 1. It is classified by the Ministry of Public Health as a third category hospital and covers all the health facilities in the Region. The Protestant hospital of Ngaoundere is located in the Norwegian district and is the biggest private hospital in the Adamaoua region. The two hospitals are referrals for HIV management and care in the Adamoua region of Cameroon.

2.2. Study Design and Population

A hospital-based cross-sectional study design was used to collect data on nutritional status of HIV-exposed children aged 0-59 months in the regional and protestant hospitals of Ngaoundere for a period of March to August 2020.

2.3. Sampling Procedures

A minimum sample size of 251 was calculated using the Cochran finite population sample formula for small population with a prevalence of 37, 8% derived from the 2018 Cameroon demographic and health survey [3]. The sampling technique was based on a two-stage sampling

approach using a purposive and a simple random sampling. At the first stage, the two HIV treatment center of the Regional and Protestant Hospitals of Ngaoundere were chosen conveniently because they host the majority of HIV patients in the region. In the second stage, HIV-exposed children aged 0-59 months were randomly selected for the study.

2.4. Data Collection

Data collection was done using a structured questionnaire. Anthropometric indicators (weight, height, and mid-upper arm circumference) were measured in selected under five children using a weighing scale, a height measuring scale (standiometer or infantometer) and a sixty mid upper arm circumference tape. The data was collected by 5 nurses and 5 data-collectors who received specific training on the different instruments of data collection and interview techniques. After collection of anthropometric measures, a structured questionnaire was administered to caregivers to collect data on socio-demographics characteristics of HIV infected mothers and their exposed children.

For clinical data, Childhood diarrheal status was defined as having two or more loose or watery stools in past 2 weeks prior the start of data collection. Fever was based on caregiver 2 weeks oral reports. HIV diagnostic method, HIV status of the child, Uptake of prophylactic ARV at birth, opportunistic infections were collected in medical records. Physical examination (Tiredness, presence of oedema) was performed by nurses.

Mid-Upper Arm Circumference (MUAC) measured at the mid-point between the tip of the shoulder and the tip of the elbow and performed by MUAC tape and was note by nurses. MUAC less than 110mm, (red color), indicates Severe Acute undernutrition (SAM). MUAC of between 110mm and 125mm, orange color, indicates Moderate Acute undernutrition (MAM). MUAC of between 125 mm and 135mm, yellow color, indicates that the child is at risk for acute malnutrition and MUAC over 135mm, green color, indicates that the child is well-nourished. Undernutrition types (Wasting, Stunting and Underweight) were determined using the 2006 World Health Organization growth standards [10]. Expressed in Z-scores, three types of undernutrition were defined Height-for-age (HAZ), for wasting or acute malnutrition, Weight-for-Height (WHZ) for stunting or chronic malnutrition and Weight-for-Age (WAZ) for underweight or mixed malnutrition. Indices less than -2 standard deviations designated moderate undernutrition and indices less than -3 standard deviations designated severe undernutrition.

2.5. Data Analysis

The data was analyzed using Statistical Package for Social Sciences (SPSS, version 26) and Emergency Nutritional Assessment (ENA version 2019) software. The children were classified on the basis of WHO standards 2006 [10]. The prevalence of wasting, stunting and underweight were

determined using the z-scores. Z-scores less than -3 standard deviations designated severe undernutrition, and less than -2 standard deviations designated moderate undernutrition. Logistic regression analysis was used to identify factors independently associated with undernutrition. Computed <0.05 was considered significant.

3. Results

3.1. Socio-demographic Characteristic of Under-Five HIV-Exposed Children

A total number of 251 HIV-exposed children between the ages of 0 to 59 months were enrolled in the study. The Regional Hospital of Ngaoundere had the highest number 157 (62.55%).

More than half 192 (76.5%) of the children were aged between 6-24 months. The mean age of the children was 17 months (16.91 ± 9.85). Similarly, 134 (53.4%) of the children were females with a female to male sex ratio of 1.14. For the birth order, 61 (24.3%) were second-born (Table 1).

Table 1. Socio-demographic characteristic of under-five HIV-exposed children.

Variable	Category	Frequency	Percentages
Child age (Months)	0-5	32	12.7
	6_24	192	76.5
	25_59	27	10.8
	Total	251	100
Child sex	Female	134	53.4
	Male	117	46.6
	Total	251	100
Birth order	1	60	23.8
	2	61	24.3
	3	58	23.1
	4	29	11.6
	5	28	11.2
	6	15	6
	Total	251	100

3.2. Clinical Characteristics of Under-Five HIV-Exposed Children

For clinical characteristics (Table 2), 6 (2.4%) had oedema, 20 (8%) presented with tiredness, 6 (1.2.4%) with opportunistic infections. Thirty-eight caregivers (15.4%) reported that their children had experienced one to two episodes of disease in the last two weeks preceding the interview. The number of children who had diarrhea was 72 (29.6%), 65 (26.7%) reported an abnormally high body temperature two weeks prior to the interview. For HIV status (Table 3), 26 (10.5%) were positive for HIV while 110 (44.4%) had unknown HIV status. Furthermore, 221 (91.7%) of HIV diagnostic method (PCR) was performed. One hundred and fifty (60.2%) children took a prophylactic Antiretroviral therapy (ART) at birth.

For micronutrients supplementation, more than half of

children 138 (56, 8%) received Vitamin A and 161 (47.7%) children received Iron.

Table 2. Clinical characteristics of under-five HIV-exposed children.

Variables	Categories	Frequency	Percentage
Colour MUAC Tape	Green	216	89.26
	Red	7	3.1
	Yellow	19	7.85
	Total	223	100
Presence of oedema	No	241	97.6
	Yes	6	2.4
	Total	247	100
State of hair	Brittle	6	2.4
	Normal	242	97.2
	Red	1	0.4
	Total	249	100
Tiredness	No	229	92
	Yes	20	8
	Total	249	100
Opportunistic infections	No opportunistic	243	97.6
	Pneumonia	3	1.6
	Tuberculosis	1	0.4
	Others	1	0.4
	Total	249	100
Number of episodes of Diarrhoea in the last six months	No disease	203	82.2
	1- 2 times	38	15.4
	3 - 4 times	6	2.4
	Total	247	100
Watery stool	No	171	70.4
	Yes	72	29.6
	Total	243	100
Frequency of stool	>1	54	74
	One	19	26
	Total	73	100
Fever	No	178	73.3
	Yes	65	26.7
	Total	243	100

Table 3. HIV status and testing of under-five HIV-exposed children.

Variables	Categories	Frequency	Percentage
HIV diagnostic methods	DNA PCR	221	91.7
	Serology	20	8.3
	Total	241	100
HIV status of the child	No	112	45.2
	Yes	26	10.5
	Don't know	110	44.4
	Total	248	100
Uptake of prophylactic ARV at birth	No	21	8.4
	Yes	150	60.2
	Don't know	78	31.3
	Total	249	100

3.3. Prevalence of Undernutrition

The overall prevalence of undernutrition among under five HIV- exposed children was 38% (Figure 1). The prevalence of wasting was 12.1% of which 16 (6.5%) of children presented with severe wasting. The prevalence of stunting was 83 (33.4%) of which 43 (17.3%) were moderately stunted and 40 (16.1%) severely stunted. Thirty five children (14.3) suffered from underweight of which 28 (11.5%) were moderately underweight and 7 (3.2%) severely underweight (Figure 2).

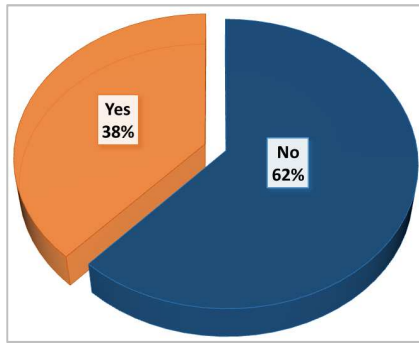


Figure 1. Overall prevalence of undernutrition among under-five HIV-exposed children.

The prevalence of undernutrition in the regional Hospital of Ngaoundere was 46.5% versus 24.5% in the Protestant Hospital of Ngaoundere (Figure 3).

Wasting, stunting and underweight were more prevalent among females than males. The prevalence of undernutrition among females was 15% for wasting and 11.6% for underweight. On the other hand, stunting was more prevalent among the males 41 (35%) (Table 4).

Wasting increased with age with the most affected age group being 24 to 59 months. Underweight decreased with age with the most affected group being 6 to 11 months. Children age between 12 to 24 months were most affected by stunting (Table 5).

Table 4. Severity of undernutrition by sex.

Wasting (n=245)	All		Boys		Girls	
	n (%)	9% CI	n (%)	9% CI	n (%)	9% CI
Prevalence of wasting	30 (12.1)	8.6 – 16.7	10 (8.7)	4.8 – 15.3 95	20 (15.0)	10.0 – 22.1 95
Prevalence of moderate wasting	14 (5.6)	3.4 – 9.3	4 (3.5)	1.4 – 8.6 95	10 (7.5)	4.1 – 13.3 95
Prevalence of severe wasting	16 (6.5)	4.0 – 10.2	6 (5.2)	2.4 – 10.9 9	10 (7.5)	4.1 – 13.3 95
Normal	215 (87.9)		104 (91.3)	-	111 (85)	-
Stunting (n=250)						
Prevalence of stunting	83 (33.2)	27.7 – 39.3	41 (35.0)	27.0 – 44.0	42 (31.6)	24.3 – 39.9
Prevalence of moderate stunting	43 (17.2)	13.0 – 22.4	20 (17.1)	11.3 – 24.9	23 (17.3)	11.8 – 24.6
Prevalence of severe stunting	40 (16.0)	12.0 – 21.1	21 (17.9)	12.0 – 25.9	19 (14.3)	9.3 – 21.2
Normal	167 (66.8)	-	76 (65)	-	91 (68.4)	-
Underweight (n=244)						
Prevalence of underweight	35 (14.3)	10.5 – 19.3	17 (14.8)	9.4 – 22.4	18 (14)	9.0 – 21
Prevalence of moderate underweight	28 (11.5)	8.1 – 16.1	15 (13.1)	8.1 – 20.4	13 (10.1)	6.0 – 16.5
Prevalence of severe underweight	7 (2.8)	1.4 – 5.8	2 (1.7)	0.5 – 6.1	5 (3.9)	1.7 – 8.8
Normal	210 (85.7)		106 (85.2)	-	114 (86)	-

Table 5. Undernutrition by age groups.

Age group	Wasting n (%)	Stunting n (%)	Underweight n (%)
6-11 months (N=105)	12 (11.4)	31 (29.5)	17 (16.2)
12-24 months (N=87)	11 (12.6)	42 (51.7)	14 (16.1)
24-59 months (N=27)	7 (25.9)	10 (37)	4 (14.8)
Total	30 (12.1)	83 (33.2)	35 (14.3)

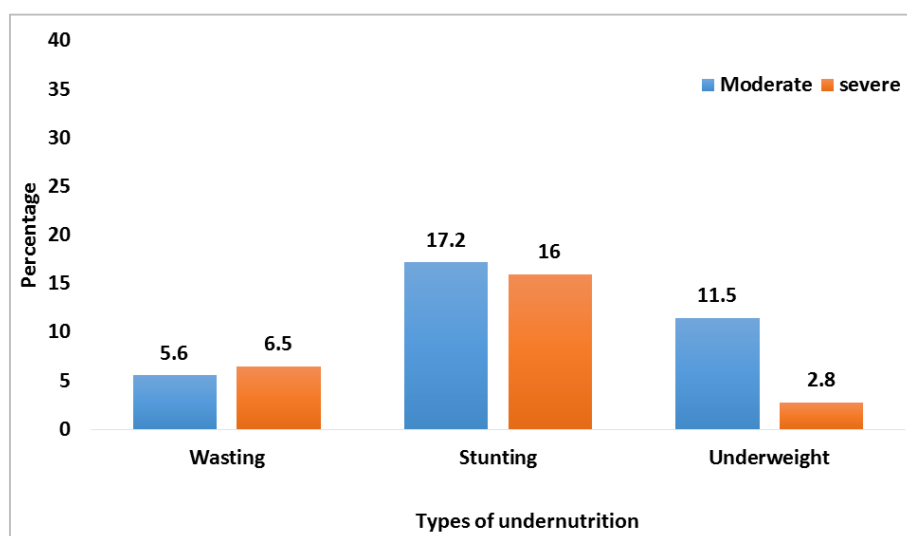


Figure 2. Severity of undernutrition types in children aged 6 to 59 months exposed to HIV.

Table 6. Factors independently associated with undernutrition.

Variable	Categories	Under-nutrition				COR	Sig.	95% CI		AOR	Sig.	95% CI	
		No	%	Yes	%			Lower	Upper			Lower	Upper
Health facility	Protestant Hospital	71	28.3	23	9.2	0.37	0.001	0.21	0.66	0.33	0.001	0.18	0.60
	Regional Hospital	84	33.5	73	29.1	1				1			
Religion	Christian	83	33.1	40	15.9	0.16	0.008	0.04	0.63	0.12	0.004	0.03	0.49
	Muslim	69	27.5	47	18.7	0.23	0.032	0.06	0.88	0.15	0.012	0.04	0.65
	Others	3	1.2	9	3.6	1				1			
Educational level	Tertiary	8	3.2	3	1.2	0.72	0.641	0.18	2.88	0.61	0.525	0.13	2.78
	Never	6	2.4	11	4.4	3.52	0.021	1.21	10.27	3.42	0.032	1.11	10.57
	Primary	70	27.9	45	17.9	1.23	0.451	0.72	2.13	1.40	0.263	0.78	2.53
	Secondary	71	28.3	37	14.7	1				1			
Family size	< 5	36	14.3	19	7.6	0.98	0.953	0.50	1.92	0.97	0.928	0.46	2.02
	10-15	31	12.4	30	12.0	1.80	0.067	0.96	3.36	1.94	0.052	1.00	3.79
	> 15	10	4.0	5	2.0	0.93	0.898	0.30	2.90	0.88	0.833	0.27	2.91
	5-9	78	31.1	42	16.7	1				1			

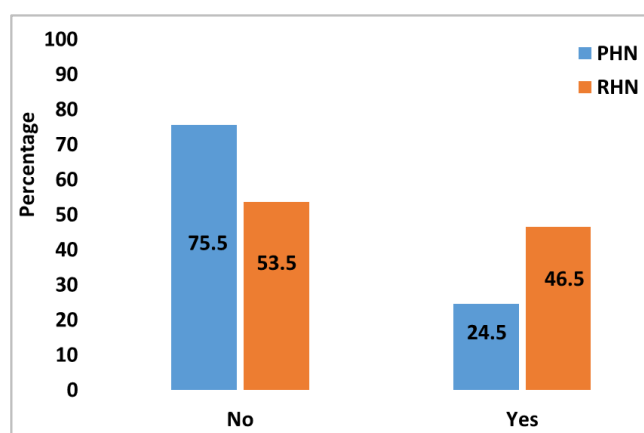


Figure 3. Distribution of undernutrition by health facility.

3.4. Factors Associated with Undernutrition of Under-Five HIV-Exposed Children

Religion and education level of HIV-infected mothers as well as health facility were significantly associated with undernutrition among under-five HIV-exposed children. The odds of children from Muslim (AOR= 0.12; 95% CI: 0.03-0.49; $p=0.004$) and Christians caregivers (AOR 0.12; 95% CI: 0.04-0.65; $p=0.012$) developing undernutrition were less compared to those from other religions. The odd of a child in the Protestant Hospital (AOR=0.33; 95% CI: 0.21-0.66; $P=0.001$) developing undernutrition was less compared to those at the Regional hospital of Ngaoundere. The odds of children from HIV-infected mothers with no education level developing undernutrition were 3.42 times higher (OR 3.42; 95% CI: 1.21-10.27; $p=0.032$) than in those with secondary school level (Table 6).

4. Discussion

The fight against malnutrition is one of the greatest public health challenges in world especially in low and middle-income countries. This study assessed the prevalence and associated factors of undernutrition among under-five children born to HIV-positive mothers (Underfive HIV-Exposed Children) followed up at the HIV care center of the

Regional and Protestant Hospitals of Ngaoundere. Exposure and infection to HIV worsen problems of child malnutrition, making children exposed to HIV a high risk group with special needs [11]. The prevalence of undernutrition among under-five HIV-exposed children was high (38%) and it is in line with the findings of Sobze., *et al* (31.8%) in Dschang, Cameroon [12]. The prevalence of wasting was 12.1% and was above the 10% WHO alert threshold, representing an alert situation. About 6.5% of them were severely wasted and according to WHO classification, severe acute malnutrition with a threshold $\geq 2\%$ is an emergency [13]. This prevalence reflects, the situation of undernutrition in Adamaoua region, where the prevalence of severe acute malnutrition was the highest in Cameroon [3]. The prevalence of stunting was 33.4%, over 30% (WHO alert threshold), which also represents an alert situation. The prevalence of underweight is 14.3% (10-19.9% WHO threshold), represents a precarious situation [13]. In Kenya, wasting, underweight, and stunting were more prevalent among HIV-exposed children than the results obtained in our study, 29% of children were underweight, 18% were wasted and 58% were stunted [14]. Another study, Megan S. McHenr *et al.*, reported that HIV infected children were much more likely to be stunted (50.9% Vs 45), wasted (13.6 Vs 5.1%), and underweight (26.5% Vs 14.8) compared to HIV-exposed children [15]. Findings of a study carried out in Nigeria reported that linear and ponderable growth were more impaired among HIV-Exposed children as compared with not exposed-children during the first 18 months of life [16].

Our results indicate that wasting and underweight are more pronounced among girls while boys were mostly stunted. Similar observations were reported in previous studies [2, 5, 6, 8]. In children between 6-59 months, high-dose vitamin A supplementation is recommended for great development. More than half of children in this study received Vitamin A and only 47.7% children received iron which is higher than results found by Shet *et al.*, [17]. Several studies shown that using vitamin supplement can reduces morbidity and mortality in HIV-positive children and improves their growth. The lack of anti-oxidant vitamins and minerals can lead to oxidative stress which can intend cause an accelerated immune cell death [11] and increase the rate of HIV replication [18]. Another study

has shown that the linear and ponderable growth in infants infected with HIV can be improved upon with the use of Vitamin A. Vitamin A also decreases the risk of stunting associated with persistent diarrhea [19].

Some studies have shown that undernutrition was associated with household composition, food aid and use of food by prescription supplements [20, 21] among HIV exposed uninfected infants. Infants with HIV infection battle with increase energy requirements, minute food intake, and nutrient malabsorption [22].

Furthermore, undernutrition remains a problem even within hospital-based settings [17]. In our study, the Regional Hospital of Ngaoundere was more affected with undernutrition. A similar study reported a prevalence of undernutrition of 40% at the Regional Hospital of Ngaoundere compared to 5% prevalence in the Protestant hospital [23]. This can be explained by the fact that Regional Hospital of Ngaoundere classified as a third category facility covers all the health facilities in the Region and it is the first referral for HIV-care and management with the highest rate of patients in Adamaoua.

In our study, only 1.23% of children presented opportunistic infections but a number of studies showed that opportunistic infections such as pulmonary tuberculosis, oropharyngeal candidiasis and anemia are frequent in the context of exposure to HIV [24, 25]. Up to 15.4% had experienced one to two episodes of disease and 29.6% had diarrhea in the last two weeks preceding the interview. The national institute of statistics in Cameroon in 2018 reported 12% and 15% diarrhea and fever episodes in the last two weeks preceding the interview among children [3]. A previous study carried out in Bamenda, Cameroon reported that HIV-exposed children have modest but significant impairment of development and a higher risk of infections predominantly low respiratory tract infections and diarrhea than HIV Un-exposed children [24]. In this study, 10.5% were positive and 44.4% had unknown status. This could be explained by the fact that the HIV test results were not available during our data-collection. In other studies, ART-treated HIV-positive children had higher rates of undernutrition than their HIV-negative counterparts [25]. For any child born to an HIV+ mother, ART should start as early as possible following childbirth and ART consists in Nevirapine to be given daily in a single dose for six weeks. In our study, only 60.2% received ART prophylaxis at birth. It has been a great challenge to keep women and infants in PMTCT programs after delivery. This led to more infants being infected during the postnatal period as a result of breastfeeding rather than pregnancy and labour [26].

Our study highlights that religion and education level of HIV-infected mothers as well as health facility were significantly associated with undernutrition in under-five HIV-exposed children. In a study carried out in Tanzania, low maternal education, few household possessions, low infant birthweight, child HIV infection were found as independent predictors of stunting, wasting, and underweight [27]. A number of studies have reported a relationship

between education and undernutrition. It has been shown that mothers' good literacy level may process greater knowledge of proper hygiene practices and optimal child caring and feeding practices, which could be particularly important in the context of HIV [28]. The prevalence of chronic malnutrition was reported to decline significantly with the mother's education level, from 39% when the mother has no education to 8% when she has the next highest level [3].

In our study, most of children were second-born but no association was found between undernutrition and birth order while other studies found that birth order of the child was associated with poor growth [29]. No associations were found between clinical characteristics of the children and undernutrition. This was contrary to the findings of Jesson *et al.*, who reported an association between acute malnutrition and severe immunodeficiency and the absence of ART; non-ART-treated children were more likely to present acute malnutrition compared to ART-treated children [30].

5. Conclusion

Our study revealed a high prevalence of stunting, wasting and underweight among under-five HIV-exposed children. Religion, education and health facility were independently associated to undernutrition among HIV-exposed children. Our study highlights the need for further improvements on nutritional assessment and growth monitoring for prevention and early detection of undernutrition on PMTCT services.

Ethics Approval and Consent to Participate

The Institutional Review Board of the Faculty of Health Sciences of the University of Buea in Cameroon approved the study (Ref: 2020/1034-1/UB/SG/IRB/FHS). The study received an administrative authorization from the Adamaoua Delegation of Public Health, and from the different Hospitals. Consent was obtained from infected mothers before enrolment of HIV-exposed children in the study.

Competing Interest

The authors declare that they have no competing interests.

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