

# Body Mass Index of HIV-infected Children on Antiretroviral Therapy Compared to HIV-uninfected Children in Vietnam

## Abstract

**Background and Objectives:** Body Mass Index is a useful tool to monitor the growth of children in general. HIV disease impacts to weight and height, consequently to BMI. In Vietnam, BMI data of HIV-infected children on ART are lacking in comparing to HIV-uninfected ones. Our study aimed to (1) determine BMI of HIV-infected comparing HIV-uninfected children; and (2) explore possible factors associating to low BMI z-score in HIV-infected children.

**Methods:** Cross-sectional study was on 209 children (105 HIV-infected, 104 HIV-uninfected) from HIVCHI, DodaLab and FilaBavi cohort.

**Results:** BMI mean of HIV-infected children was  $15, 4 \pm 2, 7$  lower than HIV-uninfected ones with BMI mean  $16, 6 \pm 2, 1$ . HIV-uninfected children at group 5-9 years had BMI significantly higher than HIV-infected children by both sex (boy & girl) with  $p < 0.05$ . The two other groups of age (2-4 years; 10-14 years) have no significant difference. The high rate of normal nutritional status at both groups of age was 66, 2 % (2-5 years) and 78, 7% (6-14 years). Prevalence of underweight at group 2-5 years was 29, 9% higher than group 6-14 years (14, 2%). HIV-infected children raised by non- parents have higher rate of low BMI z-score compared to those whose parents as main caretakers [91, 4% > 65, 7%, OR=0, 17 with 95%CI (0, 04-0, 64) and  $p=0,009$ ].

**Conclusion:** Low BMI in both HIV-infected and HIV-uninfected children in Vietnam states that the malnutrition in children is still a big challenge for resource-limited countries. Underweight is more common in HIV-infected children at age group (5-9 years) based on BMI z-score ( $< -2SD$ ). HIV-infected children who are being raised by non- parents have a higher a risk of underweight compared to those whose parents are main caretakers.

**Keywords:** ART; Children; BMI; HIV; Nutritional status; Underweight

## Research Article

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Tran CT<sup>1,2\*</sup>, A Hanberger<sup>3</sup>, Nguyen HH<sup>1</sup>, Tran KT<sup>1</sup>, Nguyen TKC<sup>1</sup> and M Larsson<sup>1,2</sup>

<sup>1</sup>Hanoi Medical University, Vietnam

<sup>2</sup>Karolinska Institutet, Sweden

<sup>3</sup>University of Linkoping, Sweden

\*Corresponding author: Tran Chi Thanh, Hanoi Medical University, Vietnam, Email: trchithanh@yahoo.com

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## Background and Objectives

HIV-infected children, who have the immune system in active to struggle against viruses, require more energy than HIV-uninfected ones. According to WHO Technical Consultation, asymptomatic HIV-infected children need about 10% nutrient requirement intake higher than to normal kids. For HIV-infected children with weight loss symptom, the energy intake needs to be increased by 50% to 100% over established requirements for otherwise healthy uninfected children [1].

High nutrient and energy dietary could help HIV-infected children in gaining weight. However, the growth of HIV-infected children is often slow due to high viral load in blood and / or the impact of opportunistic diseases to the metabolism, for instance, diarrhea and intestinal diseases [2].

Body Mass Index (BMI) is a useful tool to monitor the growth of children in general and it is an obligatory parameter collected at each time of health check-up visit of HIV-infected children on

Antiretroviral Therapy (ART). For illness children, the growth is slow and no weight-gain compared to same age healthy ones. HIV-infected children treated with protease drug may have the impact on weight and height [3]. Furthermore, no weight-gain is caused by drug side effects such as nausea, vomit, diarrhea, loss appetite and anorexia [4]. HIV disease impacts to weight and height, consequently to BMI. HIV patients on ART with BMI less than 17 have risk of mortality 2 times higher than other patients who have BMI greater than 18.5 [5].

BMI of HIV-infected children on ART in Vietnam is not reported adequately in comparing to HIV-uninfected ones. Our study aimed to (1) determine BMI of HIV-infected comparing HIV-uninfected children; and (2) explore possible factors associating to low BMI z-score in HIV-infected children.

## Methods

Cross-sectional study was on 209 children (105 HIV-infected, 104 HIV-uninfected). HIV-infected children on ART in year 2015-

2016 were chosen randomly from HIVCHI cohort (Vietnam National Children’s Hospital, Children’s Hospital number 1 and Children’s Hospital number 2) and they were from both rural and urban settings in Hanoi and Ho Chi Minh City and the surroundings of the two cities. HIV-uninfected children’s data were extracted randomly from DodaLab cohort [6] and FilaBavi cohort [7].

The weight was measured shoeless and with lightweight clothes, using standard scales according to the guideline from National Institute of Nutrition [8].

The analysis consists of the 2 groups of study subjects. Standard statistical methods were used. The ordinary least squares method was applied. A p-value of <0.05 was considered statistically significant.

### Results

A total of 209 children were enrolled in this study. The age range was vary from 2–14 years. The age group 5-9 years was

the largest [HIV-infected (64/105, 61%), HIV-uninfected (58/104, 55, 8%)].

The mean BMI of HIV-infected and HIV-uninfected children was  $15,4 \pm 2,7$  and  $16,6 \pm 2,1$ , respectively.

In the age groups 2-4 years, 5-9 years and 10-16 years were not significantly different BMI comparing HIV-infected and HIV-uninfected children ( $p > 0.05$ ).

The mean weight of HIV-infected and HIV-uninfected children was  $23,9 \pm 7,9$  kg and  $25,8 \pm 7,0$  kg, respectively.

The mean height of HIV-infected HIV-uninfected children was  $123,1 \pm 13,8$  cm and  $123,7 \pm 13,6$  cm, respectively.

Stratified analysis BMI comparison between 2 groups by sex and age showed HIV-uninfected children at group 5-9 years had BMI significantly higher than HIV-infected children by both sex (boy & girl) with  $p < 0.05$ . In the other two age groups have no significant difference (Table 1).

**Table 1:** BMI grouped by the sex and by the age range between HIV-infected and HIV-uninfected children.

	HIV-Infected Children (n=105)		HIV-Uninfected Children (n=104)		p-value (t- test)
	Boy, n(%) 45 (42,9)	Girl, n(%) 60 (57,1)	Boy, n(%) 65 (62,5)	Girl, n(%) 39 (37,5)	
<b>Age range</b>					
2-4 years	6 (5,7)	7 (6,7)	14 (13,5)	8 (7,7)	NS*
5-9 years	25 (23,8)	39 (37,1)	38 (36,5)	20 (19,2)	
10-14 years	14 (13,4)	14 (13,3)	13 (12,5)	11 (10,6)	
<b>Weight (mean)</b>	$23,9 \pm 7,9$ kg		$25,8 \pm 7,0$ kg		
2-4 years	$19,08 \pm 5,4$	$14,1 \pm 2,0$	$17,8 \pm 2,4$	$17,3 \pm 2,2$	B (NS) G (p=0.02)
5-9 years	$21,5 \pm 6,1$	$21,9 \pm 5,2$	$27,9 \pm 4,8$	$23,2 \pm 5,0$	B (p<0.001) G (NS)
10-14 years	$29,4 \pm 6,7$	$34,8 \pm 6,9$	$28,9 \pm 5,3$	$35,5 \pm 5,2$	B (NS) G (NS)
<b>Height (mean)</b>	$123,1 \pm 13,8$ cm		$123,7 \pm 13,6$ cm		
2-4 years	$104,5 \pm 6,7$	$100,4 \pm 8,5$	$103,8 \pm 8,3$	$107,8 \pm 7,2$	B (NS) G (NS)
5-9 years	$120,2 \pm 8,4$	$121,5 \pm 9,7$	$127,7 \pm 6,9$	$119,1 \pm 8,6$	B (p<0.001) G (NS)
10-14 years	$134,2 \pm 7,0$	$140,5 \pm 9,2$	$137,6 \pm 6,8$	$139,2 \pm 6,5$	B (NS) G (NS)
<b>BMI (mean)</b>	$15,4 \pm 2,7$		$16,6 \pm 2,1$		
2-4 years	$17,3 \pm 3,2$	$13,9 \pm 0,8$	$16,5 \pm 1,2$	$14,9 \pm 1,4$	B (NS) G (NS)
5-9 years	$14,7 \pm 3,1$	$14,7 \pm 2,5$	$17,1 \pm 2,2$	$16,2 \pm 1,4$	B (p<0.001) G (p=0.02)
10-14 years	$16,1 \pm 2,2$	$17,5 \pm 2,5$	$15,4 \pm 3,0$	$18,3 \pm 1,6$	B (NS) G (NS)

B=Boy, G=Girl, p-value (t-test), NS=non-significant, (\*) chi-square.

### Nutritional status classified by BMI z-score in HIV-infected children

Nutritional status is classified by BMI z-score with different criteria according to group age. The high rate of normal nutritional status at both groups of age was 66, 2% (2-5 years) and 78, 7% (6-14 years). Prevalence of underweight at group 2-5 years was 29, 9% higher than group 6-14 years (14, 2%). The rate of overweight and obesity in both groups of age were low (less than 10%) (Table 2).

### Associated Factors to low BMI z-score (cutoff <-2SD) in HIV positive children

The associated factors (characteristics of children and caretakers) to low BMI z-score between 2 groups (< -2SD; ≥ -2SD) were tested by chi-square test. Accessible and confirmable factors were chosen such as, children (sex, age range, current HIV stage); caretakers (age, relationship to the child, habitant, education level).

**Table 2:** Nutritional status classified by BMI z-score in 105 HIV-infected children.

Nutritional status	2-5 years Criteria n = 77 (%)	6-14 years Criteria n =28 (%)
Severe under-weight	Less than (-3SD) 10 (13)	Less than (-3SD) 2 (7,1)
Moderate under-weight	Less than (-2SD) 13 (16,9)	Less than (-2SD) 2 (7,1)
Normal	From-2SD to 2SD 51 (66,2)	From-2SD to 1SD 22 (78,7)
Over-weight	Greater than 2SD 2 (2,6)	Greater than 1SD 2 (7,1)
Obesity	Greater than 3SD 1 (1,3)	Greater than 2SD 0 (0)

The relationship to the child (caretakers' characteristic) is associated to low BMI z-score with  $p < 0.05$ . HIV-infected children raised by non- parents have higher rate of low BMI z-score

compared to those whose parents as main caretakers [91, 4% > 65, 7%, OR=0, 17 with 95%CI (0, 04 - 0, 64) and  $p = 0,009$ ]. (Table 3).

**Table 3:** Associated factors to low BMI z-score in 105 HIV-infected children.

Characteristics		BMI z-score	
		<-2SD (n=27, 25, 7%)	≥-2SD (n=78,74,3%)
<b>Children</b>			
Sex	Boy	11 (40,7)	34 (43,6)
	Girl	16 (59,3)	44 (56,4)
Age range	2-4 years	3 (11,1)	10 (12,8)
	5-9 years	20 (74,1)	44 (56,4)
	10-14 years	4 (14,8)	24 (30,8)
Current HIV stage	HIV stage 1	24 (92,3)	70 (92,1)
	HIV stage ≥ 2	2 (7,7)	6 (7,9)
<b>Caretakers</b>			
Age	< 30 years	7 (25,9)	12 (15,4)
	30 - 59 years	20 (74,1)	58 (74,4)
	≥ 60 years	0 (0)	8 (10,2)
Relationship to the child*	Parents	3 (8,6)	24 (34,3)
	Non-parents	32 (91,4)	46 (65,7)
Habitant	Urban	12 (26,7)	14 (23,7)
	Rural	33 (73,3)	45 (76,3)
Education level	Illiteracy	7 (25,9)	22 (28,2)
	Literacy	20 (74,1)	56 (71,8)

(\*) Significant difference with  $p < 0.05$  (chi-square)

## Discussion

The present study documents low BMI in both HIV-infected and HIV-uninfected children (less than 17), and HIV-infected children at group 5-9 years are significant lower than HIV-uninfected children. Our low BMI result ( $<-2SD$ ) with prevalence 25, 7% is higher than the result of previous study with 13, 5% [9]. The rate of malnutrition reported in year 2015–2016 is higher than in year 2012, this may be these children got old and the high rate of malnutrition at group of 5-9 years. One more thing, these two studies were at the same study sites (Vietnam National Children's Hospital, Children's Hospital number 1, Children's Hospital's number 2 and An Hoa clinic).

Sunguya et al. [10] conducted a study on 213 HIV positive age group and documented that 22.1% was underweight [10]. Kapavarapu studied in Bangalore, Indian HIV positive orphans and reported that 79% was underweight [11]. Our study in Vietnam, 25, 5% was underweight. Each country has its own impact factors and conditions and changing by time, So the rate of underweight of HIV-infected children representative for country and / or study site at a specific time.

Maternal age is related to child under nutrition [12] and the increased risk of under nutrition in children of younger mothers may relate to inexperience and inadequate child care [13]. Furthermore, maternal age and illiteracy may be associated with under nutrition of these children [14]. In our study, maternal age is not related to child nutritional status at group of age 30 – 59 years have same distribution prevalence 74,1% vs. 74,4% with BMI z-score cutoff  $-2SD$ . Parents as caretakers play crucial role in reducing under nutrition, particularly keeping BMI z-score higher than  $-2SD$  in HIV-infected children as data were found in this study 34,3% ( $>-2SD$ , parent caretakers) vs. 8,6 % ( $<-2SD$ , non-parent caretakers).

Children's factors investigated in our study have no relation to the low BMI z-score in HIV-infected children. In Mandefro Asfaw's study, presence of diarrhea in the past two weeks, male sex and pre-lactal feeding were significantly associated with stunting [15,16]. Our cohort was in good health at the time of study, no opportunistic diseases like diarrhea, so only several factors were chosen, this is considered as our study limitations.

## Conclusion

Low BMI in both HIV-infected and HIV-uninfected children in Vietnam states that the malnutrition in children is still a big challenge for resource-limited countries. Underweight is very common in HIV-infected children at group of age (5-9 years) based on BMI z-score ( $<-2SD$ ). Factors associated to underweight in HIV-infected children need to be investigated more in future. In this study, HIV-infected children who are being raised by non-parents have a higher risk of underweight compared to those whose parents are main caretakers.

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