



# Nutritional Status of Tuberculous Children Diagnosed and Treated in an Urban Area in DR Congo

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## Abstract

**Introduction:** Tuberculosis and malnutrition are major health problems in DR Congo, and children are particularly vulnerable. The objective of this study is to determine the incidence of malnutrition in tuberculous children in DR Congo and to identify the associated factors. **Methodology:** A cross sectional study was conducted, and concerned 22 Tuberculosis Diagnosis and Treatment Centers (TDTCs). It was carried out over a period from 2013 to 2015 and involved 717 tuberculosis children less than 15 years of age. Nutritional status was assessed on the basis of the values of the Z-score Weight for age (global malnutrition) according to the NCHS curves. **Results:** Tuberculosis incidence was 8.2%. The prevalence of underweight (<-2 z-score) is 20.8%, of which 8.4% is severely malnourished (<-3 z-score). An age of less than 60 months is significantly associated with poor nutritional status (OR = 0.3, CI 0.2 - 0.5). TB-HIV co-infection is significantly associated with poor nutritional status (OR = 0.4, CI 0.2 - 0.6). It was noticed that the outcome is favorable (recovery) in patients with good nutritional status (OR = 12, CI 8.0 - 18.9). **Conclusion:** Underweight is present in Congolese tuberculosis children. An adequate nutritional policy is needed to improve the prognosis of the disease.

## Subject Areas

Pediatrics

## Keywords

Tuberculosis, Child, Nutritional Status, DR Congo

## 1. Introduction

With 2 billion people infected worldwide and 9.4 million newly infected per year, tuberculosis is a major global infectious disease [1]. The Democratic Republic of Congo (DRC) is one of the 22 countries that support more than 80% of the burden of tuberculosis in the world [2]. Indeed, in the DRC, tuberculosis has a prevalence of 842 cases per 100,000 inhabitants with 84% of new bacilliferous cases. The DRC occupies the 11<sup>th</sup> rank of the most affected African countries [1]. This remains a significant cause of mortality and morbidity in low-resources countries.

At least a half million children are infected with tuberculosis each year, and an estimated 70,000 are dying [1]. About 11% of tuberculosis cases concern children less than 15 years of age [3]. In underdeveloped countries, children account for more than 25% of the tuberculosis burden, but only between 3% and 6% of tuberculosis cases in developed countries [3].

Malnutrition has a high prevalence among children living in countries where tuberculosis is highly endemic and contributes to 2.2 million deaths among children fewer than five years of age [4]. According to the UNICEF 2014 report, 24% of children in the DRC are moderately or severely underweight; 43% have moderate or severe stunting and 9% are wasting [5]. Malnourished children are at greater risk of contracting tuberculosis, and vice versa, tuberculosis is likely to degrade the nutritional status of affected children [6].

We have conducted this study in order to establish the nutritional profile of the tuberculous children in the DRC. To achieve this we have set the following specific objectives: to determine the incidence of malnutrition in tuberculous children in an urban area of DR Congo and to identify factors associated to the nutritional status in these patients.

## 2. Material and Methods

### 2.1. Study Context

This study was conducted in Lubumbashi. It is the economic capital of the DR Congo; it is also the capital of the province of Haut-Katanga. Moreover, it is the second most populous city of the DR Congo. Its population would be around 2 million inhabitants according to the latest estimates, with an area of 747 km<sup>2</sup>. Its density is 2391 habitants/km<sup>2</sup>.

In DR Congo, tuberculosis control is the mission of the National Tuberculosis Control Program (NTP). In order to achieve its various objectives, the NTP recommends an integrated approach to tuberculosis control activities in primary health care structures in line with the strategy for strengthening the health system.

The structure that ensures the diagnosis and treatment of tuberculosis patients is called the Tuberculosis Diagnosis and Treatment Center (TDTC). The TDTC is the functional unit of the NTP. The TDTC is equipped with diagnostic tools (a microscope with immersion lens, rapid diagnostic tests, etc.) endorsed by the

WHO, and has trained medical personnel. A sample of the sputum smears collected by the TDTCs is also regularly monitored by the higher level according to the national strategy in this area.

Some TDTCs are equipped with XPERT MTB/Rif machines depending on their strategic location and the number of suspected multiresistant (MR) cases surroundings.

Screening and treatment are free. The drug supply and other inputs to tuberculosis control are subsidized.

The data were collected after all of the TDTCs of Lubumbashi, 22 centers.

## **2.2. Period and Study Design**

This is a descriptive cross-sectional study, which was conducted from 1st January 2013 to 31st December 2015, a 3 years period.

## **2.3. Population of Study**

Our target population is children under 15 years of age, living in Lubumbashi.

## **2.4. Sampling**

- Size sample: 8699 tuberculosis cases were collected during the period of our study, including 717 children having constituted our sample.
- Sample type: we proceeded to a convenience sampling, according with inclusion criteria below.
- Inclusion criteria: we have included children from 0 to 14 years diagnosed and treated for tuberculosis. The diagnosis of tuberculosis was based on NTP guide criteria in conformity with WHO recommendations for TB in children. The following elements were researched: a significant Keith Edwards score [7] with at least one paraclinic criterion suggestive of tuberculosis: a positive Ziehl test, an evocative X-ray, a positive intradermoreaction, a positive serology or a positive culture of Koch Bacillus.
- Non-inclusion criteria: patients with incomplete study parameters were excluded from the study.

## **2.5. Study Parameters**

The following socio-demographic parameters were collected for each child: age in months, sex and commune of provenance.

Apart from weight, elements of anamnesis and clinical examination were collected, the HIV status and the evolution especially.

## **2.6. Data Collection**

We have carried out the technique of documentary review to carry out the collection of our data. It was based on the follow-up records and the registers of the patients as drawn up in the different TDTCs.

For the evaluation of nutritional status, the usual material used to perform anthropometry was used, namely a Salter® scale with accuracy to 100 mg for

weight gain.

HIV serology was made with a rapid screening test (Determine®) confirmed by a 2<sup>nd</sup> discriminative test (Unigold®).

## 2.7. Processing Data

- The determination of the nutritional status's is made based on the following indicators: weight and age, allowing the calculation of Z-score Weight for Age to indicate global malnutrition.

The calculation of Z-score is based on the following formula:

Z-score= (Measured value - Average value in the reference population)/ Standard deviation of the reference population.

In this study, the Z-score calculation used the ENA software (Emergency Nutrition Assessment) 2007 Version, based on NCHS curves. Nutritional status was classified as follows: normal nutritional status (Z-score greater than or equal to  $-1.00$ ), mild malnutrition (Z-score between  $-2.00$  to  $-1.01$ ), moderate malnutrition (Z-score between  $-3.00$  to  $-2.01$ ) and severe malnutrition (Z-score less than  $-3.00$ ) [8].

- The encoding of data was made using Excel 2013 software on Windows 2013.
- The processing of data was made by using Epi-Info 7 (2013), to generate statistical tests. So was calculated the mean with standard deviation, and the median. When association is performed between two or more parameters, Odds-ratio was generated, with a 95% confidence interval. The p-value significance level is  $<5\%$ .

## 2.8. Ethical Considerations

Respect for the anonymity of patients was respected. The administrative authorizations required for the completion of the data collection were duly obtained.

## 3. Results

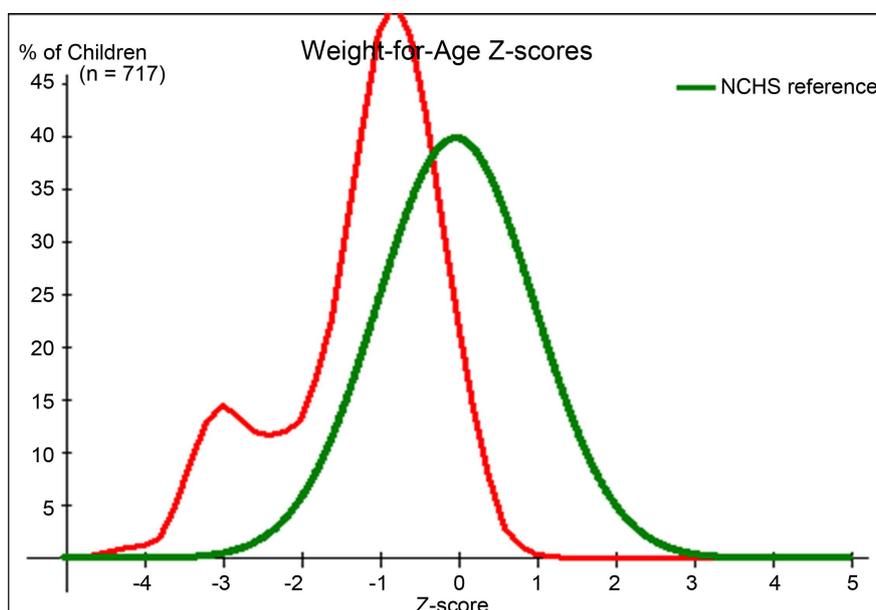
The frequency of tuberculosis in children compared to the total number of patients followed for tuberculosis in Lubumbashi is 717/8699 cases, a frequency of 8.2%.

**Figure 1** shows that the distribution curve of the study population is deviated to the left of the reference Gauss curve, suggesting that part of the population is affected by the weight deficit.

The prevalence of underweight ( $<-2$  z-score) was 20.8% (CI 17.8 - 23.8) (n = 149). It is more frequent for boys with 23.6% (CI 19.3 - 27.9) (n = 89) than girls with 17.6% (CI 13.6 - 21.7) (n = 60).

The prevalence of moderate malnutrition ( $<-2$  z-score and  $\geq-3$  z-score) was 12.4% (10.0 - 14.8 CI) (n = 89). It is more common for boys with 13.3% (9.8 - 16.7 CI) (n = 50) than girls, 11.5% (8.1 - 14.9 CI) (n = 39).

The prevalence of severe malnutrition ( $<-3$  z-score) was 8.4% (6.3 - 10.4 CI) (n = 60). It is more common for boys with 10.3% (7.3 - 13.4 CI) (n = 60) than



**Figure 1.** Distribution of cases according to the Weight-for-Age Z-score.

**Table 1.** Distribution of cases according to the socio-demographic parameters of patients.

	Settings	Number of cases	Percentage	Statistical parameters
Age	<60 months	163	22.7 %	Mean = 100.2 months Extremes = 6 and 168 months Median = 108 months; SD = 47.6 months
	> 60 months	554	77.3%	
Sex	Female (F)	341	47.5%	Sex-ratio F/M = 0.9
	Male (M)	376	52.5%	
Origin	Lubumbashi	656	91.5%	
	Out of Lubumbashi	61	8.5%	

girls with 6.2% (3.6 - 8.7 CI) (n = 21) (**Table 2**).

**Table 3** reveals some significant associations with nutritional status. First, there is 30% of chance for a tuberculous child under 60 months of age to have a poor nutritional status. Then there is a greater chance for tuberculous patients HIV positive to have poor nutritional status (40% more likely) than for HIV negative patients. Finally, there is a 12-fold increase in the chance of recovery in patients with better nutritional status than in those in poor nutritional status.

## 4. Discussion

### 4.1. Limitation of Study

It should be recognized that the nutritional status assessment was not extended to the Weigh- f-height and height-for-age Z-scores, which could have highlighted acute malnutrition and chronic malnutrition, respectively. This is related to the fact that the examination of the patient, often summarized in several TDCTs, forgets to mention the size. The Z-score Weight-for-Age used here is

**Table 2.** Distribution of cases according to the Z-score PPA.

Weight-for-Age Z-score	Cases	Percentage
>-1	365	50.9%
-1 to 2	203	28.3%
-2 to -3	89	12.4%
<-3	60	8.4%

**Table 3.** Factors associated with nutritional status.

Parameters	>-1 Z-score WFA	≤-1 Z-score WFA	P-Value	OR	CI	
Age	<60 months	52	111	0.0000	0.3	0.2 to 0.5
	≥60 months	313	241			
Provenance	Out of Lubumbashi	26	35	0.1760	0.6	0.4 to 1.1
	Lubumbashi	339	317			
TB-HIV Co-infection	HIV+	48	91	0.0000	0.4	0.2 to 0.6
	HIV-	317	261			
Issue	Recovery	335	167	0.0000	12	8.0 - 18.9
	Death or therapeutic failure	30	185			

the reflection of the underweight alone, hence global malnutrition.

## 4.2. Description of the Population

Our study population constitutes 8.2% of the total tuberculosis population monitored in Lubumbashi. This is a high frequency, but it falls within the thresholds of the figures presented in other studies in sub-Saharan Africa, between 6% and 39%. These figures reflect the precarious living conditions of the population, but probably also the result of the high rate of HIV infection, including tuberculosis can be a corollary [9] [10] [11] [12].

In comparison, we know that in developed countries tuberculosis is essentially an adult pathology; an 8-year Taiwan study that found 0.85% of tuberculosis cases in children compared to cases diagnosed in adults [13].

In terms of socio-demographic parameters, most of the patients came from the city of Lubumbashi (91.4%). There is no significant difference in the distribution of cases in relation to sex, with the sex ratio being 0.9.

## 4.3. General Nutritional Status of Patients

According to the EDS II report in the DRC, about 23% of children under five are underweight and 7% in severe form. These proportions are significantly higher than those expected in a healthy and well-nourished population (2.3% and 0.1%, respectively) [14]. In our study, the prevalence of underweight (<-2 z-score) was 20.8%, of which 8.4% was severely malnourished (<-3 z-score). This is supplementary to the nutritional status of the general Congolese population.

Nevertheless, there is evidence of greater risk in patients with a precarious nutritional status to develop tuberculosis. One study highlights the role of vitamin D receptors, influencing the immune response to respiratory infections in malnourished children, particularly in tuberculosis. This also suggests the wider need to supplement these tuberculous children with micronutrients and macronutrients [4] [15]. However, this option is neither explicit nor systematic in the national program for the management of tuberculosis patients in DR Congo.

#### **4.4. Factors Associated with Nutritional Status**

The first factor highlighted as significantly associated with the nutritional status of malnourished is age. Age less than 60 months is associated with a significantly more deleterious nutritional status than age greater than 60 months. In DR Congo, the risk of developing underweight is increased by 5 years (21% of the population at this age) and is already present even in infants younger than 6 months (10% of infants) [14]. This underlines the urgent need to integrate nutritional management into anti-tuberculosis treatment in children in general.

Second, it has been shown that poor nutritional status is significantly associated with positive HIV serology. HIV leads to immunodeficiency, on which tuberculosis finds a propitious ground for development. At the same time, HIV immunodeficiency is itself responsible for a more or less sensitive alteration in the nutritional status of patients. In addition, both malnutrition and HIV negatively influence the risk of developing tuberculosis and the outcome of treatment due to deterioration of the immune defenses mediated by T lymphocytes, hence the association between HIV-TB co-infection and poor nutritional status [16] [17] [18].

Finally, a more favorable outcome was significantly associated with good nutritional status ( $p < 0.001$ ; OR = 12, CI 8.0 - 18.9). Indeed, it is widely recognized that nutrition is an important underbody to the immune response. Malnutrition alone or associated with other pathologies (especially tuberculosis) is one of the leading causes of infant mortality in sub-Saharan Africa [4] [19]. Thus, improving the nutritional status of tuberculous malnourished children would be beneficial in improving their prognosis.

### **5. Conclusion**

This study assessed the nutritional status of children with tuberculosis and treated in a city in the DR Congo. It appears that a significant proportion of children suffer from underweight. It is therefore imperative that a policy of nutritional supplementation for tuberculous children in DR Congo be developed concomitantly with tuberculosis treatment, especially if they are very young or if they suffer from HIV co-infection.

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