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Provision of Anti-Tuberculosis Treatment on Nutritional Status in Children with Pulmonary Tuberculosis at Dr. Moewardi Hospital, Surakarta, Central Java

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ABSTRACT

Background: Tuberculosis caused by Mycobacterium tuberculosis, remains a significant global health issue. In Indonesia, the number of childhood TB cases has risen substantially from 33,366 in 2020 to 56,622 in 2022. TB can contribute to nutritional disorders, while treatment with anti-tuberculosis drugs (OAT) may help improve nutritional status. This study aims to evaluate the differences in nutritional status among toddlers with pulmonary TB before and after receiving OAT treatment at Dr. Moewardi Regional General Hospital, Indonesia.

Subjects and Method: This study utilized a comparative analytical design with a cross-sectional approach and employed a retrospective purposive sampling technique. It was conducted at Dr. Moewardi Regional General Hospital from 2017 to 2024 using a total sampling method, identifying the nutritional status of toddlers before and after OAT administration. The dependent variable was anti-tuberculosis drugs (OAT) treatment The independent variables was nutritional status Resulting in 42 samples that met the inclusion and exclusion criteria for toddlers aged 1–5 years. Data were processed using SPSS and analyzed with the Wilcoxon signed-rank test.

Results: The male gender was higher by 25 people (59.52%) and female by 17 people (40.47%). The highest age sample of toddlers before treatment was 2 years (33.33%) and after treatment 3 years (33.33%). The highest nutritional status before OAT treatment was malnutrition (59.52%) while after treatment it was good nutrition (66.66%). The nutritional status of toddlers was higher (Mean = 2.90; SD = 0.57) than before (Mean = 2.12; SD = 0.63), and this result was statistically significant ($p<0.001$).

Conclusion: There is a significant differences between the nutritional status of toddlers suffering from pulmonary tuberculosis before and after OAT treatment at Dr. Moewardi Regional General Hospital.

Keywords: pulmonary tuberculosis, nutritional status, anti-tuberculosis drugs

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BACKGROUND

Tuberculosis (TB) is a contagius disease caused by Mycobacterium tuberculosis, which can affect individuals of all ages and is easily transmitted through infectious droplets (Wijaya et al., 2021). Indonesia holds the second highest TB burden globally after India, reporting 969,000 cases and approximately 93,000 TB related deaths annually, equivalent to 11 deaths per hour (Ministry of Health of the Republic of Indonesia, 2022) . In 2020, TB incidence worldwide reached 10 million cases, with Southeast Asia accounting for 44% of the global burden, making TB a major public health concern in Indonesia (Dirjen P2P, 2023).

Tuberculosis (TB) remains a significant global health concern. In 2022, it was responsible for approximately 1.3 million deaths, ranking as the second leading cause of mortality from infectious diseases after COVID-19 (World Health Organization, 2023). Moreover, an estimated 54.3% of TB cases go undiagnosed and unreported, largely due to restricted access to diagnostic facilities (Ministry of Health of the Republic of Indonesia, 2020).

In Central Java, TB remains a significant concern. According to the Central Java Statistics Agency in 2021, the TB incidence rate was 114.6 per 100.000 population, with a treatment success rate of 84.3% (BPS Surakarta, 2021). In Surakarta, the number of pulmonary TB cases has steadily increased from 598 cases in 2019 to 2.393 cases in 2023 (BPS Surakarta, 2019). These statistics highlight the growing burden of TB in the region, emphasizing the urgent need for improved diagnosis, treatment, and prevention strategies 2023 (BPS Surakarta, 2019).

WHO declared TB a Global Emergency in 1993 and incorporated it into the Sustainable Development Goals (SDGs) (Perhimpunan Dokter Paru Indonesia, 2021). The End TB Strategy, targeting a 90% reduction in TB mortality and an 80% decrease in new cases by 2030, underscores the urgent need for effective TB management (Wijaya et al., 2021).

Nutritional status is a critical determinant of optimal growth and development. The first 1,000 days of life, spanning from conception to two years of age often referred to as the golden age represent a crucial period characterized by rapid brain development (Fatriyani and Nunung, 2020). Adequate nutritional intake during this stage is essential to ensure optimal physical and cognitive growth (Fatriyani and Nunung, 2020).

The immune response tuberculosis (TB), from primary infection to latent TB and eventually active TB, significantly influences weight loss in TB patients (Téllez-Navarrete et al., 2021). In active TB, catabolic processes lead to an increased basal metabolic rate, thereby elevating the body's energy demands. However, this is often accompanied by a decline in energy intake. Furthermore, the presence of pro-inflammatory cytokines disrupts amino acid and protein synthesis, exacerbating weight loss in TB patients (Téllez-Navarrete et al., 2021).

After anti-tuberculosis drugs (OAT) has been shown to contribute to the improvement of nutritional status among TB patients. Following the completion of OAT, reductions Pro-inflammatory cytokines levels are observed, along with an increase in fatty acid synthesis and a decrease in fat lipolysis, ultimately promoting weight gain (Surahman et al,, 2023). Additionally, OAT has been associated with elevated leptin levels, a hormone that regulates appetite, which may further contribute to post-treatment weight gain (Surahman et al., 2023).

Given the high prevalence of TB in toddlers and the lack of research on diffe-

rences in nutritional status before and after anti-tuberculosis drugs (OAT) treatment, particularly in Surakarta, this study aims to investigate this issue at Dr. Moewardi Regional General Hospital. The findings are expected to contribute to TB management and raise public awareness, ultimately aiding in reducing TB cases.

SUBJECTS AND METHOD

1. Study Design

The study is comparative analytical research with a retrospective cross-sectional design. It utilizes medical record data from Dr. Moewardi Regional General Hospital for the period of January 2017 to August 2024.

2. Population and Subject

Population this study focuses on children aged 1–5 years who have been diagnosed with pulmonary tuberculosis (TB), completed anti-tuberculosis drugs (OAT) treatment, and have been declared cured. The exclusion criteria include patients with incomplete medical record data, such as missing height and weight measurements before and after treatment, children with congenital abnormalities, children diagnosed with pulmonary TB who also have immunodeficiency conditions such as HIV or other immune disorders, and children diagnosed with pulmonary TB who also have chronic diseases such as cancer, diabetes, or thyroid disorders. The sampling method used in this study is purposive sampling, with a total sample size of 42 participants determined through total sampling.

3. Study Variable

The independent variable is OAT treatment, defined as toddlers who have completed both the intensive and continuation phases and were declared cured. It is measured using secondary data from medical records, with a nominal scale. The outcome is categorized as toddlers who completed treatment and were cured. The dependent variable is nutritional status, defined as the adequacy of nutrient intake based on weight-for-length/height. It is also measured through secondary medical record data, using a nominal scale. The outcomes include: severe malnutrition, undernutrition, normal nutrition, at risk of overweight, overweight, and obesity.

4. Operational Definition of Variable

Anti-tuberculosis drugs (OAT) therapy completed by toddlers includes both the intensive and continuation phases, ensuring that the child has been declared cured. The data were obtained from patient medical records.

Nutritional status refers to the adequacy of nutrition, assessed through patient medical records. The nutritional status of toddlers was evaluated using the WHO growth chart, which categorizes weight for length (0–2 years) and weight for height (3–5 years). The data were then classified into two categories: malnutrition (including severe malnutrition and undernutrition) and normal nutrition (including risk of overweight, overweight, and obesity).

5. Study Instrument

The instrument used in this study is the WHO growth chart for assessing the nutritional status of children, which includes weight for length (0–2 years) and weight for height (3–5 years). The data collected consists of the patients' weight and length or height, which are then categorized based on the WHO growth chart before and after anti-tuberculosis treatment (OAT).

6. Data Analysis

Data in this study were processed using SPSS software. The Wilcoxon Signed Rank Test was utilized to compare two paired samples exhibiting a non-normal distribu-

tion. This statistical method is widely applied to evaluate pre and post-treatment measurements within the same group (Syafriani et al., 2023).

7. Research Ethics

Ethical considerations, including anonymity and the confidentiality of medical records, were thoroughly upheld throughout the study. Ethical approval for this research was granted by the Research Ethics Committee of Dr. Moewardi Hospital, Surakarta, Indonesia, under approval number 1.270/V/HREC/2024, issued on May 15, 2024.

RESULTS

1. Sample Characteristics

Based on Table 1, the sample consisted of 42 children with varying characteristics in terms of gender, age, and nutritional status. In terms of gender distribution, the majority were male, totaling 25 children (59.52%), while 17 children (40.47%) were female.

Regarding age, most children were 2 and 3 years old, each group comprising 25 children or 29.76% of the total. This was followed by 1-year-olds (16 children or 19.05%), 4-year-olds (10 children or 11.90%), and the smallest group being 5-year-olds with 8 children (9.52%).

For nutritional status, the largest proportion of children had normal nutrition, accounting for 39 children (46.42%). Undernutrition was identified in 34 children (40.47%), while 6 children (7.14%) were classified as severely malnourished. A smaller group of 5 children (5.95%) were at risk of becoming overweight. Notably, none of the children in this sample were overweight or obese.

Table 1. Characteristic Sample

Characteristics	Frequency (n)	Percentage (%)
Gender		
Male	25	59.52
Female	17	40.47
Age (Years)		
1 year	16	19.05
2 years	25	29.76
3 years	25	29.76
4 years	10	11.90
5 years	8	9.52
Nutritional Status		
Severe malnutrition	6	7.14
Undernutrition	34	40.47
Normal nutrition	39	46.42
Risk of overweight	5	5.95
Overweight	0	0
Obesity	0	0

2. Bivariate Analysis

A normality test was performed on 42 samples to evaluate data distribution before further analysis. Given the sample size of fewer than 50, the Shapiro-Wilk test was applied. The results indicated that the data distribution before and after anti-tuberculosis drug (OAT) treatment was not normal, as the p-value (<0.001) was lower than the significance threshold ($p<0.05$)

If the data met the normality assumption, the Paired T-test would be utilized for

analysis. However, since the assumption was not satisfied, the Wilcoxon Signed Rank Test was employed instead. This statistical approach aimed to assess differences in the nutritional status of toddlers before and after OAT treatment. The Wilcoxon Signed Rank Test yielded a p-value of <0.001, which was below the significance level ($p<0.05$). Consequently, the null hypothesis (H_0) was rejected, and the alternative hypothesis (H_1) was accepted, confirming a significant change in the nutritional status of toddlers with pulmonary TB following OAT treatment (Table 2).

Table 5. Differences nutritional status before and after OAT treatment

Variable	Before Treatment			After Treatment			p
	n	Mean	SD	n	Mean	SD	
Nutritional Status	30	2.12	0.63	30	2.90	0.57	0.001

DISCUSSION

This study collected data from 42 samples, predominantly male children (25 cases). According to Nurjana et al. (2019), male are 1.6 times more likely to be infected with tuberculosis (TB) than female. This is related to male children tendency to engage in outdoor activities more frequently than female, increasing their risk of TB exposure (Nurjana et al., 2019). The number of pediatric tuberculosis cases in Indonesia has increased from 2020 to 2022. In 2020, there were 33,366 reported cases, which rose to 56,622 cases in 2022, with a higher incidence among male than female (Mayestika and Hasmira, 2021). Furthermore, a study by Kristini and Hamidah (2020) reported that pulmonary TB cases across all age groups were more prevalent among male patients than female patients. This may be attributed to male lower awareness of health maintenance and their higher exposure to risk factors compared to women.

The findings of this study are consistent with previous research. A study conducted between 2020 and 2021 at the Cempaka Putih District Health Center reported 54 male pulmonary TB patients (55.7%) and 43 female patients (44.3%) (Mustika et al., 2023). Similarly, a study by Wijaya et al. (2021) on the epidemiology of pulmonary TB in Indramayu Regency found that 66.1% of TB patients were male, while 33.9% were female. Additionally, a study by Amina and Dwi (2019) on the epidemiology of pulmonary tuberculosis at the Pulmonary Clinic of Dr. H. Chasan Boesoirie General Hospital in Ternate in 2018 reported that 73 male patients accounted for 62.4% of total cases.

Young children, particularly toddlers, are at a higher risk of developing pulmonary TB due to their immature cellular immune system (Nevita et al., 2016). In addition to incomplete immune development, children and toddlers are more vulnerable to pulmonary TB infection due to their higher levels of activity and social interaction compared to other age groups (Saleh et al., 2023). Children under five years old are also at a high risk of progression from TB infection to active TB disease (Wijaya et al., 2021). Correspondingly, research by Brajadenta et al. (2018) found that TB cases were more prevalent in the 0–5-year-old age group than in older age groups. This is further supported by a study

conducted by Lulu, Yusroh, and Husin (2018), which identified toddlers as the most affected age group for pediatric TB cases at Al-Ihsan General Hospital from July to December 2017. Additionally, other risk factors may contribute to an increased incidence of pulmonary TB in toddlers. Widyastuti et al. (2021) reported that children aged 1–5 years with poor nutritional status were 1.8 times more likely to develop pulmonary TB.

Furthermore, based on Table 2, data obtained from Dr. Moewardi General Hospital from 2017 to 2024 indicated that the highest number of diagnosed TB cases occurred among 2 years old children. This is closely related to the incomplete development of the immune system, making young children more susceptible to infection (Immawati et al., 2020). This finding aligns with a study by Nevita et al. (2016), which reported that children under the age of 2 are at high risk of developing respiratory diseases. Moreover, children under 2 years old have an extremely high risk (30–40%) of developing progressive primary TB within one year (Wijaya et al., 2021).

Tuberculosis is closely associated with nutritional status. Children suffering from tuberculosis may experience nutritional disorders, often marked by weight loss, which can eventually lead to undernutrition or severe malnutrition (Fatriyani and Nunung, 2020). Weight loss in TB patients may result from suboptimal protein intake, muscle catabolism due to inflammation during infection, an increased metabolic rate, and a reduction in micronutrient levels in the body (Téllez-Navarrete et al., 2021). Additionally, pulmonary TB patients exhibit an increase in the cytokine TNF-α, which is associated with leptin, a hormone that suppresses appetite. Leptin and cholecystokinin (CCK) work together to induce a feeling of satiety, thereby reducing nutrient and mineral intake (Safitri, 2019). This finding aligns with a study conducted by Lulu et al. (2018) at Al-Ihsan General Hospital from July to December 2017, which reported that out of 68 children with pulmonary TB and nutritional disorders, 39 were classified as undernourished, and 29 were classified as severely malnourished.

Table 5 illustrates the nutritional status of toddlers with pulmonary TB before and after anti-tuberculosis drug (OAT) treatment, based on 42 samples. A normality test was performed to assess data distribution. If the data followed a normal distribution, the Paired T-test would be used for analysis; otherwise, the Wilcoxon Signed Rank Test would be applied. The normality test results indicated a non-normal distribution ($p<0.001$, lower than $p<0.05$). Therefore, the Wilcoxon Signed Rank Test was conducted, revealing significant results ($p<0.001$, lower than $p<0.05$). As a result, the null hypothesis (H_0) was rejected, and the alternative hypothesis (H_1) was accepted, confirming a significant change in the nutritional status of toddlers with pulmonary TB following OAT treatment at Dr. Moewardi General Hospital.

Several studies support these findings. A study by Latief et al. (2021) found that pulmonary TB patients who had undergone OAT treatment for more than two months showed improvements in nutritional status. This improvement was attributed to the reduction in infection and the decline in pro-inflammatory cytokines such as IL-1β, IL-6, and TNF-α. This process enhances fatty acid synthesis and reduces fat lipolysis in tissues, leading to increased fat mass and improved nutritional status (Latief et al., 2021). Additionally, a study by Fadila and Meirina (2021) on the effect of intensive-phase OAT therapy on the nutritional status of TB

patients aged 0–5 years revealed a positive impact, showing weight gain after intensive-phase OAT administration.

Early diagnosis of latent pediatric TB and immediate treatment can also prevent the progression to active TB, thereby improving nutritional status, although this is not the case for all patients (Tebandite et al., 2018). Furthermore, a study conducted at Ganting Sidoarjo Health Center examined differences in the nutritional status of pulmonary TB patients aged 15–55 years before and after six months of anti-tuberculosis drugs OAT treatment. The study found a significant difference based on patients' Body Mass Index (BMI) (Amala, 2016). Before OAT treatment, the nutritional status of the patients was as follows: 43 patients (71.7%) had normal nutritional status, 11 patients (18.3%) were undernourished, and 6 patients (10.0%) were severely malnourished. After six months of OAT therapy, there was an improvement in nutritional status, with 53 patients (88.3%) achieving normal nutritional status, 4 patients (6.7%) remaining undernourished, and only 3 patients (5.0%) classified as severely malnourished (Amala, 2016).

There are several limitations in this study. Firstly, this study used retrospective data, which may pose a risk of bias in data collection and recording. Secondly, the sample in this study was obtained from a single healthcare facility, making it unsuitable as a guideline or for comparison with other healthcare facilities in different regions. Additionally, several other factors, such as adherence to OAT consumption, dietary patterns, psychosocial factors, and environmental factors, could not be controlled in this study.

The conclusion of this study is that there is a significant difference in the nutritional status of children with pulmonary tuberculosis before and after OAT treatment at Dr. Moewardi General Hospital. Several recommendations for future research include conducting direct interviews and measurements to obtain more accurate data, expanding the sample size to ensure more representative and generalizable results, and considering other influencing factors, such as adherence to OAT consumption, dietary patterns, psychosocial factors, and environmental factors.

AUTHORS CONTRIBUTION

Ni Nyoman Ratna Sri Dewi was responsible for the conception and design of the study, data collection, data analysis, interpretation of results, and the writing of the manuscript. Pitra Sekarhandini provided overall supervision and guidance throughout the research process until its completion. Aisya Fikritama Aditya contributed specifically to the development and refinement of the research methodology. All authors reviewed and approved the final version of the manuscript for publication.

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CONFLICT OF INTEREST

There is no conflict of interest in this study.

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