

**BODY MASS INDEX (BMI) OF CHILDREN WITH TETRALOGY OF FALLOT (TOF)**

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**ABSTRACT**

**Background:** Malnutrition is a common cause of morbidity and mortality amongst children with TOF. **Objective:** To analyze the BMI profile of children with TOF age 0 – 18 years old at Pediatric Department, Dr. Soetomo General Hospital, Surabaya. **Material and method:** A cross-sectional study of the BMI from the medical record of TOF patients age 0 – 18 years old at the Pediatric Department, Dr. Soetomo General Hospital, Surabaya since January 2016 to December 2017 was conducted. The data included gender, age group, demographic distribution, weight, and height. BMI was calculated by WHO formula reference; body weight (kg) divided by height squared body ( $m^2$ ), which was converted into z-score histogram size. BMI classification was guided by the Government's Anthropometry Standards for Nutritional Status Assessment. **Result:** From 84 TOF patients, there were 43 males (51%) and 41 females (49%). The most dominant age group is 0 – 4 years old ( $n=47;56\%$ ). The majority of patients were from outside of Surabaya ( $n=64;76,2\%$ ). Based on their BMI, 36 patients (42.9%) have severe underweight, 10 patients (11.9%) were underweight, and 35 patients (41.7%) were normal, whilst the rests (3.6%) were overweight. **Conclusion:** In this study, the number of male patients was slightly higher than female patients. The majority of TOF patients were 0 – 4 years old and resided out town of Surabaya. The predominant BMI found was the underweight and severe underweight below of normal BMI. **Keywords:** Tetralogy of Fallot, children, characteristic, Body Mass, Index.

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**Background**

Tetralogy of Fallot (TOF) is a type of cyanosis CHD characterized by 4 abnormal structures of the heart, that are *ventricular septal defect (VSD)*, pulmonary artery obstruction, right ventricular hypertrophy, and *aortic overriding* (Ontoseno, 2014). These abnormalities can disrupt the patient's hemodynamics which results in stunted growth and development in TOF patients. Malnutrition is often found in patients with congenital heart disease (CHD). A study reported that 90.4% of congenital heart disease patients in Nigeria are malnourished. 60% of patients with cyanosis PJB have a malnutrition condition. The condition is associated with anemia, congestive heart failure, poor fat diets, and surgical delays in TOF patients (Okoromah, *et al.*, 2011). In Indonesia, 59% of patients with congenital heart disease in the intensive care unit (ICU) of the pediatric heart at a type A hospital reported experiencing malnutrition. Malnutrition in TOF patients affects the quality of post-surgery. This is indicated by the extended treatment time using a mechanical ventilation machine thereby extending the ICU *stay* (Marwali, *et al.*, 2015). BMI is one of the indicators of nutrition in someone based on a person's weight and height according to gender and age group (Ministry of Health Republic of Indonesia, 2013). The pathology of the TOF interferes with the hemodynamics of the patient's body where perfusion and supply of nutrients to the organs and tissues drops so that it will cause growth and development obstacles. This can be marked by the low BMI in children with TOF (Polat, *et al.*, 2010); although this is still debated, moreover data on BMI in children with TOF has not been widely reported in Indonesia (Wulandari, *et al.*, 2018).

**Objective**

This study was conducted to determine the profile of BMI in TOF patients - children aged 0-18 years old who had been treated at the

Pediatric SMF, Dr. Soetomo General Hospital, Surabaya during 2016-2017.

**Material and Method**

This research is a *cross-sectional* observational study by using the medical record data of TOF patients aged 0-18 years old that were treated at the Pediatric SMF, Dr. Soetomo General Hospital, Surabaya in January 2016 - December 2017. Patients with incomplete/ not found data would be excluded. The variables of this study include gender, age group, demographic distribution, weight, and height. Weight and height data were the data when the patient was first admitted to the hospital. *BMI* Calculation of BMI was carried out by the WHO formula reference; that is body weight (kg) divided by height squared body (m<sup>2</sup>). Data from this study were analyzed by using descriptive statistics including percentile analysis and BMI z-score histograms which were then classified into 4 groups according to the Decree of the Minister of Health of Republic of Indonesia Number 1995 of 2010 concerning Anthropometric Standards for Assessment of Children's Nutrition Status. Classification of BMI in children is the classification based on age at 0 - 60 months; group 1 = severe underweight with a threshold <-3 SD, group 2 = underweight with a threshold of -3 SD up to <-2 SD, group 3 = normal with a threshold of -2 SD up to 2 SD, and group 4 = overweight with a threshold >2 SD (Ministry of Health Republic of Indonesia, 2011).

**Result**

In that period there were 118 pediatric patients diagnosed with TOF, but in the process, 34 files were excluded. Therefore, the sample of data used in this study was 84 patients. From the 84 TOF pediatric patients, there were 43 male patients (51%) and 41 female patients (49%). Detailed descriptive statistical data can be seen in Table 1 and 2.

Table 1. Data on gender, age group, and address of pediatric TOF patients in the Pediatric SMF, Dr. Soetomo General Hospital, Surabaya in 2016 – 2017.

		Male (n)	Female (n)	Total (n)
Age Group	0 – 4	27	20	47
	5 – 10	7	15	22
	11 – 18	9	6	15
Address	Surabaya	9	11	20
	Outside of Surabaya	34	30	64
BMI Category	Severe	14	22	36
	Underweight	7	3	10
	Underweight	19	16	35
	Normal	3	0	3
	Overweight			

Table 2. Comparison of BMI statistical data for pediatric TOF patients in the Pediatric SMF, Dr. Soetomo General Hospital, Surabaya in 2016 – 2017.

	Male	Female	Combined Sex
N	43	41	84
Mean	16.388	13.811	15.130
Std. Error of Mean	1.0937	0.4069	0.6073
Std. Deviation	7.1716	2.6056	5.5656
Variance	51.432	6.789	30.976
Skewness	3.005	0.052	3.686
Std. Error of Skewness	0.361	0.369	0.263
Range	40.0	12.5	40.5
Minimum	8.0	7.5	7.5
Maximum	48.0	20.0	48.0
Percentiles			
- 5	10.524	8.368	9.974
- 25	12.927	12.308	12.627
- 50	14.746	13.350	13.888
- 75	17.244	16.008	16.029
- 95	36.208	18.725	21.957

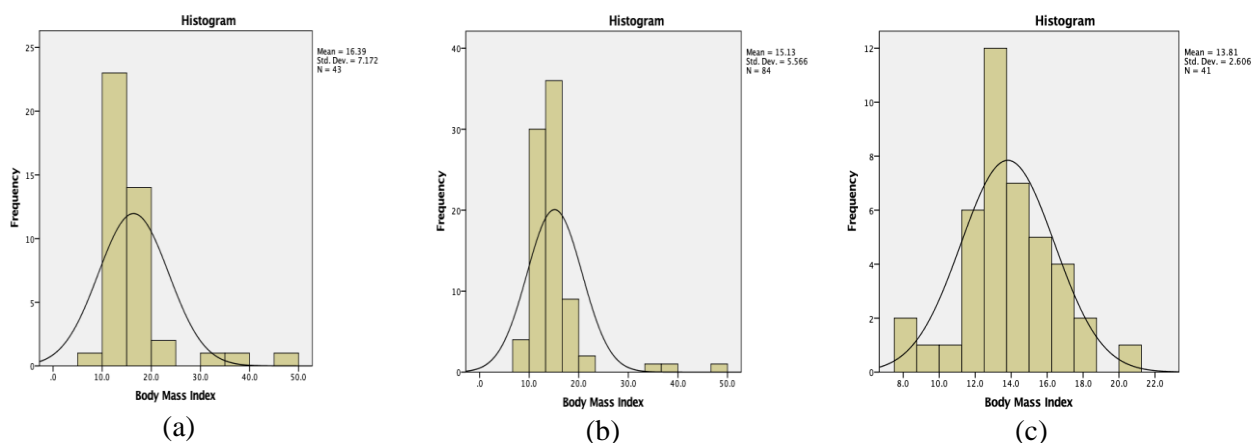


Figure 1. BMI distribution in TOF pediatric patients with male (a), female (b), and combined sex (c).

Based on the result of the study, most dominant patients found in TOF pediatric are in the age group of 0-4 years old, as many as 47 patients (56%). In the age group of 5-10 years old, there were 22 patients (26.2%) and in the age group of 11-18 years old, there were 15 patients (17.9%). From the study, 64 patients (76.2%) were from outside of Surabaya and 20 patients (23.8%) were from Surabaya. In this study, TOF patients included in the severely underweight category were 36 patients (42.9%), the underweight category was 10 patients (11.9%), the normal category was 35 patients (41.7%), and in the overweight category, there were 3 patients (3.6%) (Table 1-2).

### Discussion

From the result of the study, it was found that the number of male patients was slightly higher than female patients. Based on a year of care, TOF pediatric patients who were admitted to the hospital in 2016 were mostly female, while in 2017, the majority was male. Gender is one of the risk factors that is still being debated regarding the correlation with the occurrence of TOF in children. Research in Ontario, Canada showed that there are more TOF girls than boys (van Dongen, *et al.*, 2003). The opposite result was obtained in the study by Valente, *et al.* (2019). The study was based on data from the Center for Congenital Heart in America, Canada and Europe. Based on the result of the study, the number of TOF patients for boys was higher than TOF patients for girls (Valente, *et al.*, 2019).

In this study, the majority of TOF patients were diagnosed in the age group of 0-4 years old. This is not much different from the research conducted by Pozzi *et al.* (2000), where the age of most TOF pediatric patients was in the age range of 0 - 6 years old. It was reported that the handling of TOF patients at the early age did not result in increased mortality; by doing *transannular patch*, it does not cause side effects in the short or medium term, it can even provide several benefits including reducing risk factors for arrhythmias, decreasing the severity of right ventricular hypertrophy and fibrosis, and promoting normal pulmonary vascularization (Pozzi, *et al.*, 2000).

From the analysis of medical record data, most of the TOF pediatric patients came from

outside of Surabaya. This might be due to Dr. Soetomo General Hospital is a referral hospital center for eastern Indonesia. Besides, by using of *Universal Health Coverage* in Indonesia, it makes people get easy to choose the best health facilities. In 2014, the Social Insurance Administration Organization (BPJS) was officially employed as a national health insurance guarantee. The cost of handling a TOF case can be borne by BPJS which includes types of operative and non-operative actions (BPJS Health Insurance, 2018).

Most of the TOF pediatric patients in this study were categorized as 'underweight' and 'severely underweight' based on the BMI classification from the Decree of the Minister of Health of Republic of Indonesia Number 1995 of 2010 concerning Anthropometric Standards for Assessment of Children's Nutrition Status (Ministry of Health Republic of Indonesia, 2011). This is similar to the result of research conducted by Schwartz *et al.* (2017), it was reported that pediatric patients (1 – 15 years) with congenital heart disease (CHD) have an *underweight* prevalence which is higher compared to the general population. *Underweight* condition in patients with CHD can indicate the decrease of *intake* nutrition in patients due to impaired cardiovascular function and respiration; besides the relative hypoperfusion due to cyanosis. This affects the average growth and development rate of TOF children so that it falls below the average of the control group in the same age period. Other factors that can disrupt of growth and development in children with TOF is a fairly long period of CHD management both in conservative and operative therapy; the time of surgery for total correction and *BT-shunt* therapy as well as other tertiary diagnostic therapies that determine a child's stay with TOF can cause nutritional disorders due to chronic physical and psychological stress (Daymont, *et al.*, 2013). In an Egyptian study, it was reported that 84% of patients with poor nutritional status were found in patients with congenital heart defects including TOF; where poor nutritional status or malnutrition is the most frequent complication. TOF causes the patient's hemodynamic condition to be disrupted and causes complications and accompanying pathology including anemia, decreased SaO<sub>2</sub>, heart failure, and pulmonary hypertension which often causes a decrease in

the nutritional status of children with TOF (Hassan, *et al.*, 2015). Correction of operative pre-treatment anemia has been reported to reduce morbidity and mortality in children with TOF, one of which is through iron supplementation therapy (Ontoseno and Soebijanto, 2014; Rose, *et al.*, 2007). Iron supplementation therapy can also reduce hematocrit levels in TOF patients with relative iron deficiency conditions (Ontoseno, 2008).

### Conclusion

From this study, it was found that male patients were slightly more numerous than female patients. Most TOF cases are at the age of 0-4 years old. The majority of patients come from outside of Surabaya. Most pediatric patients with TOF are found in the category below the normal BMI standard.

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