Comparison of 2006 WHO Child Growth Standards and 2005 Growth Diagrams of Indonesian Children: Impact on Burden of Malnutrition

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Abstract

Background: Child nutritional status needs to be assessed accurately so that early and appropriate management can be carried out. Indonesia has launched child growth standards in 2005, known as Growth Diagrams of Indonesian Children (GDIC), while the WHO 2006 child growth standards (WHO-CGS) is currently use as standards to assess growth of Indonesian children.

Aim: This study aims to analyze differences in the interpretation of nutritional status between 2006 WHO-CGS and 2005 GDIC.

Method: This is a cross sectional study. 1162 children aged 0-60 months in five selected villages in a public health center in East Java, Indonesia were included in this study. Interpretation of growth was categorized into weight-for-age, length/height-for-age, and weight-for-length/height based on two growth assessment standards; 2006 WHO-GCS and 2005 GDIC.

Results: 2005 GDIC detected underweight, stunted, wasted, and obese children fewer than the 2006 WHO-CGS. There are significant differences in the interpretation of weight-for-age in girls aged 0-50 weeks ($p<0.001$) and length/height-for-age in children aged 0-60 months ($p<0.001$). While weight-for-length/height showed significant differences in boys aged 0-60 months ($p=0.008$) and aged 6-36 months ($p=0.027$).

Conclusion: 2005 GDIC detects fewer children with malnutrition than 2006 WHO-CGS. The significant difference on interpretation between two growth charts was particularly found in height-for-age.

***Keywords**: 2006 WHO child growth standards, 2005 Growth Diagrams of Indonesian Children, malnutrition, children 0-60 months*

Introduction

Malnutrition is one of the important public health problems, affecting more than 900 million people worldwide. It is responsible for the highest death rates in children and has long-term physiological impacts. Malnutrition in children has been linked to poor mental development and school performance as well as behavior disorders. [1] Children's height for 2 years of age is the best predictor of human capital, therefore malnutrition is associated with lower human capital. Damage suffered early in life leads to permanent decline and may also affect future generations. Malnutrition prevention might bring important health, educational, and economic benefits. Chronic diseases are especially common in malnourished children who gain rapid weight gain in their growth.[2] Cooperation of all stakeholders is needed to act to overcome malnutrition. [3]

The prevalence of underweight children under five years old within the world in 2011 is estimated at 16% (101 million) and has shown a decrease from 1990 with 159 million. The prevalence of stunted and very stunted toddlers in the world in 2016 was 22.9% (155.8

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million). But this data has shown a decrease compared to 2011 which was 26%. [4] The 2018 national prevalence of underweight and stunted children is higher than the world prevalence (17.7% and 30.8%, respectively), but it shows lower prevalence than 2013 national data (19.6% and 37.2% respectively). [5] Those prevalence rates were obtained from interpretations of nutritional status using the 2006 WHO child growth standards (2006 WHO-CGS).

Large number of malnutrition prevalence becomes national priority program and concern in daily clinical management. Nonetheless, several studies have concluded that the interpretation of nutritional status using the WHO child growth standards results in overestimation of malnutrition prevalence rate. [6–10] Those studies were conducted to compare interpretation between the 2006 WHO-CGS growth chart and the national growth charts of each country. This suggests that specific factors play a role to affect child growth in each country.

Indonesia has developed 2005 growth diagrams of Indonesian children (2005 GDIC), even though it has not been widely used.[11] This research will analyze the different interpretations between 2006 WHO-CGS and 2005 GDIC, and also underline the importance of using national growth charts to measure nutritional status more accurately.

Method

This study was cross sectional study conducted on October-November 2017. Secondary data were obtained from medical record of five selected villages in the working area of Berbek community health center in East Java, Indonesia. A total of 1162 boys and girls aged 0-60 months who took part in the routine Pos Pelayanan Terpadu (posyandu)/integrated healthcare center in their respective villages on August 2017 were included in this study. Patients with congenital anomalies, chronic diseases, or patients taking long-term corticosteroids were not included in the study.

The selection of five villages from nineteen villages was chosen used simple random sampling. Children were divided into boys and girls, and each sex group were divided into three age groups; 0-5 months, 6-36 months, and 37-60 months. Anthropometric data was collected, both weight (kg) and length/height (cm). The data were plotted based on its nutritional status using two growth charts, the 2006 WHO-CGS and 2005 GDIC. The nutritional status is categorized into weight-for-age, length/height-for-age, and weight-for-length/height. The data were statistically analyzed through comparison test using the Wilcoxon Signed-rank Test. $p<0.05$ was considered significant.

Results

Table 1 shows the sample characteristics of children. From a total of 1162 children under five the majority of children were male (53.4%) and their age were 6-36 months (55.5%). Measurements using the two growth charts cannot be done in all age groups because the weight-for-age diagram of 2005 GDIC is only available for children aged 0-50 weeks and weight-for-length/height diagrams of 2005 GDIC is only available for children with length/height <60 cm. Of about 1162 children, only weight-for-age of 374 children were measured using those 2 standards, and only weight-for-length/height of 1094 children were measured using those 2 standards. However, length/height-for-age can be measure in every sex and age groups. The total prevalence of underweight, stunted, wasted, and obesity among children was smaller when interpreted using 2005 GDIC growth chart.

Table 1. Characteristics of children and prevalence of stunted, underweight, and obesity among children

Characteristics	n (%)	Mean±SD
Sex		
Male	621 (53,4%)	-
Female	541 (46,6%)	

***Cont.*. Table 1. Characteristics of children and prevalence of stunted, underweight, and obesity among children**

Age		
0-5 months	152 (13,1%)	-
6-36 months	645 (55,5%)	
37-60 months	365 (31,4%)	
Height	-	
0-5 months		58,33 ± 5,30
6-36 months		77,11 ± 9,04
37-60 months		95,79 ± 6,21
Weight	-	
0-5 months		6.15 ± 1.25
6-36 months		10.14 ± 3.92
37-60 months		14.34 ± 2.41
	WHO 2006	GDIC 2005
Underweight (0-50 weeks)	20 (5,34%)	3 (0,80%)
Stunted (0-60 months)	346 (29,8%)	24 (2,06%)
Wasted (0-60 months)	42 (3,83%)	0 (0 %)
Obesity (0-60 months)	91 (8,31%)	22 (2,01 %)

Most of children have normal weight-for-age, both according to 2006 WHO-CGS or 2005 GDIC. 2005 GDIC detects fewer underweight children in both sexes and fewer obese boys than 2006 WHO-CGS. The difference of weight-for-age interpretation was significant only for girls ($p<0.001$). Most of children have normal weight-for-length/height, both according to 2006 WHO-CGS or 2005 GDIC. 2005 GDIC detects fewer both wasted and obese children than 2006 WHO-CGS. The difference of weight-for-length/height interpretation was significant only for boys aged 0-60 months ($p=0.008$) and boys 6-36 months ($p=0.027$).

Height interpretation based on age comparison on male toddlers 0-60 Months old, 0-5 Months old, 6-36 Months old, 37-60 Months old ($p<0.000$)

Discussion

Abnormalities of child growth either under-nutrition or over-nutrition are associated with morbidity and mortality as well as long term impacts in adulthood, such as cardiovascular and metabolic disease [12]. Therefore, precise measurement of growth is important to monitor child health and prevent malnutrition.

This study shows that both growth charts mostly detect normal growth in our study participants. Prevalence of national under-five underweight, stunted, and wasted children were higher (17.7%, 30.8%, 10.2%, respectively), but obese children was fewer (8.0%) than prevalence found in this study. However, prevalence of stunted children in this study was higher than world prevalence in 2016. [4]

2006 WHO-CGS detects more underweight,

stunted, wasted, and obese children than 2005 GDIC. However, significant differences were only found in weight-for-age of girl, height-for-age of all age and sex groups, weight-for-length/height of 0-60 months boys, and 3-36 months boys.

This indicates that Indonesian children are lighter and shorter than the standard population used to develop the 2006 WHO-CGS.[13] Previous study also suggest that the nutritional status of Indonesian children according to weight-for-length/height tends to be the same as the population of American children because Indonesian children are lighter and shorter. [11]

Weight-for-age interpretation was only significantly difference in 0-50 weeks girl, and weight-for-age interpretation was only significantly difference in 0-60 months boys and 3-36 months boys. This suggests that gender plays an important role in child growth. Genetic expressions that affect body weight appear to be significantly higher in girls starting at 9 months compared to boys. [14]

Racial factor is thought to be associated with child growth difference between Indonesian and American populations. But the influence of race in child growth is still controversial. Despite differences in race, WHO *Multicentre Growth Reference Study Group* (2006) found similar child growth rate among their subjects. It is thought that environmental factor such as nutrition have more impact on child growth, because poor nutrition and infection can increase risk of stunted children. [15] Previous review also indicate that application of specific racial and ethnic groups growth chart is not recommended because child growth are more affected by environmental factors rather than genetic factors .[16] Therefore, WHO recommends to use only one growth chart for all child populations in the world. [17]

However, some studies show that the interpretation of height-for-age using WHO chart shows different result than interpretation using height-for-age national chart of some countries .[18] Racial difference in child growth is a fact but this phenomenon is caused by inequality in environmental factors such as economics, psychosocial, and cultural factors that affect minority groups. However, previous study has shown the biological influence on child growth. Hong Kong Chinese children is shorter than WHO growth standards as a result of epigenetic constrains on growth rather than environmental factors [19]. Lipid metabolism, fat distribution, and bone age are also related to race/ethnicity. African American children have less visceral and hepatic fat, lower rates of lipolysis, and lower adiponectin than white children. African American and white children bone age mature slower than Asian and Hispanic children.

A meta-analysis from 55 countries also showed that the standard devation score, (SDS) of European children in general are +0.5 SD, while children from Saudi Arabia and India are -0.5 SD compared to the WHO 2006 chart reference population [20]. Research by Batubara et al (2006) also shows that Indonesian children have lower SDS than the 2000 CDC chart reference population [11]. This data shows that there are different characteristics of child growth in various regions.

The different interpretations of two growth chart in this study indicate that estimation of children malnutrition in Indonesia using 2006 WHO-CGS is exaggerated, and perhaps Indonesian children have grown in accordance with their genetic potential. This can lead to unnecessary examination and intervention which can interfere exclusive breastfeeding and cause excessive supplemental feeding [7]. Formula milk and excessive supplementation of food can cause excess weight which will be accompanied by long-term complications in the future. It must be considered in the national policy of malnutrition management in Indonesia. However, because children's growth is not only influenced by race or genetic factors, good environmental factors must also be considered. Interventions to correct problems that affect the nutritional status of the population such as lack of breast milk, low or high calorie food, lack of health facilities, sanitation, and poverty must be continued [17].

This study also has several limitations. Our study analyzed secondary data collected from integrated healthcare center, hence anthropometric measurements tend to vary in each center. Nutrient intake including breast milk and parent socioeconomic status were not evaluated. This might lead to some bias in evaluating differences in interpretation of nutritional status.

Application of growth chart that developed from Indonesian children as standard population should be considered in estimating children with malnutrition. Further study is needed to confirm whether the interpretation of child nutritional status using growth chart is consistent with their clinical condition and also to determine whether Indonesian children have grown

according to their genetic potential.

Conclusion

2005 GDIC detects fewer children with malnutrition than 2006 WHO-CGS. The significant difference on interpretation between two growth charts was particularly found in height-for-age.

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