Mid-Upper Arm Circumference to Predict Malnutrition

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The double burden of malnutrition (under- and overnutrition) is a serious public health issue in childhood. The mid-upper arm circumference (MUAC) is a simple tool for screening nutritional status, but studies of the optimal cutoff to define malnutrition are limited. This study aimed to explore the prediction of malnutrition by MUAC in Sri Lankan schoolchildren. The participants were 538 students (202 boys, 336 girls) aged 5–10 years. Spearman's rank correlation was calculated for MUAC and both body-mass-index-for-age z-score (BAZ) and height-for-age z-score (HAZ). Receiver operating characteristic (ROC) analysis was conducted to assess the ability of MUAC to correctly classify malnutrition, after stratifying for age and birth weight. MUAC correlated significantly with BAZ (r = 0.84) and HAZ (r = 0.35). The areas under the ROC curve for thinness, overweight, obesity, and stunting were 0.88, 0.97, 0.97, and 0.77, respectively. The optimal MUAC cutoff values for predicting thinness and stunting were 167.5 mm and 162.5 mm, respectively; the optimal cutoffs for predicting overweight and obesity were 190.5 mm and 218.0 mm, respectively. These cutoffs differed after stratification by age group and birth weight. Our results confirm MUAC to be a useful tool for monitoring growth in schoolchildren.

Keywords: child malnutrition ; anthropometry ; mid-upper arm circumference ; BMI-for-age z-score ; height-for-age z-score ; thinness and stunting ; overweight and obesity ; cutoffs ; schoolchildren ; Sri Lanka

1. Introduction

Child malnutrition is a serious public health concern worldwide [1]. In urban Sri Lanka, approximately one in three primary-school children suffer the double burden of malnutrition (thinness or overweight/obesity), defined by the World Health Organization (WHO) Child Growth Standards as body mass index (BMI)-for-age z-score (BAZ) that is <−2 standard deviation (SD) and >1 SD, respectively [2]. Stunting (low height-for-age) is also recognized as a critical indicator of chronic undernutrition in assessing child growth and development, and the proportion of stunting among children aged 5–6 years old is estimated at 8.7% in Sri Lanka [3]. Early detection of and intervention against childhood malnutrition are important, given the lifelong adverse impacts of thinness, stunting, and overweight on academic performance and economic productivity [4], health-related quality of life [5], metabolic syndrome [6], and adult mortality [7].

2. Role of MUAC

Measurement of mid-upper arm circumference (MUAC) provides a simple and reliable tool for screening nutritional status and also enables rapid assessment of large populations in epidemiological field study. Traditionally, MUAC has served as a practical proxy measure of undernutrition and in particular, of severe acute malnutrition among infants, children under 5 years [8], and pregnant women [9]. A study of Cambodian infants under age 30 months showed the probability of acute malnutrition as defined by MUAC, varies with height-for-age z-score (HAZ) [10]. Further, repeated cohort studies have shown MUAC to be a good predictor of mortality risk in Gambian infants [11], Southeast African children and adolescents [12], and in Taiwanese older adults [13]. Despite this, there are no universally established age- and sex-specific MUAC cutoff values for identification of undernutrition in children over 5 years.

Recently, MUAC was found to be highly accurate for detecting overweight in schoolchildren in South Africa [14] and the Netherlands [15], but the cutoffs for overweight in schoolchildren established in both studies were inconsistent. There have been few studies examining MUAC cutoffs for overweight in Asian children over 5 years. Furthermore, one study in Delhi showed that birth weight affects nutritional status in schoolchildren [16]; based on this finding, a birth weight–stratified MUAC cutoff will more accurately identify vulnerable children.

In this study, we aimed to identify the MUAC cutoff values that best predict malnutrition (under- and overnutrition) in primary school children aged 5–10 years. The second aim was to obtain more accurate MUAC cutoff values for school children in Sri Lanka, where low birth weight is prevalent.

3. Conclusions

Our findings showed that MUAC is a good predictor of malnutrition (under- and overnutrition) in Sri Lankan schoolchildren and that MUAC cutoff values for malnutrition differ according to age group and birth weight. Easily performed, regular growth monitoring with the MUAC should be undertaken for ongoing assessment of nutritional status in schoolchildren.

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