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Unveiling nutritional inequalities: Anthropometric measures among socio-economically disadvantaged groups in Palakkad, Kerala

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Abstract

The nutritional status of preschool children plays a critical role in their overall growth and development. This study explores the correlation between various anthropometric measures—height, weight, BMI, Mid-Upper Arm Circumference (MUAC), head circumference, and skinfold thickness—in 150 preschool children aged 0-6 years from Scheduled Caste (SC) and Scheduled Tribe (ST) communities in Palakkad district, Kerala. The findings reveal strong positive correlations between height and weight, underlining their significance as indicators of growth and nutritional health. Additionally, height showed positive associations with MUAC, head circumference, and skinfold thickness, suggesting that taller children tend to have better muscle and fat reserves and more advanced cranial development. Weight also demonstrated positive correlations with MUAC, head circumference, and skinfold thickness, highlighting its role in assessing overall nutritional status. The study further identifies a negative correlation between BMI and height, suggesting the limitations of using BMI as a standalone measure, particularly in populations with varied body types. These results stress the importance of adopting a multidimensional approach to assessing nutritional health, utilizing a combination of anthropometric measures for more accurate evaluations. The findings have important implications for improving nutrition interventions and health strategies aimed at enhancing child well-being in marginalized communities.

Keywords: Anthropometric measures, nutritional status, preschool children, BMI, MUAC, scheduled caste, scheduled tribe

Introduction

Every country and society's future relies upon the children. They are the first sign of progress and change of society. The effectiveness with which a community or nation nourishes, safeguards, and looks after its most vulnerable citizens is reflected in its child welfare systems (Kalitha and Deshpande, 2011) [1]. Brain development in children aged 0–6 is crucial as it lays the foundation for their future. Understanding early brain functions aids in fostering development and designing age-appropriate activities (Bredekamp, 2017) [2]. Good nutrition is vital for reducing chronic illnesses which affect both the privileged and the poor, as well as diseases linked to poverty (Banerjee and Duflo, 2011) [3]. Because adequate and balanced nutrition is a key determinant of healthy physiological and psychological growth and development (Sharma, Chuang, & Hedberg, 2011). [4]

Tribal population comprises 8.6 per cent in India, which is considered the most prominent country with low incomes. India continues to have difficulties addressing the disparity in healthcare between its indigenous and non-indigenous populations (Kumar *et al.*, 2020) [5]. In 2018, an estimated 6.2 million children under 15 died, mostly from preventable causes, with 5.3 million deaths in the first five years. Leading causes included malnutrition, pneumonia, birth complications, and congenital defects (UNESCO, 2019) [6]. A cross-sectional study in 25 children. It also revealed severe stunting in 9% of tribal and 8.9% of non-tribal female children. (Raju *et al.*, 2021) [7].

This study evaluates the correlation with height, weight, BMI, MUAC, head circumference, and skinfold thickness in 150 preschool children aged 0-6 from Scheduled Caste and Scheduled Tribe communities in Palakkad district.

Materials and Methods

Location of study

The study was conducted in Palakkad district, Kerala specifically targeting various blocks and municipalities where Scheduled Caste (SC) and Scheduled Tribe families resides.

Selection of Respondents
150 preschoolers who regularly attended Anganwadi centres were chosen at random from families belonging to Scheduled Caste (SC) and Scheduled Tribes (ST) for assessing the nutritional status.

Design of study
A cross sectional observational study was utilized for gathering different variables, from Anganwadi teachers and parents using suitable structured questionnaires.

Nutritional status assessment
The nutritional status of preschool children was assessed using standard techniques of anthropometric, clinical examinations and dietary profile.

Anthropometric measurements
Height, weight, mid upper arm thickness (MUAC), head circumference, skin fold thickness was taken under anthropometric measurements in this study and were collected using Stadiometer, spring scale, MUAC tapes, flexible metal tape and skinfold caliper.

Result and Discussion

Table 1: Correlation Analysis

	Height(cm)	Weight(kg)	BMI	MUAC	Head circumference	Skinfold thickness
Height	1	0.754***	-0.256**	0.614***	0.645***	0.559***
Weight	0.754***	1	0.492***	0.508***	0.531***	0.482***
BMI	-0.256**	0.492***	1	-0.114	-0.094	-0.051
MUAC	0.614***	0.508***	-0.114	1	0.589***	0.499***
Head Circumference	0.645***	0.531***	-0.094	0.589***	1	0.479***
Skinfold thickness	0.559***	0.482***	-0.051	0.499***	0.479***	1

*** Correlation is significant at 0.001 level (two tailed)
** Correlation is significant at 0.01 level (two tailed)
* Correlation is significant at 0.05 level (two tailed

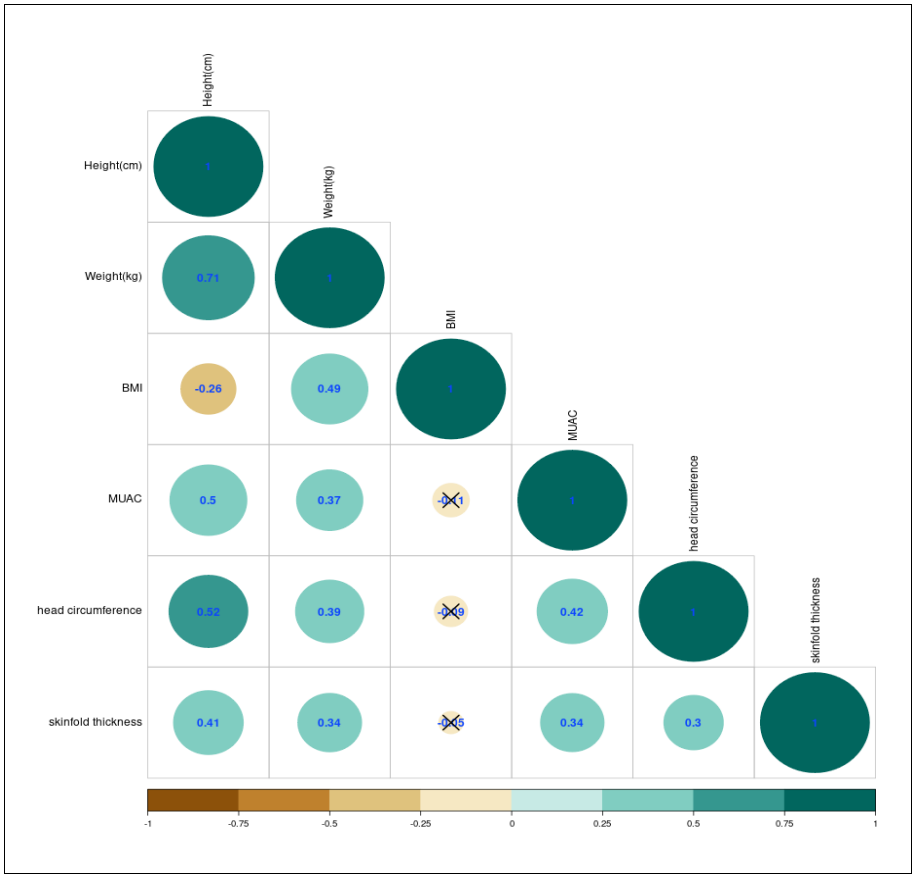

Fig 1: Correlogram

The correlation analysis presented in Table 1 reveals significant relationships between various anthropometric measures, highlighting the interconnectedness of these variables in assessing growth and nutritional status. Height and weight were strongly positively correlated ($r = 0.754$, $p < 0.001$), consistent with the expectation that taller individuals tend to have higher body weight. This positive association underscores the importance of considering both height and weight together when evaluating physical development. A study conducted by Black *et al.*, (2013) [8] supports this, suggesting that height and weight are among the most reliable indicators of growth during early

childhood, as they reflect the overall nutritional and health status of children

Furthermore, height was positively correlated with other body measurements, including Mid-Upper Arm Circumference (MUAC) ($r = 0.614$, $p < 0.001$), head circumference ($r = 0.645$, $p < 0.001$), and skinfold thickness ($r = 0.559$, $p < 0.001$), suggesting that taller individuals tend to exhibit greater muscle and fat reserves as well as more advanced cranial development. These correlations reflect overall growth and development, indicating that height is a key factor influencing other body measures. A study by Lozoff *et al.,* (2006) [9] found that taller children tend to have more developed muscle mass and fat stores, both of which are closely related to overall growth and nutrition.

Weight also demonstrated positive correlations with MUAC ($r = 0.508$, $p < 0.001$), head circumference ($r = 0.531$, $p < 0.001$), and skinfold thickness ($r = 0.482$, $p < 0.001$), further emphasizing the relationship between body mass and other components of body composition. The positive correlation with MUAC indicates that individuals with higher body weight tend to have larger arm circumferences, which are critical indicators of nutritional status, particularly in evaluating muscle and fat stores. The association with skinfold thickness suggests that higher body weight is linked to greater subcutaneous fat accumulation, another important marker of nutritional status. The findings of NCHS (2000) [10], which noted that MUAC can be particularly useful in assessing malnutrition, especially in settings where weight and height measurements may not always be available.

BMI showed a negative correlation with height ($r = -0.256$, $p < 0.01$), which may reflect the tendency for shorter individuals to have higher BMI values relative to their weight. This inverse relationship highlights the limitations of BMI as a sole indicator of nutritional status, particularly in populations with varying statures. BMI was positively correlated with weight ($r = 0.492$, $p < 0.001$), as expected, but the modest strength of this correlation suggests that other factors, such as body composition (fat vs. lean mass), also influence BMI values.

MUAC exhibited significant positive correlations with height ($r = 0.614$, $p < 0.001$), weight ($r = 0.508$, $p < 0.001$), and head circumference ($r = 0.589$, $p < 0.001$), underscoring its role as an important measure of muscle and fat stores which is consistent with studies by Shrimpton *et al.*, (2001), who found MUAC to be a strong predictor of nutritional status and an effective screening tool for identifying children at risk of malnutrition. The correlation with head circumference highlights the link between overall body growth and brain development, particularly in young children where proper nutrition is critical for both physical and cognitive development. Head circumference itself was positively correlated with height ($r = 0.645$, $p < 0.001$), weight ($r = 0.531$, $p < 0.001$), and MUAC ($r = 0.589$, $p < 0.001$), supporting its use as a key indicator of cranial and brain development.

Finally, skinfold thickness showed positive correlations with height ($r = 0.559$, $p < 0.001$), weight ($r = 0.482$, $p < 0.001$), MUAC ($r = 0.499$, $p < 0.001$), and head circumference ($r = 0.479$, $p < 0.001$), reflecting its role as an indicator of subcutaneous fat. These findings emphasize that children with higher body measurements, such as greater height, weight, and MUAC, tend to have higher levels of subcutaneous fat, which is an important consideration in assessing overall nutritional health.

Conclusion

In conclusion, this study provides valuable insights into the correlations between key anthropometric measures—height, weight, BMI, MUAC, head circumference, and skinfold thickness—among preschool children aged 0-6 years from Scheduled Caste and Scheduled Tribe communities in Palakkad district. The results highlight the interconnectedness of these variables in evaluating malnutrition and overall nutritional status. Strong positive correlations between height and weight confirm their critical role as reliable indicators of growth and health in early childhood. Additionally, height was positively associated with other body measurements, such as MUAC, head circumference, and skinfold thickness, suggesting that taller children tend to have better-developed muscle and fat reserves, as well as appropriate cranial growth, all of which are essential for preventing malnutrition. The negative correlation between BMI and height reveals the limitations of BMI as a standalone measure, particularly in populations with varying body types, reinforcing the need for complementary indicators like MUAC and skinfold thickness to more accurately assess malnutrition. This study underscores the importance of a multidimensional approach to assessing nutritional health, as no single anthropometric measure can provide a complete picture. The findings emphasize the need for comprehensive monitoring strategies that combine multiple indicators to accurately identify malnutrition and inform targeted interventions, particularly in vulnerable populations. These results contribute to the growing body of evidence supporting the use of a range of anthropometric measures in the assessment and prevention of malnutrition, offering valuable implications for public health practices and policy.

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