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Original Research Article

Anthropometry of Pre-School Children in a Slum Area of Thane City

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Abstract

This complete enumeration, cross-sectional, descriptive study was conducted in a slum area of Kalwa, in Thane city, Maharashtra state, India. Anthropometric measurements were carried out on 326 pre-school children (girls: n=146; 44.78% and boys: n=180; 55.22%) aged between 3 and 5 years, so that interventional measures could be initiated. Amongst the study participants, the gender differences in weight-for-height, body mass index and mid upper arm circumference was not statistically significant. When compared with Child Growth Standards of the Indian Association of Paediatrics, both the body mass index and mid upper arm circumference were significantly lower in both sexes, across the three age groups. The present study revealed the ubiquitous existence of under-nutrition without significant gender-related bias among pre-school children. Since under-nutrition in childhood is related to slower cognitive development and substantial deleterious health effects later in life, it is necessary to undertake a multi-pronged approach comprising maternal nutrition education, promotion of infant and young child feeding practices and nutritional supplementation programmes.

Keywords: Anthropometry, Pre-school children, Slum area.

INTRODUCTION

The word "anthropometry" is derived from the Greek words: *anthropo* (human) and *metron* (measure) and pertains to measurement of a range of parameters in humans. Human measurements were obtained in ancient times for selecting sturdy men for military service and to pick out slaves for hard labour. Alphonse Bertillon (1853-1914), who is considered the father of anthropometry, devised a classification system based on anthropometric measurements of criminals in custody to identify repeat offenders. Human measurements are obtained for determining nutritional status, designing furniture, planning seating arrangements in vehicles, and for manufacturing ready-made garments and footwear. The statistical data pertaining to body dimensions are utilized to optimize products for various ethnic groups. Three-dimensional scanners are now available to carry out anthropometric measurements.

Anthropometry of pre-school children is an easy and cost-effective community-based method for detecting hidden under-nutrition [1]. Besides triggering vulnerability to a gamut of infections, under-nutrition in pre-school children also adversely affects academic performance and reduces work capacity and productivity in later years and thus, the damaging effects of under-nutrition can potentially reduce a nation's economic growth [2]. Livelihood-driven rural-urban migration causes considerable inequalities in health-related conditions [3]. Studies from developing countries have reported high frequencies of under-nutrition among children living in urban slums [4-6]. Most under-nourished children live in urban slums and belong to disadvantaged families. An estimated one-third of India's urban population will be dwelling in slums by the year 2020 [7].

Slums are heterogeneous contiguous settlements, where the inhabitants reside in a cluster of dilapidated dwellings that lack privacy, have public or no toilet facilities, are deficient in basic amenities, with inadequate arrangement for drainage and for disposal of solid wastes and garbage [8, 9]. Though slum dwellers experience higher levels of socioeconomic disadvantage as compared to other urban residents, not all families living in slums are poverty-stricken or uneducated [10]. The concept of a slum may exhibit national, inter-state and inter-city differences depending on the prevailing socio-economic conditions and social perceptions [11]. As per Census 2011 data, the slum population constitutes about 23% of the total urban population, [12] but the Indian data on slum dwellers would be not in agreement with that of the United Nations, which would include all deprived and impoverished areas, and not just those recognized as "slums" by the Indian

government [11]. Technically, pavement dwellers do not live in "slums" and are usually not considered as "slum dwellers" [13]. Frequently, a slum is not accepted by the public authorities as an integral or equal part of the city [9]. In India, though a notification as a "slum" settlement is a pre-requisite for provision of potable water supply and sanitation, many settlements exhibiting slum-like characteristics are never notified [14].

The objective of the present study was to determine anthropometric measurements of pre-school children in order to identify under-nutrition and initiate interventional measures.

Materials and Methods

This complete enumeration, cross-sectional, descriptive study was conducted in July-August 2018 in Shantinagar slum area of Kalwa (East) in Thane city, Maharashtra state, India. This slum area has a population of about 16,000, of which, about two-thirds comprise migrants from various parts of India. In addition to an Urban Health Post, which provides both clinic-based and outreach health care services in this slum area, primary level health care and pre-primary level education – nursery and kindergarten (KG) – are provided by a non-governmental organization (NGO). The anthropometric measurements were carried out on pre-school girls and boys who were enrolled in nursery (3-year olds), junior KG (4-year olds) and senior KG (5-year olds) after obtaining consent of school authorities and parents.

The height, weight and mid upper arm circumference (MUAC) were measured by the same observer using the same measuring instruments to prevent inter-observer and inter-instrument errors. Height was measured in metres using a measuring tape hoisted on a vertical wall, with the child standing in erect position without shoes or headgear with head in Frankfort plane, feet together, heels, buttocks and upper part of the back touching the hoisted measuring tape [15]. All children were asked to empty their bladder before they were weighed. Body weight was measured, before lunch, in kilograms, using a pre-calibrated digital weighing scale (OMRON Healthcare India Pvt. Ltd., Gurgaon, Haryana), with the child standing evenly on both feet without footwear, wearing normal indoor clothing [15].

The body mass index (BMI) was calculated by dividing the weight (in kilograms) by the square of the height (in metres). The BMI of the participants in the study was compared with the Child Growth Standards of the Indian Association of Paediatrics (IAP), 2006 [16], which are age-related standards for children.

The MUAC was measured in centimetres mid-way between the tip of acromion and olecranon process, using standard MUAC tape (UNICEF S0145620 MUAC, Child 11.5 Red/PAC-50) with the left arm hanging relaxed, with the child wearing normal indoor clothing and the sleeves rolled up. The MUAC of the participants in the study was compared with the IAP Child Growth Standards, 2006 [16].

Categorical data were presented as frequencies or percentages and continuous data as Mean and Standard deviation (SD). The 95% Confidence Interval (CI) was expressed as: "[Mean–1.96*Standard Error] – [Mean+1.96*Standard Error]". The data were analyzed using EpiInfo Version 7.0 (public domain software package from Centre for Disease Control and Prevention, Atlanta, GA, USA). The level of statistical significance was set at $p<0.05$.

Results and Discussion

Anthropometric measurements were carried out on a total of 326 pre-school children aged between 3 and 5 years – 146 (44.78%) girls and 180 (55.22%) boys. More than half of the world's undernourished people live in India. 54% children are under-weight, 52% are stunted, while 17% are wasted [17]. In the present study, 146 (44.78%) of the 326 pre-school children were girls. This finding could possibly indicate apparent lack of gender bias regarding school enrolment among slum-dwelling parents in the study area, perhaps due to continuing campaign for female education by various government and non-government organizations. A Varanasi-based study [18] found a high proportion of males in their study cohort while other studies [19, 20] have reported a female preponderance.

Weight-For-Height

In the present study, the proportion of children with below-normal weight-for-height was higher among 3-year old and 5-year old girls, as compared to their male counterparts. Among 3-year olds, 20.97% girls and 16.33% boys had below-normal weight-for-height but the gender difference was not significant ($Z=0.628$; $p=0.530$). The percentage of 4-year old girls and boys with below-normal weight-for-height was 12.07% and 21.43%, respectively, with no significance ($Z=1.512$; $p=0.130$) in the gender difference. Among 5-year olds, 34.62% girls and 19.15% boys had below-normal weight-for-height and the gender difference was not significant ($Z=1.412$; $p=0.158$). Studies conducted in urban slums of Berhampur, Odisha [21] and Rohtak, Haryana [22], have also reported no significant gender difference in prevalence of under-nutrition. In contrast, a Gujarat-based study [23], and a Pune-based study, [24] have reported higher prevalence of under-nutrition among in girls, compared with boys. In India, about 43% of under-five children are underweight (weight-for-age), 48% are stunted (height-for-age), and 20% exhibit signs of wasting (weight-for-height) [25]. The prevalence of under-nutrition among slum-swelling pre-school children in this study was much less than that reported by studies conducted in Kolkata [26], Nagpur

[27], Rohtak [22], Varanasi [28], and Vishakhapatnam [29].

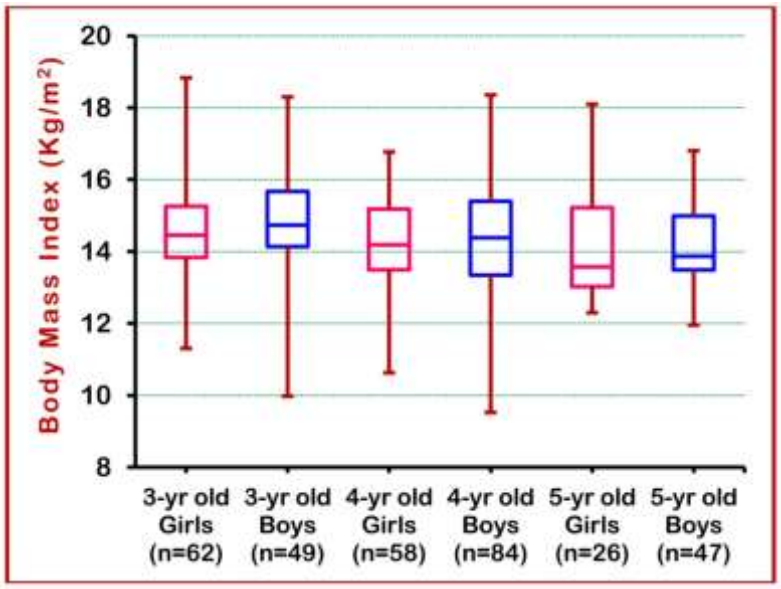

Fig-1: Boxplot of body mass index

Table-1: Gender distribution of BMI

Age	Gender (n)	Body mass index (Kg/m^2)				
		Mean	SD	95% CI	Z value #	p value
3 years	Females (n=62)	14.51	1.49	14.14 – 14.88	1.186	0.236
	Males (n=49)	14.85	1.46	14.44 – 15.26		
4 years	Females (n=58)	14.17	1.36	13.82 – 14.52	1.271	0.203
	Males (n=84)	14.47	1.42	14.17 – 14.78		
5 years	Females (n=26)	14.16	1.54	13.56 – 14.75	0.003	0.997
	Males (n=47)	14.17	1.12	13.85 – 14.49		

Standard error of difference between two means; SD = Standard deviation

Body Mass Index

Overall, the median values of BMI for boys were higher than that for girls across the three age groups but the minimum BMI was very low for 3-year olds and 4-year olds of both sexes (Fig-1). Overall, the mean BMI for boys was higher than that for girls across the three age groups, but the gender differences were not statistically significant (Table-1). But, when the mean BMI of the participants was compared with that of IAP Child Growth Standards [16], the difference was highly significant across the three age groups in both sexes (Table-2).

Table-2: Comparison of mean BMI (Kg/m^2) with IAP standards, 2006

Age	Gender	SD	Difference	t value †	p value
3 years	Female (n=62)	1.49	0.89	4.665	<0.00001*
	Male (n=49)	1.46	0.67	3.179	0.001 *
4 years	Female (n=58)	1.36	0.85	4.718	<0.00001*
	Male (n=84)	1.42	0.97	6.223	<0.00001*
5 years	Female (n=26)	1.54	0.95	3.084	0.002*
	Male (n=47)	1.12	0.98	5.934	<0.00001*

SD = Standard deviation; † Unpaired t-test * Significant

Mid Upper Arm Circumference

The minimum MUAC was below normal for 3-year old girls (11.5 cm) as well as for 3-year old boys (12 cm). The median MUAC was identical (15 cm) for 3-year old boys and for both sexes among 4- and 5-year olds, but was lower (14.5 cm) for 3-year old girls (Fig-2). Across the three age groups in the present study, the mean MUAC for boys was higher than that for girls, but the gender differences were not statistically significant (Table-3). However, comparison of mean MUAC of the participants with that of IAP Child Growth Standards [16], exhibited highly significant difference across the three age groups in both sexes (Table-4). As compared to weight-for-height, the mid upper arm circumference (MUAC) correlates better with lean mass ratio (ratio of estimated mass of limbs to estimated mass of trunk)

[30]. Being a simple measurement, MUAC is used as an age-independent screening tool for estimating acute under-nutrition in pre-school children or in situations where exact age of the child is not known [31].

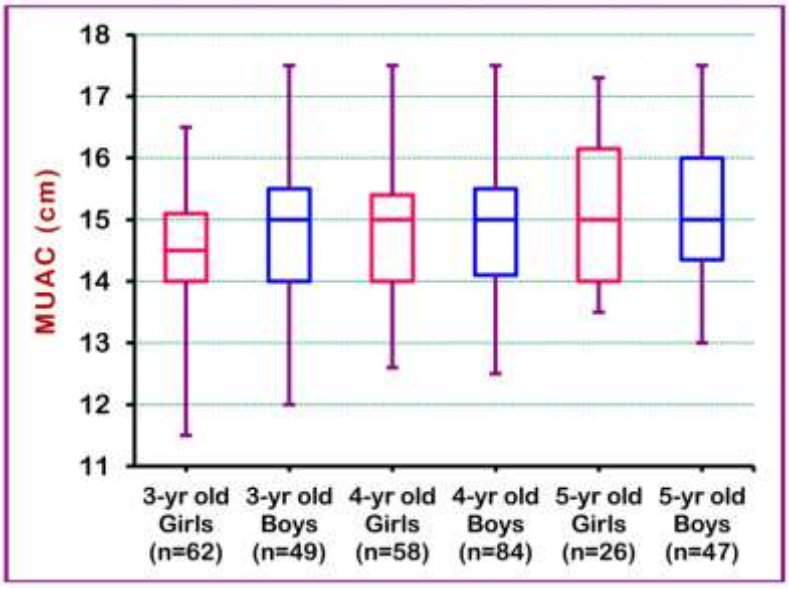

Fig-2: Boxplot of mid upper arm circumference

Limitations

Since the focus of the present study was on anthropometric measurements, the risk factors for under-nutrition were not studied. A larger study would be required so that the results can be extrapolated.

Table-3: Gender distribution of MUAC

Age	Gender (n)	Mid upper arm circumference (cm)				
		Mean	SD	95% CI	Z value #	p value
3 years	Females (n=62)	14.51	0.98	14.27 – 14.76	1.378	0.168
	Males (n=49)	14.79	1.12	14.48 – 15.11		
4 years	Females (n=58)	14.82	1.01	14.56 – 15.08	0.053	0.957
	Males (n=84)	14.96	1.01	14.74 – 15.17		
5 years	Females (n=26)	15.11	1.26	14.62 – 15.59	0.011	0.991
	Males (n=47)	15.15	1.09	14.84 – 15.46		

Standard error of difference between two means; SD = Standard deviation

Table-4: Comparison of mean MUAC (cm) with IAP standards, 2006

Age	Gender	SD	Difference	t value †	p value
3 years	Female (n=62)	0.98	0.91	7.252	<0.00001*
	Male (n=49)	1.12	0.99	6.124	<0.00001*
4 years	Female (n=58)	1.01	0.92	6.877	<0.00001*
	Male (n=84)	1.01	0.86	7.757	<0.00001*
5 years	Female (n=26)	1.26	1.01	4.007	0.0004*
	Male (n=47)	1.09	0.95	5.911	<0.00001*

SD = Standard deviation; † Unpaired t-test * Significant

CONCLUSION

The present study revealed the pervasive presence of under-nutrition without significant gender-related bias among pre-school children in the study area. Since under-nutrition in childhood is associated with slower cognitive development and considerable health impairments later in life, it is necessary to adopt a multi-pronged approach comprising nutrition education of mothers, promotion of infant and young child feeding practices and nutritional supplementation programmes.

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