

Comparative Anthropometric Analysis of Preschool Children from Bulgaria and India

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Abstract: The nutritional well-being of children is a priority in both national and global policies concerning public health preservation. Nutrition and physical activity serve as key determinants of health and are essential for ensuring optimal growth and development in children. Childhood malnutrition or obesity has both immediate and long-term effects on physical, psychological, and social health and well-being.

A comparative study of anthropometric data on preschool children from Bulgaria and India revealed a significant height difference of 14.28 cm among four-year-old boys from both nations. Consequently, there is also a considerable weight difference of 5.45 kg. The weight discrepancy among four-year-old girls mirrors that of the boys, with a difference of 5.21 kg. However, the height disparity among girls, measuring 12.30 cm, is smaller than that observed in boys of the same age. This can be attributed to the minimal height difference of 0.49 cm between Indian boys and girls, whereas, among Bulgarian children, boys tend to be taller than girls by an average of 2.90 cm.

Upon analyzing the data for five-year-old boys and girls from both countries, similar trends to those observed in the four-year-old cohort emerge. The disparities in weight and height remain consistent, with no observable growth increments in Indian children that would reduce the gap between them and their Bulgarian counterparts.

When comparing the data of children from both countries, categorized by age and gender, with the global standards set by the World Health Organization (WHO), Bulgarian children in both age groups fall within the "MED" category. This classification indicates that Bulgarian children meet the global health standards for body weight. A concerning observation, however, is that Indian children are significantly below the WHO-defined norm. Three-year-old Indian girls weigh 3.77 kg below the standard, while boys of the same age fall short by 3.52 kg. A similar pattern is observed in five-year-olds, where girls are underweight by 4.49 kg and boys by 4.31 kg.

A further comparison of height and weight data for five-year-old Indian children reveals that their growth corresponds to that of three-year-old Bulgarian children, with an average height of 100 cm. In terms of weight, their measurements align with those of a 2.5-year-old child, averaging 14 kg.

The conducted study and the comparative analysis of anthropometric indicators give us a clear idea of the health status of the growing generations in 2024 in Bulgaria and India.

Keywords: underweight, anthropometry, preschool, Bulgaria, West Bengal, India.

PROBLEM STATEMENT

The nutrition of children and adolescents is a priority in the National Health Policy. Nutrition and physical activity are key determinants of health and essential conditions for ensuring optimal growth and development during childhood and adolescence—a period in which lifelong health habits are formed.

Proper nutrition and the upbringing of children are among the most important responsibilities of parents. That is why not only students, future teachers, but also parents must possess a rich sports culture and knowledge related to children's hygiene regimen, proper nutrition and recovery, which they can successfully apply to the healthy and biological development of children (Rumenov, 2022). From birth, parental care includes ensuring adequate nutrition, which directly impacts a child's health, growth, and development.

It is known that the different stages in ontogenesis are a real reflection of the chain of events in the process of individual growth and development. Each of these stages is characterized by a unique and specific combination of biological characteristics, which are influenced by a complex of different environmental and genetic factors. The influence of these factors changes at different ages, but is especially pronounced in early childhood. (Mladenova, 2021).

The human body requires essential nutrients to survive, and adequate supply and consumption of all necessary nutrients is essential for the growth and development of every child (Hoque et al 2024). Childhood can be considered the most important phase of the human life cycle, as the rapid growth during this stage creates the adult body. An adequate diet is essential for every child to maintain normal growth (Ahmad et al., 2020).

The age range of 3 to 6 years is particularly crucial for establishing a healthy dietary pattern, as children tend to imitate adults and are in a phase of developing their eating habits. Malnutrition, overnutrition, and unbalanced diets can all have adverse effects on children's health. Indicators of adequate nutrition in children include height measurements appropriate for their age and weight proportional to their height.

In our study, we compare the anthropometric indicators of preschool children between Bulgaria and India. Other such studies on the influence of external factors on the process of physical development have also provoked research

interest in Dokova, N. and Guberova, M., (2017) in assessing the anthropometric status of preschool children.

Childhood is a unique stage of human development, during which the need for energy and essential nutrients per kilogram of body weight is significantly higher than in adults. Research indicates that more than 250 million children under the age of five worldwide may fail to reach their biological potential due to various factors, with nutrition being one of the most significant. Healthy nutrition provides the body with all the necessary nutrients and energy to maintain its biological functions effectively, while in children, it must also meet the demands of growth and development.

The object of the study is the anthropometric status of children from Bulgaria and India, while the subject comprises specific anthropometric indicators—height and weight.

The research sample consists of 400 children aged 4 and 5 years from Bulgaria and India.

The research objective of the study is to compare the anthropometric indicators of children from Bulgaria and India.

Research Tasks

1. Theoretical justification of the problem;
2. Conducting a comparative analysis of the examined indicators;
3. Drawing conclusions and recommendations.

METHODS

The measurement of the anthropometric indicators of Bulgarian children was conducted in December 2024 in Blagoevgrad, Bulgaria. The comparative data for the two groups were obtained from the study by Hoque et al. (2024), conducted in West Bengal, India.

To achieve the research objective, the following tests were applied:

Standard height measurement (cm) with an accuracy of 0.05 cm.

Weight measurement (kg) using the electronic scale “TANITA” BC-545C.

Age determination.

The obtained results were processed using mathematical and statistical analysis in Excel, with applied variation and comparative analysis of the data.

RESULTS AND DISCUSSION

Anthropometric measurements were conducted on 4- and 5-year-old children, with 100 participants in each age group. The results were compared with

the study by Hoque et al. (2024), analyzing the weight and height of the two cohorts—one from Bulgaria and the other from India.

Table 1. Anthropometric characteristics of the studied preschool children (n=100 in each age-sex category).

Age (years)	Sex	Weight (kg) Mean ±SD		Height (cm) Mean ±SD		Difference between India and Bulgaria Weight (kg) Mean	Difference between India and Bulgaria Height (cm) Mean
		Indian	Bulgarian	Indian	Bulgarian		
4	Boys	12.58±1.82	18.03±3.60	95.20±4.36	109.48±6.71	5.45	14.28
	Girls	12.33±1.66	17.54±2.47	94.28±4.72	106.58±5.37	5.21	12.30
5	Boys	13.99±1.85	19.93±3.35	100.31±4.47	115.89±3.82	5.94	15.58
	Girls	13.71±2.49	19.44±3.87	100.91±4.98	114.44±6.25	5.73	13.53

In Table 1, we present the measured weight and height data for Bulgarian and Indian children, categorized by gender—boys and girls.

Four-year-old Bulgarian boys have an average height of 109.48 cm, while Indian boys measure 95.20 cm, resulting in a significant height difference of 14.28 cm. This discrepancy also translates into a considerable difference in weight—5.45 kg, with Bulgarian boys averaging 18.03 kg compared to 12.58 kg for Indian boys.

For four-year-old girls, the weight difference is similar to that of boys—5.21 kg, with Bulgarian girls averaging 17.54 kg and Indian girls 12.58 kg. The average height of Bulgarian girls is 106.58 cm, while Indian girls measure 95.20 cm, leading to a height difference of 12.30 cm, which is slightly smaller than that observed in boys. This is due to the fact that Indian boys and girls exhibit minimal height variation (0.49 cm), whereas Bulgarian boys are taller than their female peers by 2.90 cm on average.

Upon analyzing the data for five-year-old boys and girls from both countries, we observe a similar trend to that of the four-year-olds. The differences in weight and height remain consistent, with no significant growth increments among Indian children that would reduce the gap between them and their Bulgarian counterparts.

The average weight of five-year-old Bulgarian boys is 19.93 kg, whereas Indian boys weigh 13.99 kg, reflecting a 5.94 kg difference. In terms of height, Bulgarian boys measure 115.89 cm, while Indian boys are 100.31 cm tall, leading to a 15.58 cm height gap.

For five-year-old girls, the weight difference remains nearly identical to that of the boys—5.73 kg. The average height of Bulgarian girls is 114.44 cm, whereas

Indian girls measure 100.91 cm, maintaining a substantial difference in stature between the two groups.

When comparing the height and weight data of five-year-old Indian children, their growth corresponds to that of three-year-old Bulgarian children, with an average height of 100 cm. In terms of weight, they align with 2.5-year-old Bulgarian children, averaging 14 kg. According to the WHO (2021), a child with underweight status exhibits characteristics of stunted growth, wasting, or both.

Table 2 presents the results for four- and five-year-old children, this time with genders combined within each age group. The dataset includes 200 Bulgarian and 200 Indian children aged four, and the same division applies to the five-year-old groups.

In the mixed-gender groups, the height difference is 13.19 cm among four-year-olds, and a nearly identical 13.76 cm among five-year-olds. Both populations show an annual height increase of approximately 7 cm.

The average weight of four-year-old Indian children is 12.46 kg, whereas Bulgarian children of the same age weigh 17.77 kg, resulting in a 5.31 kg difference. Among five-year-olds, the weight difference remains nearly the same—5.58 kg, with Indian children averaging 13.85 kg, compared to 19.68 kg for Bulgarian children.

Table 2. Anthropometric characteristics of the studied preschool children (n=200 in each age category).

Age (years)	Weight (kg) (sex combined) Mean \pm SD		Height (cm) (sex combined) Mean \pm SD		Difference between India and Bulgaria Weight (kg)	Difference between India and Bulgaria Height (cm)
	Indian	Bulgarian	Indian	Bulgarian		
4	12.46 \pm 1.75	17.77 \pm 3.03	94.74 \pm 4.56	107.93 \pm 6.15	5.31	13.19
5	13.85 \pm 1.96	19.68 \pm 3.60	101.41 \pm 4.75	115.17 \pm 5.19	5.58	13.76

In the extremely harsh living conditions faced by a large portion of India's population, approximately 20% of preschool-aged children are underweight (FAO, 2020). The lack of access to drinking water, fresh food, adequate household cooking facilities, bathrooms, and toilets further exacerbates the challenges to healthy growth among young children. According to the WHO (2020), "malnutrition refers to deficiencies, excesses, or imbalances in the intake of energy and/or nutrients."

Tables 3 and 4 compare the data of children from both countries, categorized by gender and age, against the World Health Organization (WHO) growth standards. In both age groups, Bulgarian children fall within the "MED" category, indicating that they are within the global standard weight norms.

A concerning finding is that Indian children fall significantly below the WHO-defined norms. Among three-year-olds, girls are classified under the -2 SD (standard deviation) category, weighing 3.77 kg below the norm, while boys fall into the -3 SD category, weighing 3.52 kg below the norm.

For five-year-old children, the results are identical to those of the younger group. Girls fall within the -2 SD category, weighing 4.49 kg below the norm, while boys are classified under -3 SD, with a weight deficit of 4.31 kg, remaining below the standard growth benchmarks.

Table 3. World Health Organization – Child growth standards for 4 year olds.

	-3SD	-2 SD	-1 SD	MED	1 SD	2 SD	3 SD
Girls	10.9	12.3	14.0	16.1	18.5	21.5	25.2
		Indian – 12.33		Bulgarian – 17.54			
Boys	11.2	12.7	14.4	16.3	18.6	21.2	24.2
	Indian – 12.58			Bulgarian – 18.03			

Table 4. World Health Organization - Child growth standarts for 5 years old

	-3SD	-2 SD	-1 SD	MED	1 SD	2 SD	3 SD
Girls	12.1	13.7	15.8	18.2	21.2	24.9	29.5
		Indian – 13.71		Bulgarian – 19.93			
Boys	12.4	14.1	16.0	18.3	21.0	24.2	27.9
	Indian – 13.99			Bulgarian – 19.			

CONCLUSIONS AND RECOMMENDATIONS

Information regarding child malnutrition in India is widely known, but a comparative analysis such as this provides a clear and quantifiable understanding of the extent of undernourishment and its impact on physical development.

Following the comparison of anthropometric data between Bulgarian and Indian 4-5-year-old children, we reached the following conclusions:

1. Four-year-old Bulgarian boys are 14.28 cm taller and 5.45 kg heavier than their Indian counterparts.
2. Four-year-old Bulgarian girls are 12.30 cm taller and 5.21 kg heavier than Indian girls of the same age.
3. Indian four-year-old children (boys and girls) show no significant height difference (0.49 cm), whereas Bulgarian boys are, on average, 2.90 cm taller than Bulgarian girls.

4. Five-year-old Bulgarian boys are 15.58 cm taller than Indian boys, while Bulgarian girls surpass Indian girls by 13.53 cm in height.

5. Five-year-old Bulgarian boys are 5.94 kg heavier than their Indian peers, and Bulgarian girls show a similar trend, being 5.73 kg heavier than Indian girls.

6. The height and weight of five-year-old Indian children correspond to those of three-year-old Bulgarian children, with an average height of 100 cm and a weight of 14 kg—typical for a 2.5-year-old Bulgarian child.

7. Four-year-old Indian girls fall into the -2 SD category, weighing 3.77 kg below the WHO-defined standard, while Indian boys are classified under -3 SD, weighing 3.52 kg below the norm.

8. Five-year-old Indian girls remain in the -2 SD category, with a weight deficit of 4.49 kg, while boys fall into the -3 SD category, weighing 4.31 kg below the WHO standard.

The comparative analysis shows that urgent measures are needed for the growing children in India. We recommend that the state, in collaboration with the Health Institutions:

1. To support families with one or more children by trying first of all to provide fresh food (such as fruits, vegetables, meat) necessary for the growth and development of the adolescents;

2. To ensure running water necessary for the hygienic needs of the families;

3. To carry out campaigns to help the families in need, because the future of a country lies in the young generation.

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