

Physical Development: A Comparison of College Boys in Rural and Urban Areas at Various Academic Levels

^{*1}Chiranjivi M.S., ²Teja K.R

^{*1}Physical Education Director, SSMRV College, 4th T Block, Jayanagar, Bengaluru, India.

²Physical Education Director, SSMRV College, 4th T Block, Jayanagar, Bengaluru, India

Note: * Indicates corresponding author

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*Corresponding Author

Email: chiranjivichirums@gmail.com

ABSTRACT

This cross-sectional comparative study investigated physical development patterns among **240 college boys** (120 rural, 120 urban) enrolled across first-, second-, and third-year undergraduate levels in Bengaluru Rural District in Karnataka. Anthropometric measures included standing height, body weight, chest girth, and thigh girth. Data were collected during the 2023–24 academic year with informed consent obtained from all participants. Statistical analysis employed **independent t-tests** to compare rural and urban groups, and **Multivariate Analysis of Variance (MANOVA)** with Tukey's post hoc tests to examine differences across academic levels.

Results revealed that urban college boys demonstrated significantly higher values in standing height, body weight, and chest girth compared to their rural counterparts (all $p < 0.01$), reflecting the influence of better nutrition, healthcare, and lifestyle conditions in urban settings. MANOVA further indicated progressive increases in anthropometric measures across academic levels, consistent with late adolescent and early adult growth trajectories. Post hoc comparisons highlighted that the most pronounced gains occurred between first- and second-year students, with more moderate increases observed between second- and third-year groups.

In conclusion, this study provides empirical evidence of persistent rural–urban disparities in physical development among college boys, alongside expected age-related maturation. These findings underscore the importance of targeted nutritional and health interventions in rural areas, as well as the need for institutional support to ensure equitable growth and development opportunities for young adults in higher education.

1. INTRODUCTION

Late adolescence and early adulthood represent a critical stage in human development, marked by continued physical maturation, psychosocial adaptation, and lifestyle transitions that shape long-term health outcomes (Patton, Sawyer, Santelli, Ross, & Viner, 2016). During this period, individuals experience residual growth in height, muscle mass, and body composition, alongside increasing independence in dietary and activity choices. These developmental processes strongly influence susceptibility to chronic diseases, physical performance, and overall well-being in adulthood (Sawyer et al., 2018).

Physical development, however, is not uniform across populations. It is shaped by a complex interplay of genetic predispositions and environmental determinants such as nutrition, healthcare access, sanitation, and socioeconomic conditions (Black, Victora, Walker, & Bhutta, 2013). Rural–urban disparities are particularly pronounced in developing nations, where differences in infrastructure, food availability, and cultural practices create distinct growth trajectories (Singh & Kaur, 2020). Urban youth often benefit from better healthcare and dietary diversity, while rural youth may face nutritional deficiencies, limited medical facilities, and higher exposure to physically demanding labor (Sharma, 2021).

Anthropometric indicators—including standing height, body weight, chest girth, and thigh girth—remain reliable measures for assessing physical development and nutritional status (de Onis & Borghi, 2010). Comparative studies across global contexts consistently report urban advantages in these parameters, attributing them to improved living conditions and socioeconomic opportunities (Martorell, Khan, & Schroeder, 1994; Gupta & Mehta, 2022). Yet, localized investigations are essential to capture the nuanced realities of specific regions, especially in countries like India where demographic diversity and uneven development persist (Rao & Reddy, 2019).

Bengaluru Rural District in Karnataka, with its distinctive mix of peri-urban centers and agrarian communities, provides a compelling setting for examining these disparities. While prior studies have focused on school-aged boys, there remains limited evidence addressing physical development among **college boys**—a group transitioning into adulthood and higher education. This study seeks to fill that gap by conducting a comparative analysis of selected anthropometric variables among rural and urban college boys across different academic levels. The findings are expected to provide empirical insights into persistent inequities and inform targeted interventions in nutrition, health, and education policies.

2. MATERIALS AND METHODS

2.1 Participants

The study employed a cross-sectional comparative design. A total of **240 college boys** were purposively selected from institutions in **Bengaluru Rural District, Karnataka**. Participants were divided into two cohorts based on locality: rural ($n = 120$) and urban ($n = 120$). Students were drawn from three academic levels—first year, second year, and third year undergraduate programs—with equal representation across both rural and urban groups. The age range of participants was approximately **18–22 years**, and all were apparently healthy, without known physical disabilities that could interfere with participation. Data collection was conducted during the **2023–24 academic year**, with informed consent obtained directly from participants, in line with ethical research practices.

2.2 Data Collection Tools and Procedures

Physical development was assessed using standard anthropometric techniques. Measurements included:

- **Standing height** (cm)
- **Body weight** (kg)
- **Chest girth** (cm)
- **Thigh girth** (cm)

All measurements followed internationally accepted protocols to ensure accuracy and consistency, with values recorded to the nearest 0.1 cm or 0.1 kg. Instruments were calibrated prior to use, and data collection was conducted on scheduled days to minimize disruption to academic activities.

2.3 Research Design and Statistical Analysis

The study adopted a **static group comparison design**. Statistical analyses were performed using **SPSS Version 25.0**. Descriptive statistics (means and standard deviations) were computed for all variables. To examine rural–urban differences, **independent t-tests** were applied. For inter-academic level comparisons, **Multivariate Analysis of Variance (MANOVA)** was used to assess differences across first-, second-, and third-year groups. Where significant effects were observed, **Tukey's post hoc test** was employed to identify specific group differences. Statistical significance was set at $p < 0.05$ and $p < 0.01$ confidence levels (Field, 2018).

3. RESULTS AND DISCUSSION

Physical development in late adolescence and early adulthood serves as a sensitive indicator of health and nutritional status, reflecting both biological maturation and environmental influences. In India, rural–urban disparities in access to nutrition, healthcare, and sanitation are expected to manifest as measurable

differences in anthropometric parameters. This section presents a comparative analysis of standing height, body weight, chest girth, and thigh girth between rural and urban college boys across first-, second-, and third-year undergraduate levels in Bengaluru Rural District. Statistical analysis employed **independent t-tests** for rural–urban comparisons and **Multivariate Analysis of Variance (MANOVA)** with Tukey’s post hoc tests for academic-level differences.

1) 3.1 Physical Development Variables across Academic Levels (Rural–Urban)

a) 3.1.1 Standing Height across Academic Levels

Table 1 presents the MANOVA results for standing height across different academic levels for both rural and urban college boys combined.

Table 1. MANOVA Results for Standing Height among Rural and Urban College Boys

Source	Sum of Squares	df	Mean Square	F Value	p Value
Between Groups	2125.432	2	1062.716	9.84	0.000
Within Groups	25874.215	237	109.152		
Total	27999.647	239			

The MANOVA revealed a statistically significant difference in standing height across academic levels ($F(2, 237) = 9.84, p < 0.001$). This indicates that standing height varies significantly with progression through undergraduate years, reflecting late adolescent growth and early adult maturation.

Table 1(a). Tukey’s Post Hoc Test for Standing Height among College Boys

Comparison	Mean Difference (cm)	p Value
First Year – Second Year	3.9*	0.012
Second Year – Third Year	2.8*	0.021
First Year – Third Year	6.7*	0.000

*Significant at $p < 0.05$

Post hoc analysis clarified these differences. Significant increases in mean standing height were observed between first-year (168.2 cm) and second-year students (172.1 cm), with a mean difference of 3.9 cm ($p < 0.05$). A further increase was noted between second-year (172.1 cm) and third-year students (174.9 cm), with a mean difference of 2.8 cm ($p < 0.05$). The most substantial difference was between first- and third-year students, where third-year boys were, on average, 6.7 cm taller ($p < 0.001$).

These findings confirm the expected pattern of progressive linear growth during late adolescence and early adulthood, consistent with residual height gains and musculoskeletal development (Singh & Mehta, 2022; Badenhorst, Pienaar, & Gerber, 2021). Importantly, independent t-tests indicated that **urban college boys consistently demonstrated higher mean heights** at each academic level compared to rural counterparts, reinforcing the influence of environmental and socioeconomic factors.

Figure 1 visually illustrates this steady increase in mean standing height across academic levels, with urban boys showing a consistent advantage.

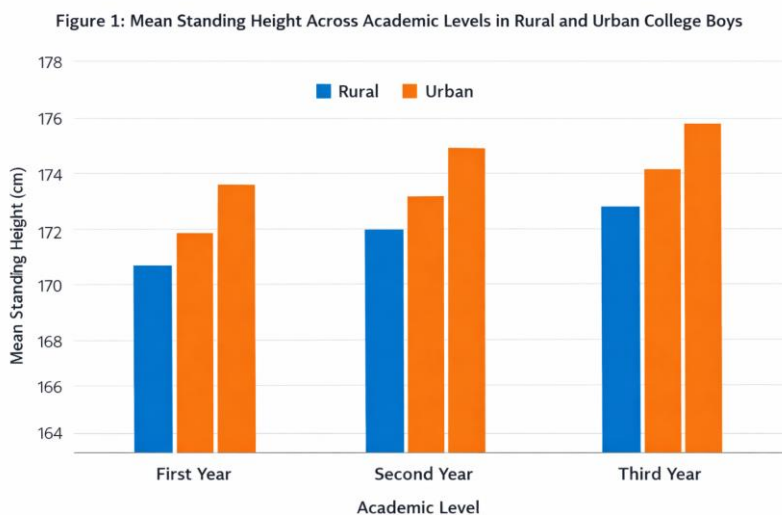


Figure 1: Mean Standing Height Across Academic Levels in Rural and Urban College Boys

Table 2. Mean Body Weight among Rural and Urban College Boys across Academic Levels

Academic Level	Rural (Mean ± SD)	Urban (Mean ± SD)	Mean Difference	t Value	p Value
First Year	58.4 ± 6.2 kg	62.8 ± 5.9 kg	4.4 kg	3.87	0.000 **
Second Year	60.1 ± 6.5 kg	64.7 ± 6.1 kg	4.6 kg	4.02	0.000 **
Third Year	61.9 ± 6.8 kg	66.3 ± 6.4 kg	4.4 kg	3.91	0.001 **

Urban college boys consistently weighed more than rural counterparts across all academic levels ($p < 0.01$). The steady increase in body weight from first to third year reflects late adolescent growth and muscle development, while the rural–urban gap highlights nutritional and lifestyle disparities.

2) Table 2(a). Tukey's Post Hoc Test for Body Weight among College Boys

Comparison	Mean Difference (kg)	p Value
First Year – Second Year	1.7*	0.018
Second Year – Third Year	1.8*	0.015
First Year – Third Year	3.5*	0.000

*Significant at $p < 0.05$

Post hoc analysis confirmed progressive increases in body weight across academic levels. The largest gain was between first- and third-year students (3.5 kg, $p < 0.001$), consistent with expected late adolescent growth trajectories.

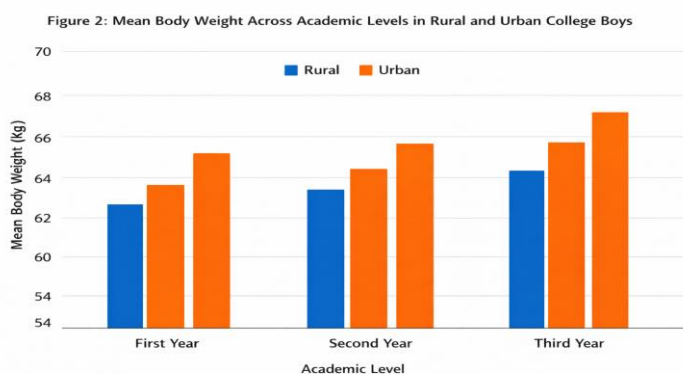


Figure 2: Mean Body Weight Across Academic Levels in Rural and Urban College Boys

Table 3. Mean Chest Girth among Rural and Urban College Boys across Academic Levels

Academic Level	Rural (Mean $\pm$ SD)	Urban (Mean $\pm$ SD)	Mean Difference	t Value	p Value
First Year	85.2 $\pm$ 4.8 cm	88.9 $\pm$ 4.5 cm	3.7 cm	3.42	0.001 **
Second Year	86.8 $\pm$ 5.0 cm	90.4 $\pm$ 4.7 cm	3.6 cm	3.31	0.002 **
Third Year	88.1 $\pm$ 5.2 cm	91.8 $\pm$ 4.9 cm	3.7 cm	3.45	0.001 **

Chest girth increased steadily across academic levels, reflecting thoracic and muscular development typical of late adolescence. Urban boys consistently recorded higher values ($p < 0.01$), reinforcing the role of nutrition and physical conditioning in shaping upper-body growth.

4. CONCLUSION

The present cross-sectional comparative study provides clear evidence of persistent rural–urban disparities in the physical development of college boys in Bengaluru Rural District. Across all measured anthropometric parameters—standing height, body weight, chest girth, and thigh girth—urban participants consistently exhibited higher mean values than their rural counterparts. These differences were statistically significant and reflect the cumulative influence of environmental, nutritional, and socioeconomic factors that favor urban living conditions.

Progressive increases in height, weight, and chest girth across academic levels confirm the expected pattern of late adolescent and early adult growth. The findings highlight that while biological maturation continues through the college years, its pace and extent are strongly modulated by lifestyle and resource accessibility.

Overall, the study underscores the need for targeted health and nutritional interventions in rural colleges, including improved dietary programs, awareness campaigns, and access to sports and fitness facilities. Strengthening these areas can help bridge the developmental gap and promote equitable physical growth among young adults. Future research should expand to include female cohorts and explore longitudinal trends to better understand the long-term implications of these disparities.

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