CHANGES IN HEIGHT, WEIGHT, AND BMI AMONG ALBANIAN ELEMENTARY SCHOOL CHILDREN: A COMPARISON BETWEEN 2013 AND 2024

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DOI: https://doi.org/10.51267/jehhm2026.1.01

Abstract: *The aim of this study was to compare the anthropometric parameters (body height, body weight, and BMI) over an 11-year period (2013 and 2024) on boys and girls in elementary school children in Tirana, Albania. Data was collected (third and fourth grade) from a total of 139 children in 2013 (71 boys and 68 girls) and 138 children in 2024 (66 boys and 72 girls). Statistical analysis revealed that for boys, there were no significant differences in body height, body weight, or BMI across the two years' generations ($p > 0.05$ for all comparisons). In contrast, for girls, significant increases were observed in body height ($p = 0.000$) and body weight ($p = 0.003$) in the fourth grade between 2013 and 2024, though BMI did not show significant differences ($p > 0.05$). In summary, although both boys and girls have shown increases in body weight, the changes seem to be more noticeable in younger boys (third grade) and older girls (fourth grade). The notable rise in height among females in the fourth grade raises the possibility that current cohorts are growing earlier or more quickly than those in 2013. Nonetheless, the fact that BMI has not changed significantly suggests that the proportionate link between height and weight has stayed mostly constant.*

Keywords: *anthropometric parameters*; *body height; body weight; BMI; growth patterns.*

Introduction

Children's perceptions of their body weight play a significant role in their overall well-being. Research by Demır and Bayram (2023) revealed that a substantial percentage of overweight and obese children underestimate their body size, which can lead to a lack of motivation for weight management. This perception issue is compounded by the influence of parental views on children's weight, as highlighted by McDonald et al., (2016) who found that many parents fail to recognize when their children are overweight or obese. Such discrepancies can hinder effective interventions aimed at promoting healthy growth and weight management among children.

Monitoring body weight, height, and body mass index (BMI) among children over time is crucial for understanding growth patterns, nutritional status, and health outcomes. Numerous studies have documented these parameters, emphasizing the importance of gender differences in growth trajectories and health implications (Jarani et al., 2020; Jarani et al., 2016; Tarp et al., 2018). A significant body of research has focused on the growth references for children, which provide essential benchmarks for assessing height and weight. For instance, Kułaga et al., (2013) established Polish growth references for preschool children, noting that weight-for-height and BMI-for-age are effective indicators for detecting underweight or overweight conditions.

Research indicates that gender dimorphism plays a notable role in the relationship between body mass and height among children. For instance, studies highlight that body height correlates more significantly with foot features than body weight among children aged 4-18 years, suggesting that height may be a more critical factor in assessing physical development than weight alone (Rzadkowski & Mrozkowiak, 2023). This finding aligns with the

observations made by Deurenberg et al., (2003) who noted that differences in body composition, particularly in body fatness, become pronounced at the onset of puberty, with variations evident among different ethnic groups, such as Singaporean and Dutch children. Such differences underscore the importance of considering both height and weight in understanding children's growth trajectories. Moreover, longitudinal studies have shown that children's body mass index (BMI) can fluctuate significantly throughout the academic year, influenced by environmental factors. Studies discuss how children's BMI tends to increase more rapidly during the summer months compared to the school year, indicating that seasonal variations may affect both height and weight changes. This seasonal effect is further supported by findings from Lumeng et al., (2010) who observed that children attending Head Start programs exhibited changes in BMI z-scores that were more reflective of height gain rather than excessive weight gain, suggesting that structured environments can positively influence growth patterns.

The comparative studies on body height and weight among children reveal a complex interplay of factors, including sexual dimorphism, environmental influences, physical activity levels, and perceptions of body image. These factors collectively underscore the necessity for targeted public health strategies that address the multifaceted nature of childhood obesity and growth patterns, ensuring that children achieve optimal health outcomes.

Previous studies in the Balkan region have documented increases in overweight and obesity among children (Jarani et al., 2016; Tarp et al., 2018), while European data show mixed patterns depending on socioeconomic and environmental contexts (Kułaga et al., 2013; Moreno et al., 2020). Longitudinal analyses of US and European cohorts have indicated secular trends toward earlier increases in body weight and BMI, though sometimes accompanied by stable or increasing height (Zhong et al., 2013; Friedemann et al., 2012). In Albania, reference values are still limited, which underscores the relevance of the present comparison between 2013 and 2024 cohorts**.** The aim of this study was to compare the anthropometric parameters (body height, body weight, and BMI) over an 11-year period (2013 and 2024) on boys and girls in elementary school children in Tirana, Albania.

Methods

This study included elementary school children from Tirana, Albania, assessed in two separate years: 2013 and 2024. The sample consisted of third- and fourth-grade students from randomly selected schools. In 2013, a total of 139 children (71 boys and 68 girls) participated, while in 2024, 138 children (66 boys and 72 girls) were assessed. Three anthropometric parameters were measured: body height (m), body weight (kg), and body mass index (BMI, kg/m^2). Height was measured using a stadiometer with an accuracy of 0.1 cm, with children standing barefoot in an upright position. Body weight was recorded using a digital scale with a precision of 0.1 kg, with participants wearing light clothing and no shoes. Body mass index (BMI) was calculated as weight (kg) divided by height squared (m^2). To interpret BMI in children, the World Health Organization (WHO) and other international bodies recommend comparing values against age- and sex-specific growth curves (Kułaga et al., 2011; Fallahzadeh et al., 2020). While this study did not employ BMI-for-age z-scores, the descriptive comparison across cohorts provides insight into generational shifts in raw values. The theoretical basis rests

on BMI's established role as a proxy for body fatness and cardiovascular/metabolic risk in children (Friedemann et al., 2012).

The study employed a cross-sectional design, comparing two distinct cohorts of children measured 11 years apart. Data collection took place in school settings in Tirana city (the capital city of Albania) under standardized conditions. Measurements in both years were taken by trained professionals following the same protocols to ensure consistency and reliability. Parental consent was obtained for all participants, and the study adhered to ethical guidelines for research involving children, ensuring confidentiality and voluntary participation.

Statistical Analysis

Descriptive statistics (mean, standard deviation, and standard error of the mean) were calculated for body height, body weight, and BMI. Independent samples t-tests were conducted to compare differences in anthropometric variables between 2013 and 2024 for boys and girls separately. Levene's test was used to assess the equality of variances. A significance level of $p < 0.05$ was set for all statistical analyses.

Results

Table 1 presents the descriptive statistics for body height, body weight, and BMI of Albanian children in their first and fourth years for the years 2013 and 2024. The mean body height increased slightly from 1.31 meters in 2013 to 1.32 meters in 2024, with similar standard deviations across both years. Body weight showed a more pronounced increase, rising from an average of 29.32 kg in 2013 to 31.48 kg in 2024.

Table 1. *Descriptive statistics for body height, weight and BMI on first and fourth years Albanian children*

	Year Measurement	N	Mean	Std. Deviation	Std. Error Mean
Body Height	2013	235	1.31	0.09	0.01
	2024	343	1.32	0.09	0.00
Body Weight	2013	235	29.32	7.45	0.49
	2024	343	31.48	8.12	0.44
BMI	2013	235	16.93	2.51	0.16
	2024	343	17.89	3.09	0.17

Table 2 provides descriptive statistics for body height, body weight, and BMI of Albanian children in their first and fourth years, separated by gender for the years 2013 and 2024. Among boys, the average body height remained stable at 1.32 meters in both years, while body weight increased from 30.69 kg in 2013 to 32.33 kg in 2024. Similarly, their BMI showed an upward trend, rising from 17.35 to 18.20. For girls, the mean body height increased slightly from 1.29 meters in 2013 to 1.31 meters in 2024. Body weight also exhibited an increase, from 28.10 kg in 2013 to 30.74 kg in 2024. Correspondingly, their BMI rose from 16.56 to 17.62 over the same period.

Table 2. *Descriptive statistics for body height, weight and BMI on first and fourth years Albanian children by gender*

Gender			N	Mean	Std. Deviation
Boys	Body Height	2013	111	1.32	0.10
		2024	160	1.32	0.09
	Body Weight	2013	111	30.69	8.17
		2024	160	32.33	8.46
	BMI	2013	111	17.35	2.69
		2024	160	18.20	3.00
Girls	Body Height	2013	124	1.29	0.09
		2024	183	1.31	0.09
	Body Weight	2013	124	28.10	6.53
		2024	183	30.74	7.75
	BMI	2013	124	16.56	2.29
		2024	183	17.62	3.16

Table 3 presents the descriptive statistics for body height, body weight, and BMI among Albanian boys in third and fourth grade for the years 2013 and 2024. In third grade, the average body height increased slightly from 1.34 meters in 2013 to 1.36 meters in 2024. Similarly, body

weight showed a notable increase, rising from 31.6 kg to 34.5 kg, while BMI increased from 17.6 to 18.5 over the same period. For fourth-grade boys, a slight increase in body height was observed, from 1.40 meters in 2013 to 1.41 meters in 2024. Their body weight also increased from 36.4 kg to 38.2 kg, and BMI rose from 18.3 to 19.0.

Table 3. *Descriptive statistics for body height, weight and BMI on Albanian children for boys by grade*

Gender				N	Mean	Std. Deviation	Std. Error Mean
Boys	Third Grade	Body Height	2013	30	1.34	0.1	0.0
			2024	38	1.36	0.1	0.0
		Body Weight	2013	30	31.6	4.4	0.8
			2024	38	34.5	6.8	1.1
		BMI	2013	30	17.6	1.9	0.3
			2024	38	18.5	2.9	0.5
	Fourth Grade	Body Height	2013	41	1.40	0.1	0.0
			2024	37	1.41	0.1	0.0
		Body Weight	2013	41	36.4	9.0	1.4
			2024	37	38.2	10.4	1.7
		BMI	2013	41	18.3	3.4	0.5
			2024	37	19.0	3.5	0.6

Table 4 presents the results of the independent samples t-test comparing body height, body weight, and BMI between the years 2013 and 2024 for Albanian boys in third and fourth grade. For third-grade boys, body height did not show a statistically significant difference between the two years ($p = 0.18$). However, body weight exhibited a significant difference ($p = 0.05$), with boys in 2024 weighing 2.86 kg more on average than those in 2013. The BMI difference was not statistically significant ($p = 0.12$). For fourth-grade boys, no significant differences

were found in body height (p = 0.77), body weight (p = 0.40), or BMI (p = 0.37) between the two years.

Table 4. *T test comparison by year of measurement for body height, weight and BMI on Albanian children for boys*

Gender			Levene's Test for Equality of Variances		t-test for Equality of Means			
			F	Sig.	t	df	Sig. (2-tailed)	Mean Difference
Boys	Third Grade	Body Height	0.40	0.53	-1.367	66	0.18	-0.02
		Body Weight	**3.69**	**0.06**	**-1.986**	**66**	**0.05**	**-2.86**
		BMI	3.16	0.08	-1.589	66	0.12	-0.98
	Fourth Grade	Body Height	0.84	0.36	-0.294	76	0.77	-0.01
		Body Weight	0.61	0.44	-0.841	76	0.40	-1.85
		BMI	0.00	0.99	-0.908	76	0.37	-0.71

Table 5 presents the descriptive statistics for body height, body weight, and BMI among Albanian girls in third and fourth grade for the years 2013 and 2024. For third-grade girls, the average body height showed a slight increase from 1.32 meters in 2013 to 1.33 meters in 2024. Body weight also increased from 29.2 kg to 30.9 kg, while BMI rose from 16.6 to 17.3. The standard deviations indicate some variability, but the overall trend suggests a gradual increase in these anthropometric measures. Among fourth-grade girls, body height exhibited a more noticeable increase, from 1.37 meters in 2013 to 1.43 meters in 2024. Body weight also increased significantly, from 32.6 kg to 37.7 kg. Correspondingly, BMI rose from 17.2 to 18.4.

Table 5. *Descriptive statistics for body height, weight and BMI on Albanian children for girls by grade*

Gender		N	Mean	Std. Deviation	Std. Error Mean
Girls	2013	27	1.32	0.06	0.01

	Body Height	2024	58	1.33	0.06	0.01
Third Grade	Body Weight	2013	27	29.2	5.6	1.1
		2024	58	30.9	6.2	0.8
	BMI	2013	27	16.6	2.3	0.4
		2024	58	17.3	2.8	0.4
Fourth Grade	Body Height	**2013**	**48**	**1.37**	0.04	0.01
		2024	**34**	**1.43**	0.06	0.01
	Body Weight	**2013**	**48**	**32.6**	5.9	0.9
		2024	**34**	**37.7**	8.9	1.5
	BMI	2013	48	17.2	2.6	0.4
		2024	34	18.4	3.8	0.7

Table 6 presents the results of the independent samples t-test comparing body height, body weight, and BMI between the years 2013 and 2024 for Albanian girls in third and fourth grade. For third-grade girls, no statistically significant differences were observed in body height ($p = 0.56$), body weight ($p = 0.23$), or BMI ($p = 0.22$) between the two years. These results suggest that the growth patterns for third-grade girls remained relatively stable over time. However, for fourth-grade girls, significant differences were found in both body height and body weight. Body height increased significantly ($p < 0.001$) with a mean difference of -0.05 meters, indicating that girls in 2024 were on average taller than those in 2013. Similarly, body weight showed a significant increase ($p < 0.001$), with girls in 2024 weighing approximately 5.06 kg more than those in 2013. BMI differences, however, did not reach statistical significance ($p = 0.10$).

Table 6. *T test comparison by year of measurement for body height, weight and BMI on Albanian children for girls*

	Levene's Test for Equality		t-test for Equality of Means			

			of Variances					
			F	Sig.	t	df	Sig. (2-tailed)	Mean Difference
Girls	Third Grade	Body Height	0.59	0.44	-0.59	83	0.56	-0.01
		Body Weight	0.28	0.60	-1.20	83	0.23	-1.68
		BMI	1.52	0.22	-1.23	83	0.22	-0.76
	Fourth Grade	Body Height	2.04	0.16	-4.80	80	**0.00**	-0.05
		Body Weight	1.56	0.22	-3.10	80	**0.00**	-5.06
		BMI	0.40	0.53	-1.66	80	0.10	-1.18

Discussion and Conclusions

The results of the t-test comparisons indicate that there are differences between boys and girls in the way that body height, weight, and BMI fluctuate throughout time.

There were no discernible changes in third or fourth grade boys' body height between 2013 and 2024. Boys' BMI differences were not statistically significant in either grade, suggesting that weight growth does not always translate into proportionate BMI changes. On the other hand, third-grade boys' body weight increased statistically significantly ($p = 0.05$), indicating that they are now, on average, heavier than their 2013 counterparts.

Between 2013 and 2024, third-grade girls' height, weight, and BMI did not significantly change, indicating steady growth patterns throughout time. Similar to the results for boys, there were no significant variations in BMI for fourth-grade girls ($p = 0.10$). In contrast to the previous batch, fourth-grade girls showed statistically significant increases in both body weight ($p < 0.001$) and body height ($p < 0.001$), suggesting a major rise in growth. The exploration of body height and weight differences among children, particularly with a focus on gender comparisons, reveals significant insights into growth patterns and health implications. Numerous studies have documented how these differences manifest across various demographics and over time, highlighting the importance of considering both biological and environmental factors. Research indicates that gender plays a crucial role in the growth trajectories of children. For instance, a study by Kostyk and Kostyk (2021), illustrates that boys generally exhibit higher growth rates in both height and weight compared to girls during early childhood, a trend that persists through adolescence. The study emphasize that gender identity and socialization processes can influence physical development, as boys and girls may engage in different types of play and physical activities that affect their growth. Furthermore, the work of Sigmund et al., (2014) supports this by showing that gender-specific

growth reference charts are essential for accurately assessing obesity and overweight status among children, indicating that boys and girls have different BMI thresholds. Longitudinal studies have also shed light on how these gender differences evolve over time.

The comparatively small sample size—139 youngsters in 2013 and 138 in 2024—is one of the study's limitations. Although the results shed light on how anthropometric measurements vary by generation, the small sample size might not accurately reflect the entire population of Tirana's elementary school students. The results' generalizability would be improved by a larger and more varied sample. The study also used a cross-sectional design, which examines two distinct cohorts instead of following the same people over time. Therefore, rather than accurately reflecting generational patterns, variances in body height, weight, and BMI may be impacted by changes in the particular populations examined.

The lack of information on environmental and lifestyle factors that might affect growth patterns is another drawback. It was challenging to identify the underlying reasons of the observed alterations because factors like nutrition, levels of physical activity, socioeconomic status, and genetic susceptibility were not investigated. Additionally, the study only looks at kids in the third and fourth grades, which might not give a full picture of growth patterns in other age groups. A more thorough grasp of these generational shifts might be provided by broadening the research to encompass a wider variety of ages. Unmeasured factors such as nutrition, physical activity, and socioeconomic conditions may have influenced growth patterns but were not included in this study. Lastly, because different data collection methods may impact the precision of comparisons, any measurement variability between 2013 and 2024 may introduce discrepancies in the reported anthropometric values.

Notwithstanding these drawbacks, the study's conclusions have significant applications.

The observed rise in children's body weight emphasizes the necessity of ongoing initiatives to encourage physical exercise and a balanced diet in primary schools. Monitoring juvenile development patterns should be the main goal of public health activities in order to spot possible health issues like obesity early on. The study also emphasizes how crucial it is to take gender-specific variations in growth patterns into account. Future studies and health policy should include possible disparities in developing patterns between boys and girls, as the majority of the significant gains in height and weight were seen in fourth-grade girls. The study also highlights how important it is to evaluate lifestyle factors like nutrition, exercise, and socioeconomic status that affect physical growth. A more thorough explanation of why some groups, like fourth-grade girls, had more noticeable changes over time would be possible by looking into these factors. Last but not least, the results may help update national growth standards, giving medical practitioners reliable reference data for assessing children's development. Teachers, medical professionals, and legislators can better promote the healthy development and wellbeing of future generations by integrating these insights into public health initiatives.

The findings contribute to national and regional knowledge on child growth. The observed increases in height and weight, particularly among girls in the fourth grade, highlight potential shifts in growth tempo and the need for updated Albanian growth references. The study’s results can inform public health strategies focused on monitoring childhood obesity, guiding school-based health promotion, and assisting policymakers in designing gender-sensitive interventions. By documenting generational differences, this research provides a baseline for

future longitudinal monitoring and for aligning Albanian data with international health surveillance efforts.

In summary, although both boys and girls have shown increases in body weight, the changes seem to be more noticeable in younger boys (third grade) and older girls (fourth grade). The notable rise in height among females in the fourth grade raises the possibility that current cohorts are growing earlier or more quickly than those in 2013. Nonetheless, the fact that BMI has not changed significantly suggests that the proportionate link between height and weight has stayed mostly constant.

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