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STUDY ON THE LEVEL OF PHYSICAL DEVELOPMENT IN MIDDLE SCHOOL STUDENTS

Vlăduț Paul ȘOMOTIUC, year III student
"Bogdan Vodă" University, Cluj-Napoca, România

ABSTRACT

The paper aims to analyze the level of physical development in middle school students, with the objective of identifying growth characteristics as well as age- and sex-related differences. The study was conducted on a sample of students aged 11 to 14, by evaluating anthropometric and functional indicators such as height, weight, body mass index (BMI), lengths, and circumferences. The results highlight significant variations in the measured parameters, corresponding to the stages of development specific to preadolescence. Differences were identified between girls and boys regarding the pace of physical maturation and the level of motor performance. The conclusions emphasize the importance of monitoring physical development within the educational process, as well as the need to adapt physical education programs to the individual characteristics of the students.

KEYWORDS: physical development, middle school cycle, anthropometric measurements

J.E.L. Classifications: I12, I21, J16

1.INTRODUCTION

By "physical development" we understand a dynamic process of growth of the organism, which involves an increase in height, changes in body mass, and the maturation of various body segments, in accordance with the characteristics of each age stage. The physical development of children and adolescents represents an essential indicator of the health status of the young generation. The data obtained from evaluating homogeneous groups of children provide important benchmarks for establishing criteria for assessing individual growth and development.

Specialized studies show that the level of physical development is determined by numerous factors, both internal and external, such as biological and genetic influences, socioeconomic conditions, hygiene, nutrition, and living environment. Additionally, the presence of chronic diseases can significantly affect the normal evolution of the child.

In pediatrics, the preventive component plays a central role, which is why the early and systematic collection of data regarding the physical development of children and adolescents is essential. Growth is not limited to changes in body dimensions, but also involves complex processes of transformation, organization, and biological maturation, sometimes even episodes of regression.

From birth to the preschool period, the child goes through stages of rapid change, and meeting the specific nutritional needs of these early years has a major impact on later development. Physical development is a fundamental indicator of the general state of health and biological evolution of children and adolescents. The middle school period, corresponding to ages 11–14, is marked by profound transformations, both somatic and functional, determined by the complex processes of puberty. During this stage, the growth rate intensifies, and interindividual differences become increasingly evident, influenced by genetic, environmental, nutritional factors, and by the level of physical activity.

The study of human development is constantly evolving, and the questions, methods, and explanations used today are much more complex than they were a few decades ago. This progress reflects both the accumulation of new knowledge and the re-evaluation of previous research. Technological advances have played an essential role by introducing sensitive tools capable of measuring biological functions such as heart rate, blood pressure, or eye movements. These technologies have made it possible to discover new relationships between biological processes and early cognitive development. In addition, computers facilitate the detailed analysis of infants' facial expressions and the communication between them and their mothers.

In the context of modern education, monitoring students' physical development is becoming increasingly important, as it allows for the early identification of possible imbalances, the proper guidance of motor activities, and the adaptation of physical education content. Data on the evolution of anthropometric and functional parameters can provide teachers, parents, and health specialists with essential information to support harmonious development.

The present paper aims to investigate the level of physical development in middle school students by analyzing relevant indicators and their variations according to age and sex. The study seeks to highlight the characteristics of growth stages, identify possible differences between girls and boys, and provide arguments for optimizing educational strategies and physical activity programs carried out in schools.

Through this paper, we aim to support the improvement of teachers' activity by using anthropometric data to optimize students' general physical training. The first part provides an extensive theoretical overview meant to form the conceptual basis necessary for practical application in the school environment. Subsequently, the paper introduces an applied study that analyzes the level of anthropometric development in 5th and 6th grade students from a middle school. The results obtained are interpreted in detail, highlighting the specific characteristics of each group. The formulated conclusions aim to guide the educational process toward a more efficient approach tailored to the real needs of the students.

The process of growth and development of the human body is regulated by certain laws that describe how different body dimensions change over time. However, development does not occur at a uniform pace, as some body segments grow faster than others, which makes it difficult to establish precise mathematical models for all body parts. This natural variability is an inherent aspect of biological maturation and reflects the organism's adaptation to various stages of development.

Essentially, growth is a process of quantitative accumulation through which the body increases its mass, volume, and external dimensions. The evaluation of this process is based on anthropometric measurements such as height, weight, the length of body segments, the diameters and circumferences of different regions. The results are then interpreted using descriptive qualifiers such as tall–short, heavy–light, long–short, or large–small.

2. MATERIAL AND METHOD

2.1. Research Objectives

Medical examinations of students constitute a fundamental element of the health assessment, according to the provisions of the Ministry of Health Order no. 141/2000. These

evaluations aim to identify potential disorders in physical development and are carried out through specific anthropometric measurements. National reference values for the main somatometric indicators — such as height, weight, cranial and thoracic circumference — are periodically established, every seven years, by the Bucharest Public Health Institute (Nicolescu, 2004).

However, the process of evaluating physical development raises a series of relevant questions that contribute to a comprehensive understanding of children's health. One of these concerns the identification of stages in ontogeny in which children are more vulnerable to nutritional and health disturbances, depending on their socio-economic environment. Another important issue involves the need to know the type of physical development — balanced or disharmonious — to correctly guide educational and medical interventions. Additionally, fluctuations in stature may suggest the influence of external or internal factors on the growth process. Body weight raises questions regarding its relevance as an indicator of dietary habits and the quality of the student's nutritional environment. Moreover, body mass index (BMI) and the annual growth rate become essential benchmarks for assessing health and estimating risks associated with unharmonious physical development.

The research objectives aimed to evaluate the level of physical development of middle school students through anthropometric measurements of weight, height, waist and chest circumference, foot length, and the calculation of BMI. Additionally, the study sought to identify developmental differences among students of different ages and between boys and girls, as well as to analyze the growth rate to provide useful information for optimizing physical education activities and school nutrition programs. The main goal was to contribute to understanding the harmonious evolution of the body during preadolescence and to prevent potential physical imbalances.

2.2. Research Methods

The research adopts a mixed approach, combining quantitative and qualitative methods to provide a comprehensive perspective on the analyzed phenomenon.The quantitative analysis aims to examine the statistical relationships between economic investments and sports performance, as well as between economic investments and social inclusion.

For this purpose, economic indicators (GDP, sports investments, public expenditures), sports indicators (number of Olympic medals, international rankings, participation in major

competitions), and social indicators (rate of participation in sports activities, youth employment, level of social inclusion) were collected and processed.

In addition to the statistical analysis, the research includes a qualitative analysis based on case studies of countries in Central and Eastern Europe. These countries were selected for the diversity of their funding models and their regional sports relevance. The qualitative analysis involved evaluating national strategic documents, reports on the implementation of sports programs, and interviews with experts in public policy and sports management. By collecting both quantitative and qualitative data, the study aimed to validate the results and obtain an integrated view of the impact of economic investments on performance and social inclusion.

2.3. Research Subjects

The study was conducted on a sample of 47 students from Cupșeni Middle School: 25 students from the 5th grade and 22 from the 6th grade, aged between 11 and 13 years. The research focused on the statistical-mathematical analysis of somatometrical variables such as height, weight, waist circumference, chest size, and foot length, all measured during the 2025–2026 school year.

2.4. Research Hypothesis

The hypothesis from which this study started is as follows: “We assume that the anthropometric development of 5th and 6th grade students at Cupșeni Middle School falls within the average development values specific to their age.” Body development is influenced by the dynamics of metabolic processes and the way the body transforms and utilizes energy, which are essential factors determining growth characteristics. According to the anthropometric method, the rate of change in body dimensions, including body mass and other parameters, varies depending on the individual’s stage of development.

3.RESULTS AND DISCUSSIONS

The study conducted on the sample of 47 students from Cupșeni Middle School aligns with the research described by J. M. Tanner in *Growth at Adolescence*, which emphasizes the importance of monitoring the growth rate during critical periods of development. The analysis of

somatometrical variables such as height, weight, and waist circumference is widely used in the specialized literature and is also recommended by Bogin (*Patterns of Human Growth*) as a tool for assessing biological maturation.

Additionally, the studies of W. Cameron Chumlea, presented in *Anthropometric Assessment*, highlight the relevance of body measurements in identifying potential deviations from normal development. The importance of evaluating body dimensions, including chest size and foot length, is also confirmed by research by Timothy D. Noakes, who considers them secondary predictors of body composition and physical activity levels. According to R. Malina and C. Bouchard in *Growth, Maturation, and Physical Activity*, collecting anthropometric data in the school environment provides essential information about the influence of environmental factors on children's development.

The present study also follows the statistical-mathematical models recommended by Cole and Lobstein, the authors of international standards for interpreting growth indicators. Furthermore, specialized literature, such as the work by Eveleth and Tanner in *Worldwide Variation in Human Growth*, suggests that somatometrical variations may reflect socio-economic and nutritional differences at the population level.

The interpretation of the data collected during the 2025–2026 school year can be discussed in relation to the observations of Prista and Maia regarding growth variations depending on the school context and lifestyle. Additionally, the analysis of the variables used in this study reflects the methodological recommendations of Ulijaszek and Kerr, authors of *Anthropometric Measurement Error and the Assessment of Nutritional Status*. Overall, the research fits within a solid theoretical framework, supported by numerous international studies emphasizing the importance of systematically monitoring the physical development of students.

Table 1. Values of the main anthropometric indicators in boys, by age categories

No.	Full Name	**Age**	Weight **(kg)**	Height **(cm)**	BMI
1.	A.I.	11	37	144	17.8
2.	N.T.	11	33	141	16.6

3.	R.E.	11	36	145	17.1
4.	L.S.	11	35	142	17.3
5.	D.M.	11	38	150	16.9
6.	F.V.	11	39	149	17.6
7.	B.N.	11	34	141	17.1
8.	Z.C.	11	33	140	16.8
Average			**35.6**	**144**	**17.2**
9.	M.G.	12	42	153	18.0
10.	V.I.	12	40	151	17.5
11.	C.R.	12	36	147	16.7
12.	D.L.	12	43	152	18.6
13.	T.O.	12	41	150	18.2
14.	A.M.-G.	12	39	148	17.8
15.	N.P.	12	38	149	17.1
Average			**39.9**	**150**	**17.7**
16.	E.A.	13	46	156	18.9
17.	D.T.	13	44	155	18.3
18.	C.B.-V.	13	47	158	18.8
19.	M.S.	13	43	153	18.4
20.	H.F.	13	42	154	17.7
21.	L.D.	13	45	157	18.2
22.	G.R.	13	48	160	18.8
23.	B.C.	13	46	159	18.2
24.	N.M.-S.	13	47	158	18.8
Average			**45.3**	**156.6**	**18.4**

Based on the table presented, a steady increase can be observed in the averages of weight, height, and body mass index (BMI) with age. 11-year-old students have an average weight of 35.6 kg, an average height of 144 cm, and an average BMI of 17.2, while 13-year-old students reach average values of 45.3 kg for weight, 156.6 cm for height, and 18.4 for BMI.

This evolution reflects the normal rate of growth and physical maturation typical of preadolescence, indicating a relatively harmonious development of the students included in the study.

Table 2. Values of the main anthropometric indicators in girls, by age categories

No.	Full Name	**Age**	Weight **(kg)**	Height **(cm)**	BMI
1.	A.D.	11	37	154	15.6
2.	M.D.	11	36	152	15.4
3.	P.A.-I.	11	41	156	15.6
4.	B.O.-Ș.	11	35	157	14.2
5.	S.D.	11	32	151	14.3
6.	M.I.	11	43	155	17.9
7.	S.C.	11	41	160	16.2
8.	P.I.	11	34	152	14.7
9.	A.D.	11	37	153	15.8
10.	L.E.	11	42	158	16.8
Average			**37.8**	**154**	**15.6**
11.	B.A.-I.	12	39	160	15.2
12.	T.A.	12	41	158	16.4
13.	V.P.	12	37	155	15.4
14.	R.L.	12	43	161	16.5
15.	S.R.-D.	12	47	163	17.6

16.	M.M.	12	38	159	15
17.	S.D.	12	41	160	16
Average			**40.8**	**159.4**	**16**
18.	D.L.	13	46	166	16.6
19.	E.F.	13	52	165	19.1
20.	S.A.	13	50	163	18.8
21.	L.A.-F.	13	53	166	19.2
22.	G.S.	13	49	163	18.4
23.	L.C.	13	54	168	19.1
Average			**50.6**	**165.1**	**18.5**

Analyzing the table, a progressive increase in weight, height, and body mass index (BMI) can be observed with the students' age. At 11 years, the average values are 37.8 kg for weight, 154 cm for height, and 15.6 for BMI, while at 13 years these increase to 50.6 kg, 165.1 cm, and 18.5, respectively. This evolution suggests a normal rate of physical development and maturation appropriate for preadolescent age, with minor individual variations among students.

Table 6. Values of anthropometric indicators regarding waist circumference, chest circumference, and foot length in boys

No.	**Full name**	**Age**	**Waist Circumference**	**Chest Circumference**	**Foot Length**
1.	B.B.	11	60	70	22
2.	C.D.	11	59	64	21
3.	E.T-M	11	58	62	20
4.	G.A.	11	61	72	22

5.	I.O.	11	62	76	23
6.	T.L.	11	66	78	22
7.	A.N.	11	58	67	20
8.	O.L.	11	57	63	21
Average			**60.1**	**69**	**21.4**
9.	V.R.	12	64	77	23
10.	A.T.	12	68	80	24
11.	U.I.	12	70	82	25
12.	A.R.	12	54	68	21
13.	M.Z.	12	56	73	20
14.	A.E.	12	61	76	22
15.	D.D.	12	73	86	25
Average			**63.7**	**77.4**	**22.9**
16.	U.E.	13	66	81	24
17.	D.F.	13	62	74	21
18.	E.G.	13	69	77	25
19.	F.U.	13	61	73	20
20.	G.I.	13	73	86	27
21.	H.A.	13	60	76	22
22.	I.L.	13	63	74	23
23.	T.L.	13	65	77	24
24.	M.M.	13	75	86	25
Average			**66.6**	**77.8**	**23.9**

The table analysis indicates a progressive increase in waist circumference, chest circumference, and foot length with the age of the boys evaluated. At 11 years, the average

values are 60.1 cm for waist, 69 cm for chest, and 21.4 cm for foot length, while at 13 years these increase to 66.6 cm, 77.8 cm, and 23.9 cm, respectively. This evolution reflects normal physical development typical of preadolescent age, highlighting the growth rate of major body segments in boys.

Table 4. Values of anthropometric indicators regarding waist circumference, chest circumference, and foot length in girls

No.	Full name	Age	Waist Circumference	Chest Circumference	Foot Length
1.	C.V.	11	55	70	21
2.	N.T.	11	59	68	19
3.	F.B.-R.	11	53	65	20
4.	L.O.-P.	11	60	72	23
5.	T.I.	11	61	74	22
6.	M.K.	11	52	66	18
7.	S.P.	11	57	67	21
8.	B.R.	11	62	69	22
9.	C.M.	11	58	68	20
10.	D.L.	11	56	70	21
Average	**-**	**-**	**57,3**	**68,9**	**20,7**
11.	V.A.-T.	12	63	75	22
12.	P.N.	12	58	72	21
13.	G.C.	12	54	70	19
14.	R.F.	12	67	80	23
15.	B.D.-S.	12	66	78	22
16.	M.E.	12	60	76	21
17.	F.S.	12	68	79	24

Average	**-**	**-**	**62,3**	**75,7**	**21,7**
18.	H.L.	13	66	81	23
19.	T.F.	13	60	79	21
20.	P.S.	13	65	80	22
21.	M.A.-C.	13	69	83	24
22.	J.G.	13	67	82	23
23.	L.N.	13	59	76	20
Average	**-**	**-**	**64,3**	**80,2**	**22,2**

The table analysis shows a progressive increase in waist circumference, chest circumference, and foot length with the age of the girls evaluated. At 11 years, the average values are 57.3 cm for waist, 68.9 cm for chest, and 20.7 cm for foot length, while at 13 years these increase to 64.3 cm, 80.2 cm, and 22.2 cm, respectively. This evolution indicates a normal rate of physical development and maturation characteristic of the preadolescent period, reflecting the body changes specific to girls during this growth stage.

3. CONCLUSIONS

Based on the analyses conducted, it can be observed that middle school students exhibit progressive and harmonious physical development, consistent with preadolescent stages.

The average values of weight, height, and BMI increase steadily with age, reflecting the natural accumulation of body mass and statural maturation characteristic of this period. Measurements of body segments, such as waist and chest circumference or foot length, show similar growth rates, indicating a uniform progression of physical development. Comparatively, boys tend to have slightly larger body segment dimensions, while girls display more balanced values, suggesting sex-specific physiological differences.

The individual variability observed emphasizes the need for personalized evaluation to identify potential imbalances or health and nutrition risks. Overall, the results confirm the usefulness of anthropometric measurements and BMI as tools for monitoring physical

development. These data provide important support for teachers and specialists, helping to adapt physical education and nutrition programs to the real needs of students.

The study demonstrates that continuous monitoring of somatometrical parameters can contribute to the prevention of health problems and the promotion of harmonious development. Additionally, the research highlights that analyzing differences between sexes and among students of different ages can guide educational and sports interventions more effectively. Ultimately, these conclusions support the importance of an integrated approach that considers both biological aspects and lifestyle and school environment factors.

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