Sex-related differences in chest dimensions in 9-10 – years old Bulgarian children

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Abstract

Objectives. This study aimed to characterize the sexual differences in chest dimensions and shape in Bulgarian schoolchildren and the relation of chest measurements with vital capacity and some anthropometric parameters.
Material and methods. A total of 107 (60 boys and 47 girls) schoolchildren aged 9-10 years from Sofia, Bulgaria were studied. Chest's diameters and circumference, waist circumference and vital capacity of each subject were measured. Thoracic index and BMI were calculated.
Results. In 9-10 years old children the sexual differences of some variables are well expressed as the boys had greater values than girls.
Conclusions. Significant positive association of all chest dimensions with anthropometric features in both sexes was observed. A significant and positive relation between some torso parameters and vital capacity also was found. In boys it was low and in girls - moderate.

Keywords: chest dimensions, thoracic index, vital capacity, Bulgarian schoolchildren.

Introduction

Chest characteristic is a basic indicator for tracing the changes in physical status and body constitution of man and in some cases for his health status. The main chest dimensions give important information about the chest shape and massiveness, as well for the fat and muscle mass accumulation in the trunk. There are also regional differences caused by socio-economic differences and changes in the daily diet structure of children, with consequences especially on their growth and development (Baciu, 2011). Some authors established strong relation between trunk development and lung function. (Schrader et al., 1984; DeGroodt et al., 1986; Asher et al., 1987; Connett et al., 1994). High correlation between lung volumes and height increment in children is determined too. Therefore, most of the published reference values of lung function are based on height. Fisher et al., (1990) proved that there is proportional relationship between lung volumes and function and weight.

The aim of the present study was to characterize the sexual differences in chest dimensions and shape in Bulgarian schoolchildren and the relation of chest measurements with vital capacity and some anthropometric parameters.

Material and Methods

A total of 107 (60 boys and 47 girls) children aged 9-10 years from two primary school in Sofia, Bulgaria were studied. The children and their parents volunteered for the research and gave their written informed consent. Ethical agreement to perform the study was obtained from the Human Ethical Committee of Institute of Experimental Morphology, Pathology and Anthropology with Museum – Bulgarian Academy of Sciences (Protocol № 3/11.04.2018) and conducted in accordance with the declaration of Helsinki for human studies of the World Medical Association (Declaration of Helsinki, 2008).

Height, weight, chest's diameters, chest circumference in pause and waist circumference of each subject were measured by using the Martin Saller's classical methods from the right side of the body. Transversal diameter (chest breadth) of the thorax was measured from left to right midaxillary line (at the level of the mesosternal) in cm. Sagittal diameter (chest depth) of the thorax was measured in the sagittal plane (from the mesosternal to the apex of corresponding processus spinosus of the spine) in cm. Thoracic index and body mass index (BMI) were calculated by the formulas:

Thoracic index = Chest depth * 100 / Chest breadth

BMI = Body weight (kg)/ Body height $(m)^2$

The metrical data were analyzed by SPSS software, version 16.00. The independent sample t-test was performed to compare the mean values of the anthropometric measurements between genders. Statistical significance was set at $P< 0.05$. Pearson's correlation analysis was used investigating the relationship among chest's dimensions, anthropometric variables and vital capacity.

Results

The mean values of anthropometric features in 9-10 years old children were presented on **Table 1.** Height, weight, BMI and waist circumference were higher in boys compared to girls. The differences between sexes were not statistically significant in height, weight and BMI. The values of waist circumference were higher in boys than in girls and significant differences were observed ($p = 0.016$).

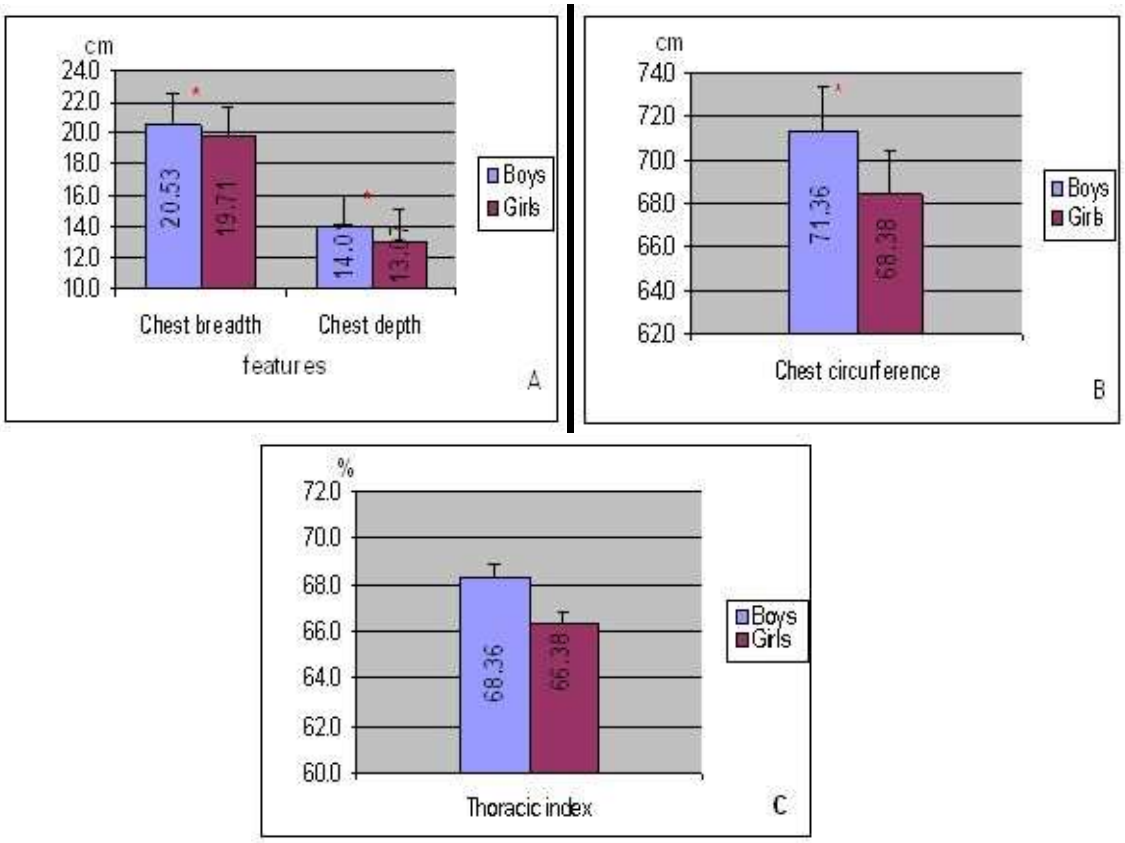
Table 1. Anthropometric characteristics in 9-10 years old Bulgarian children

Participants / Traits	Boys (n=60)		Girls (n=47)		P-value
	Mean	(SD)	Mean	(SD)	
Age	9.60	(0.49)	9.49	(0.51)	0.258
Height (cm)	143.00	(6.39)	141.00	(6.78)	0.770
Weight (kg)	39.16	(8.63)	36.48	(7.80)	0.990
BMI (kg/m^2)	18.93	(3.44)	17.82	(3.52)	0.106
Waist circumference (cm)	67.07	(8.87)	63.07	(7.61)	0.016*

*Statistical significant differences

The data analysis of two chest diameters and chest circumference showed significant sexual differences ($p<0.05$), as the boys aged 9-10 years had higher values than girls of the same ages (Fig. 1 A, B). The thoracic index, expressed by the ratio between antero-posterior and transversal diameter gave information about chest shape. The sexual differences between its mean values were not significant ($p = 0.12$) (Fig. 1C).

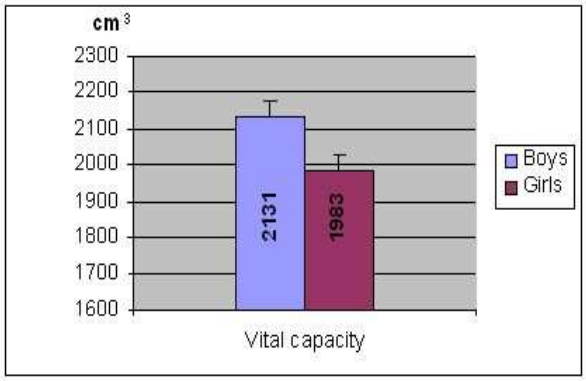
Figure 1. (A,B,C) Chests dimensions and Thoracic index in 9-10 years old Bulgarian children



It is well known that vital capacity is influenced by body growth, pubertal development, sport activity and diseases.

The mean value of vital capacity in girls was 1982.98±511.31 m^3, and in boys - 2130.83±567.93 m^3, respectively. In this early school age there were no significant differences ($p = 0.16$) between assessed groups (Fig. 2).

Figure 2. Vital capacity in 9-10 years old children



A strong association between all chest dimensions and anthropometric parameters was observed **(Table 2** and **Table 3)**. The correlation coefficients characterized relationship between stature, weight and chest parameters were mostly higher in girls. In boys the higher values of

correlation were found between BMI, waist circumference and chest parameters. A significant and positive relationship with low to moderate intensity between vital capacity and some torso parameters in both sexes was established. Vital capacity correlated positively also with body height and weight, as the intensity was only moderate.

Table 2. Correlation between vital capacity, chest dimensions and waist circumference in 9-10 years old schoolboys

Traits	Height	Weight	BMI	Waist circ.	Chest breadth	Chest depth	Chest circ.	Vital capacity
Height	1	0.591**	0.232	0.401*	0.492**	0.456**	0.385**	0.339**
Weight		1	0.919**	0.913**	0.879**	0.678**	0.906**	0.305*
BMI			1	0.911**	0.822**	0.594**	0.931**	0.210
Waist circ.				1	0.817**	0.667**	0.938**	0.178
Chest breadth					1	0.524**	0.868**	0.281*
Chest depth						1	0.641**	0.293*
Chest circ.							1	0.210
Vital capacity								1

**Statistical significant differences at $p<0.01$;
* Statistical significant differences at $p<0.05$;

Table 3. Correlation between vital capacity, chest dimensions and waist circumference in 9-10 years old schoolgirls

Traits	Height	Weight	BMI	Waist circ.	Chest breadth	Chest depth	Chest circ.	Vital capacity
Height	1	0.763**	0.313*	0.541*	0.588**	0.666**	0.615**	0.404**
Weight		1	0.681**	0.881**	0.862**	0.836**	0.917**	0.371*
BMI			1	0.673**	0.615**	0.542**	0.650**	0.142
Waist circ.				1	0.798**	0.728**	0.858**	0.122
Chest breadth					1	0.716**	0.888**	0.323*
Chest depth						1	0.798**	0.279
Chest circ.							1	0.375**
Vital capacity								1

**Statistical significant differences at $p<0.01$;
* Statistical significant differences at $p<0.05$;

Discussions

During the growth period, clearly expressed sexual differences are observed in different anthropometric parameters. The present study provided information for differences between sexes in chest dimensions and vital capacity in Bulgarian primary schoolchildren. Descriptive statistics of the basic anthropometric features showed that the boys were taller and heavier than girls, but statistically significant sexual differences were not established. Similar results are presented by Nacheva et al. (2012). According to data of two chest diameters and chest

circumference the boys had significantly wider and deeper chest and bigger chest circumference than girls in this age. The results correspond those obtained by Živičnjak et al. (2008), according to which the males had broader chest and larger antero-posterior chest diameter than females.

Considerable distinctions are noted also for waist circumference which values are higher in boys. A study conducted in 2001-2002 in Bulgaria showed that the values of chest and waist circumferences are equal in girls and boys aged 10 years. In the next age they are significantly higher in boys than in girls (Mitova, 2005). Data from the National Health Survey in the United States also reported results close to these one in the present study (National Center for Health Statistics, 1973). The current data of the chest and waist circumferences were considerably higher than those from the investigation of Bulgarian children and youths (Nacheva et al., 2012). Contrary to this the values of chests diameters and thoracic index were significantly lower. During childhood and adolescents the shape of thorax is changed from cone with base turned down in infants to cone with base turned upwards in adults. It should be noted that the present results confirmed this definition and reported for the negligible gender differences in thoracic index in the studied Bulgarian children.

The vital capacity is a one of the parameters that provide information of lung function (LF). Spirometry is the technique to evaluate how well the lung function is helpful in the diagnoses and monitoring of diseases as well as the epidemiological surveys. During the growth LF is influenced by anthropometric, environmental and socio-economic factors, body composition, sex, maturity, ethnicity (Vijayan, 1990; Karacan, 2008; Whitrow and Harding, 2008; Adedoyin, 2010; Pekkarinen, 2012; Jat, 2013). In this early school age significant sexual differences in mean values of vital capacity are not observed ($p = 0.16$), although the boys had greater ones.

This research also examined the relationship between anthropometric features and vital capacity in the early school age. The correlation matrix showed significant relation of the vital capacity with height and weight and was not significantly associated with BMI in both males and females. The finding was confirmed by other authors (Kivastik and Kingisepp, 2000; Medarov, Strachan and Cohen 2005; Roy, 2014). Contrary to our results Behera et al. (2014) indicated a significant association of vital capacity with BMI in case of females.

Conclusions

In 9-10 years old children the sexual differences of some anthropometric variables are well expressed as the boys had greater values than girls. Significant positive association of all chest dimensions with anthropometric features in both sexes was observed. A significant and positive relation between some torso parameters and vital capacity also was found. In boys it was low and in girls - moderate.

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