

## QUANTITATIVE AND QUALITATIVE EXAMINATION OF ANTHROPOMETRICAL PARAMETERS IN PRESCHOOL CHILDREN WITH SELF-ORGANIZING MAPS

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### Abstract

Growth monitoring and promotion of optimal growth are essential components of primary health care for children. Serial measurements of weight, height/length, for all children and measurements of circular and transversal parameters compared with growth of large sample population help to confirm a child's healthy growth and development. It also allows early identification of potential nutritional or health problems and enables prompt action before a child's health is seriously compromised. The aim of the study was to compare quantitative and qualitative examination of anthropometric parameters as indicator of growth and nutritional status in preschool children. Anthropometric parameters were measured on healthy children, defining longitudinal, circular and transversal dimensionality of the skeleton using standard technique and instruments. The qualitative examination was detected with self-organizing maps. The majority of anthropometrical parameters have shown significant age and sex specific differences in favour of female subjects. The height-for-age index values corresponding to the 50<sup>th</sup> percentile showed slightly higher values in our female subjects 115.4 cm than in our male subjects 113.2 cm. The values of 50<sup>th</sup> percentile of BMI in our male subjects were 15.94 kg/m<sup>2</sup> whereas in our females were 15.64 kg/m<sup>2</sup>. These results show that obesity prevention is recommended, and detected values could be applied for evaluation of deviations in growth and nutritional status in preschool children.

**Key words:** anthropometry, growth, self-organizing maps, preschool children

### Introduction

Continuing process of growth and development in preschool children is one of the major characteristics. The growth is very difficult process which means qualitative changes of the structure, function and reactivity of some organs, changes in psychophysical characteristics of the child and his adjustment to the social conditions in the surrounding he/she lives. On the other hand, nutrition is also an important factor that has impact on all stages of growth and development, and hence its influence has to be constantly monitored especially its influence on the health status, morbidity and mortality [1]. Therefore, it is necessary to determine the nutritional status of the populations groups and individuals which is a result of their dietary patterns and utilization nutrients in the metabolic processes. That is why childhood is a very sensitive period of growth, development and maturation when numerous changes happen in the organism. Monitoring and evaluation of growth and development in this period is very important [2-3]. Current knowledge points out to an increasing rate of risk factors for onset of non-communicable diseases in the developed and underdeveloped countries, where it is necessary to undertake preventive measurements in early preschool age. The estimation of the child's growth, detection of underweight and/or overweight and obesity is possible according to the standards of the WHO, which show the directions on the children normal growth. They show that children born in different regions have potential to grow and develop in equal span for height and weight for that age. These directions on children growth offer a new prospective period, and not only a descriptive one [4]. Anthropologic examinations, being non-invasive, simple, easy adaptable to children's age, enable monitoring of the dynamics of child's growth and also indicate disorders in the nutritional status during this preschool period. Longitudinal, circular and transversal dimensionality of the skeleton might be defined by measuring the adequate anthropometric parameters.

**Aim:** Qualitative examinations using self-organizing maps of some anthropometric parameters as indicators of growth and nutritional status in preschool children.

### Subjects and methods

Healthy preschool children of both sexes of both nationality were included in the study. The total number of subjects (n=200) was divided into two groups based on sex criterion, boys (n=100) and girls (n=100). Some anthropometric parameters were measured according to the guidelines of the International Biological Programme (IBP), such as body weight, longitudinal dimensions: body height, body weight, length of the arm, length of the leg; circular dimensions of the skeleton: head circumference, , mid-upper arm circumference, thigh circumference; transversal dimensions of the elbow and knee and skin-folds of biceps, scapula and cheek). Standard anthropometric instruments were used (anthropometer by Martin, calliper square, elastic plastic band and medical decimal scales). We used self-organizing maps generated as neural networks, where we put our data base to separate sexes and nationality. The following indices were selected and calculated: weight-for-age, height-for-age and BMI (body mass index). Data obtained were analyzed with descriptive statistics presented with measures of central tendency and its deviations (arithmetic standard values and standard deviation) as well as with ranges (percentiles).

### Results:

Mean values and standard deviations of the examined anthropometric parameters in preschool children are presented in Table 1.

**Table 1.** Body weight, body height, BMI, lengths and circumferences of the extremities in pre-school children (mean and standard deviation).

Sex	n	Body weight (kg)	Body height (cm)	BMI (kg/m <sup>2</sup> )	Arm length (cm)	Leg length (cm)	Head circumference (cm)	Upper arm circumference (cm)	Thigh circumference (cm)
Boys	100	21.5 ± 3.0	115.5± 5.8	15.94	45.9±3.7	58.8±5.7	49.8±2.4	15.6±1.8	15.91±1.87
Girls	100	21.72 ± 3.8	115.1± 6.0	15.64	45.5±2.9	59.4±5.6	49.4±1.7	16.0±1.7	16.01±1.59

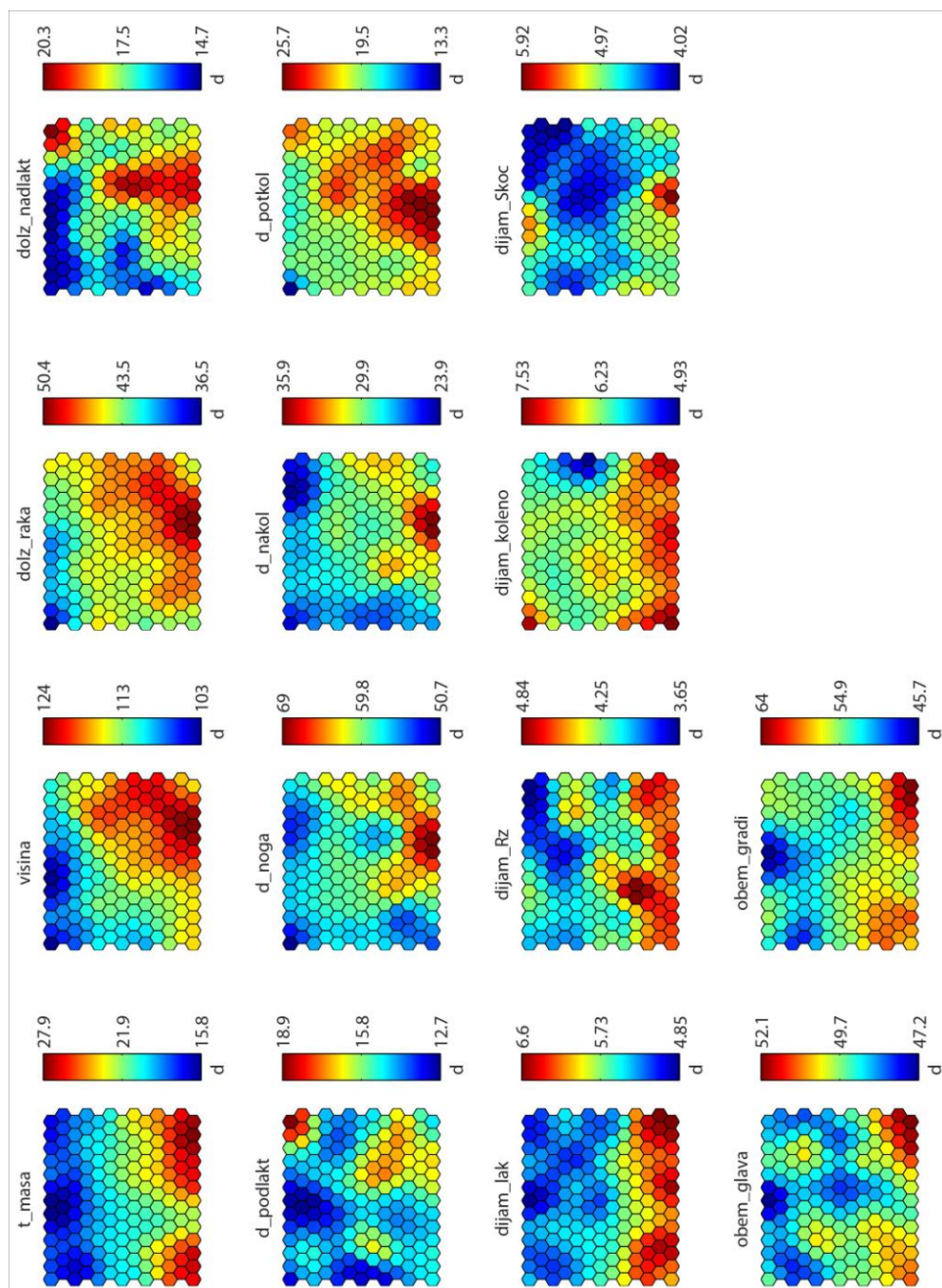
Table 1 lists mean values and standard deviations of the following parameters: weight, height, BMI, length of the extremities (arms and legs) and circumferences of the head, upper arm and thigh. Body weight of the boys was 21.5 ± 3.0, height 115.5 ±5.8 and BMI 15.94 kg/m<sup>2</sup>. Girls had the following values for the same parameters: weight 21.72 ±3.8 kg, height 115.1 ±6.0 cm and 15.64 kg/m<sup>2</sup> for BMI. Girls showed slightly higher values for weight and height instead of boys. There was no significant difference between the examined parameters except for circular parameters (upper arm 16.0 cm±1.7 and thigh circumference 16.01 cm±1.59) where the significant difference was in favor of girls. For quantitative examination with self-organizing maps we can see that were differences between Christians and Muslims children. In figure 1 the samples are marked by gender. Based on the layout of the gender labels, there is no tendency to group by gender. Figure 2 of the trained SOM shows the religious affiliation markings. Here, unlike the previous image, the clustering of data according to religious affiliation can be observed. If you look, you can see the most Christians are grouped in the middle and at the bottom of the map. While most of the Muslims are grouped in the upper left part of SOM. This grouping of samples according to religious affiliation can help us to read them from the previously presented layers of the map according to which the measured parameters differ in both groups of children figure 1. Based on the comparison made on the map, it can be noticed that Christian children aged 5 years, body height, arm length, upper arm, forearm and lower leg length are higher. In the section on Muslim children, a larger body mass, head and chest circumference, hip circumference, upper arm,

forearm, upper leg and abdominal skin -fold are observed. According to these results, the best discriminatory parameters between the two populations are the skin folds of the cheek, chin and biceps.

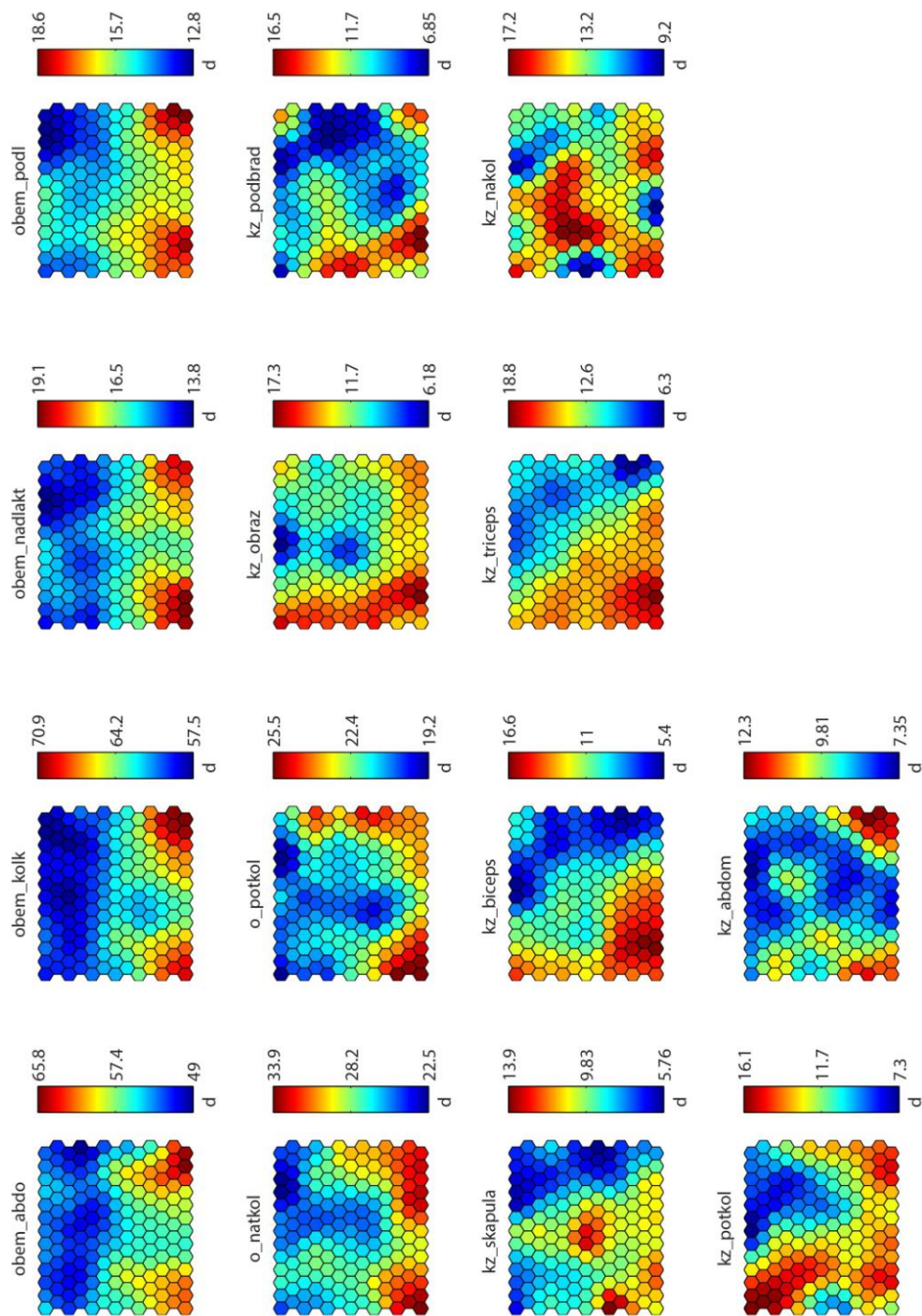
There was also a difference in the skin folds. The skin-fold of biceps, scapula and cheek were parameters who were discriminated between two nationalities. Borderline values for (5<sup>th</sup> and 85<sup>th</sup> percentile) in girls were 106.95 cm (5<sup>th</sup> percentile) and 120.52 cm (85<sup>th</sup> percentile) for height-for-age, 15.82 and 26.5 kg for weight-for-age and 13.97 and 18.90 kg/m<sup>2</sup> for BMI. Boys had the following values for the same parameters: 101.1 cm (5<sup>th</sup> percentile) and 121.85 cm (85<sup>th</sup> percentile) for height-for-age; 16 and 24 kg for weight-for-age and 13 and 17.83 kg/m<sup>2</sup> for BMI. In Table 2 were values for skin-folds for biceps, scapula and cheek are shown.

**Table 2.** Values for skin-folds in preschool children

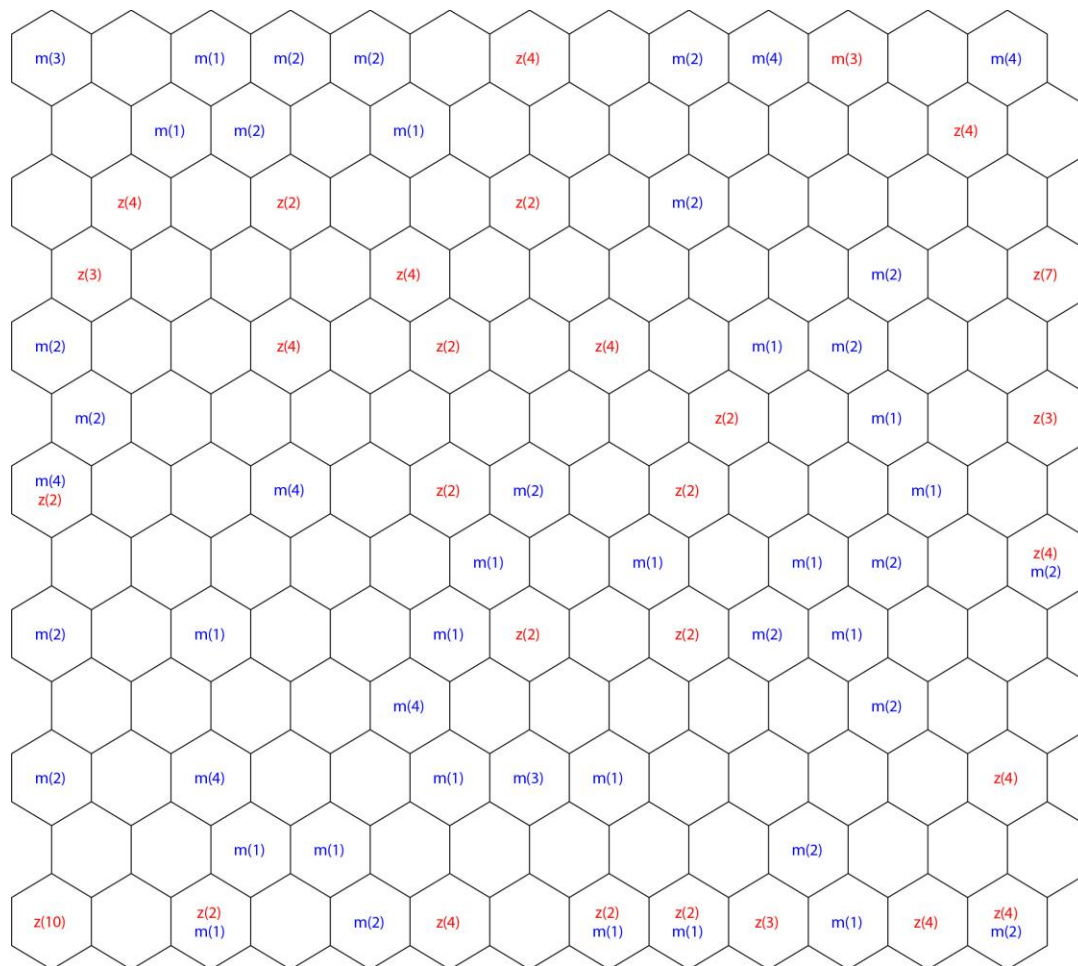
Boys	biceps	scapula	cheek
X and SD	10.6±3.9	8.5±2.7	12.3±2.7
Girls			
X and SD	9.7±3.3	9.6±2.6	11.7±3.3



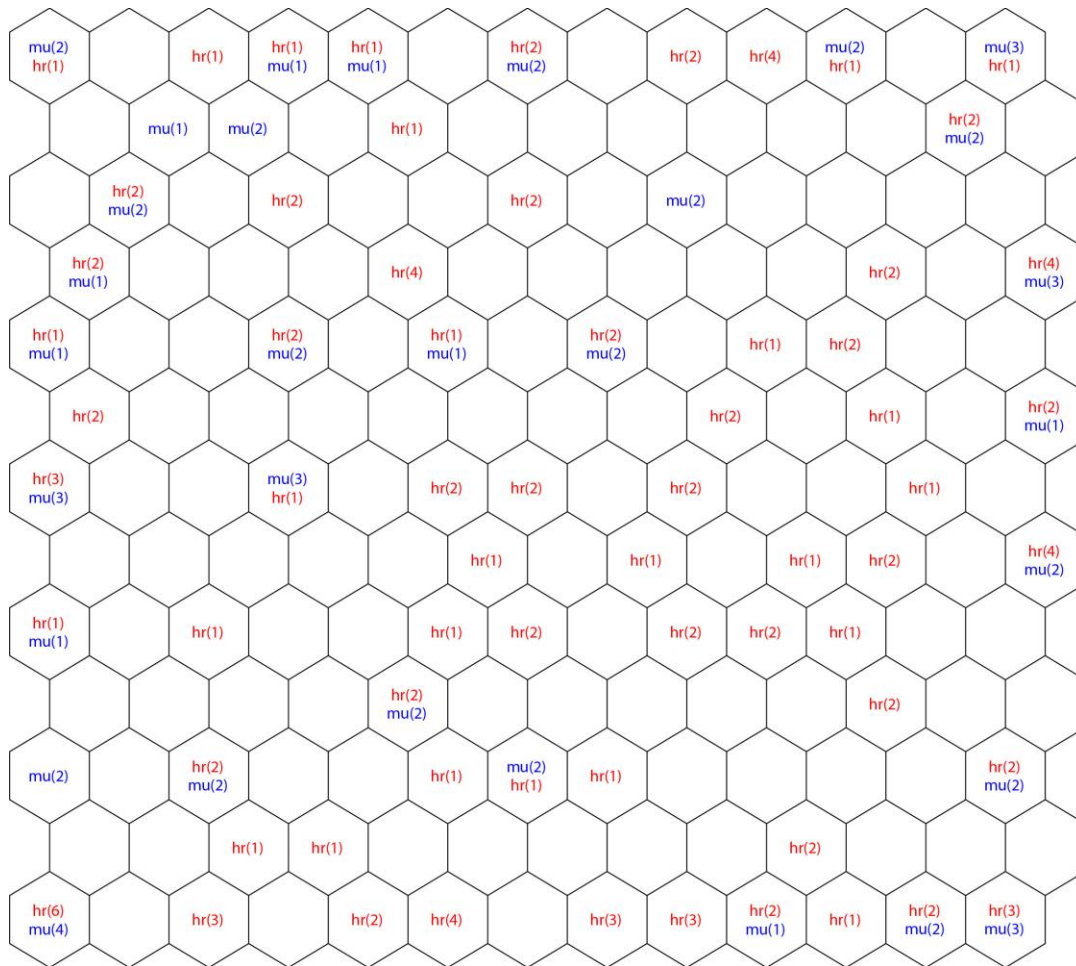
**Figure 1.** Self-organizing maps in preschool children and parameters



**Figure 1a .** Self-organizing maps in preschool children and parameters



**Figure 2.** Self-organizing maps in preschool children in both sexes and nationality



**Figure 2a.** Self-organizing maps in preschool children in both sexes and nationality

### Discussion

In our study the examined anthropometric parameters define longitudinal and circular dimensionality of the skeleton are used for assessment of growth and nutritional status in preschool children. It was discovered that mean values of almost all examined anthropometric parameters were slightly higher in girls. More significant differences were observed in circumferences of the extremities, particularly the upper arm circumference and the thigh circumference that were higher in girls. Some percentile ranges of the anthropometric parameters were calculated in preschool children from both nationality. Data obtained were compared with similar anthropometric studies conducted in children from other populations that were insignificantly higher than the values obtained in NCHS, WHO and CDC [5-8]. Longitudinal parameters are considered to be the most reliable indices of the physical growth in children, and circular parameters along with body weight indicate the body volume, that is its mass. Body weight as parameter of its own is a very weak indicator for assessment of overweight and does not correspond with the reference curve for assessment of weight-for-height indices. BMI (body mass index) or index for weight/height<sup>2</sup> is very popular for assessment of obesity or overweight in adults for many

years, but it has been recently used in preschool population. The importance of the most stable anthropometric parameters, the basic being body weight and body height, has been used in very different forms such as indices for presenting the growth and nutritional status in preschool children.[9-10]. The height-for-age children shows the linear growth and the deviation in its values, which is being detected at the 5<sup>th</sup> percentile as a borderline value is aimed at discovering children with obstacles in the linear growth as a result of misbalanced nutrition [11-12]. Our values for 50<sup>th</sup> percentile for indices weight-for-age and height-for-age were in girls 20 kg and 115 cm, and 20 kg and 113.2 cm in boys. These values were slightly higher than those found in the NCHS reference population as well as those reported by the WHO for the same age. [13]. The index of body mass, is a good indicator that monitors the degree of body mass, it is easily calculated and the result obtained is used for assessment of children who are obese, overweight underweight or with normal weight. [14-15]. Also the qualitative examination using self-organizing maps can show the differences between both nationality especially in samples marked by gender and basic anthropometers such as body weight and body height. Values above 50<sup>th</sup> percentile in our children were slightly lower, than those found in children from Canada, and slightly higher in children from Great Britain [16]. The obtained differences between the children from both nationality in our study and other studies and with reference to the standard values have shown the existence of population differences in anthropometric parameters that depend on many factors (external and internal). It is necessary to comply with the WHO recommendations that stress the necessity for each country to prepare its own anthropometric standards that are indispensable for classification and detection of growth and development disorders as well as nutritional status in children population [17].

### **Conclusion**

The examined parameters in this study shown that girls have slightly higher values for body height than boys and almost the same body weight in both sexes, particularly in circular parameters such as the upper arm circumference and the thigh circumference. There were no other significant statistical differences. Overweight and obesity have become a matter of growing concern. Monitoring their trends can help in creating criteria for normal growth and development, as well as assessment for nutritional status in preschool children from both nationality.

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