

CHILDHOOD OBESITY IN MACEDONIAN PRESCHOOL CHILDREN, PREVALENCE AND PREVENTION

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Abstract

Assessment of sex-specific differences of anthropometric parameters as indicator of growth and nutritional status in preschool children from Macedonia.

The study included a total of 200 healthy preschool children from Macedonian nationality. Thirteen anthropometric parameters were measured, defining longitudinal, circular and transversal dimensionality of the skeleton using standard technique and instruments for measurement. The following indices were selected and calculated: weight-for-age; height-for-age and BMI. Skin-folds (triceps, scapula, thigh) were also measured. Qualitative examinations were with self-organizing maps.

Sex-specific differences for almost all anthropometric parameters were detected, but they were not significant. Girls showed higher values than boys regarding height and weight, but there were no significant differences concerning BMI. Values at the 50th percentile in girls were 20 kg for BW, 108.1 cm for BH and 16.82 kg/m² for BMI. The values of these parameters in boys were 19.75 kg for BW, 108.25 cm for BH and 16.24 for kg/m² for BMI. The values for triceps skin-fold were higher in boys than (13.0 ±3.0) than in girls (12.5 ±3.6).

The results obtained can be used as criteria for assessment and detecting deviations in growth and nutritional status in preschool children.

Key words: anthropometry, growth, nutritional status, preschool children, self organizing maps.

Introduction

Childhood obesity has reached epidemic levels in developed countries. Overweight and obesity in childhood are known to have significant impact on both physical and psychological health. The mechanism of obesity development is not fully understood and it is believed to be a disorder with multiple causes.

Environmental factors, lifestyle preferences and cultural environment play roles in the rising prevalence of obesity worldwide. In general, overweight and obesity are assumed to be the results of an increase in caloric and fat intake. On the other hand, there are supporting evidence that excessive sugar intake by soft drinks, increased portion size and steady decline in physical activity have been playing major roles in the rising rates of obesity all around the world [1].

Consequently, over-consumption of calories and reduced physical activity are involved in childhood obesity. Almost all researchers agree that prevention could be the key strategy for controlling the current epidemic of obesity. Prevention may include primary prevention of overweight or obesity, secondary prevention or prevention of weight regains following weight loss, and avoidance of more weight increase in obese persons unable to lose weight.

Until now, most approaches have focused on changing the behaviour of individuals in diet and exercises. It seems, however, that these strategies have had little impact on the growing increase of the obesity epidemic. While about 50% of the adults are overweight and obese in many countries, it is difficult to reduce excessive weight once it becomes established.

Children should therefore be considered the priority population for intervention strategies. Prevention may be achieved through a variety of interventions targeting built environment, physical activity and diet [2].

Some of these potential strategies for intervention in children can be implemented by targeting preschool institutions, schools or after schools services as natural setting for influencing the diet and physical activity.

All in all, there is an urgent need to initiate prevention and treatment of obesity in children.

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. [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 [4].

They show that children born in different regions have potential to grow and develop in an equal span for height and weight for that age. [5].

These directions on children growth offer a new prospective period, and not only a descriptive one. 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: Evaluation of sex-specific differences in anthropometric parameters as indicators of growth and nutritional status in preschool children of Macedonian nationality.

Subjects and methods

Healthy preschool children of both sexes of Macedonian 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) aged 4-4.99. Thirteenth anthropometric parameters were measured according to the guidelines of the International Biological Programme (IBP), such as body weight, longitudinal dimensions: body height, length of the arm, length of the leg; circular dimensions of the skeleton: head circumference, abdominal circumference, mid-upper arm circumference, forearm circumference, thigh circumference. transversal dimensions of the elbow and knee and skin-folds of triceps, scapula and thigh).

Standard anthropometric instruments were used (anthropometer by Martin, calliper square, elastic plastic band and medical decimal scales). 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). We used self-organizing maps generated as neural networks, where we put our data base to separate sexes and nationality.

Results

Mean values and standard deviations of the examined anthropometric parameters in preschool children of Macedonian nationality are presented in Table 1 and Table 2.

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, forearm and thigh. Body weight of the boys was 19.9 ± 3.0 , height 108.4 ± 4.9 and BMI 16.55 ± 2.20 kg/m². Girls had the following values for the same parameters: weight 19.9 ± 3.1 kg, height 108.2 ± 6.3 cm and 16.89 ± 1.54 kg/m² 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 16.2 ± 1.6 and forearm circumference $13.7\text{cm}\pm 1.5$) where the significant difference was in favor of girls. There was also a difference in the skin folds.

The skin-fold of triceps was higher in boys ($13.3\text{ mm}\pm 3.0$); and skin-fold of scapula showed higher values in girls ($10.0\text{ mm}\pm 3.8$) (Table 2). The thigh circumferences were higher in boys (29.9 ± 3.2) than in girls (27.2 ± 3.2).

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

Sex	N	Body weight (kg)	Body height (cm)	BMI (kg/m ²)	Lenght (cm)	
					Arm	Leg
Boys	100	19.9 ± 3.0	108.4 ± 4.9	16.55 ± 2.20	$42.3\pm 2.6^*$	55.7 ± 4.2
Girls	100	19.9 ± 3.1	108.2 ± 6.3	16.89 ± 1.54	42.9 ± 3.3	$57.3\pm 4.4^*$

Sex	N	Circumferences (cm) Abdomen	Head	Upper arm	Fore arm	Thigh
Girls	100	$53.3\pm 4.0^*$	$49.5\pm 1.8^*$	16.2 ± 1.6	13.7 ± 1.5	$27.2\pm 3.2^*$

Table 2. Values of skin-folds in pre-school children of Macedonian nationality.

	Subscapula	Triceps	Upper leg
Boys			
X	9.1 ± 3.1	13.0 ± 3.0	11.0 ± 3.8
SD			
Girls			
X	$10.0\pm 3.8^*$	12.5 ± 3.6	$11.1\pm 3.6^*$
SD			

Table 3. Sex-specific percentiles of the indexes: weight-for-age, height-for-age and BMI in Macedonian children.

	<i>PERCENTILES</i>								
Boys	5	10	15	25	50	75	85	90	95
Body weight	14	15	16	16	19.75	22	23	23.1	24.1
Body height	99.97	100.9	101.42	101.35	108.25	112.12	114	114	114.52
BMI	14.32	14.71	15.02	15.02	16.24	17.93	18.58	19.22	21.11
Girls									
Body weight	14	15	15	18	20	21.37	23.1	25	25.35
Body height	95.3	99	99.95	103.37	108.1	111.75	114.55	115.85	118.22
BMI	14.37	14.66	15.34	15.89	16.82	17.79	18.74	19.17	20.20

Sex-specific percentiles for the indices weight-for-age, height-for-age and BMI for preschool children from Macedonian nationality are shown in Table 3. Borderline values (5th and 85th percentile) in girls were 95.3 cm (5th percentile) and 114.55 cm (85th percentile) for height-for-age, 14.00 and 23.1 kg for weight-for-age and 14.37 and 18.74 kg/m² for BMI.

Boys had the following values for the same parameters: 99.97 cm (5th percentile) and 114 cm (85th percentile) for height-for-age; 14 and 23 kg for weight-for-age and 14.32 and 18.58 kg/m² for BMI.

In Table 4 percentile values for upper leg circumference, and skin-folds for triceps and scapula are shown.

Table 4. Percentile values for thigh circumference and skin-folds in preschool children of Macedonian nationality.

	<i>PERCENTILES</i>								
BOYS	5	10	15	25	50	75	85	90	95
Upper leg	13	13.50	14.0	14.2	15.5	17	17	17.8	18.5
Scapula	4.80	6.00	6.00	7.00	9.00	11.00	12.00	12.10	16.00
Triceps	9.00	9.0	10.00	10.00	13.00	15.00	16.15	17.10	18.05
GIRLS									
Upper leg	14	14	14.4	14.58	15.50	17.00	18.00	18.41	19.03
Scapula	4.0	4.90	5.99	7.75	10.00	13.00	14.00	15.00	16.05
Triceps	7.00	8.00	8.00	9.00	14.00	15.00	16.00	17.00	18.00

For quantitative examination with self-organizing maps we can see that there were differences between Christians and Muslims children. In figure 1 and 1a the samples are marked by gender. Based on the layout of the gender labels, there is no tendency to group by gender.

In Figure 2 and 2a, the samples are marked by gender and religion. It is noted that the regrouping of the data is according to religious affiliation.

If you look at it, you can see that the majority of Christians are grouped in the lower left part of the map, while the Muslims are grouped in the upper right part of the SOM (self organizing maps).

It is interesting to note here that the children with the lowest and highest weight are of the Muslim faith, while the Christians are of average body mass.

The length of the upper knee and the lower knee in Christians is greater, and a similar trend is observed in the head circumference. In Muslim children, a higher value of the skin folds on the cheek, scapula, triceps, biceps and lower leg can be observed. Figure 2a shows the layers of the trained SOM for 4-4.99 year-old children and their parameters.

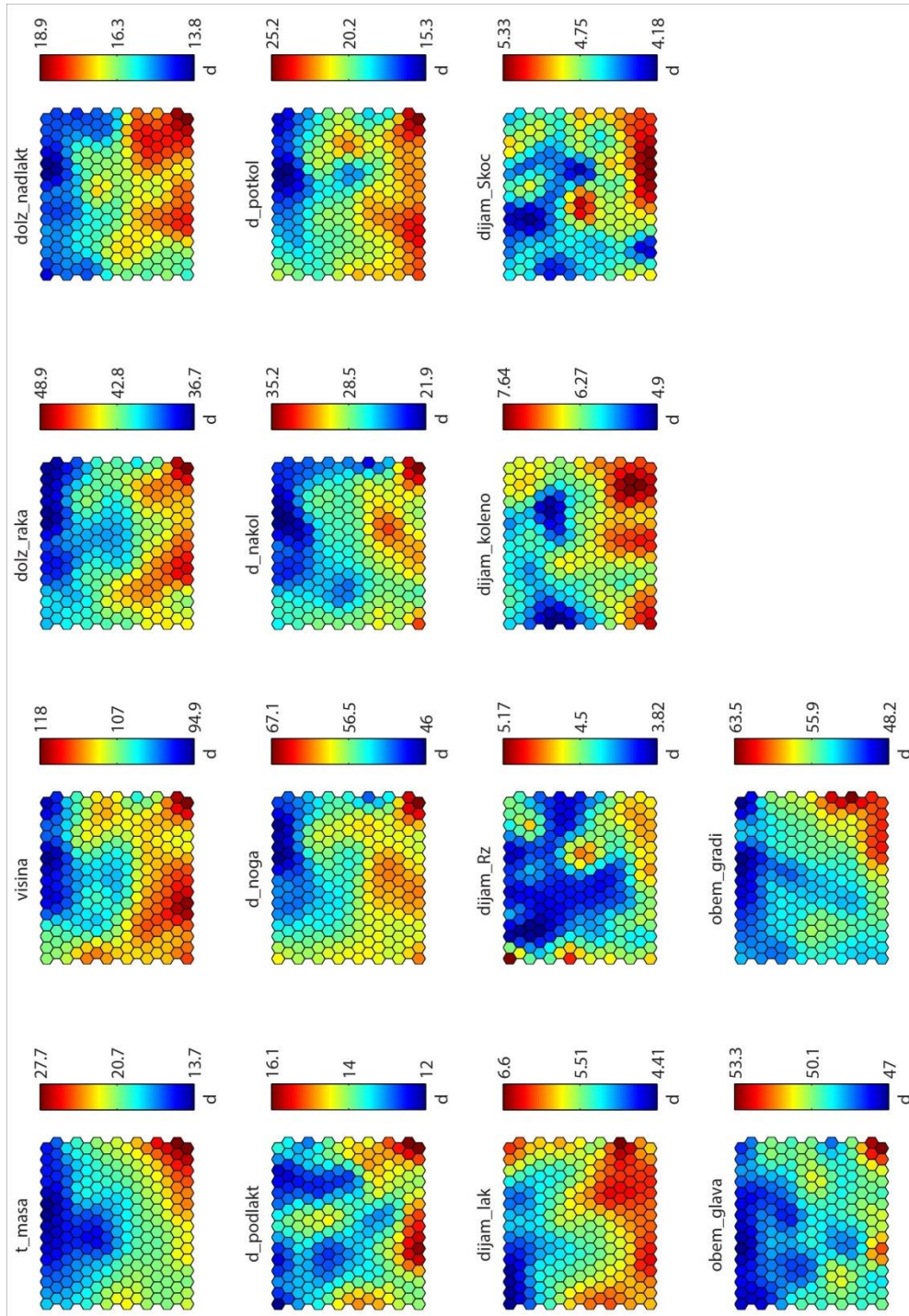


Figure 1. Self-organizing maps in preschool children and parameters

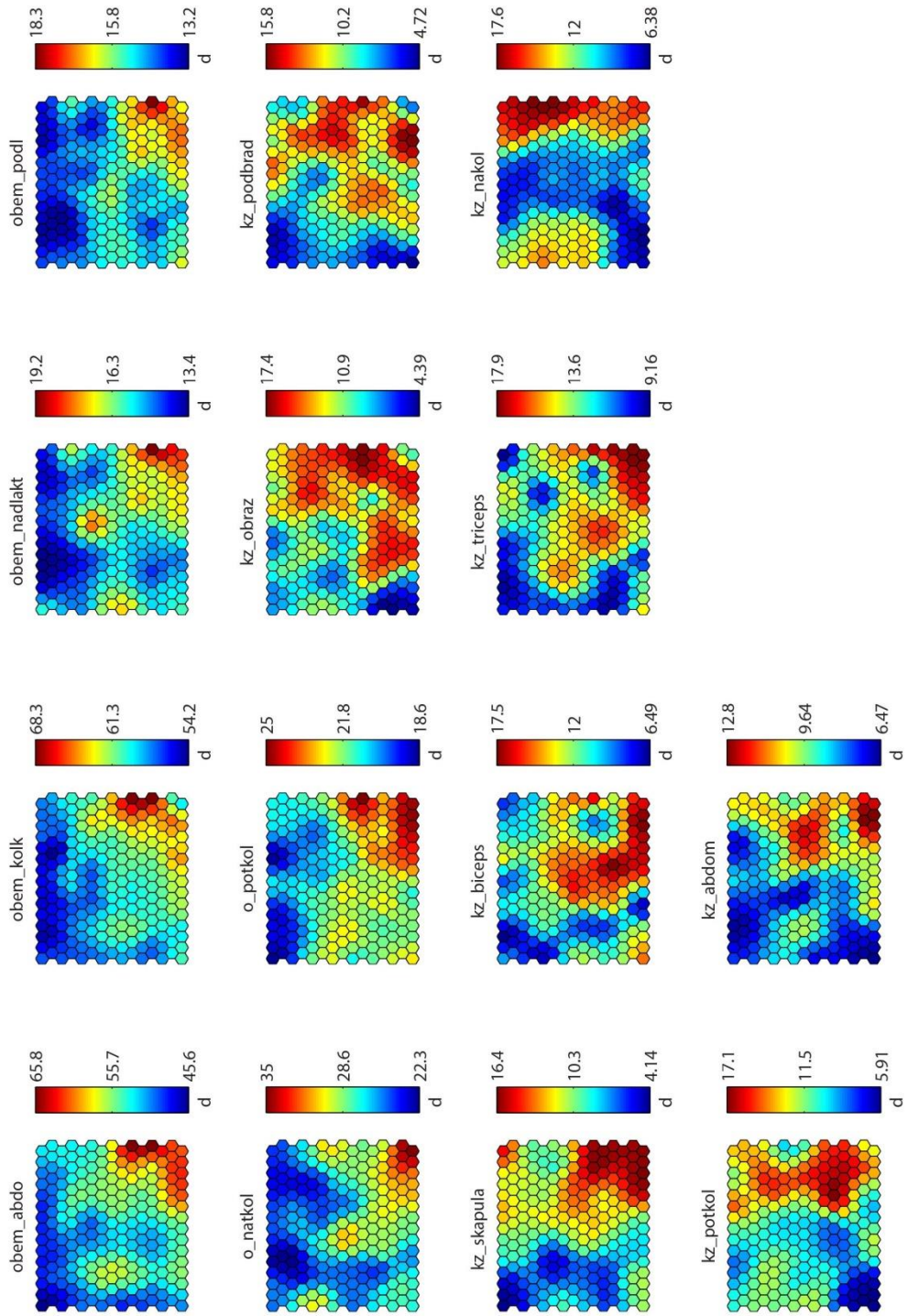


Figure 1a . Self-organizing maps in preschool children and parameters

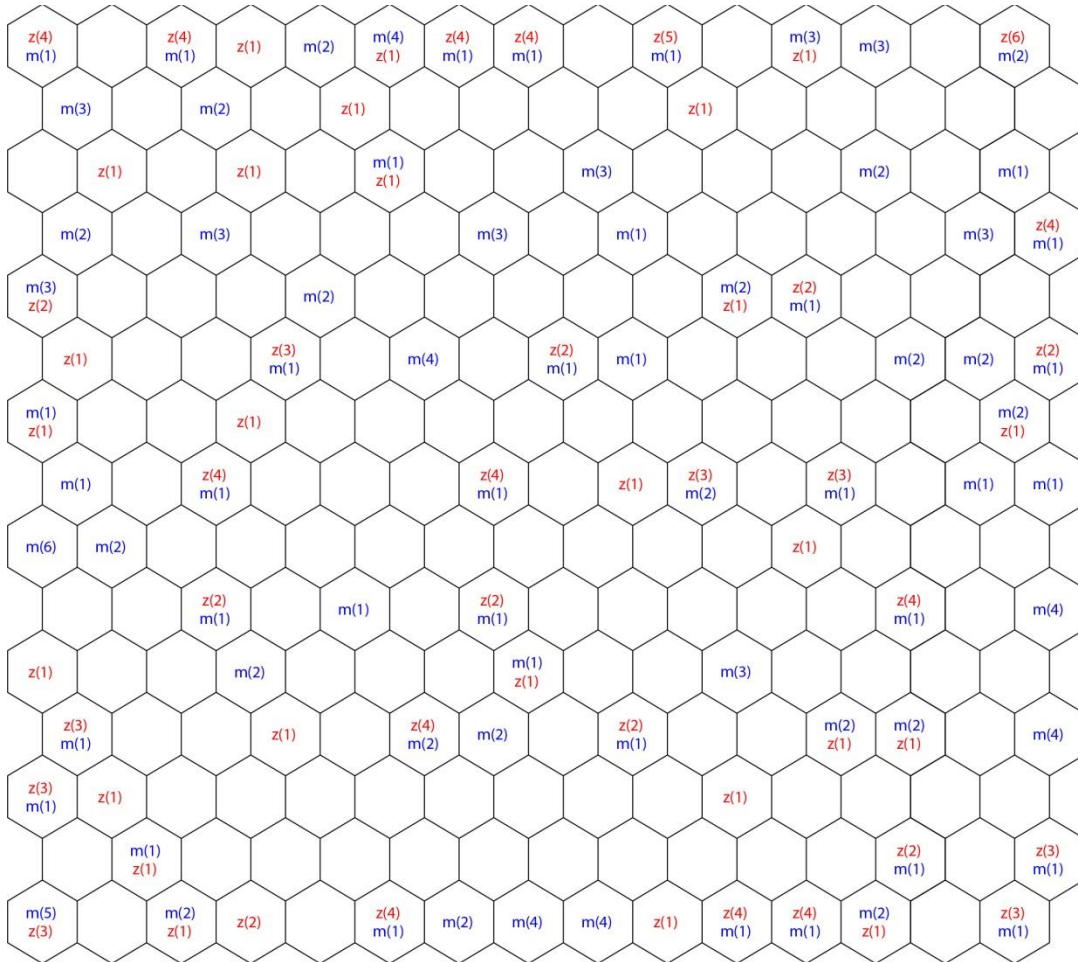


Figure 2. Self-organizing maps in preschool children in both sexes and nationality

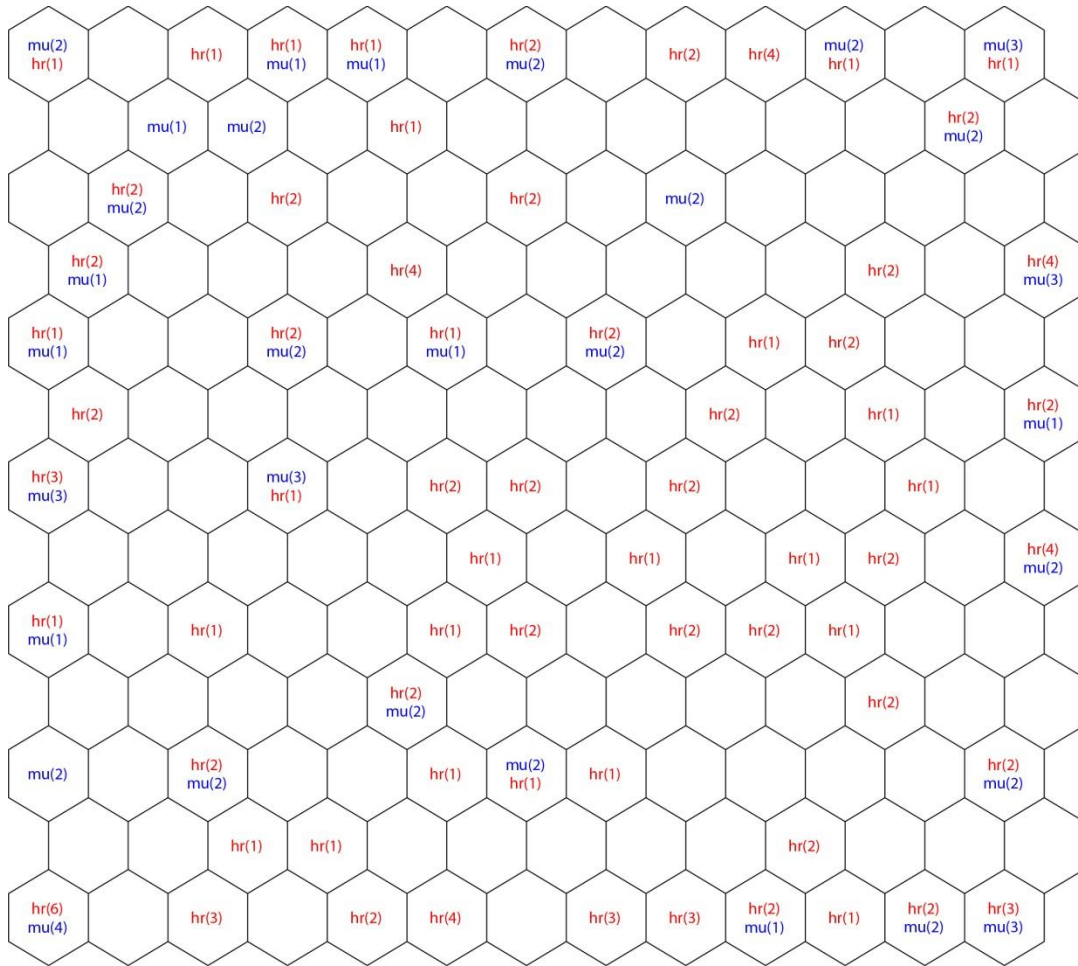


Figure 2a. Self-organizing maps in preschool children in both sexes and nationality.

Discussion

The examined anthropometric parameters in our study define longitudinal and circular dimensionality of the skeleton and 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 higher in girls.

More significant differences were observed in circumferences of the extremities, particularly the upper arm circumference in girls and the thigh circumference that were higher in boys. Some percentile ranges of the anthropometric parameters were calculated in preschool children aged 4-4.99 from Macedonian 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 [6]. 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 a 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/height² 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 [6-7].

The height-for-age index shows the linear growth and deviation in its values, which is being detected at the 5th percentile as a borderline value is aimed at discovering children with obstacles in the linear growth as a result of misbalanced nutrition [8].

Our values for the 50th percentile for the indices weight-for-age and height-for-age were in girls 20 kg and 108.1 cm, and 19.75 kg and 108.25 cm in boys. The values of body weight and height in children aged 4-4.99 from Macedonian nationality were higher than children at the same age from Albanian nationality. 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. Values above the 85th and 95th percentile are useful in detecting children at risk of obesity [9].

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. [10,17-19].

Values above the 50th percentile in our children were slightly lower, than those found in children from Canada, and slightly higher in children from Great Britain and Brazil [11,22-23].

The obtained differences between the children from Macedonian 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 [12].

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Also the qualitative examination using self-organizing maps can show the differences between both nationality especially in samples marked by gender, religion and basic anthropometers such as body weight and body height.

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 [20-21,24-25].

Conclusion

Girls have shown slightly higher values for body weight and height than boys, particularly in circular parameters such as the upper arm circumference but the thigh circumference was higher in boys. 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 of nutritional status in preschool children from Macedonian nationality.

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