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Short notice

State Nutrition of Pre-School Children

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Abstract: The aim of the research was to analyse the state of nutrition in pre-school children. The sample enrolled 325 children, among which 196 boys and 129 girls. There was measuring in May 2015. The data were analysed by descriptive statistics methods and multivariate (MANOVA) variance analyses for $p \leq 0.05$. It was established that boys and girls of pre-school age significantly differ in statistical terms as far as nutrition state is concerned. Univaried (ANOVA) variance analyses pointed to differences also in following variables *Body Mass, Ideal Body Mass* and *Body Mass Index* in favor of girls and *Relative Body Mass* in favor of boys. The percentage of undernourished children was extremely high (31.76%), at the same time there were 13.54% of overweight children. 54.70% of children were found to be of normal nutritional status.
Key words: detection, differences, nutrition, pre-school age.

Introduction

Obesity is a chronic disease revealed through over accumulation of fat tissue in body and weight gain (Gibney, Vorester, & Kok, 2002). Whether a person is obese or not can be established without delay by measuring their actual weight and height and entering details into computer program. Obesity has been on a rise in past 20 years and with the present rise rate it is reaching a global epidemic scale. It has been verified that inactivity can negatively reflect the BMI of pre-school children (Jago et al., 2005). According to information provided by World Health Organisation more than one billion of world population suffers from overweight and three million people are obese (WHO, 2005). Obesity is commonly described as over-accumulation of fat tissue in a body, clinically expressed by Body Mass Index – BMI, but, there are other methods in use (Tsigos et al., 2008). BMI is a number calculated from a child's weight and height (Mei et al., 2002). BMI is a reliable indicator of body fatness for most children and teens. BMI does not measure body fat directly, but research has shown that BMI correlates to direct measures of body fat, such as underwater weighing and dual energy x-ray absorptiometry (DXA) (Freedman et al., 1999). BMI can be considered an alternative for direct measures of body fat. Additionally, BMI is an inexpensive and easy-to-perform method of screening for weight categories that may lead to health problems. For children and teens, BMI is age- and sex-specific and is often referred to as BMI-for-age. After BMI is calculated for children and teens, the BMI number is plotted on the CDC BMI-for-age growth charts (for either girls or boys) to obtain a percentile ranking. Percentiles are the most commonly used indicator to assess the size and growth patterns of individual children in the United States (Must, & Anderson, 2003). The growth charts show the weight status categories used with children and teens (underweight, healthy weight, overweight, and obese) (Whitaker et al., 1997).

BMI-for-age weight status categories and the corresponding percentiles are shown in the following table.

Table 1. *Percentile range of BMI status*

Weight Status Category	Percentile Range
Underweight	Less than the 5th percentile
Healthy weight	5th percentile to less than the 85th percentile
Overweight	85th to less than the 95th percentile
Obese	Equal to or greater than the 95th percentile

BMI is used as a screening tool to identify possible weight problems for children. American Academy of Pediatrics (AAP) recommend the use of BMI to screen for overweight and obesity in children beginning at 2 years old. For children, BMI is used to screen for obesity, overweight, healthy weight, or underweight (Ferraro, Thorpe, & Wilkinson, 2003). However, BMI is not a diagnostic tool. For example, a child may have a high BMI for age and sex, but to determine if excess fat is a problem, a provider would need to perform further assessments. These assessments might include skin fold thickness measurements, evaluations of diet, physical activity, family history, and other appropriate health screenings. Although the BMI number is calculated the same way for children and adults, the criteria used to interpret the meaning of the BMI number for children and teens are different from those used for adults. For children and teens, BMI age- and sex-specific percentiles are used for two reasons:

- The amount of body fat changes with age.
- The amount of body fat differs between girls and boys.

The energy consumption and specific levels of physical activity may have greater influence to body composition in early childhood (Atkin, & Davies, 2000). Among children who were obese at the age of 7 (ITM>95. percentile) 43% of girls and 63% of boys remain obese at the age of thirty (Pover, Lake, & Cole, 1997). In Serbia 54% of population are overweight with highest prevalence in Vojvodina where 34.5% are overweight and 23% obese (Grujić et al., 2005). In view of higher frequency of obese children, the aim of this paper was to establish the nourishment state of pre-school children in Belgrade, and also to determine the quantitative analyses of differences between boys and girls of pre-school age.

Materials and Methods

The sample was selected from pre-school children population of both genders from Belgrade municipality. The children, aged 5 to 6, were attending preschool The 11th of April in Novi Beograd and were from different social backgrounds.

The sample consisted of 325 children, among which 196 boys 97 (5 year olds) and 66 (6 year olds) and 129 girls 99 (5 year olds) and 63 (6 year olds). Assessment included anthropometric dimensions of the measurement of one variable for the evaluation of longitudinal dimensionality of the skeleton 1) *Body Height* and one variable for assessing the volume and mass of the body 2) *Body Weight* to the respect of the international biological program IBP for each measure. Based on these two dimensions measured are calculated and made an ideal body weight (IBW) for boys and for girls IBW down your formula 3) *Ideal Body Weight* (kg); continues to be obtained relative body weight (RBW) on the basis that the body weight is distributed with the received ideal body weight and multiplied by 100 4) *Relative body weight* (%), in the end BMI is obtained by dividing the body weight divided by the squared body height 5) *Body Mass Index* (kg/m^2).

Ideal Body Mass for boys – **(IBM) = BH-100 – (BH-150)/4 + (Y-20)/4**
Ideal Body Mass for girls – **(IBM) =BH-100 – (BH-150)/2.5 + (Y-20)/4**
Key: BH – Body Height; Y – Life time.

Relative body weight - **(RBM) = BW/IBM*100**
Key: BW – Body Weight; IBM – Ideal Body Mass.

Body mass index – **(BMI) = BW/(BH)^2**
Key: BW – Body Weight; BH – Body Height.

For classification of nourishment level Harison's classification cited by (Kristiforović-Ilić, 2004).

Table 2. *Categorization nutritional status*

Score BMI	kg/m^2
Body mass index	category
<16	severe under nutrition
16-16,9	central under nutrition
17-18,4	moderate under nutrition

18,5-24,9	normal scope of nutrition
25-29,9	overweight
30-39,9	obesity
>40	morbid obesity

The descriptive statistics of body composition variables have been calculated for the arithmetic mean (M) and standard deviation (S), while the application of the multivariate (MANOVA) and univariate (ANOVA) analysis provided the statistically significant differences between respondent grups formed on the basis of sexually dimorphic differences.

Results

Analyses of descriptive statistics (table 1) pointed to homogeny of male and female sub-sample subjects only for the skeleton length variable, *Body Height,* while increased differences have been noticed in other variables. Such results are consequence of disproportional development of children, the fact that body weight is influenced by not only genetics but furthermore by socio-economical factors, way of living and level of physical activity.

Based on multivariate variance analyses significant differences in nutrition state of pre-school boys and girls were established. By individual analyses statistically significant differences were verified for variables *Body Weight, Ideal Body Weight* and *Body Mass Index* in favor of girls and *Relative Body Mass* in favor of boys. Comparing the two sub-samples the average normal level of nutrition is evident, as concluded based on BMI, while based on RTM the normal level of nutrition can be assumed in case of boys and underweight in case of girls. Such results point to well balanced diet that corresponds to the needs of pre-school children and a satisfactory degree of physical activity of children of opposite sex. In the view of ITM values it can be concluded that subjects from both sub-samples are deficient in *Ideal Body Mass*, in average about 4 kilograms.

Table 3. *Descriptive Statistics and Differences*

Variable	Boys (N=196)		Girls (N=129)		f	p
	M(AS)	SD(S)	M(AS)	SD(S)		
Body Height (mm)	1187.81	64.28	1183.77	66.23	0.30	0.58
Body Weight (kg)	28.07	5.01	30.10	4.93	12.89	0.00
Ideal Body Mass (kg)	32.21	4.75	34.65	3.91	7.86	0.01
Relative Body Mass (%)	94.61	19.77	87.75	16.14	10.80	0.00
Body Mass Index (kg/m^2)	19.97	3.64	21.63	3.94	15.03	0.00

F=24,501; P=0,000

Key: *AS – arithmetic mean; S – standard deviation; f – unvaried f test; p – level of statistical significance of f test; F – multivariate Wilks' F test; P - statistical significance of multivariate F test.*

For the purpose of easier understanding of the results at the index of nutrition the *Body Mass Index* was sorted by sex. Three classifications were taken into consideration: underweight, normal and overweight.

Table 4. *The Distribution of BMI by Sex*

Body Mass Index	Boys (N=196)		Grls (N=129)		Total (N=325)	
Percentile	n	%	n	%	n	%
<30 (<18,5 kg/m^2) Underweight	75	38.27	28	21.71	103	31.76
30-85 (18,5-24,9 kg/m^2) Normal	99	50.51	79	61.24	178	54.70
>85(>25 kg/m^2) Overweight	22	11.22	22	17.05	44	13.54
Total	196	100	129	100	325	100

The results presented in table 2 point out to a high percentage of children with low body mass, undernourished (38.27% of boys and 21.71% of girls which makes total of 103 children). Normal body mass values were found in 178 subjects (99 boys and 79 girls), and overweight were 22 boys and 44 girls, a total of 13.54%.

Conclusion

The most significant factors for setting off of obesity are believed to be genetic and metabolic factors, unhealthy living accompanied by diet inapt to body needs food high in energy value. The children of pre-school age suffer more often from overweight and obesity than undernourishment (Silveira et al., 2013). There should also be mentioned socio-cultural, psychological and neuroendocrine factors (high level of cortisole, lower levels of thyroid gland hormones, growth hormone deficiency and others). The main risk factors for obesity are: genetics 50-70%; intake of excessive calories and ill-assorted food (basic carbohydrates combined with concentrated fats or protein); insufficient physical activity (70%) (Eveleth, & Tanner, 1990).

The diversity of nutrition status of preschool children was explored on a sample of 325 subjects. The research pointed out to a remarkably high percentage of undernourished children within sample group (31.76%), while the percentage of overweight children is 13.54%. Normal nutrition level was found in 54.07% of sample. It is obvious that general overweight prevalence of 13.54% is still fairly low compared to countries of Western Europe and USA (Yajnik, 2000). As far as Eastern Europe is concerned contrasting results were noted in Georgia (Kherkheulidze et al., 2010). The general prevalence of malnutrition was 31.76%, but this is beyond the study and nearly half are obtained Markovic et al., (2008), who found that in one part of Serbia (Šumadija), 17.7% of children were malnourished.

By applying adequate formulas to software of modern apparatus quick and precise insight into the nourishment state of children was made possible. Today the best results of children's body composition assessment and physical development monitoring are achieved by the new technology such as Bioelectrical Impedance (BIA) (Goran et al., 1993). The large number of factors that influence obesity in children has been recognized and divided into several groups: feeding habits, physical (in) activity (length of physical activity during a day, type of activity, hours of sleep), factors related to parents (obesity of mother or both parents, mother's weight during the pregnancy, mother's smoking habits during the pregnancy, education level of family, family size and others) as well as factors related to the educational institutions (Jovanović et al., 2010; Pelemiš et al., 2014).

The results of multivariate variance analyses indicated significantly different levels of nourishment status of gender dimorphic pre-school age sample subjects from Belgrade. Both sub-samples were noted for aberration from ideal body mass, in average about 4.1 kg (boys) and 4.5 kg (girls). Biological, psychological and sociological factors are important in development and state of nutrition of children. This result corresponds with the findings of research conducted by Western authors who have established that information on bodily composition are used very often but they also recognized existing gap in standards and an extensive lack of understanding of problems related to *Body Mass Index* (Meyer et al., 2010). Namely, it has been established that children who train sport have increased levels of continuous and acute energy loss of weight. The research results are in accordance with the results of nourishment state, that is to say the constitution affiliation, gained in AP Vodvodina (Republic of Serbia) which is defined by the undernourishment state followed by associated values which point to week physical constitution (Vasić, & Jakonić, 2009). The results of this study have pointed out the evident underweight of pre-school children of both sexes. There is a small number of overweight children but it can not be expected that such trend will continue at later stages of their life. Prevention of underweight should include increase of physical activity, reduction of energy intake, adjustment of factors rooted in environment that influence body mass and also parental education.

Considering that results of severe weight disorders treatments, especially overweight and underweight, are by and large unsatisfactory, most authors agree that prevention should take lead (Koplan, Liverman, & Kraak, 2004; Goldman et al., 2004). We would like to add that early detection, monitoring and supporting, not only the children, but a family as a whole, to change the life style, level of physical activity and the diet quality may provide an answer.

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Statement
The authors have equally contributed to the paper.

Conflict of interest
We declarate there is not conflict of interest between authors.

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Stanje uhranjenosti predškolske dece

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Abstrakt: Cilj istraživanja bio je analizirati stanje uhranjenosti kod dece predškolskog uzrasta. Uzorak je sačinjavalo 325 dece, među kojima je 196 dečaka i 129 devojčica. Merenje je vršeno u maju 2015. godine. Podaci su analizirani deskriptivnom statistikom, te metodama multivarijatne (MANOVA) analize varijanse na nivou $p \leq 0.05$. Utvrđeno je da se dečaci i devojčice predškolskog uzrasta značajno razlikuju kada je stanje uhranjenosti u pitanju. Univarijatna (ANOVA) analiza varijanse ukazuje na razlike ispoljene u sledećim varijablama *Telesna masa, Idealna telesna masa* i *Indeks uhranjenosti* u korist devojčica i *Relativna telesna masa* u korist dečaka. Postotak pothranjene dece je izuzetno visok (31,76%), u isto vreme bilo je 13,54% dece sa prekomernom telesnom težinom, a 54,70% dece je bilo normalne uhranjenosti.
Ključne reči: detekcija, razlike, uhranjenost, predškolska deca.