

## Children's nutrition specificity related to general sporting activities practiced in kindergartens

*Particularitățile alimentației la copii în funcție de activitatea fizică desfășurată în grădinițe*

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### Abstract

*Background.* Physical activity is fundamental to ensuring child and adult health. Regular sport activities can reduce the risk of cardiovascular and metabolic disease, increasing the immune function in both adults and children.

*Aim.* The aim of the study was to analyze the characteristics of physical activity from kindergartens with an extended program and the menu plan adaption according to the type of sport activity carried out and its duration, intensity and frequency.

*Methods.* A retrospective observational study was conducted in Târgu Mureș, Romania, between June - July 2016. Within the study we included subjects enrolled in 11 kindergartens with an extended program from the city. We had a sample of 1856 subjects, aged between 2.5 and 6 years. The data considered of interest were related to the sport duration (min), frequency (number of classes per week), type of activity, food plan and nutritional values of the menu.

*Results.* Thirty minutes of mandatory physical activity were scheduled during a day, consisting of gymnastics. For optional sports activities, the children attended dance, swimming, zumba or gymnastics classes under the guidance of a qualified coach. The duration of an optional activity was between 30-60 min/week. During the days with the dance program there was a significant increase in fat consumption. In the case of other macronutrients, no significant differences were observed.

*Conclusions.* It is necessary to improve sport activities, both mandatory and optional, and to adapt the food plan within the institutions according to the sustained activity and its characteristics.

**Keywords:** children, sport, nutrition, kindergarten.

### Rezumat

*Premize.* Activitatea fizică este un element esențial în asigurarea stării de sănătate. Activitățile sportive uzuale, de intensitate medie, pot reduce riscul de patologie cardiovasculară sau metabolică, îmbunătățind funcția imună atât la adult, cât și la copil.

*Obiective.* Scopul lucrării a fost de a analiza caracteristicile activității fizice din grădinițele cu program prelungit și nivelul de adaptare al planului alimentar la tipul de activitate susținut, durata, intensitatea și frecvența acesteia.

*Metode.* A fost desfășurat un studiu de tip observational, retrospectiv, în Târgu Mureș, România, în perioada iunie-iulie 2016. În studiu au fost incluși subiecți înscriși în 11 grădinițe cu program prelungit din oraș. Lotul de studiu a fost alcătuit din 1856 de subiecți, cu vârstă cuprinsă între 2,5 și 6 ani. Datele considerate de interes au fost relaționate cu durata activității fizice (minute), frecvența (numărul de ore dintr-o săptămână), tipul de activitate, planul alimentar și valorile nutriționale ale meniului.

*Rezultate.* Treizeci de minute de activitate fizică obligatorie erau programate în decursul unei zile. Pentru sportul opțional, copiii au urmat cursuri de dans, înot, Zumba sau gimnastică, sub supravegherea unui antrenor calificat. Durata unei activități opționale era de 30-60 min/săptămână. În timpul zilelor cu antrenament de dans, a fost observată o creștere semnificativă a consumului de grăsimi. În cazul altor macronutrienți nu au fost observate diferențe semnificative.

*Concluzii.* Este nevoie de o îmbunătățire a activității sportive a copilului, atât activitate obligatorie, cât și opțională, și de o adaptare a planului alimentar din cadrul instituțiilor în funcție de activitatea susținută și caracteristicile acesteia.

**Cuvinte cheie:** copii, sport, nutriție, grădiniță.

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**Introduction**

Physical activity is fundamental to ensuring child and adult health (Felfe et al., 2016). Regular sport activities can reduce the risk of cardiovascular and metabolic disease, increasing the immune function in both adults and children (Timmons, 2007). Due to these benefits, recreational sport is practiced in schools since early ages (kindergarten), being divided into two categories: mandatory and optional physical activity. In optional sport activities, children can choose from gymnastics, dance, swimming or other classes depending on the range provided by the educational institution (Leoni et al., 2008). However, being optional means involving additional costs for parents. Apart from the educational program, preschool children can practice other types of sporting activities, without being involved in organized sports structures, represented by sports clubs (Merkel, 2013).

At the same time, nutrition is the basis of a healthy lifestyle (Purcel et al., 2013). Thereby, preschool educational institutions are bound to provide 75% of the child's nutritional needs, through energy, macronutrient and micronutrient needs (Hirschman et al., 2013). Although these regulations are mentioned in the legislation, in the case of regular physical activity practice, the child's food plan should be adapted and individualized according to the daily scheduled activity (Lucas et al., 2017).

**Hypothesis**

The aim of the study was to analyze the characteristics of physical activity from kindergartens with an extended program and the menu plan adaptation according to the type of sport activity carried out and its duration, intensity and frequency. The periodization of physical activity in the educational curriculum can generate important changes in the nutritional needs of the child. The hypothesis is that food intake is not adjusted according to the type of effort and total effort time.

**Material and method**

*Research protocol*

A retrospective observational study was conducted after obtaining the institutional approval and parental consent to include the children in the study group. The study inclusion criteria were: kindergartens with an extended program from Târgu Mureş, Romania, along with healthy subjects, suitable for involvement in an organized sports program. The exclusion criteria were related to chronic or acute diseases with an impact on physical activity.

*a) Period and place of the research*

The study was conducted during June - July 2016 in Târgu Mureş. Within the study we included subjects enrolled in 11 kindergartens with an extended program from the city.

*b) Subjects and groups*

The study included a sample of 1856 subjects, aged between 2.5 and 6 years. To preserve institutional confidentiality, we assigned a number from K1 to K11 to all kindergartens.

*c) Tests applied*

The level of optional and mandatory physical activity in each institution was analyzed based on data provided by the administrative department. The data considered of interest regarding physical activity were related to the effort duration (min), frequency (number of classes per week), type of optional and mandatory sport activities provided for the child, along with the number of children enrolled in the two mentioned types of activity. Food data were made available by the administrative department using the exact food product amount/day/child. Dietary data were collected over a period of 10 working days, 2 consecutive weeks, respectively. Based on the collected data, the amount of protein (kcal/g), fat (kcal/g) and carbohydrates (kcal/g) was calculated, as well as the caloric value (kcal) of the menu. In order to calculate the nutritional value of the menu (macronutrients and caloric value), the national food database, approved by the Romanian Ministry of Health was used.

*d) Statistical processing*

Statistical evaluation was performed using GraphPad Prism 7.0. software. The confidence level was set at 95%,  $p \leq 0.05$  being considered statistically significant. The descriptive data of interest were represented by mean, median, minimum and maximum values, standard deviation (SD), coefficient of variation (CV) and standard error (SE). For inferential statistics, Spearman's test, D'Agostino & Pearson omnibus normality test, and one-way ANOVA were applied in data analysis.

**Results**

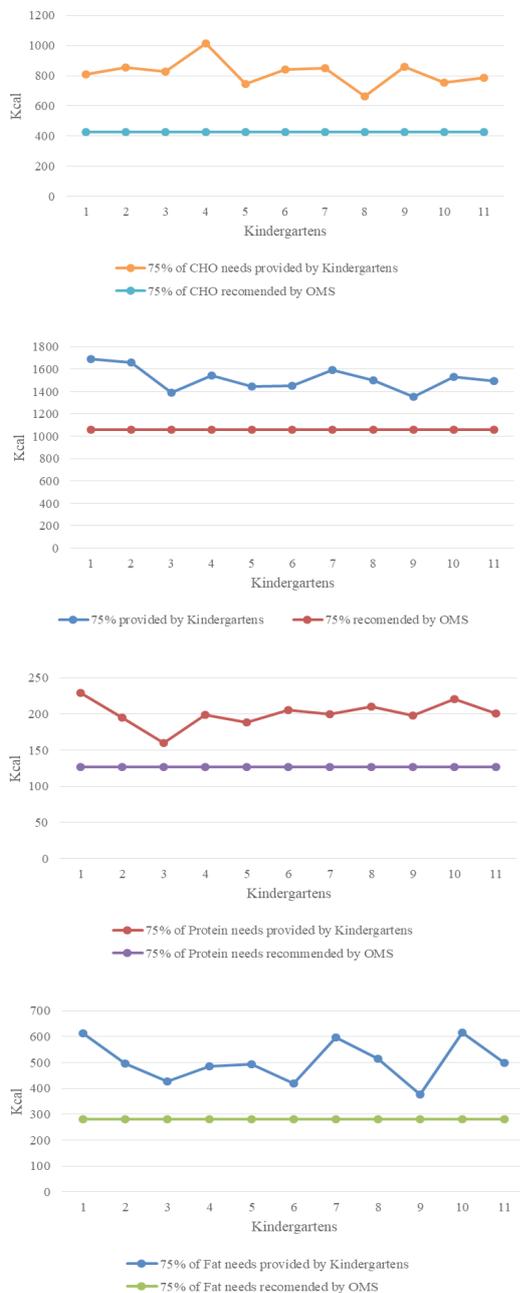
Of the total number of subjects, the participation level in the mandatory physical activity was 100% (n=1856), with a reduced level of the optional physical activity at 67.88% (n=1260). The detailed analysis of K1-K11 daily menus showed significant differences compared to World Health Organization's recommendations. Thus, Table I shows the average nutritional values proposed by the educational

**Table I**  
Descriptive statistics regarding energy intake distribution in macronutrients.

Kindergartens	75% of the daily energy needs	Calories (Kcal)			%		
		Carbohydrates	Lipids	Proteins	Carbohydrates	Lipids	Proteins
K1	1692	811.3	613.9	229.4	47.95	36.28	13.56
K2	1662	855.1	496.2	195.5	51.45	29.86	11.76
K3	1390	825.2	427.2	159.7	59.37	30.73	11.49
K4	1545	1015	484.2	199	65.70	31.34	12.88
K5	1445	745.5	493.6	188.2	51.59	34.16	13.02
K6	1452	840.6	418.1	206	57.89	28.79	14.19
K7	1593	850.3	595.8	199.6	53.38	37.40	12.53
K8	1498	661.5	515.4	210.7	44.16	34.41	14.07
K9	1355	858.8	375.6	197.9	63.38	27.72	14.61
K10	1529	754.2	615.7	221.2	49.33	40.27	14.47
K11	1496	784.4	499.1	200.4	52.43	33.36	13.40

institutions. The nutritional value of the menus is expressed in calories (kcal), and those for Carbohydrates, Proteins and Fat are expressed in calories (kcal) and percentage (%) from the total energy intake.

Regarding the total energy value, differences from international recommendations are significant ( $p < 0.0001$ ). A mean difference of 454.0 kcal was recorded between the main recommendations and the actual practice in the kindergartens (95% CI: 383.2 to 524.7). For carbohydrates, a mean difference of 390.4 kcal (95% CI: 330.9 to 449.9) was calculated (Figure 1), the result being statistically significant different compared to recommendations ( $p < 0.0001$ ). The mean difference in protein intake was 148.1 kcal (95% CI: 136.0 to 160.2 CI) and in fat intake 215.6 kcal (95% CI: 162.1 to 269.1), the difference being significant in both cases ( $p < 0.0001$ ).



**Fig. 1** - The evolution of energy consumption recommended by WHO and the energy density provided in kindergartens (75%) through carbohydrates, proteins, fats

Thirty minutes of mandatory physical activity were scheduled during a day, consisting of gymnastics. For optional sports activities, children attended dance, swimming, Zumba or gymnastics classes under the guidance of a qualified coach. The duration of an optional activity was between 30-60 min/week, being scheduled in all the studied kindergartens according to the following data: 150 min dance/week, 60 min swimming/week, 150 min Zumba/week and 210 min gymnastics/week. Thus, important differences were identified regarding the international recommendations and the activity proposed at national level, as shown in Figure 2.



**Fig. 2** - Differences between the minimum activity recommendation/day and the proposed physical activity program over a 5-day period in the kindergartens.

Table II shows the number of children enrolled in optional recreational sports activities. Data are expressed as percentage of the total number of subjects.

**Table II**  
Type of activity and number of participants enrolled in optional recreational sports activities

Subjects	Dance	Swimming	Zumba	Gymnastics	No activity
No. of enrolled children	178	87	496	499	596
% of the study group	9.59	4.69	26.72	26.89	32.11

Following the association of nutrition with the physical activity performed along with its duration and frequency, it was observed that the food plan was not adapted to the level of activity, either in terms of energy value or in terms of macronutrient distribution, as shown in Table III.

**Table III**  
Association of the physical activity performed and food ingestion adaptation.

Energy intake	Zumba		Swimming		Gymnastics	
	p	r	p	r	p	r
Calories	0.0757	-0.6587	0.2678	-0.5409	0.7342	0.1437
Carbohydrates	0.444	-0.3172	0.7984	0.1352	0.9327	0.03593
Lipids	0.5604	-0.244	0.0687	-0.7775	0.6915	0.1677
Proteins	0.8182	0.09759	0.6042	0.2704	0.6287	0.2036

A significant statistical association was observed in the case of dance classes. During the days with a dance program, there was a significant increase in fat consumption ( $p = 0.0048$ ,  $r = 0.974$ ). In the case of other macronutrients,

no significant differences were observed (calories:  $p = 0.088$ , carbohydrates:  $p = 0.492$ , proteins:  $p = 0.321$ ).

Insignificant statistical data were obtained when the food plan was associated with the total number of minutes spent in organized optional or mandatory sports during a day. Thus, energy consumption was not adapted to recommendations and the physical activity level, as shown in Table IV.

**Table IV**  
Association of total physical activity and food ingestion adaptation during a day

Data		Statistical results			
Parameter 1	Parameter 2	p	r	95% confidence interval	
				Lower	Upper
Effort	Calories	0.4495	-0.2548	-0.7505	0.4244
	Carbo- hydrates	0.5998	0.1784	-0.4879	0.7133
	Lipids	0.1559	-0.4587	-0.8365	0.2146
	Proteins	0.246	-0.3822	-0.8063	0.3013

## Discussions

The level of physical activity carried out in kindergartens is variable according to the existing data. The main studies suggest 160 minutes of physical activity over a week. This amount of effort is distributed on 3 different training days over the week, depending on the child's development. Recent discussions have highlighted that the reported total effort time is not sufficient for kindergarten groups and primary school children groups. Thus, Strong et al. (2005) proposed an increased level of moderate activity (60 minutes) over a day. The main characteristics of the effort must be developed for children so that the program will be enjoyable, involving a variety of activities. Zumba fitness, mentioned in our study as an option for the program, is described as a difficult sport which can cause injuries, according to Inouye et al. (2013), but carried out at a reduced intensity it can meet the daily activity needs (Vendramin et al., 2016).

Keeping a sports activity program is also a priority on non-educational days. Caroli et al. (2011) reported a significant increase in physical activity over the weekend, but with differences between countries and cultures.

From a functional point of view, increasing the level of activity can generate an increase in energy requirements. Thus, meeting energy needs becomes a priority. Based on the fact that these educational structures should meet 75% out of 100% daily energy needs and based on the results obtained, we can suggest a menu adaptation, according to the educational and physical program of the child. The main changes regarding the menu can result in a qualitative improvement in the body's dietary and hydration status, according to specific age requirements. Based on the results obtained, the child's energy needs are exceeded by increasing the total intake of simple carbohydrates and fats (Welker et al., 2016). According to Dubios et al. (2007), increasing carbohydrate intake between meals can expose children to weight and inactive mass gain. Protein consumption seems to be important based on the protein sources consumed by children. Often, increasing protein intake can generate a significant increase in fat

consumption (Weker et al., 2011).

Thus, establishing a direct link between the 60 minute sports activity within a day and increasing energy input by qualitative sources becomes a priority. This priority can be controlled by the two main served meals (Briefel et al., 2009) and the two snacks offered during the day, in kindergartens. At the same time, food consumption in the family for the remaining 25% should establish an appropriate balance and complement the menu (Weker, 2006). Nutritional education can be performed through nutrition lessons and practical culinary experiences in kindergartens, relating to the physical activity program recommended for each age (Lynch, 2015).

## Conclusions

1. The meals served in preschool kindergartens in relation to the scheduled sport activity indicate that food intake and the menu structure do not change depending on the physical activity performed by the children.
2. Total energy intake through carbohydrates, fats and proteins exceeds the child's energy needs and the official international recommendation.
3. A proportion of 32.12% of the sample subjects do not perform optional physical activities.
4. The duration and frequency of sports activities do not comply with the official recommendations.
5. It is necessary to improve both mandatory and optional sport activity and to adapt the food plan within institutions to the activity performed and its characteristics.

## Conflicts of interest

There are no conflicts of interest concerning the results or methodology of the study.

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