Plant Archives Vol. 21, Supplement 1, 2021 pp. 666-671 e-ISSN:2581-6063 (online), ISSN:0972-5210

Plant Archives

Journal homepage: http://www.plantarchives.org
doi link : https://doi.org/10.51470/PLANTARCHIVES.2021.v21.S1.101

THE RELATION BETWEEN OBESITY AMONG PRESCHOOL CHILDREN AND QUALITY OF THEIR DIETARY INTAKE

Nahla Ali ABD-Elrahman*, Sonia Saleh El Marasy, Afaf Abd El Fattah Tawfik*, Hanaa Hussein Elsayd* and Alaa Osama Aboraya****

* Nutritional Chemistry and Metabolism Department, National Nutrition Institute, 16 Kasr El Aini street, Cairo, Egypt.
** Faculty of Home Economics, Helwan University, Egypt.
Correspondence Address: Prof. Hanaa H Elsayed ; Nutritional Chemistry and Metabolism Department, National Nutrition Institute, 16 Kasr El Aini street, Cairo, Egypt.- Email address: hanaa_hamad2003@yahoo.com

ABSTRACT

Childhood obesity is top of mind for health professionals and the public because of heightened media attention about this issue. Obesity is now undoubtedly a growing worldwide health problem. Lifestyle behaviors and diet play an important role in developing childhood obesity. This study amid to determine the association between several dietary factors and obesity among Egyptian preschool children as compared to normal children. The study was purposed as included (30) preschooler aged 2-<6 years old, with a high linear growth, randomly selected from the outpatient clinic of National Nutrition Institute (NNI) and (30) normal case in the same age and sex as a control group. All participants were subjected to the baseline assessment (dietary intake including "Twenty four-hour recall "method and "food frequency questionnaire'; anthropometric measurements including weight and height. Results showed that mean weight for age Z score is significantly higher among obese than the control group. Dietary intake analysis showed that mean intake of all macronutrients was the highest in obesity while micronutrients was lower in malnutrition group compared to the control group. Conclusion, it seemed that dietary intake deficiency of several micronutrients for obese children intake might play an important role of their growth. Preventive strategies to protect against malnutrition and promote healthy eating consumption recommended.

Keywords: Diet Quality - Malnutrition – preschool children

Introduction

Obesity are linked to more deaths worldwide than underweight. In 2014, more than 1.9 billion adults, 18 years and older, were overweight being over 600 million obese (WHO, 2016). Childhood obesity is a condition where excess body fat negatively affects a child's health. The diagnosis of obesity often based on BMI. Due to the rising prevalence of obesity in children and its many adverse health effects it recognized as a serious public health concern (Kopelman *et al*., 2005). A substantial body of evidence suggest that body composition is not only a matter of the amount of calories ingested, but that the macronutrient distribution and micronutrient content and other dietary factors within the diet are critical contributors to fat mass and body weight regulation. Adipose tissues play crucial roles in the development of obesity, with white adipose tissue (WAT) functioning as an energy storage organ, while brown adipose tissue (BAT) as an energy consumption organ. Several studies have suggested the importance of WAT metabolism and WAT- derived factors in the development of obesity and systemic insulin resistance, being a key event in the pathophysiology of the metabolic syndrome (MetS) (Lafontan 2014). Indeed, obesity and accompanying comorbidities are associated with an altered function of the WAT adipocytes, especially concerning the synthesis and secretion of adipokines (Klöting and Blüher 2014; Jung and Choi 2014). Several studies have also suggested emerging roles of BAT in the physiological regulation of metabolism, such as control of triglyceride clearance and glucose homeostasis.

Dietary intake include pattern of consumption and diet composition, which can provide useful information about diet quality and it is relation to obesity (So *et al*., 2017; Johnson *et al*., 2018). However, Shi *et al*. (2018) suggested that the exemplary is to interpret an eating pattern as a predictor of the risk of being childhood obesity.

Thus, this study aimed to determine the association between several dietary factors and the risk of obesity among Egyptian preschool children as compared to normal children

Materials and Methods

A research, done on 60 preschool children aged (2-<6 years) come outpatient clinic of National Nutrition Institute (NNI), Cairo during the period January 2019 to July 2019. Cases were separated to two classification: Control or normal group, this group (30 with orderly linear growth) matched age and sex with the other group (obesity) which were classified by weight for age.

After taking verbal consent from the parents, of each the studied cases as well as the controls subjected to the following procedures.

- *Assessment of the social class* of the family estimated according to Fahmy and El-Sherbeni (1983) and

activity questions relating to the hours per week spent in physical activity, the hours per day spent.

- *Dietary Intake:* the study participants assessed by means of two quantitative non-consecutive 24-hour dietary recalls (one for a weekday and the other for a weekend). The energy and main nutrients content of the 24-hour food intake was computed through the food composition tables of the national nutrition institute (NNI, 2006). The vitamin and mineral contents of food and beverages consumed was compared to the recommended nutrient intake based on the report of joint WHO/FAO Expert Consultation on human vitamin and mineral requirements (2002).
- *Dietary pattern " Food Frequency Questionnaire"*

  This method used to obtain qualitative descriptive information about usual food and beverage consumption pattern for the whole family per week (daily, less than 3 times per week or equal or more than 3 times per week and monthly).

  Anthropometric measures measured according to standardized methods of the World Health Organization (WHO, 1995). Measurements taken included: The Childs weight, length or height, and their Z-score is calculated of weight for age using the computer program ANTHRO [version 1.01 1990
- Measurement of weight: The body weight measured using the Platform scale (Ghalli *et al.,* 2002).
- Measurement of height or length: The height measured to the nearest centimeter, row data entered separately to the WHO growth charts for age and sex (Ghalli *et al.,* 2002).

Statistical data analysis:

Data analyzed by using SPSS (version 16). Data for all variables presented as means with their standard deviations; Comparison of means made using unpaired student's t-test. P values of (<0.05) were considered significant were identified by Artimage and Berry (1987).

Ethical considerations:

An informed consent obtained from the parents of the children before getting them involved in the study according to the rules of the ethics committee of the National Nutrition Institute. The steps of the study, the aim, the potential benefits, and hazards all discussed with the parents.

Results & Discussion

Table (1) descripted the sample characteristics. It showed that the boy's number was higher than girls for normal group were. While obese children both gender was equal number. In the same table children age was among 2-<6 y as a preschooler. The highest percentage of low economic was in normal group. Light and moderate physical activity were equal percentage in both groups. Physical inactivity of children has also shown to be a serious cause, and children who fail to engage in regular physical activity are at greater risk of obesity. Now a new study finds that, contrary to conventional wisdom, preschoolers do not move around a lot, even when they are playing outside (Brown *et al*., 2009). In the recent decades, family practices have significantly changed, and several of these practices greatly contribute to childhood obesity (Stassen, 2014). With a decreasing number of mothers who breast-feed, more infants become obese children as they grow up and are reared on infant formula instead (Melnik, 2012). Less children go outside and engage in active play as technology, such as television and video games, keep children indoors. Rather than walking or biking to a bus stop or directly to school, more school-age children are driven to school by their parents, reducing physical activity. As family sizes decrease, the children's pester power, their ability to force adults to do what they want, increases. This ability enables them to have easier access to calorie packed foods, such as candy and soda drinks. The social context around family mealtime plays a role in rates of childhood obesity (Stassen, 2014)

Table 1 : Sample characteristics

Personal characteristics	Categories	Normal children (*N* =30)		Obese children (*N* =30)	
		No	%	No	%
Number	boys	18	60%	15	50%
	girls	12	40%	15	50%
Age groups	1-3 year	9	30%	-------	------
	4-5 year	18	60%	18	60%
	6 year	3	10%	12	40%
physical activity	Light	15	50%	15	50%
	Moderate	15	50%	15	50%
	Bedridden	-----	-----	-----	-----
Economic class	Low	18	60%	16	55%
	Middle	12	40%	14	45%
	High	-----	----	-----	----
Family size	1 – 2 subjects	------	------	------	------
	3– 4 subjects	16	53 %	20	65%
	5 – 6 subjects	14	47 %	10	35%
	7 – 9 subjects	--	-----	----	-----

Table 2 : Growth ideal, Weight, Height, BMI- Z-Score, and BMI -Percentile (mean ± SE) for age preschool children

Parameters/ Groups	Normal (N=30)	Obesity (N=30)	*P* value
Growth ideal	17.2 ± 0.3	12.2±0.2	0.000 (8.85 E-28)
Weight	17.3±0.4	36.9±0.4	0.000 (1.89 E-71)
Height	99.0 ±1.2	113±0.8	0.000 (2.23 E-17)
BMI Z-Score	1.4±0.1	3.8±0.1	0.000 (2.28 E-24)
BMI Percentile	80.8±1.8	100±0.01	0.000 (7.75 E-80)

Less than the 5th percentile = Underweight; 5th to less than the 85th percentile= Healthy Weight; 85th to less than the 95th percentile= Overweight; Equal to or greater than the 95th percentile= Obese; sig. (P< 0.05). Normal – 2 to + 2 SD. Tall: + 2 SD (WHO, 1995).

Table (2) showed that there are high significant difference between the two groups as regard their weight, height, body mass index (BMI)-z-score and BMI-percentile. Z-score of obesity group was (3.8) more than -2 SD while normal group was (1.4) in normal range (*-2 to + 2 SD)* (WHO, 1995). The obese group was (100%) more than 95thpercentile, but control group was (80.8) in healthy weight (less than 85th) according to the linear chart of BMI percentile (Shypailo, 2020). This BMI-calculator automatically adjusts for differences in height, age, and

gender, making it is one of the best tools for evaluating a growing child's weight (Shypailo 2020). In practice, HA Z-score or WH Z-score are calculated: the differences between the observed values and the growth standards as a fraction or multiple of the SD of the mean values of the standards. Because this SD increases with age, the absolute HA difference (cm) has suggested to be more appropriate in terms of identifying the time course of stunting and appropriate periods for intervention (Leroy *et al*., 2014).

When intake of unhealthy foods, some authors suggest that intakes above the recommended frequency (less than once a week) are associated with weight gain (Mesas *et al*., 2012). Data in table (3) observed that obesity group consumed 153% calorie, 294%protein, 255% carbohydrate and 187% fat from RDA (WHO, 2014) versus 89% calorie, 84% protein, 82% carbohydrate and 87% fat of control group. Eexcess calories are stored throughout in body as fat. Excessive fat cells adipose in tissue and accumulation that may impair health', and cause of obesity and overweight is an energy imbalance between calories consumed and calories expended (WHO, 2014).

Excess protein intake during infancy is positively related to childhood obesity (Grote and Theurich, 2014). A randomized trial by Weber *et al*. (2014) reported that infants who received a higher protein content formula (HP group) in the first year of life showed a significantly higher BMI at 6 years of age than those who received a lower protein content formula (LP group) and those who were breastfed. Moreover, the risk of obesity in the HP group was 2.43 times higher than that in the LP group. Günther *et al*. (2006) and Ohlund *et al*. (2010) showed that during the period of complementary feeding (aged 6 to 18 months), higher protein intake would lead to increased BMI at 4 to 7 years and greater risk of later obesity. Intervention and observational studies by Koletzko (2005) and Koletzko *et al*. (2009) supported the hypothesis that high protein intake promotes rapid weight gain during the childhood. The quantity of dietary protein affect its ability to stimulate the secretion of insulin-like growth factor I (IGF-I) {the mediator of growth hormone}, a hormone that stimulates bone and tissue growth (Dror and Allen, 2011).

Table 3 : Mean and percent from RDA of Macronutrients intake for normal cases, obese children (No=30/ each)

Parameters/ Groups	Normal G1	Obesity G2
Macronutrients intake		
Calorie (kcal)	1248±1.4	2135±65.7
RDI	**1400 kcal**	
% from RDI	89%	153%
Protein (g)	15.9±0.2	55.9±1.8
RDI	**19g**	
% from RDI	84%	294%
Carbohydrate (g)	106.0±1.3	331.2±13.8
RDI	**130 g**	
% from RDI	82%	255%
Fat (g)	30.3±1.2	65.4±16.8
RDI	**35g**	
% from RDI	87%	187%

RDA according WHO (2004)

Mean fat intake was 187% of RDA among obese group compared to 87% of RDA of normal children. Over-consumption of dietary fat (mainly triglycerides) from foods can lead to obesity (Bray and, Popkin, 1998). Since the rate of obesity in adults and children is increasing, dietary fat should be reduced to balance energy consumption and energy needs, and there is a special need for fat-modified food (Lichtenstein *et al*., 1998). For another special kind of fat, the dairy fat, however, it is not the case. Dairy fat is commonly viewed as the contributor of dairy product to the development of obesity because of its high energy dense, cholesterol content and saturated fatty acid. Kratz *et al.* (2013) concluded that high dairy fat intake is inversely associated with obesity.

This study highlighted the importance of micronutrients consumption among children. The present results in table (4) illustrated that the iron lower intake of two groups compared to their RDA. Due to the poor diet caused by foods high in calorie but low in nutrients consumption, obese children are susceptible not only to complications such as fatigue but also to a variety of micronutrient deficiencies (Daniels *et al*., 2005). In addition, obesity is associated with low-grade inflammatory changes that increase Fe tissue storage and affect the level of circulating serum Fe, leading to tissue overload and decreased availability of Fe for hematopoiesis (Emam *et al*., 2018). During childhood, iron deficiency could lead to impaired cognitive and physical functionality and increased risk of mortality (Murray *et al*., 2012). The prevalence of iron and Zn deficiency is widely believed to be widespread in developing countries because of low intakes of animal products, diets high in phytates, which inhibit iron and Zn absorption (De Benoist *et al*., 2007). Further, zinc deficient makes infants and young children are prone to infections and growth retardation (Hess, *et al*., 2009). The major cause of micronutrient malnutrition is a diet consisting mainly of staple foods and lacking in animal sources (Bouis, 2003). Deficiency results from insufficient absorption of iron or excess loss. Absorption tightly regulated in the intestines, depending on the iron status of the individual, the type of iron, and other nutritional factors. Once iron is absorbed, it is well conserved (Beard, 2001).

Calcium intake in this study was extremely low of obese group as compared to natural group. Existing evidence shows that increasing consumption of dietary calcium is associated with lower body weight, BMI and obesity. The mechanism of dietary calcium in reducing body fat may be the result of lipolysis stimulation and lipogenesis inhibition (DeJongh *et al*., 2006). High intake of dietary calcium would suppress adipocyte lipid accretion during overconsumption of an energy-dense diet and increase lipolysis and preserve thermogenesis during caloric restriction, thereby markedly accelerate weight loss (Zemel, 2002; 2003). Phosphorus intake was (126%) of obese group versus (51%) of control group. They also had significantly lower mean values for calcium and phosphorus, which have a significant role in bone growth (Alshammari *et al*., 2017). Elevated dietary phosphorus consumption may influence inflammatory disease by altering cytokine levels. Phosphates are associated with numerous disorders, ranging from vascular calcification, obesity to premature aging, possibly because of an increased inflammatory response (Goodson *et al*., 2019).

The increasing intake of vitamins might have a positive relationship with the prevalence of children obesity (Zhou

and Zhou, 2014). Existing evidence showed that increased B vitamins (B1, B2 and niacin) intake was strongly correlated with the prevalence of obesity and diabetes (Zhou *et al*., 2010), because B vitamins can enhance fat synthesis. The finding in table 4 indicated that the two studied groups had low intake of vitamins D compared to percent of RDA. Vitamin D participates with parathyroid hormone (PTH) in a functional paracrine feedback loop in the growth plate between 1,25(OH)2D and PTH-related protein (PTHrP). Thus 1, 25(OH) 2D decreases PTHrP production, while PTHrP increases chondrocyte sensitivity to 1, 25(OH) 2D by increasing vitamin D receptor production (Bach, *et al*., 2014). There are a plenty of evidences from genetic and animal studies that vitamin D may play a positive role in inhibiting adipogenesis (Vanlint, 2013) and (Vinh quốc *et al*., 2013). Follow-up (Lee *et al*., 2013) of preadolescent children showed that vitamin D was inversely associated with the indicators of adiposity, and adequate vitamin D intake is crucial to prevent childhood obesity.

Table 4 : Mean and percent from RDA of Micronutrients intake for normal cases, obese children (No=30/ each)

Micronutrients intake		
Parameters/ Groups	**Normal G1**	**Obesity G2**
Iron (mg)	7.9±0.7	9.9±2.1
RDI	**10mg**	
% from RDI	79%	99%
Zinc (mg)	3.7±0.5	6.7±1.5
RDI	**5mg**	
% from RDI	74%	134%
Calcium (mg)	725.0±23.6	327.7±17.6
RDI	**1000mg**	
% from RDI	73%	33%
Phosphorus (mg)	254.0±8.0	628.3±25.4
RDI	**500mg**	
% from RDI	51%	126%
Vit D (µg)	520.0±6.2	445.0±7.7
RDI	**600 µg**	
% from RDI	87%	74%

Table (5) showed that the obese group most of them range from 83% to 100% intake Bread, Rice, Baked, Indomie, Potatoes chipsey, triangles cheese, Sugar, Soft drinks, and fast food more than three time per day. Malik *et al.* (2006) reported that sugar-sweetened beverages (SSBs) provided little nutritional benefit and the consumption of SSBs that causes weight gain be due to the low satiety of liquid carbohydrates, thus resulting in incomplete compensation of energy at subsequent meals. They concluded that the consumption of SSBs, particularly among children and adolescents, should be discouraged. There is increasing concern that intake of free sugars – particularly in the form of sugar-sweetened beverages – increases overall energy intake and may reduce the intake of foods containing more nutritionally adequate calories, leading to an unhealthy diet, weight gain and increased risk of no communicable diseases (WHO 2016).

Fast food consumption is associated with lower dietary quality (Paeratakul *et al*., 2003) and (Bowman *et al*., 2004). Paeratakul *et al*. (2003) reported that fast food consumption would lead to higher energy and fat intake but lower intake of healthful nutrients. Similar results were observed in the research of Bowman *et al*. (2004) who found that fast food consumption among children might affect dietary quality that could plausibly increase the risk of obesity. 17% only in obese group received fresh vegetable more than three time in week. Vegetables and fruits (VFs) have to prevent obesity because of their low energy dense, high water and fiber content (De Oliveira *et al*., 2008). Epstein *et al*. (2001) reported that the percentage of overweight in families with increased VFs consumption was significantly lower than that in those with decreased high-fat/high-sugar consumption. This finding suggested that VFs alone are not the cure for preventing obesity. VFs that produces the anti-obesity effect (Reichmann, 2009). 73% from obese children assimilation corn oil less than 3 time/day. These food habit give more calorie for obese. 83% and 90% from normal children intake fresh vegetable and cooked vegetable more than 3 time/ day. In addition, fruits represented 87% consumed of normal group. These dietary habits of the two groups had their impact on their growth. In addition, when one self-assesses energy intake, under- and over-reporting consumption may occur (Dhurandhar *et al*., 2015). Dieting is the most described behavioral risk factor for binge eating disorder (BED) onset. It well documented that dieting increases the risk of overeating to counteract the caloric deprivation and, therefore, weight gain over time, but this is more likely to happen during adolescent's stage (Stice *et al*., 2002)

Table 5 : Diet History for all Subjects

Food and Beverage	**Frequency of consumption normal (N=30)**										**Frequency of consumption obese (N=30)**									
	D		%		W		%		M	%	D		%		W		%		M	%
	<3	>3			<3	>3					<3	>3			<3	>3				
Bread	25	**--**	83	--	--	--	--	--	--	--	25	--	83	--	--	--	--	--	--	--
Rice	--	25	--	83	--		--		--	--	30	--	100	--	--	--	--	--	--	--
Baked	--	--	--	--	5	--	17	--	--	--	26	--	87	--	--	--	--	--	--	--
Indomie	--	--	--	--	5	--	17	--	--	--	30	--	100	--	--	--	--	--	--	--
Potatos	--	20	--	67	--		--		--	--	28	--	93	--	--	--	--	--	--	--
Potato|	--	--	--	--	**---**	--	**--**	--	--	--	--	--	**--**	--	--	--	--	--	5	17
Chipsey	--	--	--	--	15	--	50	--	--	--	30	--	100	--	--	--	--	--	--	--
Bean	--	--	--	--	10	--	33	--	--	--	--	--	--	--	10	--	33	--	--	--
Falafel	--	--	--	--	20		67		--	--	--	--	--	--	--	16	--	53	--	--

Lima bean	--	--	--	--	15	--	50	--	--	--	--	--	--	--	--	--	--	--	20	67
Lentil	--	--	--	--	--	--	--	--	20	67	--	--	--	--	--	--	--	--	--	--
Fresh vegetables	--	25	--	83	--		--		--	--	--	--	--	--	--	5		17	--	--
Cooked vegetables	--	27	--	90	--		--		--	--	--	--	--	--	8	--	27	--	--	--
Fruits	26	--	87	--	--	--	--	--	--	--	--	--	--	--	10	--	33	--	--	--
Juices	--	--	--	--	22	--	73	**--**	--	--	--	--	--	--	--	16	--	53	--	--
Meat	--	26	--	87	--		--		--	--	--	5	--	17	2	--	7	--	23	77
Processed meat	--		--		--	--	--	--	20	67	20	--	67	--	--	--	--	--	--	--
Liver	--	--	--	--	20	--	67	--	--	--	--	--	--	--	--	--	--	--	5	17
Birds	--	18	--	60		--	--		--	--	--	--	--	--	--	4	--	13	--	--
Fish	--		--		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
High fat fish	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Tilapia fish	--	24	--	80		--	--		--	--	--	--	--	--	3	--	10	--	--	--
Milk	--	25	--	83	--		--		--	--	--	--	--	--	--	6	--	20	--	--
White cheese	25		83		--	--	--	--	--	--	--	13	--	43	--	--	--	--	--	--
Triangles' cheese	--	--	--	--	--	--	--	--	--	--	25	--	83	--	--	--	--	--	--	--
Yogurt	--	26	--	87		--		--	--	--	--	--	**--**	--	10	--	33	**---**	--	--
Egg	25	--	83	--	--		--		--	--	**--**	22	**--**	73	--	--	--	--	15	50
Sugar		20		67	--	--	--	--	--	--	30	--	100	--	--	--	--	--	--	--
Dessert	--	--	--	--		15		50	--	--	29	--	87	--	**--**	--	--	--	--	--
Sweets	--		--		--	10	--	33	--	--	28	--	93	--	**--**	--	--	--	--	--
Honey	--	--	--	--	--	--	--	--	15	50	--	18	**---**	60	**--**	--	--	--	--	--
Jam	--	--	--	--	--	--	--	--	10	33	--	22	---	73	**--**	--	--	--	--	--
Salt	--	27	--	90	--	--	--	--	--	--	--	30	**--**	100	**--**	--	--	--	--	--
Stimulant drinks	--		--		--	10	--	33	--	--	--	25	--	83	**--**	--	--	--	--	--
Soft drinks		--		--	--	10	--	33	--	--	30	--	100	--	**--**	--	--	--	--	--
Fast food	--	--	--	--	--	--	--	--	5	17	27	--	90	**---**	**--**	--	--	--	--	--
Hot oil	--	--	--	--	--	--	--	--	--	--	--	--	**---**	--	**--**	--	--	--	--	--
Corn oil	--	30	--	100	**--**	--	--	--	--	--	--	22	--	73	**--**	**--**	--	--	--	--
Hydrogenated oils		--	--	--	--	--	--	--	--	--		--	--	--	**--**	--	--	--	--	--
D= Daly; W= weekly and M= Monthly																				

Conclusion

The dietary patterns derived from the current study based on a considerable number of children could provide practical information for health authorities designing nutritional interventions and preventive strategies targeting obese children. Parents should be made aware of the "good diet" for choosing their child's food.

References

Alshammari, E.; Suneetha, E.; Adnan, M.; Khan, S. and Alazzeh, A. (2017). Growth Profile and Its Association with Nutrient Intake and Dietary Patterns among Children and Adolescents in Hail Region of Saudi Arabia. BioMed Research Inter-national, Volume 2017.

Artimage, G.Y. and Berry, W.G. (1987). Statistical Methods 7th Ed. Ames, Iowa Stata University Press, 39- 63.

Bach, F.C.; Rutten, K.R. and Hendriks, K. (2014). The paracrine feedback loop between vitamin D3 (1, 25 (OH) 2D3) and PTHrP in prehypertrophic chondrocytes. J Cell Physiol 229, 1999 – 2014.

Beard, (2001). Connor JR. Iron status and neural functioning. Annu Rev. Nutr; 23:41–58

Bouis, H.E. (2003). Micronutrient fortification of plants through plant breeding: Can improve nutrition in man at low cost? Proc. Nutr. Soc., 62: 403 – 411.

Bowman, S.A.; Gortmaker, S.L.; Ebbeling, C.B.; Pereira, M.A.; Ludwig, D.S. (2004). Effects of fast-food consumption on energy intake and diet quality among children in a national household survey. Pediatrics, 213: 212-218.

Brown, W.H.; Pfeiffer, K.A.; McIver, K.L.; Dowda, M.; Addy, C.L. and Pate, R.R. (2009). Social and Environmental Factors Associated with Preschoolers' Non-sedentary Physical Activity. Summarized from Child Development, Vol. 80, Issue 1 The Society

for Research in Child Development, Inc. All rights reserved.

Bray, G.A. and Popkin, B.M. (1998). Dietary fat intake does affect obesity! Am J Clin Nutr; 68:1157-1173.

Daniels, S.R.; Arnett, D.K.; Eckel, R.H.; Gidding, S.S.; Hayman, L.L.; Kumanyika, S.; Robinson, T.N.; Scott, B.J.; St Jeor, S. and Williams, C.L. (2005). Overweight in children and adolescents: pathophysiology, consequences, prevention and treatment. Circulation, 111(15): 1999-2012.

De Benoist, B.; Darnton-Hill I. and Davidsson, L. (2007). Conclusions of the Joint WHO/UNICEF/IAEA/IZiNCG Interagency Meeting on Zinc Status Indicators. Food Nutr Bull 28: S480 – S484.

De-Jongh, E.D.; Binkley, T.L. and Specker, B.L. (2006). Fat mass gain is lower in calcium-supplemented than in supplemented preschool children with low dietary calcium intakes. Am J Clin Nutr., 84: 1123-1127.

De Oliveira, M.C.; Sichieri, R. and Venturim Mozzer, R. (2008). A low-energy dense diet adding fruit reduces weight and energy intake in women. Appetite 2008; 51: 291-295.

Dhurandhar, N.V.; Schoeller, D. and Brown, A.W. (2015). Energy balance meas-urement: when some-thing is not better than nothing is. Int J Obes. ; 39: 1109– 1113.