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MACRONUTRIENT INTAKE AND PHYSICAL FITNESS: DIFFERENCES AMONG NORMAL WEIGHT, OVERWEIGHT AND OBESE SCHOOL GOING GIRLS

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ABSTRACT

The purpose of the study was to observe the differences in macronutrient intake and physical fitness among normal weight (NW), overweight (OW) and obese (O) school going girls. Female children were purposively selected from schools of Mumbai, Nashik, Nagpur and Pune cities from Maharashtra. A total of 450 girls (50 girls from NW, OW & O category from each age group of 10, 11 & 12 yrs were selected. The data regarding macronutrient intake was collected by taking three days dietary recall and energy derived from macronutrients was calculated. Fitness tests including sit and reach test, sergeant jump test and sit up test were conducted and the scores were compared to the normative data for age. The results suggest that the mean values of macronutrient intake of OW and O girls of all age groups (10 yrs, 11 yrs and 12 yrs) were high as compared with NW girls. Mean values of all the three fitness tests of OW and O girls were lower than NW girls. The study concluded that there is a vast difference among NW, OW & O girls for macronutrient intake and physical fitness. From a public health perspective, observations in the present study suggest the importance of primary prevention of obesity from early childhood with continuation of health promotion activities throughout the course of life to control cardiovascular risks associated with overweight and obesity.

Keywords: macronutrients, energy intake, physical fitness, overweight & obese

INTRODUCTION

Traditionally, a fat child is considered as an 'attractive' child, and is often referred to as a 'healthy' child. However, the adverse and serious consequences of childhood obesity are now proven beyond doubt (Styne, D. M., 2001 and Lobstein, T. et al., 2004). Childhood obesity affects both developed as well as developing countries like India of

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all socio-economic groups, irrespective of age, sex or ethnicity. However, obese children have substantial risks for morbidity such as hypertension and dyslipidemia even before they reach adulthood (Tounian, P. et al., 2001 & Freedman, D. S. et al., 1999). Thus, obesity a major health concerns of today's era has been imposing a major health issue globally. An increasing prevalence of obesity throughout the world has been noted. About 10% of school children aged between 5 to 17 years around the globe are overweight, out of which 50% to 80% become obese adults. Obesity has significant impact on both physical and psychological health of the child, increasing the chances of the overweight children to suffer from hyperlipidemia, abnormal glucose tolerance and diabetes, hypertension, coronary artery disease, infertility, orthopaedic problems, etc. in their later life (Arora, M. et al., 2017).

Preventive efforts have been aimed at identifying early markers influencing the development of obesity in children (Rosenbaum, M. and Leibel, R. L., 1998). In particular, high-fat, high-sugar & high refined carbohydrate diets have been associated with the development of childhood adiposity (Birch, L. L. and Fisher, J. O., 1998). Investigations assessing the role of energy and macronutrient (protein, fat and carbohydrate) intake in the development of adiposity in children have given controversial results (Rolland-Cachera, M. F. and Bellisle, F., 1986 & Frank, G. C. et al., 1978). Diet plays a major role in the prevalence of obesity. It is believed that over nutrition at any stage during the life span increases the fat cell size and also creating the conditions for new recruitment of fat cells leading to obesity (Fauci, A. S. and Martin, J. B., 1998).

The specific causes of overweight and obesity in childhood are complex, but despite the consideration of genetic and physiologic aspects, reduction in physical activity, decreased physical fitness, an increased amount of time devoted to

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sedentary lifestyle and increased caloric intake due to environmental changes seem to be important factors for weight gain (Drenowatz, C. et al., 2014). Goyal, R. K. et al. (2010) also reported that physical inactivity influences the children's body mass index, with overweight and obese children being less likely to participate in sports and other outdoor activities. Hence, diet, physical activity and sedentary behaviour cluster in children and adolescents in both healthy and unhealthy ways (Leech, R. H. et al., 2014).

Thus, the aim of the present study is to see the differences in macronutrient intake and physical fitness among normal weight, overweight and obese school going girls from age group 10-12 yrs.

METHODOLOGY

The proposed research work was carried out to see the differences between obese and non-obese girls of 10-12 yrs of age as far as macronutrient intake and physical fitness are concerned. Differences in outcome were tested between obese and non-obese girls of 10 to 12 yrs of age. The study was conducted in Mumbai, Nashik, Pune and Nagpur cities in Maharashtra, India. Schools were randomly selected & from these schools, normal weight (NW), overweight (OW) and obese (O) girls were purposively selected (n=450). The subjects were grouped as a control and experimental as shown in Table 1.

The assessment of macronutrient intake was done by three days dietary recall. Subjects were properly instructed to fill out the details about food intake. The dietary recall was divided according to the number of meals, food consumed and amount of food in household measures. Macronutrient intake was calculated by using food composition tables (Gopalan et al., 2012). Based on three major nutrients, energy intake of subjects was calculated. Adequacy of energy & macronutrient intake of subjects was done by comparing the intake values with recommended dietary allowances (RDAs) (NIN/ICMR, 2009).

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For assessment of lower back/upper thigh flexibility among all the female subjects, sit and reach test was performed. To assess the explosive strength, sergeant jump test was conducted whereas for assessing truncal strength, sit-ups test was performed. Standard test procedures were followed (Nande, P. J. & Vali, S. A., 2010). Results of the tests were compared with the normative data.

RESULTS AND DISCUSSION

Macronutrient distribution, together with food properties (energy density, satiety value, taste, metabolic response elicited, etc.), are all nutritional factors conditioning energy balance. Therefore, they have the potential to contribute to better maintenance of body weight and better metabolic regulation (Aller, E. E. et al., 2011). The collected data on three major macronutrient intakes is tabulated and presented in Table 2.

Macronutrient Intake

According to the figures given in Table 2, in comparison with NW girls, the mean daily intake of energy and all three macronutrients was significantly greater among OW & O girls ($z=18.20$ & 37.20, respectively, $p<0.01$). Energy intake was found to be excess by 24.78% & 52. 39% among OW & O subjects as compared to the RDAs ($z=25.41$ & 52.39, respectively, $p<0.01$). Studies showed that increased total energy intake was positively associated with BMI (Aeberli, I. et al., 2007 & Hui, L. L. et al., 2003) & studies also showed that obese children consumed more than non-obese children (Gillis, L. J. et al., 2002 & Waxman, M. & Stunkard, A. J., 1980).

Similarly, mean daily intake of three major nutrients i.e. carbohydrates, protein & fat among OW & O girls was found to be excess than among NW girls ($z=4.36$ to 32.80, Table 2). Greater individual variations were noted for the intake of these three nutrients. Carbohydrate intake was less in NW girls ranging from 222.52 to 412.00 g whereas in OW and O girls it was ranging from 264.74 to

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496.25 g and 300 to 550.70 g, respectively. According to Antunes, B. M. M. et al. (2015), the correlation between carbohydrates and inflammatory cytokines which are responsible for obesity is due to the predominance of carbohydrates intake. The amount and type of carbohydrates influences the metabolic responses. Indeed, high carbohydrate and specifically high sugar consumption are often considered particularly harmful with respect to energy balance disturbances, the balance between nutrient storage and oxidation, the effects on hunger and satiety, and hence, on caloric intake and energy balance (Aller, E. E. et al., 2011). Energy-dense foods are rich in refined carbohydrates and unhealthy fats like cholesterol, saturated fatty acids. Snack-food items and soft drinks make up the majority of energy-dense foods (Drewnowski, A., 2007). People consuming more energy-dense foods are more likely to have higher BMI (Ledikwe, J. H. et al., 2006).

With the increase in energy intake protein intake was also found to be increased. In comparison with RDAs, mean daily protein intake among all three groups of girls was found to be significantly high (z=39.63, 47.02 & 40.22, respectively for NW, OW & O girls, Table 2), with % excess for NW, OW & O girls calculated as 71.76, 82.77 & 110.72, respectively. Koletzko, B. et al. (2016) opined that markedly high protein intake can cause overweight and obesity. For the present study, it was observed that subjects consumed protein rich sources like milk powder, cheese, paneer, oral health supplements, protein drinks which lead to higher protein consumption.

OW & O girls showed very high mean daily intake of total fat (89.90±8.85 & 104.77±12.79 g, respectively, Table 2) which was found to be significantly greater than that among NW girls (64.31±8.03 g, z=26.20 for NW vs. OW & 32.80 for NW vs. O, $p<0.01$). Scientific evidence shows that high-fat diets have a high energy

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density and low satiety value, which facilitate passive overconsumption (Green, S. M. et al., 2000).

All three macronutrients showed positive correlation with weight (carbohydrates: r=0.0381 to 0.1230, protein: r=0.0092 to 0.0566 and fat: r=0.0160 to 0.0379) & likewise, all three macronutrients showed positive correlations with BMI. Antunes, B. M. M. et al. (2015) stated that macronutrients intake is associated with low-grade inflammation in obesity, by production of inflammatory cytokines and alteration of the lipid profile. All the findings from these studies and the results of the present study indicate that there is a direct correlation between macronutrient intake and the weight status.

Macronutrient intake, especially excess carbohydrate & fat, affects the physical fitness by affecting weight status. A decrease in physical fitness has been associated with childhood obesity (Paschaleri, Z. et al., 2016). Various studies have shown that low fitness in children and adolescents is associated with adiposity (Moliner-Urdiales, D. et al., 2010, Ara, I. et al., 2007 & Nassis, G. P. et al., 2005).

Physical Fitness

Figures 1 and 2 show the data on sit and reach test of the subjects. It was seen from Figure 1 that the mean value for beyond toe reach was high in NW subjects (8.78 cm) than OW (2.37 cm) and O subjects (-4.41 cm).

Figure 2 reveals the percentage wise distribution of subjects based on distance reach (sit & reach test) which indicates that performance was poor in OW (45.33%) and O (86.67%) subjects. They were unable to touch the feet because of their extended tummies. In contrast to this, 32 % NW girls performed excellently with maximum mean distance touch beyond toe recorded as 25 cm. Study by Malina, R. M. et al. (1995) showed similar results and stated that the reduced flexibility of the fattest girls was most likely

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due to the inert, non-contributory load imposed by the fat mass.

Data on sergeant jump test and sit ups test of the subjects is exposed in Table 3. Scores directed that the performance of sergeant jump test among NW girls was rated as 'average' (30.59±10.54 cm) while the performance of OW (23.65±8.00 cm) and O girls (19.80±8.08 cm) was found to be 'below average' (Table 3). When between group comparison was done, significant differences of sergeant jump test results were noted for NW vs. OW & NW vs. O (z= 6.42, & 9.95, respectively, $p<0.01$). Owing to extra body weight, vertical jumping became difficult among OW & O girls. Fatness had its greatest impact on those items requiring projection of the body jumps, therefore, obese girls perform poorly than lean girls (Malina, R. M. et al., 1995).

Data on sit ups test of the subjects from Table 3 revealed that the performance of OW & O girls was found to be 'below average' & 'poor', respectively whereas the performance of NW girls was rated as 'above average'. Abdominal fat deposition created discomfort among OW & O girls for the sit ups. Between group comparison for sit up test performance revealed statistically significant differences (z=14.39 & 16.87 for NW vs. OW & NW vs. O, respectively, $p<0.01$). Study in young females found a negative correlation between activities, such as sit-up and sergeant jump among participants in the obese group (Shin, J. Y. & Ha, C. H., 2016).

For this study, body weight showed negative correlation with the performance of sergeant jump test and sit ups test among OW and O subjects as shown in Table 4.

Studies reported that overweight and obesity decrease the physical exercise capability and then reduce health-related physical fitness (Kovacs, V. A. et al., 2009 and Ding, Z. et al., 1990).

Studies revealed that overweight and obesity were associated with worse physical fitness and their results show low

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physical fitness levels in overweight/obese children and adolescents. Their results also indicated a low physical fitness levels in overweight/obese children and adolescents (Martinez-Vizcaino, V. et al., 2014).

CONCLUSION

It is concluded that there was a difference in macronutrient intake and physical fitness among NW, OW & O school going girls aged 10-12 yrs. Macronutrient intake was directly proportional to the weight status and affected flexibility, explosive strength and trunk strength in subjects. OW and O girls performed below average in all the three fitness tests as compared to NW girls.

Table 1: Age wise classification of the subjects

Sr. No.	Age (Years)	Girls (n = 450)		
		Control	Experimental	
		Normal Weight (NW)	Overweight (OW)	Obese (O)
1	10	50	50	50
2	11	50	50	50
3	12	50	50	50
Total		**150**	**150**	**150**

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Table 2: Data on Daily Intake of Energy & Energy Yielding Nutrients by Subjects

Sr. No.	Variables	Girls (N=450)			z Values#
		NW (n=150)	OW (n=150)	O (n=150)	
1	**ENERGY (kcal)**				
i	**M±SD**	**1977±214**	**2508±240**	**3063±287**	NW vs. OW = 20.20* NW vs. O = 37.20* OW vs. O = 18.20**
ii	**Range**	1546-2682	2050-3162	2333-3809	
iii	**RDA**	2010			
iv	**z Values§**	1.89	25.41*	44.94*	
v	**%Excess**	-1.64	+24.78	+52.39	
2	**CARBOHYDRATE (g)**				
i	**M±SD**	**280.26±38.42**	**350.90±48.85**	**429.04±45.58**	NW vs. OW = 13.90* NW vs. O = 30.60* OW vs. O = 14.30**
ii	**Range**	222.52-412.00	264.74-496.25	300.00-550.70	
3	**PROTEIN (g)**				
i	**M±SD**	**69.39±8.96**	**73.84±8.71**	**85.13±13.62**	NW vs. OW = 4.36* NW vs. O = 11.80* OW vs. O = 8.55**
ii	**Range**	47.56-94.65	52.24-94.00	55.00-125.42	
iii	**RDA**	40.4			
iv	**z Values§**	39.63*	47.02*	40.22*	
v	**% Excess**	+71.76	+82.77	+110.72	
4	**TOTAL FAT (g)**				
i	**M±SD**	**64.31±8.03**	**89.90±8.85**	**104.77±12.79**	NW vs. OW = 26.20* NW vs. O = 32.80* OW vs. O = 11.70**
ii	**Range**	40.05-80.74	63.43-102.00	79.00-130.61	

§ - z values are for comparison between intake of subjects & RDA; # - z values are for comparison between NW, OW & O subjects; * - Significant at both 5 % and 1% levels ($p<0.01$); ** - Significant at 5 % level but insignificant at 1 % level ($0.01<p<0.05$); Values without any mark indicate insignificant difference at both 5% & 1% levels ($p>0.05$)

Figure 1: Data on Sit & Reach Test for Subjects (Distance in cm)

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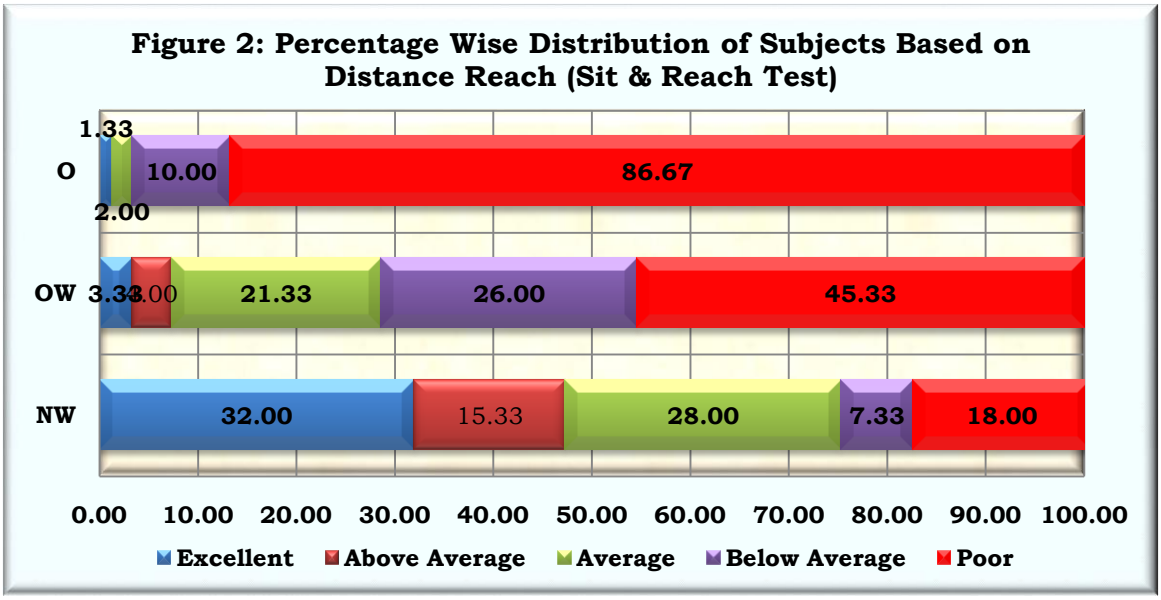

Table 3: Data on Sergeant Jump Test and Sit Ups Test of the subjects

Sr. No.	PARAMETERS	NW (n=150)	OW (n=150)	O (n=150)	z Values#
I	**JUMP DISTANCE (cm)**				
i	M±SD	30.59±10.54	23.65±8.00	19.80±8.08	NW vs. OW = 6.42* NW vs. O = 9.95* OW vs. O = 4.15*
ii	Range	7.00-54.00	8.00-38.00	6.00-40.00	
iii	Performance Assessment	Average	Below Average	Below Average	
II	**NUMBER OF SIT UPS COMPLETED IN 30 SECONDS**				
i	M±SD	16.29±7.28	6.02±4.84	4.81±4.06	NW vs. OW = 14.39* NW vs. O = 16.87* OW vs. O = 2.35**
ii	Range	2.00-37.00	1.00-20.00	1.00-18.00	
iii	Performance Assessment	Above Average	Below Average	Poor	

- z values are for comparison between NW, OW & O subjects; * - Significant at both 5 % and 1% levels ($p<0.01$); ** - Significant at 5 % level but insignificant at 1 % level ($0.01<p<0.05$); Values without any mark indicate insignificant difference at both 5% & 1% levels ($p>0.05$)

Table 4: Data on Coefficient of Correlation between Weight Status and Sergeant Jump Test and Sit Ups Test

Sr. No.	Parameters	"r" Values		
		NW	OW	O
1	Weight vs. Sergeant Jump Test Performance	0.0070	-0.2518	-0.1557
2	Weight vs. Sit Ups Test Performance	0.0432	-0.2484	-0.0670
3	Energy Intake vs. Sergeant Jump Test Performance	0.1235	-0.0635	-0.0350
4	Energy Intake vs. Sit Ups Test Performance	0.0222	-0.0438	-0.0889

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REFERENCES

- Aeberli, I. Kaspar, M. and Zimmermann, M. B. Dietary intake and physical activity of normal weight and overweight 6 to 14 year old Swiss children (2007). *Swiss Medical Weekly*, 137: Pp. 424-430.
- Aller, E. E. Abete, I. Astrup, A. Martinez, J. A. and Van Baak, M. A. (2011). Starches, sugars and obesity. *Nutrients*, 3(3): Pp. 341-369.
- Antunes, B. M. M. Monteiro, P. A. Silveira, L. S. Brunholi, C. C. Lira, F. S. and Jr. Freitas, I. F. Macronutrient intake is correlated with dyslipidemia and low-grade inflammation in childhood obesity but mostly in male obese (2015). *Nutricion Hospitalaria*, 32(3): Pp. 997-1003.
- Ara, I. Moreno, L. A. Leiva, M. T. Gutin, B. and Casajus, J. A. Adiposity, physical activity, and physical fitness among children from Aragon, Spain (2007). Obesity (Silver Spring), 15: Pp. 1918-1924.
- Birch, L. L. and Fisher, J. O. (1998). Development of Eating Behaviours among Children and Adolescents. Paediatrics, 101: Pp. 539-549.
- Ding, Z. Jiang, J. and Xu, J. Injury of obesity in aerobic capacity in Children (1990). *Chinese Journal of Paediatrics*, 28(6): Pp. 341-343.
- Drenowatz, C. Kobel, S. Kettner, S. Kesztyüs, D. and Steinacker, J. M. Interaction of Sedentary Behaviour, Sports Participation and Fitness with Weight Status in Elementary School Children (2014). *European Journal of Sport Science*, 14: Pp. 100-105.
- Drewnowski, A. The real contribution of added sugars and fats to obesity (2007). *Epidemiological Review*, 29: Pp. 160-171.
- Fauci, A. S. and Martin, J. B. (1998). Harrison's, Principle of internal medicine, Vol-1, Part-5, Chapter No.-75, 14th Edition, International Edition, Pp. 460.
- Frank, G. C. Berenson, G. S. and Webber, L. S. (1978). Dietary studies and the

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relationship of diet to cardiovascular disease risk factor variables in 10-year-old children: the Bogalusa Heart Study. *American Journal of Clinical Nutrition*, 31: Pp. 328-340.

- Freedman, D. S. Dietz, W. H. Srinivasan, S. R. and Berenson, G. S. (1999). The relation of overweight to cardiovascular risk factors among children and adolescents: the Bogalusa Heart Study. *Pediatrics*, 103: Pp. 1175-1182.
- Gillis, L. J. Kennedy, L. C. Gillis, A. M. and Bar-Or, O. (2002). Relationship between juvenile obesity, dietary energy and fat intake and physical activity. *International Journal of Obesity Related Metabolic Disorders*, 26: Pp. 458-463.
- Gopalan, C. Rama Sastri, B. V. and Balasubramaniam, S. C. (2012). Nutritive Values of Indian Foods. National Institute of Nutrition, Indian Council of Medical Research.
- Goyal, R. K. Shah, V. N. Saboo, B. D. Phatak, S. R. Shah, N. N. Gohel, M. C. Raval, P. B. and Patel, S. S. (2010). Prevalence of overweight and obesity in Indian adolescent school going children: it's relationship with socioeconomic status and associated lifestyle factors. *Journal of Association of Physicians India*, 58: Pp. 151-158.
- Green, S. M. Wales, J. K. Lawton, C. L. and Blundell, J. E. (2000). Comparison of high-fat and high-carbohydrate foods in a meal or snack on short-term fat and energy intakes in obese women. *British Journal of Nutrition*, 84: Pp. 521-530.
- Hui, L. L. Nelson, E. A. Yu, L. M. Li, A. M. and Fok, T. F. (2003). Risk factors for childhood overweight in 6- to 7-y-old Hong Kong children. *International Journal of Obesity Related Metabolic Disorders*, 27: Pp. 1411-1418.
- Indian Council of Medical Research. 2009. Nutrient requirements and recommended dietary allowances for Indians. National

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Institute of Nutrition. (http://icmr.nic.in/final/RDA-2010.pdf).

- Koletzko, B. Demmelmair, H. Grote, V. Prell, C. and Weber, M. (2016). High protein intake in young children and increased weight gain and obesity risk. *American Journal of Clinical Nutrition*, 103: Pp. 303-314.
- Kovacs, V. A. Fajcsak, Z. Gabor, A. and Martos, E. (2009). School based exercise program improves fitness, body composition and cardiovascular risk profile in overweight/obese children. *Acta Physiologica Hungarica*, 96(3): Pp. 337-347.
- Ledikwe, J. H. Blanck, H. M. Khan, L. K. Serdula, M. K. Seymour, J. D. Tohill, B. C. and Rolls, B. J. (2006). Low-energy density diets are associated with high diet quality in adults in the United States. Journal of American Dietetic Association, 106: Pp. 1172-1180.
- Leech, R. H. Mc.Naughton, S. A. and Timperio, A. (2014). The clustering of diet, physical activity and sedentary behaviour in children and adolescents: a review. *International Journal of Behavioural Nutrition and Physical Activity*, 11: Pp. 4.
- Lobstein, T. Baur, L. and Uauy, R. (2004). Obesity in children and young people: A crisis in public health. Report to the WHO. Published by IASO International Obesity Task Force, London.
- Malina, R. M. Beunen, G. I. Claessens, A. L. Lefevre, J. and Eynde, B. V. Renson, R. Vanreusel, B. and Simons, J. (1995). Fatness and Physical Fitness of Girls 7 to 17 Years. *Obesity Research*, 3: Pp. 221-231.
- Martinez-Vizcaino, V. Garcia-Prieto, J. C. Diez-Fernandez, A. Olivas-Bravo, A. and Sanchez-Lopez, M. (2014). Excess of weight, but not underweight, is associated with poor physical fitness in children and adolescents from Castilla-La Mancha, Spain. *European Journal of Paediatrics*, 173: Pp.727.

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- Moliner-Urdiales, D. Ortega, F. B. Vicente-Rodriguez, G. Rey-Lopez, J. P. Gracia-Marco, L. Widhalm, K. Rey-Lopez, J. P. Gracia-Marco, L. Sjostrom, M. Moreno, L. A. Castillo, M. J. Ruiz, J. R. (2010). Association of physical activity with muscular strength and fat-free mass in adolescents: the HELENA study. *European Journal of Applied Physiology*, 109: Pp. 1119-1127.
- Nande, P. J. and Vali, S. A. (2010). Fitness Evaluation Tests for Competitive Sports, 1st edition, Himalaya Publishing House, Pp. 23-25.
- Nassis, G. P. Psarra, G. and Sidossis, L. S. (2005). Central and total adiposity are lower in overweight and obese children with high cardiorespiratory fitness. *European Journal of Clinical Nutrition*, 59: Pp. 137-141.
- Paschaleri, Z. Arabatzi, F. Papitsa, A. Giagazoglou, P. and Kellis, E. (2016). Physical activity, physical fitness and overweight in early schoolchildren. *Journal of Sports Medicine and Doping Studies*, 6: Pp. 2.
- Rolland-Cachera, M. F. and Bellisle, F. (1986). No Correlation between Adiposity and Food Intake: Why are Working Class Children Fatter? *American Journal of Clinical Nutrition*, 44: Pp. 779-787.
- Rolland-Cachera, M. F. Bellisle, F. Tiche, J. Chantrel, A. M. Guilloud-Bataille, M. Vol, S. and Pequignot, G. (1990). Relationship between adiposity and food intake: an example of pseudo-contradictory results obtained in case-control versus between- population studies. *International Journal of Epidemiology*, 19: Pp. 571-577.
- Rosenbaum, M. and Leibel, R. L. (1998). The physiology of body weight regulation: relevance to the etiology of obesity in children. *Paediatrics*, 101: Pp. 525-539.
- Shin, J. Y. and Ha, C. H. (2016). Relationships between blood pressure and health and fitness-related variables in

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www.vmsindia.org

obese women. *Journal of Physical Therapy Science*, 28: Pp. 2933-2937.

- Styne, D. M. Childhood and adolescent obesity (2001). *Psychiatric Clinics of North America*,; 48: Pp. 823-847.
- Tounian, P. Aggoun, Y. Dubern, B. Varille, V. Guy-Grand, B. Sidi, D. Girardet, J. P. and Bonnet, D. (2001). Presence of increased stiffness of the common carotid artery and endothelial dysfunction in severely obese children: a prospective study. Lancet, 358: Pp. 1400-1404.
- Waxman, M. and Stunkard, A. J.(1980). Caloric intake and expenditure of obese boys. *Journal of Pediatrics*, 96: Pp. 187-193.