IF : 4.547 | IC Value 80.26 VOLUME-6, ISSUE-11, NOVEMBER-2017 • ISSN No 2277 - 8160

Original Research Paper Home Science

CARDIOVASCULAR HEALTH AND CONICITY INDEX: AN OBSERVATIONAL STUDY AMONG NORMAL WEIGHT, OVERWEIGHT AND OBESE SCHOOL GOING BOYS (10-12 YEARS)

Tejashree A. Joshi Research Scholar in Food Science & Nutrition Department of Home Science, Rashtrasant Tukadoji Maharaj Nagpur University, Mahatma Jyotiba Phule Educational Campus, Amravati Road-440033, Nagpur (Maharashtra)

Prajakta J. Nande Assistant Professor in Food Science & Nutrition Department of Home Science, Rashtrasant Tukadoji Maharaj Nagpur University, Mahatma Jyotiba Phule Educational Campus, Amravati Road-440033, Nagpur (Maharashtra)

ABSTRACT

The purpose of the study was to observe the difference in blood pressure and conicity index among normal weight (NW), overweight (OW) and obese (O) school going boys between the age of 10 yrs, 11 yrs and 12 yrs. Male children were purposively selected from schools in Mumbai, Nashik, Nagpur and Pune cities in Maharashtra. A total of 450 boys (50 boys from NW, OW & O category from each age group) was selected. Anthropometric measurements included standing height, body weight and waist circumference; Cooper's 12 minute's run-walk test was used to derive VO2max of subjects. Blood pressure was recorded at rest. Conicity index was derived. Based on three day's dietary recall, carbohydrates, proteins and fat intake of subjects was calculated. Energy intake was derived. The results suggest that the mean values of standing height of OW and O boys of all age groups (10 yrs, 11 yrs and 12 yrs) were lower as compared with NW boys. Mean values of waist circumference and blood pressure of OW and O boys were greater than NW boys. The OW & O subjects showed reduced aerobic work capacity. The study concluded that there is a vast difference among the school going male children between 10 yrs, 11 yrs and 12 yrs of age as far as blood pressure parameters and conicity index are concerned & conicity index was directly correlated with the blood pressure. 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 :

INTRODUCTION:

Childhood obesity is one of the major health problems not only in developed countries but also in developing countries like India. Barlow, S. E. (2007) defines "overweight" as a body mass index (BMI)–for-age of >85th percentile but <95th percentile in children and adolescents, and "obesity" a BMI-for-age of >95th percentile. World health organization (WHO) defines obesity and overweight in children (5-19 yrs) as overweight is BMI-for-age greater than 1 standard deviation above the WHO growth reference median or a body mass index (BMI)–for-age of >85th percentile but <95th percentile in children and adolescents, and obesity is greater than 2 standard deviations above the WHO growth reference median. Some recent WHO global estimates show that, the worldwide prevalence of obesity more than doubled between 1980 and 2014. Overall, about 13% of the world's adult population (11% of men and 15% of women) were obese in 2014. In 2014, more than 1.9 billion adults aged 18 years and older were overweight. Of these over 600 million adults were obese. In 2014, an estimated 41 million children under the age of 5 years were overweight or obese. Once considered a high-income country problem, overweight and obesity are now on the rise in low- and middle-income countries, particularly in urban settings. Nearly half of the children under 5 who were overweight or obese in 2014 lived in Asia. Overweight and obesity are linked to more deaths worldwide than underweight. Globally there are more people who are obese than underweight - this occurs in every region except parts of sub-Saharan Africa and Asia (http://www.who.int/mediacentre/factsheets/fs311/en/).

Over the last 5 years, reports from several developing countries indicate prevalence rates of obesity (inclusive of overweight) >15% in children and adolescents aged 5-19 years, the rate in India was 22.0% . Moreover, secular trends also indicate an alarming increase in obesity in developing countries which in India was from 4.9 to 6.6% between 2003-2004 and 2005-2006. (Gupta, N. et al., 2012).

Various studies from India also showed the increased prevalence of obesity. Results of a study from Punjab (Mohan, B. et al., 2004) revealed that children in the age group of 11-17 years residing in urban areas were more overweight (11.6%) compared to children from rural areas (4.7%). But more children were obese in rural areas (3.6%) compared to urban areas (2.6%). There are few studies, reporting, prevalence of childhood and adolescent obesity and overweight from different parts of India (Punjab, Maharashtra, Delhi and South India) that range from 3% to 29%, and also indicate that the prevalence is higher in urban than in rural areas (Mahajan, P. B. et al., 2011).

Obesity always comes with many consequences or adverse health effects including metabolic syndrome like diabetes mellitus, cardiovascular diseases like hypertension etc. Study by Dyson, P. A. et al. (2013) on 'High rates of child hypertension associated with obesity: a community survey in China, India and Mexico' showed that hypertension is a significant risk factor for cardiovascular disease and epidemiological evidence suggests that it is increasing in parallel with obesity in children and adolescents in low- and middle-income countries. Their study concluded that rates of hypertension and overweight and obesity are high in school children in China, India and Mexico, and increased bodyweight is a significant risk factor for hypertension. Obesity is identified as the most important risk factor affecting blood pressure (BP) distribution in children (Urrutia-Rojas, X. et al., 2006 and Srinivasan, S. R. et al., 2006). Considering the strong correlations of anthropometric parameters such as weight, height, body mass index (BMI), and waist circumference(WC) with BP (Genovesi, S. et al., 2008), an indirect assessment of high BP using these indices may be an efficient strategy in the community set up (Kajale, N. A. et al., 2014). Thus, anthropometric indices emerge as an important screening method as they can be used to investigate the association between adiposity and high blood pressure in adults and in children and adolescents (Beck, C. C., 2011 and Zhang, Y. and Wang, Y., 2010). Along with the weight status, excess body fat or adiposity especially central or abdominal is also an important cardio-metabolic risk factor. The abdominal fat or waist circumference directly affects the cardiovascular health as well as physical fitness level. The cardio respiratory component is one of the most important components of health related fitness. It is a direct indicator of the physiological status of the person. It reflects the total capacity of the cardiovascular and respiratory systems to supply oxygen during long-term physical activity and reflects the ability to perform prolonged strenuous exercise (Ruiz et al., 2006). The conicity index, which evaluates waist circumference in relation to height and weight, appears to have a prognostic value and found to relate to

atherogenic risk factors similar to that of waist to hip ratio (whr) in adults and it has the advantage of accounting for total adiposity without requiring measurement of hip circumference (Valdez, R. et al., 1993). This may contribute to the superior performance of the conicity index compared with WHR for identifying children with high trunk fat and thereby with high blood pressure values.

Considering that the anthropometric indices like conicity index are low-cost, easy-to-use, reproducible and non-invasive methods that can be used for screening children with high blood pressure, the present study aims to observe the blood pressure and conicity index differences among normal weight, overweight and obese school going boys between the age 10 yrs-12 yrs.

METHODOLOGY:

The proposed research work was carried out to see the differences between obese and non-obese boys of 10 to 12 years of age as far as blood pressure and conicity index are concerned. Differences in outcome were tested between obese and non-obese boys 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) boys were purposively selected (n=450). The subjects were grouped as a control and experimental as shown in Table 1.

Table 1: Age wise classification of the subjects

Sr. No.	Age (Years)	Boys (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

From height & weight, body mass index (body mass index) of subjects was derived [Weight (kg) ÷ Height (m2)]. Worldwide, BMI is used as a screening tool to identify possible weight problems for children. WHO (World Health Organization) and CDC (Centres for Disease Control and Prevention) recommend the use of BMI to screen for overweight and obesity among children (http://www.who.int/childgrowth/standards/bmi_for_age/en/, WHO, 2012 and http://www.cdc.gov/healthyweight/assessing/bmi/). Following BMI percentile criteria given by CDC has been used to select the control and experimental groups.

Table 2: BMI Percentile Criteria

Sr. No.	Weight Status Category	Percentile Range
1	Normal Weight Category i.e. Healthy Weight	5th to less than 85th percentile
2	Overweight Category	85th to less than 95th percentile
3	Obese Category	Equal to or greater than 95th percentile

Besides height & weight, waist circumference of subjects was also measured. Conicity index was calculated according to the following equation of Valdez, R. (1991): Conicity Index = [(Waist Circumference) ÷ {0.109 (√Weight in kilograms ÷ Height in meters)}].

Blood pressure (BP) measurement was taken on the left arm with the subject supine, using standard BP apparatus. Systolic BP (SBP) and diastolic BP (DBP) were measured and used for analysis.

Cooper's 12 minutes run-walk test which is used as an indicator of cardiorespiratory fitness was conducted. The subjects were asked to run as much as they can for 12 minutes; the distance covered was noted in meters. VO2max i.e. maximal consumption of oxygen which is an indicator of aerobic work capacity was derived using below formula: VO2max = [(Distance covered in meters - 504.9) ÷ 44.73] (Nande, P. J. & Vali, S. A., 2010).

RESULTS:

The collected data on anthropometric characteristics of subjects included in the study are described in Table 3. Anthropometric measurements were compared between NW, OW & O male children. It was observed that the mean values of standing height of OW and O boys were less compared to the mean values of standing height of NW boys. The lowest height noted was 119.4 cm in O boys while the highest height noted was 166.1 cm in NW boys. Even though height is nutritionally influenced, it is genetically inherited.

Table 3: Data on anthropometric measurements of subjects

Sr. No.	Parameters	10 Years			11 Years			12 Years		
		NW	OW	O	NW	OW	O	NW	OW	O
1.	Height (cm)									
I	Mean±SD	140.54±6.52	137.40±6.35	135.56±8.14	144.66±9.01	143.75±6.82	142.25±7.21	149.5±7.16	144.84±5.61	143.69±8.06
ii	Range	124.0 -153.0	124.5 -152.0	119.4 - 157.0	125.5- 164.0	127.8 -157.0	124.5 -154.5	134.7 -166.1	132.2 -155.0	124.2 -157.0
2.	Body Weight (kg)									
i	Mean±SD	34.26±4.99	39.44±3.47	45.36±5.21	36.11±6.09	43.73±4.87	47.81±5.18	37.88±5.77	47.04±4.09	55.38±6.31
ii	Range	25.5 -44.2	32.5 -50.1	33.2 -57.3	26.9 -52.3	34.0 -53.5	37.7 -59.5	29.0 -52.7	40.0 -57.2	44.5 -73.4
3.	BMI (kg/m2)									
i	Mean±SD	17.29±1.83	20.90±0.77	24.70±2.18	17.05±1.73	21.10±1.01	23.62±1.88	16.97±1.85	22.40±0.97	26.81±1.95
Ii	Range	14.59 -23.13	19.41- 22.39	21.8-32.77	14.39 -20.67	20.15- 24.69	21.13 - 29.42	14.56 - 21.22	19.56 - 24.76	22.9-31.89
4.	Waist Circumference (cm)									
I	Mean±SD	59.28±4.73	71.58±2.46	77.72±4.75	59.80±6.49	75.72±6.19	83.10±6.13	59.10±3.39	80.28±6.40	85.52±6.61
Ii	Range	52.0 -69.0	76.0 -65.0	69.0 -86.0	50.0 -75.0	62.0 -85.0	68.0 -94.0	53.0 -66.0	68.0 -91.0	69.0 - 95.0
5.	Conicity Index									
I	Mean±SD	1.2±0.1	1.4±0.1	1.3±0.1	1.2±0.1	1.2±0.1	1.2±0.1	1.1±0.1	1.2±0.1	1.3±0.1
Ii	Range	1.0-1.5	1.0-1.5	1.2-1.5	1.0-1.3	1.0-1.4	1.1-1.3	0.9-1.4	1.0-1.5	1.0-1.6

The present study revealed that that with the increase in BMI the mean values of waist circumference of subjects were also increased indicating positive correlation between waist circumference and BMI ®= 0.2445 to 0.6744). WC values were ranging from 50-75 cm, 62-91 cm and 68-95 cm in NW, OW & O boys from all the age groups, respectively. The interest in waist circumference stems from research linking accumulated visceral adipose tissue to increased health risks and metabolic disorders in children and adults (Katzmarzyk, P. T. et. al., 2004 and Gower, B. A., et. al., 1999). Subjects in the upper percentiles for abdominal circumference or waist circumference are considered obese and at increased risk for morbidity, specifically type 2 diabetes and the metabolic syndrome, and mortality (Nicklas, B. J. et al., 2004 and Ziegler, E. E. and Filer, L. J., 1994).

Conicity index (CI) was increasing with the increase in weight status of the subjects. Though there was no difference found in the mean values of CI among all the groups of boys aged 11 yrs (1.2), CI was found to be less in NW boys (1.2) than OW & O boys of 10 yrs and 12 yrs. It indicates that abdominal obesity was seen to be more in OW & O boys as compared to NW boys of 10 yrs and 12 yrs.

Table 4: Data on blood pressure of the subjects

Sr. No.	Parameters	10 Years			11 Years			12 Years		
		NW	OW	O	NW	OW	O	NW	OW	O
1.	**SBP (mm/Hg)**									
	Mean±SD	94.40±8.24	107.20±10.52	115.38±13.12	93.48±7.84	105.34±9.05	122.18±19.06	97.24±9.55	108.26±10.78	121.48±19.31
	Range	60.0-115.0	92.0-136.0	88.0-140.0	75.0-112.0	92.00-135.0	89.0-168.0	80.0-123.0	86.0- 130.0	89.0- 168.0
2.	**DBP (mm/Hg)**									
	Mean±SD	65.88±11.05	75.82±11.28	78.60±11.49	63.78±7.10	75.80±11.42	76.44±12.96	64.02±10.90	78.22±9.83	80.66±11.00
	Range	43.0 – 111.0	45.0 –99.0	53.0 – 100.0	45.0 – 80.0	50.0 –99.0	53.0 – 100.0	40.0 -90.0	59.0 –99.0	65.0 – 101.0

The present study uncovered that the mean values of SBP were found to be high in OW boys (107.20±10.52, 105.34±9.05 and 108.26±10.78 in 10 yrs, 11 yrs and 12 yrs, respectively) and O boys (115.38±13.12, 122.18±19.06 and 121.48±19.31in 10 yrs, 11 yrs and 12 yrs, respectively) as compared to NW boys (94.40±8.24, 93.48±7.84 and 97.24±9.55 in 10 yrs, 11 yrs and 12 yrs, respectively). Similarly DBP was found to be high among OW & O male subjects ranging from 45-99 mm/Hg and 53-101 mm/Hg respectively. Thus, the results from present study revealed that BP was increasing with the increase in BMI and CI. Cai, L. et al.(2014) mentioned in their study on 'effect of childhood obesity prevention programs on blood pressure' that overweight and obesity are associated with high blood pressure, which even with moderate elevations was already considered a health risk; the present study strongly supports this statement.

Table 5: Data on respiratory rate and VO2max of the subjects

Sr. No.	Parameters	10 Years			11 Years			12 Years		
		NW	OW	O	NW	OW	O	NW	OW	O
1.	**Vo_2max (ml/kg/minute)**									
I	Mean±SD	44.2±6.3	37.8±5.9	33.0±8.8	46.9±4.1	33.4±3.6	25.7±5.6	52.2±5.8	37.9±11.2	26.0±12.7
ii	Range	30.6 -55.8	13.9-47.4	22.2-55.8	39.0 -55.8	23.9-39.0	3.2-35.7	42.4-64.2	13.9-60.8	2.1-65.8

Derived mean values of VO_2max of subjects when compared with the normative data showed that it was superior in NW boys (44.2±6.3, 46.9 ±4.1 and 52.2 ±5.8 ml/kg/minute, respectively for 10 yrs, 11 yrs & 12 yrs), fair in OW boys (37.8 ±5.9, 33.4 ±3.6 and 37.9±11.2 ml/kg/minute, respectively for 10 yrs, 11 yrs & 12 yrs) and poor in O boys (33.0 ±8.8, 25.7 ±5.6 and 26.0±12.7 ml/kg/minute, respectively for 10 yrs, 11 yrs & 12 yrs). Fitness is calculated per unit of body weight, so if fat increases, aerobic fitness declines (Nande, P. J. & Vali, S. A., 2010). Thus VO_2max was negatively correlated with the body weight (r= -0.0076 to -0.6745), BMI (r= -0.0201 to -0.6900) and CI (r= -0.0243 to -0.5400).

Childhood obesity in school-going Indian children is also high. Present study has shown that there was high prevalence of obesity in school going male children between the age of 10 yrs, 11 yrs and 12 yrs. Results showed that there was a vast difference between the school going male children between 10 yrs, 11 yrs and 12 yrs of age as far as conicity index and blood pressure are concerned. Moreover, anthropometric measurement like waist circumference of overweight and obese male children was associated with the risk of high systolic and diastolic blood pressure and decreased aerobic fitness.

CONCLUSION:

Anthropometric measurements body weight and waist circumference among school going male children from age group 10-12 yrs were found to be associated with the risk of hypertension. Conicity index which is an indicator of abdominal obesity was associated with risk of hypertension. The association of conicity index with cardiovascular risk factors was similar to those of anthropometric measurements. Body weight, BMI and conicity index were associated with decreased VO_2max indicating lower cardiorespiratory fitness. The study concludes that there was a difference between conicity index and blood pressure measurements among normal weight, overweight and obese boys between the age of 10 yrs, 11 yrs and 12 yrs. With the increase in weight, BMI and CI, blood pressure was also found to be increased, while cardiorespiratory fitness was decreased. Thus, present study highlights the importance of creating awareness and suggesting preventive measures for childhood obesity by feeding healthy from early childhood and also monitoring it throughout the life.

Reference

1. Barlow, S. E. Expert committee recommendations regarding the prevention, assessment, and treatment of child and adolescent overweight and obesity: summary report. Pediatrics, 2007; 120:S164-S192.
2. Beck, C. C. Lopes, A. S. and Pitanga, F. J. G. Anthropometric indexes of overweight and obesity as predictores of lipid changes in adolescents. The RevistaPaulista de Pediatria, 2011; 29(1): 46-53.
3. Cai, L. Wilson, R. F. Segal, J. B. Kim, M. T. Wang, Y. and Wu, Y. Effect of childhood obesity prevention programs on blood pressure: A systematic review and meta-analysis. Circulation, 2014; 129(18): 1832-1839.
4. Centers for Disease Control and Prevention. Division of Nutrition, Physical Activity and Obesity, National Center for Chronic Disease Prevention and Health Promotion. . Available from: http://www.cdc.gov/obesity/childhood/defining.html
5. Dyson, P. A. Anthony, D. Fenton, B. and Stevens, D. E. High rates of child hypertension associated with obesity: a community survey in China, India and Mexico. Paediatrics and International Child Health, 2013; 34 (1): 43-49.
6. Genovesi, S. Antolini, L. Giussani, M. Pieruzzi, F. Galbiati, S. Valsecchi, M. G. Brambilla, P. and Stella, A. Usefulness of waist circumference for the identification of childhood hypertension. Journal of Hypertension, 2008; 26:1563-1570.
7. Grant, S. Corbett, K. Amjadt, A. M. Wilson, J. and Aitchisont, T. A comparison of methods of predicting maximum oxygen uptake. British Journal of Sports Medicine, 1995; 29 (3):147-152.
8. Gupta, N. Goel, K. Shah, P. and Misra, A. Childhood Obesity in Developing Countries: Epidemiology, Determinants, and Prevention. The Journal of Clinical Endocrinology & Metabolism, 2010, 15(2): 128-130.
9. Kajale, N. A. Khadilkar, A. V. Chiplonkar, S. A. And Khadilkar, V. V. Body Fat Indices for Identifying Risk of Hypertension in Indian Children. Indian Paediatrics, 2014; 51: 555-556.
10. Mahajan, P. B. Purty, A. J. Singh, Z. Cherian, J. Natesan, M. Arepally, S. and Senthilvel, V. Study of Childhood Obesity Among School Children Aged 6 to 12 Years in Union Territory of Puducherry. Indian Journal of Community Medicine, 2011; 36(1): 45-50.
11. Nande, P. J. and Vali, S. A. 2010. Fitness Evaluation Tests for Competitive Sports, 1st edition, Himalaya Publishing House, 23-25.
12. National Obesity Observatory. Body Mass Index as a measure of obesity, 2009.
13. Nicklas, B. J. Penninx, B. W. Cesari, M. Kritchevsky, S. B. Newman, A. B. Kanaya, A. M. Pahor, M. Jingzhong, D. and Harris, T. B. Association of visceral adipose tissue with incident myocardial infarction in older men and women: the Health, Aging and Body Composition Study. American Journal of epidemiology, 2004; 160(8): 741-749.
14. Ruiz, J. R. Ortega, F. B. Gutierrez, A. Meusel, D. Sjöström, M. and Castillo, M.J. Health-related fitness assessment in childhood and adolescence: a European approach based on the AVENA, EYHS and HELENA studies. Journal of Public Health, 2006; 14(5): 269-277.
15. Srinivasan, S. R. Myers, L. and Berenson, G. S. Changes in metabolic syndrome variables since childhood in pre hypertensive and hypertensive subjects: the Bogalusa Heart Study. Hypertension, 2006; 48:33-9.
16. Urrutia-Rojas, X. Egbuchunam, C. U. Bae, S. Menchaca, J. Bayona, M. Rivers, P. A. and Singh, K. P. High blood pressure in school children: prevalence and risk factors. BMC Pediatrics, 2006; 6:32.
17. Valdez, R. A simple model-based index of abdominal adiposity. Journal of Clinical Epidemiology, 1991; 44(9): 955-960.
18. Valdez, R. Seidell, J. C. Ahn, Y. I. and Weiss, K. M. A new index of abdominal adiposity as an indicator of risk for cardiovascular disease: A cross population study. International Journal of Obesity Related Metabolic Disorders, 1993; 17:77-82.
19. World Health Organization. Physical status: the use and interpretation of anthropometry. Geneva: WHO; 1995.
20. Zhang, Y. and Wang, Y. Relationship of subcutaneous fat distributional pattern to blood pressure levels among children and adolescents in Shandong, China. International Journal of Cardiology, 2014; 176(3): 1210-1221.
21. Ziegler, E. E. and Filer, L. J. Junior Editors. Bray obesity. Present knowledge in nutrition. 7th ed. Washington, DC: International Life Sciences Institute, 1994; 19-32.