E-ISSN 2250-0944

ISSN 2250-1150
doi: 10.48047/ijprt/15.02.237

Research Article

Comparative study of autonomic nervous system activity in overweight, normal and underweight school children in eastern Odisha basing on BMI criteria

Debasish Das [1], Laba Kumar Naik 2,Nayan Ranjan Hansda3 .

[1] Assistant Professor, Department of Physiology, FM medical college and hospital ,odisha.
2 Assistant Professor, Department of Orthopaedics, FM medical college and hospital ,odisha.
3 Assistant Professor, Department of Paediatrics , FM medical college and hospital ,odisha.

Abstract

Aim: This study was undertaken to investigate and compare the autonomic nervous system activity in age matched overweight, underweight and normal weight school going boys in eastern Odisha.

Material and method: 90 Boys between age group of 11yr-16yr were subjected to study out of which 30were overweight (BMI>25), next 30 were underweight (BMI<18.5), rest 30 were control group having normal BMI. Cold pressure test and handgrip dynamometer test were performed and blood pressure was measured during and after the tests as measures of cardiovascular parameter.

Results: Baseline SBP and MAP were significantly higher in overweight boys & lower in underweight boys. Maximum rise of SBP, DBP & MAP during hand grip dynamometer test were significantly higher in overweight boys & lower in underweight boys. Increase in SBP & MAP from their basal value during cold pressure test were significantly lower in overweight boys & higher in underweight boys.

Conclusion: Thus it is concluded that both overweight &underweight boys have derangement of sympathetic cardiovascular function.

Keywords: SBP- Systolic blood pressure, DBP-Diastolic blood pressure, MAP-Mean arterial pressure

Introduction

Prevalence of childhood obesity and overweight is seen now in urban areas causing various cardiovascular, metabolic and endocrine health problems. Studies have shown the relation between the autonomic activity and obesity (1). Energy balance is largely affected by ANS activity of individuals (2). Obesity is a major health problem all over the world including the rural and urban area of India. Obesity is a result of rapidly changing life style which involves consumption of fast food with lack of physical activity. Obesity for prolonged period results in decreasing the lung volume and its capacities by affecting both lung and chest wall compliance. The use of BMI for the prediction of risk factor clustering among children & adolescent has significant clinical utility (3). Obese humans have decreased responsiveness to sympathetic stimulation and down regulated receptors in white adipose tissue(4). Gaining weight combines regularly with metabolic changes revealing adaptation processes towards “resistance” of feedback loops involved especially in organ systems ensuring supply and utilization of energy(5)(6). It has been documented that ANS is significantly compromised in malnourished children (7)(8). Our study is undertaken to investigate and compare the sympathetic cardiovascular parameters in age matched overweight, underweight & normal weight school going boys in eastern Odisha.

Materials and method

This prospective study was conducted in the research lab of Dept. of physiology, Fakir Mohon medical college, Remuna, Balasore, Odisha, during the period from Nov.2024 to May 2025 after due approval from the Institutional Ethics Committee. Study included 90 boys between age group 11-16 were subjected to study, out

of which 30 were normal weight (BMI-18.5-25) , 30 were overweight (BMI>25), rest 30 were underweight (BMI<18.5). Each child was informed about the procedures and informed verbal consent was obtained from their parents or teachers. Subjects with any disease or abnormality were excluded from study. Height in cm and weight in kg were measured by Stadiometer and Digital weighing scale respectively.BMI was calculated using Quetlet's index.

BMI=weight/height (kg/meter^2)

Blood pressure was recorded by Omron digital blood pressure recorder.

Baseline SBP, DBP was recorded. MAP was calculated.

Hand grip dynamometer test:

Subject was asked to grip the Med scale hand grip dynamometer with their dominant hand at 30% of maximal voluntary contraction for 3 minutes. Maximum SBP, DBP, & MAP change in BP from basal value were noted down for each minute. Mean was calculated.

Cold pressure test:

Subject was asked to immerse his hand in cold water (temp 4-6·C) for 1min. Then remove his hand. BP measurement was made from other arm at 30sec & 1min interval. Maximum increase & change of BP (SBP, DBP, and MBP) was determined. Mean was calculated

Observation

Variable	Control	Overweight	Underweight
Age(yr)	14.2±0.9	14.6±1.3	14±0.9
Height(cm)	157.4±6.7	161.4±10.2	158.1±8.1
Weight(kg)	52±4.3	72.2±12.9	42.4±5.1
BMI	21±1.4	27.5±3.2	16.9±1.1

Table-1 Anthropometric characteristics between control & study groups

Variable	Control	Underweight	Overweight	P-value
SBP(mmhg)	104.5±6.8	104 ±10.5	115.8±9.8	0.0011*
DBP(mmhg	65.6±6.4	63.8±9.4	69.4±5.6	0.151
MAP(mmhg)	78.6±5.2	77.2±8.9	84.9±5.7	0.011*

Table-2 Comparison of basal blood pressure response in control & study groups

Variable(mmhg)	Control	Underweight	Overweight	P-value
SBPMAX	127.7±12.6	124.5±12.5	137.8±13	0.033*
SBPDIF	23.1±10.7	20.5±14.8	22±13.1	0.816
DBPMAX	78.8±10	77.5±9.1	88.3±14.9	0.034*
DBPDIF	13.2±10.8	13.6±11.9	18.9±12.1	0.369
MAPMAX	95.1±10.1	93.1±9.1	104.8±13.6	0.019*
MAPDIF	16.5±9.7	15.9±10.9	19.9±11.5	0.594

TABLE-3 comparison of blood pressure response to hand grip dynamometer test in control & study group

Variable(mmhg)	Control	Underweight	Overweight	P-value

SBPMAX	122.1±8.8	128.6±12.8	127± 14.2	0.177
SBPDIF	17.5±10.7	24.6±14.6	11.2±9.2	0.022*
DBPMAX	77.9±8.8	80.2±9.4	80.1±10.1	0.678
DBPDIF	12.2±10.2	16.3±10.3	10.7±6.8	0.314
MAPMAX	92.6±7.1	96.3±8.7	95.8±11.1	0.348
MAPDIF	14±8.1	19.1±9.3	10.9±7	0.0461*

TABLE-4 Comparison of blood pressure response to cold pressure test in control & study groups

SBP-Systolic Blood Pressure, DBP-Diastolic Blood Pressure, MAP-Mean Arterial pressure
MAX-Maximum increase in BP during a test
DIF-Difference between maximum increase in BP during a test from its basal value.
*- Statistical significant.

All data are expressed as means ± sd. Differences between underweight, overweight & normal weight groups were tested using SPSS software for statistics. P-value less than 0.05 was statistical significant.

Result

Basal SBP, DBP & MAP are lowest in underweight & highest in overweight subjects. From this only SBP & DBP are statistical significant. During the Hand grip dynamometer test maximum rise of SBP, DBP & MAP were statistical significant. Rise is highest in overweight& lowest in underweight subjects. Difference between maximum rise of SBP, DBP & MAP from their basal value did not show any statistical significance. During the Cold pressure test the maximum rise of SBP, DBP & MAP did not show any statistical significance. Difference of SBP, DBP & MAP was lowest in overweight and highest in underweight subjects. From this only SBP & MAP are statistical significant.

Discussion

In overweight children initially sympathetic stimulation occur to reduce body weight (catabolic effect). That causes an increase in vasomotor tone & cardiac output. So the final result is increase in basal SBP,DBP & MAP in overweight children(9). But beyond equilibrium, sympathetic nervous system cannot act to reduce body weight. This causes sympathetic insufficiency in chronic overweight children which makes them pre- hypertensive. This is shown by these tests. Cold pressure test is an indicator of vasoconstrictor tone. The lesser increase in SBP, DBP & MAP during cold pressure test from its basal value in overweight boys in compare to control group suggest sympathetic insufficiency (10). Sympathetic insufficiency leads to inadequate sympathetic cholinergic vasodilatation in contracting muscles resulting in significant increase in maximum SBP, DBP & MAP during Hand grip dynamometer test (11). But in underweight boys sympathetic system is not sufficiently stimulated. In sympathetic function, fall in SBP after standing decreased with increased BMI and rise in DBP after sustained handgrip Increased with increasing BMI. Kimura et al (12) and Chaudhuri et al (13) also found that overweight subjects had significantly lower autonomic functions as compared to normal weight subjects.

Conclusion

Our results indicate sympathetic insufficiency in overweight children. Data for underweight children is not so contrast. So this study establishes the correlation of ANS (sympathetic activity), body weight regulation (energy balance) & cardiovascular function.

Reference

[1]. Venkatnaraya KM, Campagna AF, Imperatore G.Type2 diabetes in children: a problem lurking from india? *Indian Pediatr* 2001;38:17.

[2]. Bray GA. Autonomic and endocrine factors in the regulation of energy balance. *Fed Proc*. 1986; 45[5]:1404-1410

[3]. Katzmarzyk PT, Srinibash SR, ChenW, Malina RM, Bouchard C, and waist hip ratio as diagnostic tests for fatness in adolescents. *Int J Obese* 2004;doi:10.1038/sj.ijo.0802867, URL: *www.nature.com.*last accessed3 Jan2005.

[4]. Bedi M, Babbar R, Chakrabarty AS, Sachdev HP. Comparative study of autonomic nervous system activity in malnourished and normal children in India*. Inn Trop Paediatr*1999;19: 185- 189.

[5]. Heinrich WL. Autonomic insufficiency.*ArchInternMed*1982;142:339-344.

[6]. Sorof J, Daniels S. Obesity hypertension in children. A problem of epidemic proportions. Hypertension 2005;45:1159-1164.

[7]. De Simone G, Mancini M, Turko S,Marotta I, Gaeta I, Lannuzzi R, Ferrara LA, Mancini M. Cardiovascular response to the cold test in obese subjects. Effect of a hypocaloric, normal sodium diet. Minerva endocrinol. 1990 Oct-Dec; 15(4): 231-233.

[8]. Leary AC, Donnan PT, MacDonald TM, Murphy MB. The influence of physical activity on the variability of ambulatory bloodpressue. Am J Hypertens. 2003; 13: 1067-73.

[9]. Ravisankar P, Madanmohan, Kaviraja U, and E. Sankaranarayanan Prakash. Correlation between body mass index and bloodpressure indices, handgrip strength and handgrip endurance in overweight adolescents. Indian J Physiol Pharmacol 2005; 49(4): 455-461.

[10]. Nageswari KR, SharmaR, Kohli DR. Assessment of respiratory and sympathetic cardiovascular parameters in obese school children. Indian J Physiol Pharmacol 2007;51(3):235-243.

(11). Schwartz MW, Baskin DG, Kaiyala KJ, Woods SC. Model for the regulation of energy balance and adiposity by the central nervous system Am J Clin Nutr. 1999;69:584-596.

(12). Kimura T, Matsumoto T, Akiyoshi M, Owa Y, Miyasaka N, Aso T, et al. Body fat and blood lipids in postmenopausal women are related to resting autonomic nervous system activity. Eur J Appl Physiol. 2006; 97:542-7.

(13). Chaudhuri A, Borade NG, Tirumalai J, Saldanha D, Ghosh B, Srivastava K. A study of autonomic functions and obesity in postmenopausal women. Ind Psychiatry J. 2012; 21:39-43