Short Communication

Evaluation of autonomic function in obese and non obese adolescents

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Abstract

Reports on autonomic dysfunction associated with obesity in adolescent population are limited and also are conflicting. Therefore in the present study, we have evaluated the difference in autonomic function between the obese and nonobese adolescents. Sixty-five adolescent subjects aged between 17 and 19 years were selected from HAHC Hospital, Jamia Hamdard. Based on their body mass index, these subjects were divided into a nonobese group (n = 54) and obese group (n = 11). Autonomic function tests for assessing parasympathetic function (such as heart rate response to immediate standing and standing to lying ratio) and sympathetic function (such as blood pressure response to immediate standing and cold pressor test) were employed. There was no difference in sympathetic and parasympathetic function between the obese and nonobese adolescents. Therefore, the findings of the present study suggest that the autonomic dysfunction was not statistically significant in the studied adolescent population.

Key words: Adolescence, autonomic dysfunction, obesity

Received: 5th August, 2015; ***Revised:*** 11th September, 2015; ***Accepted:*** 28th September, 2015

INTRODUCTION

Adolescence is considered to be one of the critical periods for the development of obesity.[1] Obesity arises due to the interaction between various genetic and environmental factors.[2-4] The last two decades of the previous century have witnessed a dramatic increase in healthcare costs due to obesity and related issues among children and adolescents.[4] Globally, an estimated 10% of school children between 5 and 17 years of age are overweight or obese in India.[5] According to an estimate by the World Health Organization, there will be about 2.3 billion overweight and over 700 million obese people of age 15 and above by 2015.[6] A study from South India reported a prevalence of 3.6% in the age group of 13–18 years in Chennai in 2002,[7] 3.4% in age group of 5–16 years in Mysore in 2009,[8] and 3.6–7% in North India.[9-12]

Autonomic nervous system is involved in energy metabolism and regulation of cardiovascular system,[6] therefore it is considered that one or more subgroups of obesity have an alteration in their autonomic nervous system that may promote obesity and account for clinical consequences of obesity. In adult obese, both the divisions of autonomic nervous system are affected which may further cause various cardiovascular complications.[11]

Obesity is becoming a global epidemic in both children and adults and is associated with co-morbidities such as cardiovascular diseases, diabetes, hypertension, cancer, and sleep apnea. Therefore, emphasis should be laid on early detection of the autonomic dysfunction in obese adolescent population. Though few have studied the altered autonomic function in obese adolescents, the results were conflicting. Hence, in this study, we have

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Access this article online	
Quick Response Code:	Website: www.ijcep.org
	DOI: 10.4103/2348-8093.169961

How to cite this article: Khan N, Ganai J, Kohli S, Muthukrishnan S. Evaluation of autonomic function in obese and non obese adolescents. Int J Clin Exp Physiol 2015;2:195-8.

assessed and compared the autonomic dysfunction in obese and nonobese adolescents.

MATERIALS AND METHODS

After ethical approval from the Ethical Committee of Jamia Hamdard a sample of 65 subjects (17–19 years) were grouped into obese group (body mass index [BMI] >30 kg/m^2) and nonobese group (BMI – 18.5–29.9 kg/m^2). Athletes, smokers, alcoholics, subjects with any known medical condition in past 6 weeks and subjects on any medication were not included in the study. Informed consent was taken from the recruited subjects after explaining in detail about the procedure.

The four autonomic function tests employed were:

1. Heart rate response to immediate standing (30:15):

After a rest of 15 min in the supine position, the electrocardiogram (ECG) leads were positioned, and ECG recording was started. The patient was asked to stand from the supine position without displacing the leads. 30:15 ratio was calculated by taking the ratio of longest R-R interval around beat 30, and shortest R-R interval around beat 15 after standing.

2. Standing to lying ratio (S/L ratio):

In standing position, ECG was recorded for 20 beats, and then the patient was asked to lie down with the leads attached as quickly as possible. The ECG recording continued for 60 more beats in the lying position. The point at which subject started to lie down was marked. S/L ratio was calculated as the longest R-R interval during 5 beats before lying down to shortest R-R interval 10 beats after lying down.

3. Blood pressure response to standing:

Blood pressure was recorded in the supine position, and the subject was then asked to stand immediately motionless and blood pressure recording was noted after 30 s interval for 2 min. The difference between the readings of systolic blood pressure and diastolic blood pressure in lying and immediate standing were calculated.

4. Cold pressor test:

The subject was comfortably seated in a chair, and the resting blood pressure was recorded. The subject was then asked to immerse his/her other hand in cold water maintained at 4–6°C till the wrist joint. Blood pressure measurement was taken from other arm at pain threshold time.

Data analysis was done using SPSS version 17 (IBM Developers). Independent Student's *t*-test was used to determine the differences in autonomic function responses in obese adolescent and nonobese adolescent.

RESULTS

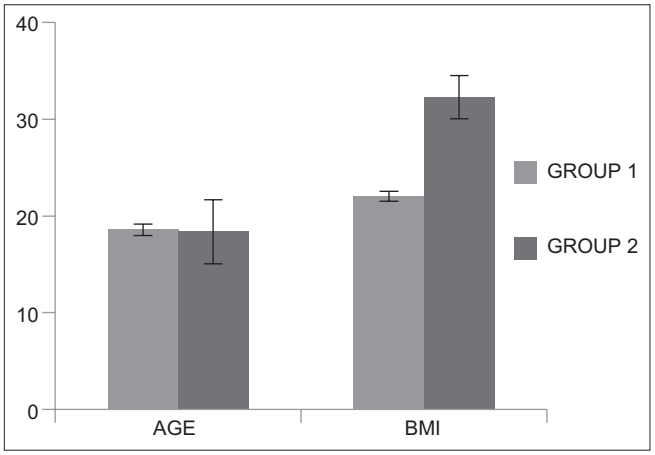
The mean age of the subjects was 18.57 ± 0.602 in the nonobese adolescent group and 18.36 ± 0.505 in the obese adolescent group [Graph 1]. The systolic and diastolic blood pressure changes in response to cold pressor test were not found to be significant statistically with *P* values of 0.225 and 0.23 in the obese and nonobese adolescents, respectively. The mean systolic blood pressure change for the nonobese group is 4.80 ± 11.56 and for the obese group is 0.18 ± 10.43. The mean diastolic blood pressure is 4.78 ± 10.16 in the nonobese group, and 9.09 ± 13.51 in the obese group was also not significant [Table 1].

The mean value for diastolic blood pressure for the nonobese group was 7.61 ± 6.89 and for the obese group is 9.36 ± 7.61 in response to standing was not significant ($P = 0.453$). The mean value for systolic blood pressure in nonobese group is 7.94 ± 7.14 and in the obese group, it was 7.91 ± 15.73 was also not significant ($P = 0.991$). 30:15 ratio; heart rate response to immediate standing was not statistically significant ($P = 0.348$).

DISCUSSION

There was no statistically significant difference in sympathetic function tests between the obese and nonobese adolescents. Rossi *et al*.[13] and Tonhajzerova *et al*.[14] have also reported no significant difference in the sympathetic function tests between obese and nonobese subjects, which are in agreement with the findings of the present study suggesting a less frequent involvement of sympathetic function.

The parasympathetic function tests such as heart rate response to immediate standing ($P = 0.34$) and S/L ratio



Graph 1: Demographic data (original). Group 1: Nonobese group ($n = 54$), Group 2: Obese group ($n = 11$)

Table 1: Autonomic function responses in obese and nonobese adolescents

Variables	Group 1 (*n*=54)		Group 2 (*n*=11)		*P*	*t*
	Mean	SD	Mean	SD		
SYS (systolic BP response to standing)	7.94	7.14	7.91	15.73	0.991	0.012
DIAS (diastolic BP response to standing)	7.61	6.89	9.36	7.61	0.453	0.755
Diastolic (cold pressor test)	4.78	10.16	9.09	13.51	0.23	1.21
Systolic (cold pressor test)	4.80	11.56	0.18	10.43	0.225	1.22
30:15 (R1)	1.26	0.216	1.19	0.278	0.348	945
Standing to lying ratio (R2)	1.13	0.16	1.24	0.27	0.063	1.89

Group 1: Obese group, Group 2: Nonobese group, BP: Blood pressure, SD: Standard deviation. Data expressed as Mean and SD. Statistical analysis of data was done by Students *t* test. *P*>0.05 was considered significant

($P = 0.063$) were also found to be not significant between obese and nonobese adolescents. Both parasympathetic and sympathetic divisions have been found to be affected in the adult obese population as compared to the nonobese adult population.[2] In adolescent population, Vanderlei *et al*.[15] reported a reduction in both parasympathetic and sympathetic function in the obese adolescent group as compared to the nonobese adolescent group and whereas another study by Tasçilar *et al*. on cardiac autonomic function in obese adolescents reported a parasympathetic withdrawal and sympathetic predominance.[16]

Autonomic nervous system has been reported to be affected by the duration of obesity, level of obesity as well as the physical activity levels. It has also been reported that physically active children both obese and nonobese children have a greater autonomic nervous system activity compared to the inactive children.[17] It has also been reported that cardiac autonomic functions get affected in extremely obese children, and there was no difference in the cardiac autonomic function between the normal weight and overweight children.[18] Rabbia *et al*. reported that children with a shorter history of obesity had no marked sympathovagal imbalance, characterized by reduced tonic cardiac vagal outflow and an increase in the sympathetic hyperactivity whereas children who were obese for a longer duration had reduced sympathovagal imbalance.[19] In adolescence with longer duration of obesity, the cardiac autonomic functions tend to normalize suggesting regionalization of the sympathetic activation in the kidney and vasculature with a resetting of baroreflex control of the cardiovascular system or involvement of other nonautonomic factors to maintain arterial hypertension.

In present study, the mean BMI for the obese group was 32.27 which might have not resulted in a statistically significant difference between the obese and the nonobese adolescent group. As the level of physical activity also plays an important role in the regulation of autonomic function response, the subjects in the present study mainly comprised college going students who were not sedentary. Therefore from the findings of the present study, we might suggest that the level of obesity and physical activity plays an important role in the autonomic nervous system function.[18] Confounding factors such as duration of obesity, the level of physical activity, and family history were not taken into consideration in the present study.

CONCLUSION

The results of the present study indicate that there was no difference in autonomic function between the obese and nonobese adolescents, which could be due to the level of obesity and physical activity in these subjects. Therefore, future studies should be conducted in a larger sample size considering the other confounding factors. However as earlier studies have reported higher risks associated with adulthood obesity, appropriate interventions should be planned at the earlier ages.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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