Assessment of Cardiovascular Parameters in Obese Children: A Comparative Study

Harvir Singh Sodhi[1], Manpreet Singh[2]

ABSTRACT

Introduction: Overweight and obesity have been linked with high mortality and morbidity rate. A large number of populations belonging to different cultural groups, economic backgrounds and age groups are affected by this disorder. Hence; we assessed the cardiovascular parameters in obese children in comparison with control groups.

Material and Methods: The study was conducted in the department of physiology in the medical institute.Study population consisted of children randomly selected from two schools to get groups with diversified socioeconomic status.Screening of children belonging to age group 8-16 years was done. Measurement of height (in metres) and weight (in kilograms) was done for the identification of obese/overweight school children. As per the standard procedure, baseline systolic and diastolic blood pressure of the subjects was recorded onlyafter they were made to rest for 10 minutes. Blood pressure was recorded using proper cuff size. Cold pressortest (CPT) and Handgrip dynamometer test (HGT) was done in all the subjects. All the results were analysed by SPSS software.

Results: The test group had mean Body Mass Index (BMI) of 29.8±1.68 kg/m^2 whereas control group had mean BMI of 18.58±0.8 kg/m^2. Preceding the Cold Pressor Test and Handgrip dynamometer test, the readings of baseline diastolic BP in test group subjects were considerably increased ($P<0.05$) in contrast to the control group ($P<0.05$).

Conclusion: obesity in children is a predisposing factor for hypertension and cardiovascular diseases in later years.

Keywords: Cardiovascular, Children, Obesity

INTRODUCTION

Overweight and obesity have been linked with high mortality and morbidity rate. A large number of populations belonging to different cultural groups, economic backgrounds and age groups are affected by this disorder.[1-3] It is characterised by disturbances in energy levels. Several studies conducted in different states of India like Punjab, Delhi and in South India have observed an increase in frequency of obesity and overweight in children.[4,5] Over the years concern has been grown on the fact that increasing obesity among adults might affect their cardiovascular health.[2] When a person accumulates adipose tissue a variety of changes occur in the cardiorespiratory structure and function. Hence obesity may affect the heart and lungs through its influence on the known risk factors of hypertension, dyslipidemia and glucose intolerance. The cardiovascular disorders due to obesity result in increased mortality from coronary artery disease, heart failure, arrhythmias and sudden death.[3,4] Hence; we planned this study to assess the cardiovascular parameters in obese children in comparison with control groups.

MATERIAL AND METHODS

The study was conducted in the department of physiology in the medical institute.Study population consisted of children randomly selected from two schools to get groups with diversified socioeconomic status. Screening of children belonging to age group 8-16 years was done. Measurement of height (in metres) and weight (in kilograms) was done for the identification of obese/overweight school children. Calculation of BMI (Body Mass Index) was done according to the following formula:

Body mass index = Weight (Kilograms)/ Height^2 (metres^2)

The standard protocol of Body Mass Index-for-age was used for scaling of obesity.[6] Those children having BMI more than the cut-off valuewere placed in the test/obese group. Following the criteria mentioned above, we recognised a sum of 30 0bese children. For the control group, we selected equal number of non-obese children and matched them for age and sex. Brief personal and medical history was taken. Children suffering from medical conditions, apprehensive and non-cooperative children were excluded from the study. A detailed explanation of criteria for the study and techniques to be performed were given to the subjects. An informed consent in written form as per Helsinki Declaration was obtained from each subject. As children belonging to study populations were minors, an informed consent was also signed by parents/guardians. Certain details required for the study like dietary habits, family history, and amount of physical work were obtained with the help of questionnaires/ personal data form which were given to the children and were asked to complete it. For the assessment of cardiovascular parameters in the test and control groups following tests were performed: As per the standard procedure, baseline systolic and diastolic blood pressure of the subjects was recorded onlyafter they were made to rest for 10 minutes. Blood pressure was recorded using proper cuff size. To remove any bias in the following tests, blood pressure readings were taken twice for each subject and baseline blood pressure (systolic and diastolic) was obtained from the average of the two recordings.

Cold pressortest (CPT)

Water was maintained at 4^{0}C temperature and the right hand of subject was submerged in the water up to wrist. Now, Blood pressure was measured with hand still submerged in water at 30 seconds and 1 minute. After 1 minute, hand was taken out and blood pressure was measured at each minute till blood pressure reverted to the baseline.[7] The maximum elevation of the blood

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Cardiovascular parameters	Blood pressure (BP) (mmHg)	Control group	Test group	P-value
Hand grip dynamometer test	Baseline diastolic BP (mean ± S D)	75.6 ±6.90	82.3 ± 8.2	<0.007
	Maximum diastolic BP (mean ± S D)	91.5 ±5.50	93.6 ±6.22	N S
	Change in diastolic BP (Δ) (mean ± S D)	15.9 ± 5.23	12.15 ± 3.90	<0.004
Cold pressor test	Baseline diastolic BP (mean ± S D)	70.2 ± 3.65	77.4 ± 5.30	<0.003
	Change in diastolic BP (Δ) (mean ± S D)	81.3 ±6.35	94.3 ±7.89	<0.003
	Change in diastolic BP (Δ) (mean ± S D)	11.1 ± 5.55	18.3 ± 7.35	<0.04

Table-1: Comparison of blood pressure response to hand grip dynamometer test and cold pressor Test in control and obese groups (n=30 each).

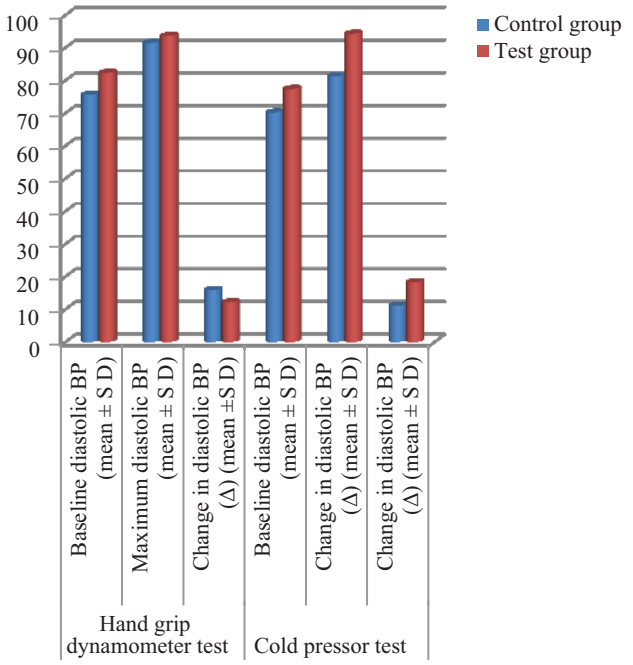

Figure-1: Comparison of blood pressure response to hand grip dynamometer test and cold pressor Test in control and obese groups (n=30 each).

pressure from baseline value (average of two recordings) called as the range or response (Δ) was recorded. Similarly, the highest readings of systolic and diastolic blood pressure attained, known as ceiling values were recorded.[8] The next test was performed after giving rest for 30 minutes to the subjects.

Handgrip dynamometer test (HGT)

The investigators gave details about the test by self-demonstration. Recording of the baseline systolic and diastolic blood pressure was done and noted. Now, the subjects were instructed to grip the handgrip dynamometer firmly up to their potential for few seconds to achieve Maximal Voluntary Contraction (MVC) and value of force exerted maximally was noted.

The subjects were instructed to rest for few minutes. After this, using the 30% of the maximal voluntary contraction they were made to carry out isometric contractions up to the level of fatigueless.[9] While the patient was performing exercise, systolic and diastolic blood pressure was recorded after each minute. The calculated value of average of systolic and diastolic blood pressure, rise in systolic and diastolic blood pressure during isometric exercise and readings of systolic and diastolic BP which were maximal during the exercise were recorded.

STATISTICAL ANALYSIS

All the results were analysed by SPSS software. Chi square test and student t test was used for the assessment of level of significance.

RESULTS

The test group had mean Body Mass Index (BMI) of 29.8±1.68 kg/m^2 whereas control group had mean BMI of 18.58±0.8 kg/m^2. Preceding the Cold Pressor Test and Handgrip dynamometer test, the readings of baseline diastolic BP in test group subjects were considerably increased (P<0.05) in contrast to the control group (P<0.05). Before performing the Cold Pressor Test (CPT) and Handgrip dynamometer test (HGT), the readings of baseline diastolic blood pressure were pooled and mean value was calculated for each subject. The values of mean diastolic blood pressure for each subject and the BMI were used for a simple regressive analysis. A positive association of DBP with BMI was observed (p<0.05). When we performed the Cold pressor test, test group had significantly increased values for the response/range (Δ) and the ceiling value/maximal response associated with diastolic blood pressure in contrast to control group (p < 0.05, Table 1). The obese group has significantly decreased value as compared to control group for the response to isometric exercise (Δ),which is calculated as the difference between highest reading of diastolic BP and average of 2 readings of baseline diastolic BP (p < 0.004).

DISCUSSION

Sustained hypertension is very common in obese children which have been estimated to be 15.33% and 43.1% of overweight and obese children in urban area and 6.82% and 61.7% in children in rural area.[10]

In our study, increased values of baseline diastolic blood pressure (DBP) preceding cold pressor test and isometric test in obese children were observed. A significantly positive correlation was found between increased values of baseline DBP and BMI. These observations have helped to hypothesize that increased vasoconstrictor tone and/or rise in circulatory load on heart leads to rise in cardiac output due to increased Body Mass Index which might be the reason for increased levels of baseline diastolic blood pressure in obese/overweight children.[11,12]

Cold Pressor Test (CPT) is used to indicate vasoconstrictor tone which provokes pressor response to a cold stimulus. Every individual has a different response of blood pressure to Cold pressor test. Cold pressor test in the present study is reported to have higher maximal/ceiling value as well as range/response (Δ) of diastolic blood pressure in test group as compared to control group. Hines and co-workers.[13,14] Indicated that the vasopressor response to locally applied cold was due to an increase in the total peripheral resistance as a result of vasoconstriction and that the cardiac output did not change.

The standardised value for abnormal response in Cold Pressor Test is recognised as rise of 20/20 mmHg or more. In our study, the values were in range of normal values even though there was significant increase in diastolic blood pressure (ΔDBP) indicating increased sympathetic responses.[15]

Previous authors have defined response to Handgrip dynamometer test as a rise of diastolic blood pressure of 15 mmHg or more as normal, 11–15 mmHg as borderline and 10 mmHg or less as abnormal.[16]

Borderline response was exhibited by the obese children whereas control group children exhibited normal response. There is increase in cardiac output and blood pressure with slight alterations in total peripheral resistance that depends on the heart rate as mentioned in the literature.[16] So, diverse physiological principles are used for the explanation of observations during Cold Pressor Test and Handgrip Dynamometer test. Instability in the autonomic system is found in the obese children as there was imbalance in sympathetic cardiovascular functions. This imbalance in cardiovascular function can be observed in the form of increased level of baseline diastolic blood pressure, heightened response to Cold Pressor Test and borderline response to Handgrip dynamometer. In the previous studies by some authors, it has been reported that there is both increased sympathetic activity in response to exercise and hypo function of the sympathetic system in obese children.[17,18]

This dichotomy in our observations can be explained by the following hypothesis. It is a well-known fact that whenever stimulus to sympathetic system is provided, there is increase in arterial pressure. This can be due to (i) increase in heart rate and force of contraction which leads to increased cardiac output and blood pressure or reversibly (ii) increase in peripheral blood resistance and blood pressure due to vasoconstriction. The heightened action of cardiac sympathetic fibres is responsible for first action and heightened action of peripheral vasoconstrictor fibres for second action.[19] Vasoconstrictor response to cold in normotensive and hypertensive population is accredited to activation of preferred peripheral vasoconstrictor fibres. In the literature, it has been reported that action of cardiac sympathetic fibres are responsible for increased heart rate, cardiac output and blood pressure induced by isometric exercise.[20] The borderline response to isometric exercise in the obese children was found due to decreased response in cardiac sympathetic activity. On the contrary, there was increased total peripheral resistance and diastolic blood pressure due to increase in peripheral sympathetic activity. Baseline diastolic blood pressure before applying any kind of stimulus (cold or exercise) was increased in the obese children because of increased vasoconstrictor tone at rest.[21]

CONCLUSION

From the above results the authors concluded that obesity in children is a predisposing factor for hypertension and cardiovascular diseases in later years.

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