

## Study of the cardio respiratory response to six minute walk test in normal weight, overweight and obese children aged 7 to 10 years

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### Abstract

**Aim:** To study the cardio respiratory response to six minute walk test in normal weight, overweight and obese children aged 7 to 10 years.

**Methodology:** An experimental study was carried out to study cardiorespiratory fitness in normal weight, overweight and obese children aged 7 to 10 years. 120 children divided into three groups as normal weight, overweight and obese according to percentile chart for age and gender using simple random sampling. Physiological responses of children to six minute walk test were evaluated using (BP, RR, HR, Distance walked, RPE). Data was documented pre and post 6 MWT and analyzed using ANOVA and Bonferroni multiple comparison test.

**Result:** Physiological variable showed statistical significant changes were observed in obese grade. When intergroup analysis was done, it was found that obese children showed maximum rise in terms of (SBP, RR, RPE) as compared to normal weight peers. There is no significant difference observed in overweight and obese. And overweight children also showed statistically significant higher response as compared to normal weight peers. Distance covered in six minute was found to be significantly higher in normal weight children as compared to overweight and obese.

**Conclusion:** The study concludes that six minute walk test response is significantly higher with higher grades of BMI, which can be effectively used to assess their cardio respiratory fitness.

**Keywords:** BMI, 6 MWT, Cardio respiratory response.

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### 1. Introduction

Cardio respiratory fitness is impaired in obese children and is among the main reasons for their low engagement into physical activities. First Cardio respiratory fitness is an important clinical parameter for the diagnosis and follows up of the current and future functional and metabolic health of obese youth. Second cardiorespiratory fitness is necessary information to obtain when implementing interventions for treatment obesity. Reference values have facilitated the use of 6MWT and allow determining whether a child has good or poor cardio respiratory fitness of the six minute walk test protocol with gas exchange measurements.[1] Cardio respiratory fitness is based on physical activity programs in pediatric population, assessed by six minute walk test. [2]

### 2. Materials and methods

#### 2.1 Procedure

Permission from Head of Institute and Principal of school obtained. Approval from Ethical Committee was obtained. Children of age group 7 to 10 years were divided into three groups according to the BMI grading for their age and sex [3]. Expected sample size of 120 subjects was allotted in three groups. Consent was taken from parents and study was explained in detail. After their willingness, they were allotted in BMI groups. Pretest vital parameters were taken and six minute walk test was performed according to ATS guideline.[4] Posttest vitals and distance covered were recorded. Data was collected in the form of pre and posttest vital parameters and distance walked, rate of perceived exertion using Borg's Scale.[5]

**2.2 Data analysis**

Statistical software STATA version 10.0 was used for data analysis. Tests used for statistical analysis are:

1. ANOVA and f test
2. Bonefferoni multiple comparison test

**2.2.1 One way ANOVA and F test:**

To compare mean difference of pre and post six minute walk test change in values of systolic blood pressure, diastolic blood pressure, heart rate, respiratory rate, rate of perceived exertion and distance walked in normal weight, overweight and obese children.

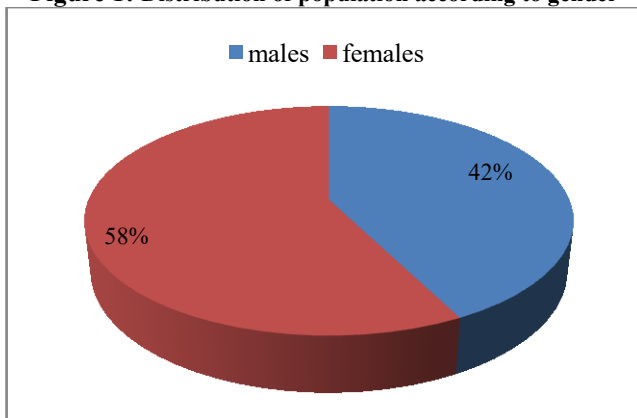
**2.2.2 Bonefferoni multiple comparisons test:**

For Intergroup comparison of mean difference in immediate and resting values of systolic blood pressure, diastolic blood pressure, heart rate, respiratory rate, rate of perceived exertion and distance covered in six minute walk test amongst normal weight, overweight and obese children.

**3. Results**

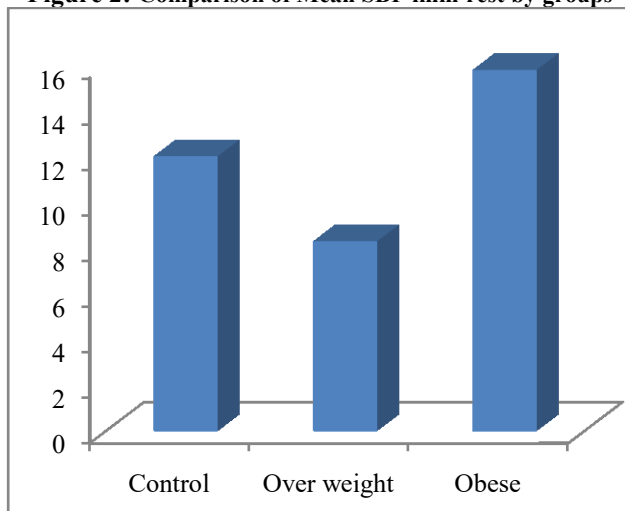
- Number of participants in each group were 40. (normal weight, overweight and obese).
- In this study, distribution of sample population showed 58% female and 42% male population.

**Figure 1: Distribution of population according to gender**



**3.2 Systolic blood pressure response:**

**Figure 2: Comparison of Mean SBP imm-rest by groups**



**Table 1: Comparison of Mean SBP imm-rest by groups (by ANOVA and F- test)**

Group	No.	Age	
		Mean	SD
Normal weight	40	12.02	4.17
Over weight	40	8.3	5.62
Obese	40	15.8	5.95
P values		0.00001	

Comparison of systolic blood pressure mean difference in normal weight overweight and obese group calculated by ANOVA are 12.02±4.17, 8.3±5.6, and 15.8±5.9 respectively and p value is 0.00001 for each i.e. the systolic blood pressure response is statistically highly significant.

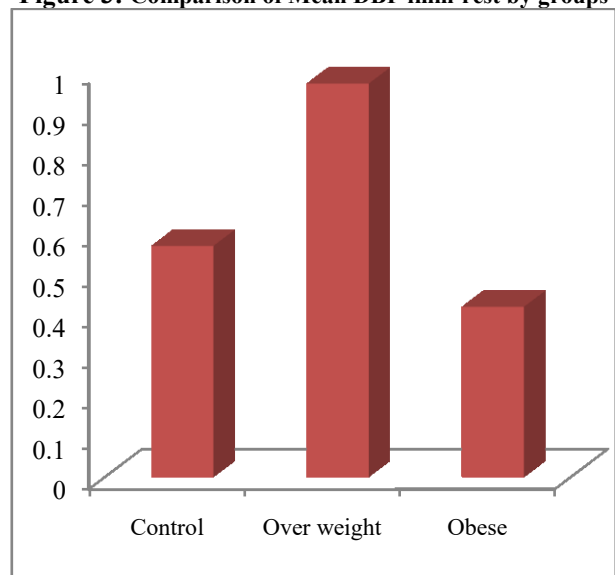
**Table 2: Comparisons of Mean SBP imm-rest (by Bonferroni multiple comparison test)**

Pairs by groups	No.	Resp	
		Mean diff	P-value
Control vs OW	40	3.725	0.005
Control vs Obese	40	3.775	0.005
OW vs Obese	40	7.5	0.000

- 1) When Normal weight children compared with overweight group, their mean difference is 3.72 (p value 0.005). It shows statistically significant difference in systolic blood pressure response post 6 MWT.
- 2) When Normal weight children compared with obese group showed mean difference of 3.77 and p value 0.005 suggesting that there is statistically significant difference between these groups. Obese has higher response compared to normal weight group.
- 3) Comparison of overweight and obese groups showed mean difference of 7.5 with p value 0.0001 showing statistically significant difference in these groups i.e. overweight to obese shows change in response to 6MWT.

**3.3 Diastolic blood pressure response**

**Figure 3: Comparison of Mean DBP imm-rest by groups**



**Table 3: Comparison of Mean DBP imm-rest by groups (by ANOVA and F- test)**

roup	No.	Age	
		Mean	SD
Control	40	0.57	2.94
Over weight	40	0.97	4.91
Obese	40	0.42	3.65
P values		0.2056	

Comparison of diastolic pressure mean difference values amongst normal weight, overweight and obese group calculated by ANOVA are  $0.57 \pm 2.9$ ,  $0.97 \pm 4.9$ , and  $0.42 \pm 3.6$  respectively, p value is 0.208 showing no statistical significant difference among groups i.e. there is no change in diastolic blood pressure response to 6 MWT in these groups.

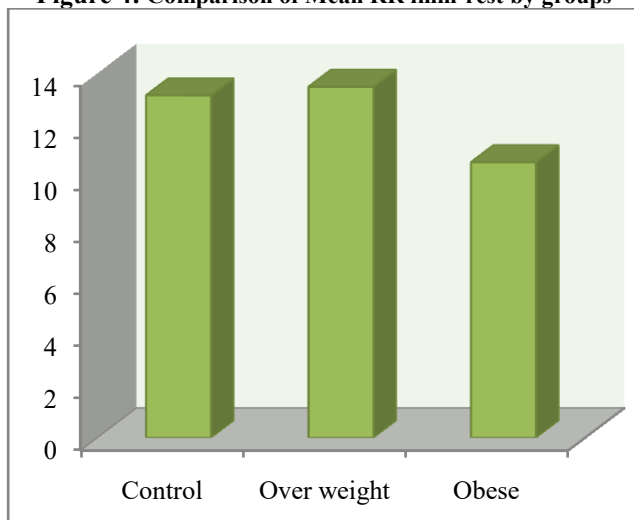
**Table 4: Comparisons of Mean DBP imm-rest (by Bonferroni multiple comparison test)**

Pairs by groups	No.	Resp	
		Mean diff	P-value
Control vs OW	40	1.55	0.240
Control vs Obese	40	1	0.771
OW vs Obese	40	0.55	1.000

- 1) Normal weight group comparison with overweight group shows mean difference of 1.55 with p value 0.240 suggesting that there is no statistically significant difference between these groups. i.e. there is no significant change in diastolic blood pressure response to 6MWT between these groups.
- 2) When Normal weight group compared with obese groups for mean difference of diastolic blood pressure, it is 1 with p value 0.0771 suggesting that there is no statistically significant difference between these groups.
- 3) Comparison of overweight and obese groups showed mean difference of 0.55 with p value 1.00 showing no statistical significant difference in these groups i.e. there is no significant change in diastolic blood pressure response to 6MWT between these groups.

**3.4 Respiratory rate response:**

**Figure 4: Comparison of Mean RR imm-rest by groups**



**Table 5: Comparison of Mean RR imm-rest by groups (by ANOVA and F- test)**

Group	No.	Age	
		Mean	SD
Control	40	13.17	3.2
Over weight	40	13.5	5.55
Obese	40	10.6	4.92
P values		0.0115	

Comparison of respiratory rate mean difference values in normal weight, overweight, and obese group calculated by ANOVA are  $13.17 \pm 3.2$ ,  $13.5 \pm 5.55$ , and  $10.6 \pm 4.92$  respectively and p value is 0.01 showing statistical significant difference among groups.

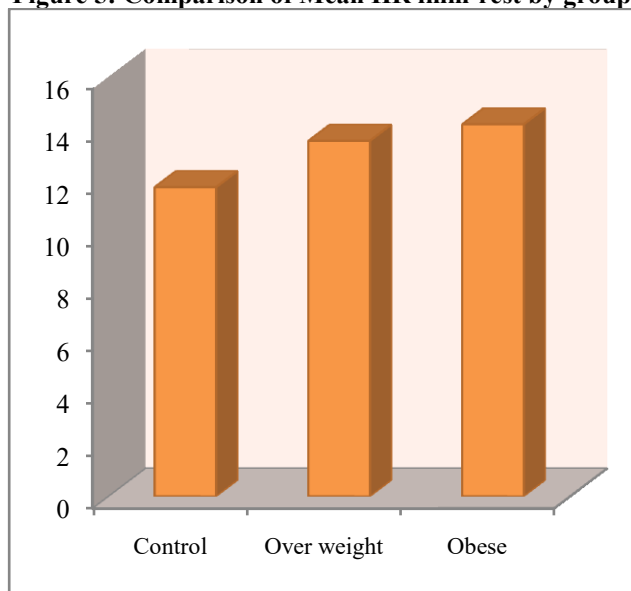
**Table 6: Comparisons of Mean RR imm-rest (by Bonferroni multiple comparison test)**

Pairs by groups	No.	Resp	
		Mean diff	P-value
Control vs OW	40	0.32	0.01
Control vs Obese	40	2.57	0.045
OW vs Obese	40	2.9	0.019

- 1) Comparison between Normal weight and overweight group shows mean difference of 0.32 with p value 0.01 which suggest that there is statistically significant difference between these groups.
- 2) When normal weight group compared with obese it is found that, the mean value is 2.57 and  $p=0.01$  suggest that there is statistically significant difference. I, e. respiratory rate response to 6MWT between these groups show statistically significant change.
- 3) Over weight group compared with obese group showed mean difference of 2.9 with p value 0.01 suggesting that there is statistically significant difference between these groups. i.e. there is statistically significant change in respiratory rate response to 6MWT between these groups.

**3.5 Heart rate response**

**Figure 5: Comparison of Mean HR imm-rest by groups**



**Table 7: Comparison of Mean HR imm-rest by groups (by ANOVA and F- test)**

Group	No.	Age	
		Mean	SD
Control	40	11.8	4.74
Over weight	40	13.57	4.24
Obese	40	14.2	4.89
P values		0.0598	

Comparison of heart rate Mean difference values amongst normal weight, overweight and obese group calculated by ANOVA are 11.8± 4.74, 13.57±4.24, and 14.2±4.8 respectively and p value is 0.05 showing statistical significant difference among groups.

**Table 8: Comparisons of Mean HR imm-rest (by Bonferroni multiple comparison test)**

Pairs by groups	No.	Resp	
		Mean diff	P-value
Control vs OW	40	1.775	0.268
Control vs Obese	40	2.4	0.067
OW vs Obese	40	0.62	1.000

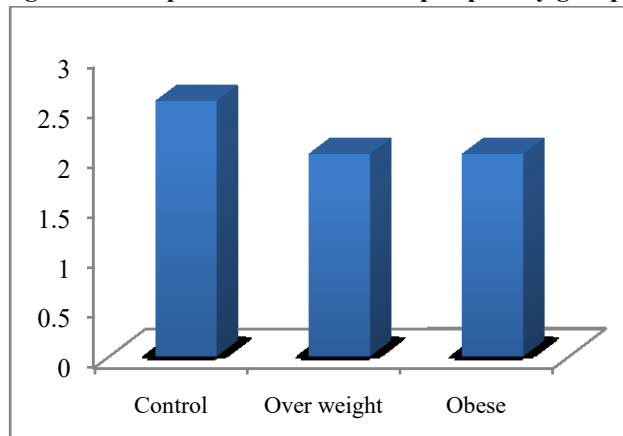
- 1) Comparison between Normal weight and overweight group shows mean difference of 1.77 with p value 0.2 showed that there is no statistically significant difference between these groups.
- 2) When normal weight group compared with obese, the mean value is found to be 2.4 and p=0.06 suggesting no statistical significant difference in these groups.
- 3) When Normal weight group compared with obese showed mean difference of 0.62 with p value 1 suggesting that there is no statistical significant difference between these groups.

**3.6 Rate of perceived exertion response**

**Table 9: Comparison of Mean RPE Pre-Post by groups (by ANOVA and F- test)**

Group	No.	Age	
		Mean	SD
Control	40	2.55	1.17
Over weight	40	2.02	1.09
Obese	40	2.02	1.09
P values		0.0585	

**Figure 6: Comparison of Mean RPE pre-post by groups**



Comparison of rate of perceived exertion mean difference values amongst normal weight, overweight and obese group calculated by ANOVA are 2.55± 1.17, 2.02±1.09, and 2.02±1.09 respectively and p value is 0.05 showing no statistical significant difference among groups.

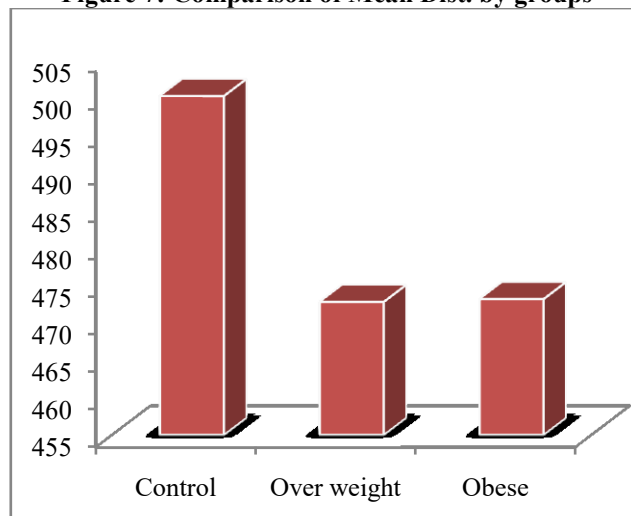
**Table 10: Comparisons of mean rpe pre-post (by Bonferroni multiple comparison test)**

Pairs by groups	No.	Resp	
		Mean diff	P-value
Control vs OW	40	0.52	0.0117
Control vs Obese	40	0.52	0.0117
OW vs Obese	40	0	1.000

- 1) Comparison between Normal weight and overweight group shows mean difference of 0.52 with p value 0.01 showed that there is statistical significant difference between these groups.
- 2) When normal weight group compared with obese, the mean value is found to be 0.52 the values are statistical significant p=0.01 i.e. there is statistical significant change in rate of perceived exertion between these groups.
- 3) Overweight group compared with obese group showed mean difference of 20 with p value 1 suggesting that there is no statistical significant difference in rate of perceived exertion between these groups.

**3.7 Distance covered:**

**Figure 7: Comparison of Mean Dist. by groups**



**Table 11: Comparison of Mean Distance Walked by groups (by ANOVA and F- test)**

Group	No.	Age	
		Mean	SD
Control	40	500.12	25.63
Over weight	40	472.7	21.61
Obese	40	473.07	23.93
P values		0.0000	

Comparison of distance covered mean values among normal weight overweight and obese group calculated by ANOVA are 500.12± 25.63, 472.7±25.61, and 473.07±23.93 respectively and p value is 0.00001 showing statistical significant difference amongst groups.

**Table 12: Comparisons of Mean dw (by Bonferroni multiple comparison test)**

Pairs by groups	No.	Resp	
		Mean diff	P-value
Control vs OW	40	27.42	0.000
Control vs Obese	40	27.05	0.000
OW vs Obese	40	0.37	1.000

- 1) Comparison between Normal weight group with overweight group shows mean difference of 27.42 with p value 0.0001 showed that there is statistical significant difference between these groups
- 2) Normal weight group compared with obese group showed mean difference of 27.05 with p value 0.0001 which suggests that there is statistical significant difference in distance covered between these groups after 6MWT.
- 3) Comparison of overweight and obese groups showed mean difference of 0.37 with p value 1.000 showing no statistical significant difference in these groups.

#### 4. Discussion

The results have showed that there was a significant increment in cardio respiratory parameters like (SBP, RR, HR, RPE, DW) after six minute walk test in obese as compared to normal weight and overweight children. Our results are in line with study conducted by Neeti Pathare *et al* on normal weight and overweight aged 5-9 years. They found that the children who were OW had higher systolic BP post-6WMT. [6] Further Renugadevi T, Supriya K Vinod conducted a study on 6 MWT effect on normal weight and overweight children. They suggested that physiological response is higher in overweight children than normal weight children, which also supports finding of our study [7].

##### 4.1 Systolic blood pressure response

Comparison of mean systolic blood pressure after the test in normal weight, overweight and obese children shows significant changes. It was observed that the mean difference of SBP is significantly higher in obese and overweight group as compared to normal weight which is supported by study of Neeti Pathare *et al* in the year 2012. And they found that children who were overweight had higher systolic BP at rest and post-6WMT.[6] Renugadevi suggested that this could be due to increase in demand of oxygen by the muscles and is fulfilled by the heart via an increase in its cardiac output and increase of blood circulation to the contracting muscles.[7]

##### 4.2 Diastolic blood pressure response

The current study reveals that there is little difference in diastolic blood pressure values which is supported by findings of study conducted by Renugadevi. They found that there was no significant change in DBP. Renugadevi and co-worker suggest that this could be owing to the pattern of lower cardiac output response to

submaximal exercise in children along with lower stroke volume leading to decrease in resistance of blood flow due to vasodilatation in working muscle leading to little diastolic blood pressure changes.[7]

##### 4.3 Respiratory rate response

In our study mean difference in respiratory rate response is found to be significantly higher in obese children than in normal and overweight children. Inter group comparison by Bonefferoni test reveals that the obese group of children have higher respiratory response to submaximal exercise (p=0.01).These findings coincides with the results from study conducted by Renugadevi T. who supported the increment of respiratory rate in normal weight and overweight children after six minute walktest.[7] Julien Aucouturior and David Thivel suggested obesity is associated with increased exertional dyspnea because it imposes additional stress to ventilation during exercise as a direct result of increased BMI requiring greater metabolic energy exchange and secondary functional impairment as a result of altered pulmonary function.[1] K Parmeshwaram, David Todd reported decrease in total respiratory compliance of obese as compared to normal individuals. This is due to decrease in lung compliance that relates to increase pulmonary blood flow. Primary reason is due to a decrease in chest wall compliance associated with accumulation of fat in and around ribs, diaphragm and the abdomen. [8]

##### 4.4 Heart rate response

The baseline increment in mean heart rate response is supported by the work of Lanmer *et al* [9]. Mcardle also reported that during exercise neural signals originating from higher cerebral regions and peripheral afferents from arterial baroreceptor, skeletal muscles results in sympathetic adjustment, consequently mean arterial blood pressure, heart rate, stroke volume and total peripheral resistance rises. [10]

##### 4.5 Rate of perceived exertion response

This finding coincides with study of Julien Aucouturior and David Thivel who suggest that, in obese work of breathing and oxygen cost has been estimated to be 70% higher and four times greater than normal. Obesity is associated with increased exertional dyspnoea. This is mainly because of the increased effort required to move their larger body mass and carry an excessive amount of body fat.[1]

##### 4.6 Distance covered response

Patrick Calders, Benedicte Deforch Sabine Verschelde, Jacques Bouckaert, Frederic Chevalier Eddy Bassle, Ann Tanghe, Patrick De Bod, Hilde Franckx also suggest that the distance covered during the 6-minute walk test and the 12-minute walk/run test is correlated with all anthropometrical data.[11] Lanmers *et al* suggested similar findings.[9] Not surprisingly several studies have shown lower distances completed during the 6MWT in obese compared to lean children.

#### 4. Conclusion

Results of this study demonstrated that six minute walk test response is higher for higher grades of BMI. The physiological variables assessed (BP, HR, RR, RPE) are significantly higher in overweight and obese children as compared to normal weights. And distance covered is significantly higher in normal weight children as compared to overweight and obese.

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