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# Effect of Six Minute Walk Test on Physiological Variables among Normal Weight and Overweight Children - A Quasi-Experimental Study

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## Abstract

Obesity is when a person is carrying too much body fat for their height and sex. Without lifestyle changes to increase the amount of physical activity done on a daily basis, or reduce the amount of calories consumed, people can become obese. Childhood obesity is also a global problem. Obesity and overweight, in addition to their related diseases, are largely preventable by early identification and treatment. The intention of this study is to compare the effects of six minute walk test on physiological variables among normal weight versus overweight children. The study was conducted in three different schools. 150 children who satisfied with inclusion criteria of the study were selected from three schools via stratified random sampling. The subjects were divided into 2 groups - Group I with normal weight children and Group II with overweight children. Each group contained 75 subjects. The six-minute walk test (6MWT) was administered to all the children. The participant's Physiological Variables (BP, HR, RR, and RPE) were recorded, before and instantaneously following the test. The findings revealed that the resting SBP, DBP, HR and RR were observed to be significantly higher (p=<0.0001) in Overweight children than Normal Weight children. There are differences observed in the physiological variables with 6MWT in overweight children when compared with normal weight children {NW: SBP – 10.67%, DBP – 0.84%, HR – 13.74%, RR – 44.30%; OW: SBP – 7.43%, DBP – 2.54%, HR – 15.67%, RR – 36.77%}. Six-minute walk distance (6MWD) was 6.16 % higher in NW than OW children. These differences were statistically significant (p value = <0.0001, NW: 509.96M, OW: 479.46m).

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## Introduction

Overweight and obesity represent a rapidly growing threat to the healthy populations in an increasing number of countries *(Park, 2005)*. Overweight and obesity augment one's risk of developing serious cardiovascular, pulmonary and metabolic diseases and disorders. Likewise, individuals who are underweight may have a higher risk than others of cardiac, musculoskeletal, and reproductive disorders. Thus healthy weight is a key to a healthy and longer life *Heyward, (2006).* The World Health Organisation (WHO) described obesity as one of today's most abandoned public health problems, affecting every region of the globe (*Pednekar et al, 2008)*. Globally, the prevalence of overweight and obesity has reached epidemic proportions. The World Health Organisation reported that there are more than 1 billion overweight adults; at least 300 million of them are obese *(Puska et al, 2003)*. The incidence of overweight and obesity in children and adults varies among countries, depending in part on the nation's level of industrialisation *Heyward, (2006).* Childhood obesity is also a global problem. Irrespective of age, sex or way of life; childhood obesity affects both developed and developing countries of all socio-economic groups. It has been estimated that worldwide over 22 million children are obese under the age of 5 and 1 in 10 children is overweight (*Deckelbaum and Williams, 2001; Kosti & Panagiotakos 2006)*. Indian data concerning current trends in childhood obesity are rising. Prevalence of overweight and obesity is increasing in children and adolescents in India as reflected in various studies conducted in states of Punjab *(Mohan et al, 2004; Chattwal et al, 2004)*, Delhi *(Chatterjee, 2002; Marwaha et al, 2006)*, in South India *(Ramachandran et al, 2002; Raj et al, 2007) and others (Bharati, 2008; Raj, 2009; Kotian, 2010; Laxmaiah et al, 2010; Gupta et al, 2011; Stigler et al, 2011)*.

Overweight and obese children are apt to stay obese into adulthood and further possible to develop non-communicable diseases like diabetes and cardiovascular diseases at a younger age. Overweight and obesity and their related diseases are basically preventable by early identification and treatment. There is an increased demand for clinical assessment tools to assess exercise capacity in children who are overweight. Six minute walk test is an uncomplicated, useful, reliable and valid measure to estimate the submaximal exercise capacity in healthy children and children with chronic disease or cardio-pulmonary disease. In addition to the 6MWD, the test provides valuable information on BP, HR, $SaO_2$ levels. There will be a mild rise in cardiac parameters (PR, RR, and BP) after 6MWT due to the physiologic response of the human body *(Rajak et al, 2012).* Studies show that prevalence of sustained hypertension has been found in overweight and obese children *(Deckelbaum and Williams, 2001;*

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*Raj et al, 2007).* While literature exists on 6MWT in children, the researches' are unclear to state whether there is difference in physiological variables among normal weight and overweight children or not. This study is therefore aimed to investigate compare the physiological variables with 6MWT in overweight children and normal weight children.

## Material and Methods

A Quasi experimental approach with Pre test – post test non equivalent group design was adopted for the study. The samples were selected from the selected three schools around Tirunelveli via stratified random sampling. The study was carried out from November 2013 to February 2014. The study included the children in the age group between 8-11 years, both boys and girls, who were normal weight group with BMI < 85$^{th}$ percentile and the subjects who were overweight group with BMI 85$^{th}$ to < 95$^{th}$ percentile. The sample consisted of 150 children, 75 each in Normal weight children and Overweight children groups. The tools used for the data collection were Digital Weighing Machine, Scale with Measuring Bar, Online CDC'S BMI Percentile Calculator for Children and Teen, Mercury Sphygmomanometer, Stethoscope, Children's Pictorial OMNI Scale for RPE, and Stop watch. The tools were found valid and reliable. The six-minute walk test (6MWT) was applied to all the children. The participant's Physiological Variables (BP, HR, RR, and RPE) were recorded on a day before and immediately following the six-minute walk test. There were 4 dropouts in the sample out of 98 in Normal weight group, 2 dropouts in the samples out of 78 in Overweight group. Finally 2 groups were equalised by randomisation with each group containining 75 children. Before including the subject a clear explanation was given to every individual participant, oral and written consent was obtained from the individual's parents.

## Result and Discussion

The result of the data were analysed using the descriptive statistics, the analysis was done using Graph Pad Prism 6 for Window Version 6.04. Baseline characteristics of the study sample are mentioned in table 1. Mean age of normal weight group is 9.16 years and overweight group is 9.19 years. Mean BMI of normal weight group is 33.95% and overweight group is 89.64%.

**Table 1: Baseline Characteristics of the Study Sample**

| Characteristics | Normal Weight | Overweight |
|---|---|---|
| N | 75 | 75 |
| Age(yrs) Mean±SD | 9.16 ± 0.79 | 9.19 ± 0.91 |
| Male(N):Female(N) | 41:34 | 37:38 |
| Height(cm) Mean± SD | 128.57±5.53 | 130.17 ± 6.09 |
| Weight(kg) Mean± SD | 26.29 ± 3.94 | 34.84 ± 4.77 |
| BMI Mean±SD | 33.95±23.31 | 89.64±3.02 |

Comparison of the pre-test (at rest) values of physiological variables (BP, HR, RR, and RPE) among NW and OW groups are mentioned in table 2. The results from the study show that the pre-test (at rest) systolic blood pressure (SBP) was


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observed to be significantly higher in Overweight children than Normal weight children. This result coincides with the results from the study conducted in New York on Normal weight & Overweight children aged 5-9 years *(Pathare et al, 2012).* Mean Pre-test diastolic blood pressure (DBP), heart rate (HR) and respiratory rate (RR) were also significantly higher in Overweight children. These results agree with the results of another study that also reported higher resting heart rate (HR) in overweight children (mean age 12.9 years) than normal weight children *(Geiger et al, 2011).* All children scored 0 in their pre-test rate of perceived exertion (RPE) in pictorial OMNI scale. All children were studied during morning session to avoid variations.

**Table 2 Comparison of the Resting Values of Physiological Variables (BP, HR, RR & RPE) Among NW (Normal Weight) and OW (Overwight) Groups**

| Physiological Variables | Group | Mean ± SEM | Difference Between Means | T | P |
|---|---|---|---|---|---|
| SBP | NW | 103.9 ± 0.7875 | 10.08 ± 1.105 | 9.119 | <0.0001**** |
| | OW | 114 ±0.7758 | | | |
| DBP | NW | 70.51 ± 0.4988 | 6.707 ± 0.7720 | 8.688 | <0.0001**** |
| | OW | 77.21 ± 0.5892 | | | |
| HR | NW | 71.61 ± 0.9956 | 4.907 ± 1.204 | 4.074 | <0.0001**** |
| | OW | 76.52 ± 0.6777 | | | |
| RR | NW | 23.05 ± 0.3719 | 5.253 ± 0.8510 | 6.173 | <0.0001**** |
| | OW | 28.31 ± 0.7655 | | | |

**** *Extremely significant*

Among NW children group 5 female and 2 male children were under pre-hypertension category, another 68 children were under normal Blood Pressure category. In the Overweight children group 11 children (8 female, 3 male) were under pre-hypertension category, 34 children (20 female, 14 male) under stage-I hypertension category, 1 male child was under stage-II hypertension category. Hypertension may be due to the increased sympathetic activity. These differences noted in Blood Pressure are vital because hypertension in childhood has been shown to be related with hypertension later in life. Analysis of the comparison of the effect of 6MWT on physiological variables (BP, HR, RR, and RPE) among NW and OW groups are presented in table 3. The results established that there was a significant increase in the physiological variables used (SBP, DBP, HR, RR & RPE) after


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six-minute walk test (6MWT). These results concur with the results from the study conducted in Loni by *Rajak et al, (2012)* on healthy children aged 5-6 years who also reported mild increases in cardiac parameters following six-minute walk test (6MWT). This is due to an 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. As this process advances with increasing physical exertion, the workload on vital organs increases. Thus this increased work causes a rise in basal parameters. The difference between the pre-test and post-test systolic blood pressure (SBP) was higher in NW children, but the difference between the pre-test and post-test diastolic blood pressure (DBP), heart rate (HR) were higher in overweight children.

**Table 3: Comparison of the Effect of 6MWT on Physiological Variables (BP, HR, RR & RPE) Among NW and OW Groups**

| Variable | Group | | Mean ± SD | Mean Of Diff | Diff B/W Means | T | P |
|---|---|---|---|---|---|---|---|
| SBP | NW | Pre-test | 103.92 ± 6.82 | 11.72 | 2.213 ± 0.6548 | 3.380 | 0.0009*** |
| | | Post-test | 115.64 ± 8.27 | | | | |
| | OW | Pre-test | 114 ± 6.72 | 8.80 | | | |
| | | Post-test | 122.8 ± 7.24 | | | | |
| DBP | NW | Pre-test | 70.5 ± 4.32 | 0.6 | 1.253 ± 0.4951 | 2.531 | 0.0124* |
| | | Post-test | 71.1 ± 4.65 | | | | |
| | OW | Pre-test | 77.21 ± 5.1 | 1.987 | | | |
| | | Post-test | 79.2 ± 7.56 | | | | |
| HR | NW | Pre-test | 71.61 ± 8.62 | 10.57 | 2.387 ± 1.01 | 2.362 | 0.0195* |
| | | Post-test | 82.18 ± 7.5 | | | | |
| | OW | Pre-test | 76.52 ± 5.87 | 13.01 | | | |
| | | Post-test | 89.53 ± 6.66 | | | | |
| RR | NW | Pre-test | 23.05 ± 3.22 | 13.12 | -0.3733 ± 0.6418 | 0.5817 | 0.0124$^{NS}$ |
| | | Post-test | 36.17 ± 4.5 | | | | |


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| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | **OW** | **Pre-test** | **28.3 ± 6.62** | **12.75** | | | |
| | | **Post-test** | **41.05 ± 5.62** | | | | |
| **RPE** | **NW** | **Pre-test** | **0** | **3.027** | **-0.1733 ± 0.2259** | **0.7671** | **0.4442$^{NS}$** |
| | | **Post-test** | **3.03 ± 1.42** | | | | |
| | **OW** | **Pre-test** | **0** | **2.853** | | | |
| | | ***Post-test*** | ***2.9 ± 1.3*** | | | | |

*** *Extremely significant, * Significant, NS – Not Significant*

The main finding of this study was the 6MWD of NW children (509.96m) was higher than OW children (479.46m). The normal weight children's six-minute walk distance (6MWD) value corresponds with the normal values for children of 4-11 years reported in children from UK. *Klepper and Muir (2011)* recommend that reference values of the 6MWT performance developed for children residing in one country may not be appropriate to those in other countries. Length of corridor, height, choice of footwear, motivation, attitude towards the activity may also affect these parameters. Although the *American Thoracic Society guidelines (2002)* recommend 30m length straight corridor, a study conducted by *Weiss (2000)* establish that the difference in six-minute walk distance (6MWD) among straight tracks range from 15-50m was not significant. The pathway used in this present study measured 20m. The test was performed by each student individually, so the differences should not have favoured either group.

**Table 4: Comparison of 6MWD among NW and OW Groups**

| S.No | Group | Mean ± SD | T | P |
|---|---|---|---|---|
| **1.** | **NW** | **509.96 ± 38.45** | **4.852** | **<0.0001****** |
| **2.** | **OW** | **479.46 ± 38.52** | | |

**** Extremely significant

*Conclusion:* The study concludes that the resting SBP, DBP, HR, RR are higher in overweight children than normal weight children. There are differences in physiological variables with 6MWT in overweight children when compared with normal weight children {NW: SBP – 10.67%, DBP – 0.84%, HR – 13.74%, RR – 44.30%; OW: SBP – 7.43%, DBP – 2.54%, HR – 15.67%, RR – 36.77%}. The differences in physiological variables (DBP, HR) with 6MWT are higher in OW children than NW children. 6MWD is 6.16 % higher in NW than OW children. These differences are statistically significant (NW: 509.96M, OW: 479.46m). Since hypertension in childhood has been shown to be linked with hypertension later in life, the differences noted in BP are the vital one. This study provides a new data and


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reference values, and adds to a limited research in effect of 6MWT on physiological variable in Indian children particularly those in south India.

*Limitations:* This study was conducted in school-setting and the mental stress might influence the difference in parameters. This study did not examine the relationship between physical activity and six-minute walk test performance, between height and 6MWD, between BMI and academic performance.

*Recommendations:* This study may be conducted in urban children also and can compare the rural and urban children's 6MWT performance. The children may be studied with barefoot to avoid variations from the choice of footwear. The study may be conducted apart from school setting, to avoid the various constraints in school setting. Underweight children were also identified during the selection of sample for this study. In future, the study may be conducted in underweight children to compare the variations in cardio-respiratory parameters with normal weight children.

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**Conflict of Interest None Declared**