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Differences in Health Related Physical Activity and Fitness of Elementary School Children

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Abstract. Research supports a correlation between physical activity level and obesity; however, there is no definitive method for measuring physical activity level in children. This study will determine if test results of the Progressive Aerobic Cardiovascular Endurance Run (PACER) and the results of average activity levels recorded in the form of activity logs, including pedometer data, are an effective means of determining an individual's risk of developing childhood obesity as measured using Body Mass Index (BMI). Seventy-six participants (n=37, boys n=39) in grades 3, 4, and 5 took part in a study comparing BMI to PACER and number of steps using a pedometer. Data were computed using the Pearson product moment correlation relating average steps in time to BMI, and PACER scores to BMI to determine if a significant relationship existed. The results indicated the relationships between BMI and PACER, and BMI and pedometer steps were low, suggesting that a portion of this total variance may be explained by other measures.

1. Introduction

Childhood obesity rates in the United States have soared in the past three decades, indicating an expected future increase in health care costs and demand for physical therapy to address predicted health conditions and their cause. Research supports a correlation between physical activity level and obesity. Literature related to use of pedometers to predict activity levels is limited to their use in adults. Previous research has proven use of pedometers in predicting activity levels in adults to be significant (Tudor-Locke 2005). One pedometer study used children as subjects and indicated a high correlation to activity (Beets 2005). Studies related to predicted activity levels found a weak inverse relationship between subject activity level and BMI and also between pedometer-determined activity levels and the subject's percentage overweight (Tudor-Locke 2004). PACER was used to determine fitness levels of subjects as supported in previous research (van Mechelen 1986). Research focused specifically on children's BMI and correlating it to either the PACER or average steps in time was not to be found. This study will determine if test results of the PACER and the results of average activity levels recorded in the form of activity logs are an effective means of determining the individual's risk of developing childhood obesity. Based on these findings we hope to find a method that will accurately assess which children are obese or at risk of becoming obese in the hope that a prescription can be made to the individual to reduce their risk of obesity.

2. Experiment, Results, Discussion

Participants consisted of 37 girls and 39 boys enrolled in grades 3, 4, and 5 at a rural Midwest school district. Height and weight were recorded for each student, and were converted to BMI (kg/m^2). The PACER protocol outlined by the FITNESS-GRAM Test User's Manual (Welk et al, 2000) was used to assess cardiovascular fitness. The Walk4Life Duo pedometer was used to measure both number of steps and steps in time.

Anthropometric measurements were taken and the PACER was administered during regular scheduled physical education classes. To monitor activity levels, the students were instructed to wear the pedometers for an eight-day period. The children recorded their pedometer step counts at the beginning of each day for seven 24 hour periods.

Significance was determined for BMI, PACER, and pedometer data variables. Significant differences for the variables were found about a .05 alpha level. For significant variables, the coefficient of determination (r^2) was calculated via the interclass correlation coefficient (ICC).

Upon examination of the data, no significant changes ($p < .05$) were seen relating BMI to average steps per minute during the week or weekend, BMI to pedometer steps per day, or BMI to pedometer step time for either gender. However, significant changes, ($p > .05$), were recorded for three constructs for girls: BMI to PACER practice test, BMI to PACER trial 1, and BMI to pedometer overall average steps per minute. For each of these variables the coefficient of determination was calculated to determine the magnitude of the effect (r^2). For BMI to practice PACER test r^2 was .3859, for BMI to PACER trial 1 r^2 was .3788 and for BMI to pedometer overall steps per minute r was .3924. Each of these values was determined to be low, demonstrating an effect that accounted for less than 40% of the observed significant change. Similar data was found for the boys of the study. Significant changes were recorded for two constructs, BMI to PACER practice test, and BMI to PACER trial 1. Coefficients of determination (r^2) were calculated for both constructs. For BMI to PACER practice test, r^2 was found to be .3176. For BMI to PACER trial 1 r^2 was .3417. Similar to the results seen with the girls, the boys' coefficients of determination were found to be low, accounting for less than 35% of the observed significant change.

One interesting finding was the poor correlation between BMI and step counts. One proposed explanation was that the pedometer does not take into account the intensity of the activity that is occurring. Another reason our data did not show a significant correlation between PACER and BMI might have been a lack of grouping in our data when comparing BMI to the PACER. We did not compare how children with high BMI are performed on the PACER compared to those of low BMI. A study conducted by GP Nassis and LS Sidossis also compared BMI to shuttle run scores for children in two groups: overweight/obese and nonoverweight. Comparing BMI to fitness test, significant inverse correlations were seen between fitness levels and BMI for both genders specifically related to their grouping (GP Nassis and LS Sidossis 2005).

A concept that our study needs to address concerning the correlations of pedometer and PACER scores to BMI, is the large confidence interval demonstrated for r for both constructs. Due to this large interval it is difficult to conclude significant relationships, and may be attributed to poor homogeneity of our variance. We recommend further data collection on a larger sample to provide a more complete comparison of the true relationships of the constructs of interest.

Another factor that influences both the correlations of pedometer and PACER to BMI is the misunderstanding of what the BMI component represents. In some cases the increase in body weight can be attributed to increased muscle mass, that can be associated with individuals that are both fit and highly active. Based on findings in a study by Duncan JS, Scholfield G, Duncan EK (2006), we assume that the participants that had high BMI's associated with their increased muscle mass had higher scores for the PACER and higher step counts on the pedometer step components. The participants with high BMI's but high body fat compositions commonly seen in sedentary individuals were expected to have lower scores on the PACER and the components of interest for the pedometer. When the two different trends combined, the overall effect was lost, resulting in the low correlations for both constructs.

3. Conclusion

The intention of our study was to examine the relationships of BMI to field measured cardiovascular fitness and overall physical activity level as measured by 7 day pedometer logs. After examining our data we found that despite significant results for both genders for BMI to components of the PACER and the pedometer, the overall effect for both was very small.

4. Acknowledgements

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[3]Tudor-Locke 2004

[4]van Mechelen

[5]Welk

[6]GP Nassis and LS Sidossis Central and total adiposity are lower in overweight and obese children with high cardiorespiratory fitness *European Journal of Clinical Nutrition* (2005) 59, 137–141. doi:10.1038/sj.ejcn.1602061

[7]Duncan JS, Schofield G, Duncan EK Pedometer-determined physical activity and body composition in New Zealand children pedometer *Med Sci Sports Exerc.* 2006 Aug;38(8):1402-