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REP as a Predictor of Weight Categories Determined by Anthropometric Measurements

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RPE AS A PREDICTOR OF WEIGHT CATEGORIES DETERMINED BY ANTHROPOMETRIC MEASUREMENTS

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ABSTRACT

Obesity has become one of the leading public health issues in the world today. An aspect of this issue that must be addressed in order for it to not persist as a problem in the future is the issue of childhood obesity. One of the most common screening methods to determine if a child is classified as overweight or obese is to utilize anthropometric measurements like body mass index, and waist-to-height ratios. Past studies have shown that children who are categorized as overweight or obese can struggle with physical activity and typically have lower fitness levels as their anthropometric measurements increase. Ratings of perceived exertion have been shown to be able to be used to estimate aerobic fitness via vo2 max and anaerobic fitness by estimating 1 rep maximums. PURPOSE: To determine if RPE ratings of children would have a significant relationship with their weight categories, as classified by their BMI percentiles or waist-to-height ratios. METHODS: Data was obtained from a group of 33 subjects, ages four to seventeen, from the Proyecto Raices program. RPE ratings were recorded using an OMNI step scale at two different sites. BMI percentiles and weight categories were found after recording the subjects' heights and weights, calculating BMI, and then using the CDC data tables of BMI per birth date in months and sex. Waist-to-height ratios and weight categories were determined by first calculating the ratios after recording the participant's heights and waist circumferences, and the classifying them using the criteria of a previous study. RESULTS: No significant relationships were found between the RPE ratings of the participants and their anthropometric measurements of weight classifications, with the exception of the female participants having a significant relationship between their RPE ratings at site 2 and their waist-to-height ratios. CONCLUSION: It may be possible to further this research with more strict exercise protocols and a larger sample size, but the accuracy and practicality of anthropometric measurements alone should be considered as a first choice to screen children for being overweight or obese.

Chapter I:

Introduction

Childhood obesity has become a growing epidemic in the United States and has shown no signs of slowing down. According to a study conducted on obesity trends from 2009-2010, 31.8% of all children aged 2-19 are considered overweight, and 16.8% of children from this age group are considered obese (Ogden, Carroll, Kit, & Flegal, 2012). One of the easiest and most accurate ways to assess if a child is considered overweight or obese is to measure the child's body mass index (BMI) (Roche, Siervogel, Chumela, & Webb, 1981). The BMI is calculated by dividing the child's weight in kilograms by his or her height in meters squared, and has been shown to be a reliable estimate of a child's total body fat. Because a high BMI in children has also been shown to be a predictor of higher BMI as an adult (Guo & Chumeea, 1999), it is imperative to identify those children who are currently, or at risk of becoming, overweight or obese in order to intervene and improve the child's body composition prior to adulthood. Because children's bodies are changing so rapidly, the BMI of a child is compared by percentile to other children of the same age and sex. The Center for Disease Control and Prevention (CDC) has outlined what the different percentiles mean. Children under the 5th percentile are considered underweight, children from the 5th to 84th percentile are considered normal or healthy weight, while children from the 85th to 94th percentile are considered overweight, and children from the 95th percentile and higher are considered obese (CDC, 2015).

In addition to BMI, another body measurement that has been shown to be a valid predictor of disease risk in children is waist circumference and waist-to-height ratios (Savva et al., 2000). Waist circumference looks to measure adipose tissue specifically around the abdominal area of the body. This visceral abdominal adipose tissue is often considered far more dangerous than other subcutaneous fat and is generally associated with higher disease risk and metabolic complications of obesity (Kissebah, Vydelingum, Murray, Evans, Kalkhoff, & Adams, 1982). A way to account for the differences in size of children's waist circumferences based on their age and development is to measure the waist-to-height ratio. A child's waist-to-height ratio is calculated by dividing the waist circumference in centimeters by the child's height in centimeters.

Rate of perceived exertion (RPE) is a psycho-physiological scale which requires the mind and body to rate one's feelings of effort, strain, discomfort, and or fatigue experienced during aerobic or resistance training (Utter, Kang, & Robertson, 2015). When working with children, a validated scale to track perceived exertion is the Children's OMNI-step scale of perceived exertion (Robertson et al., 2005). In the past, the rate of perceived exertion or RPE has been validated as a way to describe how much effort a person is accurately exerting and, in exercise testing, as a measure for when to stop certain tests.

Previous studies have shown that individuals with higher fitness levels typically have BMI measurements and percentiles that are lower and closer to the healthy range as compared to people with lower fitness levels (Srivastava, S., Dhar, U., & Malhotra, V., 2013). While it would be expected that RPE ratings would be higher in people with a lower level of fitness, it has not been explored whether or not the RPE ratings of an activity could be a predictor of anthropometric measurements or the weight status categories that these measurements define, with higher RPE ratings being associated with higher percentiles of these measurements and less healthy weight statuses. This study's goal was to identify if RPE scores could be used to predict or identify children who were considered overweight or obese, and therefore who are at a greater risk of metabolic complications as identified by their BMI percentiles and waist-to-height measurements.

Chapter II:

Literature Review

A leading public health issue that greatly affects the world today is the ever increasing rate of obesity and obesity related health issues. One study indicated that 34.9% of adults over the age of 20 are considered obese (Ogden, Carroll, Kit, & Flegal, 2014). These statistics are troubling due to the large extent of health problems and medical costs associated with obesity. Obesity has been found to have stronger associations with the occurrence of chronic medical conditions, reduced health-related quality of life, and increased care and medication spending than other public health threats including smoking and chronic alcohol consumption (Sturm, 2002). With so many problems associated with obesity and with so much attention that has been focused on the topic of obesity in the last few years, there has not been a significant change in obesity rates among any age group in the United States from 2003 to 2012 (Ogden et al., 2014).

Childhood obesity has also become a very concerning public health issue in the United States and has shown no signs of declining in the last 15 years. According to a study conducted on obesity trends from 2009-2010, 31.8% of all children aged 2-19 are considered overweight, and 16.8% of children in this age group are considered obese (Ogden et al., 2012). Childhood obesity comes with many of the same health risks and comorbidities that are associated with the disease in adults. These comorbidities include elevated blood pressure, dyslipidemia, and a higher prevalence of factors associated with insulin resistance and Type 2 Diabetes. The high numbers of childhood obesity trends can also predict what the next generation of adults might look like. One study found that there was a significant correlation with body mass index at 9 years old to body mass index at 50 years old (Wright, Parker, Lamont, & Craft, 2001). In addition to an increased risk of obesity in adulthood, morbidity and mortality in the adult population is increased in individuals who were overweight during childhood, even if they lose the extra weight during adulthood (Deckelbaum & Williams, 2001). The increased risk of obesity and comorbidities in adults that were obese as children is an important reason to identify and monitor obesity in children early on. This is in order to make sure that necessary lifestyle changes are made in an effort to have a healthier adult life later on.

Body mass index (BMI) is a measurement, found by dividing a person's weight in kilograms by the square of their height in meters. This measure can be used to screen people by placing them in weight categories that may reflect their risk of weight-related health problems. Although BMI can be considered an inaccurate way to estimate health risks in some athletic populations, it has been shown to be an accurate predictor of health risks in the average general population (Dorn, Schisterman, Winkelstein, & Trevisan, 1997). A higher BMI has been associated with an increased risk of death from many causes including, cardiovascular disease and cancer. These risks are increased among both males and females of all ages as the BMI ranges increase to moderate and severe levels of obesity (Calle, Thun, & Petrelli, 2000). BMI has also been validated in children as an accurate method of determining if a child is considered overweight or obese, and therefore at a higher risk of health problems (Roche et al., 2012). BMI measurements in children have specifically been used as markers to track if high BMI measurements in children translate to diseases and health risks as adults. One study showed that of the overweight children (BMI ≥95th percentile) that were measured, 77% of them remained obese (BMI ≥ 30) and at a greater risk for health issues. These risks included adverse levels of lipids, insulin resistance, and high blood pressures (Freedman, Khan, Dietz, Srinivasan, & Berenson, 2001).

The waist-to-height ratio is the measurement of an individual's waist divided by height using the same unit. The use of waist-to-height ratios in addition to BMI measurements is important because while BMI is generally a good estimate of a person's risk of health problems associated with excess fat, the distribution areas of this excess fat can be just as important to track. This is most important when tracking excess fat in the upper body around the abdomen. It has been shown that individuals with excess upper body fat in the abdominal areas have significantly higher glucose readings, insulin intolerance, fasting plasma triglycerides, and other metabolic complications in comparison to those with excess fat predominantly in their lower bodies (Kissebah et al., 1982). Since waist-to-height ratio measures this specific region of the body and compares it to the height of the individual, telling results can be found on individuals who may have a healthy BMI but an unhealthy waist-to-height ratio. One study found that using BMI as a screening tool alone for health risks, missed 35% of men and 14% of women who would be considered overweight by waist-to-height ratio (Ashwell & Gibson, 2009).

When assessing children for health risks, waist-to-height ratios specifically measure the body where the most dangerous type of excess fat is distributed. It can therefore be a better predictor of excess body fat than BMI or waist circumference alone (Brambilla, Bedogni, Heo, & Pietrobelli, 2013). The use of waist-to-height ratio to assess children is specifically useful because unlike BMI which must take into account the child's exact age and sex, waist-to-height ratio does not. An unfortunate trend in children's waist-to-height ratios has been shown, just like obesity, to be dramatically increasing over the last two decades. One study estimated that abdominal obesity as defined by waist-to-height ratio has increased from 1988 to 2004 in ages 2 to 19 by 65.4% in boys and by 69.4% in girls (Li, Ford, Mokdad, & Cook, 2006).

Rate of perceived exertion (RPE) is a psycho-physiological scale which requires the mind and body to rate one's feelings of effort, strain, discomfort, and or fatigue experienced during aerobic or resistance training (Utter et al., 2015). In past studies, RPE ratings have been a valid predictor of aerobic fitness by predicting VO_2 max levels (Coquart, Garcin, Parfitt, Tourny-Chollet, & Eston, 2014) as well as of anaerobic fitness by predicting one rep maximums (Robertson et al., 2008). In the past anthropometric measurements have also been shown to have a relationship with fitness levels. A high BMI and obesity rating have been shown to be limiting factors for children performing physical activities. One study found that overweight and obesity as classified by BMI scores were limiting factors for fitness performance (Tokmakidis, Kasambalis, & Christodoulos, 2006). In addition to this, waist circumference and waist-to-height ratio have also been shown to have an inverse relationship to cardio-respiratory fitness in children (Ortega et al., 2007)

Although RPE ratings have been shown to be able to predict certain aspects of fitness, and anthropometric measurements have shown to have an inverse relationship to fitness levels and performance, there is no research that has looked at whether or not RPE ratings could have a significant relationship with the weight categories that are classified by anthropometric measurements.

Chapter III:

Methods

This study tested thirty-three children from the Proyecto Raices program (9 boys and 24 girls) ranging in age from four to seventeen years old. All of the children were Hispanic and from the greater Akron, Ohio area. The study was conducted under the supervision of Dr.Mary MacCracken, the Executive Director of the P.A.C.E (Physical Activity & Character Education) program, during two regularly scheduled physical activity sessions (i.e., February 6 and 20, 2016). The first session took place in the basement of St. Matthew's parish office building (designated as site 1), and the second session took place in the St. Matthew's school gymnasium (designated as site 2).

Anthropometric measurements of the children’s height, weight, and waist circumference were all recorded without shoes and during the first session at site 1 by either a graduate assistant student or by an undergraduate student working on the project. Weight was measured in kilograms to the nearest tenth of a kilogram. Height and waist circumference were measured to the nearest tenth of a centimeter. The heights were recorded using a stadiometer with a fixed vertical backboard and an adjustable headpiece, and the waist circumferences were measured using a flexible measuring tape. All of the children's measurements and individual information including birthdays were recorded onto the data sheets created by Dr. MacCracken and Nicholas Mendola.

The children's BMI scores were calculated using the children's weight (kg)/ $\mathrm{Height}^2(\mathrm{m}^2)$. The children's BMI's were placed into the correct percentiles and weight categories as outlined by the CDC data tables of BMI per birth date in months and sex (CDC, 2001). The percentile in which the waist circumference of each child was placed was determined by the Center for Disease Control and Prevention's Anthropometric Reference Data for Children and Adults: United States 2007-2010 (Fryer, Gu, & Ogden, 2012).

The waist-to-height ratios of the children were calculated as waist circumference (cm)/height (cm). The children were then placed into one of three weight categories as defined by a previous study (Khoury, Manlhiot, & Mccrindle, 2013). The first defined category was classified as children with a waist-to-height ratio of less than 0.5 and considered to be healthy similar to the level of health risk as a child with a BMI lower than the 85th percentile. The second defined category was classified as children whose waist-to-height ratio was within a range of 0.5 to less than 0.6. This ratio range had a similar level of risk factors as that of children with a BMI range from the 85th percentile to less than the 95th percentile and was considered overweight. The third defined category was for waist-to-height ratios of 0.6 and greater and had a similar level of risk factor as a BMI at the 95th percentile and greater, and was classified as obese.

The RPE scores of each child was recorded at both site 1 and site 2. Each child was asked individually after having the OMNI step scale briefly explained to help with comprehension of what was being asked of them. The children recorded their RPE ratings by circling the place on the OMNI step scale (Figure 1.) they thought best represented their exertion level. Originally both sessions were to be held at site 2; however, because of a last minute change in location the first session was moved to site 1 where there was much less room for the children to perform physical activity. While some physical activity was performed in small amounts by some of the children, many of the children were sitting at tables coloring or performing other less physically strenuous activities. At the second session at site 2, there was much more space available and was a much more physical activity friendly environment than at site 1. Site 2 was a large gymnasium which had basketball hoops and many other different activities available including soccer balls, basketballs, footballs, jump ropes, and music to which the children were dancing.

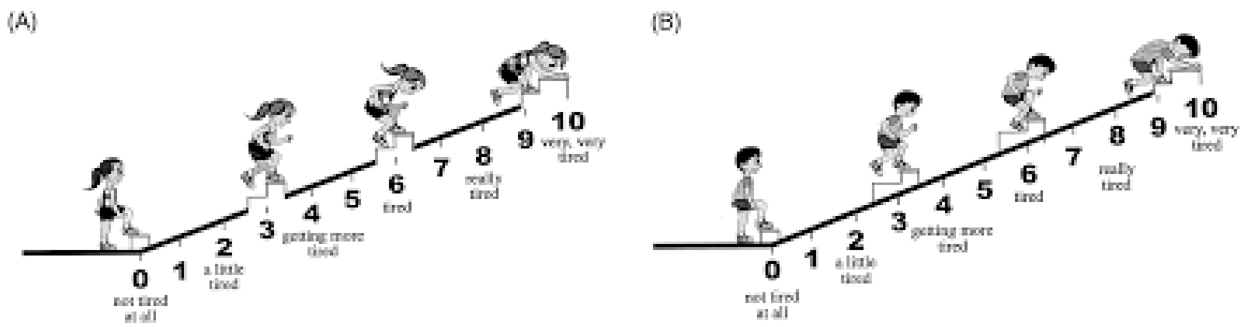

*Figure 1.*OMNI RPE Step Scale

All of the data was analyzed by the regression function in Microsoft Excel. Both site 1 and site 2's RPE ratings were compared to the BMI and waist-to-height ratios of the corresponding child. The statistical results were then interpreted for significance based on the results of the regression function providing both an r-value to describe the relationship between the site RPE ratings and the anthropometric values (BMI and waist-to-height ratio). The data was compared for the entire group and then significance was set at $p < 0.05$

Chapter IV:

Results:

In order to interpret the data to determine any significant relationship between the RPE ratings and either of the anthropometric measurements, the RPE ratings from each site were run through a statistical regression function in Microsoft Excel. The regression analysis of site 1 and site 2's RPE ratings as compared to the BMI percentiles of all of the children showed no statistical significance. Site 1 had a *p*-value = 0.406 and an *r*-value = 0.197 while site 2 had a *p*-value = 0.446 and *r*-value = 0.222. Likewise the regression analysis of both site's RPE ratings in relation to the waist-to-height ratios of all of the children also showed no statistical significance with both *p*-values > 0.05. Site 1had a *p*-value = 0.894 and an *r*-value = 0.033, while site 2 had a *p*-value = 0.08, and *r*-value = 0.5. The analysis of the male group's RPE ratings in relationship to their BMI percentiles and waist-to-height ratios both also showed no significance at either site. At site 1 the male group had a *p*-value = 0.295 and *r*-value = 0.*59* for BMI and a *p*-value= 0.487 and *r*-value = 0.415 for waist-to-height ratio. At site 2 the male the male group had a *p*-value= 0.39 and *r*-value = 0.5 for BMI and a *p*-value = 0.177 and *r*-value = 0.712 for waist-to-height ratio. The analysis of the female group's RPE ratings for both sites in comparison to BMI percentiles as well as the RPE ratings for site 1 in comparison to their waist-to-height ratios were shown to not be significant with all of them having *p* > 0.05. At site 1 the female group had a *p*-value = 0.577 and *r*-value = 0.156 for BMI and a *p*-value = 0.679 and *r*-value = 0.122 for waist-to-height ratio. At site 2 the female groups *p*-value = 0.602 and *r*-value = 0.202. The exception that did show significance was in the analysis of the female group's RPE ratings at site 2 compared to their waist-to-height ratios which had a *p*-value of 0.045 and *r*-value of 0.718, however with such low sample sizes it is very difficult to determine actual significance.

The mean RPE ratings for both sites were also found and compared after being sorted into one of the three health status categories previously defined and based on the children's BMI percentiles or waist-to-height ratios. The mean RPE ratings for both sites and categorized by BMI percentile health status are shown in table 1, and the mean RPE ratings for both sites and categorized by waist-to-height ratios are shown in table 2. The mean RPE ratings of the children who attended both sessions were compared to determine if there were a statistically significant difference between the mean RPE ratings at each site. These results are shown in tables 3 and 4.

When looking at boys and girls together, there seemed to be no significance between the RPE ratings and their anthropometric measurements. When examining the mean RPE ratings for each site for all participants categorized by either BMI percentile or waist-to-height ratios, the findings did not follow expected patterns. The results of this study seem to indicate that the original hypothesis that RPE ratings would be able to be used as a predictor of anthropometric measurements to classify both boys and girls who are in an unhealthy weight status, is not valid. However this study found one significant relationship between the girls' RPE ratings at Site 2 (high activity) and their waist-to-height ratio meaning that overweight girls appeared to exercise at a level not as strenuous as their healthy weight counterparts. At Site 1 where a smaller space meant much less activity was possible, these overweight girls tired much more quickly from the exercise they were able to do compared to their healthy weight counterparts.

Due to the difference in the physical environment between sites 1 and 2, mean RPE ratings of the children would have been expected to be higher across all of the children at site 2 than at site 1. This is due to the fact that at site 1 the space for physical activity was much more limited and many of the children primarily took part in what would be expected to be less strenuous activities such as sitting at tables and coloring. Site 2 was a large gymnasium where the children were performing typically more strenuous physical activities such as dancing to music, and playing basketball and football. For the children who were classified as healthy or obese by their BMI percentiles or waist-to-height ratios, the mean RPE ratings were higher at site 2 than at site 1. However, the difference in mean RPE ratings were very small, with all but the healthy children as classified by their waist-to-height ratios having differences in mean RPE ratings of less than one between the two sites. These mean RPE ratings are shown in tables 5 through 8 which and are separated by health status as classified by their BMI percentile or waist-to-height ratio. The children that were classified as overweight by their BMI percentiles or their waist-to-height ratios had an unexpected difference in mean RPE ratings for both sites. In both overweight classifications, the mean RPE was much higher at site 1 than it was at site 2, with both having a mean RPE rating of 2.00 for site 2 but having a mean of 6.67 for BMI percentile group and a mean of 7.17 for waist-to-height ratio group.

The comparison of the mean RPE ratings at each site determined that in the male participants who attended both sessions, the mean RPE ratings followed the expected pattern of site 2 being higher than site 1 (Table 3). The comparison of the same RPE ratings in the female participants that attended both sessions showed the opposite of the expected pattern with Site 2 having lower mean RPE ratings than site 1 (Table 4). However, no statistically significant differences were found between the mean RPE ratings at both sites in either of the groups.

This unexpected pattern in the mean RPE ratings of the children could be a result of the children not fully understanding the OMNI step scale that was being used during the study. Although the OMNI step scale was explained to each child, there were some apparent language barriers between the researchers and the children participating in the study. In addition to this, while the OMNI step scale is what is commonly used in children to assess RPE, it has been previously validated and used the most successfully in studies where children performed some types of stepping or cycling activities and not in more free form physical activity where the children were just playing and not adhering to strict exercise protocols.

Comparing the site RPE ratings to the anthropometric measurements did not show a statistical significance with an alpha of 0.05 with the exception of the female children when they had their site RPE ratings compared to their waist-to-height ratios. In this case when the groups of data were compared, a *p*-value of 0.045 was obtained which indicated that there was a statistically significant relationship. When comparing this data the *r*-value was calculated to be 0.718 which seems to show a positive relationship between the site 2 RPE ratings and recorded waist-to-height ratios. This group does show a more positive relationship and more statistical significance than when all of the children's RPE ratings are compared and much more than when just the male group's RPE ratings are compared. Reasons for this specific result may be due to comprehension of the RPE OMNI Step Scale that was used. The average age of the female children at Site 2 whose RPE ratings were tested in comparison to their waist-to-height ratios had a mean age of 98.5 months. This is lower than the whole group's average age of 113.0 months. It is possible that the group of younger female children understood the OMNI step scale less than the rest of the older children and this is the reason for the difference in significant result findings.

Table 1: Mean RPE Ratings by BMI Status

	BMI Stat	Mean	Std. Deviation	N
rpe1	Healthy	1.0000	1.54919	6
	Obese	6.0000	4.51664	6
	Overweight	.0000	.00000	2
	Total	3.0000	4.01918	14
rpe2	Healthy	3.1667	2.40139	6
	Obese	2.6667	1.96638	6
	Overweight	3.0000	4.24264	2
	Total	2.9286	2.26900	14

Table 2: Mean RPE Ratings by WtHt Ratio Status

	WtHt Stat	Mean	Std. Deviation	N
rpe1	**Healthy**	**1.0000**	**1.73205**	**3**
	Obese	**4.3333**	**4.58984**	**6**
	Overweight	**2.6000**	**4.33590**	**5**
	Total	**3.0000**	**4.01918**	**14**
rpe2	**Healthy**	**2.3333**	**.57735**	**3**
	Obese	**3.3333**	**2.33809**	**6**
	Overweight	**2.8000**	**3.03315**	**5**
	Total	**2.9286**	**2.26900**	**14**

Table 3 **: Paired Samples Statistics(a) of Females**

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	rpe1	4	9	4.66369	1.55456
	rpe2	2.3333	9	2.34521	0.78174

a sex = F

Paired Samples Test(a)

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	rpe1 - rpe2	1.66667	5.45436	1.81812	-2.52592	5.85926	0.917	8	0.386

a sex = F

Table 4 **: Paired Samples Statistics(a) of Males**

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	rpe1	1.2	5	1.64317	0.73485
	rpe2	4	5	1.87083	0.83666

a sex = M

Paired Samples Test(a)

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	rpe1 - rpe2	-2.8	2.48998	1.11355	-5.89172	0.29172	-2.514	4	0.066

a sex = M

Table 5: Male BMI Status RPE readings

BMI status	n at Site 1	Site 1 RPE Mean	n at Site 2	Site 2 RPE Mean
Healthy	2	0.00	2	4.00
Overweight	0	n/a	0	n/a
Obese	3	2.00	3	2.67

Table 6: Male WtHt Ratio Status RPE Ratings

WtHt Ratio Status	n at site 1	Site 1 RPE Mean	n at Site 2	Site 2 RPE Mean
Healthy	1	0.00	1	6.00
Overweight	0	n/a	0	n/a
Obese	4	1.50	4	2.50

Table 7: Female BMI Status RPE ratings

BMI status	n at Site 1	Site 1 RPE Mean	n at Site 2	Site 2 RPE Mean
Healthy	7	3.71	3	3.67
Overweight	3	6.67	3	2.00
Obese	5	1.60	3	2.67

Table 8: Female WtHt Ratio Status RPE Ratings

WtHt Ratio Status	n at site 1	Site 1 RPE Mean	n at Site 2	Site 2 RPE Mean
Healthy	5	1.20	2	4.50
Overweight	6	7.17	4	2.00
Obese	3	1.67	2	1.00

Chapter V:

Discussion:

The results of this study did not support the hypothesis that the participants RPE ratings would have significant relationships with their anthropometric measurements and the weight status categories that those measurements classify them as. When looking at the RPE ratings in each weight category, the results do not align with previous research. Previous studies have shown that there is an inverse relationship between waist circumference and waist-to-height ratio with physical fitness (Tokmakidis et al., 2006). However when looking at the RPE ratings of each group classified by waist-to-height ratio it was found that the overweight group had the highest RPE ratings amongst all three categories for site1, higher than both the healthy and obese group. It would have been expected that the obese children would have been working the hardest trying participating in physical activity, followed by the overweight children, and then the healthy children. However this could be the result of the limited space for physical activity site 1, or a lack of understanding of the OMNI scale that was being used to records RPE ratings.

The OMNI step scale of perceived exertion that was used in this study has previously been validated for the use on children to record RPE ratings accurately (Robertson et al., 2005). However the children that participated in this study did not seem to be able to understand the OMNI scale. For example a child that was sitting down and coloring at site 1 would give an answer of 10 on the OMNI scale, meaning they were "very very tired", when they appeared to be not exerting themselves physically or showing any typical signs of level 10 exertion such as perspiration or heavier breath.

When looking at the classifications of the participants into weight categories, there did seem to be an advantage to using waist-to-height ratio as well as BMI. Previous studies have found that using waist-to-height ratio and waist circumference as a screening tool could help to identify at risk individuals who have a healthy BMI status (Ashwell & Gibson, 2009). This study found that three participants who were classified as healthy by their BMI status were considered to be overweight when classified by their waist-to-height ratio. This difference in classification is important because the students who had changed classifications between the two measurements, were accounted for by having their RPE ratings analyzed in both groups.

There were many limitations involved in this study that also may have impacted the recorded data. The total sample sized used in of the Proyecto Raices children was thirty three. However only children that attended the first measurement session at site 1 had their anthropometric measurements recorded. This brought the sample size of children that could be used down to 21 total children (15 girls and 6 boys). In addition to the initial drop in sample size, not all of the children that attended the first session at site 1 also attended the second session at site 2. Only 14 children attended both sessions and recorded RPE ratings at both sites. This left 7 students who had RPE ratings recorded only from site 1. In addition to the small sample sizes, all of the children who participated were Hispanic and lived in the greater Akron, Ohio area. Any future studies in this topic area should be performed with a larger and more diverse sample size. Another limitation that was previously mentioned was the limited comprehension of the OMNI step scale by the children. This may have been due to a language barrier between the researchers and the children, whom did not appear to understand or speak English at the level used by the researchers to relay instructions and information. Several of the children listed an RPE rating of 10 which is considered "very, very tired" at site 1, while they were performing activities that typically would not normally be considered physically taxing such as coloring with crayons while sitting at a table. On the other hand, at site 2 in the gymnasium several children recorded their RPE ratings as zero, which is considered "Not tired at all", when they appeared to be sweating and breathing heavily, which are typically signs of physical exertion and stress during physical activity. These very high and very low RPE ratings may not have been accurate representations of some of the children's actual exertion levels. In future studies, in order to limit these types of inaccurate ratings, children should use this RPE scale for months not two days. In addition, having the children perform a step or cycling exercise instead of free playing might give more accurate RPE readings. The change from free play to a more precise exercise protocol of cycling or stepping would keep the exercise intensity of all of the children more constant and would not lead to some of the children performing less physical activity then others. In addition, the OMNI step scale that was used has been used very successfully in past studies to record RPE ratings that accurately reflect actual exertion levels specifically when the physical activity being performed is a stepping or cycling protocol (Robertson et al., 2005). An additional change that is recommended in any future studies would be to have similar or the same protocols for physical activity at every site. This study was limited by a last minute change to site 1 which changed it from the same large gymnasium as site 2 to a much smaller basement of an office building. This change in site location limited the physical activity that the children could take part in and therefore potentially altered the RPE ratings due to the lesser amount of physical activity possibility.

Future Directions:

1. Future research should be done with a larger and more diverse sample of children so that statistics are less influenced by small n-values.

2. Further research should work to assure there are no factors such as language barriers between researcher and participant which could lead to miscommunications in regard to RPE recording instructions.

3. Further research should utilize a more structured step or cycle exercise protocol to insure children are exercising at similar work levels, instead of a free play environment.

Chapter VI:

Conclusion

Childhood obesity is one of the largest public health issues that the United States has faced and the problem has showed no signs of slowing down. This study looked to find new insight in regard to identifying current and at risk children who are a part of this issue. The use of RPE ratings during physical fitness activities to try to identify children who are overweight or obese as classified by anthropometric measurements has very little previous research on the topic. The results of this study indicated that there were no statistically significant relationships between the RPE ratings of the tested children and their anthropometric measurements which classified them as healthy, overweight, or obese. While the results of this study could have been impacted by the limitations previously stated, further studies on this topic would need to change procedures to have a more controlled and precise environment for the physical activity to take place for the RPE ratings, as well as have a much larger and diverse sample population that allows for more data to be collected.

Future studies should also keep in mind that if RPE is found to be able to be related to the anthropometric measurements that can identify overweight and obese children, that it may be a more practical method of identification to just record the anthropometric measurements and use them alone to identify these groups of children.

Conducting this study showed the importance of strict and exact procedure during data collection. The difference in activity of all of the children in the free play setting like this may have had a significant influence on the results that were gathered. By having more structured protocol in a study, it would be much less likely for this type of uncontrolled factor to influence results. In addition, conducting this study showed just how important it is to have a solid foundation of research and studies on which to base the structure of your study on. There is no direct research on this exact topic and it was much more difficult because there were so many variables that were being considered with no previous results with which to compare to. This also showed that more is not always necessarily better in the case of research. It may have been more beneficial to focus on one aspect of this study more in depth, than going into several variables with less detail. For example maybe only focus on waist-to-height ratios and not BMI instead of focusing on both.

This study also showed some of the challenges that could be expected to be faced when conducting a study with participants who are children or adolescents. Younger participants may not be as reliable or cooperative in a study that has less strict protocol like this one. Because of this it is important to have optimal communication with participants to make sure there are no misunderstandings or other miscommunications in regard to directions or protocol of the study. It is important to be understanding when there are language barriers between the researcher and participants and a reliable translator should be utilized in assisting with communications to ensure the best results for the researcher and the safety for the participants.

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