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The Effect of Participation in Organized Soccer on Fitnessgram Scores in 11-12 Year Old Girls

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This Scholarly Project, submitted by Gale G. Dockstader, Kristin R. Naplin, Keli N. Waterworth, and Lyndsey M.R. Ziemer in partial fulfillment of the requirements for the Degree of Doctor of Physical Therapy from the University of North Dakota, has been read by the Advisor and Chairperson of Physical Therapy under whom the work has been done and is hereby approved.

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PERMISSION

Title: The Effects of Participation in Organized Soccer on Fitnessgram Scores in Girls Ages 11-12

Department: Physical Therapy

Degree: Doctor of Physical Therapy

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Date 12.16.05

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ABSTRACT

Purpose: Childhood obesity is increasing at an alarming rate throughout the United States and has been associated with multiple health complications such as heart disease and diabetes. Due to these increasing rates and health effects, there is a need to determine effective methods to measure physical activity as well as promote physical activity. One form of determining a child's level of fitness is through the Fitnessgram. This study was designed to determine if formally testing fitness levels with the Fitnessgram in 11-12 year old girls participating in organized soccer is correlated with changes in fitness levels from pre-season to post-season, determine if using a measure such as the Fitnessgram influences the motivation to participate in organized and non-organized physical activities, and determine if girls participating in organized soccer have higher fitness levels when compared to normative data. **Subjects:** Subjects were recruited from a soccer club and consisted of four female soccer players ages 11 to 12. Inclusion was based on participation in organized girls soccer and exclusion was based on parent/guardian and/or player's refusal to consent to participation. **Instrumentation:** The Fitnessgram was used to provide feedback on whether or not the child achieved the criterion referenced age and gender specific standards for physical activity or fitness. In addition, participants were asked to complete questionnaires relative to the study. **Procedure:** Fitnessgram protocol was followed to evaluate strength, flexibility, body composition, and endurance. Subjects completed six tests both pre and post season

which included curl-ups, trunk lifts, push-ups, PACER, skinfold measurements and sit and reach. **Data Analysis: A** related sample t-test compared pre and post-season measurements for curl-ups, trunk lift, push-ups, PACER test, and sit and reach measurements. **Results:** Results of this study revealed no significant difference in pre-season Fitnessgram scores compared to post-season scores. **Conclusion and Clinical Implications:** A major focus of physical therapy is to promote health and wellness across the lifespan. This includes advocating the benefits of exercise, encouraging participation in physical activity, and educating on the risks of obesity. In the future health professionals as well and educators could utilize the Fitnessgram to provide an objective measure of a child's fitness level in reference to standardized age and gender specific norms.

CHAPTER I

INTRODUCTION

Childhood obesity is increasing at an alarming rate throughout the United States. The National Health and Nutrition Examination Survey (NHANES) indicated that from 1999 to 2002 the occurrence of childhood obesity among children and adolescents has nearly tripled.[1] Obesity contributes to the development of health problems. Obesity has been linked to the development of dyslipidemia, gallstones, diabetes mellitus, hypertension, and cancer.[2] A study by Gidding[3] consisting of 48 boys and girls ages 8 to 17 years with increased body mass index $\geq$40 kg/m^2 showed severe physical deconditioning, hyperinsulinemia, dyslipedemia, and respiratory abnormalities. Childhood obesity is influenced by a poor diet and a decreased amount of physical activity.[4] In a study[5] of 878 children ages 11-15 the only significant risk factor for having a high BMI was their amount of physical activity. Being overweight and having a high BMI is due to the amount of time spent performing physical and sedentary activities. After a four month treatment program of 74 subjects ages 7 to 11 the physical training group participants showed an increase in total body composition and cardiovascular fitness related to a decrease in total body fat mass, an increase in total body fat free mass, and a decreased exercise heart rate.[6] After 50 overweight subjects performed a nine month intervention of lifestyle focused, fitness-orientated gym class, there was a significantly greater decline in percentage of body fat, significant increases in cardiovascular fitness, and fasting insulin levels compared to the control group.[7] Physical

activity is related to a decrease in childhood obesity and regular exercise is a vital component for maintaining a healthy weight in adolescents. In a study by Nemet[8], 24 obese children were subjected to a three month intervention program of diet and exercise. At one year follow-up, significant differences were seen in body weight, BMI, and body fat percentage as well as amount of physical activity compared to the control group of 22 obese subjects. Motivation also plays a factor when assessing one's physical activity. In a study of 314 boys age 6 to 10 years old involved in a recreational basketball program a 24-item questionnaire was given regarding motivation, importance, and perception of athletic ability.[9] Results showed children regard having fun, doing their best, and learning skills as high importance while participating in organized sports, whereas winning was of minimal importance. Literature has shown that childhood obesity is related to a decreased amount of physical activity. One way to decrease the incidence of childhood obesity is for children to participate in exercise. A type of exercise children could participate in is soccer. When researching the sport of soccer pre and post-season fitness levels should be performed to determine if soccer helps to increase a child's level of fitness. Due to the fact children participate in many other types of activities; these also need to be taken into account when assessing a child's level of fitness.

Problem Statement

Due to the increasing rates of childhood obesity, there is a need to determine effective methods to measure physical activity in young girls as well as promote physical activity. One form of determining a child's level of fitness is through the Fitnessgram, which is a tool that references a child's fitness data to a nationalized norm. The researchers chose to study levels of fitness in girls ages 11 to 12 that participate in

organized sports. Soccer was chosen because the season correlated to the time frame in which the researchers planned to collect data.

Purpose

More than 20 million children between the ages of 6 and 16 participate in organized sports programs outside of school.[9] The researchers were unable to find literature related to the effects of organized soccer on the fitness levels of 11 to 12 year old girls. Therefore, this study has three purposes. The first is to determine if formally testing fitness levels with the Fitnessgram in 11-12 year old girls participating in organized soccer is correlated with changes in fitness levels from pre-season to post-season. The second purpose is to determine if using a measure such as the Fitnessgram influences the motivation to participate in organized soccer. The third purpose is to determine if girls participating in organized soccer have higher fitness levels compared to normative data.

Significance of Study

This study is important to physical therapy because it addressed the nationwide problem of childhood obesity. A significant aspect of physical therapy is promoting health and wellness across the lifespan. Obesity has been associated with multiple complications, such as heart disease and diabetes. They are thought to be caused by a decreased amount of physical activity.[2] Examining physical activity and fitness levels in a sample population of a girls soccer team may help in addressing issues associated with obesity. The results of this study will provide information about the fitness levels of the subjects and their level of involvement in non-organized physical activity over a five

week period of time. From this information it can be determined what variables may influence fitness levels in an organized girls soccer team.

Research Questions

Research Question #1: Does participation in organized soccer influence fitness levels pre-season to post-season in 11-12 year old girls?

Research Question #2: Does formally testing fitness levels influence motivation in 11-12 year old girls participating in organized soccer?

Research Question #3: Based on normative data do girls participating in organized soccer have higher fitness levels?

Hypothesis

Null hypothesis: There is no change in fitness levels and motivation based on Fitnessgram data in 11-12 year old girls participating in organized soccer from pre-season to post-season.

Alternate hypothesis: There is a change in fitness levels and motivation based on Fitnessgram data in 11-12 year old girls participating in organized soccer from pre-season to post-season.

CHAPTER II

LITERATURE REVIEW

Overweight and obesity has reached epidemic levels in the United States and represents a serious health concern for a growing number of children and adolescents. According to the Center for Disease Control and Prevention, overweight for children and adolescents is defined as a body mass index (BMI) in the 85th to <95th percentile range for age and obesity is defined as a BMI >95th percentile for age.[10]

Statistical data regarding overweight and obesity in the United States is based on cross-sectional nationally representative health examination surveys from the NHANES program of the National Center for Health Statistics and the Centers for Disease Control and Prevention.[10] Results of these surveys showed the prevalence of overweight and obesity among children to be relatively stable from 1960 to 1980. However, data revealed a marked increase from 1988 to 1994 and a continued trend for increased incidence of obesity among children and adolescents between 1999 and 2002. The most recent estimates from NHANES in 1999 to 2002 revealed a total of 15.8% of children aged 6 to 11 years and 16.1% of adolescents aged 12 to 19 years were classified as overweight indicating that the prevalence of obesity among children and adolescents has nearly tripled over a short period of time.[1]

Obesity during the childhood and adolescence years has a significant impact on physical health and performance. Grundy et al[2] described long term detrimental outcomes

of obesity including high synthetic rates for lipids, hyperinsulinemia, and insulin resistance in addition to the onset of several disorders such as dyslipidemia, gallstones, diabetes mellitus, and hypertension. Moreover, epidemiologic and experimental evidence also supports the possibility of a correlation between obesity and cancer. Furthermore, Gidding et al[3] examined cardiovascular risk factors, respiratory function, and insulin metabolism in a cross sectional analysis of 48 boys and girls ages 8 to 17 years with a body mass index $\geq$ 40 kg/m. Results of the study revealed severe physical deconditioning, hyperinsulinemia, dyslipidemia, and respiratory abnormalities for the majority of participants. In addition, hypertension, left ventricular hypertrophy, and diabetes mellitus were present in 15% to 20% of participants.[3]

Obesity greatly influences a child's performance as well. Bar-Or and Ward [11] found children who are obese required a higher oxygen uptake capacity to perform a specific task. Obese children must perform at a higher percentage of their maximal oxygen uptake, which is usually lower compared to non-obese children. This results in a diminished reserve capacity and a perception of higher exertion while performing a task.

In addition, Maffeis et al[12] reported that the metabolic and physiologic responses were significantly lower in 17 non-obese children with 95% ideal body weight than in 23 overweight children with 138% ideal body weight during walking and running on a treadmill at different intensities. It was concluded that overweight children expended 50% more energy moving their bodies compared to the non-obese children.

Furthermore, a study[12] conducted at Louisiana State University Health Sciences Center examined the level of obesity at which children experience a significantly greater physiologic and metabolic response to weight-bearing activity compared to non-obese

children. The study included 35 obese and 12 non-obese children age 7 to 17 years. Participants walked on a treadmill for three 5 minute intervals at 4.0, 4.8, and 5.6 km/h on 0% grade and treadmill elevation was subsequently increased 2% every 2 minutes until voluntary termination by the participants. Results showed at the highest workload of 5.6 km/h, normal weight children were exercising at 38% VO_2max, overweight children at 54% VO_2max, obese children at 72% VO_2max, and severely obese children at 82% VO_2max. The obese and severely obese participants consistently displayed greater physiologic and metabolic responses with few exceptions for a given level of intensity compared to the overweight and normal weight participants.

Obesity not only impacts physical health and performance but also influences psychosocial health as well. Negative self-image has been documented in overweight children as young as 5 years old and obese adolescents show declining degrees of self-esteem associated with sadness, loneliness, nervousness, and high-risk behavior.[13] Pinhas-Hamiel[13] assessed the impact of obesity on health related quality of life in a cross sectional study of 182 children and adolescents. Quality of life is a subjective measure of an individual's personal experiences regarding physical ability, psychological well being, social interactions, and school or work performance. Results showed that obese children had lower health related quality of life scores compared to normal weight children in the areas of physical, social, and school domains.

While the health related consequences of obesity are well defined, the mechanism for the development of obesity is not entirely understood. Nevertheless, it is well established that obesity occurs as a result of energy intake, which exceeds energy expenditure. Several etiologies account for this imbalance including genetic and

environmental factors. In a limited number of cases, childhood obesity is a result of medical diagnoses such as hypothyroidism or a leptin deficiency. However, most cases of childhood obesity are greatly influenced by lifestyle behaviors and cultural environmental factors including poor diet and a decline in physical activity.[4]

One theory that explains the increasing prevalence of obesity among children and adolescents is the steady decline in physical activity. A randomized control trial conducted by Patrick et al[4] examined diet, physical activity, and sedentary behaviors as risk factors for overweight in adolescence. Patrick found that of the seven dietary and physical activity variables examined, the only risk factor for a higher body mass index among boys and girls was due to an inadequate level of vigorous physical activity and overweight status was found to be related to the amount of time spent participating in physical and sedentary activities.

In addition, excessive media use has been deemed as a possible cause of overweight and obesity among youth. In a meta-analysis reviewing the evidence of excessive media use related to body fatness and activity level, Marshall et al[14] concluded a statistically significant negative relationship existed between media use to body fat and activity level. While the correlation was small, it was nevertheless present. Therefore, while television viewing and video games do not account fully for the increased prevalence of obesity, it may be contributing factor in which to consider.

In response to the significant impact that the cultural environment has on the lifestyle behaviors of children and the increasing prevalence of childhood overweight and obesity, an effective treatment strategy must address increasing the level of physical activity in which children participate. Owens et al[6] examined the effect of controlled

physical training without dietary intervention on 7 to 11 year old obese children in a randomized control trial. Baseline data included body composition measured with DXA, cardiovascular fitness expressed as heart rate during submaximal cycling on a supine ergometer, and recollection of daily physical activity for the previous seven days. Participants were randomly assigned to either the physical training group or the control group and then reevaluated at four months following the intervention period. Physical training included 20 minutes of exercise on machines such as a treadmill or trampoline followed by 20 minutes of playing games such as basketball or dodgeball five days a week. The goal during physical training was to keep each child's heart rate above 150 beats per minute measured with heart rate monitors that represents 70 to 75% of the maximal heart rate for this age group. Following the four month intervention period, results showed improved total body composition and cardiovascular fitness for the physical training group compared to the control group. This was demonstrated by a significant decline in percent of body fat attributed to a decline in total body fat mass and an increase in total body fat free mass and a reduced exercise heart rate.

Furthermore, in a school base setting, Carrel et al[7] measured body composition, cardiovascular fitness, and insulin sensitivity in 50 overweight middle school children with a body mass index above the 95th percentile. Participants were randomly assigned to either the treatment group, which included a lifestyle focused, fitness oriented gym class or the control group that consisted of a standard gym class. Evaluations were completed at baseline before the start of the school year and nine months later at the end of the school year. No differences were present relative to body mass index, cardiovascular fitness, or insulin sensitivity at baseline. However, after completion of the nine month

intervention, there was a significantly greater decrease in percentage of body fat, significant improvements in cardiovascular fitness, and significant improvements in fasting insulin levels compared to the control group.

The Council for Physical Education for Children (COPEC) of the National Association for Sport and Physical Activity (NASPE) developed physical activity guidelines for children. According to the NASPE, elementary aged children should achieve at least 30 to 60 minutes of appropriate physical activity on all or most days of the week while an accumulation of more than 60 minutes up to several hours per day is encouraged. In addition, periods of activity lasting 10 to 15 minutes or more at a moderate to vigorous intensity level are encouraged, extended periods of inactivity are considered inappropriate, and incorporating a variety of physical activities is recommended.[15]

Accurate assessment of physical activity in children is necessary to identify current levels of activity and to assess the effectiveness of intervention programs designed to increase physical activity. Common techniques used in assessing the physical activity of children and adolescents include direct observation, heart rate monitors, accelerometers, pedometers, and self-report instruments.[16]

In a systematic review, Sirard and Pate[16] examined the strengths, limitations, and validity of criterion standards, objective techniques, and subjective measures of physical activity assessments in children and adolescents. Heart rate monitors were valid in classifying ranges of physical activity such as highly active, somewhat active, and sedentary but lacks the specificity required to estimate physical activity. In addition, laboratory and field validations of pedometers and accelerometers revealed high

correlations with oxygen consumption and direct observation as criterion based assessments. Physical activity has also been assessed with self-report instruments that have reported 73.4% to 86.3% agreement with direct observation. However, self-report measures are subjective and revealed the least validation results. Self-report measures also rely on responses of the child or adolescent.

Based on the definition of physical activity, direct observation is deemed the gold standard for measurement. Therefore, direct observation is considered the most practical and appropriate criterion based measure of physical activity. However, in situations where direct observation is not possible due to time, personnel, or monetary limitations then accelerometers appear to be the most promising alternative.[16]

A reliable and valid method of assessing the fitness levels of children and adolescents is the Fitnessgram. The Fitnessgram is a comprehensive health related fitness and activity assessment with a computerized reporting system. The reports provide feedback based on whether the child achieved the criterion-referenced standards for physical activity or fitness. The Fitnessgram is a complete battery of health-related fitness items that are scored using criterion-referenced standards. These standards are age and gender specific. The Fitnessgram is composed of six field tests aimed to measure aerobic capacity, muscle strength, endurance, and flexibility, as well as body composition. The field tests include the Progressive Aerobic Cardiovascular Endurance Run (PACER), curl-up, trunk lift, push-up, and sit and reach test. The Fitnessgram was designed through the Cooper Institute and the validity and reliability of each field test was determined along with the reliability and validity of the criterion itself.[17]

More than 20 million children between the ages of 6 and 16 participate in organized sports programs outside of school and their motivation for participation is an important factor to consider. Stern et al[9] administered a 24 item questionnaire designed to measure participation motivation in 314 boys age 6 to 10 years old involved in a recreational basketball program. The questionnaire was comprised of three components. The first was designed to assure understanding of the concept of "importance", the second to determine participation motivation, and the third to determine individual perception of personal athletic ability. Results showed among the younger age group that "learn to do my best" was the most highly rated as "extremely important" whereas "win games" was only rated as "important". In addition, items related to improving skills, being physically fit, and feeling part of a team were also highly rated and "having fun" was rated as very "important". The findings suggest that children desire their experiences with organized sports to provide situations in which they are able to put forth their best efforts and learn as much as possible.

CHAPTER III

METHODOLOGY

Subjects

Subjects were recruited from a Soccer Club. Those whom participated in the study were 4 female soccer players' ages 11 to 12. Participants were recruited during the first week of practice. Inclusion was based on participation in organized girls soccer and exclusion was based on parent/guardian and/or player's refusal to consent to participation. Each girl was individually analyzed by one of the four testers. Informed consent and IRB approval were obtained prior to the initiation of the study.

Instrumentation

The Fitnessgram is a comprehensive health-related fitness and computerized reporting system. The reports provide feedback on whether or not the child achieved the criterion-referenced standards for physical activity or fitness. The Fitnessgram is a complete battery of health-related fitness items that are scored using criterion-referenced standards. These standards are age and gender specific.[17] The Fitnessgram was obtained through the Cooper Institute in Dallas Texas. The Pacer CD was obtained through Human Kinetics in Champaign Illinois.

Validity and reliability of instruments

The Fitnessgram is a reliable and valid method of assessing the fitness levels of children and adolescents. When the Fitnessgram was developed, the validity and

reliability of each field test was determined along with the reliability and validity of the criterion itself. The paragraphs below reveal specific figures for each field test separately. Definitions of terms include inter tester (r) reliability which refers to consistency of two different testers administering the same test to the same students and intra tester (R) reliability refers to the ability for a single rater to observe the same performance by the same student.[18]

Aerobic capacity is formally measured using a graded exercise test in which maximum oxygen uptake is measured through progressively increasing the intensity of exercise and is commonly administered on a treadmill or cycle ergometer. However, an alternative method of assessing aerobic capacity with the Fitnessgram in order to establish VO_2 max is the PACER test. Studies[19] have shown high test-retest reliability for VO_2 max (ml x kg^{-1} x min^{-1}) as an acceptable measure of physical fitness in children and adolescents. Paterson et al[19] demonstrated r = .95 with a treadmill run test, r = .87 with a jog test, and r = .47 with a walk test while Cunningham et al[19] found r = .56 with a walk/run treadmill test. Specifically, four studies have reported high reliability of the PACER test as a measure of aerobic capacity. Reliability coefficients were found to be above .84 in children and adolescents. In 1997, Mahar et al[19] reported a reliability coefficient of r = .90 in a study of 137 males and 104 females ages 10 to 11 years old, and in 1992, Liu et al found a reliability coefficient of R = .93 in a study of 20 males and females ages 12 to 15 years old.

The PACER test has also demonstrated moderate to good validity with children 10 years of age and older and is estimated with an error of 10 to 15% of the mean. Specifically, the concurrent validity of the PACER test has been established in several

studies through directly correlating the VO_2 max or highest test stage achieved at the end of the PACER test to the VO_2 max achieved on a treadmill test. The validity of the PACER test according to Barnett et al from a sample of 27 boys and 28 girls had a validity coefficient of 0.74.[19]

The skin fold method to estimate body composition is used with the Fitnessgram. The use of two skin folds is successfully used to predict body composition in most children. The skin fold test has shown to be reliable providing that the person administering the test has proper training. The same caliper was used pre and post-season as well as the same tester, which increases the reliability and validity.[21]

The musculoskeletal assessment consisted of curl-ups, trunk lift, push-ups, and sit and reach. Studies done by Anderson et al[18] showed a reliability coefficient of .70 for the curl-up test. Studies have also shown as the age group tested increases the reliability coefficient increases for the curl-up test. Electromyography studies[18] have shown logical validity for the curl-up test in assessing abdominal strength. Absolute validity has been shown hard to document due to lack of definitive criteria for measuring abdominal strength. Limited information is available on the reliability on the trunk extension assessment in elementary aged individuals. There was also limited information on the validity but is considered to have logical validity. Romain and Mahar[18] found for a 90-degree push-up, which is the Fitnessgram method, in elementary individuals showed excellent reliability. McManis et al[18] showed an increase in reliability of collage age individuals as compared to high school individuals. The purpose of the sit and reach test is to determine hamstring length not low back flexibility. Correlations between the various versions of the sit and reach and low back flexibility ($r = .10$ to $.47$) are

consistently low, so any sit and reach version cannot be considered a valid measure of low back flexibility. Four studies[18] have established extremely high reliability for the sit and reach test with correlations of .93 to .99 and 95% confidence intervals of .89 to .99 at the widest. Allen and Broer[18] both found inter tester reliability to be r = .97. Broer[18] also found the validity has been proven high at r = .67. Reliability for the stand and reach, sit and reach, and sit and reach modified has been shown to be extremely consistent throughout.

Procedures

Prior to testing, the researchers provided an explanation of the study including its purpose, assessment procedures, and potential rewards and risks involved. Letters of cooperation were obtained from the soccer club as well as the coaching staff. Consent forms and assent forms were given to athletes and parents on the first day of practice to be sent home. A deadline of one week was established for inclusion in the study. Forms were returned to the researchers before testing began. The Fitnessgram was completed twice during the soccer season and followed the protocol for testing as designed by the Fitnessgram.

A short questionnaire was also completed by subjects once at the beginning of the season addressing issues such as the number of organized sports participants are involved in during the academic year and how many times per week, why they are involved in soccer, and if they feel more motivated to try harder during the season knowing that their fitness levels will be assessed again. The questionnaire took place at the beginning of the season during the second week of practice once all consent and assent forms were received and a follow up questionnaire was completed at the end of the soccer season.

The Fitnessgram was used to evaluate each player's strength with curl-ups and push-ups, flexibility with the trunk lift and sit and reach, and endurance with the PACER test. In addition, skin fold measurements were taken at the tricep and calf to measure body composition.

First, strength was tested with curl-ups. This consisted of curl-ups, which were to a cadenced beep from the PACER CD. This was performed lying supine with the knees flexed approximately to 140 degrees, feet flat on the floor, legs slightly apart, and arms straight and parallel to the trunk with palms of hands resting on the ground. A measuring strip was placed at the tip of the participants' fingers while the participant's head was on the ground (Figure 1). The participants were then asked to curl up while reaching her fingertips to the opposite side of the strip (Figure 2). If this was not accomplished twice in a row or other form corrections were made the participant was finished with this test. At that point the number of curl-ups was recorded.[20]

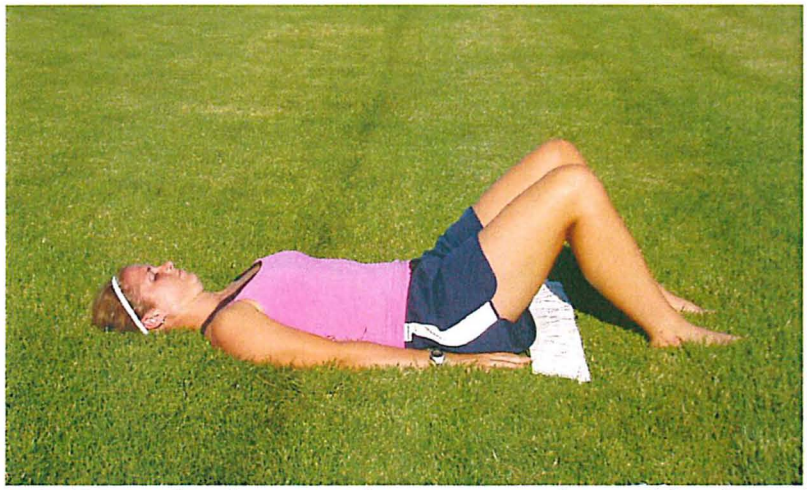

Figure 1. Researcher demonstrating proper starting position for curl-up.

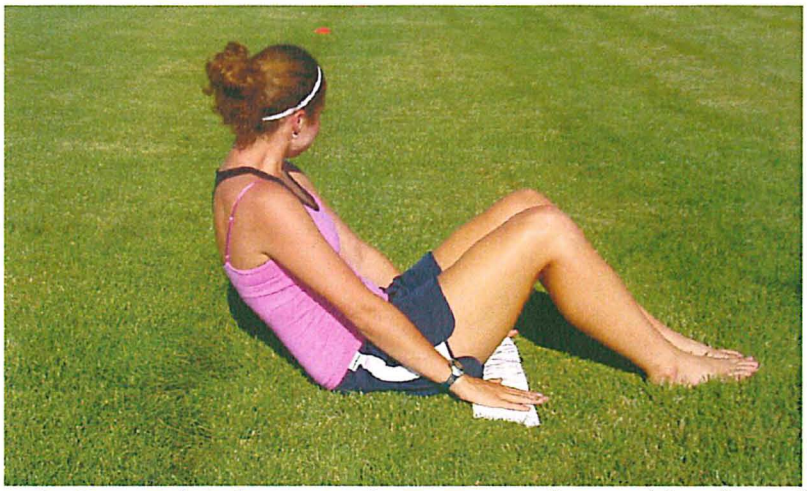

Figure 2. Researcher demonstrating proper ending position for curl-up.

Second, flexibility was tested with the trunk lift. The participants were asked to lie face down, with toes pointed and arms are placed beside their thighs. The line was placed under the participant's eyes. They were then asked to extend their back while keeping their eyes focused on the line (Figure 3). The researches then measured the distance from the ground to the participants chin. The maximum score possible for this test was 12 inches.[20]

Figure 3. Researcher demonstrating proper ending position for trunk lift.

Third, strength was tested with push-ups. The participants assumed a prone position on the ground with the hands placed under and slightly wider than the shoulders, fingers stretched out, legs straight and slightly apart, and toes tucked under. To constitute a push-up, the participant must push up fully (Figure 4) and flex elbows to at least 90 degrees (Figure 5). If form corrections were made twice in a row the participant was instructed to stop the test and the number of full push-ups was recorded.[20]

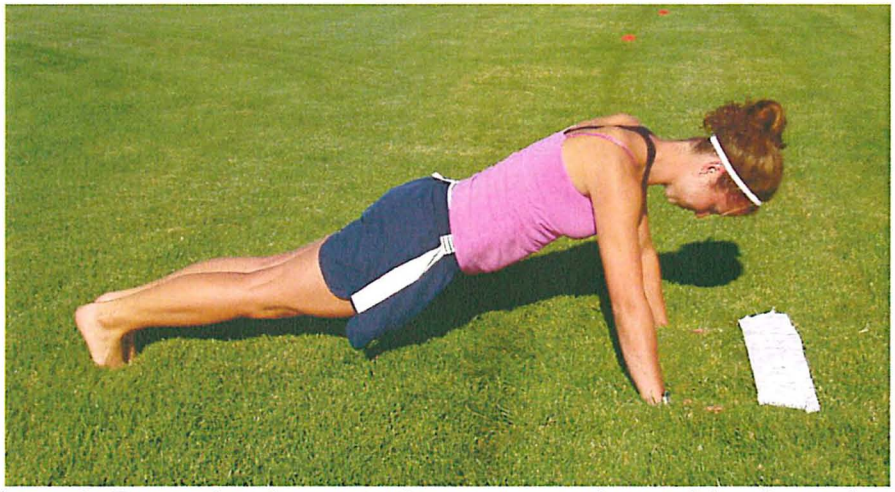

Figure 4. Researcher demonstrating proper starting position for push-up.

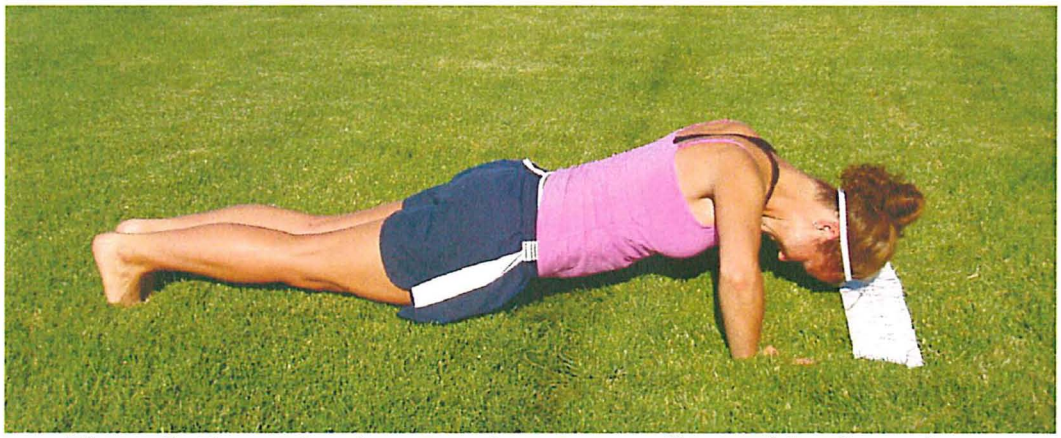

Figure 5. Researcher demonstrating proper ending position for push-up.

Fourth, endurance was tested with the PACER test. During the PACER test the participants were asked to run back and forth a distance of 20 meters at a pace specified by the PACER CD which increased in rate each minute (Figure 6). A point is scored for each 20-meter distance run completed. If participants did not make it across the line prior to the cadence beep (Figure 7) they were given a warning and they would have one more chance to make it across the other line before being excluded. Once the participants completed the test the number of 20 meters was recorded. Participants were encouraged to run as long as they wish and not to the point of exhaustion.[20]

Figure 6. Researchers demonstrating the PACER test.

Figure 7. Researchers demonstrating the PACER test.

Fifth, flexibility was tested with the sit and reach test. A box with a measuring stick was used for this test and the participants were asked to remove their shoes and place their feet flat against the box. With palms facing down the participants were asked to reach as far forward without bending their knees while keeping their back straight. This distance was then measured by the researcher (Figure 8) with a maximum score possible of 12 inches.[20]

Figure 8. Researcher demonstrating the proper positioning for sit and reach test.

Sixth, a Certified Athletic Trainer measured skin folds with a Skindex caliper. Three measurements were taken on the right triceps at the midpoint between the acromion and the elbow with a pinch in the vertical position (Figure 9). Next three measurements were taken on the outside of the right calf at the level of maximum calf girth, also in a vertical position (Figure 10). The knee was flexed to 90 degrees to maximize relaxation. The average of the three trials was recorded for each body part.[20,21]

Figure 9. Researcher demonstrating tricep skin fold measurement.

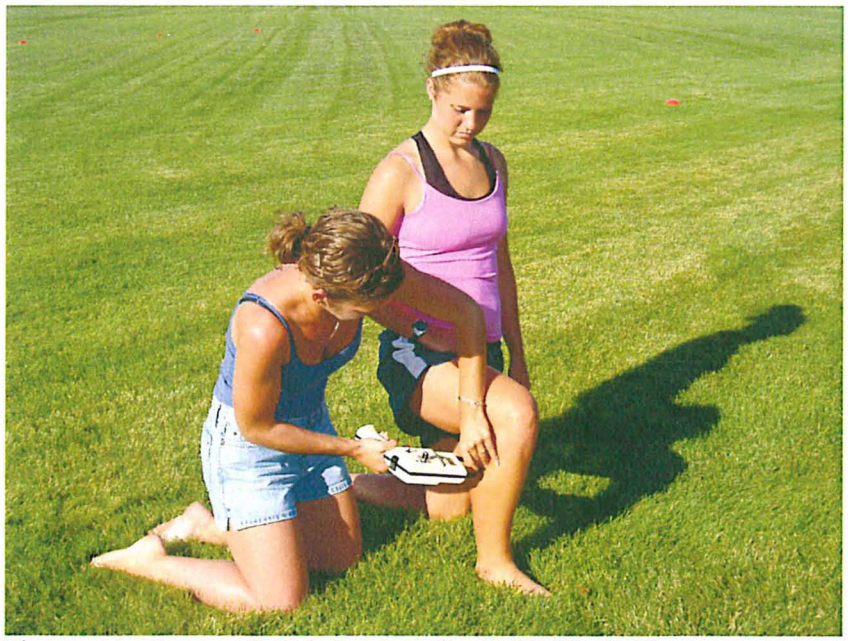

Figure 10. Researcher demonstrating calf skin fold measurement.

Following the completion of testing, the participants were awarded Dairy Queen while they filled out the follow up questionnaires. The four participants also received a five dollar gift certificate to the GAP.

During the two testing days there was a Certified Athletic Trainer on site and all researchers were CPR and first aid certified. The team's coaches were also present at the time of pre and post testing. Warm-up and cool-down exercises were administered before and after the fitness testing per a pre-designed program by the coaches. Water was available and participants were reminded that if at any time they wished to discontinue participation or involvement that they may do so without any repercussions.[20]

Data Analysis

The researchers made no interventions and subjects completed their normal soccer training regimen. A paired or repeated t-test was run initially. This measure is defined as a single sample of individuals measured more than once on the same dependent variable. The same subjects were used in all of the treatment conditions. Consequently the data has to be normally distributed.[22] The dependent variables used were fitness scores pre and post in areas of curl-ups, push-ups, PACER, body composition, sit and reach, and trunk lift. The independent variables were the individual levels of training. An alpha level of .05 was used. Not all data was normally distributed so a Non-Parametric Wilcoxon test was also ran under the same alpha level and data was analyzed was a second time. No significant difference was found for either analysis.

CHAPTER IV

RESULTS

Subject Profile

The subjects in this study were 11 to 12 year old female participants of summer soccer and were recruited from a soccer club. The soccer team consisted of fifteen 11 to 12 year old girls, however, eleven subjects were excluded after they were unable to make both testing sessions. Four subjects were included in the final analysis of the data.

Test Description

A related sample t-test compared pre-season and post-season measurements for curl-ups, trunk lift, push-ups, PACER test, and sit and reach measurements. (Results are presented in Table 1) To determine body composition percentage of the participants, a Certified Athletic Trainer took tricep and calf, skin fold measurements. To allow the researchers a means to compare the participants to girls their age, the BMI-for-age chart was used. Using the BMI-for-age chart the researchers were able to determine the subjects' percentile rank and further classify if the subjects were underweight, normal weight, at risk to become overweight, or overweight. (Results for subjects' BMI and percentile ranking are presented in Table 3)[11]

Table 1. Analytical Data

Test Description	Before M±SD	After M±SD	t	df	P (2-tailed)
Curl Ups	50.75 ± 28	46.75 ± 22	.424	3	.700
Trunk Lift	9.5 ± 2	8.0 ± 2	1.44	3	.245
Push Ups	26.75 ± 20	25 ± 12.0	.426	3	.699
PACER test	63.5 ± 12	68.75 ± 15	-2.719	3	.073
Sit and Reach	16.7± 4	17.75 ± 4	-2.828	3	.066

Table 2. Fitnessgram Body Composition Classification

Subject ID	Pre-Season Classification	Post-Season Classification
1	Very Low	Very Low
2	Very Low	Very Low
3	Very Low	Very Low
4	Very Low	Very Low

Table 3. Subject BMI and Percentile Ranking

Subject ID	Height (feet)	Weight (#)	BMI	Percentile Rank (%)	Classification*
1	5'5"	108	18	15.02	Normal
2	5'1"	85	16.1	15.63	Normal
3	5'5"	116	19.3	15.80	Normal
4	5'4"	120	20.6	14.87	Normal

*According to values for Percentile Rank Classification underweight BMI is $<5^{th}$ percentile, normal is 5^{th} to $<85^{th}$ percentile, at risk for overweight is 85^{th} to $<95^{th}$ percentile, and overweight is $\geq 95^{th}$ percentile.

CHAPTER V

DISCUSSION

After running a related sample t-test comparing pre-season and post-season measurements for curl-ups, trunk lift, push-ups, PACER test, and sit and reach measurements there were no significant differences found. The researchers feel this may be due to the high fitness level of the soccer girls prior to the beginning of the season. The Fitnessgram manual has established healthy fitness zones for all of the categories previously mentioned; the girls tested above the healthy zones both pre and post-season in all categories listed, with the exception of the trunk lift where they fell in the healthy fitness zone.

To achieve a significant difference in results in girls who were already very fit to begin with would be quite challenging and not necessarily recommended. These girls, according to the Fitnessgram standards were classified as very low but still within the healthy fitness zone. (Results are presented in Table 2). Due to a limited amount of lapsed time between the pre-season and post-season testing and their preexisting fitness level the results were not surprising.

A pre and post-season survey was completed by the girls and the answers to the questions led the researchers to believe the girls are playing soccer because it was fun as well as to get exercise to help stay in shape. All subjects reported multi-sport involvement including participation in basketball, volleyball, track & field and

gymnastics. The increased involvement of the athletes in other activities helps to support why the girls demonstrated such increased fitness levels. Of important note, all participants stated in the survey their parents participate in regular exercise. All athletes stated not being as good as another teammate would motivate them to try harder, but would continue to play even if this were the case. In the post-season survey, the athletes reported no increase in motivation secondary to knowing they were going to be tested at the end of the season, but also stated they would always try their best.

It is clear both from the results of the Fitnessgram and from the pre and post-season surveys these girls have achieved a high fitness level compared to those their age and are motivated young girls. A similar study would be indicated in girls who are not involved in regular exercise, after the initial testing session an organized exercise regimen could be implemented for a pre-determined amount of time, followed by a post exercise testing session. Testing participants without previous regular exercise may give a better understanding of the effectiveness of regular exercise in girls ages 11 to 12.

Study Limitations

There were several factors limiting the results of this study. Due to the unpredictable North Dakota weather, researchers had three weeks of rained out practices. The consent and assent forms were distributed on June 7, 2005 and the initial plan was to give the athletes one week to sign and return the forms and have the first testing session on June 14, 2005. Following cancellation of the initial testing times, two other dates were rescheduled, but again were cancelled due to weather. It was not until June 28, 2005 that the first testing took place, with approximately three weeks of practice and

games already underway. The final assessment of the participants took place on August 2, 2005.

Due to the delays in the testing, the researchers and athletes unfortunately now had a decreased chance of showing improvement due to the short duration between testing sessions. Between initial and final testing, there was one month of practice and games instead of the anticipated two months.

Athlete compliance became another factor limiting this study. There were fifteen athletes on the team; however eleven athletes had to be excluded from the study secondary to not being present during both testing sessions.

The subject sample size was small and targeted going into the study, and due to participants leaving for summer vacations and holidays the researchers ended with limited data of just four participants to work with.

CHAPTER VI

CONCLUSION

The purpose of this study was to identify if participation in organized soccer effects Fitnessgram scores in girls ages 11 to 12. Results of this study revealed no significant difference in pre-season Fitnessgram scores compared to post-season scores. However, participants tested above nationalized standards in all tested categories with the exception of post-season trunk lift. The results indicate further research is needed to provide more objective and quantifiable data to validate the effects of participation in organized soccer on Fitnessgram scores. It is recommended that future studies of this nature include larger sample size and an increased duration between testing times to show more accurately the effects of organized soccer on fitness levels.

Clinical Implications

It is important to address the nationwide problem of childhood obesity due to the increasing rates of health complications such as heart disease and diabetes related to a decreased level of physical activity.[2] A major focus of physical therapy is to promote health and wellness across the lifespan. This includes advocating the benefits of exercise, encouraging participation in physical activity, and educating on the risks of obesity. Developing a healthy and active lifestyle early in childhood may promote a lifelong commitment to health and wellness. In the future health professionals as well and

educators could utilize the Fitnessgram to provide an objective measure of a child's fitness level in reference to standardized age and gender specific norms.

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