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EFFECTS OF A SPORTS PERFORMANCE TRAINING PROGRAM ON
ADOLESCENT ATHLETES

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EFFECTS OF A SPORTS PERFORMANCE TRAINING PROGRAM ON ADOLESCENT ATHLETES

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ABSTRACT

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The purpose of this study was to determine the effects of a training intervention that combined strength, plyometric, and speed and agility training on sports performance in adolescents. Twelve middle and high school girls and boys (aged 14.7 ± 1.7 years) participated in a seven week youth sports performance training (YSPT) intervention. The program met three days a week on non-consecutive days for ninety minutes. At baseline and after training all participants performed a static and countermovement vertical jump, push-ups, pro agility run, overhead medicine ball toss, and 40 yard dash. These skills were assessed for quality of the skill using a 1-5 Likert scale. While vertical jump, overhead medicine ball toss, and the 40 yard dash all improved, the paired samples t-test revealed significant improvements only in push-ups (29.5 ± 18.6 , 38.8 ± 15.8 , $P = 0.0$) and pro agility (5.2 ± 0.4 , 5.1 ± 0.3 sec, $P=0.024$) from baseline to after training. The Wilcoxon test demonstrated significant improvements in the quality of the skill only for pro agility. These findings suggest that a short-term youth training program that focuses on sports performance may have a positive effect on upper body muscular strength and endurance and agility in adolescents.

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INTRODUCTION

Sports performance programs have increased in popularity and exposure among youth. The term sports performance encompasses speed, power, and strength that enhance athletic ability or performance (8, 19). It is well accepted and documented that strength training is safe and effective for youth (2, 3, 4, 5, 8, 14, 15). More importantly, many studies have stated numerous benefits of youth strength training such as increased strength and improved motor fitness (3,8). Nonetheless, all organizations supporting strength training for youth conclude that youth should be properly supervised, follow correct exercise prescription, and perform all exercises with correct form and technique in order to maximize benefits and minimize risks (2, 3, 4, 5, 8, 14).

Young athletes benefit most from practicing skills critical to their sport, but incorporating strength through sports performance training into their training regime can be even more beneficial (2). Young athletes can develop increased muscle strength and power, improved motor performance skills, and enhanced sports performance to name a few (17). In addition, improvement in sports performance, or athletic ability, can be trained through a multi-component sport performance program that includes plyometric and speed training in addition to resistance training (18). The degree of effectiveness of sport performance programs is largely dependent on the program design and quality of instruction.

A combination of strength training and plyometric training programs are recommended for adults when greater gains in motor performance are warranted (6).

Although there is some literature to suggest that plyometric training may be safe and effective for children and adolescents, this type of training lacks sufficient research and is a less accepted form of training this population. Additionally, despite increased research focused on youth participating in Olympic based lifts and maximal strength testing, the American Academy of Pediatrics (AAP) states that youth should avoid competitive power lifting, body building, and maximal lifts until they reach physical and skeletal maturity (3, 8). It is suggested that explosive and rapid lifting of weights during routine strength training is not recommended because safe technique may be difficult to maintain and body tissues may be stressed too abruptly (3, 11, 12). Although research supports youth strength training as a safe and effective mode of training, plyometric and speed training warrant further research and the AAP is hesitant to support participation in one-repetition maximal lifting or Olympic lifting (3).

Other variables, including growth, maturation, and learning may play a role in the gains made by youth involved in structured sports performance programs. Understanding the changes that occur in youth during growth and maturation is an important component when observing potential changes resulting from training. The majority of research has lacked controlling for normal growth and maturation. During and after puberty, training-induced gains in males and females are associated with increased muscle mass due to growth or hormonal influences (8). Whereas growth and maturation can affect training outcomes, learning effect is another variable to consider. Many times youth are not exposed to the complex tasks involved in sports performance skills. As a result, training related changes seen over time might simply be an outcome of learning the task.

To date, there have been few prospective studies that have investigated multi-component youth sports performance training programs while the demand for a well-trained youth athlete is increasing. In addition, researchers studying youth and sports performance training programs have lacked in controlling for normal growth, maturation, and learning (15). Therefore, the purpose of this study was to determine the effects of a short-term, multi-component training intervention that combined strength training, plyometric activities, and speed and agility drills on athletic ability in adolescents.

METHODS

Experimental Approach to the Problem

Middle and high school youth participated in a seven-week youth sports performance training (YSPT) intervention that met during the summer for three days a week on non-consecutive days for ninety minutes. The training included strength training, plyometrics, medicine ball exercises, speed and agility training, and active range of movement exercises in the warm-up and cool-down. A seven-week training program was used because improvements have been seen in youth and strength and sports performance interventions lasting about eight weeks, with training volumes of two to three days a week (8, 15). Unlike many studies that fail to attribute increases in sports performance due to possible growth and maturation as well as a learning effect, we chose to include these characteristics to further determine training related responses.

Subjects

Twelve middle and high school boys and girls (9 boys and 3 girls) aged 14.7 ± 1.7 years volunteered and completed a seven-week YSPT program. Prior to gathering youth participants, the university's Institutional Review Board Committee approved the project.

Additionally, both the youth and their parents were briefed of the training program through a written informed consent. Parents were also asked to complete a health history questionnaire on their youth. We solicited youth who were in middle or high school, entering grades seven through twelve. All youth listed the sports they played and indicated whether they had any prior strength training experience in the past. Descriptive characteristics of the subject's strength training and sports experience are presented in Tables 1 and 2.

Table 1. Subjects' years beginning and playing sports.

| | Total (n=12) | Boys (n=9) | Girls (n=3) |
|--------------------------|--------------|------------|-------------|
| Age began playing sports | 5.3±1.1 | 5.0±0.7 | 6.0±2.0 |
| Years playing sports | 8.9±1.6 | 8.4±0.9 | 10.3±2.5 |

Table 2. Frequency of lifting experience and sports played (Total n=12).

| | |
|-----------------------------|---|
| Lifting experience (yes) | 9 |
| No prior lifting experience | 3 |
| Baseball | 3 |
| Basketball | 9 |
| Golf | 1 |
| Football | 3 |
| Soccer | 3 |
| Track | 4 |
| Volleyball | 1 |
| Softball | 2 |
| Cross-country | 4 |

Procedures

Height (cm), weight (kg), and sitting height (cm) were measured according to accepted protocols (16). Date of birth was asked to determine decimal age. From the measured physical characteristics, sitting height-to-height ratio was estimated. Table 3 shows the subjects growth and maturation characteristics pre and post training. The

principle investigator made all physical characteristic measurements. Both height and sitting height were measured twice for 12 subjects in order to calculate a Pearson Product moment correlation and a technical error of measurement (16). We found a high, positive correlation for the replicated measures of height ($r=0.99$) and sitting height ($r=0.99$).

Additionally, the technical error of measurement was 0.22 for height and 0.18 for sitting height; solidifying that height and sitting height were again reliable within the tester.

Reliability of height and sitting height measurements are located in table 4.

Table 3. Pre and postraining subject characteristics.

| | Total (n=12) | Boys (n=9) | Girls (n=3) |
|----------------------------------|--------------|------------|-------------|
| Decimal age (years) | 14.7±1.7 | 14.0±1.3 | 16.8±1.1 |
| Pre height (cm) | 169.3±4.3 | 167.8±3.5 | 173.6±4.1 |
| Post height (cm) | 171.8±4.2* | 170.2±3.2 | 176.5±3.7 |
| Pre weight (kg) | 59.3±9.8 | 56.1±6.7 | 68.7±12.8 |
| Post weight (kg) | 60.0±9.4 | 56.7±5.9 | 70.2±12.1 |
| Pre sitting height (cm) | 84.7±3.5 | 83.1±2.4 | 89.4±1.4 |
| Post sitting height (cm) | 86.8±3.8* | 85.3±0.5 | 91.3±1.6 |
| Pre sitting height/height ratio | 0.5±0.01 | 0.5±0.01 | 0.52±0.01 |
| Post sitting height/height ratio | 0.5±0.02* | 0.5±0.01 | 0.52±0.01 |

*Indicates significant difference ($p<0.05$) within a group between pretraining and postraining values.

Table 4. Reliability of height and sitting height measurements.

| | Correlation | TEM |
|----------------|-------------|------|
| Height | 0.992** | 0.22 |
| Sitting height | 0.994** | 0.18 |

**Indicates significant correlation ($p<0.01$)

The principal investigator, who was a National Strength and Condition Association (NSCA) Certified Strength and Conditioning Specialist, designed the seven-week intervention or YSPT program. The purpose was to improve area youths' athletic performance. Three coaches were recruited through the university's NSCA recognized strength and conditioning undergraduate and graduate programs. Two of the YSPT

coaches were undergraduate students and were NSCA Certified Personal Trainers and one was a graduate student who held a Certified Strength and Conditioning Specialist certification. Prior to the start of the YSPT program, all coaches completed a two-hour training session developed by the principal investigator.

Athletic Performance Tests

All subjects were tested prior to and after the intervention. Athletic performance tests used in this project included the following: a) vertical jump (static and countermovement); b) push-ups; c) pro agility; d) two kilogram backward overhead medicine ball throw for distance; and e) 36.6 meter sprint (40 yard dash). These tests were chosen as they are universally accepted in strength and conditioning as valid measures for each of the specific motor skills (e.g. 40 yd dash is a valid measure for speed) and the tests were specific and relevant to the YSPT program (13). Instructions for assessment for all athletic performance tests were taken directly from standardized protocols (13). To familiarize the subjects with the athletic performance, they watched a five minute instructional-based video before each of the athletic performance tests were performed. Subjects were told to read the written instructions on the screen, which was followed by a demonstration of a person performing the test on the video. The principal investigator, along with the help of advisors and the YSPT coaches, developed this video.

The athletic performance tests were done in order of a) vertical jump (static and then countermovement); b) push-ups; c) pro agility; d) backward overhead medicine ball throw for distance; and e) 36.6 meter sprint. At least one minute of rest was provided when multiple trials were required. In order to estimate leg power, vertical jump (cm) was performed using the Just Jump system (Probotics, Huntsville, Alabama). The best of

three jumps was used as the outcome in each of the static and countermovement tests. Total number of push-ups to exhaustion were counted and used to determine upper body strength/endurance. Time to completion (seconds) in the pro-agility test was used to assess agility or the ability to change directions quickly while the better of two trials was used as the outcome. To assess total body explosive power and general athletic ability, a two kilogram backward overhead medicine ball throw (cm) was used and the best of three distances thrown was used as the outcome measure. Finally, subject's performed a 36.6-meter sprint (seconds) and the better of two trials were recorded. Timing was done using a hand held stopwatch.

Along with the outcome measure for each test performed, the quality of the test was also addressed. The YSPT coaches were responsible for conducting the sports performance tests and evaluating a qualitative score for both pre and post training to ensure reliable results. A five point Likert scale was used to assess the quality of the skill performed. After all trials of each athletic performance test were complete, a YSPT coach ranked each subject, based on their opinion of subjects' overall technique and form, using the five point Likert scale. Also, to increase reliability, all coaches were given written directions for the athletic performance test they conducted and performed prior to the actual testing. They were told to give each subject the same instruction, encouragement, and feedback.

Intervention

After pre testing, subjects were grouped into their YSPT groups according to age and skill level with a student to teacher ratio of six to one. The YSPT program met three days a week on non-consecutive days (M, W, F) for ninety minutes. The program's main

components consisted of a dynamic warm-up and cool-down, strength training, speed and agility, plyometrics, and medicine ball drills. See Table 5 for a weekly overview of the YSPT program.

Table 5. Youth Sports Performance Program weekly training overview.

| Monday | Wednesday | Friday |
|-----------------------------------|----------------------------|--|
| Dynamic Warm-up (15 min) | Dynamic Warm-up (15 min) | Dynamic Warm-up (15 min) |
| Plyometrics (lower body) (30 min) | Speed and Agility (30 min) | Medicine Ball (15 min) Power Clean (15 min) |
| Upper body strength (30 min) | Sprint mechanics (30 min) | Lower body strength (30 min) |
| Cool-Down (15 min) | Cool-Down (15 min) | Cool-Down (15 min) |

The YSPT program followed appropriate NSCA recommended strength guidelines and progressions for youth (8,19). Previous NSCA youth strength guidelines recommend beginning with relatively light loads of 12 to 15 repetitions as to allow for appropriate adjustments to be made. Also, a progression of one to three sets of six to fifteen repetitions on two or three nonconsecutive days, depending on the goal of a program, are recommended and were utilized in the development of this intervention (19). The strength training for the YSPT involved a variety of body weight, band and free weight exercises. Youth completed two sets of ten to twelve repetitions for the first two weeks, two to three sets of ten to twelve repetitions for weeks three and four, and two to three sets of eight to ten repetitions in weeks five, six and seven. Subjects' intensity was monitored individually through the ability to perform each set with correct form and technique within the repetition range. When the desired amount of repetitions was performed, the weight was increased by five to ten percent and the repetitions were decreased to the lower end of the prescribed training range. Throughout the study, all

subjects were encouraged to increase the amount of weight lifted but only if correct technique and form were maintained. Appropriate rests of 60 to 90 minutes were given between each set of strength exercises. The power clean was taught in progression of starting position, low pull, high pull and then full power clean. Youth completed between two to three sets of four to six repetitions throughout the progression of the power clean while lower intensities were used to emphasize form, technique, and explosiveness. Finally, the speed, agility and plyometric programs, including the medicine ball exercises, followed appropriate adult training guidelines since there are a lack of standardizations and guidelines existing for youth training loads in this type of training. Subjects performed one to two sets of four to six repetitions of each plyometric, speed, agility or medicine ball exercise. The speed, agility and plyometric training had a technique orientated instruction focus including some sprinting mechanics training. Appropriate rest of two to three minutes was given between each set for the power clean, speed, agility, and plyometric training exercises. It is important to note that the athletic performance tests (e.g. push-ups) were never performed as exercises throughout the seven week YSPT program. Table 6 illustrates a comprehensive list all of the strength, speed, agility, plyometric, and other exercises utilized during the YSPT program.

Table 6. YSPT program exercise list.

| Dynamic warm-up | Strength exercises | Speed and agility | Plyometrics | Medicine ball drills |
|----------------------|---------------------|-------------------------------------|------------------------------|----------------------|
| Carioca | Power clean | Build ups | Double leg jump for height | Chest pass |
| Walking lunges | Squat (variations) | Game: sharks and minnows | Double leg jump for distance | Side throw |
| Frankensteins | Lunges | Game: builders and bulldozers | Double leg jump for lateral | Overhead throw |
| Walking RDL's | SLDL | Freeze tag | Skip for height | Wood chop |
| Sumo squat | RDL | Lateral shuffle | Skip for distance | Partner twist |
| High knees | Ham curls | Teach base position | Double leg tuck jump | Throw for height |
| Butt kicks | Leg press | Back pedal | 3 consecutive jump | Throw for distance |
| Inchworm | Step-ups | Acceleration | Jump squat | Med ball drops |
| Bear crawl | Band ab/adduction | Sprint mechanics/technique and form | Split squat jump | Sit-ups |
| Arm circle toe walk | Bench press | Indian run | Lateral box jump | |
| Lateral lunge | DB flies | Hollow sprints | Box jump up | |
| Scorpion | Band chest pull | Cone drills | Jump over barrier | |
| Walking quad stretch | Inverted row | | Single leg hop | |
| Walking knee hug | Overhead press | | Line side to side hop | |
| Spiderman walk | Shoulder raises | | Drop landing | |
| | 1-arm bent over row | | Jump rope | |
| | Seated row | | Game: Hop tag | |
| | Lat pull down | | Burpees | |
| | Superman | | | |
| | Biceps/Triceps | | | |
| | Abdominal exercises | | | |

Statistical Analyses

A paired samples t-test was performed to determine if there were any differences in the athletic performance outcome measures and physical characteristics over time. Considering no control group was utilized, effect size was also calculated from pre to post training to determine if there was a small (0.2 or less), moderate (about 0.5) or large (0.8 or more) meaningfulness of the outcomes in each athletic performance test. Another paired samples t-test, with a Wilcoxon signed ranks test, was used to find any differences in the quality of the sports performance test skill based on a one through five Likert Scale. Finally, a Pearson Product moment correlation and the technical error of measurement were performed for height and sitting height to check reliability within the tester. A level of significance was set $p < 0.05$ (2-tailed).

RESULTS

Physical Characteristics

All subjects were average height and weight while calculated BMI fell within normal ranges for the YSPT group (20.6 ± 3.0), boys (20.0 ± 2.5) and girls (22.7 ± 3.7). Sitting height-to-height ratio was reported as normal. More importantly, the boys sitting height to height ratio (0.5 ± 0.01 , 0.5 ± 0.01) was lower than the girl's ratio (0.52 ± 0.01 , 0.52 ± 0.01). Height (169.3 ± 4.3 cm, 171.8 ± 4.2 cm) and sitting height (84.7 ± 3.5 cm, 86.8 ± 3.8 cm) significantly increased over the seven-week program intervention. All physical characteristics can be found in Table 3.

Athletic Performance

The number of push-ups completed (29.5 ± 18.6 , 38.8 ± 5.8) and time in the pro-agility (5.2 ± 0.3 sec., 5.1 ± 0.3 sec.) significantly improved over the seven-week training session. Nonetheless, it is important to note changes, while small, were still made in the static vertical jump, backward overhead medicine ball throw, and the 36.6 meter sprint (Table 5). Effect size showed a moderate effect for push-ups (0.54) and a small effect for pro-agility (-0.30), 40-yard dash (-0.21), overhead medicine ball throw (0.17), and static (-0.08) and countermovement (-0.12) vertical jumps. All athletic performance results are found in table 7.

Table 7. YPST athletic performance tests at baseline and post-training.

| | Baseline | Posttraining | p value | Effect size |
|---|-----------------|----------------|---------|-------------|
| Push-ups | 29.5 ± 18.6 | 38.8 ± 5.8 | 0.00* | 0.54 |
| VJ (static jump) (cm) | 40.9 ± 8.4 | 41.4 ± 5.8 | 0.63 | 0.078 |
| VJ (countermovement Jump) (cm) | 42.7 ± 7.6 | 41.9 ± 4.6 | 0.54 | -0.12 |
| Pro-agility (sec) | 5.2 ± 0.3 | 5.1 ± 0.3 | 0.02* | -0.30 |
| Backward overhead medicine ball throw (m) | 10.5 ± 1.8 | 10.8 ± 1.6 | 0.37 | 0.17 |
| 36.6 meter sprint (sec) | 6.2 ± 0.6 | 6.0 ± 0.5 | 0.40 | -0.21 |

*Significantly greater improvement from baseline ($p < 0.05$).

Quality of Skill Performance

A Wilcoxon signed ranks test indicated significant improvement of the quality of the skill, or the technique and form, performed only in the pro-agility (3.08 ± 0.83 , 4.08 ± 0.52). Little to no improvements were made in the quality of skill performed in push-ups, the vertical jump tests, the backward overhead medicine ball throw or the 36.6 meter sprint. Table 8 shows the quality of the athletic performance skill performed at baseline and posttraining.

Table 8. YSPT athletic performance quality of skill using a 1-5 Likert scale at baseline and postraining.

| Dependent Variable | Baseline | Post-training | P value |
|---------------------------------------|------------|---------------|---------|
| Push-ups | 3.79±0.72 | 3.75±0.75 | 0.89 |
| Vertical jump | 4.00±0.83 | 4.08±0.67 | 1.00 |
| Pro-agility | 3.08±0.76 | 4.08±0.52 | 0.00* |
| Backward overhead medicine ball throw | 3.46± 0.45 | 3.50±0.52 | 0.56 |
| 36.6 meter sprint | 4.29±0.84 | 4.17±0.58 | 0.56 |

*Significantly greater improvement from baseline ($p < 0.05$).

DISCUSSION

Overall, our results suggest youth can benefit from a combination of resistance, plyometric, and speed and agility training lasting seven weeks. In addition, we found the quality of the skill improved over time in the pro agility athletic performance test. Further discussion or understanding into the effects of a multi-component, youth sports performance program on athletic performance has many facets that include growth and maturation, program design, motor learning, and other limitations.

Growth and maturation may play a role in the gains made by youth involved in structured sports performance programs due to increasing amounts of muscle mass due to growth or hormonal influences. Again, the majority of research has lacked controlling for normal growth and maturation. Our subjects' physical characteristics were within average height and weight ranges, while calculated BMI fell within normal ranges for the YSPT group, boys and girls. In addition, sitting height-to-height ratio indicated most subjects were in normal ratios, but may still be growing. More importantly, the boys sitting height to height ratio was lower then the girl's ratio suggesting the boys in the YSPT program were younger and still growing compared to the girls who seemed to be towards the end of growth and maturation stages. Further, we found that within the girls'

age range they ranked in the 95th percentile for height and above the 75th percentile for weight while the boys' age range ranked within the 50th for both height and weight. Again, this could mean that the boys in the group were younger and growing more than the girls. Although subjects' weight did not change, within the seven week YSPT program the subjects' height and sitting height grew significantly. In looking at our sample, while changes did occur in height and sitting height, the TEM was within normal limits therefore we believe this may have been a result of measurement error versus actual growth. According to a meta-analysis review on weight training in youth-growth, maturation and safety, gains associated in strength with resistance training seem to be independent of changes in body composition and estimated muscularity (15). However, with this age group it is entirely possible some gains made in muscular strength and endurance (push-up athletic performance test) may have been a result of normal growth and maturation due to the boys being in the process of growth and maturation. Our results show that growth could have had an effect on athletic performance but more importantly the YSPT program did not negatively impact growth and maturation of youth, which is consistent with previous research (15). It is also important to note that no injuries were reported within the seven-week training program. Consistent with research, youth strength and sports performance training programs are safe and effective.

The degree of effectiveness of sports performance programs is largely dependent on the program design and the quality of instruction or the conditions of practice. The YSPT program was comprehensive, as it included many training factors such as strength training, plyometrics, speed and agility training and instructional based training, in order to maximize overall athleticism. This is a limitation because it is hard to determine

which training produced the greatest effects on each athletic performance test. Similarly, Meyer and colleagues' (17) research on multi-component sports performance training were also unable to determine which training component was most effective or whether the effects were a result of a combination of different types of training in female adolescent athletes. This suggests that research should continue not only in multi-component sports conditioning programs, but also in more controlled training programs such as strength training only programs.

It is important to design sports performance programs specific to the goals of the program and to the specific characteristics of the neuromuscular system being trained (19). Although few training activities have 100% carryover to sport or activity in terms of specificity, a sports performance training program that includes different types of training may be effective for increased athletic ability or movement in youth (6). Research by Faigenbaum (6), who combined resistance training with plyometrics, and Meyer and colleagues (17), who combined resistance training with plyometrics and speed training, reported significantly greater improvements in upper body power, lower body power and speed and agility in adolescent athletes than a non-exercising control group. Our YSPT program also encompassed different types of resistance and sports performance training exercises and loads (resistance, plyometrics, speed and agility training) in order to improve overall athleticism. While our subjects did not see as many improvements as the previous studies had reported, we still saw significant improvements in upper body muscular strength and endurance as well as sprinting speed. Thus the effects of multi-component sports performance training programs, which combines resistance training along with other athletic training modes such as plyometrics, may

actually be synergistic, or the combined effects of different training modes may be greater than each program performed alone (6).

A sports performance program's volume (sets, repetitions, load) and study length can also have large effects on outcomes. Research in youth and strength training has found that study lengths of as little as eight weeks, with training volumes of two to three days a week had significant outcomes on increased strength and performance in youth (8, 15). The YSPT was seven weeks in length and consisted of a variety of training modes that were spread throughout each week. As a result, the YPST program is of short duration and maintained lower volumes (sets, reps and load), which may have limited the effects of the overall athletic performance outcomes. Overall, research does suggest that larger effects of athleticism can be seen in youth in strength and sports performance training programs that consist of higher volumes and longer study lengths (8). Even though increased training length and volumes are needed in order to see more significant improvements, it can be unrealistic for the youth athlete to fit this into their sport schedules. We choose a seven week study duration for youth because they were done with school for the summer and it was before sports programs started again in the fall. Although we may have seen more significant results with an increased volume of exercises throughout the week and a longer study duration, the results may suggest that positive adaptations in athletic performance can occur with relatively low training volumes and short duration study lengths.

Overall, there has been a lack of control for the learning effect during youth strength training and sports performance program interventions. Previous studies usually have subjects go through an intensive familiarization process of the athletic performance

outcomes being tested. These familiarization processes includes subjects practicing the athletic performance tests prior to actual data collection, but in our study we only had subjects watch a video of the tests without any practice. Additionally, we never included the athletic performance tests in the training program; rather we chose activities or exercises that were biomechanically and metabolically transferrable to the outcome tests. As familiarization, or practice of the athletic performance tests, is a form of learning the skill, we choose purposely to exclude this prior to data collection. To control for learning we documented the quality of the skill performed pre and postraining. Our subjects performed the athletic performance tests with better quality in the pro-agility. More importantly, the subjects' time in the pro-agility also improved significantly. It has been suggested that comprehensive conditioning programs that include plyometric training, strength training, as well as technique orientated instruction on sprinting mechanics maybe most likely to enhance running performance and agility (Faigenbaum, 2006). It is likely that the pro-agility athletic performance test improved significantly due to motor learning effects. A recent review related to youth and strength training found relatively small increases in muscle size compared with gains in strength, which suggest that responses to strength training stimuli in youth are largely neural and may include a learning component (15). Perhaps this further illustrates that the neural and motor learning effects of a youth sports performance training program on subjects may have an impact on the transfer of skills to athletic performance tests or possibly into sports participation. As a result, training related changes seen over time might simply be an outcome of learning the task through practice and experience.

Finally, a limitation to this study was the lack of a control group. As mentioned previously, research has found that youth strength training and multi-component sports performance programs found significant gains in athleticism compared to non-exercising control groups. Although we did not compare our YSPT program to a control group, the effect size showed a moderate effect for push-ups and a small effect for pro-agility, 36.6 meter sprint, backward overhead medicine ball throw, and static and countermovement vertical jumps.

PRACTICAL APPLICATIONS

Results of this study suggest that a short-term training program that focuses on movements important in athletic performance can have a positive effect on upper body muscular strength and endurance and agility in adolescents. Furthermore, the fact that the quality of the skill improved with training suggests that learning more difficult skills (e.g. plyometrics) can also result in positive adaptations to movement skills. In addition, we suggest researchers continue to investigate the effects of growth and maturation as well as learning a skill on performance in these adolescent athletes. A multi-component sports performance training program, that includes strength training, plyometric training, speed and agility training, is safe and may improve adolescents' athletic performance. More importantly, a sports performance training program for youth of short duration and relatively low training volumes may suggest neural and learning effects can transfer into athletic performance abilities. Further research is warranted in studying multi-component youth sports performance training programs compared to strength training only programs or regular sports participation. While the demand for a well-trained youth athlete is increasing, research still lacks in recommending training protocol beyond strength

training guidelines. With increased research in multi-component training, along with other athletic performance studies in youth, such as plyometric programs, the strength and conditioning field can set standards and norms for youth and other sports performance measures beyond strength training.

ACKNOWLEDGEMENTS

The YSPT program was made possible through the collaboration of the University of Wisconsin-La Crosse Exercise and Sports Science Strength and Conditioning Program, the Exercise and Sports Science Human Performance Laboratory, the local area YMCA, and a donation from Lifetime Fitness. Also, thank you to the YSPT coaches for their dedication to the young athletes.

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APPENDIX A
LITERATURE REVIEW

REVIEW OF LITERATURE

Introduction

The purpose of this paper is to review the literature related to adolescent athletes and sports performance training. Sports performance training most commonly refers to training that includes such things as strength, plyometrics, and speed and agility that are used to increase ones athletic ability or performance in sports. Strength training in youth has concluded to be safe and effective for developing and enhancing the young athlete (1,2,3,4,5,8,10,18,19). Few studies have researched the effects of strength training combined with other forms of sports performance training such as plyometrics (6). Increased knowledge about safe and effective sports performance training programs for youth warrants further research.

Sports performance has increased in popularity and exposure among youth. It is well accepted and documented that strength training in youth is safe and effective, despite past positions. Medical and fitness organizations that support a supervised and proper exercise prescription for youth and strength training are: American Academy of Pediatrics, American Orthopedic Society for Sports Medicine, National Strength and Conditioning Association, and the American College of Sports Medicine. Many reviews and studies state numerous benefits of strength training as well as the risks associated. These findings suggest similar and general program considerations, but all research and professionals will suggest a sports program for youth are properly supervised and follow correct exercise prescription and form and technique to maximize benefits and minimize risks.

Youth

The term youth is a general term that encompasses preadolescent and adolescents. Preadolescence or children refers to a period of development in which boys and girls have not yet developed secondary sex characteristics. This period is classified in levels one and two of the Tanner stages for sexual maturation and is 11 years of age in girls and 13 years of age in boys. Adolescence is a period of time between childhood and adulthood. This includes girls ages 12-18 years and boys 14-18 years of age and levels three and four of the Tanner Stages. For the purposes of this paper the term youth will be used.

Strength Training

Strength training is important to define since the evolution of different strength related sports. Strength training, also known as resistance training, is physical conditioning used to increase one's ability to exert or resist force (21). It is important to note that strength training does not include the competitive sports of weightlifting, powerlifting and body building (18).

Risks/Concerns Associated with Youth and Strength Training

Previously, resistance training in youth was not recommended due to a high risk of injuries (10). Much of this concern was due to the data that was gathered by the National Electronic Injury Surveillance System (NEISS) of the U.S. Consumer Product Safety Commission, which gathers data in various hospital locations collecting the number of injuries related to exercises and equipment (3). In NEISS's initial reports, related injuries did not specify what caused the injury and included those cases from the competitive sport of weight lifting and power lifting. The most common resistance

training injuries in the NEISS reports were sprains and strains with the hand, low back and upper trunk being commonly injured areas (3, 24, 25). After further investigation of their reports poor training, excessive loading, poorly designed equipment, free access to the equipment, or lack of qualified adult supervision, caused injuries (10). Appropriate strength training programs have not had adverse effects on linear growth, growth plates, or cardiovascular system (1,2,3,4,5,10,19).

Due to more reported injuries from powerlifting and body lifting, the American Academy of Pediatrics condones the practice of weightlifting, powerlifting, body building and repetitive use of maximal amounts of weight. They state that these competitive strength training modes should be avoided until physical and skeletal maturity unless further data is produced (1,2,3). Although there are numerous studies of preadolescents and adolescents training safely in these manners, the potential for injury during performance should not be overlooked (8). More research needs to be done in this area.

Doctors should always clear young athletes before starting any exercise program in order to caution against any pre existing conditions. Like any other exercise program or recreational activity, resistance training does pose some inherent risks. In fact, sports such as soccer, basketball or football, place sport specific forces on the joints of young athletes that may be greater in magnitude and duration than those resulting from an appropriately designed strength program (10). We should be careful not to generalize the results of injuries related to the competitive sports of weightlifting compared to carefully designed and supervised youth strength training programs. According to an evidence-based review by Malina (2006), experimental training protocols with weights and

resistance training machines are relatively safe. Risk can be minimized by close adult supervision, proper instruction, and careful selection of training equipment (8).

Effectiveness of Strength Training

Contrary to past beliefs, youth can see effects such as increased strength just as adults. Health professionals thought children were not trainable due to inadequate levels of circulating androgen hormones. According a youth strength training review (19), all but one study concluded significant increased muscular strength gains in programs that trained two or three times per week. It is also interesting enough that it noted pre and early pubertal youth showed small gains in estimated arm muscle compared with significant gains in strength. This suggests the response is due largely to neural factors and may include a learning component (19).

Youth will see rapid decreases of strength and performance due to periods of inactivity, injury, or other factors that would be considered a period of detraining (14, 19). Studies showed a decrease in strength only after eight weeks of no resistance training. Also, participation in physical activities, such as football, soccer, and basketball during the detraining period did not maintain the children's training induced strength gains (10). Because there is little effect on muscle size during preadolescents, it seems that changes in neuromuscular functioning and possibly motor coordination, would be at least partly responsible for the detraining response observed from children (10). Although youth can effectively gain strength with a proper strength training program, they can lose performance gains if they discontinue a strength exercise program.

Potential Benefits

In addition to strength gains, there are many additional benefits to youth strength or sports conditioning program such as enhancing long term health and psychological health, preventing injuries, and improving sports performance (2). More importantly, youth participating in strength and sport conditioning programs will be better prepared to tolerate the sometimes forceful demands imposed on their skeletal system in their sports participation (8). First, there are many health related benefits such as improvements in youth's components of physical fitness; cardiovascular fitness (if the strength training program includes a cardiovascular training component), increased muscular strength and endurance, and improved body composition and flexibility. Also, positive changes have been noted in bone density, connective tissue, blood pressure, and blood lipid profiles (1,2,3,4,8,10).

Injury Prevention

To date, information on strength training and injuries is very limited. As stated previously, research has indicated that experimental training protocols involving strength training are safe and injuries were generally associated with improper technique and unsupervised activity (19). On the other hand, even though very little research exists there may be the potential for sports conditioning programs to prevent injuries. Due to increased sports participation and the demand for a highly trained young athlete, most youth programs are focused on sport specific skills rather than fundamental fitness skills.

Youth are specializing in one sport at younger ages and participate in longer training periods. The lack of emphasizing fundamental fitness skills, and participation in only one sport, may not only discriminate the youth whose motor skills are not as well developed, but lead to acute and repetitive micotrauma, or overuse injuries (8).

Psychological Health

The potential for improvements in psychosocial health is often taken for granted. It is well know that adults benefit from a strength training and other exercise programs far beyond the physical effects. Although research is limited in youth, psychological benefits resulting form strength training programs may have the same effect as it does in adults in increasing the total psychosocial well-being of children. Starting an exercise program for youth helps foster favorable attitudes towards fitness and lifelong exercise. It is important to remember that inappropriate coaching methods and unethical training practices can have a negative effect on children's emotional and psychological health, which may lead to the abuse of performance enhancing drugs, eating disorders, burnout, and other adverse consequences (8). In conclusions, coaches and instructors should treat every child to their uniqueness and have an understanding of various learning styles (12).

Improved Motor Performance Skills

Although, muscular strength and endurance are attractive for improved sports performance, youth sports conditioning programs can also increase other motor fitness skills that help develop better athleticism. For example, studies have shown increases in jumping ability (long and vertical jump) and speed and agility time (20).

It is important to note that some studies have reported significant gains in strength without significant improvements in selected motor performance skills, though (8). The degree of effectiveness of sports performance programs is largely dependent on the program design and quality of instruction.

Program Design

A combination of strength training and plyometric training programs are recommended for adults when greater gains in motor performance are warranted (6). Although there is some literature to suggest that plyometric training may be safe and effective for children and adolescents, this type of training lacks sufficient research and is a less accepted form of training for youth. It is suggested that explosive and rapid lifting of weights during routine strength training is not recommended because safe technique may be difficult to maintain and body tissues may be stressed too abruptly (3, 11, 12). Although research supports youth strength training as a safe and effective mode of training, plyometric and speed training warrant further research and the AAP is hesitant to support participation in one-repetition maximal lifting or Olympic lifting.

Program Volume

A sports performance program's volume (sets, repetitions, load) and study length can also have large effects on outcomes. Research in youth and strength training has found that study lengths of as little as eight weeks, with training volumes of two to three days a week had significant outcomes on increased strength and performance in youth (8, 19). Results from a previous investigation on different strength training protocols in youth, found that high repetition training protocol (either with a moderate or heavy load combined with medicine ball training) is more effective than other training protocols in

children (8). Together, the research suggests that larger effects of athleticism can be seen in youth in strength and sports performance training programs that consist of higher volumes: higher repetitions, increased sets, and training weekly volumes of two to three days a week.

Standards and Guidelines

It is important to recognize the recommended standards and guidelines for youth and strength training. The National Strength and conditioning Association (NSCA) recommends strength guidelines and progressions for youth. The strength guidelines recommend beginning with relatively light loads of 12 to 15 repetitions as to allow for appropriate adjustments to be made. Also, a progression of one to three sets of six to fifteen repetitions on two or three nonconsecutive days, depending on the goal of a program, are recommended (21). When the desired amount of repetitions are performed, the weight is only increased by five to ten percent or the repetitions are decreased to the lower end of the prescribed training range. Youth should also be encouraged to increase the amount of weight lifted but only with correct technique and form. Finally, NSCA recommends using a variety of ways to weight train including free weights, machine weights and body weight exercises.

The Current Position of the NSCA on Youth and Strength Training (1996 Position Statement):

1. A properly designed and supervised resistance program is safe for children.
2. A properly designed and supervised resistance training program can increase the strength of children.

3. A properly designed and supervised resistance training program can help to enhance the motor fitness skills and sports performance of children.
4. A properly designed and supervised resistance training program can help to prevent injuries in youth sports and recreational activities.
5. A properly designed and supervised resistance training program can help to improve the psychosocial well-being of children.
6. A properly designed and supervised resistance training program can enhance the overall health of a child.

Recommendations from the American Academy of Pediatrics on Strength Training by Children and Adolescents:

1. Proper resistance techniques and safety precautions should be followed so that strength training programs for youth are safe and effective.
2. Youth should avoid power lifting, body building, and maximal lifts until they reach physical and skeletal maturity.
3. Athletes should not use performance-enhancing substances or anabolic steroids. Youth who participate in strength training programs should be educated about those risks.
4. Pediatricians should be asked to recommend or evaluate a strength training program for children and adolescents before the child starts an exercise program.
5. Aerobic training should be coupled with resistance training if general health benefits are the goal.
6. Strength training programs should include a 15 minute warm-up and cool-down.
7. Athletes should have adequate intake of fluids and proper nutrition.

8. Specific strength training exercises should be learned initially with no load.
Strength training should involve 2 to 3 sets of higher repetitions (8-15) 2 to 3 times per week and be at least 8 weeks in duration.
9. A general strengthening program should address all major muscle groups and exercise through a full range of motion.
10. Any sign of illness or injury from strength training should be evaluated before allowing participation again.
11. Instructors or personal trainers should have certifications reflecting specific qualifications in pediatric strength training.
12. Proper technique and strict supervision by a qualified instructor are critical safety components of any youth strength training program.

Youth Strength Training Guidelines by Faigenbaum (2000):

1. Qualified adults should provide supervision and instruction at all times.
2. Participants should wear appropriate clothing and footwear in the training area.
3. The training environment should be safe and free of hazards.
4. Realistic goals consistent with the needs and abilities of each participant should be established.
5. Warm up by performing at least 10 minutes of light aerobic and stretching exercises.
6. Begin with one light set of 10 to 15 repetitions on 6 to 8 exercises: Encourage success by choosing the appropriate exercises and workloads for each student.

7. Focus on participation and proper technique instead of amount of weight lifted.
8. 1 to 3 sets of a variety of single and multi-joint exercises can be performed.
9. Teach students how to use workout cards and regularly review each student's progress.
10. Adult spotters should actively assist the participant, in the event of a failed repetition.
11. Two to three nonconsecutive training sessions per week are appropriate.
12. Increase the resistance gradually as strength improves (approx. 5-10%).
13. Strength training program should be varied over time to optimize training adaptations and prevent boredom.
14. Strength training should be one part of a well-balanced youth fitness program.
15. Participants should be encouraged to optimize their dietary intake and properly hydrate.

Limitations of Research

Even though strength training and youth has been a popular research topic in the last ten years, there are still limitations to the researchers findings. Major study limitations are short study durations, low training volumes or poor program design, lack of control for learning effect, growth and maturation and finally lack of control group.

Conclusions

Sports conditioning programs are relatively safe under the appropriate conditions and may have positive effects on fitness related components and sports performance skills. Further research is warranted in studying multi-component youth sports

performance training programs compared to only strength training programs or regular sports participation. A multi-component sports performance training program, that includes strength training, plyometric training, speed and agility training, and Olympic lifting may improve adolescents' athletic performance beyond that of a strength training program only. In addition, within this age group more investigation into the effects of growth and maturation as well as learning a skill on performance in these adolescent athletes is warranted. While the demand for a well trained youth athlete is increasing, research still lacks in recommending training protocol beyond strength training guidelines. With increased research in multi-component training, along with other athletic training studies such as plyometric programs, the strength and conditioning field can set standards and norms for youth and other sports performance measures beyond strength training.

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APPENDIX B

YOUTH SPORTS PERFORMANCE TRAINING PROGRAM BROCHURE

What can I expect from this program?
Sign up for our sports performance training program now so you can develop and increase muscle strength and endurance, bone density, improved body composition, cardiorespiratory fitness, and physical performance in recreational or competitive activities.

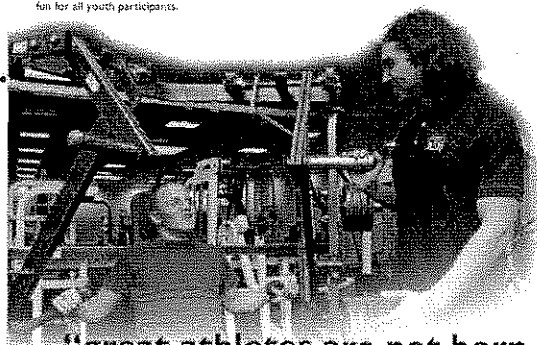
In addition to sports training, the YMCA will focus on character development, nutrition and general health and wellness topics.

Age-specific training guidelines, program variations, and certified supervision will make this performance training program safe, effective, and fun for all youth participants.

The Youth Sports Performance Training Program is sponsored in part by:

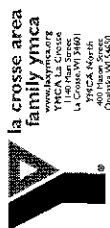
Life Fitness

UW-L Strength and Conditioning



"great athletes are not born, they are made"

Image: iStockphoto.com, Timothy Shaffer - 1



la crosse area family ymca

take your performance to the next level

Y

youth sports performance training

Image: iStockphoto.com, Timothy Shaffer - 1

la crosse area family ymca

sports performance training

This sports specific program is for youth athletes who want to compete at a high level. It is a program based on doing hard work the right way.

The training program is designed by U.S.A. Banting Coach, Dennis Kline, who has trained elite athletes such as Olympic Gold Medalist Andrew Rodd. The training includes strength, speed and agility, Olympic lifts, and plyometrics; all of the areas needed to be an all around athlete.

Who is eligible for this training program?
The sports performance training program is offered to both boys and girls that are entering the 7th through 12th grades.

- All program participants will be grouped according to age and/or skill level.

What are the benefits of the youth sports performance training program?
• One-on-one attention in a small group setting
• 1 staff person per 6 participants.

• Staff are Certified Strength and Conditioning Specialists or Certified Personal Trainers from the National Strength and Conditioning Association.

• The program will be customized for participants sports specific demands of football, soccer, volleyball, cross country, wrestling, basketball and even spring sports.

• Participants will receive T-shirt, pre and post-program testing to see growth, and season based instructional handouts to continue training throughout the year.

• Meet and train with UW-L Athletes!



We build strong kids, strong families, strong communities.



Image: iStockphoto.com, Timothy Shaffer - 1

When is the youth sports performance training program offered?

The training program is offered on Mondays, Wednesdays and Fridays from June 16 through August 7th for a total of 8 weeks and is offered from 7:30am-9:00am, 9:15am-10:45am, or 11:00am-12:30pm.

How do I get started?

Fill out the registration form included in this brochure by June 11, 2008 and return it to either YMCA location. You can drop it off or mail it to the attention of Youth Sports Performance Training, La Crosse Area Family YMCA, 1140 Main Street, La Crosse, WI 54601.

Registrations are limited to 24 participants per time slot.

For Further Information contact Brandon Corcoran at 608-782-9622 ext. 285 or Rachel Haxgus at ext. 229.

Which location offers the Youth Sports Performance Training program?
The training program is being offered at UW-L's Mitchell Hall.

What is the cost?

Family members - \$170.00*
Youth wellness members - \$180.00
Community participants \$190.00

*An additional 50% discount is offered to YMCA family members for youth athletes who enrolled in the program.

Youth Sports Performance Training Registration Form

YMCA member: ☐ Yes ☐ No

Type membership: ☐ Family ☐ Youth Wellness

Name: _____

Date of Birth: _____ Grade Entering: _____

Address: _____

City: _____ State: _____ Zip: _____

Phone: (_____) _____

TIME (circle one)
7:30am-9:00am 9:15am-10:45am 11:00am-12:30pm

PAYMENT OPTIONS

☐ Cash ☐ Check ☐ Charge

Type of credit card: ☐ Mastercard ☐ VISA

☐ American Express ☐ Discover

Account: _____

Expiration: _____

3 digit code on back signature block: _____

Signature: _____

Send Mail-in Registration to the attention of the Youth Sports Performance Training, La Crosse Area Family YMCA, 1140 Main Street, La Crosse, WI 54601

Image: iStockphoto.com, Timothy Shaffer - 1

APPENDIX C
INFORMED CONSENT

University of Wisconsin – La Crosse, Department of Exercise and Sport Science

Study Title: The effects of strength training on physical fitness, motivation, and self-perception in adolescents.

Why have you been asked to participate in this study?

You are being asked to participate because you are a teenager, associated with the YMCA, and between the ages of 12 and 18 years. For this study we will be having you perform some strength related tests and a bone and body composition analysis. The purpose of this study is to examine physical fitness in teenage boys and girls.

What will happen to you if you agree to participate in this study?

If you decide to participate in this study, you will be asked to attend two testing sessions – a pre and post-test. These tests will take place approximately six weeks apart, starting in June and ending in August. Each testing session will last approximately 60 minutes and will occur in Mitchell Hall of the UW-L campus in the Strength Center and Human Performance Lab. During the strength center session you will be asked to perform the following: 1) a vertical jump; 2) a leg press using proper technique and a lightly weighted bar; 3) as many push-ups as you can with proper form; 4) a standing long jump; 5) an agility run; and 6) an overhead ball throw.

How much time is required if you participate in this study?

The total amount of time for each pre and post-test is approximately 60 minutes. This will be performed approximately six weeks apart. In addition, you are responsible for transportation to and from the testing sessions held at UW-L. If you are registered for the youth sports performance class you will have an additional time commitment of one hour, twice a week.

Do you have to take part in this study?

Taking part in this research study is your decision. You may decide to stop participation at any time. If you decide to stop you should tell the researcher immediately. In addition, the researcher may stop you from taking part in this study at any time if it is in your best interest, if you do not follow the study rules, or if the study is stopped.

What are the possible risks and discomforts that are a result of this study?

There are minimal risks associated with participation in this study. The strength testing sessions may cause some muscle strains and muscle soreness. However, proper technique will be enforced and proper stretching will be required and certified personnel will administer each test. If injury occurs, during the testing sessions, appropriate medical attention will be provided. However, UW-L is not liable for the injury and your health insurer may cover the cost of this medical care as UW-L has no plans to compensate you, financially or otherwise.

How will you benefit by participating in this study?

Information from this study may help to further understand the effects of strength training as a lifetime physical activity on fitness. You will specifically benefit by learning information concerning your physical fitness.

How will my information stay confidential?

All information will be kept confidential. As a participant you will be assigned a number upon consent to participate. This identification number will be used for all data that is collected. All information will remain confidential unless authorized by federal agencies.

What happens if you get sick or hurt as a result of the study?

In the unlikely event that any injury or illness occurs as a result of this research, the Board of Regents of the University of Wisconsin System, and the University of Wisconsin La-Crosse, their officers, agents and employees, do not automatically provide reimbursement for medical care or other compensation. Payment for treatment of any injury or illness must be provided by my or my third-party payor, such as my health insurer or Medicare. If any injury or illness occurs in the course of research, or for more information, you are encouraged to notify the investigator in charge.

If you have questions or concerns, who should be contacted?

If you have any remaining questions, you may contact Rachel Hazuga, Wellness Director at the La Crosse YMCA at (608) 782-9622 or Dr. Rebecca Battista, at (608) 785-8182. Questions regarding the protection of human subjects may be addressed to the UW – La Crosse Institutional Review Board for the Protection of Human Subjects (608) 785-8124.

Informed Assent Form

Child/Adolescent's Understanding:

Have all of your questions regarding how the research study might affect you been answered?

Yes/No (Circle one)

If you want to be a part of the study, please sign your name. If you do not want to be a part of the study, then do not sign your name. ***You can say no to being in the study, and you will not be disliked or treated differently.***

Child/Adolescent's Signature

Date of signature

Printed name of Subject

Parent's/Court-Appointed Guardian's Understanding:

Have all your questions about how the research study is going to affect your child and or/yourself been answered?

Yes/No (circle one).

I believe my child is fully informed and is willing to participate in this study.

Parent's/Court Appointed Guardian's Signature

Date of signature

Investigator/Presenter

I have discussed with study and the possible risks and benefits of the study with the child, and I believe he/she is fully informed and is willing to participate.

Presenter's Signature

Date of Presentation

What does signing this consent form mean?

A signature indicates:

1. You or your child have read the above.
2. You or your child have freely decided to take part in the research study described above.
3. The studies general purposes, details of involvement and possible risks and discomforts have been explained to you and your child.

APPENDIX D

WRITTEN INSTRUCTIONS FOR THE ATHLETIC PERFORMANCE TESTS

Test #1 Vertical Jump
Tester: Josh Hockett

Staffing:

- 1 Judge/recorder

Equipment:

- Electronic timing mat - the Just Jump System

1. Countermovement Jump Procedure:

- The athlete stands as still as possible on the mat with weight evenly distributed over both feet.
- The athlete should place his/her hands on their hips.
- Without taking a step, the athlete lowers himself or herself in a countermovement (flexes the knees and hips, brings trunk forward) and jumps vertically as high as possible.
- The athlete then lands back on the mat with both feet landing at the same time
- To be accurate, you must ensure that both feet land back on the mat with legs nearly fully extended, as landing with the legs bent can give incorrect larger scores.

2. Static Jump Procedure:

- The athlete stands as still as possible on the mat with weight evenly distributed over both feet.
- The athlete should place his/her hands on their hips.
- Without taking a step, the athlete lowers himself or herself and **pauses for at least 3 seconds** and jumps vertically as high as possible.
- The athlete then lands back on the mat with both feet landing at the same time
- To be accurate, you must ensure that both feet land back on the mat with legs nearly fully extended, as landing with the legs bent can give incorrect larger scores.

Attempts: three attempts

Record jump height given to the nearest 0.5 or 1.0 cm and the time in the air.

Test # 2 Push-up Test
Tester: Randy Erickson

Staffing: 1

Equipment:

- Mat or soft area to perform push-up test
- Foam block (place under chest)

Procedure:

- The individual assumes the up position with his body rigid and straight. The hands are slightly wider than shoulder-width apart and the fingers are pointing straight.
- A partner places a foam block on the floor beneath the individual's chest.
- The individual lowers himself to the block and raises himself back to the starting position.
- Throughout each push-up the individual should maintain a rigid back.
- The partner counts the total number of pushups performed to exhaustion (they quit or bad form).
- ***The female performs the push-up from the bent-knee position. Her hands should be placed slight ahead of her shoulders so that in the lowered position her hands are directly under her shoulders.

Attempts: Subject performs as many repetitions as possible without pausing or to exhaustion.

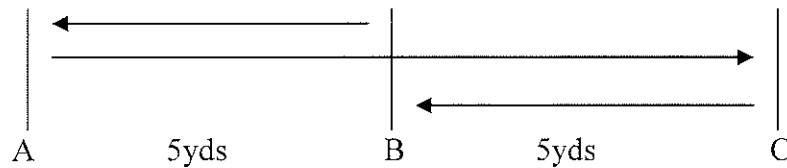
Record number of repetitions to exhaustion.

Test #3 Pro Agility
Tester: Adam Bisek

Staffing: 1

Equipment:

- 15 yds of uncluttered, flat, safe space
- Stopwatch
- Tape measure
- 50m (164 ft) Tape Measure



Procedure:

- Place tape down to mark the start/finish line. Measure out 15 feet (or 5 yards) each direction and place tape. Place cones on (A), (B), and (C).
- The athlete will straddle the start/finish line with one hand down on start line.
- The athlete will be stationary for 2 seconds.
- Timers will be standing at the start/finish line. The timer will start the watch as the hand comes off the ground or on the athlete's initial movement and stop the watch as the torso crosses the finish line.
- The athlete will sprint from point (B) to point (A) touching the tape then changing direction and sprints to point (C) touching the tape, then changes directions again and sprints across the finish line (B).

Attempts: 1

Record the best time to the nearest 0.01 second

Test #4 Overhead Med Ball Throw
Testers: Randy Erickson and Adam Bisek

Purpose: This test measures upper body strength and explosive power.

Staffing: 2 testers - one to mark results another to check technique at start (if available a person to shag the ball).

Equipment:

- 2 kg medicine ball
- Tape measure

Procedure:

- The subject stands at a line with their heels touching the line. They should face the opposite direction from which the ball is to be thrown.
- The ball is held with the hands on the side and slightly behind the center.
- The ball should be thrown vigorously backward **as far as possible**.
- The subject is permitted to step backward over the line after the ball is released, and is in fact encouraged to do so in maximizing the distance of the throw.

Attempts: Three attempts are allowed.

****When recording the distance, you can either move the tape to where the ball landed or less accurately align where the ball landed to the approximate distance on the tape.**

Record the distance the ball was thrown to the nearest 0.5 or 1.0 cm

Test #5 40 yard Sprint
Tester: Josh Hockett – timer and Aimee Schneider – ready set go

Purpose: The aim of this test is to determine acceleration, and also a reliable indicator of speed, agility and quickness.

Staffing: 2 - 1 timer, 1 person to say ready, set, go.

Equipment:

- At least 60 yds of uncluttered, flat, safe space
- Stopwatch
- Tape measure
- 50m (164 ft) Tape Measure
- Cones (beginning and end)

Procedure:

- Measure out 120 feet and place tape at the start and finish of the 40, with cones at each side of the tape for additional reference marks.
- The athlete should start in a 3 or 4 point stance with hands on the starting line.
- The athlete should run through the entire 40 yd and not slow down until crossing the line.
- Give the commands ready-set-go
- The timer will start the watch upon initial movement of the athlete and stop the watch as the torso crosses the finish line.
- Timer will be standing at the finish line with step watch in hand.

Attempts: Three attempts will be given to each athlete

Record the best time to the nearest 0.01 second

APPENDIX E

FINAL LETTER TO YOUTH AND PARENTS

August 24, 2008

Dear _____,

Thank you for participating in this summer's *La Crosse Area Family YMCA Youth Sports Performance Training Program*. Enclosed you will find your results from the pre and post sports performance tests as well as a program evaluation and survey.

We would appreciate your feedback and input on the program evaluation and survey because it is important to us as well as critical for the future success of this program.

We hope you enjoyed your time with us this summer and are successful in your upcoming sports seasons! Remember that the coaches and I are always available to answer your questions or assist you in the La Crosse Area Family YMCA's Wellness Center.

Hope to see you at next summer's YSPT program!

Sincerely,

Rachel Hazuga
YMCA Health and Wellness Director
rhazuga@laxymca.org
782-9622 ext 229

Youth Sports Performance Coaches:

Randy Erickson
Josh Hockett
Adam Bisek
Tyler Reynolds
Aimee Scheinder

Below are your results from the pre and post sports performance tests. If any of the scores are missing that means that you were not present for one of the testing days. Although results from the program varied between individuals (with at least everybody improving in at least one or more areas), overall the group improved in all tests. It is possible that you may have improved without the results indicating it. Some people test better than others and also keep in mind that the test results can be affected by many variables including: attendance throughout summer session, personal effort throughout the summer session, outside activities of the YPST program, test knowledge, effort presented on testing day, and many more. If you would like to discuss your results, please feel free to contact me.

The vertical jump test assesses anaerobic power in athletic populations. It provides a measurement of strength and power of the lower body.

| | | |
|-------------------------------|-----------|------------|
| Static Vertical Jump | Pre-Test: | Post-test: |
| Countermovement Vertical Jump | Pre-Test: | Post-test: |

The push-up test assesses muscular strength and endurance of the upper-body.

| | | |
|----------|-----------|------------|
| Push-ups | Pre-Test: | Post-test: |
|----------|-----------|------------|

The pro-agility test measures agility or the ability to change direction rapidly.

| | | |
|-------------|-----------|------------|
| Pro-Agility | Pre-Test: | Post-test: |
|-------------|-----------|------------|

The medicine ball throw test assesses muscular power of the upper body.

| | | |
|---------------------|----------|-----------|
| Medicine Ball Throw | Pre-Test | Post-Test |
|---------------------|----------|-----------|

The 40 yard dash test assesses speed or the ability to perform a movement in as short as time as possible.

| | | |
|--------------|-----------|------------|
| 40 Yard Dash | Pre-Test: | Post-Test: |
|--------------|-----------|------------|

APPENDIX F

YOUTH SPORTS PERFORMANCE TRAINING PROGRAM EVALUATION

Youth Sports Performance Program Evaluation and Survey

Please help us serve you better. We need your feedback – good or bad.

*Completed evaluations can be mailed in or returned to either Member Services Desk.
Thank you!*

We encourage you to fill out this evaluation and survey with your child.

Participant info: Boy Girl (Circle One) **Grade:** _____ **Practice Time:** _____

| | Excellent 4 | Above Expectations 3 | Meets Expectations 2 | Needs Improvement 1 |
|--|--------------------------|-----------------------------------|-----------------------------------|----------------------------------|
| Instructor's knowledge of class material | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Instructor's helpfulness & cooperation | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Precautions taken to insure safety and lack of injury | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Value of class for the price | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| My child gained self-confidence | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| My child increased their skills | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Character development was taught | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Facility Location and space | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| Overall satisfaction | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |

Youth Sport Performance Program Survey

- Did you like the dates/times of the summer YSPT program? Yes No
If No, what suggestions do you have?
- Will you sign up for the YSPT summer program next year? Yes No
- Would you recommend this program to others? Yes No
- Would you be interested in a school year (Sept.-May) YSPT Program? Yes No
If Yes, what suggestions do you have for dates/times?