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Effects of an 8-Week Training Program on Performance in Female High School Volleyball Players

Richard Armstrong
University of Rhode Island

EFFECTS OF AN 8-WEEK TRAINING PROGRAM ON PERFORMANCE IN FEMALE HIGH SCHOOL VOLLEYBALL PLAYERS

BY

RICHARD ARMSTRONG

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RICHARD M. ARMSTRONG

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Major Professor ______________________________

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Abstract

The purpose of this study was to determine the effects of an 8-week training program on performance measures in high school aged female volleyball players. Twenty-five female volleyball players from the Rhode Island Junior Rams volleyball club program (mean age 15.6 ± 1.15) completed the study. The subjects trained two nights per week for 8 weeks using different methods of resistance training techniques. The resistance training program involved a full body workout consisting of 2 sets of 10 exercises during each training session. Training sessions took place on court during normal practice times for the club teams using affordable and readily available sports specific training equipment. Performance measures were conducted before and after the training program. Significant differences were found in body mass index (BMI) (21.99 ± 2.61 vs. 22.33 ± 2.81), balance right (31.09 ± 28.68 vs. 49.48 ± 37.03), balance left (34.30 ± 31.53 vs. 52.35 ± 42.18), T-test (12.68 ± .72 vs. 12.36 ± .46), medicine ball chest pass (337.88 ± 28.45 vs. 314.52 ± 32.32), and modified pull up (13.20 ± 5.29 vs. 11.36 ± 3.46). There were no significant differences in sit and reach (50.70 ± 7.23 vs. 50.80 ± 7.66), vertical jump max (18.10 ± 2.34 vs. 18.22 ± 1.84), and repeated vertical jump (16.62 ± 2.18 vs. 16.46 ± 1.55). Subjects that had lower levels of fitness at baseline improved more than those who were more fit at baseline. It was concluded that the training program was effective in producing changes in performance measures.

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Introduction

In the United States, approximately 30 million children and adolescents participate in competitive organized sports, with even more participating in recreational and community-based physical activities. It is estimated that 50 percent of boys and 25 percent of girls under the age of 18 participate in some form of these organized activities (Youth Resistance Training: Position Statement and Literature Review, 1996). The 1999-2000 National Health and Examination Survey (NHANES) found that 35% and 56% of adolescent males reported participating in moderate-to-vigorous physical activity for 60 and 30 minutes a day, respectively, while only 20% and 35% of adolescent females reported participating in the same amount of activity (So-Yeun & Foley, 2005). These studies suggest that girls are less active than boys in organized sports, recreational activities, and general physical activity. However, girl's participation in school athletic programs and community-based recreational programs has been growing. Girls now comprise 37 percent of all high-school athletes; an increase from one in 27 girls who participated in 1971 to one in three girls in 1994. In 1994-1995, 2,240,000 girls participated in high school sports (National Federation of State High School Associations (NFSHA), 1995-1996).

The introduction of strength training programs may benefit the increasing number of girls who participate in competitive sports. Strength training can be described as using a variety of resistances to increase muscle strength including free weights, selectorized machines, resistance tubing, body weight, and other methods to enhance performance and possibly reduce the risk of injury in athletes (Faigenbaum & Schram, 2004; American Academy of Pediatrics (AAP), 2001; Team Physician and

Conditioning of Athletes for Sports: A consensus Statement, 2000). The need for properly designed strength training programs for adolescents has recently gained acceptance. In the past, it was believed that strength training made young athletes more susceptible to repetitive stress injuries, injuries to the immature spine, epiphyseal growth center injuries, stunted growth, and negative cardiovascular effects such as increased blood pressure during strength training exercises (AAP, 2001). These myths have been rejected, and recent guidelines have been put in place by the National Strength and Conditioning Association, American College of Sports Medicine, and the American Academy of Pediatrics to ensure that proper precautions are taken when applying strength training to the youth population (Youth Resistance Training, 1996; American College of Sports Medicine, 2002; AAP, 2001). The National Strength and Conditioning Association states "a properly designed and supervised resistance training program is safe for children" (Youth Resistance Training, 1996).

The benefits of strength training are similar in the adolescent and adult population and include increases in muscle strength, muscle endurance, muscle power, bone mineral density, and body composition, as well as improvements in proprioception and motor performance skills (Kraemer & Fleck, 1993; Faigenbaum, La rosa Loud, O'Connell, Glover, O'Connell & Westcott, 2001; Faigenbaum & Schram, 2004). Motor skill development is important because (1) motor skill proficiency is necessary to participate in activities that build endurance, power, and strength and (2) a certain level of fitness is required to be involved in exercise and sport activities (Physical Activity & Sport in the Lives of Girls, 1997). Psychosocial benefits such as improvements in one's attitude towards fitness, self-concept, and socialization, and an increase in self-confidence may also be associated with strength training in adolescents (Faigenbaum, 1995; Faigenbaum and Schram, 2004). Although the benefits of resistance training are similar in both the youth and adult populations, there are differences in the way training effects the individual based on maturity (Fleck & Kraemer, 2004). During childhood and early adolescence, most strength gains occur from neural adaptations. Strength gains in the adult population are a result of neural adaptations and hypertrophy. The growth of the muscles begins after adolescence in most individuals.

To receive the benefits associated with resistance training, programs must be properly designed and monitored. The goals of the adolescent athlete often include improved performance. Therefore, the strength and conditioning professional must complete an assessment of the athlete and a needs-analysis of the sport to meet the specific needs of the young athlete. Evaluation of the athlete provides baseline data for effective program design and determines the progress of the athlete. Many different fitness and motor performance variables can be trained, including but not limited to, strength, power, agility, balance, and endurance. A needs-analysis of the sports-specific movements will help in the development of specific training programs for the athletes. The program design must be specific to the needs of the athlete as well as the sports that they are preparing for. Programs also must be individualized to the athlete based on their prior training and conditioning, level of maturity, and level of performance and of fitness. Resistance training programs can be designed for young athletes of all ages and abilities.

Another benefit of resistance training may be decreasing the number of injuries suffered by young athletes. With the large number of youth involved in sport and physical activities, injuries are likely to happen. It has been estimated that almost 40 percent of all injuries in the U.S. are a result of sports participation with the risk increasing as a child ages (Reesner & Bahr, 2003). Henja et al. (1981) studied injury rates in high school athletes who participated and did not participate in strength training. Trained athletes had a lower injury rate compared to the non-training group. Studies conducted by Wedderkopp et al. (1999) and Hewett et al. (1999) show similar results. These studies suggest that young athletes should participate in resistance training to be properly prepared for sports participation and to reduce injury rates associated with sport and physical activity.

The research on the impact of strength training in adolescents is limited, especially investigations focusing exclusively on girls. The purpose of the study is to measure the effects of an 8-week training program on performance measures in female high school volleyball players. It was hypothesized that significant improvement in balance and proprioception, upper body and lower body anaerobic power, agiltiy, and modified pull-up tests would be demonstrated after the completion of the 8-week training program.

Review of Literature

In the United States approximately 30 million youth participate in competitive organized sports, with even more participating in recreational and community based activities (Youth Resistance Training: Position Statement Paper and Literature Review, 1996). It is estimated that 50 percent of boys and 25 percent of girls under the age of 18 participate in these organized activities. In this review, the term youth will be used to describe the period of life that includes prepubescent and adolescent years in a broad category (Youth Resistance Training, 1996).

Youth participation in strength training and other forms of resistance training was once thought to lead to or cause an increased chance of injury. Since the child or adolescent was still growing it was believed that s/he would be more susceptible to injuries such as repetitive stress injuries, injuries to the immature spine, epiphyseal growth center injuries, and even stunted growth (Pediatrics: Intensive training and sports specialization in young athletes, 2005). There has been no evidence to support any of the claims of increased injury rates in young athletes who participate in resistance training. However the potential for injuries may be higher in an adolescent because growth plates may be weaker and less resistance to sheer forces than in a younger child (Youth Resistance Training, 1996). Despite this slight risk, strength training is beneficial for young athletes in preparation for the stresses of athletic competition.

There is a need for appropriately designed training programs for young athletes to ensure that they remain safe while training for and participating in sports and recreational activities. In this review, strength training for youth athletes will be discussed with particular attention paid to gender differences, motor performance skills, injuries related to the female gender, and to the sport of volleyball.

Strength Training

Strength training can be classified as a form of physical conditioning that involves the use of a wide variety of resistances to increase muscular strength including free weights, selectorized machines, resistance tubing, body weight, and other resistance methods (Faigenbaum & Schram, 2004; American Academy of Pediatrics (AAP), 2001). With the use of a variety of equipment and techniques, training programs can be designed for any population. Training programs have many benefits for their participants including increases in muscle strength, muscle endurance, muscle power, and bone mineral density; improvement in proprioception, motor performance skills and body composition; and injury prevention (Kreamer & Fleck, 1993; Faigenbaum, La Rosa Loud, O'Connell, Glover, O'Connell & Westcott, 2001; Faigenbaum & Schram, 2004). Improvement in one's attitude towards fitness and self-concept, increased socialization, and an increase in self confidence may also be associated with resistance training (Faigenbaum, 1995;Faigenbaum & Schram, 2004).

Strength training may have beneficial effects on overweight children when it is combined with other forms of aerobic exercise (Benjamin & Glow, 2003). These benefits include possible reduction in the risk of diabetes and hypertension, as well as decreases in cholesterol. If started at a young age they will learn skills that will lead them to a healthy lifestyle not only throughout their childhood, but continuing into adulthood.

To understand the principles of strength training it is helpful to gain an understanding of basic muscle physiology that is associated with strength training. In general there are two distinct types of muscle fibers. Fast twitch muscle fibers, which fatigue quickly, are primarily used to produce rapid force. Slow twitch fibers, which are three to five times slower, are somewhat fatigue resistant and are used during more aerobic activities (McKardle, Katch & Katch; Baechle & Earle, 2000). The stimulus for the activation of the muscle to produce force comes from the neuromuscular system where a high-level central control command signal is sent out. The signal is then sent to lower level controls until transferred into a motor unit command, which in turn activates the muscle fiber that is innervated by the specific motor unit (Kraemer, Fleck & Evans, 1996). A motor unit is the functional unit of movement, and consists of an anterior motoneuron and the specific muscle fiber that it innervates (McKardle, Katch & Katch, 1996).

Maximal force production requires the recruitment of all motor units, and also requires that they fire at a rate fast enough to produce maximal force (Kraemer, Fleck & Evans, 1996). Muscle force is greater when the number of motor units involved is greater, the size of the motor unit is greater, and the rate of firing is faster (Baechle & Earle, 2000). This model suggests that untrained individuals may not be able to recruit the highest number of motor units, and are therefore not be able to activate their muscle maximally (Kraemer, Fleck & Evans, 1996). Strength training affects the neuromuscular system and the generation of muscle force by improvements in the recruitment and firing rates of motor units.

An enlargement of the muscle fibers accompanied by an increase in muscle mass is referred to as hypertrophy (Baechle & Earle, 2000). Hypertrophy of the muscle results in an increase in the cross sectional area, which, in turn, increases force development. Resistance exercise causes muscle hypertrophy of each specific type of muscle fiber with fast twitch fibers showing an increased response to resistance training when compared with slow twitch fibers (Widrick, Stelzer, Shoepe & Garner, 2002). For the action of muscle hypertrophy to occur it seems to require longer periods of time than the adaptation of the neuromuscular system. Periods of resistance training involving 16 or more sessions seem to be required for the increase in muscle fiber size (Kraemer, Fleck & Evans, 1996).

Youth strength training, when supervised and conducted properly, has been accepted as a beneficial mode of exercise for individuals under the age of eighteen (AAP, 2001). Guidelines focusing in the safety and effectiveness of youth participation in strength training have been established by such organizations as American College of Sports Medicine, National Strength and Conditioning Association, and American Academy of Pediatrics (American College of Sports Medicine, 2002; Youth Resistance Training, 1996; American Academy of Pediatrics (AAP), 2004). Hamill (1994) found that injuries resulting from resistance training by 13-16 year olds were not significant and showed that resistance training was safer (.0012 injuries per 100 participation hours) than many other sports and activities. It has been demonstrated that strength training in the youth population is safe, and may result in a lower rate of injuries in youth who participate in athletics after the completion of a training program (Benjamin & Glow, 2003).

There appears to be differences in how children and adults increase strength as a result of resistance training. Prior to reaching puberty, strength gains in youth do not occur due to an actual increase in the size of muscle (hypertrophy). Instead, it is due changes in the nervous system, with strength gains occurring from improvements in functional ability (Kreamer & Fleck, 1993). This training effect increases the neuromuscular response of the muscle in the number of motor neurons that fire during each muscle contraction (AAP, 2001). Ozmun et al. (1994) found that there were no changes in circumference measures following 8-weeks of training of the elbow flexors on muscle size in prepubescent children. It was concluded that the gains in strength came from neuromuscular adaptations rather than hypertrophy (Ozmun, Mikesky & Surburg, 1994). Motor unit activation may also contribute to strength gains in youth. Belanger and McComas (1981) demonstrated an increased motor unit activation of the elbow flexors and knee extensors of 9% and 12 % after 10 weeks of training in young boys, which demonstrates that resistance training does increase strength in youth.

The reason for the differences in training effects between children and adults is due to the fact that youth have not reached full maturity. At birth, a child's total body weight is made up of about 25 percent muscle mass, and this number increases until adulthood where about 40 percent of the total body weight is muscle mass (Baechle & Earle, 2000). There are also sex differences between males and females as they mature. During puberty males increase testosterone, which increases muscle mass, and females increase estrogen, which causes increased body fat deposit, and gender specific development (Baechle & Earle, 2000). The increase in muscle mass in females occurs at a slower rate than in males, with peak muscle mass occurring in males between 18-25, and in females between 16-20 years of age (Baechle & Earle, 2000). This suggests that training programs initiated before and during the years of peak muscle and growth would have a positive effect on the body composition of the individual.

One benefit that has been shown with resistance training along with proper nutrition has been the effect on bone mineral density. This is also important in young females because of their risk for development of osteoporosis in later life (Baechle & Earle, 2000). One type of training that is believed to effect bone mineral density is plyometrics. The increase in bone mineral density is associated with the high ground reaction forces during training that are produced because of the landing forces from jumping. Witzke and Snow (2000) reported that plyometrics improved bone mass at the greater trochanter with improvements in leg strength and balance in adolescent girls. Not only do plyometrics increase bone mass but it also increases some performance measures in female athletes (Myer et al, 2005; Hewett et al., 1996). Similar studies have shown that females who performed more weight bearing activity have a higher bone mineral density compared with athletes that participate in nonweight bearing sports (Duncan, 2002). Research has shown an increase of only 3-5% in bone mineral density results in a reduction in fracture risk from 20-30% (Witzke & Snow, 2000).

Program Design

Before a youth is to begin a training program, individual considerations regarding the design of the program must be considered. To properly assess a youth's level at the beginning of training, age is broken down into categories of: anatomical, biological, chronological, and athletic age (Bompa, 2000). These age categories account for differences in physical size, bone, reproductive, and emotional maturity (Kreamer & Fleck, 1993). Anatomical age describes what a normal child encounters during growth as seen by certain visible characteristics. Biological age is associated with the development of organs and other systems in the body that would differentiate them from someone of the same age and stature (Bompa, 2000). This differs from chronological age because there are differences in the growth and development rates (Baechle & Earle, 2000). Lastly, athletic age describes the level of each individual and their performance in a certain sport and level of competition (Bompa, 2000).

Participation in sports is also broken down into categories or stages of athletic development. By considering the different stages you can assess the needs for each individual that will be trained. The stages include the initiation stage from 6–10 years of age, athletic formation from 11–14 years, specialization from 15-18 years, and high performance at 19 years and over (Bompa, 2000). When designing a program the frequency, mode, intensity, and duration of each training session need to be determined to assign each individual with a properly developed training program (AAP, 2001). Age, maturity, and the stage of athletic development will also factor into the level each individual will begin their training at. Frequency refers to the number of times an individual trains usually within a one-week period. Mode is the type of exercises that are performed during training, and intensity is the level of muscle activity that is related to the work performed per unit of time, or "power output" (Baechle & Earle, 2000).

The program design of a resistance training program for youth should also incorporate other forms of aerobic and anaerobic exercise to help promote physical activity and to develop a variety of motor performance skills (The Team Physician and Conditioning of Athletes for Sports: A Consensus Statement, 2000). Two characteristics of strength training that are of concern are the quality of the instruction and the rate of progression (Baechle & Earle, 2000). A qualified strength and conditioning professional who has an understanding of youth resistance training is necessary for safe and effective program delivery. The rate of progression is important because the limitations of the youth should not be exceeded and therefore they should begin and progress at a rate that is acceptable for each child (Baechle & Earle, 2000). The main focus of the training should be on proper technique and form. This includes multi-joint exercises that focus on proper technique and not the amount of weight that is lifted (Baechle & Earle, 2000).

The question is what program is best and safest for youth to perform? In a position statement by the NSCA on Youth Resistance Training it is recommended that 1 to 3 sets of 6 to 15 repetitions of upper and lower body exercises be performed 2 to 3 days a week (Youth Resistance Training, 1996). The American Academy of Pediatrics has a similar position of low resistance exercise of 8 to 15 repetitions 2 to 3 times per week (AAP, 2001). In a study by Faigenbaum La Rosa Loud, O'Connell et al. (2001) higher repetition and light load training resulted in a larger increase in upper body strength and local muscular endurance than low repetition and high load training (Faigenbaum, 2001). This type of training has also resulted in significant increases in strength for both the upper and lower body when compared to control groups.

However, detraining of only 8-weeks brought the youths strength gains back to baseline levels. (Faignebaum, Westcott, Micheli, Outerbridge, Long, LaRosa Loud & Zaichkowsky, 1996). These studies demonstrate that youth can have increases in strength but need an appropriately designed year-round program in order to prepare them for competition and maintain the increases in strength.

Motor and Performance Skills

Motor and performance skills such as the long jump, vertical jump, 30-meter dash times, push-ups to failure, and agility run times can be improved by resistance training programs (Faigenbaum, 1993; Youth resistance training, 1996). Conversely other studies have shown increases in strength after weeks of training without improvements in motor performance (Brown, Lilligard, Henderson, Wilson, Lewis, Hough & Stringer, 1992; Faigenbaum, Zaichkowsky, Westcott, Micheli, and Fehlandt, 1993). The differences in results may be attributed to the programs that the studies used and the difference in age groups of the youth that were involved. Programs that only addressed one aspect of strength training and did not address performance or motor performance skills may impact improvements experienced by the subjects.

One program that seems to be effective in improving performance measures is the use of neuromuscular training programs (Myer, Ford, Palumbo & Hewett, 2005). Benefits received by both males and females from these types of programs include increases in power, agility, and speed. Often, female athletes experience a greater benefit from the programs because of a decreased baseline level of strength and power that is often seen when compared to males. These programs involve different types of training, which include plyometrics, movement training, balance training, resistance training, core strengthening, and speed training (Myer, Ford et al., 2005). Myer et al. (2005) found that a 6-week neuromuscular training program resulted in a 92 percent increase in the 1RM predicted squat, a 20 percent increase in the 1RM predicted bench press, improvements in biomechanics during landing, and greater dynamic knee stability. Biomechanics during landing are important for injury prevention. Grey et al. (1985) found that 58 percent of all knee injuries in a group of female basketball players were a result of landing from a jump. The position of the knee when landing is important because a less stable knee correlates with an increase in peak landing forces at the knee joint (Henry & Kaeding, 2001).

Lower extremity mechanical efficiency and jumping ability have been labeled as indicators of sport performance in many different sports with power output being a main predictor of jump performance (Kollias, Panoutsakopoulos, & Papaiakovou, 2004). It has been demonstrated that jump training results in improvements in performance of high school female volleyball athletes (Hewett, Stroupe, Nance & Noyes, 1996). During six weeks of training, four techniques were used during the training program: (1) correct posture and body alignment (2) jumping straight up with little movement (3) soft landings (4) and instant recoil for another jump. This type of training resulted in decrease landing forces of the subjects and a 1.5-inch average increase in vertical jump of all the subjects (Hewett et al., 1996). A similar study by Dunnam et al. (1988) resulted in a 1.25-inch increase in vertical jump in collegiate female volleyball players after 11 months of training. The differences in the results of these studies may be due to age group and the level of training experience of the subjects that were trained and tested. The female high school athletes may have increased the vertical jump more over a shorter period of time because of their inexperience and lack of training. Therefore training in less experienced athletes or would result in larger gains than in female collegiate athletes who had been training for longer periods of time. Along with the benefits received from lower body plyometrics, the addition of upper-body plyometrics into a training program may increase upper body performance gains in the athletes.

Studies involving neuromuscular training have shown similar results in the increase in strength and balance after training. Paterno et al. (2004) found significant increases in the single leg stability with the implementation of neuromuscular training programs. Balance training may improve postural control, which may be associated with a decreased risk of ankle injury after training (Myer, Ford et al., 2005). This type of training is important because bilateral deficits have been reported to range from 3 to 25 percent (Owings & Grabiner, 1998). Bilateral deficit can be described as "a decrease in maximum voluntary contraction (MVC) force during bilateral activation of homologous muscles compared with the sum of the forces produced during unilateral MVC of the muscles" (Owings & Grabiner, 1998). The reason could be neural mechanisms, which involve an altered motor unit frequency or recruitment during a bilateral contraction. The cause of a bilateral deficit then may be a result of decreased recruitment of motor units during bilateral contractions. Neuromuscular and balance training may then be able to train the muscles so that the bilateral deficit during contractions is decreased.

Gender Differences

There are strength differences between genders. Shepard (2000) suggested that the differences may be attributed to height as the average female is about .1 meters shorter than the average male. Other factors that may affect strength differences between the genders are the amount of muscle mass, regional differences in muscle mass between females and males, and smaller muscle fiber area in females (Fleck & Kraemer, 2004). This may have an impact on women's physical abilities and lead to as much as a 20% disadvantage in peak strength (Shepard, 2000). One measure of strength is absolute strength, which is the maximal amount of force applied during an exercise (Fleck & Kraemer, 2004). Shepard (2000) has shown that a women's average maximal mean whole body strength is 60 to 63.5% of the average male. For women upper body strength has a larger difference than lower body strength when compared to males. However when expressed as relative strength, which refers to strength relative to total body weight, the percentage of difference declines, although males still show an advantage (Fleck & Kraemer, 2004). Another difference between genders is power output. In this case, females power output relative to body weight when compared to males was 65% in a study conducted by Garhammer (Fleck and Kraemer, 2004). This could be related to the fact that females have a greater ratio of slow-twitch to fast-twitch fibers when compared to males (Burger & Burger, 2002) and only about 70% of the total fiber area overall (Shepard, 2000). A lower ratio of fast-twitch fibers could be a reason for the decrease in power output because the role fast-twitch fibers play in anaerobic activities. A female's musculature may be best suited for prolonged physical activities rather than intense burst of activity due to their muscle makeup (Shepard, 2000). This could affect the way that a female is trained and what types of exercises are chosen during a resistance training program.

There is also a difference in the duration of muscle contractions between young males and females. Young females are capable of sustaining and maintaining a longer duration contraction at sustained isometric submaximal intensities than young males (Hunter, Critchlow & Enoka, 2004). However this is only true for sustained contractions, and not intermittent ones. These findings can be attributed to the difference in strength between the two groups (Hunter et al., 2004). This information is necessary to properly design a program for males and females. In some instances males and females may not be able to perform the same exercises for the same duration of time.

Training has shown to increase fat-free mass in both males and females with both genders showing the same degree of increase. Strength gains have also shown to increase to the same relative degree and at the same rate during the same training programs over a period of time (Fleck & Kraemer, 2004). One other limiting factor is that an average females muscle does not hypertrophy to the extent of a males (Fleck & Kraemer, 2004). In a study by Staron et al. (1991) the greatest increase in body circumference over various sites was only .6 cm after 20 weeks of resistance training.

Injuries

With that number of young athletes active in competitive and noncompetitive sports, many sports related injuries occur each year (Faigenbaum & Schram, 2004). It has been theorized that almost 40 percent of all injuries occurring in children and adults in the U.S. are a result of sports participation. Injury risk increases as children age (Reesner & Bahr, 2003). In order to correct the growing problem, measures need to be taken to improve or limit the number of preventable sports related injuries suffered by these age groups. These correctable risk factors include but are not limited to muscle imbalance, inflexibility, and poor physical conditioning (Youth Resistance Training, 1996). The cause and increase in injuries is likely multifactorial since fewer youth participate in physical education, and are spending increasing the amount of time spent watching television, video games, or on the Internet (Faigenbaum & Schram, 2004). All of these factors could leave youth unprepared for the activities that they are taking part in, with their bodies not able to handle the demands of the sport or recreational pursuits (Faigenbaum & Schram, 2004).

Studies in which strength training programs are implemented have resulted in improvements in the injury rates of subjects involved. Henja et al. (1982) studied injuries in high school students who participated and did not participate in strength training. The training resulted in a 46.2 percent decrease in injuries in male and female athletes. Female athletes who participated in strength training had a 13.3 percent injury rate compared to 18.5 percent rate by female who did not strength train. This is due to a reduction in the injury rate which was accompanied by a decrease in the days missed for rehabilitation when injured. The females who did not strength train had 3 times as many days missed as the females who strength trained following a injury. The effects of strength training on injury prevention was also shown in a study by Wedderkopp et al. (1999), which studied females age 16-18, and resulted in a reduction in acute and overuse injuries in those athletes. The athletes who did not participate in the strength training program where 5.9 times more likely to be injured.

There is recent evidence that females are more susceptible to some injuries than males (Piasecki, Spindler, Warren, Andrish & Parker, 2003). At the high school level there is approximately 2 million females participating in athletics with an estimated knee injury rate of five percent (Henery & Kaeding, 2001). Studies suggest that the level of conditioning, level of muscle strength, and an altered motor control pattern may explain why female athletes are injured more frequently (Chappell, Kirkendall & Garrett, 2002). Programs involving proper hip control and strength have been shown to be beneficial in injury prevention (Zellar, McCroy, Kibler & Uhl, 2003). Also programs that address hamstring strength and power, decreased landing forces, and teaching proper neuromuscular control during jumping and landing can be beneficial to the athletes (Pettineo, Jostes & Lehr, 2004). Research has looked at neuromuscular differences between females and males, and has suggested that those differences could contribute to a higher injury rate in the female athletes (Henery & Kaeding, 2001).

Some studies show that a female athlete is two to six times more likely to suffer an ACL injury when compared to males (Piasecki et al., 2003) Females who participate in sports involving jumping and cutting have a four to six time increase in knee injuries when compared to males participating in the same sports (Hewett, Lindenfeld, Riccobene & Noyes, 1999). It is reported that more than 70% of ACL injuries that occur are sports related (Chappell et al., 2002). The incidence of knee injuries at a collegiate level each year is about 10,000 with 2200 ACL ruptures (Hewett et al., 1999). It is possible that the introduction of proper training and prevention programs at a younger age will result in a lower injury rate. There have been four theories on why this may occur in the female population. They include greater Q-angle, smaller femoral notch, neuromuscular differences, and hormonal variations (Fleck & Kraemer, 2004).

The different causes of injury can be broken down into intrinsic and extrinsic factors. The intrinsic, which cannot be changed are, smaller femoral notch, greater Q-angle, knee laxity, and hormonal variations. Extrinsic factors, which can be changed involve, a person's level of conditioning, muscle strength, and motor control patterns (Chappell et al., 2002). The focuses of how to prevent injuries needs to shift to which factors can be altered in order to give an athlete better preparation for their tasks. The effects of a properly designed resistance training program seem to help athletes increase strength and prepare them for activities leading to a decrease in injuries. Therefore these programs can be used to both increase the performance of an athlete and at the same time help to prevent injuries.

Volleyball Injuries

The most common types volleyball related injuries affect the knee, ankle, shoulder, and low back (Reesner & Bahr, 2003). Relative to other sports, it has been found that volleyball ranked fourth in injuries that occur (Backx et al., 1991). Backx et al. (1991) reported that the highest injury rate was seen in volleyball player's aged 8-17 years. The rate and number of ACL injury ranks volleyball fifth among other female sports (Pettineo et al., 2004). 80% of ACL injuries have been reported to occur via non-contact, and many of them are during the landing phase of a jump (Hewett et al., 1999). Reasons for the high incidence of injury among volleyball players is not known but sports that require a high "jump rate" could be potentially at higher risk for injuries among young athletes (Reesner & Bahr, 2003).

One reason why female jump athletes may be more susceptible to injury is because of altered motor control patterns that are exhibited. Chappell et al. (2002) found that during stop jump tasks, females had an increased proximal tibia anterior shear force during the landing phase compared to males. This anterior shear is thought to be a contributor to anterior tibial translation, which could cause a strain on the ACL, and in turn may cause a tear (Chappell et al., 2002).

Neuromuscular training has shown to improve injury rates among female athletes. Hewett et al. (1999) conducted a study in which a 6-week pre-season training program was conducted with the female athletes. The results of the study showed that knee injuries in the untrained group and trained group were .43 and .12 per 1000 exposures, which lead to a 3.6 times higher rate for untrained athletes (Hewett et al., 1999).

Ankle injuries are also a common injury among many sports. Volleyball, when compared to other sports, has a high incidence of ankle sprains when the non-contact mechanism of injury is taken into consideration (Verhagen, Beek, Twisk, Bouter, Bahr & Mechelen, 2004). Non-contact refers to injuries that mostly occur from landing after a jump and have no contact with anyone else. Athletes who suffer from sprains are more likely to reinjure the same area, which can lead to chronic pain or even instability in many instances (Verhagen et al., 2004). The main focus should be on how to prepare an athlete for the stresses of competition and what is the best way to try and prevent future injuries to the same area.

Assessment of Performance Measures

The purpose for assessing physical fitness and performance includes education of the participants, provision of data, establishing baseline levels of fitness, motivation, and stratifying risk (American College of Sports Medicine (ASCM), 2000). Testing can help an athlete and their coach to assess physical ability and note areas that may need improvement (Baechle & Earle, 2000). There are a wide variety of tests that can be performed depending on the type and specificity of the sport. Anaerobic power (vertical jump, MB chest pass), agility (T-test), and local muscular endurance tests (modified pull-ups) can all be used in a testing battery.

The vertical jump is a test of anaerobic power, and is considered to be an effective field evaluation measure of muscular power because of the correlation between jump height and maximal power when related to body mass ($W \times Kg^{-1}$) (Smilios, 1998). The rate at which force is developed may be the most important physical capacity (Wilson, Lyttle, Ostrowski & Murphy, 1995). Many sporting events including volleyball require explosive strength and it is important that explosive strength is evaluated for these athletes in order to show the effectiveness of different training programs (Moir, Sanders, Button & Glaister, 2005). The Just Jump System is one evaluation tool to assess vertical jump. The Just Jump System has been shown to be reliable and valid compared to other vertical jump measuring systems, and is recommended when a large group must be tested in a relatively short period of time due to the ease and quickness of the system (Isaacs, 1998).

Power can also be assessed in the upper extremity. Upper body power is a sport specific skill necessary for optimal volleyball performance (Dupuis, 2003).

Testing involving upper body power can be assessed using a MB chest pass, and this method of testing has been used in the determination of upper body power in previous studies (Cronin & Owen, 2004). In a study performed by Cronin and Owen (2004) strength, power and impulse were found to be predictors of chest pass performance, and that a chest pass test was a reliable and valid test.

Agility is defined as "the ability to explosively brake, change direction, and accelerate again" (Baechle & Earle, 2000). Agility along with leg power, and leg speed are important factors of performance in many sports and activities (Pauole, Madole, Garhammer, Lacourse & Rozeneck, 2000). One test used to measure this variable is the T-test. A T-test is described as measuring 4-directional agility and body control, which includes the ability to change direction while maintaining body control and speed (Pauole et al., 2000). In a study conducted by Pauole et al. (2000) the T-test was determined to be a valid measure of leg speed, followed by leg power and agility.

Local muscular endurance is the ability of a muscle group or muscle to perform repeated contractions against a resistance (Baechle & Earle, 2000). One such test is a modified pull-up test to failure. This test is used to assess upper body strength and endurance and is widely used in the youth population during fitness testing in physical education classes in schools (Merideth & Welk, 1994).

The sit and reach test measures flexibility of the lower back and hip joint mobility. Range of motion depends on different variables that include warm-up, muscle viscosity, and the flexibility of the joint capsule, ligaments and tendons (Franklin, Whaley & Howley, 2000). Poor performance on the sit-and-reach test may contribute to lower back pain if weak abdominal strength and endurance is also present (Franklin, Whaley & Howley, 2000).

Balance can be defined as the "process of maintaining the center of gravity within the body's base of support" (Prentice, 1999). Tests of balance range from double-leg stances with a subjects eyes closed to single-leg stance, and in some instances newer technology is being used where computers will measure an individuals balance. Propreoception is another term that is associated with ones balance and it refers to "conscious and unconscious appreciation of joint position" (Prentice, 1999). This type of activity is regulated by neuromuscular control and is necessary for proper joint function when participating in sports and other activities.

Conclusion

This review focused on strength training for the youth population and the effects training programs have on strength, performance measures, injury, and other variables associated with training. Strength training helps to prepare individuals for different types of activities including recreational activities, and sport competition. Currently there is limited research available on the training of adolescent female athletes. This group may be unconditioned and unprepared for sports competition if training is not started at a proper age. More research is needed explore and determine the types and effects that training programs has on these athletes.

Methods

Subjects

The subjects were 25 high school female volleyball players who were involved in the Rhode Island Junior Rams Program. The Junior Rams is a volleyball club team made up of high school female players from the surrounding region. The Junior Rams athletes practice two nights a week with practices lasting approximately 3 hours. Throughout the season the Junior Rams competed in games on some weekends, finishing with competitions at the end of their season. The Junior Rams programs consist of female players ranging in age from 14-18 years.

The subjects completed a questionnaire requesting the following information: age, grade, athletic history (including sports played and years experience), injuries, and any medical problems that may have limited them or made them ineligible to participate in the study. All participants provided individual informed written consent or assent, as well as a consent form signed by their parent or legal guardian if under the age of 18. The subjects were required to sign a medical release form to participate in the Rhode Island Junior Rams Program. Participation in the study was voluntary, and approved by the Institutional Review Board (IRB). Each of the subjects participated in 20 total sessions conducted in the following order: (1) two technique sessions, (2) pre-test (3) 16 training sessions and (4) post-test.

Technique sessions

Prior to preliminary testing, the subjects participated in two technique sessions. The athletes were taught proper lifting and training techniques that would be used during testing sessions and during the specific training sessions. The procedures and description of exercises for each different phase of the program were reviewed. Technique sessions were included to familiarize the subject with proper testing protocol and with proper technique needed for testing and training sessions. The goal of the technique sessions was to limit the difference in post-test results related to form and technique and to limit the amount of time needed for instruction at the start of and during the training sessions.

Pre- and Post-testing

Testing sessions occurred before (pre-test) and after (post-test) the 8-week program. A dynamic warm-up (see appendix B) was completed just prior to each testing session to ensure that all of the athletes were warmed up and ready to perform the testing measures. The assessments were arranged so that different muscle groups would be used in successive tests, therefore a minimal rest would be needed in between each different test. All tests were conducted on the same day and in the order listed below.

Anthropometric measurements. Height was measured using a scale-mounted stadiometer, and weight was measured using a balance scale (Detecto: Webb City, MO).

Flexibility. The sit and reach test was used to measure lower back and hip flexibility (Baechle & Earle, 2000). Athlete were instructed to take off their shoes and sit with their feet flat against a standard sit and reach box. The subject was instructed to keep their knee slightly bent and to exhale, drop their head between their arms, and reach forward as far as possible. The middle fingers of each hand were aligned and fingertips remained in contact with the box. The subject held a maximal stretch for 3 seconds. Three trials were administered with the most distal measurement used to represent flexibility (Baechle & Earle, 2000).

Balance and proprioception. The balance and proprioception test required the subject to balance on a foam roller for as long as possible while standing on one foot. A 6-inch high-density half foam roller was used. The subject stood on top of the roller (round side down), lifting one leg off of the roller to a 90 degree position, and holding a single leg stance for as long as possible. The subject was given one trial per leg to determine a maximal time for the test. The subject was also given a brief trial to get acclimated to the foam roller. This test was modified for the purpose of the study from a basic single-leg stance test used for assessment of balance (Prentice, 1999).

Agility. The T-test was used to measure the agility of the subjects (Baechle & Earle, 2000). Four cones were placed in the shape of a T, according to the protocol. The subjects began the test at the top of the T, and on the testers command the subject sprinted forward ten yards to the first cone, shuffled 5 yards to the left and touched the top of that cone, shuffled 10 yards to the right and touched the top of the cone, and then shuffled 5 yards back to the center cone (see appendix C). The test concluded with the subject running backwards to the starting point. A stopwatch was used to time each subject to the nearest tenth of a second. Two trials were completed with the best of those trials used as the subject's time

Anaerobic Power. Maximal anaerobic power was assessed with the vertical jump using a Just Jump System mat (Probotics, Huntsville, AL 03582). The Just Jump System mat is a 27-inch square mat that is attached to a hand held computer. The vertical jump is measured from the time of lift off from the mat to contact back with the mat. The system measures that height based calculations involving airtime, and the subject's time off the mat (Isaacs, 1998). The subject stood on the mat and jumped as high as possible using a counter movement jump. When in the air the subject's legs remain extended until landing back on the mat, which allows the mat to obtain the correct time in air by each subject. If improper form was used the subject was given another trial. The subject was given three trials and the best height was used to represent anaerobic power (Baechle & Earle, 2000)

Upper body anaerobic power. The medicine ball chest pass was designed to measure explosive power in the upper body. The subjects were seated with their back against a wall and their feet out in front of them. A tape measure was taped to the ground to measure the distance of the pass. During the test the subject's back remained against the wall while releasing a 4 lb. medicine ball as quick and forcefully as possible. The farthest of three tosses was used to represent their maximal effort.

Muscular endurance. The modified pull-up assessed local muscular endurance of the upper body specifically using the back musculature (Merideth & Welk, 1999). The subjects lied supine on the ground underneath a bar suspended 33 inches off of the floor. With their feet out, only heels touching, the subject extended their arms up to grasp the bar. From this position the subject lifted their hips off the ground keeping the back flat and pulling their chest to a band that was placed at elbow height. The score was the number of correct exercises that the athlete completed (Merideth &Welk, 1999). If at anytime the subject failed to use the proper technique or could not complete any more pull-ups the test was terminated and the last correct pull-up used as the number completed.

Repeated anaerobic power. The vertical jump repeated test measured the heights of four consecutive vertical jump trials to determine the average height and contact time for each of the four jumps performed (Probotics, Huntsville, AL 03582). The Just Jump System mat was used to calculate each of the jumps. The same procedures apply as the vertical jump test with the subject landing and then repeating a jump four consecutive times as fast and as high as possible. The subject was given one trial. The Just Jump System measured the four jump heights and contact times, averaged those scores, and produced a readout of the averaged times on the handheld computer.

8-week Training Program

The subjects participated in an 8-week resistance training program during their normal practice time for Junior Rams. Training sessions were conducted twice per week for 30 minutes for the 8-week time period. A certified strength and conditioning specialists conducted all training sessions

Each subject performed the same exercises, sets, and repetitions in the same order. Each player was assigned to one of the three different Junior Rams teams based on their age and level of playing experience. Subjects then trained within their respected team. The reason for training in separate teams was to allow for a more manageable training group so that the subject instructor ratio was low, and so that there was no time in between training and volleyball. All of the training was done in the gymnasium where the practices where held. This was done so that training could be easily reproduced and accomplished by other programs that may have limited resources. The equipment that was used is inexpensive and readily available and included medicine balls, elastic resistance tubing, mini-bands, physioballs, hurdles, foam rollers, and other sports specific training equipment as needed. The program consisted of 10 exercises each session, with a full body workout implemented throughout the entire workout and all 16 training sessions. The training started out with basic exercises and then progressed gradually over the eight weeks of training. Exercises to improve strength, power, agility, and balance and proprioception were included throughout the training program. See appendix (A) for the 8-week training program.

Statistical analysis

Means and standard deviations were calculated for each variable. Paired T-test analysis was used to analyze the differences in the performance measures before and after the training program. Independent T-tests were used to analyze the differences in improvement scores between the lower fit and higher fit athletes. Selected bivariate correlations were determined using Pearson's product moment correlation. An alpha level of $p > 0.05$ was used for all tests of statistical significance. Data are presented as mean ± SD.

Results

Descriptive characteristics are shown in Table 1. Attendance during the training sessions for all subjects was 92 percent. Sixty-eight percent of the subjects had either perfect attendance or missed only 1 session. The average volleyball playing experience was 3.1 ± 1.3 years. 76 percent of the subjects had no prior strength training experience and 32 percent were involved in at least one other sport besides volleyball at the time of the study.

Results of the pre-test and post-test for each variable are shown in Table 2. Body mass index (BMI) significantly increased ($p < 0.05$) during the 8-week training program. There was no significant difference between pre-test and post-test scores for sit and reach, vertical jump max, and repeated vertical jump. A significant increase ($p< 0.05$) was found for balance right, balance left, t-test, MB explosive chest pass, and modified pull-ups.

We investigated if the initial level of fitness influenced the degree to which the subjects improved. For each assessment, the subjects were separated into two groups: (1) individuals with scores above the pre-test mean; and (2) individuals with scores below the pre-test mean. Therefore, it is possible that the groups (above mean and below mean) consisted of different individuals for each separate variable. Table 3 compares change scores between subjects with scores above and below the pre-test mean. There were no significant differences between the groups for sit and reach, balance right, balance left, or modified pull-ups. Subjects who were below the pre-test mean improved significantly more ($p < 0.05$) than the subjects who were above the pre-test mean for vertical jump max, T-test, MB explosive chest pass, and vertical jump repeated. In a separate analysis the subjects were broken down into younger (14-15 years) and older (16-18 years) age groups to determine if the younger less experienced subjects benefited more from the program. There were no significant differences between age categories for any variable.

Table 4 shows correlations between each test using post-test results. There were significant positive correlations between BMI and MB chest pass. Both the MB chest pass and vertical jump repeated correlated with vertical jump max with and balance right and balance left were correlated with each other. Significant negative correlations were seen between the T-test and sit and reach, vertical jump max, and vertical jump repeated.

Table 1. Physical Characteristics

n=25	Mean	SD	Range
Age (yrs.)	15.6	1.15	14 - 18
Height (cm)	168.9	4.58	155.6 - 177.8
Weight Pre (kg)	62.8	8.01	47.3 - 77.3

Table 2. Selected Performance Evaluations Before and After 8-weeks of Training

	Pre-test		Post-test		
	Mean	SD	Mean	SD	Δ
BMI (kg/m2)	21.99	2.61	22.33 *	2.81	0.34
Sit and Reach (cm)	50.70	7.23	50.80	7.66	0.10
Vertical Jump Max (in)	18.10	2.34	18.22	1.84	0.12
Balance Right (sec)	31.09	28.68	49.48 *	37.03	18.39
Balance Left (sec)	34.30	31.53	52.35 *	42.18	18.05
T-Test (sec)	12.68	0.72	12.36 *	0.46	-0.32
MB Chest Pass (cm)	314.52	32.25	337.88 *	28.45	23.36
Repeated Vertical Jump (in)	16.62	2.18	16.46	1.55	-0.16
Modified Pull-up	11.36	3.46	13.20 *	5.29	1.84

* Represents ($p<0.05$)

Table 3. Comparison of Change Scores Between Subjects Above and Below Pre-test Mean.

	Mean	SD
Sit and Reach (cm)		
Above (n=14)	-0.27	1.33
Below (n=11)	0.58	3.23
Vertical Jump Max (in)		
Above (n=13)	-0.28	0.94
Below (n=12)	0.56 *	0.91
Balance Right (sec)		
Above (n=9)	6.06	44.70
Below (n=16)	25.32	30.40
Balance Left (sec)		
Above (n=9)	5.78	32.76
Below (n=16)	24.95	38.00
T-Test (sec)		
Above (n=10)	-0.69	0.59
Below (n=15)	-0.07	0.54
MB Chest Pass (cm)		
Above (n=13)	13.38	17.86
Below (n=12)	34.17 *	20.26
Repeated Vertical Jump (in)		
Above (n=13)	-1.08	1.30
Below (n=12)	0.85 *	1.08
Modified Pull-up		
Above (n=14)	1.71	4.20
Below (n=11)	2.00	4.75

* Represents ($p<0.05$)

Table 4. Post-test Correlations

n=25	BMI	SR	VJM	BR	BL	TTEST	MB	VJR	MPU
BMI (kg/m2)	1.00	0.04	-0.23	-0.22	0.01	-0.03	0.58 *	-0.35	-0.28
SR (cm)	0.04	1.00	0.20	0.04	0.23	-0.54 *	0.17	0.27	0.04
VJM (in)	-0.23	0.20	1.00	-0.03	-0.05	-0.49 *	0.39 *	0.81 *	-0.04
BR (sec)	-0.22	0.04	-0.03	1.00	0.63 *	-0.08	-0.15	-0.10	0.23
BL (sec)	0.01	0.23	-0.05	0.63 *	1.00	-0.19	0.08	-0.14	-0.05
TTest (sec)	-0.03	-0.54 *	-0.49	-0.07	-0.19	1.00	-0.27	-0.58 *	0.17
MB (cm)	0.58 *	0.17	0.39 *	-0.15	0.08	0.27	1.00	0.15	-0.22
VJR (in)	-0.35	0.27	0.81 *	-0.10	-0.14	-0.58 *	0.15	1.00	0.04
MPU	-0.28	0.04	-0.04	0.23	-0.05	0.17	-0.22	0.04	1.00

* Significant ($p<0.05$)

BMI (body mass index), SR (sit and reach), VJM (vertical jump max),
BR (balance right), BL (balance left), TTEST (t-test), MB (medicine ball chest pass)
VJR (Vertical Jump Repeated), MPU (modified pull-up).

Discussion

The purpose of the study was to evaluate the effects an 8-week training program on selected performance measures in female high school aged volleyball players. Sports specific assessments were administered before and after the training program to measure the effects that the program had on performance measures. The study resulted in improvements in balance right, balance left, T-test, MB chest pass, and modified pull-ups, while no improvements were seen in sit and reach, vertical jump max, and repeated vertical jump.

Body weight increased during the eight-week program resulting in a significant increase in BMI. The average weight gain for the subjects was .95 kg, however even with the weight gain, 88 percent of the subjects fell within the normal category for BMI (Franklin, Whaley & Howley, 2000). The weight gain over the 8-week training period was not substantial and it is unlikely that it negatively affected the subject's performance.

Balance significantly increased in both the right and left legs, demonstrating that an 8-week training program involving balance exercises performed on unstable surfaces can improve single leg balance times. Left leg balance time was better than the right leg at the pre-test and post-test. This may have occurred because 88 percent of the subjects were right handed and therefore would predominately use their left foot to jump off of. Both the left and right balance times increased equally which demonstrates that the exercises done during training did not favor one side or the other.

The MB chest pass was used to represent upper body strength and power. This test has previously been reported as a reliable and valid measure of these variables (Cronin and Owen, 2004). The current study resulted in a significant increase in MB chest pass after completion of the training program. Power is equal to work divided by time (P=W/T) (Baechle & Earle, 2000). Power can then be defined as "the rate of performing work or the product of force and velocity" (Cronin & Owen, 2004). Therefore the increase in MB chest pass can be related to an increase in force or velocity produced by the muscles when performing the action. This is relative to the sport of volleyball where the upper body musculature is used to perform a set or overhead pass. Dupuis (2003) states that "volleyball performance can be improved primarily by developing better technique and greater explosive power," suggesting that an increase in upper body power may relate to an increase in the performance of volleyball players.

The T-test, a measure of agility, improved significantly during the training program. Pauloe et al. (2000) demonstrated the t-test to have a lower relationship to agility and leg power, but a high relationship to leg speed when compared to other test of agility. This suggests that our subjects may have increased leg speed more than agility. However, the T-test has been used for sports specific testing of volleyball to assess lower extremity movement skills, which are related to the sport (Pauloe et al., 2000). A decrease in the T-test times showed that the program helped the athletes increase performance of lower extremity movement. During the training program the subjects did not perform the t-test. Agility drills using an agility ladder, and agility rings were performed throughout the study. Therefore the agility drills that were performed throughout the study and described in Appendix A can be used effectively to improve the variables that are associated with the T-test.

Modified pull-ups increased significantly after participation in the 8-week program. The average modified pull-ups performed by girl's aged 14-18 as shown in the Fitnessgram standards are 13 (Merideth & Welk, 1999). The average before training for our subjects was 11.4, which is less than the national average. After training the average increased to 13.2, which is slightly higher than the standards measured by the Fitnessgram. Baseline measures of the subjects in the study show that prior to beginning training they were in a deconditioned state. This is evident by the measure of upper body strength when compared to the norms for the same age groups. This suggests that these subjects may not be ready for the stresses of athletic competition. The data from the study shows that the training program performed by the subjects increased upper body strength, which is relevant to the sport of volleyball.

Vertical jump max and vertical jump repeated measures did not change during the 8-week training program. It is possible that the exercises that were performed were not at a high enough intensity for the entire group to have a significant change during the program. It is also possible that more plyometric exercises were needed or that a 30 minute full body training session twice a week was not enough time to make increases in vertical jump height.

We were interested in determining the role that initial level of fitness had on improvements made by the subjects. The subjects were separated into two groups for each variable based on pre-test scores. Significantly greater improvements were shown by subjects with a score below the pre-test mean when compared to subjects with a score above the pre-test mean for vertical jump max, t-test, MB chest pass, and vertical jump repeated. The training program was not conducted at a high enough intensity to elicit the same response in the higher fit and lower fit individuals. The training program was implemented at a low intensity level to accommodate all of the different levels that were present in the subjects. Therefore the lower fit individuals benefited more because the training was appropriate for their initial starting level, but was not as appropriate for some of the subjects who were more highly fit at the beginning of the program.

Correlations were calculated to see if any of the tests were related. The results show that BMI was positively correlated with MB chest pass. These results may be associated with a higher muscle mass and therefore an increase in upper body strength. Vertical jump was not negatively related to BMI as hypothesized and could be attributed the normal range for BMI of the subjects in the study. Vertical jump and MB chest pass were positively related to each other showing that there was a relationship between upper body and lower body power output. The vertical jump tests also were negative compared to T-test, which is similar to the study by Pauloe et al. (2000). These results show that the T-test does not represent leg power because of the negative correlation with both vertical jump tests.

This study had several limitations. It cannot be determined if the results can be attributed solely to the training program since the subjects were also participating in volleyball practice during the same time. It is impossible to determine if the results of the study were due to the training program or a combination of both the training program and volleyball. The amount of training time that was given for each training session was 30 minutes, twice per week, which may not have been enough time to elicit some measures that were tested for. Also the subjects starting level of fitness and experience was different and the training program that was developed may not have been at a high enough intensity for all of the subjects to benefit.

In conclusion, this study found that significant increases in some performance measures can be seen with as little as 8-weeks of training. The training program implemented in the study is easily reproducible for the age groups that were part of the study and any volleyball program using a volleyball court and sports specific training equipment.

Appendix A

8-week Training Program

Week 1 (1)	Sets	Reps
DL Foam Roller Balance	2	30 sec
ss/w		
Jump Rope 2 Foot Hop	2	1:00 min
Crunches	2	15
ss/w		
Lying Opposites	2	8 ea.
Push-ups	2	12
ss/w		
BW Squats	2	15
Standing Partner Row (RT)	2	12
ss/w		
DL Hucks	2	8
Front Raise (RT)	2	12
ss/w		
Bicep Curls (RT)	2	12

Week 1 (2)	Sets	Reps
Mini Band Shuffle	2	10 yds.
ss/w		
Agility Ladder	2	2,3,4, 5,6
Reverse Crunches	2	15
ss/w		
Back Ext.	2	10
Chest Press (RT)	2	12
ss/w		
Split Squat	2	10 ea.
Upright Row	2	12
ss/w		
SL DL (RT)	2	8
Shoulder Press	2	12
ss/w		
Tricep Ext.	2	12

Appendix A cont...

Week 2 (1)	Sets	Reps.
DL Foam Roller Balance (half Squat)	2	:30 sec
ss/w		
Jump Rope 2 Foot Hop	2	1:30 min
Crunches	2	15
ss/w		
Lying Opposites	2	8 ea.
Push-ups	2	15
ss/w		
BW Squats	2	15
Standing Partner Row (RT)	2	12
ss/w		
DL Rocks	2	10
Front Raise (RT)	2	12
ss/w		
Bicep Curls (RT)	2	12

Week 2 (2)	Sets	Reps.
Mini Band Shuffle	2	15 yds.
ss/w		
Agility Ladder	2	2,3,4 5,6
Reverse Crunches	2	15
ss/w		
Back Ext	2	10
Chest Press (RT)	2	12
ss/w		
Split Squat	2	10 ea.
Upright Row	2	15
ss/w		
SLDL (RT)	2	8
Shoulder Press	2	12
ss/w		
Tricep Ext.	2	12

Appendix A cont...

Week 3 (1)	Sets	Reps.
SL Foam Roller Balance	2	30 sec
ss/w		
Jump Rope Alternating	2	1:00 min
Bicycle Crunches	2	10 ea.
ss/w		
Supermans	2	10
Foam Roller Push-ups	2	12
ss/w		
BW Squats w/ mini band	2	15
Alternating Row (RT)	2	8 ea.
ss/w		
Lateral BW Squat	2	6 ea.
Lateral Raises	2	10
ss/w		
Hammer Curls (RT)	2	12

Week 3 (2)	Sets	Reps
MB Chest Pass	2	8
ss/w		
Hurdle Hops 2 Feet	2	6
Trifectors	2	10
ss/w		
Reverse Hypers	2	10
Alternating Chest Press	2	8 ea.
ss/w		
Lunges	2	10 ea.
High Row (RT)	2	12
ss/w		
PB Leg Curls	2	8
Mini Band Wall Shuffles	2	5 ea.
ss/w		
Lying Extensions	2	12

Appendix A cont...

Week 4 (1)	Sets	Reps.
Shuffles	2	10 yds.
ss/w		
Tuck Jumps	2	6
Bicycle Crunches	2	12 ea.
ss/w		
Supermans	2	12
Foam Roller Push-ups	2	12
ss/w		
Foam Roller Squats	2	10
Alternating Row (RT)	2	10ea.
ss/w		
Lateral BW Squat	2	6 ea.
Lateral Raises	2	12
ss/w		
Hammer Curls (RT)	2	12

Week 4 (2)	Sets	Reps.
MB Overhead Throw	2	8
ss/w		
Lateral Hurdle Hops 2 Feet	2	6
Trifectors	2	10
ss/w		
Reverse Hypers	2	10
Alternating Chest Press	2	10 ea.
ss/w		
Lunges	2	12 ea.
High Row (RT)	2	12
ss/w		
PB Leg Curls	2	10
Mini Band Wall Shuffles	2	5 ea.
ss/w		
Lying Extensions	2	12

Appendix A cont...

Week 5 (1)	Sets	Reps.
Agility Ladder	2	10,6,8 9
ss/w		
Squat Jumps	2	10
Oblique Crunches	2	8 ea.
ss/w		
PB Back Ext.	2	10
MB Chest Series	2	5 ea.
ss/w		
MB Squats	2	10
Stagger Step Row (BT)	2	10
ss/w		
SL Buck	2	8
Alt. Shoulder Press	2	8 ea.
ss/w		
Curls (Palms Down)	2	10

Week 5 (2)	Sets	Reps.
Mini Band Walk	2	10 yds.
ss/w		
Agility Rings Hop Scotch	2	
V-ups	2	10
ss/w		
Kneeling Opposites	2	8 ea.
Upper Body Step-ups	2	10
ss/w		
MB Split Squats	2	8 ea.
Bent Over Row	2	12
ss/w		
SL SLDL	2	6 ea.
1 Arm Stabilization	2	25 sec
ss/w		
SA Pushback	2	8

Appendix A cont...

Week 6 (1)	Sets	Reps.
MB Side Thorws	2	5 ea.
ss/w		
SL Hurdle Hop	2	6
Oblique Crunches	2	10 ea.
ss/w		
PB Back Ext.	2	10
MB Chest Spirals	2	6 ea.
ss/w		
MB Squats	2	12
Stagger Step Row (RT)	2	12
ss/w		
SL Buck	2	8
Alt. Shoulder Press	2	10 ea.
ss/w		
Curls (Palms Down)	2	10

Week 6 (2)	Sets	Reps.
Agility Rings Box Drill	2	
ss/w		
MB Split Squat Jumps	2	6 ea.
V-ups	2	12
ss/w		
Kneeling Opposites	2	10 ea.
Upper Body Step-ups	2	12
ss/w		
MB Split Squats	2	10 ea.
Bent Over Row	2	12
ss/w		
SL SLDL	2	8 ea.
1 Arm Stabilization	2	30 sec
ss/w		
SA Pushback	2	10

Appendix A cont...

Week 7 (1)	Sets	Reps.
MB Back Throw	2	6 ea.
ss/w		
Bounding (SL)	2	5 ea.
MB Rotations	2	10 ea.
ss/w		
Back Ext. w/twist	2	6 ea.
MB Drop Push-ups	2	8
ss/w		
Split Squat (F) foot on FR	2	8 ea.
SL Row (RT)	2	5 ea.
ss/w		
MB Buck	2	6 ea.
BW Shld Circuit	2	:15 sec.
ss/w		
Bicep Curls Alternating	2	10

Week 7 (2)	Sets	Reps.
Agility Ladder	2	1,11,7
ss/w		
Jump Rope	2	1:30 min
MB Chop	2	8 ea.
ss/w		
Superman w/hold (:03 sec)	2	10
Physioball Push-up	2	8
ss/w		
MB Lunge w/twist	2	6 ea.
Partner Row	2	8
ss/w		
PB Single Leg Curl	2	4 ea.
Int/Ext Rotation	2	10 ea.
ss/w		
Overhead Ext.	2	10

Appendix A cont...

Week 8 (1)	Sets	Reps.
Agility Rings: Lateral Run	2	
ss/w		
Mini Band Walk (F)(B)(L)	2	10 yds
MB Rotations	2	10 ea.
ss/w		
Back Ext. w/twist	2	6 ea.
MB Explosive Push-ups	2	8
ss/w		
Split Squat (F) foot on FB	2	10 ea.
SL Row (RT)	2	6 ea.
ss/w		
MB Buck	2	6 ea.
BW Shld Circuit	2	:15 sec.
ss/w		
Bicep Curls Alternating	2	10

Week 8 (2)	Sets	Reps.
Lateral SL Hurdle Hops	2	6
ss/w		
Drop Jumps	2	5
MB Chop (L)	2	5 ea.
ss/w		
Superman w/hold (:03 sec)	2	10
Physioball Push-up	2	10
ss/w		
MB Lunge w/twist	2	8 ea.
Partner Row	2	10
ss/w		
PB Single Leg Curl	2	5 ea.
Int/Ext Rotation	2	10 ea.
ss/w		
Overhead Ext.	2	10

Appendix B

DYNAMIC WARM-UP

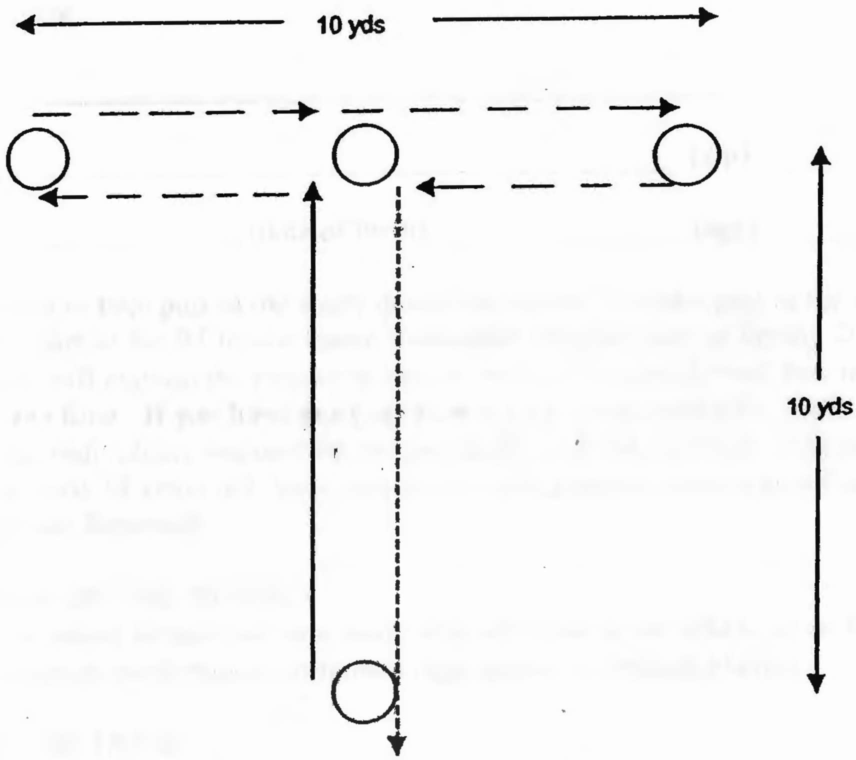
Arm Swings	x 5 ea.
Ankle Rocks	x 10
High Knee Grab	x 10 yds.
Quad/Ham Walk	x 10 yds.
High knee Run	x 10 yds.
Butt Kicks	x 10 yds.
Lateral Lunges	x 10 yds.
Straight Leg March	x 10 yds.
Forward Lunge w/ Twist	x 10 yds.
Spidermans	x 5 ea.

AGILITY DRILLS

1. Forward Shuffle
2. Forward 2- in
3. Lateral 2- in
4. Forward 1-in
5. Lateral 1- in
6. Forward High Knee
7. Slalom Jumps
8. 180's
9. 90's
10. In-in-out-out
11. Lateral In-in-out-out

Appendix C

T-TEST



Appendix D

The University of Rhode Island
Department of Kinesiology
Kingston, RI 02881

ASSENT FORM FOR RESEARCH

You hereby volunteer and give consent to participate in the research study examining the effects of an 8-week training program on performance in female high school volleyball players.

I, ____

Residing at ____ (zip) __________

(telephone) _______________ (date of birth) _______________ (age) __________

have been asked to take part in the study described below. To take part in the study you must be a part of the RI Junior Rams Volleyball Program during Spring 2005. The researcher will explain the project to you in detail. You should feel free to ask questions at any time. If you have more questions later, Deborah Riebe, Ph.D. or Rick Armstrong, the individuals responsible for this study, will discuss them with you. If you are not at least 18 years old, your parents or legal guardian must sign a Parental Consent Form for Research.

DESCRIPTION OF THE PROJECT

You have been asked to take part in a study that will look at the effects of an 8-week training program on performance in female high school volleyball players.

WHAT WILL BE DONE

If you decide to take part in the study, the following will occur:

You will participate in an 8-week supervised training program for 30 minutes during your scheduled time at Keany gymnasium for the Junior Rams Volleyball Program. Before and after the 8-week program, you will have various performance criterion assessed. Prior to the first assessment, you will participate in 2 sessions to teach you the proper technique and basic fundamentals of performing the exercises and testing measures. All of the sessions will being during normal practice times and you will not be required to attend any extra sessions. Before participation you will be asked to fill out a general questionnaire describing activity, and injuries, and how many years experience playing volleyball and training. The assessment will involve the following:

- Height and weight: Your height and weight will be measured using a standard doctor's scale.

- Sit and Reach Test: You will sit on the floor with your feet out in front of you and placed against a box. You will then reach as far forward as you can over your toes.
- Balance and Proprioception Test: You will stand on a ½ foam roller, lift one leg off the roller and balance for as long as possible.
- Medicine Ball Explosive Chest Pass: You will sit up against a wall and throw a 4-pound medicine ball as far as you can out in front of you.
- Modified Pull-ups: You lying on the ground underneath a bar that is placed above you. You will then grasp the bar and lift yourself up to that bar as many times as possible.
- Vertical Jump Test: You will jump as high as you can one time.
- Repeated Vertical Jump Test: You will jump as high as you can four times in a row.

The 8-week conditioning program will be done during practice times as assigned by the coach and myself. The program is part of your normal training for the Junior Rams Team. The conditioning program will last 30 minutes and will involve strengthening exercises using medicine balls, tubing, and jumping activities to improve volleyball performance.

RISKS OR DISCOMFORTS

The major risk associated with participation in the testing and training sessions is injury associated with volleyball including but not limited to strains, sprains, and other muscle related injury. Instruction on proper technique and adequate supervision will help minimize these risks. It is possible, although unlikely, to experience dizziness, nausea, or lightheadedness during testing or training sessions. You may experience muscle soreness following a training session and it may continue for days following training.

BENEFITS OF THE STUDY

You will learn proper exercise technique and will learn about sport-specific conditioning for volleyball. You may experience increases in strength and power, and that may improve volleyball performance and reduce the chance for injury.

CONFIDENTIALITY

Any information that is obtained and collected during the study will remain confidential and you will not be identified by name in any of the writings or publications of the study. All records will be coded. Record of codes will be locked and stored in a file cabinet in room 108 in the Tootell Building. The researchers will be the only people to have access to these records.

DECISION TO QUIT AT ANY TIME

The decision to be involved and take part in the study is up to you. You do not have to take part in this study to participate in the RI Junior Rams Volleyball Program. If you decide to take part in the study, you make stop at any time. Your decision to participate or not will not effect your ability to participate in the RI Junior Rams Volleyball Program. If you wish to terminate your participation in the study you can contact Rick Armstrong at 401-874-2980 or Dr. Deborah Riebe at 401-874-5444

RIGHTS AND COMPLAINTS:

If you are not satisfied by the study or the way it is being performed, you may discuss any concerns with Rick Armstrong (401) 874-2980 or Deborah Riebe, Ph.D. (401) 874-5444. In addition, you may contact the office of the vice provost for graduate studies, research, and outreach, 70 Lower college road, suite 2, University of Rhode Island, Kingston, Rhode Island, telephone: 401-874-4328.

It is not the policy of the University of Rhode Island to compensate subjects in the event that research procedures result in physical or psychological injury. The University of Rhode Island will, however, make its best effort to refer you to appropriate services, upon request, if injury does occur. You may discuss this question with Rick Armstrong or Deborah Riebe. However, if you experience any problems related to this study you should contact your personal physician.

I, the undersigned, have received, in my opinion, an adequate explanation of the nature, duration, and purpose of the research study, the means in which the study will be conducted, and any possible inconvenience, discomforts, and risks associated with my participation in the study.

I have read the consent form. My questions have been answered. My signature on this form means that I understand the information presented to me, and agree to participate in this research study.

____________________	____________________
Signature of the participant	Signature of the researcher
____________________	____________________
Printed name	Printed name
____________________	____________________
Date	Date

Appendix E

The University of Rhode Island
Department of Kinesiology
Kingston, RI 02881

CONSENT FORM FOR RESEARCH

You hereby volunteer and give consent to participate in the research study examining the effects of an 8-week training program on performance in female high school volleyball players.

I, ____

Residing at ____ (zip) _________

(telephone) ______________ (date of birth) ______________ (age) __________

have been asked to take part in the study described below. To take part in the study you must be a part of the RI Junior Rams Volleyball Program during Spring 2005. The researcher will explain the project to you in detail. You should feel free to ask questions at any time. If you have more questions later, Deborah Riebe, Ph.D. or Rick Armstrong, the individuals responsible for this study, will discuss them with you. If you are not at least 18 years old, your parents or legal guardian must sign a Parental Consent Form for Research.

DESCRIPTION OF THE PROJECT
You have been asked to take part in a study that will look at the effects of an 8-week training program on performance in female high school volleyball players.

WHAT WILL BE DONE
If you decide to take part in the study, the following will occur:

You will participate in an 8-week supervised training program for 30 minutes during your scheduled time at Keany gymnasium for the Junior Rams Volleyball Program. Before and after the 8-week program, you will have various performance criterion assessed. Prior to the first assessment, you will participate in 2 sessions to teach you the proper technique and basic fundamentals of performing the exercises and testing measures. All of the sessions will being during normal practice times and you will not be required to attend any extra sessions. Before participation you will be asked to fill out a general questionnaire describing activity, and injuries, and how many years experience playing volleyball and training. The assessment will involve the following:

- Height and weight: Your height and weight will be measured using a standard doctor's scale.

- Sit and Reach Test: You will sit on the floor with your feet out in front of you and placed against a box. You will then reach as far forward as you can over your toes.
- Balance and Proprioception Test: You will stand on a ½ foam roller, lift one leg off the roller and balance for as long as possible.
- Medicine Ball Explosive Chest Pass: You will sit up against a wall and throw a 4-pound medicine ball as far as you can out in front of you.
- Modified Pull-ups: You lying on the ground underneath a bar that is placed above you. You will then grasp the bar and lift yourself up to that bar as many times as possible.
- Vertical Jump Test: You will jump as high as you can one time.
- Repeated Vertical Jump Test: You will jump as high as you can four times in a row.

The 8-week conditioning program will be done during practice times as assigned by the coach and myself. The program is part of your normal training for the Junior Rams Team. The conditioning program will last 30 minutes and will involve strengthening exercises using medicine balls, tubing, and jumping activities to improve volleyball performance.

RISKS OR DISCOMFORTS

The major risk associated with participation in the testing and training sessions is injury associated with volleyball including but not limited to strains, sprains, and other muscle related injury. Instruction on proper technique and adequate supervision will help minimize these risks. It is possible, although unlikely, to experience dizziness, nausea, or lightheadedness during testing or training sessions. You may experience muscle soreness following a training session and it may continue for days following training.

BENEFITS OF THE STUDY

You will learn proper exercise technique and will learn about sport-specific conditioning for volleyball. You may experience increases in strength and power, and that may improve volleyball performance and reduce the chance for injury.

CONFIDENTIALITY

Any information that is obtained and collected during the study will remain confidential and you will not be identified by name in any of the writings or publications of the study. All records will be coded. Record of codes will be locked and stored in a file cabinet in room 108 in the Tootell Building. The researchers will be the only people to have access to these records.

DECISION TO QUIT AT ANY TIME

The decision to be involved and take part in the study is up to you. You do not have to take part in this study to participate in the RI Junior Rams Volleyball Program. If you decide to take part in the study, you make stop at any time. Your decision to participate or not will not effect your ability to participate in the RI Junior Rams Volleyball Program. If you wish to terminate your participation in the study you can contact Rick Armstrong at 401-874-2980 or Dr. Deborah Riebe at 401-874-5444

RIGHTS AND COMPLAINTS:

If you are not satisfied by the study or the way it is being performed, you may discuss any concerns with Rick Armstrong (401) 874-2980 or Deborah Riebe, Ph.D. (401) 874-5444. In addition, you may contact the office of the vice provost for graduate studies, research, and outreach, 70 Lower college road, suite 2, University of Rhode Island, Kingston, Rhode Island, telephone: 401-874-4328.

It is not the policy of the University of Rhode Island to compensate subjects in the event that research procedures result in physical or psychological injury. The University of Rhode Island will, however, make its best effort to refer you to appropriate services, upon request, if injury does occur. You may discuss this question with Rick Armstrong or Deborah Riebe. However, if you experience any problems related to this study you should contact your personal physician.

I, the undersigned, have received, in my opinion, an adequate explanation of the nature, duration, and purpose of the research study, the means in which the study will be conducted, and any possible inconvenience, discomforts, and risks associated with my participation in the study.

I have read the consent form. My questions have been answered. My signature on this form means that I understand the information presented to me, and agree to participate in this research study.

______________________________	______________________________
Signature of the participant	Signature of the researcher
______________________________	______________________________
Printed name	Printed name
______________________________	______________________________
Date	Date

Appendix F

The University of Rhode Island
Department of Kinesiology
Kingston, RI 02881

Effects of an 8-week training program on performance in female high school volleyball players.

Parental/Guardian consent for research

I am asking you to allow your child to take part in a research project called "Effects of an 8-week training program on performance in female high school volleyball players". The RI Junior Rams Program and Bob Schneck supports and is cooperating with the study. The study will implement an 8-week training program, along with two technique sessions and a pre-test, followed by a post-test to look at the difference in measures over the 8-week program. You should feel free to ask questions at any time. If you have more questions later, Deborah Riebe, Ph.D. or Rick Armstrong, the individuals responsible for this study, will discuss them with you. Rick Armstrong is a graduate assistant in Kinesiology and Strength and Conditioning coach for women's volleyball at the University of Rhode Island.

DESCRIPTION OF THE PROJECT
Your child has been asked to take part in a study that will look at the effects of an 8-week training program on performance in female high school volleyball players.

WHAT WILL BE DONE
If your child decides to take part in the study, the following will occur:

Your child will participate in an 8-week supervised training program for 30 minutes during their scheduled time at Keaney Gymnasium for the Junior Rams Volleyball Program. Before and after the 8-week program, your child will have various performance criterion assessed. Prior to the first assessment, your child will participate in 2 sessions to teach you the proper technique and basic fundamentals of performing the exercises and testing measures. All of the sessions will being during normal practice times and you will not be required to attend any extra sessions. Before participation your child will be asked to fill out a general questionnaire describing activity, and injuries, and how many years experience playing volleyball and training. The assessment will involve the following:

- Height and weight: Your child's height and weight will be measured using a standard doctor's scale.

- Sit and Reach Test: Your child will sit on the floor with your feet out in front of them and placed against a box. Your child will then reach as far forward as you can over your toes.

- Balance and Proprioception Test: Your child will stand on a ½ foam roller, lift one leg off the roller and balance for as long as possible.

- Medicine Ball Explosive Chest Pass: Your child will sit up against a wall and throw a 4-pound medicine ball as far as they can out in front of you.

- Modified Pull-ups: Your child lying on the ground underneath a bar that is placed above them. Your child will then grasp the bar and lift themselves up to that bar as many times as possible.

- Vertical Jump Test: Your child will jump as high as you can one time.

- Repeated Vertical Jump Test: Your child will jump as high as you can four times in a row.

The 8-week conditioning program will be done during practice times as assigned by the coach and myself. The program is part of normal training for the Junior Rams Team. The conditioning program will last 30 minutes and will involve strengthening exercises using medicine balls, tubing, and jumping activities to improve volleyball performance.

RISKS OR DISCOMFORTS

The major risk associated with participation in the testing and training sessions is injury associated with volleyball including but not limited to strains, sprains, and other muscle related injury. Instruction on proper technique and adequate supervision will help minimize these risks. It is possible, although unlikely, to experience dizziness, nausea, or lightheadedness during testing or training sessions. Your child may experience muscle soreness following a training session and it may continue for days following training.

BENEFITS OF THE STUDY

Your child will learn proper exercise technique and will learn about sport-specific conditioning for volleyball. Your child may experience increases in strength and power, and that may improve volleyball performance and reduce the chance for injury.

CONFIDENTIALITY

Any information that is obtained and collected during the study will remain confidential and you will not be identified by name in any of the writings or publications of the study. All records will be coded. Record of codes will be locked and stored in a file cabinet in room 108 in the Tootell Building. The researchers will be the only people to have access to these records.

DECISION TO QUIT AT ANY TIME

The decision to be involved and take part in the study is up to your child. Your child does not have to take part in this study to participate in the RI Junior Rams Volleyball Program. If your child decides to take part in the study, they make stop at any time. Your child's decision to participate or not will not affect the ability to participate in the RI Junior Rams Volleyball Program. If your child wish's to terminate their participation in the study you can contact Rick Armstrong at 401-874-2980 or Dr. Deborah Riebe at 401-874-5444

RIGHTS AND COMPLAINTS:

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I, the undersigned, have received, in my opinion, an adequate explanation of the nature, duration, and purpose of the research study, the means in which the study will be conducted, and any possible inconvenience, discomforts, and risks associated with my participation in the study.

I have read the consent form. My questions have been answered. My signature on this form means that I understand the information presented to me, and agree to allow my child to participate in this research study.

____
Name of child

____________________ Signature of the parent	____________________ Signature of the researcher
____________________ Printed name	____________________ Printed name
____________________ Date	____________________ Date

Appendix G

Questionnaire

Name: ____________________________

Age______ Grade______

How many days a week are you moderately active? 1-2 3-4 5+

How long? <30 min 30-60 min >60 min

What sports have you participated in/ How many years experience?

________________ ________________

________________ ________________

________________ ________________

________________ ________________

Are you currently participating in another sport?

Do you have any strength training experience? Y/N

If yes how long? ______

Do you have any current injuries? Y/N

If yes explain?

Do you have any medical conditions (asthma, ect…)?

Are you currently taking any medications?

Is there any reason why you would not be able to participate in the study?

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