Medicine Ball for All

A Novel Program that Enhances Physical Fitness in School-age Youths

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More than a retro fad, medicine ball training can improve fitness.

Elementary and secondary physical education teachers are incorporating a variety of lifetime physical activities into their curriculum. Not only are these activities exciting and challenging for the students, but adding variety to the curriculum provides students with an opportunity to enhance their physical, mental, and social/emotional development (National Association for Sports and Physical Education [NASPE], 2004). In addition to aerobic activities such as inline skating and mountain biking, activities that involve strength exercise can also be part of a health-enhancing curriculum (Faigenbaum, 2001). Despite outdated concerns associated with youth strength training, a compelling body of evidence indicates that strength-building activities can be a safe and effective method of conditioning for school-age youths provided that appropriate training guidelines are followed (American Academy of Pediatrics, 2001; Faigenbaum, 2003; Falk & Tenenbaum, 1996). Although it is difficult to determine the exact number of boys and girls who strength train, the Youth Risk Behavior Survey found that 52 percent of high school students reported that they performed exercises to "strengthen or tone" their muscles on three or more days per week (Centers for Disease Control and Prevention, 2004).

Different modes of strength training have proven to be safe and effective for children and teenagers (Faigenbaum & Westcott, 2000). While weight machines and free weights (i.e., barbells and dumbbells) are traditionally used to enhance youth fitness, medicine balls are becoming increasingly more popular in schools and youth sport training centers. Originally used in the rehabilitation of muscle function in older patients, medicine balls are now being used to improve health-related fitness, performance-related fitness, and participatory self-efficacy in school-age youths. Although the popularity of medicine balls has declined somewhat in the United States since the 1950s, physical educators are now rediscovering the many benefits that can be achieved by using medicine balls in their classes and after-school programs.

This article will provide an overview of medicine ball training and will describe our "Medicine Ball for All" program. It will focus on developing a safe, successful, and inexpensive physical activity intervention for school-age youths using medicine balls. Since quality physical education programs should help students develop health-related fitness and physical competence (NASPE, 2004), physical educators who use medicine balls need to develop a comfort level with medicine ball training that allows them to incorporate it into their curriculum. For the purpose of this article, medicine balls are defined as weighted vinyl, polyurethane, or leather balls that are portable and come in a variety of colors, shapes, and sizes (from 1 kg. to over 10 kg., or about 2 to 22 lbs.).

Why Medicine Ball Training?

Regular participation in a medicine ball training program has the potential to positively influence many health and fitness measures. Medicine ball training can be used to enhance muscle strength, muscle power, flexibility, endurance, coordination, agility, balance,

and speed. Unlike weight machines, which isolate and train individual muscles or muscle groups, medicine ball exercises train the body to function as a unit instead of as separate parts. For example, when you swing a tennis racquet, you do not think about each individual muscle, but rather about all the muscles working together to create a fluid swing. It is the creation of these so-called functional movements, which mimic natural body positions and movement speeds that occur in daily life and game situations, that makes medicine ball training so valuable. Since medicine balls come in a variety of shapes and sizes, each student can start at safe levels and gradually progress as needed. Furthermore, since body weight exercises such as chin-ups and push-ups may be too challenging for some youths who are sedentary and overweight, medicine ball programs that involve throwing, catching, and rotational movements can be structured in a way that is appropriate for all students.

Medicine ball training also requires students to use their mind as well as their body. While some medicine ball exercises are easy to perform, others are complex and require students to think about what they are doing and how they are moving. For example, performing a lunging movement while moving a medicine ball in different positions causes the body to reach outside of its "inner balance zone." Through a constant interplay of imbalance and balance, a movement such as a medicine ball walking lunge can aid the body in controlling its center of gravity. How far can a student walk and still maintain dynamic balance if you add rotational and diagonal medicine ball movements? Students individually create the answer to this task on their own, thus learning the movement forever. From our observations, an interesting consequence of the success of these exercises is a noticeable improvement in each student's participatory self-efficacy.

Our "Medicine Ball for All" Program

Due to the relatively dismal performance of our high school students on standardized physical fitness tests, we developed a progressive, challenging, and inexpensive physical activity intervention. Our goal was to create a physical activity program that would enhance physical fitness abilities and provide students with a meaningful learning experience that was consistent with their developmental needs. We call our program "Medicine Ball for All" simply because it utilizes medicine balls and is purposefully designed to be appropriate for all school-age children regardless of body size or fitness level.

We recently completed a research study designed to assess the effectiveness of our program (Faigenbaum & Mediate, 2006). We randomly assigned high school physical education students (grade 10; ages 15-16 years) into one of two groups. One group of students (n = 69) participated in our "Medicine Ball for All" program during the first 10 to 15 minutes of every 45-minute physical education class (twice per week), and the other group of students (n = 49) served as controls. Both the exercise and control groups participated in traditional physical education activities (e.g., racquet sports and basketball) during every physical education class. Before and after the six-week study period, all students performed a variety of fitness tests to assess their lower back and hamstring flexibility, lower body power, abdominal strength, upper body strength, upper body power, speed, and agility.

The study group that participated in the medicine ball training program made significantly greater gains in all fitness tests as compared to the control group. In fact, the results were so impressive and the students enjoyed the program so much that we implemented our program into all physical education classes at the high school. The following year this high school was ranked as one of the top schools in the state of Connecticut for physical fitness testing. These findings, combined with positive feedback from physical education teachers, indicated that medicine ball training can be an efficacious and enjoyable means of promoting physical fitness in high school students. Since these observations have important practical relevance for designing physical education lessons for elementary and middle school students too, our program is now a part of a district-wide physical education curriculum in kindergarten though 12th grade. This system-wide approach to fitness training has enabled all grade levels to rank among the very best in the state in regard to physical fitness testing.

Program Design Considerations

Depending on class time, lesson objectives, and the students' fitness abilities, physical education teachers can modify their lesson plan in order to incorporate some type of medicine ball training in each class. Since teaching youths about their bodies, improving motor skill performance, and exposing youths to a variety of physical activities are important class objectives, a physical education class should not be devoted entirely to medicine ball training. We "activate" our physical education classes by incorporating medicine ball training into the first 10 to 15 minutes of nearly every lesson. During this time, students perform a variety of medicine ball exercises that progress from simple to complex as their competence and confidence improve. Although the program is designed as a six-week lesson, teachers can continually modify it in order to incorporate some aspect of medicine ball training in every physical education class. For example, teachers can incorporate the warm-up activities into each class or they can focus on developing upper or lower body strength with medicine balls. Our program simply gives teachers a model from which they can use their own creativity and ideas to enhance the health and fitness of their students.

While medicine ball training is a relatively safe method of resistance exercise, teachers should take the time before every class to be sure that the exercise environment is safe, well-lit, and clean. Students need to follow directions (e.g., look at your partner and keep hands in the ready position) and understand the benefits and risks associated with medicine ball training. We regularly remind students of rules and safety tips (e.g., proper footwear, shoes tied, and no gum chewing). Since medicine ball training does require more

skill and coordination than exercising on weight machines, physical education teachers need to give proper demonstrations, clear instructions, and constructive feedback when necessary. Furthermore, always consider a student's health history when designing any exercise program and never perform an exercise that causes pain or discomfort.

We begin with teacher-directed activities and lightweight medicine balls (about 1 kg., or 2 lbs.), so that students can train their neuromuscular system to perform quality movements. Even though there is no established age requirement for medicine ball training, most six- and seven-year-olds should have the coordination and maturity to use lightweight medicine balls safely and effectively in developmentally appropriate activities.

Warm-up. Instead of static stretching, we begin each session with dynamic movements using lightweight medicine balls. Since the current warm-up practice of static stretching has been questioned recently (Knudsen, 1999, 2000; Thacker, Gilchrist, Stroup, & Kimsey, 2004), there has been a rising interest in warm-up procedures that involve the performance of dynamic movements designed to elevate core body temperature, enhance motor unit excitability, improve kinesthetic awareness, and maximize active ranges of motion (Faigenbaum, Bellucci, Bernieri, Bakker, & Hoorens, 2005; Mann & Jones, 1999). Our warm-up sessions generally last about three to five minutes and involve eight to ten different movements. Students hold and move a lightweight medicine ball (about 1 kg., or 2 lbs.) as they jog and move the ball in different positions. Each exercise is performed for about 30 seconds. For a little variety, you can create a medicine ball warm-up using cones, agility ladders, or whatever else is available. When students feel warm and start to sweat, they are ready to begin the training phase of the workout. Remember that the goal of the dynamic warm-up is not to fatigue the students, but rather to prepare them for the demands of medicine ball training. A sample of medicine ball warm-up exercises is outlined in table 1.

Table 1. Sample Medicine Ball Warm-up Activities

1. Jog holding ball near chest
2. Jog catching ball with arms straight out in front of body
3. Jog pressing ball overhead
4. Jog with ball behind back
5. Jog rolling ball to right and left
6. Jog performing body circles with ball
7. Jog and toss ball to right and left hands
8. Jog with heel kicks

Medicine Ball Training. While there are literally thousands of exercises that can be performed with medicine balls, our "Medicine Ball for All" program follows a simple progression so students experience small successes every class. The idea is for all students to gain confidence in their abilities to be physically active while exercising with medicine balls. Instead of complex exercises in which most students will fail, we begin with relatively easy movements that most children can master with a few simple coaching cues. We generally begin with about 15 exercises during the first week and add a few exercises every other week as the class progresses.

Over the course of the six-week program students may perform up to 40 different medicine ball exercises each class. Depending on the week of the program, students perform one to three sets of 7 to 10 repetitions of each exercise (table 2). If multiple sets of an exercise are performed, a recovery period of about 30 seconds between sets is suggested. During every class, we explain, demonstrate, and then have the students perform a new exercise while we watch and provide constructive feedback. The goal is for all students to develop quality movement patterns characterized by proper exercise technique and movement speed. The idea is for students to train their muscles to perform each movement correctly. Thus students should understand the skills to be learned, and classes should be designed to maximize the student's opportunities to perform the skills and experience success. In our medicine ball training programs, success is not measured simply by assessing gains in muscular strength, but rather by mastering tasks and moving forward in difficulty levels. General training guidelines appear in table 3.

We group our medicine ball conditioning exercises into the following seven categories: (1) lower body (e.g., underhand squat), (2) upper body (e.g., chest push), (3) stability (e.g., single leg toss), (4) reaction (e.g., wall chest pass), (5) core (e.g., V-sit on ball), (6) specialty movements (e.g., lateral taps), and (7) flexibility (e.g., straddle ball roll). Examples

Table 2. Summary of Training Program Variables

	Weeks 1 & 2	Weeks 3 & 4	Weeks 5 & 6
Total Time (min.)	10	12	15
Sets/Reps	1/7-10	2/7-10	2-3/7-10
MB Exercise Level*	1 & 2	3 & 4	5 & 6
Number of Exercises	15-20	20-30	30-40

**Medicine ball exercises are subjectively placed into one of six levels. Level 1 exercises are simple movements that are relatively easy to perform whereas level 6 exercises are multitask movements that involve explosive actions throughout all planes of motion.*

Table 3. Medicine Ball Training Guidelines

- The exercise environment should be safe and free of hazards.
- Every class should begin with dynamic warm-up activities.
- Start with one set of 7 to 10 repetitions with a light weight ball (1-2 kg., or 2 to 4.5 lbs.)
- Begin with simple exercises and gradually progress to more challenging exercises over time.
- Gradually increase the number of sets, number of exercises, and weight of the ball.
- Two to three nonconsecutive training sessions per week are recommended.
- Focus on proper exercise technique with controlled movements.
- Vary the training program to optimize adaptations and reduce boredom.

of selected medicine ball exercises appear in figures 1 to 6. Within each category, the exercises progress from the least challenging to the most challenging. Level one and level two exercises are the easiest to perform, whereas level five and level six exercises are the most complex and are specifically designed to elicit maximum muscle fiber recruitment while challenging cognitive abilities. For example, the straddle ball roll (figure 6) is a level-one exercise that requires students to sit in a straddle position and roll the medicine ball as far forward as possible. An example of a level-six exercise is the one-ball push-up (figure 3), which requires students to place their hands on a medicine ball while performing a push-up exercise.

Each group of exercises focuses on a specific fitness parameter, with specialty movements designed to enhance spatial awareness, reaction time, and speed. An example of a specialty exercise that we like to use is the partner toss combined with random questioning. To perform this exercise, two students chest pass a medicine ball to each other as they ask each other random questions. This type of activity keeps the students moving, thinking, and reacting just like in real life situations and sport (e.g., walking down a busy street or running for a touchdown). A more detailed description of all medicine ball exercises appears in Mediate and Faigenbaum (2004).

While the intensity of our medicine ball training program can be characterized as moderate to vigorous, our program typically results in an interval type of conditioning characterized by increases and decreases in exercise heart rates during the training session. Thus, the heart rate response to our program is more consistent with how children play and how young athletes move in sports. From our observations, most children prefer short bouts of moderate to vigorous physical activity (MVPA) with frequent periods of rest, as compared to prolonged periods of exercise at the same intensity.

In general, the heart rate response to medicine ball training (as measured by portable heart rate monitors) averages 140 to 160 beats per minute (Faigenbaum & Mediate, 2006). While a student's enjoyment of physical activity and improvement in motor skill ability are important outcomes of physical education, the amount of class time during which students engage in MVPA is also an important measure of the quality of physical education (U.S. Department of Health and Human Services, 2000). Since the amount of time that boys and girls spend engaged in MVPA during some physical education classes is falling short of national recommendations (National Institute of Child Health and Development, 2003), a progressive medicine ball training program can enhance the quality of physical education by engaging students in moderate to vigorous bouts of physical activity.

Warm-down Activities. During the warm-down period, we gradually decrease the intensity of the exercises and perform about five of the dynamic medicine ball movements that were performed during the warm-up session. We ask participants to move at "three-quarters" speed and then "half speed" during the warm-down period. The warm-down period allows the students to feel refreshed and prepared for the remaining physical education lesson.

Choosing the Right Medicine Ball

Medicine balls come in a variety of weights (from 1 kg. to over 10 kg. [2 to 22 lbs.]) and sizes (from the size of a baseball to a basketball). Some medicine balls have a textured surface or handle for easier gripping, and others are inflatable and bounce. Leather balls do not bounce, but they can be used as a base to stand on for balance training. While college athletes may use relatively heavy medicine balls (e.g., 5-10 kg. [11-22 lbs.]) for training, we suggest that children begin with one-kilogram balls and adolescents begin with two-kilogram balls. Depending on body size and fitness level, heavier balls may be appropriate for some students. Once students have developed proper exercise technique, gradually increase the weight of the medicine ball (by about 0.5-1 kg.), the distance between training partners, and, when appropriate, the movement speed of selected medicine ball exercises. Remember, the quality of the movement is far more important than the weight of the ball.

By using medicine balls of different weights and sizes, you can develop a fitness program consisting of throwing, catching, and rotational movements. In our programs, we use color-coded balls so the teachers and the students can easily keep track of the loads they are using. Obviously, it is desirable to have medicine balls of different weights and sizes to accommodate the needs and abilities of all students. Also, you will need smaller and lighter balls for one-arm exercises and leather balls if you want a base on which to stand or sit for balance and core training (e.g., V-sit on ball exercise). Commercially made medicine balls are relatively inexpensive (about $15 to $40 each depending on weight and material) and are readily available from most physical education and athletic equipment companies.

Figure 1. Underhand Squat

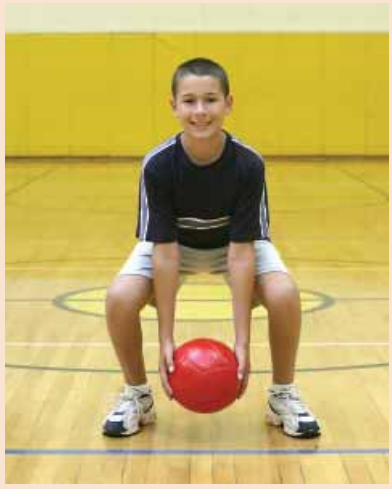

Figure 2. Walking Lunge

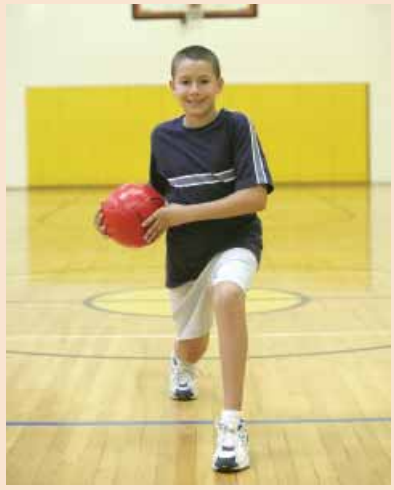

Figure 3. One-Ball Push-up

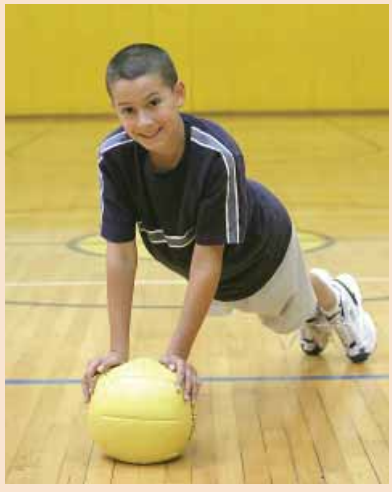

Figure 4. Single-Leg Dip

Figure 5. V-sit on Ball

Figure 6. Straddle Ball Roll

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Program Assessment

Student assessment is a critical element of our physical education program. Not only does the student assessment provide important information about the effectiveness of our medicine ball program, but it provides meaningful feedback to students about their progress. The assessment gives students an opportunity to demonstrate what they can do that they could not do before. We use a rubric that lists gradations of qualities for medicine ball training to rate the performance abilities of each student (table 4). Rubrics are not only useful for formative and summative student assessment, but they make teacher expectations clear and help students become more active participants in the assessment process.

Our measurable objectives allow for an assessment of proper skill progression, body mechanics, and appropriate technique. The performance we assess requires the student to accomplish relatively complex tasks using prior knowledge and skills. Physical education teachers perform an individual assessment on each student for each class and then an overall assessment at the end of each marking period. This assessment provides each student with information about his or her progress and enables the student and teacher to develop a plan to meet specific goals. The results are shared with parents on a quarterly basis.

Conclusion

Since medicine balls come in a variety of shapes and sizes, physical education teachers can use these balls to enhance the health and fitness of students in kindergarten through 12th grade. With qualified instruction and an appropriate progression of training loads, "Medicine Ball for All" can be a safe, effective, and fun method of developing and enhancing health-related fitness, physical competence, and positive attitudes about physical activity in school-age youths. With a little creativity, different exercises can be created for students with differing needs, goals, and abilities.

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Table 4. Analytic Rubric for Physical Fitness Assessment of Medicine Ball Training

Level of Achievement	Description
Advanced (4)	Demonstrates the motor skills, knowledge and understanding needed to perform levels 1 to 6 medicine ball exercises.
Proficient (3)	Demonstrates the motor skills, knowledge and understanding needed to perform levels 1 to 4 medicine ball exercises.
Basic (2)	Demonstrates the motor skills, knowledge and understanding needed to perform levels 1 to 2 medicine ball exercises.
Novice (1)	Demonstrates the motor skills, knowledge and understanding needed to perform level 1 medicine ball exercises.
Unacceptable	Is unable to demonstrate the motor skills, knowledge and understanding needed to perform level 1 medicine ball exercises.

Obviously, some coaches leave the profession voluntarily. Results indicated that the annual median number of coaches voluntarily leaving per school equaled almost one. The most commonly reported reason for voluntarily leaving coaching over the past five years was to take a new position. It is unclear as to whether those who left did so to take another coaching position or to take another position outside the coaching profession.

Additional reasons for coaches voluntarily leaving paralleled the reasons given for dismissals. For example, not wanting to deal with parents, and conflicts with athletes and parents, resemble the dismissal categories of "inability to maintain good player discipline" and "poor relations with administration and parents." In essence, then, coaches who leave voluntarily may do so for similar inabilities as those who have been dismissed.

Limitations and Recommendations

A limitation of this study deals with the accuracy of ADs ability to recall the specific details of coaching nonrenewals over the past five years. It is not certain how thorough ADs were in providing accurate details. While it is quite possible that some ADs simply reported the nonrenewals from memory, it is hoped that they consulted their human resources department to provide an accurate account of the nonrenewals. Another limitation exists in that our sample relied on volunteer participants rather than on a random sample. Therefore, generalizing the results of this study to the national coaching population must be regarded with some skepticism.

Despite these limitations, the nonrenewal results of this study do provide "snapshots" into the interscholastic coaching profession. Interscholastic coaching, as depicted in this study, is insecure at best in comparison to the teaching profession in general. While it is vital that interscholastic coaches have an in-depth knowledge of the sport and the education to teach it in order to win, it is apparent from the results of this study that they need to prepare themselves in other ways.

The authors recommend that future interscholastic coaches possess the knowledge and ability of how to conduct themselves in a professional manner and develop an understanding of positive public relations and conflict resolution. These topics are often discussed in management or business-related university classes. It appears that departments housing the preparation of future coaches may want to consider offering classes that directly deal with these topics as well. Regardless of which department offers the class, the authors of this study strongly encourage those who intend to enter the high school coaching profession to take university classes that address the aforementioned skills to supplement their coaching knowledge.

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