Stability Balls: Reviewing the Literature Regarding Their Use and Effectiveness

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Summary

The purpose of this review is to examine current literature about stability balls and review their various uses in athletic training, physical therapy, strength and conditioning, education, childbirth, and various other settings. Areas of interest include improving neuromuscular control, balance, strength, stability, and overall health. A comprehensive and thorough examination of all the uses and benefits of stability balls is presented. Peer-reviewed research articles and textbooks about stability balls were summarized in this literature review.

Introduction

We see these stability balls all over the place. We see them in gyms, weight rooms, physical therapy clinics, and physical education classes, but what can these stability balls exactly be used for? How effective are stability balls at doing the things they claim to do? What are some things these stability balls are used for that we do not even know much about? What are some areas of further research needed with respect to the use of stability balls? These are just a few of the many questions addressed in this review article. Strength and conditioning specialists, personal trainers, workout enthusiasts, and others will benefit from reading this literature review and answering these and others questions for themselves.

History of Stability Balls

Stability balls have been growing in popularity ever since their invention in 1963 by Italian plastics engineer Aquilino Cosani (5). Cosani first developed what was eventually named the "stability ball" as a toy in his manufacturing company. He initially made stability balls out of vanilla-scented vinyl because he intended his market to be parents. Later on in Switzerland, Quinton (29) used these toy stability balls for rehabilitation of children with neurological impairments. Quinton was a pioneer in the area of neurological rehabilitation, treating many young children with cerebral palsy and then passing on these techniques to physical therapists. She achieved great rehabilitation success with the use of stability balls. In 1970, stability balls made their first appearance in the United States, where they were used to rehabilitate patients with cerebral palsy (29). In the 1980s, applications focused on the effects stability ball exercises had on back pain (25).

The history of the stability ball is not exclusive to physical therapy. A historic study in 1988 replaced student desk chairs with stability balls to investigate whether there was improvement in overall posture. Researchers found, unexpectedly, that stability balls helped hyperactive children settle down, improved students' overall concentration, increased students' understanding of classroom lectures, increased students' organization, and improved penmanship (29). After 1990, increasing popularity in the use of stability balls brought about greater research in physical therapy, physical fitness, strength and conditioning, and personal training (5).

Names for these balls include exercise balls, physio-balls, pezzi balls, gymnastic balls, Swiss balls, fit balls, and even
The unstable design of this ball helps to activate more motor units of the stabilizing muscles in the human body than traditional exercises, thus improving overall balance and core stability (1-3, 4, 9, 15, 16, 30, 31, 39). In addition to stimulation of more motor units, stability balls have been shown to stimulate parts of the cerebellum, vestibular system, and brain stem, which are responsible for posture, balance, and body control (5).

Stability balls are versatile and can be used with or without additional equipment. This equipment may include elastic bands, medicine balls, racquets, and dumbbells. The combination of stability balls and other equipment makes them wonderful tools for physical therapists, athletic trainers, physicians, physical education teachers, special education teachers, personal trainers, and strength and conditioning specialists, as long as safety is addressed (1, 3-5, 9, 14, 16, 17, 25, 29, 30, 34-36, 39).

Increased popularity in the use of stability balls over the past 5 to 10 years has led to growing compliance in orthopedic rehabilitation patients, the physically active population, pregnant women, physical education classes, special needs populations, and the elderly (5, 11, 20, 21, 29). Patient compliance is important to maintain lifestyle modifications in learning, physical activity, and personal wellness choices (5, 20, 29).

This review will focus on the use and effectiveness of stability balls in strength and conditioning; physical fitness of children, adults, elderly, and special needs populations; orthopedic rehabilitation; and pregnancy and childbirth. The review will also list current and potential applications.

**Importance of Core Stability in Strength and Conditioning**

The main role of stability balls in resistance training is to develop a stable and neuromuscularly efficient core (1-4, 9, 15, 16, 30, 31, 39). The core is defined as the muscles that surround the body's center of gravity, and they include the abdominals, back extensors, lateral flexors, rotators, hip flexors, hip extensors, hip abductors, and hip adductors (12, 25). The core is a multisegmented portion of the body, which is predisposed to increased demands for balance control, especially during sport competition (2). That is why it is important that the core muscles be trained for strength, endurance, and neuromuscular control.

Core stability allows athletes to keep their center of gravity low and over their base of support. The control over the center of gravity allows for improved agility and quickness (2, 19). The core is sometimes the least trained portion of the kinetic chain (12, 31). The kinetic chain describes the entire body, and it allows for athletes to transfer energy from the ground, through the lower extremities, to the upper extremities, and through the sport implement, competitor, or other objects (12, 19, 25, 31, 32). This transfer of energy is required in such activities as swinging a bat, throwing a ball, making a cut, making a game-winning tackle, and shooting a jump shot (12).

Improved core strength is beneficial to overall strength and conditioning programs because it helps to lessen the chance of musculoskeletal injury (9, 12). For example, an athlete with a strong and stable core will be able to maintain better form and balance during a parallel squat than someone with a weaker core (12). In addition to injury prevention, a strong and stable core will allow for greater force and velocity transfer in weightlifting movements, such as power cleans and jerks (12).

**Benefits of Stability Balls to Strength and Conditioning**

Stability ball exercises have been shown to help improve balance, joint stability, proprioception, and neuromuscular control in athletes (1-3, 9, 14-17, 22, 31, 34, 39). The instability of the stability ball and exercises that can be performed on the stability ball provide for greater muscular unit recruitment and increased muscle firing of agonists/antagonists (1-4, 9, 16, 17, 31, 34, 39). Behm, Anderson, and Curnew (3) found that introducing an unstable surface to lower-extremity exercises compared with stable exercises increased antagonist/agonist muscle unit recruitment ratios by 30.7 to 40.2% (5). If an athlete recruits more motor units while performing strength training exercises on a stability ball, in theory this could lead to higher degrees of strength, balance, joint stability, proprioception, and neuromuscular control. This is vital to making an athlete quick, agile, balanced, and more able to make correct decisions in a split second. This, in turn, could make the person a big success in his or her sport. Now if strength and conditioning coaches bring these benefits to the entire team, their athletic programs may be enhanced (1-4, 9, 16, 17, 30, 34, 39).

Stability ball exercises in theory will improve afferent and efferent sensorimotor control, with feedback from the somatosensory system, the vestibulocochlear system, the cerebellum, and visual inputs (24). The somatosensory system includes joint receptors, muscle receptors, and free nerve endings, which sense changes in body position. The vestibulocochlear system is located within the inner ear, and it is lined with tiny hairs that bend and sense change in body position as the fluid within the chamber moves relative to the force of gravity. It is the vestibular cochlea that is responsible for sensing balance (6, 24). Visual input utilizes ambient and focal vision to sense change in position to fixed and moving targets. The cerebel-
lum then takes all of this information from the senses and corrects and controls posture and balance (2, 25).

Anecdotal improvements in balance, joint stability, neuromuscular control, and proprioceptive control from using stability ball exercises have led to their increased use in the reduction of a number of injuries (24). Strength and conditioning specialists can now use stability ball exercises to help prevent anterior cruciate ligament sprains, hamstring strains, rotator cuff pathologies, back injuries, and ankle injuries (1–4, 9, 14, 22, 24, 27, 28, 35, 36). Myers (22) reported that joint neuromuscular control is decreased after people suffer a capsuloligament injury. Myers states that this limitation is a result of impaired proprioceptive input to the central nervous system and should be addressed in addition to healing mechanical restraints of the joint. These mechanical restraints include muscles, tendons, ligaments, and bones. Myers states that incorporating functional rehabilitation is believed to increase peripheral afferent nerves at the joint capsule and muscles, reestablish afferent pathways, increase muscle coactivation, prepare muscles for eccentric and concentric actions, and increase muscle stability/stiffness about a joint. This is important because injury prevention is a common goal among athletic programs in the pursuit of successful seasons.

Stability ball exercises can also be used as a tool in strength and conditioning. Cassady and Levens (7) found abdominal stabilization exercises performed upon a stability ball raised heart rate an average of 35 beats per minute for chest exercises (bench press) and 40 beats per minute for overhead exercises (push press). They found that stability ball exercises increased oxygen consumption, suggesting they can be performed as part of a circuit training session and be effective in aerobic and anaerobic exercise (6). Circuit training, aerobic training, and anaerobic training are needed to improve an athlete's overall fitness level and to reach performance goals. However, stability ball exercises have been shown to be non-effective in training for maximum force output during maximal repetition exercises. Anderson and Behm (1) compared exercises done on stable and unstable surfaces for electromyographic activity, force output, percentage of 1 repetition maximum, and power. They found an average decrease of 30% in force, velocity, and power when instability was induced. Electromyographic activity in the prime movers was lowered when a shift was made from a stable to an unstable surface (1–4, 12, 16, 17, 39).

Research in strength and conditioning has shown us that for muscular adaptation and hypertrophy to occur, an overload must be applied to the muscles. Many researchers have concluded that if unstable training conditions do not allow for maximum force output, power, or velocity, the exercise will be ineffective in improving strength (1–4, 12, 16, 17, 39). Thus, there is still a need for resistance training on stable surfaces. The unstable surfaces, as mentioned before, will increase muscle unit recruitment, agonist/antagonist coactivation, neuromuscular control, proprioception, and balance, but the levels of strength gains will be less than exercises performed on stable surfaces (1–4, 12, 16, 17, 39).

Stanton, Reaburn, and Humphries (30) performed a study to investigate how a stability ball exercise program, performed twice a week for 6 weeks, affected running economy, running posture, and VO2 max. The results revealed no significant improvement in VO2 max, running economy, or running posture. It was concluded that stability ball exercises improved core stability but did not appear to improve physical performance in young athletes. Core stability in this study was measured using the Sahrmann core stability test (30).

Safety
Humans vary in height and weight; therefore, stability balls must be sized accordingly. Stability balls can vary in size from 0.45 m up to 1.2 m in diameter with a 10-cm increment between sizes. Proper size for the stability ball can be determined by sitting on the ball and then looking to see if the thighs are slightly above parallel to the ground. The stability ball is at correct air pressure when it feels firm but not tight or when the ball is at the correct diameter.

Safety is a major concern when people are using stability balls. Because of their unstable design, proper exercise technique should be followed to ensure safety from falls. People should not be performing stability ball exercises that are above their level of progression (13). Jeffrey (13) describes a progressive core stability program based upon 5 levels of achievement. Each level is slightly more advanced then the previous 1, and the exercises should be prescribed accordingly, based upon individual achievement level. The 5 levels are as follows:

- Mastery of core contraction.
- Static holds and slow movements in a stable environment.
- Static holds in an unstable environment and dynamic movement in a stable environment.
- Dynamic movements in an unstable environment.
- Resisted, dynamic movement in an unstable environment.

These levels not only improve safety but also ensure that proper technique will be used for all of the exercises.

Other cautions in safety may include using a belt for spotting purposes, sand bags for stabilizing wedges, and/or stabilizing platforms. People with long, loose hair should tie it back so it does not get caught during dynamic movements. Caution should also be taken to make sure stability balls are not overinflated, left in the heat, or damaged. During stability ball exercises, people should use common sense; if the exercise causes pain, they should discontinue its use (5). Cassady
(7) reported that exercises raise heart rate and oxygen consumption, and this means that certain populations should be monitored regularly for possible overexertion.

Role of Stability Balls in Orthopedic Rehabilitation

Many of the same benefits seen in strength and conditioning are also seen in orthopedic rehabilitation. Stability ball exercises can be used to train proprioception, static/dynamic balance, neuromuscular control, joint stability, and core stability (1-3, 9, 14, 15, 17, 18, 22, 31, 34, 35, 39). Walton (36) found, in a review of literature, that patients who followed a stability ball program for recurrent shoulder instability decreased the incidence of injury by 52% over a 10-year follow-up period. In addition to these benefits, stability balls can be used for range of motion, flexibility, traction, joint mobilizations, rhythmic stabilization, closed kinetic chain, and open kinetic chain exercises (5, 15, 22, 25, 35). Stability ball exercises can fit into all of the phases of rehabilitation, which include the inflammatory response phase, the fibroelastic repair phase, and the maturation phase (26).

Stability balls are used to rehabilitate injuries of the major joints in the body, including the back, shoulder, elbow, wrist, hip, knee, and ankle. Research in rehabilitation has shown that stability ball exercises improve cases of chronic low back pain, shoulder instability, shoulder impingement, and postoperative anterior cruciate ligament surgery (14, 15, 22, 25, 28, 35, 36). Myers (22) found that recurrent chronic injuries had proprioceptive deficits in the injured joint that led to decreased neuromuscular control and eventually re-injury after pain had subsided. Myers suggests that athletic trainers and physical therapists use this knowledge to address these neuromuscular control deficits with orthopedic rehabilitation. Stability balls can also be used to rehabilitate chronic injuries, such as sciatica and scoliosis (5). Orthopedic rehabilitation success has made stability balls very popular with athletic trainers, physical therapists, and occupational therapists. Stability balls are now being sold to patients for use during home exercise programs. They can be purchased online and at most shopping centers, hospitals, and orthopedic rehabilitation clinics.

Role of Stability Balls in Physical Fitness

With growing healthcare costs and overall poorer health in the United States due to lack of activity, poor nutrition, and busy lifestyles, there is an increased need for physical activity and exercise in the general population. This has left many people looking for fun and creative ways to improve physical health. Improved physical fitness levels are recommended to facilitate weight control, cardiovascular health, body strength, bone mineral density, and flexibility (7). Many researchers have reported that regular aerobic, anaerobic, and strength training exercises improve overall health (5, 8, 11, 20, 21, 29). Aerobic exercise can be defined as an exercise that is of long/constant duration of 30 minutes or longer, at a medium intensity, and has its primary energy source as beta-oxidation and anaerobic glycolysis. Studies have shown that such exercise tools as stability balls can be used to achieve long-term physical fitness components (8, 11, 20, 21).

Clark (8) reported that aerobic exercise performed on stability ball 5 to 6 times a week and resistance training performed 2 to 3 times a week in obese populations lowered body weight, body mass index, and incidence of low back pain/spasm. Clark also mentioned exercises performed on the stability ball not only improved overall health but also lowered the chance of injury by enhancing neuromuscular control. Neuromuscular control was measured using static and dynamic balance tests. The static tests include parallel stance, semitandum stance, tandem stance, and standing on 1 foot with eyes open and closed. The static tests were measured for 30 seconds, and if the person could not reach 30 seconds, that time was recorded. Dynamic balance was assessed by having the subject walk heel to toe along a 10-foot long balance beam. The subject was assessed by counting the number of correct steps taken along the 10-foot long beam (8). Clark’s study is one of the first of its kind. Future research with stability ball workouts and the obese population is needed to further support this information.

Stability balls are versatile. Stability ball exercise selection may be tailored to be very simple for beginners and more complex for the advanced. In some cases in which certain populations, such as the elderly, the obese, and stroke victims, are unable to perform total weight bearing for extended periods, stability balls allow for aerobic, anaerobic, and strength training exercises to be accomplished in a non-weight-bearing or semiwight-bearing fashion. Research has found that stability ball exercises are effective at increasing heart rate and oxygen consumption (7). These results suggest that the elderly, the obese, and stroke victims may obtain a workout while minimizing weight bearing (7, 8, 21).

In addition to physical fitness goals, stability ball exercises have been shown to improve balance in elderly, ambulatory people (33). Urbisch (33) studied 8 subjects who had a stroke greater than 6 years ago. The research found an 8-week long class, meeting twice a week, helped to improve balance in poststroke patients. Improvements in balance were measured using a Performance-Oriented Mobility Assessment, post-test questionnaire, and Berg Balance Scale (21).

Role of Stability Balls in Pregnancy

In the past few years, pregnant women have started to use stability balls. They have been used by pregnant women who were active in health clubs, then later in pregnancy classes and the delivery room. One article reported that the use of stability balls by pregnant women improved the health of the
mother and child. The results of Watkins’s (37) study state that pregnant women who perform exercises on the stability ball increased abdominal strength, stability, balance, posture, proprioception, and flexibility. These benefits provide for supple and strong abdominal muscles, which help to support the baby, decrease the incidence of back pain during pregnancy, and reduce the chances of accidental falls. The increased abdominal strength may also help during delivery to increase intra-abdominal pressure (37).

Perez (23) outlines various benefits that stability balls provide during childbirth. These benefits include facilitating fetal descent; helping with pelvic relaxation, mobility, and widening; relieving back pain; providing back pressure and massage; making contractions less painful and more productive; and providing support while in the squat position.

Finally, stability balls can be used postpartum in several different ways. Watkins (37) reports that stability balls can be used as a chair, which lessens the pressure placed on the perineum, especially right after delivery. The stability ball is valuable during breastfeeding to help promote the mother’s correct posture. Watkins also explains that babies are soothed when the person holding them is bouncing gently up and down on the ball. The stability ball can even be used with fussy babies who have gas or colic. Simply placing the baby on his or her belly on the ball helps to apply pressure to the abdomen, possibly minimizing his or her gas pains.

**Areas of Future Research**

There are many new and interesting areas of future research for stability balls. The first area should focus on the effects of stability ball exercise prescription on the obese or overweight population. This area can focus specifically on body composition, weight loss, cardiovascular health, and patient compliance. The second area of focus should include the effects of stability ball exercise on highly trained athletes, such as strongman and power lifters. The final area should focus on the effects of stability balls have on childbirth and pregnancy. How effective are they? How much pain does the stability ball alleviate during childbirth and pregnancy?

**Conclusion**

Stability balls are multifaceted in use, function, and prescription. Many people are just now beginning to realize the many different roles stability balls have other than their use in fitness clubs and physical therapy clinics. These simple balls can be used for strength and conditioning, physical fitness, injury prevention/rehabilitation, pregnancy, child delivery, and classroom education. They are fun, have many uses, and are relatively easy to use with proper instruction and supervision.

**References**

