Weighted Ball Velocity Throwing Programs Are Effective. Are the Benefits Worth the Risk?

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With springtime around the corner, spring sports are in the air! Baseball and softball seasons, for instance, have begun in southern states, and northern states will see pitchers and catchers reporting in no time! However, with the start of a new season comes the risk of throwing injuries. Previous data was suggested that more throwing injuries occur in the preseason and early season than in the later stages of a baseball season.[1] Because of the large number of overuse throwing injuries, in particular at the youth and high school levels, safety guidelines were adopted that included pitch count and rest day restrictions in an attempt to reduce injuries.[2–12] However, even with robust data, increasing media coverage of pitch counts, and increasing awareness in the general public, there is concern there has not been a reduction in overuse throwing-related injuries. Thus, there must be additional explanations for this lack of decrease in throwing injuries even with the implementation of throwing safety guidelines. One possible explanation is the interest and rise in weighted ball velocity (WBV) throwing programs. When entering a search for "weighted ball velocity throwing programs" into an internet search engine (such as www.google.com or www.bing.com), there are thousands of results that include numerous videos and advertisements on how to purchase weighted balls and participate in these training programs. However, there are many unsubstantiated claims with varying WBV throwing programs that create confusion to parents, coaches, and athletes and is reason to approach these programs with caution. Thus, due to the rising interest in this type of throwing training program, this editorial will explore WBV throwing programs as a possible contributor to this lack of reduction of throwing injury prevention.

A recent study by Reinold et al assessed pretest and post-test throwing velocity in 38 13- to 18-year-old baseball pitchers. Data points included shoulder and elbow passive range of motion, shoulder strength, elbow varus torque, and shoulder internal rotation velocity. The weighted ball throwing program group participated 3 times per week using balls varying from 2 to 32 ounces, whereas the control group used a standard 5-ounce baseball. Results indicated a statistically significant 3.3% increase in velocity and an increase of 4.3 degrees of shoulder external rotation over the 6 weeks study period. However, in addition to the increase in velocity and increase in shoulder external rotation was an increase in injury rate by 24%. No pitchers in the control group sustained injuries.[13] Another recent baseball study analyzing 17 collegiate and professional baseball pitchers sought to determine whether a 6-weeks WBV throwing program increased pitch velocity and any changes in ball speed and arm kinetics and/or kinematics.[14] Using motion capture before and after the six-week training program, results indicated 9 pitchers increased their throwing velocity, whereas 8 did not. In the supplemental data, the average increase in throwing velocity was 2.1 miles per hour (mph) and decrease in the decreased velocity group was 2.4 mph. In the group that did increase their throwing velocity, maximum elbow medial force increased 32 N as opposed to a decrease of 14 N in the group that decreased throwing velocity during the arm cocking/acceleration phase, although this data was not statistically significant. Similarly, during the arm cocking/acceleration phase of pitching, the increased velocity group saw a rise of maximum elbow varus torque of 4 N-m as opposed to a decreased of 5 N-m in the decreased throwing velocity group.[14] Furthermore, a biomechanical study of 25 high school and collegiate baseball players using slightly underweight and overweight baseballs and motion capture was recently published. The data indicated that ball velocity increased the most with underweight balls; and kinetic and kinematic data did not significantly alter throwing arm kinetics.[15] It is interesting to note that Flesig and colleagues tested pitchers in this study on a mound and flat-ground. Flat-ground throws with overweight balls lead to greater shoulder internal rotation velocity and elbow varus torque. Hence, this type of training exercise (flat ground WB throws) increased stress, and can lead to injury if used too frequently.[15] Interestingly, one systematic review indicated that there were no negative effects using overweight or underweight balls with respect to injury risk.[16] Thus, there is a lack of consistency in the literature with the usage of overweight or underweight balls with respect to injury risk.

There have been other studies inquiring whether WBV throwing programs are successful at increasing throwing velocity. Two recent systematic reviews analyzed a group of studies published in the past 50 years, one in 2009 and one in 2019.[16,17] In Caldwell et al.'s systematic review 6 of the 9 studies, ball velocity increased from 2.1 to 11.2 mph. Three Studies reported no significant difference in ball velocity. The authors concluded that while WBV throwing programs do seem to result in increased velocity, the long-term safety effects of using this training modality are not known at this time.

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TABLE 1. Benefits and Risks of Weighted Ball Velocity Programs

Benefits	Risks	Inconclusive
Increase throwing velocity	Possible increased risk of injury	Potential to change throwing mechanics
Opportunity for success (selection to elite teams, college scholarship, and professional opportunities)	Inability to participate in sport if injured	Increased risk of injury in a skeletally immature versus skeletally mature throwing athlete
Benefits of continuing to play such as:		
•Improved mental health		
•Improved social skills		
•Cardiovascular benefits		
•Development of coordination		
•Improved physical fitness and strength		

Thus, the authors concluded, "a recommendation cannot be made for or against the use of these programs without further carefully considered studies."[17] A recent biomechanical study that did not assess injuries, but did analyze medial elbow torque, pitch velocity, and arm speed in skeletally immature youth baseball pitchers indicated that increased weight in ball used resulted in greater medial elbow torque.[18] Thus, it would be reasonable to be concerned about a possible increased risk in injury in skeletally immature throwing athletes using this type of a program due to these kinetic changes and developing open growth plates. Thus, it should be pointed out that this group of throwing athletes should proceed with extreme caution if proceeding with WBV throwing programs.

Considering other throwing sports such as cricket, a recent study out of the United Kingdom looked at the effects of ball weight on speed, accuracy, and mechanics.[19] Researchers found that training with underweight and overweight balls produced an increase in bowling speed of approximately 3.3 mph (1.5 m/s) without increasing risk of injury. However, there was an indication of training with these balls induced poor bowling mechanics.[20] Two groups were used, a traditional training group that bowled only with regulation cricket balls (control) and a modified-implement training group that bowled with a combination of overweight, underweight, and regulation cricket balls (intervention). Using video analysis to study accuracy and radar guns to measure speed, the study concluded that bowling speed did indeed increase 2.5 mph (or 4 km/h) in the intervention group as opposed to 0.8 mph (1.3 km/h) in the control group. However, this study did not study injury association with different training ball weights.[19] The results of this study also present a question: which is more effective, training with underweight or overweight balls to provide a greater increase in bowling velocity?

Looking to handball as another throwing sport, colleagues from Norway compared the kinematics between underweight, regulation, and overweight balls in experienced female team handball players (mean age 18.2 ± 2.1 years). Their study indicated that ball weight likely contributed to changes in the kinematics of the throwing arm including internal rotation of the shoulder and elbow extension.[21]

TABLE 2. Recommendations

WBV throwing programs should be performed under the supervision of experts
Caution should be used in skeletally immature individuals and the risks of using this training method should be reviewed before starting a WBV throwing program
WBV throwing programs may be used cautiously in conjunction with an overall kinetic chain training program

Based on the data across multiple sports, it seems that WBV throwing programs do indeed work: that is to say they increase throwing velocity. As many athletes, coaches, parents, and the sports performance team members are aware that the amount of velocity increase, even if quite small, may provide a greater likelihood one has of being successful with respect to performance in games and potential to garner opportunities to pitch at higher levels of competition (eg in college, professionally, etc). In fact, a recent article in one of the largest and reputable newspapers in the United States highlighted the importance of velocity in baseball pitchers.[22] However, it must be emphasized that the quest for increasing pitching velocity at the expense of a pitcher's development can lead to further injury. Furthermore, robust evidence-based medicine has repeatedly indicated that the goals of a pitcher, particularly an adolescent one, should be to achieve efficient pitching biomechanics and use his or her kinetic chain appropriately to minimize kinetic chain deficits and decrease potential injury risk.[23–28] As Chalmers et al[29] notes, minimizing kinematic weak links during the pitching motion may be a factor in minimizing risk of pitching-related injury.

Concerns remain about an increased injury risk associated with these throwing programs because of changes in the throwing mechanics and age of the athlete. The role of the sports medicine team members is to keep our athletes safe, and on the field participating. However, how do we address this hot topic when speaking with coaches, athletes, sports performance professionals, and parents? Do we as a sports medicine community consider that the risk of injuring a shoulder or elbow is worth the reward of receiving a college scholarship or draft position to a professional team? On a public health level, is it more important to encourage adolescent sport participation because of the subsequent benefits of playing sports versus not being part of a team and active? None of these questions are yes or no. However, as suggested in Table 1, there are benefits and risks training with these programs. Furthermore, as Table 2 indicates, based on the data, this author provides recommendations for usage of these programs. Ultimately, what the evidence-based research has indicated is although there may be trends in one direction or another, further research is required to make a definitive statement on recommended for or against the use of WBV programs.

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