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Research article

Comparison of the Shake Weight® modality exercises when compared to traditional dumbbells

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Abstract
Individuals are continuously looking for faster, more efficient methods with which to develop physical fitness. This has led to the development of products and programs marketed towards increasing physical fitness in minimal time. The Shake Weight® (SW) has been advertised to increase muscular strength among other factors in less time than traditional weightlifting. The purpose of this study was to compare the electromyographic (EMG) muscle activity of the SW to a traditional dumbbell (DB) performing the same exercises. Twelve men (22.9 ± 1.6 years) and 13 women (23.0 ± 1.9 years) volunteered to participate in this study. Subjects performed the chest shake (CS), biceps shake (BS), and triceps shake (TS) using the SW and DW. Maximal voluntary isometric contractions (MVIC) were exhibited for all muscles. EMG activity was recorded for the pectoralis major (PM), triceps brachii (TB), biceps brachii (BB), anterior deltoid (AD), trapezius (TR), and rectus abdominus (RA) and compared to detect differences between modalities. EMG activity for each muscle group was reported as a percentage of each subject's individual MVIC. A repeated measures ANOVA revealed no significant differences between the SW and DB modalities during each exercise for all muscles except the BB ($p < 0.05$). During the CS exercise muscle activity was significantly greater for DB in the BB muscle when compared to the SW mode (50.8 ± 28.9%; 35.8 ± 30.8%). The SW did not have any advantage over the DB for any exercise, nor for any muscle group. Further, no muscle group during any of the SW trials exhibited an MVIC over 60%, the level necessary to increase muscular strength.

Key words: Physical activity, muscular strength, muscular endurance, fitness products.

Introduction

In a culture obsessed with multi-tasking, individuals are constantly looking for faster, more efficient methods to not only maintain, but increase physical fitness. This has led to an influx of products and programs used to lead consumers to believe they can get in great shape in minimal amounts of time. Examples of these products include, but are not limited to the Bodyblade® six exercises in six minutes routine, (Moreside et al., 2007), Ab Circle Pro® 3-minute workout (Willardson et al., 2010), and Perfect Pushup® (Youdas et al., 2010). Some of these products have been intricately tested and validated such as the Bodyblade® (Lister et al., 2007), while others continue to remain under speculation and scrutiny. Many times these claims use testimonies rather than proper research and validation beforehand.

Similar to other products, the Shake Weight® (SW) claims to "increase muscle tone and create muscle definition through reduction of body fat". The benefits of the SW are based on the concept of "dynamic inertia" reported by the manufacturer (www.shakeweightextreme.com). Both ends of the modality are spring loaded and allow the weight to forcefully move back and forth and claim to generate greater gains in muscle size and strength than traditional training. According to the manufacturer, SW increases muscle activity by more than 300% compared to traditional weights (LifeModeler, 2009). However, these comparisons were made by equating the SW isometric contraction of the biceps brachii to a concentric/eccentric contraction of a traditional biceps curl over a 3-second interval.

Limited research has been conducting analyzing the effectiveness of the SW (Porcari, 2011). In this study, comparisons were made between isometric contractions of the SW (biceps shake, triceps shake, shoulder shake, and chest shake) and traditional dynamic contractions of the same muscle for each individual lift (biceps curl, triceps extension, shoulder press, and chest press). When using equal weights, the SW elicited greater muscle activity (based on a percentage of maximal voluntary isometric contraction) for all exercises compared to traditional dumbbell exercises.

Isometric training has been compared to dynamic training in terms of force production and strength through range of motion (ROM). Folland et al. (2005) suggested that isometric training significantly increased isometric contraction compared to isometric contraction with dynamic training. One of the concerns with isometric training is the lack of training throughout full ROM of each joint. Knapik et al. (1983) examined angle-specific training responses to isometric training. Results from that study found that strength was increased for contractions only within 20 degrees of the training angle. Kitai and Sale (1989) also looked at joint angle in reference to isometric training. After 6 weeks, subjects increased their maximal muscular strength at angles of 0, 5, and 10 degrees from the initial training angle, but not beyond those ranges. Isometric training seems to produce increases in strength at the specific angle trained, but not through a joint's full ROM. Therefore, the purpose of this study was to examine muscle activation of the pectoralis major (PM), triceps brachii (TB), biceps brachii (BB), anterior deltoid (AD), trapezius (TR), and rectus abdominus (RA) during the chest shake (CS), biceps shake (BS), and triceps shake (TS) using the SW and DB of the same absolute weight.

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Methods

Experimental approach to the problem

Electromyography (EMG) is a valuable tool used in research to detect motor unit activity within muscle groups and between muscle groups during a dynamic or static movement (Distefano et al., 2009). Higher EMG amplitudes are indicative of greater strength of force development from the stimulated musculature. Manual muscle testing has been tested for validity and reliability and is a procedure often used to identify the maximum voluntary isometric contraction (MVIC) so that EMG activity during separate trials can be compared as a percentage of the MVIC (Cuthbert and Goodheart, 2007; Frese et al., 1987; Hsieh and Philips, 1990; Iddings et al., 1961). This study evaluated the EMG activity of the PM, RA, AD, BB, TB, and the middle portion of the TR using a SW compared to a DB of equal absolute masses employing three different shaking techniques. Surface EMG was used, and electrode placement followed the protocol outlined by Cram and Kasman (1998). Testing order for all participants was randomized to increase the internal validity of the study. This study aimed to determine if utilizing the SW as an exercise modality increases EMG activation in the three different shake conditions in comparison to shaking a traditional dumbbell.

When dealing with EMG (especially surface electrodes) there is always the possibility of crosstalk within the muscles (Distefano et al., 2009). Crosstalk was minimized in this study by using standardized techniques for electrode placement (Cram and Kasman, 1998).

Table 1. Subject demographic data. Data are means (±SD).

	Males	Females
Age (years)	22.9 (1.6)	23.0 (2.0)
Weight (kg)	83.6 (14.5)	61.0 (8.2)
Height (m)	1.80 (.08)	1.66 (.06)
Body Mass Index (BMI)	26.3 (3.5)	22.2 (3.0)

Subjects

This study was approved by the Institutional Review Board at the University of Arkansas and informed consent was obtained from each participant prior to testing. Twenty-five healthy subjects, 12 men and 13 women volunteered to participate in this study (Table 1). All subjects had no prior experience with the SW modality previous to the study. Subjects had also not participated in any workout regimen utilizing this specific method of exercise.

Instrumentation

EMG signals were collected using HeartTrace Electrodes (Cardiology Shop, Berlin, MA). Data were processed with a 8-Channel EMG (Noraxon Myopac, Scottsdale, Arizona). The 5-lb (2.26 kg) male and the 2.5-lb (1.13 kg) female SW were used for analysis (Shake Weight®, Neenah, WI). Five-lb (2.26 kg) and 2.5-lb (1.13 kg) York Rubber Hex Dumbbells were used during testing for the traditional dumbbell portions (MuscleDriver USA, Fort Mill, SC). Weights were accordingly matched with gender.

Procedures

Upon arrival, participants were fitted for the EMG electrodes. Electrodes were placed over the muscle belly running parallel to the muscle fibers on the right side of all participants for the following muscles: PM, RA, AD, BB, TB, and the middle portion of the TR. After electrode placement, each subject underwent manual muscle testing based on the work of Kendall et al. (1993) to determine the MVICfor each muscle. Manual muscle testing was performed on the right side in the following order for each participant: BB, TB, AD, RA, PM, TR. Each manual muscle test was held maximally for 5 seconds, with the largest reading being recorded as the MVIC for each muscle. The first and last second of each trial were removed in attempt to obtain steady state measures for each test. For the manual muscle test of the BB, the participant sat comfortably with their right arm fully adducted to their side. Their elbow was flexed at 90 degrees. From this position the participant was asked to flex the elbow and move the hand towards their shoulder with as much force as possible with only the use of their BB. During this time frame, a tester provided a manual resistance to the participant. For the manual muscle test of the TB, the participant started in the same position with their arm adducted to their side and elbow flexed at 90 degrees. For the TB, the participant tried to fully extend their arm against the resistance of the tester instead of flexing. Manual muscle testing of the AD consisted of the participant sitting with their arm flexed to 90 degrees at the shoulder and the elbow fully extended. Participants were then asked to resist their arm being pushed down (reducing flexion) at the shoulder against the manual resistance of the tester. Participants were then asked to lie supine on a table for testing of the RA. With their arms at their sides and legs flexed or extended in the manner the participants felt comfortable, the participants were asked to perform a crunch keeping their head and shoulders in alignment against the resistance of a tester being applied to their shoulders. Remaining the supine position, participants moved to the right edge of the table so that their right arm would hang loosely off the table. To test MVIC of the PM participants were asked to abduct their shoulder to 90 degrees and to flex their elbow to 90 degrees so that their fist pointed towards the ceiling. Resistance was then applied to the fist and bicep by the tester and the participant was asked to horizontally adduct at the shoulder to bring their arm across their chest. Finally, to test the TR, participants began in a prone position with their right arm hanging loosely from the table. Again, participants abducted their shoulder and flexed their elbow to 90 degrees so that their fist pointed towards the floor. Resistance was applied to the triceps and the elbow by the tester and participants were instructed to pull their arm towards the ceiling in a straight line, being sure not to try and pull their arm towards the side of their body. This was to ensure the TR was recorded and not the latissimus dorsi.

After the manual muscle testing period, participants were and given the gender appropriate SW and instruction on how to perform each shaking exercise. A 5.0-lb (2.26 kg) SW and 5.0-lb (2.26 kg) DB was used for males and a 2.5-lb (1.13 kg) SW and 2.5-lb (1.13 kg) DB were used for females. Participants then performed the three different exercises (CS, BS, TS, in that order). Participants were then randomly selected to start with either the DB or the SW for the testing period. Participants stood erect with their feet shoulder width apart and feet facing forward for all exercises. Subjects were instructed to perform the exercises in a shaking fashion as demonstrated by the manufacturer (www.shakeweightextreme.com) with limited range of motion. This was to ensure that each exercise closely demonstrated an isometric contraction.

Figure 1. Frontal view for proper form of the Chest Shake exercise performed during testing.

During the CS (Figure 1), participants were instructed to hold the SW or DB with both hands at a 45 degrees angle so that the top portion of the SW or dumbbell pointed towards their chin and the bottom pointed towards the floor (Figure 2). Participants' shoulders were flexed to 45 degrees and elbows were flexed at approximately 90 degrees during this shake. From here, the SW or dumbbell was to be shaken as forcefully and quickly as possible with very little joint movement at the shoulder or elbow. The shaking period lasted 5 seconds, with the 1^{st} and 5^{th} seconds discarded and the 2^{nd}-4^{th} seconds were recorded for analysis. This was done to account for any discrepancy between the starting of the timer and the participant beginning the protocol.

Figure 2. Side view for proper form of the Chest Shake exercise performed during testing.

For the BS, participants externally rotated their shoulders, abducted at the shoulder to 90 degrees, and flexed 90 degrees at the elbow so that the right fist pointed towards the ceiling (Figure 3). Then with only their right arm, participants shook the exercise equipment as hard and fast as possible only moving at the elbow in flexion and extension so that the end of the equipment moved closer and further away from their ear.

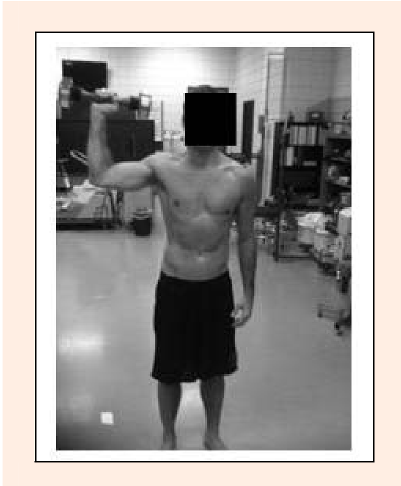

Figure 3. Frontal view for proper form of the Biceps Shake exercise performed during testing.

The TS (Figure 4) consisted of the participants holding the exercise equipment behind their heads with both hands so that the shoulders were just short of full extension and the elbows were flexed to 90 degrees (Figure 5). Participants then shook the device as hard and fast up and down as hard as possible for 5 seconds so that very minimal flexion and extension of the elbow occurred.

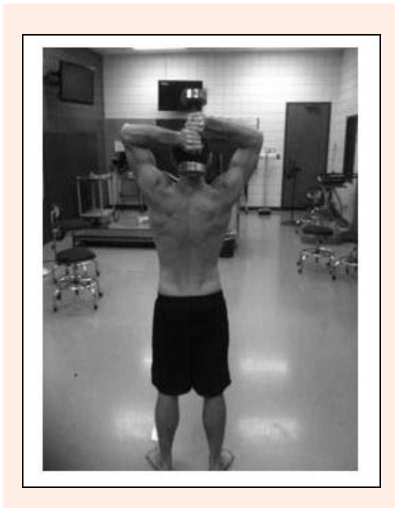

Figure 4. Rear view for proper form of the Triceps Shake exercise performed during testing.

Statistical analysis

Using SPSS (Version 19, Armonk, NY), ANOVA with a repeated-measures factor with pair-wise post hoc analyses were used to detect significant differences between the conditions. The independent variables for this study were the different shake conditions (CS, BS, TS) and two weight conditions (SW and DB). The dependent variables for this study were the EMG activity for the PM, RA, AD, BB, TB, and the middle portion of the TR. Level of significance was set at 0.05 for all analyses.

Figure 5. Side view for proper form of the Triceps Shake exercise performed during testing.

Results

All muscles were compared between the SW and DB trials for the CS, BS, and TS exercises to determine differences between modalities Table 2. For the BB muscle during the CS exercise, the traditional DB had significantly greater EMG activity when compared to the SW (F [1,22] = 5.372; p = 0.030). For all other conditions no significant differences were detected within the muscles. During the TS exercise, muscle activity was higher for the DB in all muscles compared to the SW. EMG was also higher for the DB in every muscle but the TR during the CS, and all but the AD and RA during the BS. When comparing genders, there were no significant differences between males and females for any of the exercises.

Discussion

In this study, EMG activity was examined in the PM TB, BB, AD, TR, rectus RA during the CS, SS, and BS, using the SW and a DB of the same absolute weight. It had been previously suggested that the SW modality would outperform DB when comparing the manufacturer developed exercises to traditional dynamic lifts for individual muscles (Porcari, 2011). In this study, minimal concentric and eccentric contractions of the muscles were compared using the traditional DB and SW modalities. Exercise protocols were the same for both conditions (SW, DB) as suggested by the manufacture of the SW to improve muscular strength. When examining isometric training (IT) responses compared to other protocols that utilized lengthening (LT) or shortening (ST) reactions, multiple findings have been observed. When stimulating muscle tissue in rats, it was suggested that LT > IT > ST in relation to the amount of torque generated by the stimulated muscles (Adams et al., 2004).

Traditionally, EMG analysis has not been intended to report direct muscular strength, but rather to develop a picture of subcutaneous motor-unit recruitment directly beneath the individual electrode (Youdas et al., 2010). Maximal voluntary isometric contraction is recorded based on the proposed mechanism by DiGiovine et al. (1992) classifying muscular demand into low (MVIC < 20%), moderate (MVIC 20 - 40%), high (MVIC 41 - 60%), and very high (MVIC > 60%) categories. Relative exercise intensity can therefore be reported as a percentage of MVIC for the three exercises in each condition. Contrary to previous findings (Procari, 2011), SW exercises did not produce significantly greater EMG activity in the PM, TB, BB, AD, TR, or RA muscles during any of the three exercises. In fact the only significant difference in mean muscle activity found between the two exercise modalities was in the BB during the CS exercise in favor of the traditional DB (50.8% MVIC compared to 35.8% MVIC). Results indicate that the traditional dumbbell was just as effective or greater at producing the results achievable by the SW. The purported concept of "dynamic inertia" does not seem to have any effect on the level of physical exertion generated by the movements between the two exercise conditions. This could be expected from the lower load utilized, but because the SW is only available in these sizes it was important to keep the minimal loads equal between the modalities.

It has been suggested that in order to promote gain in muscular strength during exercise, there should be a muscle activation greater that 50 - 60% of MVIC (Andersen et al., 2006; Ayotte et al., 2007). During these trials the greatest level of muscle activation (expressed as a percentage of MVIC) was 66.2% in the TR during the TS exercise using the traditional DB. None of the other exercises generated an activity level greater than 52.3%. In accordance with Andersen et al., (2006) and Ayotte et al., (2007) results indicate that performing these exercises with either modality will exhibit little to no increase in muscular strength. Meyers et al. (2005) also demonstrated

Table 2. Dumbbell (DB) vs. Shake Weight (SW)comparisons for the CS, BS, and SW conditions (expressed as percentages of MVIC, % MVIC). Data are means (±SD).

	Chest		Biceps		Triceps	
	SW	DB	SW	DB	SW	DB
Pectoralis Major	34.1 (27.0)	42.2 (36.5)	25.7 (22.4)	30.4 (20.1)	38.6 (46.1)	50.1 (68.4)
Anterior Deltoid	31.4 (19.0)	36.6 (17.4)	33.2 (16.7)	31.9 (14.8)	45.4 (27.3)	49.1 (25.3)
Rectus Abdominus	25.9 (31.2)	38.6 (15.8)	21.0 (16.8)	17.2 (11.9)	26.7 (31.3)	33.7 (33.7)
Biceps Brachii	35.8 (30.8)	50.8 (28.9) *	47.7 (28.8)	50.9 (28.2)	29.4 (21.1)	38.0 (37.7)
Triceps Brachii	46.0 (23.3)	46.1 (25.9)	50.9 (19.5)	52.3 (25.3)	50.0 (29.2)	52.0 (30.7)
Trapezius	46.1 (21.1)	43.5 (18.4)	50.9 (41.5)	52.3 (45.9)	45.4 (37.5)	66.2 (37.1)

* Indicates significant difference from SW (p < 0.05)

muscular strength gains using tube-based exercises for baseball pitchers at greater than 50% - 60% of MVIC. Greater than 20% of MVIC was deemed appropriate for warm up, but not strength gains. Although statistically insignificant, most of the DB exercises resulted in a slightly greater percentage of MVIC elicited. While EMG amplitude was too low to produce significant gains in muscle strength, this was likely due to the low absolute load utilized. The researchers acknowledge that strength training with 2.5-lb (1.13 kg) and 5.0-lb (2.26 kg) loads is unlikely to produce an anabolic effect; however the absolute intensity of the exercises was warranted.

Conclusion

The focus of this study was to determine if a traditional DB repeated the muscle activation of the SW modality when performing the same exercises. According to the results of this study, the SW had no significant increases from a traditional DB in muscle activation. This study could be reproduced with heavier weights to determine if a heavier load would elicit higher levels of activation when performing the same exercises. From a practical standpoint the traditional DB would seem to be more economical when beginning a similarly styled activity program. Data from this study also suggest that completing exercises from this program lacked the ability to generate muscle activation greater than 60% of MVIC for almost every muscle tested. This indicates that increases in muscular strength would be limited and possibly negated from using this method. Future research could also look into the ability of this exercise program to increase muscular endurance as this particular protocol only utilized five second timeframes.

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Key points

- An oscillating dumbbell is not significantly effective for eliciting muscle activity when compared to traditional dumbbells performing the same exercises.
- The SW modality did not elicit >60% MVIC which is reportedly required for increases in muscle strength.

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