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MUSCLE ACTIVATION WHEN USING THE SHAKE WEIGHT® IN COMPARISON TO TRADITIONAL DUMBBELLS

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MUSCLE ACTIVATION WHEN USING THE SHAKE WEIGHT® IN

COMPARSION TO TRADITIONAL DUMBELLS

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We recommend acceptance of this thesis in partial fulfillment of the candidate's requirements for the degree of Master of Science in Clinical Exercise Physiology

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ABSTRACT

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Purpose: To determine the amount of muscle activation when using the Shake Weight® in comparison to a traditional dumbbell of equal size. *Methods:* Sixteen apparently healthy volunteers served as subjects in the study. After three practice sessions, each subject completed two randomized exercise trials: Shake Weight® and equal sized dumbbell. To measure muscle activation, electromyography (EMG) was recorded at four upper body sites. Maximum voluntary isometric contraction (MVIC) was carried out for each muscle prior to exercise trials. The averaged EMG values from each exercise trial were represented as a percentage of EMG collected during MVIC trials for each specific muscle. *Results:* The muscle activation values were higher, for all muscles, for all Shake Weight® exercises, compared to dumbbell exercises. On average, total muscle activity (the sum of the % MVIC values for all four muscles) was 66% greater when performing a Shake Weight® exercise compared to a dumbbell exercise. *Conclusions:* It is concluded that when summing up all four muscles for any given exercise, there is statistically greater average muscle activation for the Shake Weight® in comparison to the traditional dumbbell of equal size. Thus using the Shake Weight® may result in strength improvement if used regularly.

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INTRODUCTION

Muscular strength is considered an important component of physical fitness (1,2,4,8). Strength can be improved by using free weights (i.e. barbells, dumbbells), weight machines, elastic rubber bands, or even body weight (1). When correctly performed, resistance training improves all components of muscular fitness (1). A new product on the market, which can purportedly increase strength, is the Shake Weight®. The Shake Weight® is a dumbbell shaped fitness device, sold by Fitness IQ (Vista, California). There is a 2.5 pound version for women and a 5 pound version for men. While gripping the Shake Weight® with one or both hands, users vigorously shake the weight back and forth while springs on both ends allow the weight to move back and forth. During this shaking motion, minimal range of motion occurs in the extremity being trained; therefore, the limited range of motion may result in a training response similar to that of isometric training. This raises the question of whether or not strength gains would occur throughout a full range of motion. Previous studies have demonstrated that isometric exercise training produces strength gains specific to the training angle, but less transfer to angles farther away from the training angle (6,7,10,11,14,15). Fitness IQ coined the term "dynamic inertia" to describe this motion; dynamic inertia means there is a constant engagement of muscles (18).

The Shake Weight® claims to build definition, size, and strength in less time than traditional weights, given that the muscle is contracting up to 240 times per minute if the suggested routine is completed (18). Cipriani and colleagues used EMG to evaluate motor unit recruitment in the major upper body muscles when the Shake Weight® was used, in comparison to traditional dumbbells of equal size. They reported that with the Shake Weight®, muscle activity was approximately 300% higher compared to traditional weights (17). They attributed these results to the isometric contractions induced by the Shake Weight® and rapid rate of muscle fatigue (17). These findings were not published and were simply considered a product evaluation (personal communication with Dr. Cipriani).

Because the Shake Weight® is unique in its design, comparison to other products is very limited. However, the Bodyblade® and Shake Weight® utilize similar principles in regards to rapid movement of the given device and increased upper body muscle activity. The Bodyblade® is a blade shaped device which uses inertial forces to train the muscles. In an attempt to stabilize and control the back and forth movement of the blade, approximately 270 muscle contractions per minute are generated (16). Lister et al. (13) found that when comparing the Bodyblade® to cuff weights and Thera-Band®, raw EMG tracings of the specific upper body muscle groups were significantly greater when using the Bodyblade® during shoulder flexion and abduction. When using the Bodyblade®, claims suggest the oscillating effect of the device elicits 270 muscle contraction per minute, while the Shake Weight® claims muscles contract approximately 240 times per minute (16,18). When using either the Bodyblade® or the Shake Weight®, the ends of the device begin to oscillate with movement, producing a vibratory stimulus that the muscles must resist. Additionally, both devices limit the range of motion of the extremity being trained.

Fitness IQ also used a simulation of the movement to justify their claims of the Shake Weight® product. Lifemodeler (San Clemente, California) created a computerized, standard male, human model to compare muscular responses of the Shake Weight® and a normal dumbbell curl exercise (12). Total body energy consumption and muscle force were predicted for each exercise. Lifemodeler (12) found that the Shake Weight® generates higher peak muscle forces in the main driving muscle groups compared to a similarly weighted dumbbell and predicted that an individual would have to exercise seven times longer with traditional dumbbells to expend the same total body energy as the Shake Weight®. These conclusions were based upon prediction from their model to calculate the energy consumption and muscle force.

Although product evaluations and a simulation analysis have been used to justify the effectiveness of the Shake Weight®, to our knowledge there are no studies that have been conducted to verify these claims. Therefore, the purpose of this study was to determine the degree of muscle activation when using the Shake Weight® in comparison to a traditional dumbbell of equal size.

METHODS

Subjects

Sixteen apparently healthy volunteers (male and female) between 18-30 years of age were recruited from the University of Wisconsin-La Crosse. Each completed a PAR-Q, prior to laboratory testing, to screen for potential cardiovascular or orthopedic problems. Approval from the University of Wisconsin-La Crosse Institutional Review Board for the Protection of Human Subjects was obtained before conducting this study. Informed consent was received from all subjects prior to participating in the study.

Procedures

Prior to collection of data, subjects completed three practice sessions on three separate days to learn the proper grip and performance of the Shake Weight® exercises. During each practice session, the suggested 6-minute DVD workout was followed by each participant. Exercises performed on the video were replicated during the exercise trials.

Each subject completed two exercise trials, one with the Shake Weight® and the other with an equal sized dumbbell. To enhance the reliability of our EMG data, subjects completed both exercise trials on the same day. The order of trials was randomized to control for fatigue. The testing protocol varied for males and females based upon the Shake Weight® DVD provided with the purchase of the product. Ratings of perceived exertion (RPE) were assessed following each exercise using the Borg 6-20 scale (3).

For females, the 2.5 pound Shake Weight® and a 2.5 pound dumbbell were used. The Shake Weight® trial consisted of four Shake Weight® exercises including the following: one-handed biceps shake, two-handed triceps shake, one-handed shoulder shake, and two-handed chest shake. The duration of each of these exercises was 15 seconds, which was consistent with the suggested 6-minute Shake Weight® DVD. In between each exercise, the subject rested for 2 minutes. The traditional dumbbell trial consisted of four exercises and was performed with a 2.5 pound dumbbell. The following exercises were used: biceps curl, triceps extension, shoulder press, and chest fly. All exercises, with the exception of the chest fly, were performed in a standing position. The chest fly was performed while lying on a flat bench. Each of the four exercises was performed for a 15 second duration with a 2 minute rest period between exercises. For the dumbbell trial only, a metronome was used to control the rate of the repetitions (1 repetition every 2 seconds).

For males, the 5 pound Shake Weight® and a 5 pound dumbbell were used. The Shake Weight® trial consisted of four Shake Weight® exercises including the following: one-handed biceps shake, two-handed triceps shake, one-handed shoulder shake, and two-handed chest shake. The duration of each was 30 seconds, as suggested by the Shake Weight® DVD. In between each exercise set, the subject rested for 2 minutes. The dumbbell trial also consisted of four exercises and was performed with a 5 pound dumbbell. The exercises included the following: biceps curl, triceps extension, shoulder press, and chest fly. All exercises, with the exception of the chest fly, were performed in a standing position. The chest fly was performed while lying on a flat bench. Each of the four exercises was performed for a 30 second duration with a 2 minute rest period between exercises. During the dumbbell trial only, a metronome was used to control the speed of the repetition (1 repetition every 2 seconds).

To measure muscle activation, surface electromyography (EMG) recordings were collected from four muscles during each of the eight exercise conditions. Electrodes were placed on the biceps brachii, triceps brachii, middle deltoid, and pectoralis major, on the right side of the body (5). A reference electrode (ground wire) was placed on the acromioclavicular joint on the right side of the body as well. Location of motor points on the respective muscle bellies were based off of landmarks described by Cram et al. (5). Prior to placement of electrodes, proper skin preparation was followed. The skin was abraded with sand paper and cleansed with alcohol to reduce skin impedance. Delsys DE2.1 adhesive interface surface electrodes were placed and attached to input wires from a Bagnoli 8 amplifer (Delsys, Inc, Boston, MA, USA) that interfaced with a PC. Raw EMG recordings were amplified and digitally sampled at 1000 Hz. The gain ranges varied from 100-10,000 and were adjusted based upon individual responses. The notch filter was set at 60 Hz. Data were collected over the duration of each exercise trial.

After the surface electrodes were attached to the subject, maximum voluntary isometric contractions (MVIC) were carried out for each muscle. An investigator applied manual resistance for the MVIC; for each muscle, three 8 second MVIC trials were performed. To obtain the MVIC for the biceps brachii, the subject was placed in a supine position with arm flexed to approximately 90 degrees and asked to maximally flex the arm. To obtain the MVIC for the triceps brachii, the subject was placed in a supine position with arm flexed to approximately 90 degrees and asked to maximally extend the arm. To obtain the MVIC for the middle deltoid, the subject was placed in a left lateral recumbent position and was asked to maximally abduct the arm against the strap that was placed just above the elbow. To obtain the MVIC for the pectoralis major, the subject was placed in a supine position with elbow raised from the ground and slightly bent then asked to maximally adduct the arm. The maximal EMG values were recorded during each MVIC trial and the highest value was used. The average EMG for each exercise trial for each muscle was "normalized" by dividing by the maximal EMG value recorded during the MVIC trial. The averaged EMG values from each exercise trial were represented as a percentage of MVIC for each specific muscle.

Data Analysis

Analysis was performed using the Delsys EMGworks 4.0 software (Delsys, Inc, Boston, MA, USA). In order to process the data, the raw EMG was full-wave rectified and low pass filtered at 3 Hz. Post processing of the data included averaging the EMG signal for each muscle to quantify muscle activity over a specific time and was measured in mV. Values were averaged over a 10 second time window for females and a 20 second time window for males.

For each exercise, the data were analyzed with a two-way ANOVA with repeated measures (muscle x condition). Alpha was set at .05 to achieve statistical significance. If there was a significant interaction, Tukey's post-hoc tests were used to detect differences between the dumbbell or Shake Weight conditions for each muscle.

RESULTS

The descriptive statistics associated with physical characteristics of the subjects are presented in Table 1.

Table 1. Descriptive Characteristics of the Subjects (N=16)

	Male (N=8)		Female (N=8)	
	Mean ± SD	**Range**	**Mean ± SD**	**Range**
Age (yrs)	21.9 ± 3.04	18-27	22 ± 1.69	19-24
Height (in)	71.5 ± 2.33	67-75	64.6 ± 1.06	63-66
Weight (lbs)	198.5 ± 30.20	160-260	137.6 ± 16.50	116-165

The averaged EMG values from each exercise trial were represented as a percentage of MVIC (% MVIC) for each specific muscle. The % MVIC values during the four Shake Weight® conditions compared to the standard dumbbell exercises are illustrated in Figures 1 through 4. EMG values were significantly higher for the biceps shake compared to the biceps curl for all muscles except the biceps brachii (Figure 1). When comparing the triceps shake to the triceps extension (Figure 2), there was a significant difference for all muscles except the pectoralis major. When comparing the shoulder shake to the shoulder press (Figure 3), there was a significant difference between exercises for the biceps brachii and triceps brachii. There were no significant differences between exercises for the middle deltoid and pectoralis major. When comparing the chest shake to the chest fly (Figure 4), there were significant differences between all muscles except the pectoralis major.

Figure 5 illustrates the sum of the % MVIC values for all four muscles for each Shake Weight® exercise compared to the dumbbell exercises. Total muscle activity was 88% greater when performing the biceps shake compared to the biceps curl; 65% greater when performing the triceps shake compared to the triceps extension; 50% greater when performing the shoulder shake compared to the shoulder press; and 59% greater when performing the chest shake compared to the chest fly. On average, total muscle activity was 66% greater when performing a Shake Weight exercise compared to the corresponding dumbbell exercise.

Ratings of perceived exertion (RPE) were significantly greater for the Shake Weight compared to the corresponding dumbbell exercise for all conditions: (biceps shake= 12.3 ± 2.03 vs. biceps curl= 8.8 ± 1.24; triceps shake= 11.7 ± 1.78 vs. triceps extension= 9.1 ± 1.39; shoulder shake= 12.0 ± 1.47 vs. shoulder press= 9.7 ± 1.40; chest shake= 11.9± 1.98 vs. chest fly= 9.6 ± 1.97).

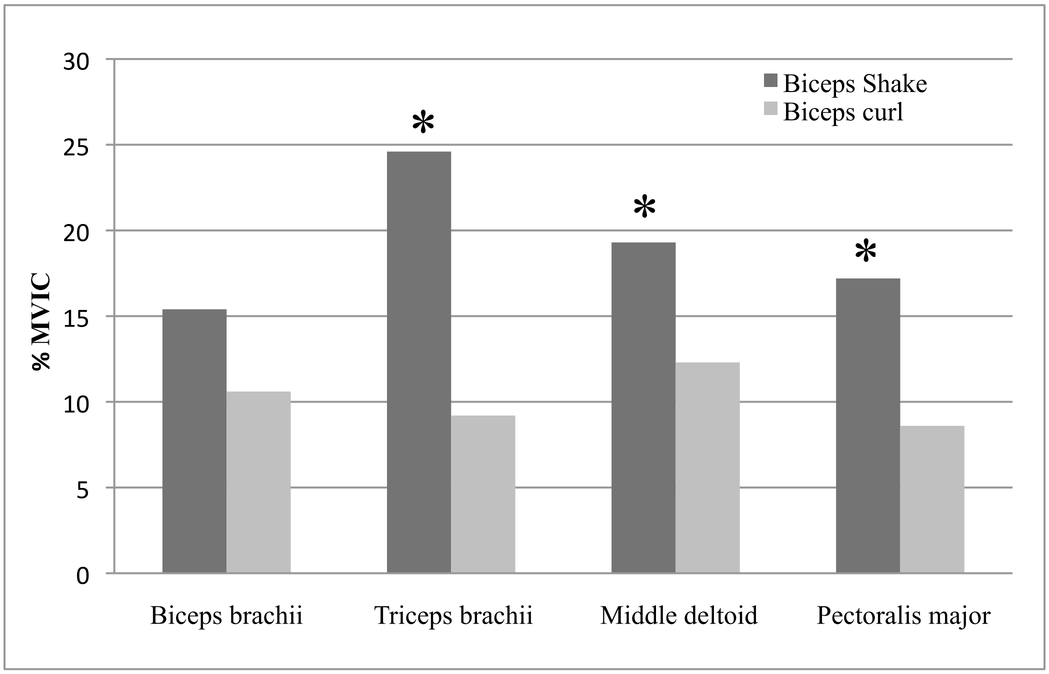

Figure 1. Averaged Muscle Activity of the Biceps Brachii, Triceps Brachii, Middle Deltoid, and Pectoralis Major for the Biceps Shake Compared to the Biceps Curl.
*Significantly different than biceps curl exercise ($p < .05$)

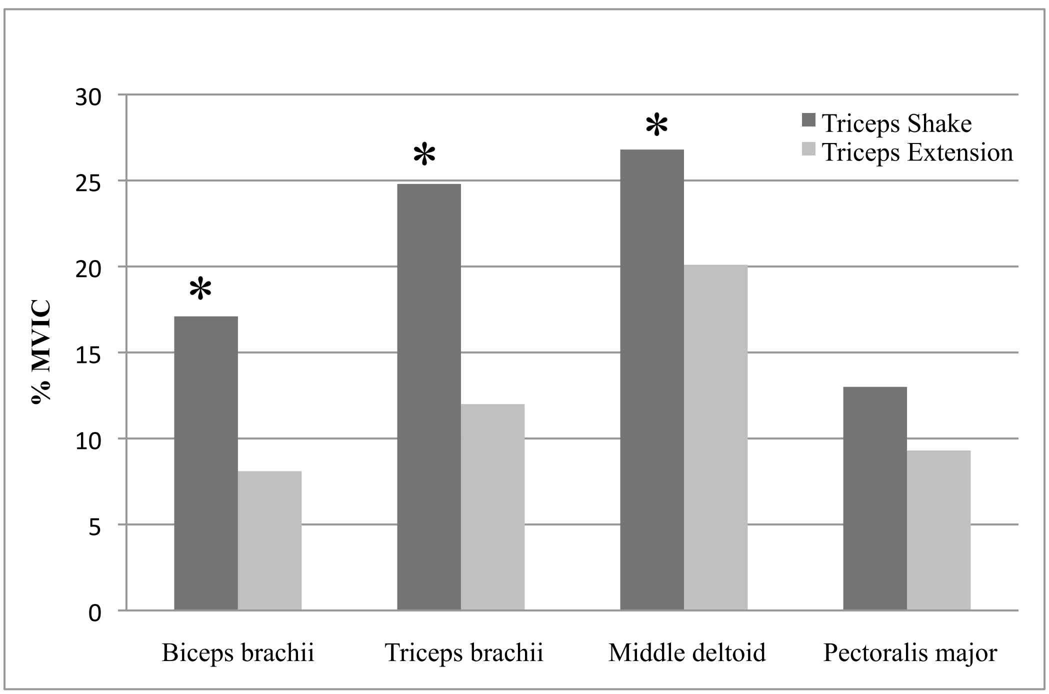

Figure 2. Averaged Muscle Activity of the Biceps Brachii, Triceps Brachii, Middle Deltoid, and Pectoralis Major for the Triceps Shake Compared to the Triceps Extension.
*Significantly different than triceps extension exercise ($p < .05$)

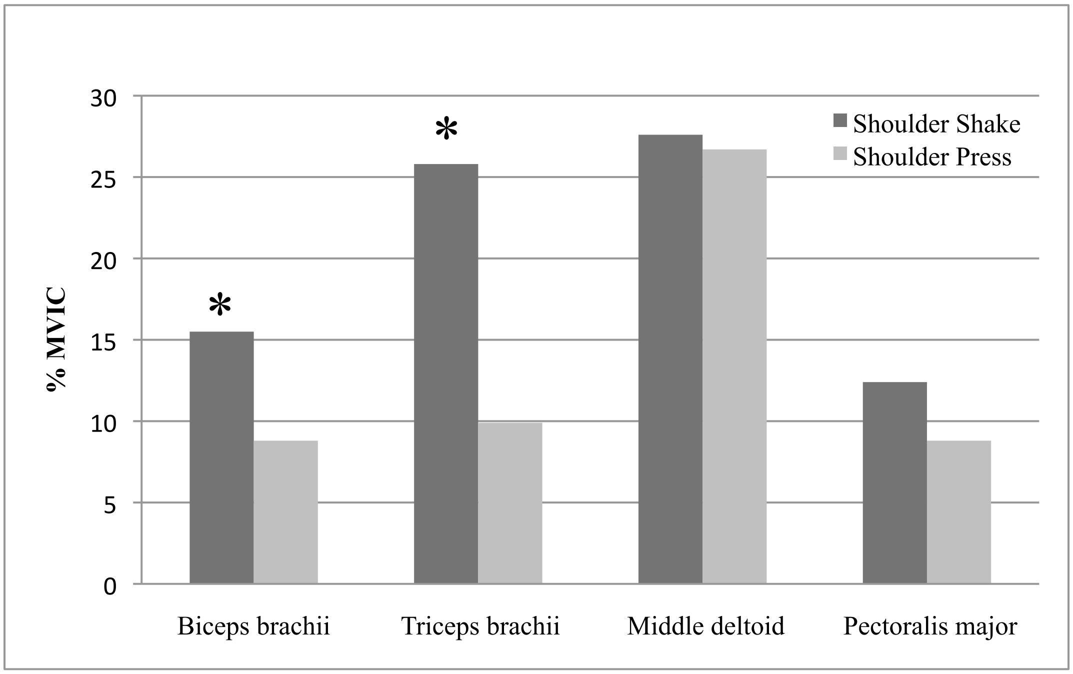

Figure 3. Averaged Muscle Activity of the Biceps Brachii, Triceps Brachii, Middle Deltoid, and Pectoralis Major for the Shoulder Shake Compared to the Shoulder Press.
*Significantly different than shoulder press exercise (p <. 05)

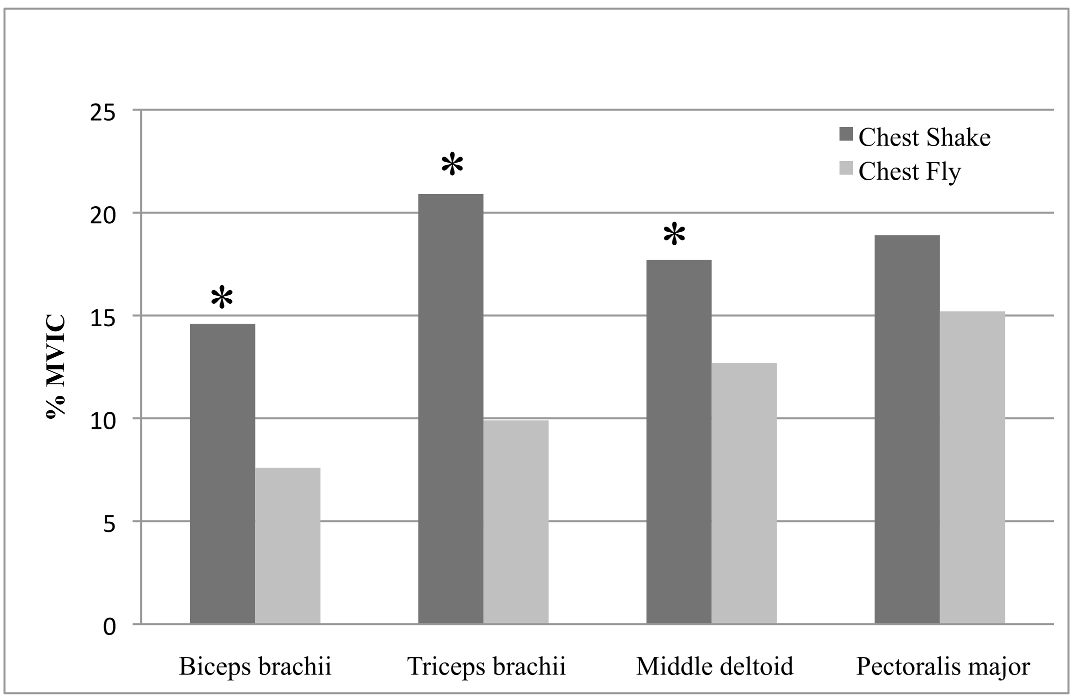

Figure 4. Averaged Muscle Activity of the Biceps Brachii, Triceps Brachii, Middle Deltoid, and Pectoralis Major for the Chest Shake Compared to the Chest Fly.
*Significantly different than chest fly exercise ($p < .05$)

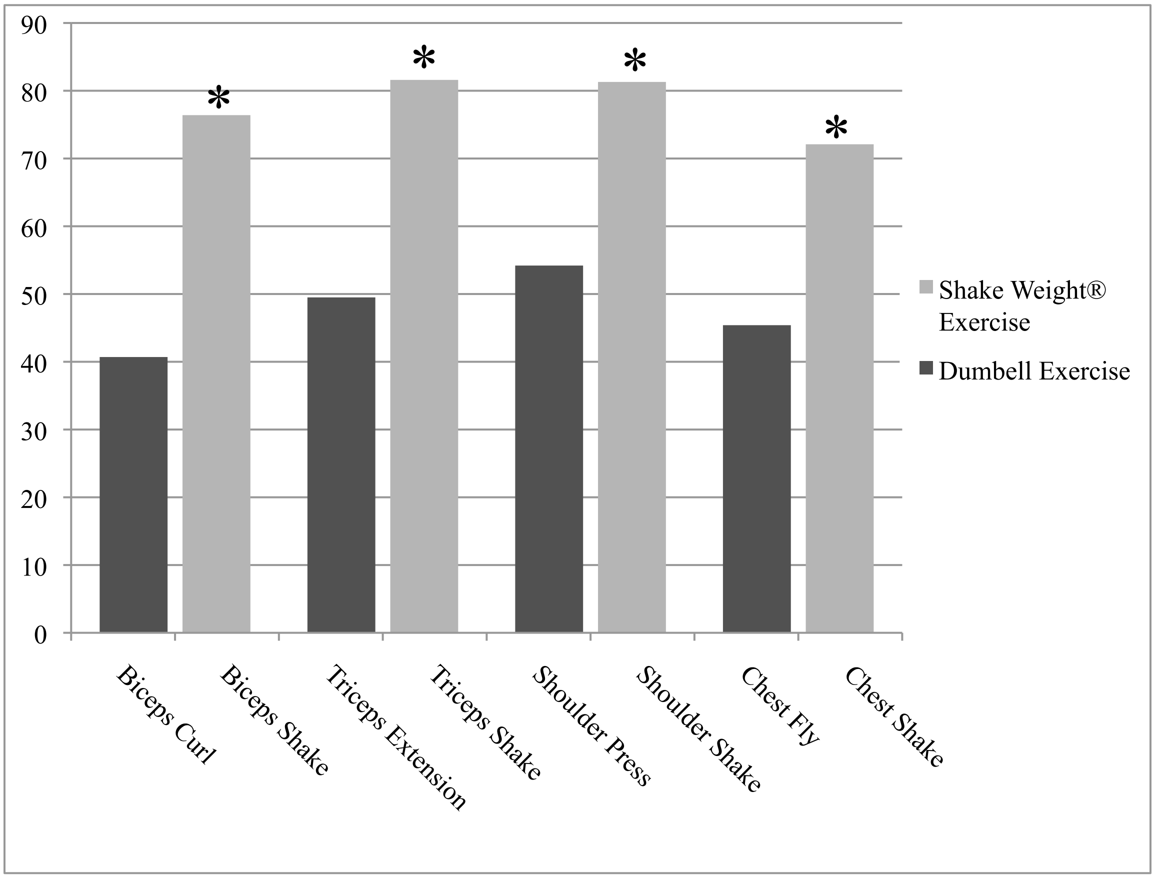

Figure 5. Sum of % MVIC for All Four Muscle Groups for Each Shake Weight® Condition Compared to the Dumbbell Exercises.
*Significantly different than dumbbell exercises (p <. 05)

DISCUSSION

The purpose of this investigation was to determine the amount of muscle activation when using the Shake Weight® in comparison to a traditional dumbbell of equal size. The current study found that EMG values were higher, for all muscles, for all Shake Weight® exercises, compared to dumbbell exercises. When summing up all four muscles for any given exercise, total EMG was significantly greater for the Shake Weight® compared to dumbbell exercises. On average, total muscle activation was 66% greater when performing a Shake Weight® exercise compared to a dumbbell exercise.

Comparison to previous literature is limited; only one other study (unpublished) measured muscle activity when using the Shake Weight® in comparison to dumbbell exercises. In that study, Cipriani also found that performing Shake Weight® exercises elicited more muscle activation than a traditional dumbbell of equal size (17). Cipriani reported that using the Shake Weight® increased upper body muscle activation by approximately 300%; our findings found an average increase of 66% for the four exercises included in our study (17). The reasoning behind why these values differ so dramatically is unclear, but may have been, in part, due to the number of muscles examined. For the current study, EMG values for four muscles were used (biceps brachii, triceps brachii, middle deltoid, and pectoralis major), whereas Cipriani examined six muscles (external oblique, middle deltoid, middle trapezius, biceps brachii, medial tricep, and thoracic erector spinae).

When summing up all muscles the EMG activity for a given Shake Weight® exercise, there was significantly greater muscle activation. However, when looking at specific muscles for each exercise, the Shake Weight® did not always result in significantly greater EMG values for the targeted muscle. For example, for the biceps exercises, the muscle activity of the biceps brachii was not significantly greater during the biceps shake compared to the biceps curl. Even though the EMG value was higher, it did not reach statistical significance. The deltoid exercises resulted in a similar finding; the middle deltoid muscle was not significantly more active during the shoulder shake compared to the shoulder press. Also, when using the Shake Weight® compared to the dumbbell during chest exercises, muscle activity of the pectoralis major was not significantly different between conditions. It should be noted, however, that the lack of statistical significant difference could, in part, be due to a relatively small sample size.

Another intriguing observation was that when using the Shake Weight®, the triceps brachii appears to be working just as hard, if not harder, than the targeted muscle for most exercises. For example, during the biceps shake, the triceps brachii was activated the most out of all four muscles evaluated, even though the biceps shake was supposed to target the biceps brachii. More specifically, the muscle activation in the triceps brachii was approximately 60% higher than the biceps brachii muscle activity during the biceps shake. When performing the chest shake, the triceps brachii elicited the most muscle activation out of all muscles tested.

While the results of the above analysis would indicate that using the Shake Weight® is superior to using either a 2.5 or 5.0 pound dumbbell, it is unrealistic to assume that individuals are going to the gym to lift that amount of weight. A traditional weightlifting regimen for toning arms would gradually incorporate weight well beyond 2.5 pounds for women and 5.0 pounds for men. Therefore, we conducted a pilot study to determine what intensity the Shake Weight® corresponded to as a percentage of an individual's one repetition maximum (1-RM). We examined five female subjects and compared the biceps shake to the biceps curl. Initially, the subject performed the biceps shake for 15 seconds. EMG activity, in microvolts, was measured in the biceps brachii only. Each subject's 1-RM was then determined for the biceps curl dumbbell exercise. The subject then performed seven biceps curls (duration of 15 seconds) at approximately 20%, 40%, 60%, and 80% of the 1-RM. EMG activity of the biceps brachii was measured during each set. A regression equation was then formulated to predict % 1 RM from EMG activity (microvolts). The EMG value for the Shake Weight® exercise was then inserted into the regression equation to predict the percentage of 1-RM that the subject would need to work at in order to elicit the equivocal level of EMG activity. It was determined that when using the Shake Weight® during the biceps shake, it corresponded to approximately 48% of 1-RM. The average 1-RM for the five female subjects was 20.5 lbs; 48% of 1-RM corresponded to approximately 10 pounds. For the women used in the pilot study, lifting 10 pounds for a biceps curl is a much more realistic weight to use for training purposes.

This data is also consistent with the RPE data obtained for all Shake Weight and dumbbell exercises. When subjects used the Shake Weight, RPE averaged 12.0 ± 0.24 compared to an average of 9.3 ± 0.44 for dumbbell exercises. Thus, subjects perceived more exertion when using the Shake Weight, in comparison to the 2.5 or 5.0 pound dumbbell.

Based on the results of the study, it would appear that using the Shake Weight® should increase muscle strength (9). When looking more closely at the design of the Shake Weight®, however, the movement is more similar to an isometric contraction of involved muscles as opposed to concentric and eccentric contractions typically used with free weight training. The Shake Weight® requires rapid, co-contraction activity of certain upper body muscles in order to produce constant back and forth movement of the Shake Weight®. Intensity varies and depends on how fast the user moves the device back and forth. Additionally, proper grip will affect results; stabilization of the wrists will allow the Shake Weight® to move back and forth on an even plane.

The Shake Weight is more like an isometric exercise as compared to a dynamic exercise; the isometric approach of exercise strengthens the muscle at the specific joint angle, with some smaller strength gains occurring at proximal joint angles (10). In comparison, isotonic weight training strengthens the muscle throughout the entire range of motion of the joint. Knapik et al. (11) found that isometric training at one specific joint angle can increase muscular strength 20° from the angle at which training is performed. However, there were significant differences between the isometric and isokinetic training groups when subjects were tested isokinetically; the isokinetic group showed significantly more improvement, suggesting that isometric training isn't as effective in increasing isokinetic strength (11). Furthermore, other studies have demonstrated that at angles greater than 20° from the training angle, little transfer of isometric training occurs; therefore, an angular-specific training response is seen (6,14,15). Gardener et al. (6) found significant increases in strength 20° from training angle with the isometric approach, yet concluded that strength increases were very specific to the training angle. This suggests that progressively smaller gains in isometric maximum strength are found as measurements are taken farther away from the training angle (15,19). Therefore, isometric strength training typically produces strength gains greatest at the joint angle trained and may be reduced at other angles (15,19).

Stone et al. (19) suggests the majority of resistance exercises making up a training program should consist of free weight exercises with emphasis on large-muscle mass exercises to elicit a greater transfer-of-training effect. Conclusively, isotonic weight training will elicit strength gains in a greater range of motion compared to the Shake Weight, a more isometric training approach. The Shake Weight® will probably result in an angular-specific training effect; this elicits strength gains at the specific joint angle, with lesser strength gain across a full range of motion (6,7,10,11,14,15). Thus, the overall carry over to functional abilities comes into question with the Shake Weight®.

CONCLUSION

New exercise equipment is constantly being advertised, through TV infomercials, with claims from improving muscular strength to loosing inches from the waist line. The Shake Weight® is the latest product on the market claiming to increase muscle strength. In the current study, 16 subjects were tested to determine muscle activation when using the Shake Weight® in comparison to traditional dumbbells of equal size. We conclude that when summing up all four muscles for any given exercise, there is statistically greater average muscle activation for the Shake Weight® in comparison to the 2.5 pound dumbbell for women and 5.0 pound dumbbell for men. Thus using the Shake Weight® may result in strength improvement if used regularly. More realistically, however, if an individual were to lift approximately 48% of 1-RM, which is common in strength training regimens, similar training benefits should be seen using isotonic weight training.

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APPENDIX A

INFORMED CONSENT DOCUMENT

<u>INFORMED CONSENT</u>

**THE EFFECTIVENESS OF THE SHAKE WEIGHT
IN COMPARISON TO TRADITIONAL DUMBBELLS**

I, _______________________________ , volunteer to participate in a research study being conducted at the University of Wisconsin-La Crosse.

Purpose and Procedure

- The purpose of this study is to determine the effectiveness of the Shake Weight in comparison to traditional dumbbells of equal weight.
- My participation will involve three separate practice sessions (15-30 minutes each) and two same day exercise trials. I will perform a Shake Weight trial and a traditional dumbbell trial.
- The total time requirement is approximately four hours over a 1-2 week period.
- During the testing, I will have surface electrodes placed on four sites of my upper body which will record muscle activity.
- Research assistants will be conducting the research under the direction of Dr. John Porcari, a Professor in the Department of Exercise and Sport Science.

Potential Risks

- I may feel fatigue and soreness as a result of performing the exercise in this study.
- I may also have redness or skin irritation at the electrode sites.
- Individuals trained in CPR, Advanced Cardiac Life Support, and First Aid will be in the laboratory. The test will be terminated if complications occur.

Rights & Confidentiality

- My participation is voluntary.
- I can withdraw from the study at any time for any reason without penalty.
- The results of this study may be published in scientific literature or presented at professional meetings, but only grouped data will be used.
- All information will be kept confidential through the use of number codes. My data will not be personally identifiable.

Possible benefits

- I and other users of the Shake Weight may better understand the effectiveness of the product.

I have read the information provided on this consent form. I have been informed of the purpose of this study, the procedures, and the expectations of myself as well as the testers, and the potential risks and benefits that may be associated with volunteering for this study. I have asked any and all questions that concerned me and received clear answers so as to fully understand all aspects of this study.

Questions regarding study procedures that may arise can be directed to John Porcari, the principal investigator, at (608) 785-8684. Questions regarding the protection of human subjects may be addressed to the University of Wisconsin-La Crosse Institutional Review Board for the Protection of Human Subjects at (608) 785-8124.

Subject: ____________________________ Date: _______________

Investigator: ____________________________ Date: _______________

APPENDIX B

RATING OF PERCEIVED EXERTION SCALE

BORG'S RATING OF PERCEIVED EXERTION SCALE

6

7 Very, Very, Light

8

9 Very Light

10

11 Fairly Light

12

13 Somewhat hard

14

15 Hard

16

17 Very hard

18

19 Very, Very hard

20

APPENDIX C

SHAKE WEIGHT® EXERCISES

Figure 6. One-handed Biceps Shake

Figure 7. Two-handed Triceps Shake

Figure 8. One-handed Shoulder Shake

Figure 9. Two-handed Chest Shake

APPENDIX D

RAW EMG TRACINGS

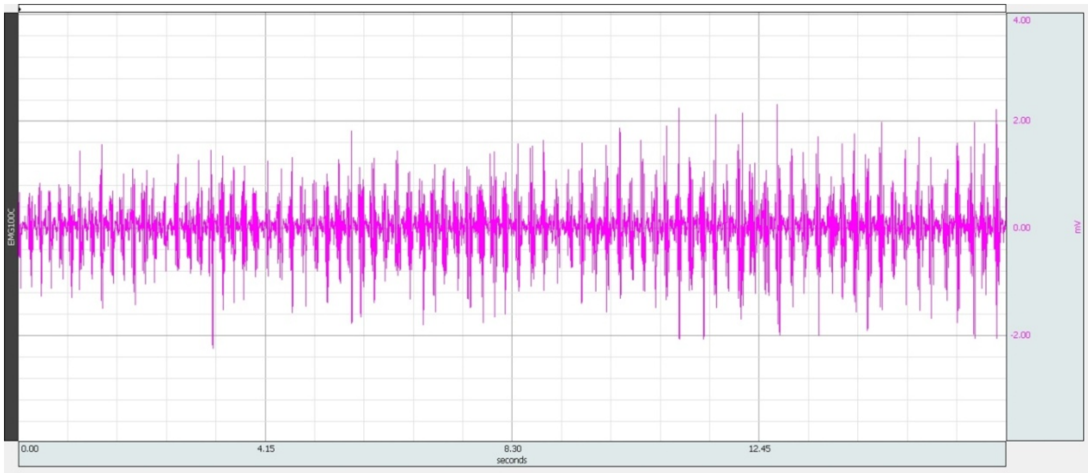

Figure 10. Shake Weight® Raw EMG Tracing

Mean Average Value (MAV) of 542 Microvolts

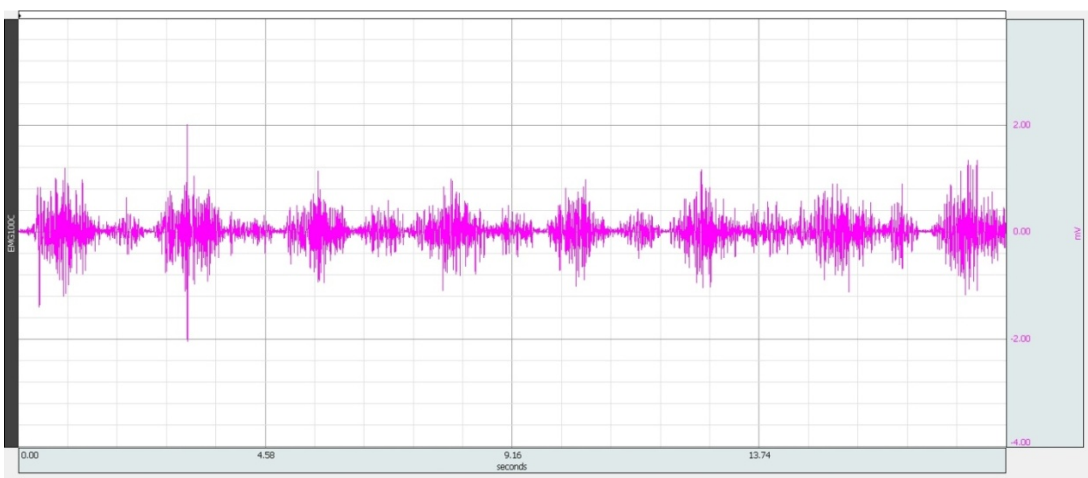

Figure 11. Two and a Half Pound Dumbbell Raw EMG Tracing

Mean Average Value (MAV) of 199 Microvolts

APPENDIX E

REVIEW OF LITERATURE

REVIEW OF LITERATURE

Introduction

A new fitness product on the market is the Shake Weight manufactured by Fitness IQ. The Shake Weight was originally marketed for women to tone and define arm, shoulder, and chest muscles in just 6 minutes a day. It is important to understand the basic concepts underlying the design of the Shake Weight to further investigate the product. The idea behind the Shake Weight includes isometric training, limited range of motion, and the concept of the vibratory training effect to produce greater muscle activity when compared to conventional resistance training.

The Shake Weight is a 2.5 pound dumbbell shaped device; a male version weighing 5 pounds has recently been marketed as well. Users vigorously shake the weight back and forth while springs at both ends move rapidly, creating an oscillation effect. This shaking motion causes constant engagement of muscles and is referred to by the manufacturer as “dynamic inertia”. The motion is similar to that of an isometric contraction because the engaged muscles do not move throughout the entire range of motion (ROM), but rather are isolated within a limited ROM. This review will investigate the concepts behind the Shake Weight in order to grasp a better understanding of whether or not the product could possibly elicit any physical benefits pertaining to strength. Due to the newness of the Shake Weight there have not been any studies published on this product.

Isometric Training

When using the Shake Weight, isometric-like contractions occur during the shaking motion as opposed to conventional strength training exercises that involve both concentric and eccentric contractions; a dynamic training approach. Isometric contractions are static and occur at a specific joint angle, whereas dynamic contractions are performed throughout the entire range of motion of the joint. Therefore, the question to address is: will training at only one joint angle increase strength throughout the full range of motion?

Kitai and Sale (1) addressed the specificity of joint angle following isometric training. Subjects performed isometric strength training of the plantarflexors at an ankle joint angle of 90°. Subjects trained 3 days per week for 6 weeks using 2 sets of 10, 5 second maximal voluntary contractions. Prior to and following the training, measurements of isometric contraction strength were taken at the training angle and at additional angles of 5º, 10º, 15º, and 20º. The results indicated that training increased voluntary strength at the training angle and the two adjacent angles only (1). It was concluded that a limitation to isometric training is that it strengthens the muscle at the specific joint training angle with small strength gains occurring at proximal joint angles.

Effects of Limited ROM on full ROM Strength

Other studies looked at the effect of limited ROM dynamic resistance training on full ROM strength development. Graves et al. (2) found that full range of motion (ROM) strength gains may be obtained from limited range of motion exercises. In that study, subjects were randomly divided into one of three training groups (A, B, AB) or a control group (C). Group A trained in a ROM limited to 120º to 60º of knee flexion, Group B trained in a ROM limited to 60º to 0º of knee flexion, and Group AB trained in a full ROM. Prior to and immediately following the variable resistance training, isometric knee extension was examined at multiple degrees of knee flexion to determine changes (2). Results indicated that all training groups showed significant improvement in isometric strength at each angle of measurement when compared to the control, with only minor exceptions (2). Although these findings point out improvement from limited ROM exercise, it is not as great as that attained from full ROM exercise. This indicates that isometric strength training does have angular-specific training affects.

Isometric vs. Dynamic Training Effects

Folland et al. (3) compared isometric training at a variety of joint angles to dynamic training. Subjects followed an individually designed training program where one leg performed only isometric training at four joint angles and other leg performed dynamic training. Both programs were conducted 3 days per week for 9 weeks. Pre and post measurements of strength were recorded. Following training, improvement in dynamic strength was similar in both legs (dynamically trained-10.7%; isometrically trained-10.5%) and isometric strength increases were significantly greater in the isometrically trained leg (dynamically trained,-13.1%; isometrically trained-18.0%) (3). Greater gains in isometric strength were attributed to the training angle specificity effect or the greater absolute torque (3). One limitation to this study was that isometric strength gains were not measured between or outside the training angle. This study attempted to compare dynamic and isometric strength training using similar relative loads and may need further investigation due to few or no other research done pertaining to these parameters.

When looking specifically at isometric exercise training, Knapick et al. (4) examined the relationship between angular specificity and strength gain. Subjects were divided into either an isometric training group or an isokinetic training group and both groups trained at 80% of their maximum voluntary contraction strength. Both groups were tested both isometrically and isokinetically at the beginning and end of the study. When tested isometrically, both groups improved equally and strength was increased at all test angles to about the same extent. However, when tested isokinetically, both groups improved, but the isokinetic group increased more. Also, results showed that isometric training at one specific joint angle can increase muscular strength 20º from the angle at which training is performed; therefore, angular-specific training response was identified for isometric exercise (4).

The ultimate goal of strength training whether it be isometric or dynamic exercise is to improve strength within a joint. Hettinger and Muller (5) indicated that a workload less than 33% of maximal force had no training effect. Therefore, if the Shake Weight can produce contractions in excess of one third of maximal force, it should elicit strength gains.

Vibration Training

Vibration training is a relatively new type of training introduced into the strength and conditioning field. The Shake Weight integrated concepts of vibration training into the design of their product. The theory behind the use of vibration is that when combined with conventional resistance training, greater gains in neuromuscular performance may be attained (6). There are two types of vibration that can be applied during exercise which include direct vibration and indirect vibration. Direct vibration is applied directly to the muscle belly or the tendon. Typically the vibration unit can be held by hand or be fixed to an exterior support (9,10,11,12). With indirect vibration, also known as whole body vibration training, the exerciser stands on a platform and the vibrations are transmitted from a platform (13,14,15).

Luo et al. (6) examined the use of vibration training to enhance muscle strength and power. Direct and indirect vibration were analyzed in his review and it was concluded that in order to activate the muscle beneficially, vibration frequency should be in the range of 30-50Hz. However, amplitude must be studied further to clearly understand optimal ranges. Therefore, the vibration training effect may be elicited through the magnitude of amplitude and frequency that are delivered to the muscle, potentially increasing muscle power and strength (6). The Shake Weight can be related to direct vibration due to the magnitude of amplitude and frequency that is applied to the muscle during the shaking motion, eliciting similar effects.

Bodyblade

Because the Shake Weight is the first product of its kind, comparison to other products are very limited. However, a blade shaped instrument called the Bodyblade uses inertial force and vibration training in their product design. To use the Bodyblade, an individual grasps the flexing device in the middle and gives it a few quick shakes. The tips of the device begin to oscillate, producing a vibratory stimulus that the muscle must resist. In attempt to stabilize and control the back and forth movement of the blade, approximately 270 muscle contractions per minute are generated (16). Lister et al. (17) found that when comparing the Bodyblade to cuff weights and a Thera-Band, muscle activity of specific upper body muscle groups (serratus anterior, upper trapezius, and lower trapeziums) were significantly greater when using the Bodyblade during shoulder flexion and abduction, as measured with EMG tracings. Therefore, compared to traditional resistance training such as cuff weights or Thera-Bands, greater muscle activation was elicited using the Bodyblade (17).

Shake Weight Product Evaluation and Simulation

Many claims advertised by Fitness IQ are based on a product evaluation and a simulation analysis of the product. However, there are no known studies published to verify these claims. The only data comes from an unpublished study conducted at San Diego State University. Dr. Daniel Cipriani, an Associate Professor at San Diego State University, used EMG monitoring to evaluate motor unit recruitment in the major upper body muscles. This study compared the Shake Weight to traditional dumbbells of equal size. Cipriani found that the Shake Weight uses four times the amount of total muscle work compared to a standard dumbbell curl (18). This is the result of an isometric contraction and rapid pace of muscle fatigue (18).

Lifemodeler (19), a world leader in biomechanics research and development of human computer models, created a computerized male model to compare muscular reactions for the Shake Weight and a normal dumbbell curl exercise. The Shake Weight simulation mimicked the resistance and frequency of using the Shake Weight at 4 cycles/sec or 240 cycles/min (19). The dumbbell curl simulation was created to perform complete flexion and extension with a pattern of 3 sec/cycle (19). Total body energy consumption and muscle force were recorded for each event at three sites including the right deltoid, right biceps, and erector spinae group. The Lifemodeler (19) simulation found that the Shake Weight generates higher peak muscle forces in the exercising muscles, predicting that an individual would have to exercise seven times longer with traditional dumbbells to expend the same total body energy as the Shake Weight.

Training involving isometric, limited range of motion, and vibratory effects were explored in this review to understand what training effects the Shake Weight may provide based on prior research. These concepts have been compared to conventional resistance training to examine which training produces a greater amount of muscle activity. The Shake Weight differs from that of conventional resistance training in that constant engagement of muscles is elicited.

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