A Six-Week Trial of Hula Hooping Using a Weighted Hoop: Effects on Skinfold, Girths, Weight, and Torso Muscle Endurance

Stuart M. McGill, Edward D.J. Cambridge, and Jordan T. Andersen

Faculty of Applied Health Sciences, Department of Kinesiology, University of Waterloo, Waterloo, Ontario, Canada

Abstract

McGill, SM, Cambridge, EDJ, and Andersen, JT. A six-week trial of hula hooping using a weighted hoop: effects on skinfold, girths, weight, and torso muscle endurance. *J Strength Cond Res* 29(5): 1279–1284, 2015–Novel ideas for core endurance training are continually being created. However, studies of their mechanism of action assist in evaluation of their potential as a training tool, for a variety of people and purposes. The specific purpose of this study was to evaluate a weighted hula hooping training program for its efficacy on improving core muscular endurance and influence on measures of body composition. Eighteen women participated in a weighted hula hooping trial lasting 6 weeks, although only 13 returned for posttrial re-assessment. Hip and waist circumferences, 5 torso muscle endurance tests, and 5 skinfold measurements ("sum of 5") were measured before and after the exercise program. Paired samples *t*-tests were performed to examine pre/post changes. On average, participants experienced a significant decrease in waist and hip circumference −3.4 cm ($p < 0.01$) and −1.4 cm ($p \leq 0.05$), respectively and waist-to-hip ratio from 89.3 cm down to 87.3 cm ($t = 3.312$, $p < 0.01$). There were no significant changes in torso muscular endurance after the 6 weeks of hooping; however, the average "sum of 5" skinfold measurements increased by 10.5 cm ($p \leq 0.05$). This study of weighted hula hooping suggested that regular hooping was associated with reduced waist and hip girth together with a redistribution of body mass; however, there were no improvements in torso muscular endurance as measured by isometric testing.

Key Words trunk muscle endurance, endurance, exercise, body mass, workout class, hula-hoop

Introduction

Searching for ways to make physical fitness refreshing while providing enough physical demand to create a positive change in health is the goal of many exercise programs. In particular, the strength and conditioning coach is often responsible to keep work outs fresh and exciting by finding new ways to challenge the fitness consumer. To this end, new core training programs are continually being developed and marketed to individuals of all ages and fitness levels. Specifically, weighted hula hooping is the latest fitness class to make claims for back health and fitness while being fun yet challenging for participants. Hula hooping was popularized in the late 1950s, but new adaptations of hula hoop construction have been suggested to create increased physical demands and potential for added fitness benefits. The development of a weighted hula hoop has been marketed to people interested in fitness with the claims mentioned above, yet little is known regarding mechanisms of action. Such information would assist who and how this new piece of equipment would benefit. This lack of knowledge may be problematic because fitness facilities are increasingly offering daytime hooping classes to a demographic dominated by stay-at-home-moms and these new devices are being marketed for the public claiming health benefits (8). The general call for investigation motivated this study and the hope is to inform the fitness community of the efficacy of such activities.

Today, hula hooping is sometimes part of a physical education curriculum for elementary aged school children (9,10). Interestingly, Kemp and Pienaar (9) suggested that a fitness program, which incorporated hula hooping, performed in a population of young girls has many health benefits including improvement in body composition, aerobic, and muscular endurance. However, that work used endurance evaluation strategies, which could be considered outdated. Interestingly, reduced torso extensor muscle endurance is linked to an elevated risk of future back disorders (2). Likewise, Salminen et al. (17) and McGill et al. (15) documented less incidence of low back pain (LBP) in those with higher isometric back muscle endurance. Besides the back pain issue, people partake in exercise/fitness classes to prevent weight gain and maintain a slim waistline. These variables were also thought important to monitor in a trial of hooping.

The mechanics of hula hooping has been of interest to researchers (3,4,16) and physics teachers alike (6,11). Both,

Address correspondence to Stuart McGill, mcgill@uwaterloo.ca.

29(5)/1279–1284

Journal of Strength and Conditioning Research

Figure 1. Weekly group training sessions with a leader (white T-shirt) were conducted in an aerobics center.

Balasubramaniam and Turvey (1) and Cluff et al. (5) have demonstrated that there are different approaches or strategies used by the user in maintaining a state of dynamic equilibrium between the torso and the hoop, including a knee strategy, an ankle-hip strategy, and a combined ankle-knee-hip strategy. However, these investigations were conducted with a normal hoop. Missing from the current literature is the analysis of the influence of a weighted hoop on mechanics and fitness variables.

The purpose of this study was to conduct a 6-week trial to assess the influence of hooping with a weighted hoop on fitness variables, such as torso muscular endurance and subcutaneous adipose, together with assessment of manufacturers' claims such as "slimming the waistline." The hoop also had a "knobby" surface on the inner ring suggested by the manufacturer to stimulate muscle activity. It was hypothesized that a hula hoop fitness class targeting an adult female population would increase torso endurance, decrease subcutaneous adipose, and reduce waist-hip girth ratios.

Methods

Experimental Approach to the Problem

An experimental 6-week exercise trial was designed to measure the effects of weighted hula hooping in which skinfolds, girths, weight, and torso muscular endurance were measured. The trial consisted of 6 exercise classes combined with at-home hula hooping 4 days per week, providing a total of 5 workout sessions per week. Measurements were performed before and after trial to observe potential changes in the dependent variables from the exercise intervention.

Subjects

Female participants aged 30–60 years with no history of disabling low back pain and were currently healthy without limitation for physical fitness were recruited to participate. All participants signed written informed consent forms and the study was approved by the university research ethics board. Individuals with a waist-to-hip ratio of 0.9 or greater were excluded from the study because of difficulty using the weighted hoop. These demographic features were selected based on the current enrollment of Powerhoop classes. Recruitment materials consisted of notices of a hooping class forming at a fitness club, together with email message announcements within the community. Volunteers registered for the classes and were given a full description of the trial, including data collection processes, fitness class scheduling, and the weighted hula hoop, before signing an information and consent letter approved by the university office for research ethics. Baseline data were collected from each participant during the week before the commencement of the exercise classes. The same data were recollected again following the 6-week trial, not later than 2 weeks after the last training session.

Week 1				
Day 1	Day 2	Day 3	Day 4	Day 5
2 minutes	3 minutes	4 minutes	5 minutes	6 minutes
Week 2				
Day 1	Day 2	Day 3	Day 4	Day 5
6 minutes	8 minutes	10 minutes	12 minutes	14 minutes
Weeks 3-6				
Day 1	Day 2	Day 3	Day 4	Day 5
15 minutes	15 minutes	15 minutes	15 minutes	15 minutes

Figure 2. Powerhoop practice schedule: graded exposure to the hoop over the 6 weeks.

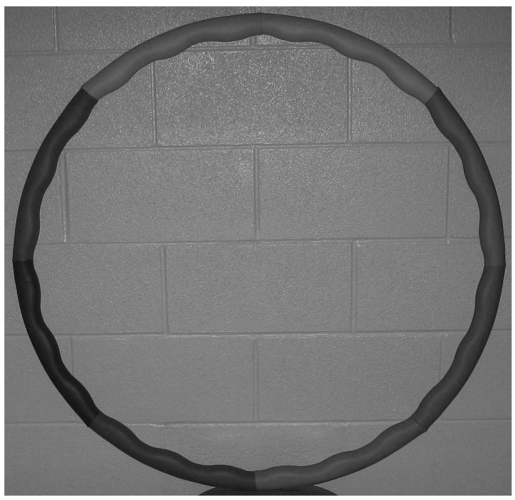

Figure 3. Powerhoop is a 1.7-kg hula hoop with a diameter of 1.02 m and comprised 8 individual segments (approximately 0.4 m in length) that connect to form a circle. The inner curvature of the hoop has 3 bumps per segment that provide mechanical stimulation for the abdominal muscles.

Eighteen women ranging in age from 32 to 58 years with a mean age of 47.1 (*SD* 7.5) years, a mean weight of 75.7 (*SD* 12.3) kg, and a mean height of 166.0 (*SD* 6.4) cm were recruited to take part in the training program (Figures 1 and 2). These women were intrinsically motivated to participate and regarded participation as an opportunity for weight management and improved health.

Procedures

Participants were informed to maintain all other aspects of their daily life and daily routine. The hoop used was a weighted hoop measuring 1.02 m in diameter with a mass of 1.7 kg. The hoop comprised 8 segments (approximately 0.4 m in length) with a "knobby" inner ring thought of having the possibility of stimulating torso muscle activity (Figure 3). One initial reservation was the initial waist-to-hip girth ratio because it was suspected that those with a larger waist girth may find successful hooping extremely difficult (i.e., a pear-shaped vs an apple-shaped mid-section about which the hoop swirled). Rather than screening for this stature, all recruited women were measured, and all were found to have a smaller waist than hip girth (mean waist/hip girth ratio of 0.89). During the trial, participants attended a formalized group class once each week and used the hoop on their own, 4 additional times per week. Participants maintained participation log-books. One of the 4 participants who did not complete the trial was unable to comply with the "at-home" exercise requirements. The logs suggested that all other subjects conducted the training on schedule.

Exercise classes were held at the same day and time each week and modeled after that offered at a local health club facility. Each session consisted of a warm-up and cool-down phase, surrounding the main training session. It is noted that some additional exercises were added to the training session warm-up, such as side squats and marching. Each session was progressive, building on the previous session to provide a graded challenge as participants became more familiar and endurable. Figure 2 explains the schedule of graded and progressive exposure over the 6 weeks, and Figure 4 illustrates the content of a sample group class session.

To evaluate this approach, the following variables were obtained by a kinesiology graduate previously trained in the techniques to measure each of the outcome variables:

- Anthropometrics–waist and hip circumferences (in centimeters), weight (in kilograms), and height (in centimeters) (in accordance with the (7) protocol);
- Torso muscular endurance (in seconds)–static V-sit

3min	Warm up - Marching - Wide marching - Ham curl, add arms - Wide marching - Face corners, toe touch, add knee - Side squats - Marching	2min	- Triceps extensions o Add squat - Biceps curls o Add squat - Roll hoop to side o Add toe touch o Add ham curl
5min	hooping - 2min L - 2min R	8min	- 2min L - 2min R - 1.5min L - 1.5min R
2min	- PH 1-arm stretch up o Add toe touch o Add ham curl - Rotate hoop overhead - Rotate hoop down around body	5min	Cool down - Reach-to-the-sky, deep breath - Quad stretches - Arm stretches - Calf stretches - On ground with PH o Ham stretch – to side o PH-to-knees o Dead Bug - Reach-to-the-sky, deep breath
5min	hooping - 2min L - 2min R		

Figure 4. Sample Powerhoop group class workout.

posture, front plank, right and left side planks, Biering-Sorensen test (after McGill et al. (13));
- Skinfold measurements (in millimeters)–triceps, biceps, subscapular area, iliac crest, and medial calf (known as the sum of 5; CSEP (7)).

Statistical Analyses

The study design was intended to compare variables related to anthropometrics, torso muscular endurance, and skinfold measurements before and after the 6-week trial. Interactions between variables were not of interest, only whether the trial influenced an individual variable.

Primary Outcome Variables. For statistical purposes, considering multiple comparisons, there were 3 main tests done as part of the primary analysis. These were selected to represent the main outcome variables, namely, waist circumference (in centimeters), the sum of the 5 endurance times (in seconds), and "sum of 5 skinfolds" score (in millimeters). Thus, paired samples *t*-tests (0.016) were performed.

Secondary Outcome Variables. For the purposes of being complete, the researchers were also interested in further examining a more complete spectrum of variables. Table 1 outlines these variables and illustrates the results of further analysis using paired *t*-tests uncorrected for multiple comparisons to provide deeper insights of those variables likely to demonstrate changes in follow-up studies.

Results

Because of various reasons (illness, injury, absence from the fitness classes, or failure to perform at-home training), only 13 women returned for the post-program assessment. Of the 13 women who completed the trial, class attendance was excellent. Only 6 participants missed a single session and only 1 missed 2 sessions, no other absenteeism was observed. Initial examination of the data revealed a normal distribution of the data for all outcome variable change scores, except 1 of the muscle endurance scores, the v-sit. There was a single outlier in the endurance testing that skewed the data (>2.5 *SD* from the mean). We are unaware of a reasonable explanation for the divergent scores in v-sit postintervention of 910 seconds increased from 463 seconds pre-intervention. This was truly curious because the other endurance tests for this individual were below the group average. It was unclear if motivation or some other factor might explain this behavior and with scores so outside the normal variance this

Table 1. Changes in anthropometrics, torso endurance, and skinfold measurements because of the 6-week hooping trial.*

	Pre		Post		Change (post − pre)	
Test	Mean	*SD*	Mean	*SD*	Mean	*SD*
Anthropometrics						
Age (y)	47.1	−7.5				
Waist circumference (cm)	93.88	9.2	90.5	9.3	−3.4†	2.3
Hip circumference (cm)	105.1	8.4	103.8	8.8	−1.4†	2.1
Weight (kg)	75.7	12.2	75.2	12.1	−0.5	1.2
Height (cm)	166.0	6.4				
BMI	27.4	4.1	27.2	4.0	−0.2	0.5
W-to-H ratio (%)	89.2	0.1	87.2	0.1	−0.0†	0.0
Torso endurance						
V-sit	196.3	185.3	215.3	263.7	19.0	147.4
V-sit (OR)	174.08	174.49	157.42	168.35	16.7	75.31
Front plank	64.8	32.3	64.9	42.5	0.2	25.6
Right side plank	47.7	13.1	55.3	18.3	6.2	18.6
Left side plank	52.4	17.3	55. 4	16.5	−0.9	16.2
Biering-Sorensen	114.4	40.3	114.3	38.3	−0.1	26.7
Skinfolds						
Triceps	26.2	5.4	30.5	8.5	4.6†	4.3
Biceps	21.4	11.0	19.2	6.8	−1.0	8.9
Subscapular area	27.7	8.3	29.2	8.9	1.2	4.6
Iliac crest	28.1	5.2	31.2	6.8	3.2†	4.9
Medial calf	24.4	9.3	26.3	11.5	2.5†	2.9
SO5S	127.7	33.7	136.4	37.8	10.6†	14.3

*BMI = body mass index; W-to-H ratio = waist-to-hip ratio; OR = outlier removed; SO5S = sum of 5 skinfolds.
†Statistical significance ($p \leq 0.05$).
Note that the "difference" measure was the sum of differences of each individual.

subject was omitted from further statistical analysis of endurance measures as they were deemed an outlier. The data were initially examined violating the statistical assumptions of normality, the single outlier was then omitted and the data were re-examined. This created normality in the data and upheld the validity of the test statistic. No matter the method used, the results were equivocal and no change in muscular endurance was observed as explained below.

Primary Analysis

The results both supported and refuted the hypotheses. Supporting the hypothesis, waist circumference decreased from 93.9 to 90.5 cm ($t = 5.257$, $p < 0.001$). Hip circumference decreased 1.4 cm as did the waist-to-hip ratio (0.02).In contrast, there were no significant changes in isometric endurance and sum of 5 skinfold measurements over the trial period. The summed endurance times showed no change with mean scores of 442 (243.49) seconds pretraining and 428.17 (245.67) seconds posttraining ($t = 0.714$, $p = 0.49$). In contrast to our prediction, the "sum of 5 skinfolds" scores increased over the course of the trial with a pretraining mean score of 125.87 (35) mm and a posttraining increase to 136.42 (38) mm ($t = -2.56$, $p < 0.03$). Significant decreases in waist circumference were consistent with our hypotheses. No changes in torso endurance and an increased "sum of 5 skinfolds" score supported the null hypothesis.

Secondary Analysis

On average, participants experienced a significant decrease in waist (3.35 cm; $p < 0.01$) and hip (1.38 cm; $p \leq 0.05$) circumference and waist-to-hip ratio (0.02; $p < 0.01$). There were no significant changes in any of the torso isometric muscular endurance tests after the 6 weeks of hooping. Group means (*SD*), and statistical results are presented in Table 1 for all anthropometric, torso endurance, and skinfold measurement tests (uncorrected for multiple comparisons).

Discussion

This experiment suggested that weighted hooping over a 6-week period, together with the warm-up and cool-down program described here, reduced waist and hip girth. Although no effect was seen in torso endurance scores over the course of the trial, skinfold measures in the limbs increased over the period of the trial. Given the observation of no change in total body weight, the most probable explanation of these diverging results was a shift in body composition from the torso to the upper extremity. Future research is needed to confirm and explore this explanation.

When comparing our data with previous studies that examined measures of adipose tissue and torso muscular endurance, some divergence is notable. Kemp and Pienaar (9) found decreases in triceps skinfold and improvements in aerobic endurance (measured by a shuttle run) and muscular endurance (measured by dynamic activities, such as curl-ups, push-ups, and "trunk lifts"). It is possible that using isometric tests of torso endurance (12), as was used in the present study, may account for differences in torso muscular endurance. The McGill (12) measures of torso endurance are isometric holds done in neutral postures, while the Kemp and Pienaar (9) measures were done out of neutral ("trunk lift") and with repetitive dynamic movements ("curl-ups"). Methodological differences in skinfold measurement were also noted. This examination used a combined score, the sum of 5, rather than a single site in an attempt to improve reliability and validity of the measures.

No studies on weighted hooping with an adult female population were available to compare with the findings of this study. However, the magnitude of the endurance scores is interesting in the context of previously published values. For example, a study of university student women (14) documented an average V-sit score of 134 seconds, while the women of this study held the V-sit 215 seconds. Conversely, the university students held the Biering-Sorensen test for back extensor endurance for 185 seconds yet the women in this study only held the posture for 114 seconds on average. Perhaps, the type of woman attracted to a hooping class as a choice of fitness activity has a characteristic profile in terms of fitness variables. It would seem that these participants chose an activity that was "abdominal centric" and not demanding of the posterior chain.

There are several limitations that would influence the interpretation and application of the data reported here. Although only women participated in this study, this would seem valid in that they were the ones who responded to the advertisement to create a hooping class. Thus, these subjects would seem to represent the demographic of potential hoopers. The posttrial measurements were taken within a 2-week window of trial completion. Although this is not ideal, data collection encompassed additional data not included in this analysis. As a result, data collection sessions were time intensive, limiting the number of data collections per day. Moreover, because of additional scheduling conflicts with the participants, a single week of data collection was not possible. On another note, the hoop studied here was a weighted hoop, such that the results may not pertain to users of conventional unweighted hoops. Finally, a control group or an alternate exercise group was not studied because there are a multitude of studies showing that group activity changes fitness-related variables. Participants were instructed to maintain all other habits and behaviors outside of the intervention of the exercise classes and at-home training during the trial and therefore any changes in outcome variables are thought to be considered a direct result of the training program.

In conclusion, the use of a weighted hoop for 6 weeks, following the regimen described here, was associated with a slimmer waistline and hip girth. Skinfold measures suggested a redistribution of body mass, but no change in total body composition was observed. Based on our results, future studies might investigate total body fat percentage as

a result of hula hooping, given the unexpected results of body composition changes observed here. Finally, and perhaps most importantly, there seems to be no change in core muscular endurance as measured by isometric testing. Those designing exercise programs for middle-aged women might consider weighted hula hooping but ought to bear in mind that alternative core training and weight management strategies will be required for improvements in muscular endurance and body composition.

Practical Applications

The mixed results obtained in this study suggest that several factors should be considered as to whether a hula hooping approach, as studied here, is appropriate for the training goals of the individual.

Acknowledgments

Financial support for direct costs was provided by Powerhoop–Norway. The authors gratefully acknowledge continued support of the Natural Sciences and Engineering Research Council, Canada, for the laboratory infrastructure.

References

1. Balasubramaniam, R and Turvey, MT. Coordination modes in the multisegmental dynamics of hula hooping. *Biol Cybern* 90: 176–190, 2004.
2. Beiring-Sorensen, F. Physical measurements as physical risk indicators for low back trouble over a one-year period. *Spine (Phila Pa 1976)* 9: 106–119, 1984.
3. Belyakov, AO and Seyranian, AP. The hula-hoop problem. *Doklady Phys* 55: 99–104, 2010.
4. Caughey, TK. Hula-Hoop: An example of heteroparametric excitation. *Am J Phys* 28: 104, 1960.
5. Cluff, T, Robertson, DG, and Balasubramaniam, R. Kinetics of hula hooping: An inverse dynamics analysis. *Hum Mov Sci* 27: 622–635, 2008.
6. Crane, R. Chattering, the chatterring, and the hula hoop. *Phys Teach* 30: 306, 1992.
7. CSEP. The Canadian physical activity. Fitness & lifestyle approach. In: *CSEP–Health & Fitness Program's Health-Related Appraisal & Counselling Srategy* (3rd ed.). Ottawa, ON: Health Canada, 2004. pp. 7–13, 17–18.
8. Heavy Hula Hoop for Your Health? *Consum Rep* 70: 43, 2005.
9. Kemp, C and Pienaar, AE. Effect aerobic-based physical activity programme physical fitness 10–15 year-old girls. *African Journal for Physical, Health Education, Research and Dance* 15: 527–542, 2009.
10. Kulinna, PH, Martin, JJ, Kliber, A, and Reed, B. Student physical activity patterns grade, gender, and activity influences. *Journal of Teaching in Physical Education* 22: 298–310, 2003.
11. Layton, W and Rodriguez, N. Segmented hoop as a physical pendulum. *Phys Teach* 51: 418, 2013.
12. McGill, SM. *Low back disorders: Evidence–Based Prevention and Rehabilitation* (2nd ed.). Champaign, IL: Human Kinetics, 2007.
13. McGill, SM, Belore, M, Crosby, I, and Russell, C. Clinical tools to quantify torso flexion endurance: Normative data from student and firefighter populations. *Occup Ergon* 9: 55–61, 2010.
14. McGill, SM, Childs, A, and Liebenson, C. Endurance times for low back stabilization exercises: Clinical targets for testing and training from a normal database. *Arch Phys Med Rehabil* 80: 941–944, 1999.
15. McGill, SM, Grenier, S, Bluhm, M, Preuss, R, Brown, S, and Russell, C. Previous history of LBP with work loss is related to lingering deficits in biomechanical, physiological, personal, psychosocial and motor control characteristics. *Ergonomics* 46: 731–746, 2003.
16. Nishizaki, J, Nakaura, S, and Sampei, M. Modeling and control of hula-hoop system. In: Proceedings of the 48th IEEE Conference on Decision and Control (CDC) held jointly with 28th Chinese Control Conference, Shanghai, China, (1), 2009. pp. 4125–4130.
17. Salminen, JJ, Maki, P, Oksanen, A, and Pentti, J. Spinal mobility and trunk muscle strength in 15-year-old schoolchildren with and without low-back pain. *Spine (Phila Pa 1976)* 17: 405–411, 1992.