

UNIVERSITY OF WISCONSIN-LA CROSSE

Graduate Studies

RELATIVE EXERCISE INTENSITY AND CALORIC EXPENDITURE OF HOOPING

A Manuscript Style Thesis Submitted in Partial Fulfillment of the Requirements for the  
Degree of Master of Science

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College of Science and Health

Clinical Exercise Physiology

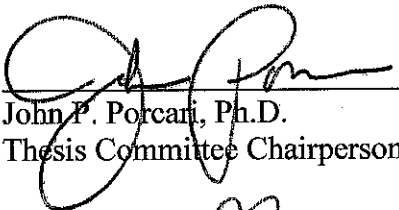
December, 2010

Relative Exercise Intensity and Caloric Expenditure of Hooping

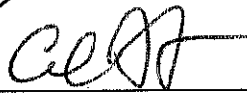
By Jordan A. Holthusen

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

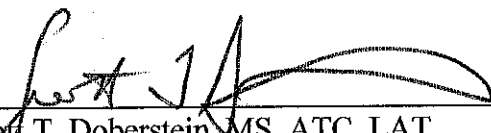
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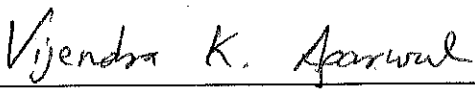
  
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## ABSTRACT

Holthusen, J.A. Relative exercise intensity and caloric expenditure of hooping. MS in Clinical Exercise Physiology, December, 2010, 44 pp. (J.P. Porcari)

The purpose of this study was to determine the relative exercise intensity and caloric expenditure of hooping. Sixteen apparently healthy females, aged 16-59 years, from the Hooked on Hooping studio in Green Bay, Wisconsin volunteered to be tested. Subjects completed a 30-minute hooping trial by following a video created by the founder of Hooked on Hooping. To measure oxygen consumption, subjects wore a portable metabolic analyzer. Heart Rate (HR) was recorded using a Polar telemetric unit and ratings of perceived exertion (RPE) were determined using the Borg 6-20 scale. Results for the study showed that the average HR was 151 bpm, corresponding to 84% HR<sub>max</sub>. Throughout the session, the average VO<sub>2</sub> measured was  $20.6 \pm 3.31$  ml/kg/min. The average caloric expenditure of hooping was calculated to be  $7.0 \pm 1.44$  Kcal/min, equivalent to  $210 \pm 43.3$  calories for 30 minutes of hooping. Average RPE was  $13.0 \pm 1.51$ , which corresponds to "somewhat hard" on the Borg scale. Based on these results, hooping was shown to meet the recommended guidelines from ACSM for improving cardiovascular fitness and controlling body weight.

## ACKNOWLEDGMENTS

I am very honored to be able to write this page of gratitude and thanks to all of the people who gave their time and efforts towards the completion of my master's thesis. I would first like to thank my thesis chairperson, John Porcari for all of your guidance, professional opinions, and countless hours you spent to help make this project complete. I am honored to have been able to work with you throughout this past year and will take with me the many things you taught me along the way.

Secondly, I would like to thank Mary Pulak of Hooked on Hooping for all of her hard work to make this project possible. You were so helpful in recruiting all of the participants and providing an adequate place for testing. Your natural enthusiasm and work ethic made testing a very memorable experience.

I would also like to thank my other committee members, Scott Doberstein and Carl Foster. Scott, you gave me exceptional guidance and offered many hours of your time that I am so grateful for. A big thank you to Chris Dodge, Human Performance Lab Manager, for offering patience and intelligent assistance when the analyzer didn't agree with us. You are a real lifesaver!

It is with much gratitude to thank the Graduate School for their generosity in awarding me with a research grant to partially fund this project.

Thank you to my parents & family for offering outstanding guidance and helping me become the individual I am today. To my fiancé Nathan, thank you for being my rock and encouraging me to follow my dreams with confidence. To my parents, family and Nathan, I cannot express enough how much I love you and appreciate all that you do.

## TABLE OF CONTENTS

	PAGE
ACKNOWLEDGEMENTS.....	iv
LIST OF TABLES.....	vi
LIST OF FIGURES.....	vii
LIST OF APPENDICES.....	viii
INTRODUCTION.....	1
METHODS.....	2
Subjects.....	2
Procedures.....	3
Statistical Analysis.....	3
RESULTS.....	4
DISCUSSION.....	9
Conclusion.....	10
REFERENCES.....	11
APPENDICES.....	13

## LIST OF TABLES

TABLE	PAGE
1. Descriptive Characteristics of the Subject Population.....	4
2. Average Exercise Responses to 30 Minutes of Hooping.....	4
3. Minute-by-Minute Heart Rate Responses during 30 Minutes of Hooping.....	7
4. Comparative Free Range Exercise Studies.....	9

## LIST OF FIGURES

FIGURE	PAGE
1. Average Heart Rate Responses.....	6
2. Average Exercise Intensity during 30 Minutes of Hooping.....	8
3. Average VO <sub>2</sub> Responses.....	8

## LIST OF APPENDICES

APPENDIX	PAGE
A. Recording Sheet for Subject Information .....	13
B. Informed Consent.....	15
C. Health History Questionnaire (PAR-Q).....	18
D. Ratings of Perceived Exertion Scale.....	20
E. Pictures of Hooping Trial.....	22
F. Review of Literature.....	25



## INTRODUCTION

Hooping is one of the newest exercise routines gaining popularity in the United States today. There are numerous purported benefits from hooping including: increased bone strength, weight loss, muscle toning, improved flexibility of the spine and pelvis, and stress relief. Hooping can also allegedly improve cognition, as it challenges the mind to concentrate while exercising (11). "Hooping hoops" are different from the traditional hula hoop in that their weight and diameter are significantly larger. Hooked on Hooping manufactures adult hoops that range from a size large (no extra weight added) weighing one pound and measuring 37-41 inches in diameter to an adult extra large version that is 42-45 inches in diameter weighing 4 lbs (11). These differences presumably make hooping more taxing as they force more vigorous muscle contractions and thereby increasing energy expenditure in order to keep the larger and heavier hoop moving.

With no concrete origin, hooping was thought to have started over 3,000 years ago (7, 13). First being recognized in Egypt, hoops were made out of grape vines and propelled on the ground by pushing them with a stick (1). In ancient Greece, these same vine hoops were used for exercise and weight loss (7). During the 14th century, hooping became very popular in England; however this popular exercise came to an abrupt end after British medics blamed it for causing heart attacks and spinal dislocations (7, 13). It was not stated as to why the medics blamed hooping for these problems, but they had people believing that it was the cause for these medical issues. During the 18<sup>th</sup> century,

hooping became known as “hula” hooping after sailors had visited Oahu, Hawaii.

Enjoying their first Luau, these sailors compared the hula dancers to hooping from their native countries and since then, the name became “hula hooping” (7).

Australia produced and sold the very first hula hoop in 1957, which was made of bamboo (7). It was then that Americans Richard Knerr and Arthur Melin, founders of Wham-O® Company, “discovered” hula hoops. They learned of the idea after visiting Australia and seeing a school age child twirling her bamboo hoop around her waist in gym class (7). Their company manufactured hoops out of a hard plastic called Marlex® and introduced them into the United States consumer market in 1958 for \$1.98 each (13). Subsequently, Wham-O sold over 100 million hoops in only two years, making it the biggest fad of the 1950s (13).

There is no known literature that supports the benefits of hooping. The American Council of Exercise (ACE) is quoted by several sources and anecdotally reports that a single hooping session can burn 200 calories per 30 minutes of exercise (4, 15). Therefore, the purpose of this study is to determine the caloric expenditure and relative exercise intensity of hooping as a free range exercise.

## **METHODS**

### **Subjects**

Subjects were 16 apparently healthy female volunteers recruited by fliers and word of mouth by the “Hooked on Hooping” staff prior to the test date. All subjects were intermediate to advanced level hoopers and completed a subject information questionnaire prior to testing (Appendix A). They also supplied written informed consent

prior to beginning the study (Appendix B) and completed a health history questionnaire (PAR-Q) (Appendix C) designed to screen for cardiac risk factors. This study was approved by the University of Wisconsin-La Crosse Institutional Review Board for the Protection of Human Subjects.

### **Procedures**

Testing was completed at the Hooked on Hooping Studio in Green Bay, Wisconsin. For testing, each participant followed a 35-minute hooping video (5 minutes of warm-up and 30 minutes of hooping) developed by the founder of "Hooked on Hooping." The 30-minute section of hooping during the video was comprised of 7 different dances/songs with diverse choreography. Prior to the test date and at their convenience, the participants had access to the video for two practice sessions. During testing, each subject wore a portable oxygen analyzer (Jaeger Oxycon Mobile Unit, San Diego, CA) and Polar telemetric unit (Lake Success, New York) while they hooped to the video at their own intensity. Heart rate (HR) and oxygen consumption ( $VO_2$ ) were recorded every minute. Caloric expenditure was determined from the  $VO_2$  data obtained. Ratings of perceived exertion (RPE) were recorded every 5 minutes using the 6-20 Borg scale (Appendix D) (2).

### **Statistical Analysis**

Standard descriptive statistics were used to characterize the study population and to determine the relative exercise intensity of hooping. Data was evaluated and calculated using Statistical Package for the Social Sciences, Inc. (SPSS) 17.0. Average HR and RPE

values were compared to the American College of Sports Medicine (ACSM) guidelines to determine the relative exercise intensity of hooping.

## RESULTS

Descriptive characteristics of the 16 subjects are presented in Table 1. The age range of the subjects was 16-59 years. Average physiological responses to the 30 minutes of hooping (excluding warm-up) are presented in Table 2.

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

Variable	Mean $\pm$ SD	Range
Age (yrs)	40.3 $\pm$ 13.96	16-59
Height (in)	65.0 $\pm$ 2.92	60-70
Weight (lbs)	151.0 $\pm$ 28.96	115-208
BMI	25.2 $\pm$ 5.02	19.5-35.8

Table 2. Average Exercise Responses to 30 Minutes of Hooping

Variable	Mean $\pm$ SD	Range
Heart rate (bpm)	151 $\pm$ 19.3	112-180
% HRmax	84 $\pm$ 9.0	65-103
VO <sub>2</sub> (ml/kg/min)	20.6 $\pm$ 3.31	15.3-27.0
Total Kcal	210 $\pm$ 43.3	150-317
Kcal/min	7.0 $\pm$ 1.44	5.0-10.6
RPE	13.0 $\pm$ 1.51	10.0-15.3

Average HR was 151 bpm, which corresponds to 84% of age-predicted HRmax  $[206.9 - (0.67 \times \text{age})]$  (3). Throughout the session, the average  $\text{VO}_2$  was  $20.6 \pm 3.31$  ml/kg/min. The average caloric expenditure of hooping was  $7.0 \pm 1.44$  Kcal/min, equivalent to  $210 \pm 43.3$  calories per 30 minutes of hooping. Average RPE was  $13.0 \pm 1.51$ , which corresponds to “somewhat hard” on the Borg Scale.

Figure 1 presents the average HR responses during the 30-minute workout section of the video; this did not include the 5-minute warm-up period. This graph illustrates the fluctuations in HR, which is in accordance with the varying intensity of the different dance routines within the 30-minute video. Table 3 expresses the average minute-by-minute heart rate responses during the 30 minutes of hooping. Figure 2 presents the relative intensity (% HRmax), with the shaded portion indicating ACSM recommended guidelines for improvement in cardiovascular fitness. Figure 3 presents the average  $\text{VO}_2$  responses during the 30-minute trial. The data points fluctuate significantly due to the constant changes in intensity from one dance/song to the next during the 30-minute hooping video session.

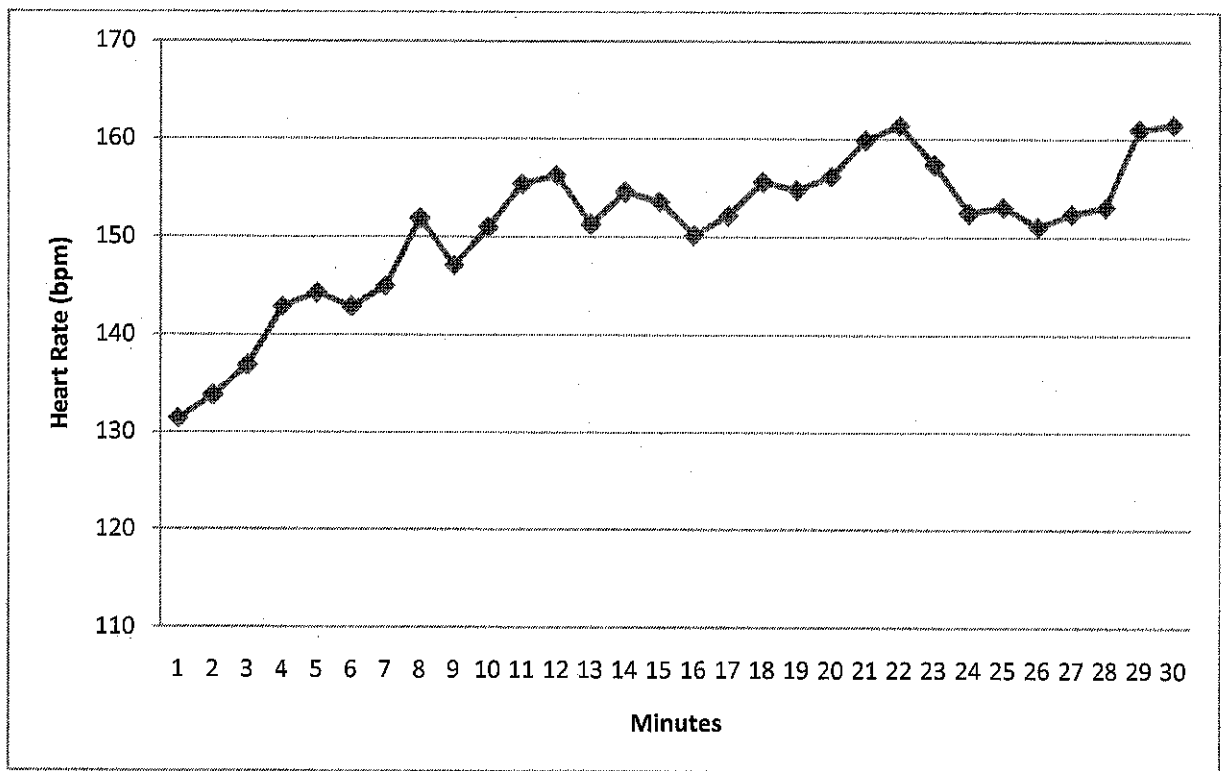


Figure 1. Average Heart Rate Responses

Table 3. Minute-by-Minute Heart Rate Response during 30 Minutes of Hooping

	<u>Heart Rate</u>	<u>(Range)</u>	<u>% HRmax</u>	<u>(Range)</u>
Minute 1	131 ± 16.4	(104-154)	73 ± 8.2	(61-87)
Minute 2	134 ± 19.6	(104-161)	74 ± 9.9	(61-93)
Minute 3	137 ± 18.3	(105-162)	76 ± 8.8	(61-92)
Minute 4	143 ± 19.6	(109-171)	79 ± 9.5	(64-98)
Minute 5	144 ± 22.1	(101-177)	80 ± 11.0	(59-101)
Minute 6	143 ± 21.9	(99-174)	79 ± 10.7	(58-96)
Minute 7	145 ± 21.1	(105-174)	81 ± 10.4	(61-98)
Minute 8	152 ± 20.6	(109-180)	84 ± 9.6	(64-102)
Minute 9	147 ± 21.4	(105-177)	82 ± 10.4	(61-100)
Minute 10	151 ± 20.9	(112-184)	84 ± 9.9	(65-102)
Minute 11	155 ± 18.8	(117-183)	86 ± 8.8	(68-103)
Minute 12	156 ± 19.6	(114-184)	87 ± 9.0	(67-104)
Minute 13	151 ± 18.5	(113-177)	84 ± 8.4	(66-100)
Minute 14	155 ± 18.0	(119-182)	86 ± 8.0	(69-104)
Minute 15	154 ± 18.0	(126-182)	85 ± 7.9	(74-104)
Minute 16	150 ± 20.6	(117-185)	83 ± 9.8	(68-106)
Minute 17	152 ± 21.6	(117-188)	85 ± 10.6	(68-107)
Minute 18	156 ± 18.1	(121-185)	86 ± 8.6	(71-106)
Minute 19	155 ± 19.5	(114-185)	86 ± 8.9	(67-106)
Minute 20	156 ± 19.1	(116-185)	87 ± 8.9	(68-106)
Minute 21	160 ± 18.6	(123-192)	89 ± 8.7	(72-110)
Minute 22	161 ± 19.4	(125-190)	90 ± 8.7	(73-108)
Minute 23	157 ± 20.3	(117-186)	87 ± 9.1	(68-106)
Minute 24	153 ± 21.7	(106-187)	85 ± 10.3	(62-107)
Minute 25	153 ± 21.6	(103-185)	85 ± 10.4	(60-105)
Minute 26	151 ± 20.0	(113-184)	84 ± 9.1	(66-102)
Minute 27	152 ± 21.6	(112-185)	85 ± 9.9	(65-102)
Minute 28	153 ± 21.4	(105-186)	85 ± 10.2	(61-106)
Minute 29	161 ± 20.7	(114-192)	89 ± 9.6	(67-110)
Minute 30	162 ± 20.5	(114-194)	90 ± 9.7	(67-111)

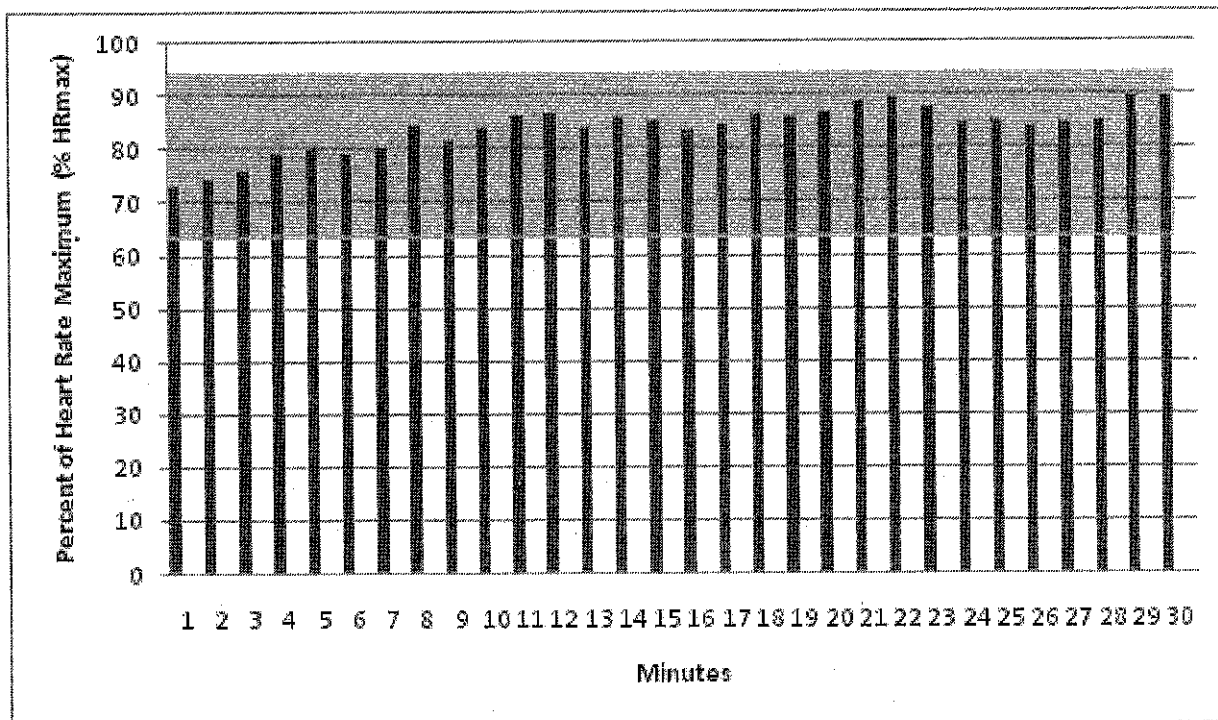


Figure 2. Average Exercise Intensity during 30 Minutes of Hooping

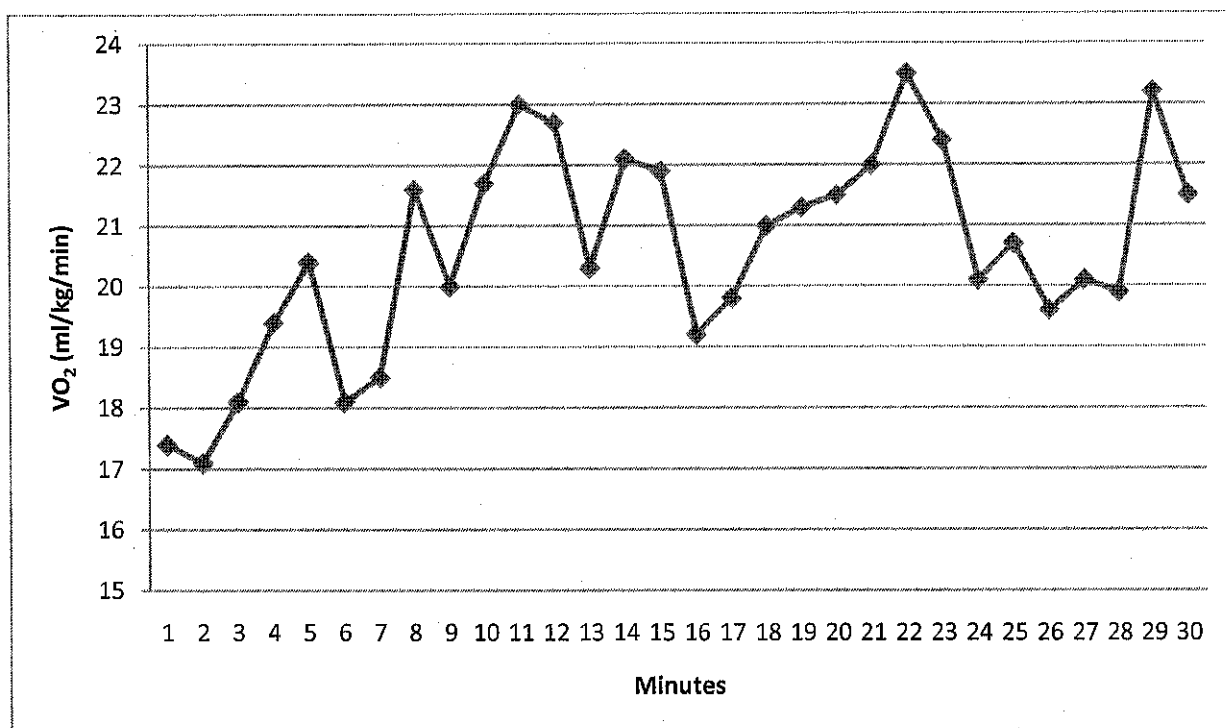


Figure 3. Average VO<sub>2</sub> Responses



## DISCUSSION

ACSM's recommendations for improving cardiovascular fitness are to exercise within the range of 50-85%  $\text{VO}_2\text{max}$  and/or 64-94%  $\text{HRmax}$  (2). This study found that the exercise intensity of 30 minutes of hooping fell within these guidelines. During the study, subjects were exercising at  $84 \pm 9\%$   $\text{HRmax}$ , which is sufficient to increase aerobic capacity. The participant's varied widely in age, fitness level, and body composition, thus it was found that there was a wide range of intensity (65-103%  $\text{HRmax}$ ) experienced by the subjects.

There are a number of other popular exercise classes being taught in fitness clubs. Table 4 below presents data comparing the intensity of hooping to other recently investigated free range exercises.

Table 4. Comparative Free Range Exercise Studies

Study	% $\text{HRmax}$	$\text{VO}_2$ (ml/kg/min)	Kcal/min
<b>Hooping</b>	<b><math>84 \pm 9.0</math></b>	<b><math>20.6 \pm 3.31</math></b>	<b><math>7.0 \pm 1.44</math></b>
Boot Camp (10)	$81 \pm 14.3$	$25.9 \pm 4.24$	$7.5 \pm 1.92$
Nia Technique (9)	$57 \pm 7.3$	$10.5 \pm 1.60$	$3.2 \pm 0.50$
Advanced Pilates (12)	$62 \pm 4.0$	$17.3 \pm 1.40$	$5.5 \pm 0.97$
Power Yoga (5)	$62 \pm 5.4$	$18.7 \pm 1.30$	$5.9 \pm 1.03$
Curves (6)	$75 \pm 6.9$	$17.0 \pm 3.50$	$6.4 \pm 0.79$
Cardio Kickboxing (8)	$86 \pm 0.0$	$25.7 \pm 2.65$	$8.1 \pm 1.24$
Step Aerobics (14)	$75 \pm 4.7$	$23.4 \pm 2.10$	$5.9 \pm 0.86$

Similar free range exercises that fall within the same range of intensity and caloric expenditure as Hooping, include Boot Camp (10), Curves (6), Cardio Kickboxing (8), and Step Aerobics (14). According to ACSM, these five exercise routines are within the recommended criteria for improving cardiovascular fitness based upon % HRmax and % VO<sub>2</sub>max (2).

ACSM also recommends burning 1,000-1,500 calories per week in order to contribute to weight management and improve cardiovascular fitness. This corresponds to 200-300 calories per session if accumulated over 5 days per week. We found that hooping can potentially burn 210 calories during a 30-minute session and falls within ACSM recommendations. For comparison, it is shown that caloric expenditure of walking on a treadmill at 4-4.5 mph is equivalent to the caloric expenditure of hooping (2).

### **Conclusion**

This study found that hooping can burn an average of 210 calories during a 30-minute hooping session. Additionally, subjects were working at 84% of HRmax while hooping. Thus, it was concluded that hooping is within ACSM's recommended guidelines for improving cardiovascular fitness and controlling body weight.

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**APPENDIX A**  
**RECORDING SHEET FOR SUBJECT INFORMATION**

Relative Exercise Intensity and Caloric Expenditure of Hooping  
Subject Information Questionnaire

Name: \_\_\_\_\_

Age: \_\_\_\_\_ Date of Birth: \_\_\_\_\_

Height in Inches: \_\_\_\_\_ Ht. in cm: \_\_\_\_\_

Weight in Pounds: \_\_\_\_\_ Wt. in kg: \_\_\_\_\_

Indicate level of proficiency in Hooping by placing an "X" in the box provided.

☐ Beginner    ☐ Intermediate    ☐ Advanced

**APPENDIX B**  
**INFORMED CONSENT**

INFORMED CONSENT FOR  
THE RELATIVE EXERCISE INTENSITY AND CALORIC EXPENDITURE  
OF HOOPING

- **Purpose and Procedure**

- The purpose of this study will be to determine the caloric expenditure and relative exercise intensity of hooping.
- My participation will involve following a 35-minute hooping video developed by the founders of "Hooked on Hooping."
- The test will take place at the Hooked on Hooping studio in Green Bay, WI.
- During the test, I will wear a portable oxygen analyzer (Oxycon) in which I will breathe through a scuba-type mouthpiece to measure my expired air and a Polar heart rate monitor with chest strap to measure my heart rate.
- I will rate my perceived exertion using the subjective rating scale.

- **Potential Risks**

- Due to the impact on the abdominal region, I may experience slight abdominal surface bruising after my session from the weight of the hoop.
- There will be certified professionals in CPR, Advanced Cardiac Life Support and First Aid present during my testing session in case of complications.

- **Rights and Confidentiality**

- I know that my participation in this study is completely voluntary and I may decide to terminate the test at any time without penalty.
- If any of my results are to be published in scientific literature, my name and personal information are to be concealed at all times.
- My data is to remain confidential in that only the primary researcher and advising professor may have access to my information.

- **Possible Benefits**

- My participation may help to determine the caloric expenditure and relative exercise intensity of hooping. These statistics can in turn, benefit others researching further angles of hooping in the future.



Any questions concerning this study may be directed to Jordan A. Holthusen (218-688-2136), the primary researcher, or the advising professor Dr. John P. Porcari, Department of Exercise and Sport Science, UW-L (608-785-8684). Questions regarding the protection of human subjects may be addressed to the UW-La Crosse Institutional Review Board for the Protection of Human Subjects, (608-785-8124 or [irb@uwlax.edu](mailto:irb@uwlax.edu)).

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Participant \_\_\_\_\_

Date \_\_\_\_\_

Researcher \_\_\_\_\_

Date \_\_\_\_\_

APPENDIX C

HEALTH HISTORY QUESTIONNAIRE (PAR-Q)

# PAR-Q Form

Regular physical activity is fun and healthy, and increasingly more people are starting to become more active every day. Being more active is very safe for most people. However, some people should check with their physician before they start becoming more physically active.

**Please complete this form as accurately and completely as possible.**

**PAR-Q FORM Please mark YES or No to the following: YES NO**

- ⤵ Has your doctor ever said that you have a heart condition and recommended only medically supervised physical activity? \_\_\_\_\_
- ⤵ Do you frequently have pains in your chest when you perform physical activity? \_\_\_\_\_
- ⤵ Have you had chest pain when you were not doing physical activity? \_\_\_\_\_
- ⤵ Have you had a stroke? \_\_\_\_\_
- ⤵ Do you lose your balance due to dizziness or do you ever lose consciousness? \_\_\_\_\_
- ⤵ Do you have a bone, joint or any other health problem that causes you pain or limitations that must be addressed when developing an exercise program (i.e. diabetes, osteoporosis, high blood pressure, high cholesterol, arthritis, anorexia, bulimia, anemia, epilepsy, respiratory ailments, back problems, etc.)? \_\_\_\_\_
- ⤵ Are you pregnant now or have given birth within the last 6 months? \_\_\_\_\_
- ⤵ Do you have asthma or exercise induced asthma? \_\_\_\_\_
- ⤵ Do you have low blood sugar levels (hypoglycemia)? \_\_\_\_\_
- ⤵ Do you have diabetes? \_\_\_\_\_
- ⤵ Have you had a recent surgery? \_\_\_\_\_

**If you have marked YES to any of the above, please elaborate below:**

\_\_\_\_\_

\_\_\_\_\_

- ⤵ Do you take any medications, either prescription or non-prescription, on a regular basis? Yes/No \_\_\_\_\_
- ⤵ What is the medication for? \_\_\_\_\_
- ⤵ How does this medication affect your ability to exercise or achieve your fitness goals? \_\_\_\_\_

**Please note: If your health changes such that you could then answer YES to any of the above questions, tell your trainer/coach. Ask whether you should change your physical activity plan.**

**I have read, understood, and completed the questionnaire. Any questions I had were answered to my full satisfaction.**

Print Name: \_\_\_\_\_ Signature: \_\_\_\_\_

Date: \_\_\_\_\_

**APPENDIX D**  
**RATINGS OF PERCEIVED EXERTION SCALE**

### Borg's Ratings of Perceived Exertion Scale

6	No exertion at all
7	Extremely Light
8	
9	Very light
10	
11	Light
12	
13	Somewhat hard
14	
15	Hard (heavy)
16	
17	Very hard
18	
19	Extremely hard
20	Maximal exertion

**APPENDIX E**  
**PICTURES OF HOOPING TRIAL**







APPENDIX F  
REVIEW OF LITERATURE

## **REVIEW OF LITERATURE**

### **Introduction**

The American College of Sports Medicine (ACSM) has been prescribing and researching the effects of exercise on the American population since 1954 (2). Although ACSM has established many physiological and psychological benefits of exercise, a sedentary lifestyle has become an ever growing risk factor for major disease in the United States (2). These diseases include: obesity, heart disease, diabetes, orthopedic problems, and hypertension (2). With this sedentary lifestyle, obesity has become the leading cause of most of these issues in the United States today (14). Obesity is categorized as having a Body Mass Index (BMI) above 30.0 or having an overall body fat percentage greater than 30% (2, 14). Today, 66.3% of adults in the United States are obese or overweight, contributing to \$147 billion in health care costs per year (14). To decrease or eliminate these risk factors and health care costs, ACSM has set forth recommendations that should result in a healthier population.

ACSM (2) recommends that every apparently healthy adult get at least 5 days of moderate intensity aerobic exercise or 3 days of vigorous intensity aerobic exercise each week. Aerobic exercise is termed to be a rhythmic, cardiovascular, and large muscle group exercise; some examples include, running/jogging, basketball, swimming or vigorous walking. These intensities can be quantified by using a maximal oxygen consumption ( $VO_2\text{max}$ ) range of 50-85% or a heart rate maximum ( $HR\text{max}$ ) of 64-94%.

Recommended caloric expenditure for these guidelines are 1,000 calories per week, which equates to 150 minutes of exercise per week or 30 minutes per day. In addition to 1,000 calories per week, it is also recommended that an individual obtain 3,000 to 4,000 steps of moderate to vigorous intensity walking each day (2).

Hooping is one of the newer exercise routines gaining popularity today that may meet these recommendations. There are numerous purported benefits from hooping including: increased bone strength, weight loss, muscle toning, improved flexibility of the spine and pelvis and stress relief (10). Hooping can also allegedly improve cognition, as it challenges the mind to concentrate while exercising (10). "Hooping hoops" are different from the traditional hula hoop in that they weigh more and their diameter is significantly larger. Hooked on Hooping (Green Bay, Wisconsin) manufactures adult hoops that range from a size large (no extra weight added) weighing one pound and measuring 37-41 inches in diameter to an adult extra large version that is 42-45 inches in diameter weighing 4 lbs (10). These differences make hooping more taxing as they force more vigorous muscle contractions and thereby increasing energy expenditure. There is no known research literature that supports the benefits of this new phenomenon of hooping. The American Council of Exercise (ACE) is quoted in many sources that hooping burns 200 calories per 30 minutes (3, 15). However, there does not appear to be any research to back up this claim.

### **History of Hooping**

With no concrete origin, hooping was thought to have started over 3,000 years ago (6, 12). First being recognized in Egypt, hoops were made out of grape vines and

propelled along the ground by pushing them with a stick (1). In ancient Greece, these same vine hoops were used for exercise and weight loss (6). During the 14th century, hooping became very popular in England; however this popular exercise came to an abrupt end after British medics blamed it for causing heart attacks and spinal dislocations (6, 12). It was not stated as to why the medics blamed hooping for these problems, but they had people believing that it was the cause for these medical issues. During the 18<sup>th</sup> century, hooping became known as “hula” hooping after sailors had visited Oahu, Hawaii. Enjoying their first Luau, these sailors compared the hula dancers to hooping from their native countries and since then the name became “hula hooping” (6).

Australia produced and sold the very first hula hoop in 1957, which was made of bamboo (6). It was then that Americans Richard Knerr and Arthur Melin, founders of Wham-O<sup>®</sup> Company, “discovered” hula hoops. They learned of the idea after visiting Australia and seeing a school age child twirling her bamboo hoop around her waist in gym class (6). Their company manufactured hoops out of a hard plastic called Marlex<sup>®</sup> and introduced them into the United States consumer market in 1958 for \$1.98 each (12). Subsequently, Wham-O sold over 100 million hoops in only 2 years, making it the biggest fad of the 1950s (12).

### **Technological Advancements**

The hula hoop has come a long way since the beginning of its time, from vines and bamboo to hard plastic. This hard, durable plastic has been used for the last 52 years to make hoops for children and adults of all ages. This recent hooping craze however, has

challenged the producers of hoops to a more advanced technology. Some hula hoop producer's use polyethylene tubing, making the hoop heavier and larger in diameter. Decorating the hoops with sparkling tapes, bright colors, and glow in the dark tape tend to give it a more appealing look. Some have developed a clear tubing and have placed colorful beads, glitter or even water inside the hoop to produce visual or audio affects when used (6). These advances in technology have allowed hula hooping to evolve from a playful activity into a potential and beneficial form of exercise.

### **ACSM Guidelines for Exercise Prescription and Other Free Range Exercises**

To quantify the overall aerobic benefits of hooping, it will be compared to ACSM's guidelines for exercise prescription and other comparable, free range exercises. The free range exercises included in this discussion are: Boot Camp, Nia Technique, Yoga, Pilates, Curves®, Cardio Kickboxing and traditional step aerobics. ACSM recommends that individuals receive moderate-intensity physical activity for at least 30 minutes per day, 5 days of the week, or 20 minutes of vigorous-intensity exercise at least 3 days of the week (2). ACSM's recommendations for improvement in cardiovascular fitness are to exercise within the range of 50-85%  $\text{VO}_2\text{max}$  or 64-94%  $\text{HRmax}$  (2).

### **Boot Camp**

Porcari et al. (9) examined the exercise intensity of a typical "boot camp" workout. Boot camp is an instructor-lead fitness class where participants perform a sequence of militaristic calisthenic-type movements. In this study, subjects first completed a maximal exercise test to determine their  $\text{VO}_2\text{max}$  and  $\text{HRmax}$ . Ratings of perceived exertion (RPE) were also assessed during the study. Each subject was then

given a boot camp video to take home and practice with before being tested. On test day, the subjects were hooked up to a portable oxygen analyzer to collect  $\text{VO}_2\text{max}$  measurements during the testing video. HR and RPE were recorded every 3 minutes. Average HR responses during the Boot Camp trial were  $152 \pm 10.1$  bpm, which corresponded to  $81 \pm 14.3\%$  HRmax. Results for  $\text{VO}_2$  were  $25.9 \pm 4.24$  ml/kg/min, which corresponded to  $62 \pm 4.24\%$   $\text{VO}_2\text{max}$ . The average RPE throughout the trial was  $13.5 \pm 1.4$ . The female subjects burned  $7.5 \pm 1.92$  Kcal/min, thus averaging  $300 \pm 74.0$  calories for the session. Therefore, intensity of the workout was found to be within ACSM guidelines for improving cardiovascular fitness.

### **Nia Technique**

Konemann et al. (8) studied the acute physiological responses to the Nia (Neuromuscular Integrative Action) Technique. Nia is a mind-body technique created to get people moving to adhere to physical activity. It combines martial arts, dance arts, and healing arts which have been found to produce physiological and psychological responses. Subjects completed a  $\text{VO}_2\text{max}$  test and a stimulated Nia class trial. Four weeks after  $\text{VO}_2\text{max}$  testing was completed, the subjects were called back to complete the Nia technique trial. Each participant followed a 55-minute Nia video while wearing a portable Cosmed K4b<sup>2</sup> analyzer to measure  $\text{VO}_2$  during the trial. Average HR responses during the Nia trial were  $107 \pm 12.1$  bpm, which corresponded to  $57 \pm 7.3\%$  HRmax. Results for  $\text{VO}_2$  were  $10.5 \pm 1.60$  ml/kg/min, which corresponded to  $32.0 \pm 7.10\%$   $\text{VO}_2\text{max}$ . The female subjects burned  $3.2 \pm 0.50$  Kcal/min, thus averaging  $165.0 \pm 27.50$  calories for the trial. Intensity of the workout did not meet ACSM standard guidelines for improving cardiovascular fitness.

## Yoga

Boehde et al. (4) studied the physiological effects of yoga. Yoga is a mind and body exercise used to strengthen and stretch the body while clearing the mind and focusing on breathing. Each subject completed a  $\text{VO}_2\text{max}$  test and two different variations of yoga. Subjects followed a 50-minute video for the two types of yoga, Hatha (beginner level) and power (advanced level).  $\text{HRmax}$  was  $187 \pm 6.6$  bpm and  $\text{VO}_2\text{max}$  was  $40.6 \pm 3.80$  ml/kg/min. Average HR responses during the Hatha yoga trial were  $89 \pm 5.8$  bpm, which corresponded to  $48 \pm 3.4\%$   $\text{HRmax}$ . Results for  $\text{VO}_2$  were  $9.8 \pm 1.30$  ml/kg/min, which corresponded to  $24.0 \pm 4.10\%$   $\text{VO}_2\text{max}$ . The female subjects burned  $3.1 \pm 0.78$  Kcal/min, thus averaging  $155 \pm 39.0$  calories for the trial. Average HR responses during the power yoga trial were  $115 \pm 8.0$  bpm, which corresponded to  $62 \pm 5.4\%$   $\text{HRmax}$ . Average  $\text{VO}_2$  was  $18.7 \pm 1.30$  ml/kg/min, which corresponded to  $46.0 \pm 4.80\%$   $\text{VO}_2\text{max}$ . The female subjects burned  $5.9 \pm 1.03$  Kcal/min, thus averaging  $237 \pm 2.0$  calories for the trial. Intensity of the workout did not meet ACSM standard guidelines for improving cardiovascular fitness.

## Pilates

Spilde et al. (11) studied the physiological responses to two levels of Pilates. Pilates is an abdominal core-focused, mind and body exercise, involving stretching, strengthening and toning poses that are focused around breathing. Each subject completed a  $\text{VO}_2\text{max}$  test and two different levels of Pilates. Subjects followed a 50-minute video for the two different levels, beginner and advanced.  $\text{HRmax}$  was  $188 \pm 6.8$  bpm and  $\text{VO}_2\text{max}$  was  $40.7 \pm 4.10$  ml/kg/min. HR responses during the

50-minute beginner workout were  $102 \pm 6.0$  bpm, which corresponded to  $54 \pm 3.6\%$  HRmax. Average  $\text{VO}_2$  was  $11.5 \pm 1.60$  ml/kg/min, which corresponded to  $28.0 \pm 4.30\%$   $\text{VO}_{2\text{max}}$ . The female subjects burned  $3.6 \pm 0.87$  Kcal/min, thus averaging  $175 \pm 43.5$  calories during the trial. Average HR responses during the advanced Pilates trial were  $117 \pm 7.2$  bpm, which corresponded to  $62 \pm 4.0\%$  HRmax. The average  $\text{VO}_2$  was  $17.3 \pm 1.40$  ml/kg/min, which corresponded to  $43.0 \pm 5.30\%$   $\text{VO}_{2\text{max}}$ . The female subjects burned  $5.6 \pm 0.97$  Kcal/min, thus averaging  $254 \pm 38.8$  calories for the session. Data gathered from the study did not meet ACSM guidelines for improving cardiovascular fitness.

### **Curves®**

Greany et al. (5) studied the exercise intensity and caloric expenditure of a typical Curves® workout. A Curves® workout consists of a 30-minute session broken down into a 25-minute circuit of 12 hydraulic resistance modalities, alternating every 30 seconds with stationary jogging, marching, or walking. Following the 25-minute workout, there was a 5-minute cool-down period consisting of stretching. Subjects completed a  $\text{VO}_{2\text{max}}$  test and 2, 30-minute Curves® trials, in the company of other Curves® clients, making it a natural workout environment. Data was collected using a K4b<sup>2</sup> portable metabolic analyzer and HR and RPE values were recorded throughout each trial. HRmax was  $169 \pm 12.4$  bpm and  $\text{VO}_{2\text{max}}$  was  $29.2 \pm 7.0$  ml/kg/min. Average HR responses during the trial were  $126 \pm 12.1$  bpm, which corresponded to  $75.0 \pm 6.9\%$  HRmax. Average  $\text{VO}_2$  was  $17.0 \pm 3.5$  ml/kg/min, which corresponded to  $59.0 \pm 7.30\%$   $\text{VO}_{2\text{max}}$ . Average RPE throughout the session was  $13.3 \pm 0.7$ . The female subjects burned  $6.4 \pm 0.79$  Kcal/min,



thus averaging  $163 \pm 19.0$  calories for the trial. Therefore, intensity of the workout was found to be within ACSM standard guidelines for improving cardiovascular fitness.

### **Cardio Kickboxing**

Immel et al. (7) studied the physiological effects to cardio kickboxing in females. Cardio kickboxing is generally offered as a group fitness class at most gyms. It is a boxing class that incorporates self defense tactics for physical conditioning. Each subject completed a  $\text{VO}_2\text{max}$  test and one cardio kickboxing trial. Data was collected using the KB1-C portable analyzer.  $\text{HRmax}$  was  $189 \pm 7.4$  bpm and  $\text{VO}_2\text{max}$  was  $36.7 \pm 6.00$  ml/kg/min. Average HR responses during the cardio kickboxing trial were  $163 \pm 10.0$  bpm, which corresponded to 86%  $\text{HRmax}$ . Average  $\text{VO}_2$  was  $25.7 \pm 2.70$  ml/kg/min, which corresponded to 70%  $\text{VO}_2\text{max}$ . The average RPE throughout the session was  $14 \pm 2.1$ . The female subjects burned  $8.1 \pm 1.20$  Kcal/min, thus averaging  $289 \pm 49.0$  calories for the trial. The intensity of the workout was determined to be within ACSM standard guidelines for improving cardiovascular fitness.

### **Step Aerobics**

Sutherland et al. (13) studied the physiological responses and perceptions of exertion in a step aerobics session. The intention of this study was to determine the cardiovascular and metabolic demands of a university step class and to evaluate HR and RPE during each session. Subject completed a  $\text{VO}_2\text{max}$  test and three step aerobics trials. The step classes were completed by following a 39-minute step video. Each trial used a different step height; 6, 8, and 10 inch steps.  $\text{VO}_2$ , HR and RPE were recorded and results for each trial were quite similar. The average HR responses for the 6-inch step height

were  $140 \pm 17.0$  bpm, which corresponded to  $70 \pm 7.5\%$  HRmax. Average  $\text{VO}_2$  was  $21.5 \pm 2.10$  ml/kg/min, which corresponded to  $45.6 \pm 6.60\%$   $\text{VO}_{2\text{max}}$ . The average RPE for the trial was  $12.3 \pm 1.00$ . The average HR responses for the 8-inch step height were  $150 \pm 10.0$  bpm, which corresponded to  $75 \pm 4.7\%$  HRmax. Average  $\text{VO}_2$  was  $23.4 \pm 2.10$  ml/kg/min, which corresponded to  $51.6 \pm 3.90\%$   $\text{VO}_{2\text{max}}$ . The average RPE for the trial was  $12.9 \pm 1.1$ . The average HR responses for the 10-inch step height were  $158 \pm 13.0$  bpm, which corresponded to  $79 \pm 5.5\%$  HRmax. The average  $\text{VO}_2$  was  $26.4 \pm 1.90$  ml/kg/min, which corresponded to  $56.2 \pm 7.30\%$   $\text{VO}_{2\text{max}}$ . The average RPE for the trial was  $13.4 \pm 1.0$ . Since the three trials were not significantly different, all trials were combined for calculating caloric expenditure. The female subjects burned  $5.9 \pm 0.86$  Kcal/min, thus averaging  $230 \pm 33.60$  calories for the trials. Therefore, intensity of the workout was determined to be within ACSM guidelines for improving cardiovascular fitness.

### **Conclusion**

Guidelines from ACSM, if followed, give sound recommendations for maintaining a healthy lifestyle. Hooping is a growing fitness craze in the United States and can purportedly meet ACSM recommendations. By comparing the physiological responses of hooping to other free range exercises, we can draw some conclusions on whether hooping contributes to an active, healthy lifestyle.

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