

March 2021

Warming Up and Cooling Down: Perceptions and Behaviors Associated with Aerobic Exercise

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Warming Up and Cooling Down: Perceptions and Behaviors Associated with Aerobic Exercise

by

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A thesis submitted in partial fulfillment
of the requirements for the degree of
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Date of Approval:
March 12, 2021

Keywords: Cardiovascular training, pre-exercise, post-exercise, attitudes

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TABLE OF CONTENTS

LIST OF TABLES	iii
ABSTRACT	iv
CHAPTER 1: INTRODUCTION	1
Rationale	1
Problem Statement	3
Research Variables.....	3
Hypotheses.....	4
Operational Definitions.....	4
Significance.....	5
CHAPTER 2: LITERATURE REVIEW	6
Guidelines for Aerobic Training.....	6
Health Problems and Benefits with Exercise.....	7
Use of Warm-Ups	8
Use of Cool-Downs.....	8
The Use of Warm-Ups and Cool-Downs.....	9
Warm-Ups and Cool-Downs in Older Adults.....	10
Conclusion	10
CHAPTER 3: METHODS.....	12
Purpose.....	12
Respondents	12
Procedure	13
Instrumentation	14
Definitions.....	14
Demographics	14
Aerobic Exercise Participation.....	14
Warm-Up Participation.....	15
Cool-Down Participation	15
Statistical Analyses	16
CHAPTER 4: RESULTS.....	17
General Warm-Up and Cool-Down Behavior	17
Specific Warm-Up Behavior with Age.....	18
Specific Warm-Up Behavior with Sex	19
Specific Warm-Up Behavior with Location	19
Specific Cool-Down Behavior with Age	20
Specific Cool-Down Behavior with Sex.....	20

Specific Cool-Down Behavior with Location.....	21
CHAPTER 5: DISCUSSION.....	22
Overview.....	22
Warm-Up Time.....	22
Location of Warm-ups and Cool-Downs.....	23
Intensity of Warm-Up.....	24
Warm-Up Behavior Related to Sex.....	24
Cool-Downs and Improving Performance.....	24
Warm-Up and Cool-Down Performance with Age.....	25
Conclusion.....	25
CHAPTER 6: REFERENCES.....	27
APPENDICES	
Appendix A: Survey Questions.....	32
Appendix B: Informed Consent.....	36
Appendix C: IRB Approval.....	39

LIST OF TABLES

Table 1: Respondent Characteristics	12
Table 2: General Warm-Up Behavior	17
Table 3: General Cool-Down Behavior	18
Table 4: Age with Specific Warm-Up Behavior	18
Table 5: Sex with Specific Warm-Up Behavior.....	19
Table 6: Location with Specific Warm-Up Behavior	20
Table 7: Age with Specific Cool-Down Behavior	20
Table 8: Sex with Specific Cool-Down Behavior.....	21
Table 9: Location with Specific Cool-Down Behavior.....	21

ABSTRACT

This study investigated the perceptual and behavioral responses regarding the use of warm-ups and cool-downs in aerobically active adults. There were 79 individuals who volunteered to participate in this study. Respondents were recruited by word of mouth or through social media and the Qualtrics survey link/QR code was on all recruitment materials in order to access the survey. The survey consisted of 47 questions. This study aimed to determine whether age, sex, or exercise location impacted perception or behavior related to warm-up and/or cool-down activities before or after the aerobic training exercise sessions. Primary results indicated the following: 1) age is positively correlated with time warming up ($p < 0.018$, $r = 0.018$, $r^2 = 0.214$), 2) males spent more time warming up than females ($p < 0.008$, $d = 0.77$), 3) outdoor exercisers spent more time warming up than indoor exercisers ($p < 0.043$, $d = 0.57$), 4) outdoor exercisers spent more time on cooling down than did indoor exercisers ($p < 0.002$, $d = 1.04$), 5) the level of intensity for warming up was positively correlated ($p < 0.012$, $d = 0.67$). These findings indicate that age, sex and exercise location play a role in warm-up and cool-down for aerobic exercise training sessions. The current design and findings are both novel and provide a framework for future research to consider perceptions and behaviors about warm-up and cool-down periods associated with aerobic exercise.

CHAPTER ONE:

INTRODUCTION

Rationale

Exercise guidelines have evolved over time and recommendations from many organizations have set forth standards. The American College of Sports Medicine (ACSM, 2020) recommendations state that all healthy adults aged 18–65 years old, should participate in moderate-intensity of aerobic physical activity for a minimum of at least 30 minutes for five days per week, or vigorous-intensity aerobic activity for a minimum of at least 20 minutes for three days per week. These guidelines help individuals know more precisely if they are meeting the national exercise recommendations. A primary goal of aerobic exercise is to improve markers of cardiorespiratory fitness, such as maximal oxygen consumption (Garber et al., 2011).

While there are many recommendations and general agreement for exercise frequency, intensity, type, and time, there is no real clarity or consensus regarding the approach individuals should have for warming up and cooling down. Some organizations, however, do provide suggestions on what warm-ups and cool-downs should include. Warm-ups should last for 5-10 minutes and the more intense the activity, the longer the warm-up should be, also, whatever activity the exerciser plans on doing for the regular exercise session (running, walking, cycling, etc.) they do the same for the warm-up but at a slower pace American Heart Association (AHA, 2014). A cool-down is an activity that involves voluntary, low-to-moderate-intensity exercise or movement performed within one hour after the training session (Van Hooren and Peake, 2018). These definitions and examples illustrate the fluidity and variability that the terms warm-up and

cool-down possess and explain the many different definitions used by individual organizations, researchers, and exercisers.

Performing a warm-up allows exercisers to have positive effects, such as showing a reduction in musculotendinous injuries (Bixler and Jones, 1992). A warm-up that is designed well can mentally and physically prepare athletes for the demands of the sports training session, by increasing blood flow to active muscles, raising core body temperature, enhancing metabolic reactions, and improving joint range of motion The National Strength and Conditioning Association (NSCA, 2017). The warm-up is a transitional phase that allows the body to adjust to the changing physiologic, biomechanics, and bioenergetic demands of the conditioning or sports phase of the exercise session and should last 5-10 minutes with including light-to-moderate intensity of aerobic and muscular endurance movements (ACSM, 2018).

Cool-downs performed after aerobic exercise may help the exerciser obtain more benefits from their training session. After the exercise session is complete, exercisers should incorporate a cool-down period involving aerobic and muscular endurance activities of light-to-moderate intensity lasting at least 5-10 minutes (ACSM, 2018). Performing a cool-down allows for better psychophysiological recovery and can end the exercise session with a more pleasurable experience and may attenuate or prevent performance decrements—or even enhance performance—during a subsequent training session or competition (Cook and Beaven, 2013). Creating a more pleasurable ending experience could result in exercisers wanting to participate in the activity again, by remembering the more favorable part of the exercise training session. The peak-end rule is a term that used to describe this phenomenon, it suggests that individuals often make a retrospective evaluation of an extended experience based on the most extreme effect they experienced during the activity (i.e., the peak effect) and based on the ending

moments of that experience (Kahneman et al., 1993). Other research studies have examined how ending an exercise training session on a more positive affect may help the exerciser report having a more pleasurable experience. Increasing the positivity at the ending of an exercise session leads people to evaluate the session in a more positive manner (Ruby et al., 2011). By performing a cool-down post aerobic exercise, individuals may obtain some of these previously mentioned effects.

Problem Statement

Performing a warm-up and performing a cool-down may facilitate a better training session, elicit a more positive emotional or perceptual response, help aid in recovery, and reduce risk of injury. There are no studies that investigate perceptions that individuals have about performing a warm-up and cool-down with an aerobic training session. The study proposed here will provide exploration into the perceptual and behavioral aspects of warm-ups and cool-downs.

Research Variables

Dependent Variables:

- 1) Warm-Up and Cool-Down Participation (frequency, intensity, type, & duration)
- 2) Warm-Up and Cool-Down Importance (frequency, intensity, type, & duration)

Moderator Variables:

- 1) Age
- 2) Sex
- 3) Exercise Location (indoor & outdoor)

Hypotheses

The hypotheses generated for this study were largely exploratory. Existing research literature cannot support confirmatory hypotheses at this time. This study is the first of its kind and represents an opportunity to acquire data that might lead to additional research on this topic. Specific exploratory hypotheses for the current study are provided below.

Research Hypothesis 1: Age will be positively associated with performing warm-ups and cool-downs more than younger respondents.

Null Hypothesis 1: The age of the respondent will not impact performance of warm-ups and cool-downs associated with aerobic exercise.

Research Hypothesis 2: Females will perform warm-ups and cool-downs more than males.

Null Hypothesis 2: Sex will not impact performance of warm-ups and cool-downs associated with aerobic exercise.

Research Hypothesis 3: Exercise sessions that are outdoors will be positively associated with performance of warm-ups and cool-downs more than exercise sessions that are indoors.

Null Hypothesis 3: Exercise location will not impact performing warm-ups and cool-downs associated with aerobic exercise.

Operational Definitions

The definition this study used to define a warm-up is loosely based on the definition provided by ACSM (2018). Warm-up: Aerobic and muscular endurance activity that is light-to-moderate intensity with changing demands on the body to adjust from rest to exercise.

The definition this study used to define a cool-down is loosely based on the definition provided by ACSM (2018). Cool-down: Light-to-moderate intensity of aerobic and muscular endurance activity to adjust from exercise to rest.

The physical activity guidelines that were referenced within this study are from ACSM (2020) stating that all healthy adults 18–65 years of age should participate in moderate intensity aerobic physical activity for a minimum of 30 minutes on five days per week, or vigorous intensity aerobic activity for a minimum of 20 minutes on three days per week.

Aerobic exercise was defined using the current ACSM (2020) guidelines. Any activity that uses large muscle groups, can be maintained continuously and is rhythmic in nature. Examples of aerobic exercise include cycling, dancing, hiking, jogging/long distance running, swimming and walking.

Muscular endurance was defined using the current ACSM (2020) guidelines. Specifically, muscular endurance is the ability of the muscle to continue to perform without fatigue.

Significance

This study will be helpful for future research and practice by providing a better understanding of the perceptions, and behaviors exercisers have towards warm-ups and cool-downs associated with aerobic exercise.

CHAPTER TWO:

LITERATURE REVIEW

Guidelines for Aerobic Training

The purpose of this literature review is to determine how the perceptions towards warm-ups and cool-downs are understood amongst aerobic exercisers. This review is looking at human behavior towards warm-ups and cool-downs, what it means to properly perform warm-ups and cool-downs with aerobic exercise, and how certain populations can be affected by performing and including warm-ups and cool-downs with aerobic exercise.

The Centers for Disease Control and Prevention (CDC), ACSM, NSCA, AHA state the recommendations for exercise guidelines that adults should be engaging in. Adults should participate in at least 150 minutes of moderate-intensity aerobic physical activity, or 75 minutes of vigorous-intensity, or an equivalent combination each week (CDC, 2020). The U.S. Department of Health and Human Services (2020a) reported that more than 80% of adults and adolescents do not engage in enough aerobic physical activity and muscle-strengthening activities to meet the guidelines. Assessing behavior change for physical activity engagement may provide more insight on whether individuals will adapt to training programs or be physically inactive. It could be mentioned that, while adults do not meet the recommendation for physical activity, there has been indication that the guidelines should be used more for promoting physical activity with current behaviors (Zenko et al., 2019). All healthy adults 18–65 years of age should participate in moderate-intensity aerobic physical activity for a minimum of 30 minutes on five

days per week, or vigorous-intensity aerobic activity for a minimum of 20 minutes on three days per week (ACSM, 2020).

Health Problems and Benefits with Exercise

The World Health Organization (WHO, 2010) revealed that 60–85% of people in the world live sedentary lifestyles, making it one of the most serious public health concerns in western countries. Lower levels of exercise or complete exercise intolerance can be extremely harmful physiologically as it can cause an increased risk of low back pain and neck pain in adults (Nilsen, 2011). With proper engagement in physical activity there are many health benefits, for instance, aerobic exercise is beneficial for cardiovascular performance. Aerobic exercises, such as running, cycling, and swimming can be beneficial for cardiovascular performance. Cardiovascular exercise also has many cognitive benefits and effects on the brain, those benefits include increases in neurotransmitter levels, improved oxygen, and nutrient delivery (Shivanna and Srinivasa, 2018).

Benefits of engaging in physical activity are also present in individuals who are suffering from breast cancer. Patients who exercised for 150 minutes per week of at least moderate physical activity showed a reduction of 24% of total mortality risk among breast cancer survivors (Schmid, 2013). There are many physiological benefits that occur with engagement in exercise, such as improved liveliness and strengthened energy and desires for living (Mavric, 2014). Being physically active is a crucial factor in helping reduce other comorbidities. Engagement in regular physical activity can positively affect mood, decrease the rate of becoming sick, and decrease the rate of death due to heart diseases, obesity, and colon cancer (Bastug, 2018).

Use of Warm-Ups

The phase for a warm-up should last about 5-10 minutes of light-to-moderate intensity of aerobic and muscular endurance activity, and the more intense the activity, the longer the warm-up should be (AHA, 2014; ACSM 2018). Performance in warm-ups can result in changes such as: increased muscle length and greater range of motion, which potentially may lead to less musculotendinous injury during physical activity (Woods et al., 2007), gradually speed up metabolic processes, increase the muscle temperature and the efficiency of the muscle contractions (Safran et al., 1988), promote an increase in core body temperature and blood flow, increase muscle-tendon suppleness, and enhance free coordinated movements (Herman, 2008). A warm-up routine consists of preparatory exercises before any physical activity and aims to reduce the risk of injury and to enhance performance (Abad, 2011). Although a warm-up has a positive effect on several physiological factors, the psychological mechanisms that facilitate peak performance cannot be ignored (Bishop, 2003). Having a well-designed warm-up before your exercise session can help with psychological aspects, for example, a warm-up will assist the athlete in mentally focusing on the upcoming task and will bring about various physiological changes that will enhance the training or competition (Swanson, 2006). Over time, a meta-analysis indicated that 79% of the analyzed studies observed performance-enhancing effects after various warm-up protocols (Fradkin et al., 2010).

Use of Cool-Downs

Cool-downs are performed following the exercise training session, and there are many ways and reasons why exercisers may perform cool-downs. Cool-downs can allow for better psychophysiological recovery following exercise and may attenuate or prevent performance decrements—or even enhance performance—during a subsequent training session (Cook and

Beaven, 2013). There are multiple examples of what a cool-down should be, ACSM (2018) states that the purpose of a cool-down is to allow for a gradual recovery of heart rate, blood pressure, and removal of metabolic end products from the muscles used during the intense phase of the workout. Another potential benefit from performing a cool-down is the facilitation of a more efficient venous return (Takahashi et al., 2001). After the exercise training session, cool-downs could benefit the exerciser with physiological aspects, and help in the recovery process.

The Use of Warm-Ups and Cool-Downs

A warm-up should last for 5-10 minutes and the more intense the activity, the longer the warm-up should be, and whatever activity the exerciser plans to do for the aerobic exercise training session (running, walking, cycling, etc.) they perform the warm-up at a slower pace (jog, walk slowly) (AHA, 2014). A well-designed warm-up can mentally, and physically prepare athletes for the demands of the sports training session and can increase blood flow to active muscles, raise core body temperature, enhance metabolic reactions, and improve joint range of motion (NSCA, 2017). Warm-ups should last about 5-10 minutes with performing light-to-moderate intensity of aerobic and muscular endurance activity which allows the body to adjust to the changing physiologic, biomechanics, and bioenergetic demands of the conditioning or sports phase of the exercise session (ACSM, 2018). There are 4 phases that physical activity sessions should include: warm-up, conditioning (aerobic, muscle strength/resistance and neuromotor exercise), cool-down, and stretching/flexibility (Piepoli, 2016). With the definitions provided by the AHA, ACSM, and NSCA a warm-up is the attempt to prepare the body psychologically and physiologically for the exercise training session.

A cool-down period involving aerobic and muscular endurance activity, of light-to-moderate intensity should last at least 5-10 minutes (ACSM, 2018). Since after doing physical

activity the exercisers heart is still beating faster than normal, body temperature is higher, and blood vessels are dilated the exerciser should walk for about 5 minutes, or until the heart rate gets below 120 beats per minute (AHA, 2014). An important factor for incorporating a cool-down is because, after an exercise session there can be an increase in blood pooling, and delayed onset muscle soreness The American Council on Exercise (ACE, 2014). Cool-downs should fill the last 5-15 minutes of the workout and include static (held for about 30 seconds) stretches for the muscle groups that were just worked (ACE, 2014). There should also be inclusion of a light form of cardiovascular exercise while performing a cool-down (Crockford, 2014). Performing a cool-down after the exercise training session, may allow for better recovery and physiological adaptations.

Warm-Ups and Cool-Downs in Older Adults

Exercise recommendations for the older adult population remains the same as previously stated by the ACSM. With older adults the U.S. Department of Health and Human Services (2020b) recommends for reducing the risk of injury, the exerciser should begin the exercise program slowly with low-intensity exercises and warm-up before exercising and perform a cool-down afterward. Aging results in increased muscle stiffness, and reduced elasticity of connective tissue, performing a warm-up and stretching prior to exercise can have a greater effect in reducing the risk of an orthopedic injury in the elderly (Pollock, 1999).

Conclusion

To date, there have been no studies published that review perceptual responses or behaviors from the aerobic exerciser's perspective on warm-ups and cool-downs. The use of a warm-up prepares the individual for their aerobic exercise, and safely allows the body and the

appropriate body systems, to prepare for the exercise training session. After completing the aerobic training session, it is beneficial to do a cool-down to return the body into a more normal and near resting state. This proposed study could provide insight for the individuals that engage in aerobic training exercise, with including warm-ups and cool-downs into the training session.

CHAPTER THREE: METHODS

Purpose

This study aimed to understand behaviors and perceptions about warm-ups and cool-downs within aerobic exercise. Three exploratory hypotheses related to age, sex, and exercise location form the basis of this study and are linked to anecdotal observations, general assumptions, and/or perceived stereotypes. It may be observed that older individuals, females, and outdoor exercisers might perceive greater benefits for participating in warm-ups and cool-downs with aerobic exercise sessions.

Respondents

Respondent demographic information is shown in Table 1. The average body weight was 155 pounds, the average height was 66 inches, and the average body mass index (BMI) was 25kg/m². The respondents who completed this survey were mostly white (n = 59), non-Hispanic (n = 62), and female (n = 59). Some responses in the categories of height and weight, aerobic exercise minutes, primary aerobic exercise minutes, primary warm-up time, and primary cool-down time were deleted because of erroneous data. Inclusion criteria for this study was ≥ 18 years of age and currently engaged in aerobic training. Exclusion criteria for this study was < 18 years of age and not currently engaged in aerobic training.

Table 1***Respondent Characteristics***

	Mean \pm SD	Range	n (%)	Sample Not Reporting
Age (years)	36 \pm 13	18-66		1
Sex				1
Male			19 (24)	
Female			59 (74)	
Height (inches)	66 + 4	59-77		2
Weight (pounds)	155 + 34	100-340		1
Body Mass Index (kg/m ²)	25 \pm 5	17-53		
Race				5
-Hispanic			13 (16)	
-Non-Hispanic			62 (76)	
-Unknown			7 (8)	
Ethnicity				5
-Alaska Native			2 (2.4)	
-American Indian			1 (1.2)	
-Asian			5 (6.1)	
-Black			3 (3.7)	
-Native Hawaiian			0 (0)	
-White			59 (72)	
-Other			5 (6.1)	

Procedure

Respondents were recruited by word of mouth, flyers, emails, and social media postings. The survey link and QR code were included on all recruitment materials which allowed the respondents to quickly access the survey, which utilized the Qualtrics survey platform (Qualtrics, Provo, UT). The first page of the survey was a welcome, and a brief overview of the study. The second page of the survey was the informed consent. After consenting to the study, the next page of the survey was the first study question. The first question asked, “Do you engage in aerobic exercise?”. Respondents who selected no to this question were exited from the survey (n = 2), for not meeting inclusion criteria. Respondents who selected yes to this question, could continue to complete the survey. After completing the survey, respondents were provided with a thank you

statement. Respondents were asked if they wanted to be considered for a randomized drawing to win an electronic Amazon gift card (every 20th respondent selected). Respondents were required to include their email address in order to be notified if selected as a winner.

Instrumentation

The survey was comprised of six sections, 1) definitions, 2) demographics, 3) aerobic exercise participation, 4) warm-up participation, and 5) cool-down participation. The sections below describe each section, and a copy of the survey is included as Appendix A.

Definitions: This section asked respondents to define the following terms: aerobic exercise, warm-up, and cool-down. Upon provision of the self-reported definitions the respondents were given a description of how these terms would be defined for the purposes of this study. Specifically, the definitions are as follows, warm-up: Aerobic and muscular endurance activity that is light-to-moderate intensity with changing demands on the body to adjust from rest to exercise. Cool-down: Aerobic and muscular endurance activity that is light-to-moderate intensity with changing demands on the body to adjust from rest to exercise. Aerobic exercise: Any activity that uses large muscle groups, can be maintained continuously and is rhythmic in nature. Examples of aerobic exercise include cycling, dancing, hiking, jogging/long distance running, swimming and walking.

Demographics: This section asked respondents questions about age, race, ethnicity, sex, weight, and height.

Aerobic Exercise Participation: This section asked respondents questions about aerobic exercise participation. First, respondents were reminded of the definition being utilized within the current study. Respondents were then asked to report how many minutes of aerobic activity

they complete in a week and to indicate the level of intensity of that aerobic exercise.

Respondents were then informed that throughout the remainder of survey they will be reporting answers based solely on their primary form of aerobic exercise. Respondents were first asked where they perform their preferred aerobic exercise, and then to select the form of their preferred aerobic exercise. Next, they were asked to report how many minutes of aerobic activity they complete in a week, and the level of intensity of that aerobic exercise.

Warm-Up Participation: In this section respondents were asked, “Do you engage in a warm-up before engaging in your primary aerobic exercise session?”. If yes was selected, they were directed to a series of questions regarding warm-ups. If no was selected, they were directed to the next round of questions that asked about cool-downs. Questions asked in this section involved asking about warm-ups, how many minutes is the warm-up, type of warm-up, warm-up intensity, the importance of a warm-up, belief in if performing a warm-up will reduce the risk of injury, improve performance, or help with recovery.

Cool-Down Participation: In this section respondents were asked, “Do you engage in a cool-down after engaging in your primary aerobic exercise session?”. If yes was selected, they were directed to a series of questions regarding cool-downs. If no was selected, they were directed to the next round of questions that asked about exercise participation and intensity. Questions asked in this section involved asking about cool-downs, how many minutes is the cool-down, type of cool-down, cool-down intensity, the importance of a cool-down, belief in if performing a cool-down will reduce the risk of injury, improve performance, or help with recovery.

Statistical Analyses

Data analysis proceeded in two phases using the IBM SPSS statistics for Macintosh, Version 27.0. Phase one included a descriptive analysis of the sample and demographic information and included means, standard deviations, and frequency counts. Phase two included the use of three different analyses. First, chi-square analyses were used to compare age, sex, and location to warm-up and cool-down behavior. Phi describes associated effect sizes, yielding the following categories: 0.05 = weak, 0.10 = moderate, 0.15 = strong, 0.25 = very strong (Cramer, 1946). Second, independent samples t-tests were used to compare sex, and location to specific warm-up and cool-down behaviors evaluating time, intensity, importance, injury, improvement, and recovery. Cohen's d describes associated effect sizes, yielding the following categories: 0.2 = small, 0.5 = medium, 0.8 = large (Cohen, 1988). Third, a bivariate correlation analysis was used to compare age to specific warm-up and cool-down behaviors evaluating time, intensity, importance, injury, improvement, and recovery. The r-squared describes the coefficient of determination, yielding the following effect sizes: 0.10 = small, 0.30 = medium, 0.50 = large (Cohen, 1988). Criterion for statistical significance for all analyses was set at a probability of 0.05.

CHAPTER FOUR:

RESULTS

General Warm-Up and Cool-Down Behavior

Analyses of warm-up and cool-down behavior indicated no significant differences for age, sex, or location ($p > 0.05$) with p-values ranging from 0.079 to 0.987. Tables 2 and 3 summarize these results. Comparing warm-ups to cool-downs the overall use of cool-downs is lower than warm-ups.

Table 2

General Warm-Up Behavior

	Does Warm-Up	Does Not Warm-Up	p-value	Phi
Age			0.937	0.01
-Younger	26 (67%)	13 (33%)		
-Older	27 (68%)	13 (32%)		
Sex			0.887	0.02
-Males	13 (68%)	6 (32%)		
-Females	40 (67%)	20 (33%)		
Location			0.079	0.45
-Indoors	30 (77%)	9 (23%)		
-Outdoors	24 (59%)	17 (41%)		

Table 3***General Cool-Down Behavior***

	Does Cool-Down	Does Not Cool-Down	p-value	Phi
Age			0.218	0.14
-Younger	18 (46%)	21 (54%)		
-Older	24 (60%)	16 (40%)		
Sex			0.381	0.01
-Males	12 (63%)	7 (37%)		
-Females	31 (52%)	29 (48%)		
Location			0.987	0.00
-Indoors	21 (54%)	18 (46%)		
-Outdoors	22 (54%)	19 (46%)		

Specific Warm-Up Behavior with Age

Analyses revealed that age was positively associated with time spent warming up ($p < 0.018$, $r\text{-squared} = 0.124$). This finding indicates that when observing age there is a difference in the time that is reported to perform a warm-up. No other significant correlations were observed ($p > 0.05$). See Table 4.

Table 4***Age with Specific Warm-Up Behavior***

	correlation	p-value	r-squared
Time (mins)	0.352	0.018*	0.124
Intensity (0-10)	0.063	0.655	0.004
Importance (1-5)	0.019	0.893	<0.001
Injury (1-5)	0.135	0.336	0.018
Improvement (1-5)	0.044	0.753	0.002
Recovery (1-5)	0.100	0.476	0.010

* indicates significance at $p < 0.05$

Specific Warm-Up Behavior with Sex

There was significance found related to sex and time (p -value < 0.008 , $d = 0.77$). See Table 5. Males reported 12.2 ± 8.3 minutes for performing a warm-up, and females reported 7.4 ± 4.2 minutes for performing a warm-up. This finding indicates that males spend more time performing a warm-up than do females. No other significant correlations were observed ($p > 0.05$).

Table 5
Sex with Specific Warm-Up Behavior

	Male	Female	p-value	d
Time (mins)	12.2 ± 8.3	7.4 ± 4.2	0.008*	0.77
Intensity (0-10)	3.1 ± 1.7	3.8 ± 1.4	0.139	0.45
Importance (1-5)	4.4 ± 0.7	4.2 ± 0.9	0.374	0.25
Injury (1-5)	4.5 ± 0.7	4.3 ± 1.0	0.519	0.24
Improvement (1-5)	4.3 ± 0.9	3.7 ± 1.1	0.072	0.60
Recovery (1-5)	4.1 ± 1.0	3.7 ± 1.1	0.234	0.38

* indicates significance at $p < 0.05$

Specific Warm-Up Behavior with Location

There was a significant difference reported when observing warm-up time and location ($p < 0.043$, $d = 0.57$). See Table 6. For indoor aerobic exercise, the time spent on a warm-up was reported to be 7.2 ± 4.8 minutes, and for outdoor aerobic exercise the time spent on a warm-up was reported to be 10.4 ± 6.4 minutes. This finding indicates that aerobic training sessions completed outdoors, respondents reported performing a warm-up longer.

Observing location and the warm-up intensity, there was significance ($p < 0.012$, $d = 0.67$). See Table 6. Aerobic exercise sessions indoors, had a higher level of intensity warm-up, than aerobic exercise sessions outdoors. Respondents reported an intensity level of 4.0 ± 1.5 for indoor, and an intensity level of 3.0 ± 1.5 if the aerobic training session was going to be

outdoors. This finding indicates that the warm-up before an indoor aerobic exercise session is more intense than the warm-up performed before outdoor aerobic exercise sessions. No other significant correlations were observed ($p > 0.05$).

Table 6

Location with Specific Warm-Up Behavior

	Indoor	Outdoor	p-value	d
Time (mins)	7.2 ± 4.8	10.4 ± 6.4	0.043*	0.57
Intensity (0-10)	4.0 ± 1.5	3.0 ± 1.5	0.012*	0.67
Importance (1-5)	4.1 ± 0.9	4.3 ± 0.8	0.376	0.24
Injury (1-5)	4.3 ± 0.9	4.4 ± 0.8	0.543	0.12
Improvement (1-5)	3.9 ± 1.1	3.7 ± 1.0	0.458	0.19
Recovery (1-5)	3.8 ± 1.1	3.7 ± 1.0	0.665	0.01

* indicates significance at $p < 0.05$

Specific Cool-Down Behavior with Age

For age and specific cool-down behavior, there were no significant findings (p -value > 0.05). See Table 7.

Table 7

Age with Specific Cool-Down Behavior

	correlation	p-value	r-squared
Time (mins)	0.123	0.439	0.015
Intensity (0-10)	0.020	0.900	<0.001
Importance (1-5)	0.173	0.272	0.030
Injury (1-5)	0.075	0.638	0.006
Improvement (1-5)	0.089	0.578	0.008
Recovery (1-5)	0.136	0.392	0.018

Specific Cool-Down Behavior with Sex

There were no significant findings relative to sex and cool-down behavior (p -value > 0.05). See Table 8.

Table 8***Sex with Specific Cool-Down Behavior***

	Male	Female	p-value	d
Time (mins)	9.6 ± 3.8	8.4 ± 5.7	0.484	0.25
Intensity (0-10)	3.0 ± 1.6	3.0 ± 1.7	0.954	0.00
Importance (1-5)	4.0 ± 1.0	4.0 ± 1.0	0.927	0.00
Injury (1-5)	4.1 ± 1.0	4.2 ± 1.1	0.832	0.10
Improvement (1-5)	3.8 ± 1.1	3.5 ± 1.2	0.452	0.25
Recovery (1-5)	4.4 ± 0.7	4.1 ± 0.8	0.279	0.40

Specific Cool-Down Behavior with Location

There was significance found for location and cool-down time, ($p < 0.002$, $d = 1.04$). See Table 9. Respondents reported spending more time performing a cool-down if the aerobic exercise session was going to be outdoors, than if it was to be indoors. This finding indicates that when cool-downs were performed after aerobic exercise that was outdoors respondents spent more time on cool-downs than aerobic exercise sessions that were indoors. No other significant correlations were observed ($p > 0.05$).

Table 9***Location with Specific Cool-Down Behavior***

	Indoor	Outdoor	p-value	d
Time (mins)	6.3 ± 3.6	11.1 ± 5.6	0.002*	1.04
Intensity (0-10)	3.3 ± 1.7	2.7 ± 1.5	0.226	0.38
Importance (1-5)	4.0 ± 1.0	4.0 ± 1.1	0.880	0.00
Injury (1-5)	4.2 ± 1.1	4.1 ± 1.0	0.762	0.10
Improvement (1-5)	3.6 ± 1.1	3.6 ± 1.1	0.808	0.00
Recovery (1-5)	4.2 ± 0.8	4.2 ± 0.7	0.815	0.00

* indicates significance at $p < 0.05$

CHAPTER FIVE:

DISCUSSION

Overview

There are no published research studies that examine perceptual and behavioral responses to warm-ups and cool-downs when engaging in aerobic activity. In this study, perceptual responses of warm-ups and cool-downs with an exerciser's aerobic activity were investigated. The relationships between age, sex, location, warm-up and cool-down perceptions and behaviors were assessed.

The initial sample size of 82 was reduced to 80 after eliminating two respondents who did not meet study qualifications, by selecting no to the inclusion question that asked if they are currently engaged in aerobic training.

Warm-Up Time

For engagement in physical activity, there are many recommendations for individuals regarding the frequency, intensity, type and time. Warm-ups should last for 5-10 minutes and the more intense the activity, the longer the warm-up should be (AHA, 2014). In this study, when observing warm-up time with age there was significance found. Other variables could possibly be examined in the future for reasons why a certain amount of time is spent on a warm-up or cool-down. What was found may be important for further investigation. With older aged individuals time could be an issue, and while retirees may have more time, they are often busy having to take care of grandchildren or doing other work volunteering, which is a reason for less

time spent on overall physical activity (Dunlap and Barry, 1999). Additionally, significance was shown for sex reporting that males invest more time in completing warm-ups than did females.

Significance was found between indoor and outdoor exercise locations when observing location and the amount of time spent on a warm-up. Respondents reported spending more time on warm-ups when the exercise session was performed outdoors, than did the respondents who were engaging in aerobic exercise that was performed indoors. Similarly, the hypothesis stated that if aerobic exercise is outdoors, there will be more time spent on warm-ups than if the aerobic exercise will be indoors. These findings could suggest that if aerobic exercise were to occur outdoors it could possibly be more vigorous, thus leading individuals to spend more time on the warm-up. With assessing aerobic activity indoors and outdoors environmental concerns could possibly be a factor in the length of warm-up time. Warm-ups should last between 5 and 10 minutes, our results indicated that when comparing age and warm-up time the minutes our respondents reported fall within the recommended duration (AHA, 2014; ACSM, 2018).

Location of Warm-Ups and Cool-Downs

This study hypothesized that individuals who engage in aerobic exercise sessions outdoors will perform in warm-ups and cool-downs more than indoor aerobic exercise sessions. Significance was found for location with warm-ups and cool-downs. Respondents reported that if aerobic exercise were indoors or outdoors, more respondents said they do a warm-up than compared to those who reported not performing a warm-up. If the aerobic training session was indoors, more respondents reported that they would perform a cool-down than those respondents who reported they do not perform a cool-down. Future research could inquire on why location has a significant impact on if an individual will report in performing a warm-up or cool-down.

Intensity of Warm-Up

While there was no hypothesis relating to intensity, there was significance found. For aerobic exercise training sessions indoors, respondents reported that the warm-up would be more intense than aerobic exercise sessions performed outdoors. However, it is interesting because one might assume that if intensity is higher than the importance of performing a warm-up before your aerobic training session would be correlated the same, which they are not. There have been studies that examined whether a higher intensity warm-up could potentially be harmful to performance. The more intense the warm-up is, it could negatively impact performance when compared to not performing a warm-up or performing warm-ups of lower intensities (De Bruyn-Prevost & Lefebure 1980; Genovely & Stamford 1982). These findings suggest that warm-ups performed at more intense levels before an aerobic exercise session could decrease performance.

Warm-Up Behavior Related to Sex

This study hypothesized that females would perform warm-ups and cool-downs more than males. Even though there were more females than males in this study, both sexes still reported performing warm-ups with a high-performance rate. However, more females reported performing a warm-up, more males reported engaging in a warm-up for a longer duration. It could be that females may need to rush through an exercise session and the reason they spend less time on a warm-up is so they can complete their exercise session quicker.

Cool-Downs and Improving Performance

There have been suggestions that cool-downs may have the ability to improve performance. A cool-down allows for better psychophysiological recovery following exercise and may attenuate or prevent performance decrements—or even enhance performance (Cook and

Beaven, 2013). Males reported that there could be an improvement with performance more so than females.

Warm-Up and Cool-Down Performance with Age

The United States Department of Health and Human Services (2020b) has stated that older-aged exercisers should warm-up before exercising and cool-down after exercising in order to reduce the risk of injury. The younger and older respondents reported more for performing a warm-up before aerobic exercise, than not performing a warm-up before aerobic exercise. The older respondents reported performing a cool-down more than not performing a cool-down. It could possibly be that older individuals value cooling down after exercise more than younger exercisers do.

Conclusion

With no current research addressing the questions that were asked in this study, the data gathered may provide insight into future projects. Variables including age, sex, and exercise location were used to compare warm-up and cool-down perceptions and behaviors. The respondent's ages in this study represents the most consistently general age group who engages in physical activity. With our sample data ranging from 18-66 years of age, these ages fall in line with the ACSM (2018) physical activity recommendations for adults. Notably, females reported more than males; however, if more males were represented in this study, it may have allowed for more significance when comparing warm-up and cool-down behaviors. Location was split into two categories, indoor and outdoor, which allowed for a broad enough depiction for respondents to comprehend.

Weaknesses of this study included the survey being accessible for only 10 days, which only yielded a sample size of 80. This study only examined aerobic exercise training and did not account for any resistance exercise training. Also, this study was entirely survey-based, which could allow for self-report bias amongst respondents.

Strengths of this study included, being the first of its kind. This study aims to support future research that examines warm-up and cool-down behavior amongst exercisers. The significance in this data provides researchers with the ability to create new ideas and questions around the topic of physical activity engagement with performing warm-ups and cool-downs. The sample population from this study ranged from 18-66 years of age highlighting a large diverse age span and ages that are generally the most engaged in physical activity.

CHAPTER SIX:

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APPENDICES

Appendix A: Survey Questions

SECTION 1: Definitions/Demographics:

WELCOME

Thank you for your interest in participating in this study. I am a graduate student at the University of South Florida studying Exercise Science and this survey is linked to my thesis project. The next several pages will guide you through the survey, which starts with the informed consent and progresses through the research questions and concludes with an opportunity to win an Amazon gift card.

The entire process will require about 10-15 minutes of your time.

I am thankful for your time and energy.

INFORMED CONSENT (See appendix B)

INTRODUCTION

The goal of this research study is to better understand behaviors and attitudes related to aerobic exercise and does not consider resistance exercise in any way.

Do you engage in aerobic exercise?

DEFINING AEROBIC EXERCISE CONCEPTS

These questions are free response.

In your own words define aerobic exercise:

In your own words define a warm-up for aerobic exercise:

In your own words define a cool-down for aerobic exercise:

The definitions provided here will be used for this study. Please read each carefully and use these definitions when responding to the questions within this survey.

Aerobic Exercise: Any activity that uses large muscle groups, can be maintained continuously and is rhythmic in nature. Examples of aerobic exercise include cycling, dancing, hiking, jogging/long distance running, swimming and walking.

Warm-up: Aerobic and muscular endurance activity that is light-to-moderate intensity with changing demands on the body to adjust from rest to exercise.

Cool-down: Light-to-moderate intensity of aerobic and muscular endurance activity to adjust from exercise to rest.

DEMOGRAPHIC INFORMATION

These questions are free response and matrix table.

Indicate your age in years: free response

Indicate your race and ethnicity: select from option provided

Indicate your biological sex: select from options provided

Indicate your height in inches: free response

Indicate your weight in pounds: free response

SECTION 2 Aerobic Exercise:

AEROBIC EXERCISE PARTICIPATION

Recall that aerobic exercise is defined as: Any activity that uses large muscle groups, can be maintained continuously and is rhythmic in nature. Examples of aerobic exercise include cycling, dancing, hiking, jogging/long distance running, swimming and walking.

These questions are free response and multiple choice.

How many minutes of aerobic exercise do you complete in an average week?

What is the average level of intensity of all your aerobic exercise sessions?

PRIMARY AEROBIC EXERCISE

These questions are free response and multiple choice.

Where do you perform your primary form of aerobic exercise?

We understand that you may complete multiple forms of aerobic exercise but you likely have one form of aerobic exercise that is your primary form and that you complete the most frequently.

What is your primary form of aerobic exercise?

How many minutes do you complete using your primary form of aerobic exercise in an average week?

What is the average level of intensity using your primary aerobic exercise sessions?

PRIMARY AEROBIC EXERCISE: WARM-UP

These questions are free response and multiple choice.

Recall that a warm-up is defined as: Aerobic and muscular endurance activity that is light-to-moderate intensity with changing demands on the body.

Do you engage in a warm-up before engaging in your primary aerobic exercise session?

Approximately how long in minutes is the warm-up for your primary form of aerobic exercise?

What type of activities are included in the warm-up for your primary form of aerobic exercise? (select all that apply)

What is the average level of intensity of your warm-up for your primary form of your aerobic exercise?

How important do you believe it is to complete a warm-up as part of your primary form of aerobic exercise?

Do you believe completing a warm-up before your primary form of aerobic exercise will reduce the risk of injury?

Do you believe completing a warm-up before your primary form of aerobic exercise will improve performance?

Do you believe completing a warm-up before your primary form of aerobic exercise will help with recovery?

PRIMARY AEROBIC EXERCISE: COOL-DOWN

These questions are free response and multiple choice.

Recall that a cool-down is defined as: Light-to-moderate intensity of aerobic and muscular endurance activity.

Do you engage in a cool-down before engaging in your primary aerobic exercise session?

Approximately how long in minutes is the cool-down for your primary form of aerobic exercise?

What type of activities are included in the cool-down for your primary form of aerobic exercise? (select all that apply)

What is the average level of intensity of your cool-down for your primary form of aerobic exercise?

How important do you believe it is to complete a cool-down as part of your primary form of aerobic exercise?

Do you believe doing a cool-down after your primary aerobic exercise session will reduce the risk of injury:

Do you believe doing a cool-down after your primary aerobic exercise session will improve performance:

Do you believe doing a cool-down after your primary aerobic exercise session will help with recovery:

SECTION 3 Exercise Preference:

EXERCISE PREFERENCE

The final portion of the survey included the use of an existing questionnaire referred to as, the Preference for and Tolerance of the Intensity of Exercise Questionnaire (PRETIE-Q). The PRETIE-Q consists of asking 16 questions that respondents will report “totally disagree” with to “totally agree” based off exercise preference and exercise intensity questions.

SECTION 4 End of Survey:

There will be a text entry box provided for respondents to input their email address.

The survey is now complete. Thank you for completing the survey. At this time if you would like to be entered to win an Amazon gift card please enter your details below:

Email address:

Appendix B: Informed Consent

Informed Consent to Participate in Research

Information to Consider Before Taking Part in this Research Study

Title: Warming Up and Cooling Down: Perceptions and Behaviors Associated with Aerobic Exercise

Study # **STUDY002174**

Overview: You are being asked to take part in a research study. The information in this document should help you to decide if you would like to participate. The sections in this Overview provide the basic information about the study. More detailed information is provided in the remainder of the document.

Study Staff: This study is being led by Balea Schumacher who is a Principal Investigator for this study at The University of South Florida. This person is called the Principal Investigator. She is being guided in this research by Marcus Kilpatrick. Other approved research staff may act on behalf of the Principal Investigator.

Study Details: This study is being conducted online. The purpose of the study is to help with future research and practice by providing a better understanding of the perceptions, attitudes, and behaviors towards warm-ups and cool-downs associated with aerobic exercise.

Participants: You are being asked to take part because you meet the criteria of being male or female, participate in aerobic training, and are 18 years of age or older.

Voluntary Participation: Your participation is voluntary. You do not have to participate and may stop your participation at any time. There will be no penalties or loss of benefits or opportunities if you do not participate or decide to stop once you start. Your decision to participate or not to participate will not affect your job status, employment record, employee evaluations, or advancement opportunities. Your decision to participate or not to participate will not affect your student status, course grade, recommendations, or access to future courses or training opportunities.

Benefits, Compensation, and Risk: We do not know if you will receive any benefit from your participation. There is no cost to participate. If you are every 20th participant you will be awarded an electronic \$25 Amazon gift card. This research is considered minimal risk. Minimal risk means that study risks are the same as the risks you face in daily life.

Confidentiality: Even if we publish the findings from this study, we will keep your study information private and confidential. Anyone with the authority to look at your records must keep them confidential.

Why are you being asked to take part?

This study will be helpful for future research and practice by providing a better understanding of the perceptions, attitudes, and behaviors towards warm-ups and cool-downs associated with aerobic exercise. There are no studies that investigate perceptions that individuals have about engaging in a warm-up and cool-down with an aerobic training session. The study proposed here will provide exploration into the psychological and perceptual aspects of warm-ups and cool-downs.

Study Procedures

If you take part in this study, you will be asked to complete the survey. Overview, the first page will be a welcome and brief overview. The second page will be the informed consent. After completing the survey participants will be provided with a thank you statement. Participants will be asked to enter their email address if they would like to be awarded an electronic \$25 Amazon gift card. Every 20th participant will be awarded a gift card. Each winner will be notified via email by the PI. Results will not be shared with the participants. No data will be able to be linked to the participant.

Alternatives / Voluntary Participation / Withdrawal

You do not have to participate in this research study.

You should only take part in this study if you want to volunteer. You should not feel that there is any pressure to take part in the study. You are free to participate in this research or withdraw at any time. There will be no penalty or loss of benefits you are entitled to receive if you stop taking part in this study. Decision to participate or not to participate will not affect your student status (course grade) or job status.

Benefits and Risks

We are unsure if you will receive any benefits by taking part in this research study. This research is considered to be minimal risk.

Compensation

If the participant agrees to input their email address every 20th person will receive a \$25 electronic Amazon gift card.

Privacy and Confidentiality

We will do our best to keep your records private and confidential. We cannot guarantee absolute confidentiality. Your personal information may be disclosed if required by law. Certain people may need to see your study records. The only people who will be allowed to see these records are: Principal Investigator, research team, the advising professor. All studies must include: The University of South Florida Institutional Review Board (IRB). Studies that are sponsored by federal agencies under the Common Rule must include: government offices such as, The Department of Health and Human Services (DHHS).

Your information or samples collected as part of the research, even if identifiers are removed, will NOT be used or distributed for future research studies.

It is possible, although unlikely, that unauthorized individuals could gain access to your responses because you are responding online. Confidentiality will be maintained to the degree permitted by the technology used. No guarantees can be made regarding the interception of data sent via the Internet. However, your participation in this online survey involves risks similar to a person's everyday use of the Internet. If you complete and submit an anonymous survey and later request your data be withdrawn, this may or may not be possible as the researcher may be unable to extract anonymous data from the database.

Contact Information

If you have any questions, concerns or complaints about this study, call Balea Schumacher at (727) 514-3212 . If you have questions about your rights, complaints, or issues as a person taking part in this study, call the USF IRB at (813) 974-5638 or contact the IRB by email at RSCH-IRB@usf.edu.

We may publish what we learn from this study. If we do, we will not let anyone know your name. We will not publish anything else that would let people know who you are. You can print a copy of this consent form for your records.

I freely give my consent to take part in this study. I understand that by proceeding with this survey, I am agreeing to take part in research, and I am 18 years of age or older.

Survey link:

https://usf.az1.qualtrics.com/jfe/form/SV_bC822GmGPUTs5vf

Appendix C: IRB Approval

February 17, 2021

Balea Schumacher 1418 Parilla Cir Trinity, FL 34655

EXEMPT DETERMINATION

Dear Balea Schumacher:

On 2/17/2021, the IRB reviewed and approved the following protocol:

The IRB determined that this protocol meets the criteria for exemption from IRB review.

In conducting this protocol, you are required to follow the requirements listed in the INVESTIGATOR MANUAL (HRP-103).

Please note, as per USF policy, once the exempt determination is made, the application is closed in BullsIRB. This does not limit your ability to conduct the research. Any proposed or anticipated change to the study design that was previously declared exempt from IRB oversight must be submitted to the IRB as a new study prior to initiation of the change. However, administrative changes, including changes in research personnel, do not warrant a modification or new application.

Ongoing IRB review and approval by this organization is not required. This determination applies only to the activities described in the IRB submission and does not apply should any changes be made. If changes are made and there are questions about whether these activities impact the exempt determination, please submit a new request to the IRB for a determination.

Application Type: Initial Study
IRB ID: STUDY002174
Review Type: Exempt 2
Title: Warming Up and Cooling Down: Perceptions and Behaviors Associated with Aerobic Exercise
Protocol: • HRP-503-SCHUMACHER- Social-Behavioral Protocol-5.docx;

Sincerely,

Jennifer Walker
IRB Research Compliance Administrator