Pain Tolerance and Sensitivity in Redheads

A thesis presented to the Department of Kinesiology

Western Illinois University

In partial fulfillment of the requirements for Honors in the Major

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ABSTRACT

Red hair makes up about 1-2% of the world's population. Of this 1-2%, there are about 2-6% of redheads in the United States. Redheads carry the melanocortin-1 receptor (MC1R) gene that controls the production of melanin, leading to red hair. This gene produces high amounts of the pigment pheomelanin which results in characteristics of freckles, fair skin, and darker eye color. Redheads possess more of the hormone MC4R which results in a higher pain sensitivity, meaning that they can sense pain at lower levels of exposure than a typical person.
They also possess higher levels of the hormone, OPRM1, which leads to the opioid inhibitor imbalance and a higher pain threshold. The imbalance of these two hormones, OPRM1 being the predominant hormone, leads to the need for more anesthesia during medical procedures. Research has shown that the pain threshold in redheads, due to MC1R, exhibit a higher pain tolerance than non-redheads. While this study was performed on mice, the MC1R gene functions in similar fashion in humans. The effects that the MC1R gene has on the pain threshold in redheads may be useful to those in the medical field so that they may provide better pain control during treatment, procedures, and recovery. Future research should investigate the pain tolerance differences between redheads and non-redheads. The rating of pain on a 1-10 scale through the application of electrical stimulation by the application of surface EMG induced muscle discomfort. We will explore the pros, cons, risks, limitations, and efficiency of five different options to conclude why electrical stimulation is the best option and the steps to perform for future exploration. An example of a study is also included for future exploration.

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Pain Tolerance and Sensitivity in Redheads

Redheads only make up 1-2% of the world. Of this 1-2%, there are about 2-6% of redheads in the United States. Although this may sound like a small percentage of people in the world, this total is around 70 to 140 million people who possess red hair (Percentage of Redheads). Redheads are perceived as experiencing pain and sensitivity to pain differently. Although this is a theory that concluded when it comes to redheads, more research is needed to be performed to determine if this is true. This research will also help better understand why these differences in pain tolerance and threshold levels occur in redheads since there has not been previous research in these two different areas. Prior research experiments, specifically on this topic of redheads and pain tolerance, was performed on redheaded mice. Although mice and humans have a close relationship with each other, no other direct experiment has been performed on humans to further confirm this research to be true.

Throughout this experiment, pain tolerance will be defined as the maximum intensity or duration of pain that an individual can endure before seeking relief or taking action to stop the pain (Cimpean). We will use the term pain sensitivity as the level at which a stimulus is perceived as painful ("What Is Pain"). These two terms will allow us to determine whether redheads do exhibit a greater pain tolerance and higher sensitivity level to pain.

Being a redhead, I have personally experienced the difference between pain tolerance and sensitivity than the normal person. An increase in anesthesia has been the main finding among redheads, which I have experienced myself (Glazier). This finding, as well as the study done at Massachusetts General Hospital, poses the question as to whether these genes that redheads hold also affect their pain tolerance and sensitivity level ("Research Reveals"). Although the findings

so far are pointing to these being true, it requires more research and studies to prove these hypotheses correct.

Objective

The ultimate goal of this research is to find whether there is a connection between redheads and a greater pain tolerance and sensitivity level to pain. The focus of this specific research is to analyze five different techniques to measure pain tolerance and sensitivity levels to determine what method will give the results we are looking for as well as will be the best technique to use. We will look at all the advantages, disadvantages, safety, risk, and efficiency of the five different techniques. Once each technique is explored, the goal is to determine which technique should be used to conclude whether the research behind redheads being more sensitive and tolerate to pain is supported.

Research Questions

- Is electrical stimulation the best technique to use to measure pain tolerance and sensitivity in redheads compared to blondes or dark hair?
- What are the advantages and disadvantages of cold pressure test, heat test, pressure algometry, pinprick test, and electrical stimulation?
- How would this research be performed?
- What causes redheads to be more tolerate and sensitive to pain and why is this research important?

Significance of the Study

The significance of this study is to prove whether prior research is supported by performing a study with human participants. If found to be true, the findings will help to better

educate doctors, dentist, or other healthcare providers to treat those with red hair and give the best care possible. Another important take away from this study would be the possibility of leading to further research on this topic and can help find whether other factors (like gender) affect the results in redheads.

Background Research

Do redheads really tolerate pain better than non-redheads? Are they more sensitive to pain? Research by Massachusetts General Hospital have found that redhead have a greater sensitivity to pain, but overall, a higher pain tolerance. Redheads carry a genetic variation of the melanocortin-1 receptor (MC1R) gene that controls the production of melanin, leading to red hair. This gene produces high amounts of the pigment pheomelanin which results in characteristics red hair, freckles, fair skin, and darker eye color. Redheads possess a protein, POMC, which is then divided into MC4R receptors which results in a higher pain sensitivity, meaning that they can sense pain at lower levels of exposure than a typical person. They also possess higher levels of the hormone, OPRM1, which leads to the opioid inhibitor imbalance and a higher pain threshold. The imbalance of these two hormones, OPRM1 being the predominant hormone, leads to the need for more anesthesia during medical procedures (Bryant). The methods of EMG application for sensing and determining levels of tolerance to different level of stimulation on redheads vs. non-redheads. A pain scale and sensitivity scale will be used to determine when redheads and non-redheads feel the electrical current as well as when the stimulation becomes too painful that the testing should be stopped. Research has shown that the pain threshold in redheads, due to MC1R, exhibit a higher pain tolerance than non-redheads. While this study was performed on mice the MC1R gene functions in similar fashion in humans. The effects that the MC1R gene has on the pain threshold in redheads may be useful to those in

the medical field so that they may provide better pain control during treatment, procedures, and recovery (Andresen). Future research will be conducted to see if these results hold true in humans on redheads and non-redheads. Future research should investigate the pain tolerance differences between redheads and non-redheads. The rating of pain on a 1-10 scale through the usage of electrical stimulation by the application of surface EMG induced muscle discomfort. Both groups must be tested and results recorded to see which group can senses and tolerates pain the best.

Hormones

Melanocorortin-1 receptor (MC1R) is a variant that leads to red hair. This gene controls pigment production and the main contributor to red hair. Red hair is also result of a deficiency in the protein proopiomelanocortin (POMC). This protein is divided into peptides and hormones. Two hormones that emerge from this protein are ones that block pain (beta-endorphin) and ones that enhance pain (melanocyte stimulating hormone). The opioid receptors (OPRM1) are affected by the hormones produced by the POMC. These receptors essentially inhibit pain. Unlike non-redheads, redheads have an imbalance in hormones with a greater number of opioid receptors. Melanocorotin-4 receptor (MC4R) affects nociceptive thresholds. This results in an increase their sensitivity to pain, specifically to heat and cold, but also resistant to pain relievers (Bryant).

Comparison of Methods

Determining what method for this study is a very important. By comparing each technique, we will be able to determine which method should be used to get the best results for

what we are looking for in terms of pain tolerance and sensitivity. Each section will explore the advantages, disadvantages, limitations, safety risk, and efficiency of each technique.

Cold Pressure Test

The first test we will examine is the cold pressure test. A cold pressure test is the term used for an ice water test. This test consists of having the participants submerge their hand into a bucket of water that is ice cold. The test is used to determine the participant's pain tolerance by measuring the amount of time they can keep their hand in ice cold water (37 degrees Fahrenheit). The goal is for the participants to keep their hand in as long as they can until the pain becomes unbearable or a time limit of 2 minutes ("Cold Pressure Pain Tolerance Test"). Some of the advantages of this test are the overall test is easily measurable, the test is easy to perform, ice and water are readily available, and the results can be used to compare the pain tolerance of each participant to the others. Although the cold pressure test has its advantages, the disadvantages outweigh the advantages. Some of the cons of the cold pressure test include safety risks, the limitations of the test, and goal of the test. Some safety risks include inducing the participants will experience mild to moderate pain due to the temperature of the water, the ice could cause potential skin damage due to sensitivity of skin (blistering), participant may experience a tingling or numbing sensation, and the test can potentially cause psychological factors like anxiety due to the anticipation of the coldness of the water. Some limitations of this test include it only measures pain tolerance but does not measure sensitivity and most people have been previously exposed to ice, which would result in an increase in pain tolerance to it over time. Another consideration of using this test would include the researcher taking blood pressures and heart rates during the test to monitor participants. Since ice triggers the sympathetic nervous system, this causes a release of norepinephrine and other stress hormones (Johnson). This would then

cause the sympathetic nervous system to increase the participants heart rate and blood pressure. Although the cold pressure test is known to be “safer,” it still comes with things to be aware of when administering the test.

Dolorimeter Heat Test

The next testing possibility would a dolorimeter heat test. A dolorimeter is a multi-purpose device that can be used to apply heat, pressure, or electrical stimulation to an area on the body to determine pain tolerance. In this case, a heat source is used to apply heat to the skin and cause pain (Lipman). The goal is to intensify the heat, which causes pain, until it becomes intolerable. Some advantages to using a dolorimeter heat test would be it is measurable with the amount of time the heat can stay applied to the participant as well as the degrees of the heat would be constant for each participant. It also is an easy method to use. Although a dolorimeter can possibly be found, the cost and availability can cause a concern. Another advantage would include the results can be used to compare each participant to determine if the hypothesis is true. Some cons to consider when administering this test would be the test would measure pain tolerance but not necessarily pain sensitivity. Some safety risks would include the heat causing mild to moderate pain. The heat may potentially burn, irritate, or damage the skin if the test gets that far. It also can trigger the body to cause a stress response. This response includes an increase in heart rate, blood pressure, and possibly psychological distress like anxiety. Due to this physiological stress placed on the participant, making sure that heart rate and blood pressure are being taken during the study would be an important step to consider. Some limitations of the test include the test possibly not being reliable due to the fact most participates would have previously been exposed to heating as a treatment at some point in their life, meaning the results might not be accurate. Another limitation would include that after the participant had the heat on

for so long, the body would eventually learn to acclimatize and get used to the temperature which would begin to mask the pain as well as alter the results.

Pressure Algometry

The third test we will look at is using a pressure algometry device. A pressure algometry is a device that is used to induce pain by applying pressure to the body until it becomes too painful for the participant. The pressure algometry device allows a measurement to be recorded as controlled pressure is being put onto the body and slowly increased. The goal is to apply pressure to the body until pain is induced and that pain is measured by the amount of pressure that was used to create that pain in which it became unbearable. Using a pressure algometry gives the researcher a pressure pain threshold, which is the point in which a pressure stimulus becomes painful the participant must stop (Pelfort). Some of the advantages of using the pressure algometry includes the pressure is measurable and can be recorded based on how much pressure is being applied to the participant in kilopascal (kPa). The main drawback to using a pressure algometry for this study would be the cost and availability of one. The main risk factors of using a pressure algometry is pain. Although this pain will be controlled pressure being put onto the body, it will still be painful and uncomfortable to each participant. A major limitation of using the pressure algometry would be cost and availability. If available and handled correctly by a trained professional, the pressure algometry could be a good technique to use to find pain tolerance and sensitivity level in redheads.

Pinprick Test

Another testing possibility would be a pinprick test. The pinprick test is a test performed by pricking the skin with an object that is considered sharp like a safety pin. This test measures

the perception of the pain that is caused by the prick. The goal is to evaluate the feeling of the pain and the difference between different types of stimuli on the skin that feel painful ("How to Assess Sensation"). The goal is to have the participant clearly describe the different types of pain they are feeling. Although this pinprick test will help identify the feeling of the sensation, it will not measure pain tolerance or the level of sensitivity the participant is experiencing. These results would not be useful for what we are using. Other cons would include it would be extremely invasive, possible skin damage from the needle, and administering the test would need to be done by a certified individual. Knowing all of this, this test would not be beneficial to use for what we are looking for and would be an invasive test to use when other options would be preferable.

Electrical Stimulation

The last technique we will explore is electrical stimulation. Electrical stimulation is a therapy method that sends electrical impulses into the skin and interact with the nerves. The device usually used in therapy is a transcutaneous electrical nerve stimulation (TENS) device. The main use for a TENS device is pain management during therapy sessions. In general, electrical stimulation is used to help reduce pain by "blocking pain signals from reaching the brain and stimulating the release of natural pain-relieving chemicals called endorphins" (Teoli). The electrical pulses being sent to the nerves usually feel like a tingly, prickly feeling. The sensation of pain is detected by nerves called nociceptors, which are located in the dermis (middle layer of the skin) and epidermis (top layer of the skin). The nociceptors being stimulated are not deep nerves and the sensation of pain, will not penetrate into deeper tissues, and the location of the Tens unit will be on the forearm, further limiting any serious risk. These nerves are called our "pain receptors" that detect stimuli (Dubin). In red heads, the MC4R receptors

cause the increase in their sensitivity to pain. Red heads also have a decreased function in the MC1R function that increases the nociceptive thresholds or “pain thresholds” and causes an imbalance in their opioid receptors that inhibit pain or increase their pain tolerance (Andersen). The goal of using electrical stimulation and a TENS device is to measure when the electrical impulses are first felt by the participant and when the electrical impulses get too painful that the study needs to be stopped. Special groups that would be excluded from being part of the study would include pregnancy, epilepsy, cancer, pacemakers, heart conditions, overactive bladder, any bleeding disorder, deep vein thrombosis, athletes who have used electrical stimulation in the past, or any special condition that would put the participant at risk using the TENS unit. (Teoli). Some of the advantages of using electrical stimulation for pain measurement is you can measure the amount of voltage each participant can reach, it can be used to compare participants to each other, it is relatively safe when used correctly, it is easily and readily available to use by a certified Athletic Trainers, and it is used often in areas like physical therapy, athletic training, etc. to treat injuries or help athletes. The safety concerns for using a TENS unit include making sure the electrodes are properly placed on the body, the impulses may cause slight discomfort or mild-moderate pain from the sensations pulsing through the body, long-term use may cause possible nerve damage, possibly skin irritation may occur due to the electrode placement, and possible psychological factors (like fear of pain or anxiety) (Cleveland Clinic). Another main consideration of using electrical stimulation includes possible increase in heart rates and blood pressures due to the stimulation of the nerves which activates the sympathetic nervous system. Being aware and monitoring these during the testing sessions can be important and provide safety to the participants if an unknown condition or problem does occur when the electrical stimulation is on.

Why Electrical Stimulation?

When looking at the pros, cons, limitations, safety, risk, and efficiency of use, electrical stimulation will give us the best results as well as give us exactly what we are looking for in terms of pain tolerance and sensitivity in redheads. Although methods of ice, heat, and pressure might be sufficient test to measure pain tolerance, they will not give us all we are looking for when it comes to pain sensitivity levels. Each of the tests would be used with the goal to measure pain tolerance, meaning that pain would occur in each test. In terms of emotional or psychological distress, each test will be used to produce pain. Although pain is not always wanted, inducing pain is required to see any results in this area of research. Each test will also cause some sort of psychological factor, even in tests like the cold pressure test. It is found that the feeling of pain, even if controlled and measured, can be unpleasant and lead to anxiety or discomfort, especially in individuals with a low pain tolerance or pre-existing anxiety (Cimpean). Some steps to prepare the participants for the pain will be making sure to provide clear and full explanation of each step that will be taken, allowing to participant to stop whenever they need to, and taking all the safety steps to keep the participant safe (Williamson). Another important thing to consider when performing testing is that pain perception and tolerance is somewhat subjective. Although this can occur in any test performed, this can influence results which is something to consider when analyzing the results.

Example Method for Electrical Stimulation

Participants

Students with any of the natural hair colors of blonde, brunette, or redhead will be accepted. Participants will be excluded from this study if they have sustained an injury or been involved in any musculoskeletal therapy or practice which required the utilization of electrical

stimulation as part of their rehabilitation. Also, anyone who self-reports that they are or have ever been pregnant will be excluded from this study, not because of any risk to the mother or child rather due to the fact that pregnancy may increase pain tolerance (Ohel). Other groups that will be excluded will include those with a known heart condition, epilepsy, overactive bladder, bleeding disorder, cancer, deep vein thrombosis, or any other condition that would put them at risk. For this study, around 36 total participants will be tested which would be about 12 from each hair color (blonde, brunette, red).

Procedure

Students will be recruited verbally and given an informed consent form, PAR-Q/ Health History form, and a demographic form. Prior to the start of the study, the informed consent, PAR-Q, health history form, and demographics form will be completed to ensure all participants are safe and able to be a part of the study. On a separate day, the testing session will occur. When the participant walks in the athletic training room, the researcher will collect the forms and will talk the participant through what the session will include. This will include discussion of what the study will include and instructions to the participant to have them tell you when they first feel the electrical impulse and when the mild pain becomes too much. When the study is being performed, the test will be administered by a certified athletic trainer. To start the study, the athletic trainer will get a brand new pair of electrical pads for each participant and place one on the distal portion of the forearm and one on the proximal portion of the forearm. Once the pads are placed correctly, the athletic trainer will attach the electrical stimulation machine to the pads through the wires. Once everything is secured, a warning to participant will be given that the testing will begin. The trainer will turn on the TENS machine and slowing turn the dial up in volts. The participant will indicate when they first feel the electrical pulses and record that

voltage number as well as record pain level from the pain scale in data collection sheet. The dial is continued to be increased in voltages until participant feels the mild pain has become too much and want to stop. The voltage number will be recorded, and the dial will be turned back to zero. Then the pain level will be record from the pain scale in the data collection sheet. Once completed, the trainer will remove the pads and turn off the machine. The participant will be dismissed, and data will be analyzed once all participant numbers are recorded.

Materials

Recruitment Script. The recruitment script is a written guide on how to recruit participants for the study (Appendix A).

Informed Consent. The informed consent sheet is a form that proves information to the participants about the study, risks, exclusions, confidentiality, and other information the participant needs to decide to volunteer for the study (Appendix B & C).

PAR-Q / Health History. The PAR-Q and health history is a universal form used to ensure participants are physically prepared to complete the study (Appendix D & E).

Demographic Questionnaire. The demographic questionnaire will be used to determine injury history as well as previous athletic/physical training completed by the participants (Appendix F).

Aggregate Data Collection Sheet. These data collection sheets will used on the day of the study to collect and record data for each participant (Appendix G & H & I)

Pain Scale. The 1-10 pain scale will be used on the day of study to determine the participants pain level at that time (Appendix J)

Electrical Stimulation Machine. The electrical stimulation (TENS machine) being used is a Chattanooga Vectra Genisys Electrotherapy Combination Stim/Ultrasound System Model Number 2671.

Data Analysis

The results will be analyzed by using the aggregate data collection sheet. Each sensitivity level and tolerance for each participant will be recorded in the sheet in voltages. After, they will rate how painful the sensitivity level felt on a scale of 1-10 as well as how painful the tolerance felt on a scale of 1-10. Once all participants have been tested, each red head will be compared to the results of threshold and tolerance level to those of the brunettes and blondes to determine if redheads are more sensitive to pain but can withstand more pain than others.

Conclusion

Throughout this paper, we compared the different techniques that could possibly be used to test pain tolerance and sensitivity. When looking at the pros, cons, limitations, safety, and efficiency of each technique, we find that electrical stimulation will give us exactly what we are looking for in the safest way possible. For future exploration, an example of how to perform the study is included. When performed, the results will help educate and explain whether redheads have a different pain tolerance and thhreshold level to pain. Using the results will also help treat and care for the redhead population, in areas like healthcare, to give them the correct and best type of treatment based on this study's results.

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Appendix A: Recruitment Script

Recruitment Script

My name is Alexis Betker and I am an undergraduate honor's student, in the kinesiology department here at Western Illinois University. I am conducting a research study to find data to support research on pain tolerance and pain sensitivity. You all are invited to participate in the study. If you agree, you would be participating in a mild pain test which will be conducted using electrical stimulation.

Before committing to the study, I want to make you aware of the participation criteria. You should:

- Have not had electrical stimulation used on you before to the point where you could have increased your tolerance each time
- Have never been pregnant
- Be a natural redhead, blonde or brunette
- Not have any medical conditions that require you to have a pacemaker, defibrillator, etc.
- No known heart conditions, epilepsy, overactive bladder, bleeding disorder, cancer, deep vein thrombosis, etc.
- No other condition that would make you more sensitive to pain or have an issue dealing with mild pain

If you meet these requirements then, please contact the researchers so we can meet and start the study. Again, I appreciate your interest in being part of this study.

The forms and testing day will all occur within one session and one session will be the only requirement. It is also anticipated to take no more than 20 minutes as well.

Participation in this study is voluntary. No names or identifying factors will be associated with the values reported in results and analysis.

If you have questions or would like to participate, please contact me at aa-betker@wiu.edu.

Thank you all for your time.

Appendix B: Consent Form

Pain Tolerance and Sensitivity Based Upon Physical Traits

Purpose

You are being asked to participate in a research study about pain sensitivity and pain tolerance. The purpose of this study is to determine what impact certain traits might have upon pain. You were selected as a possible participant because you possess some of those traits. Please read this form and ask any questions that you may have before agreeing to be in the research.

Exclusion

By reading and signing this form you assert that you have not had electrical stimulation used on you for the purpose of injury rehabilitation or other procedures before to the point where you could have altered your sensitivity or tolerance to pain. You also declare that you have not been pregnant, or are currently pregnant, or possess any other no other condition that would make you more/less sensitive to pain or have an issue dealing with mild pain.

Information about Participants' Involvement in the Study

The study will take place in an athletic training room on the campus of WIU. The entire process should take you about 20 minutes to fill out forms, listen to the procedures of the study, and it requires only 1 test session to complete.

If you agree to be a participant in this research, we will be applying a mild electrical current from rehabilitation device commonly used in athletic training therapies. As we apply the stimulation we will then ask you to identify the following things:

1. When your first feel the electrical stimulation pulses
2. When the stimulation is at a level that you would consider "painful"
3. When the stimulation is at a level that you would consider your "maximal tolerable pain"

Risks

This research has the following risk: mild pain or discomfort at place of pads or slight skin irritation if sensitive skin where pads are placed. The likelihood of anything more than mild pain or discomfort is very small. Irritation is unlikely but would be minimal if it did occur. A certified athletic trainer will oversee all sessions and be able to provide first aid for any injuries that may occur. This includes, but is not limited to, icing, applying compression, and elevating the injured limb. In the unlikely chance of serious injury, in addition to providing basic first aid, I will activate EMS in the event an emergency occurs.

Benefits

The aggregate information recorded will be presented at the WIU Undergraduate Research Day and participants will be able to learn the results of the pain sensitivity and tolerances of the different samples in the study. This study aims to determine if certain traits are linked to pain sensitivity and tolerance.

Appendix C

Confidentiality

The information in this research will be kept confidential. Data will be collected on a secure and locked office and locked file cabinet on the campus of WIU. The data will be made available only to the persons conducting the research. No reference will be made in oral or written reports that could link participants to the research.

Voluntary Participation

You do not have to perform any activity you do not want to. You do not have to answer any question you do not want to answer. Participation in this study is voluntary. If you decide to participate, you may withdraw from the study at any time without penalty and without loss of benefits to which you are otherwise entitled.

Contact Information:

This project has been reviewed and approved by the WIU Institutional Review Board. Questions concerning your rights as a participant in this research may be directed to IRB Administrator, at (309) 298-1191 or IRB@wiu.edu.

If there are any questions at any time about the study or the procedures, or you experience adverse effects as a result of participating in this study, please contact:

Faculty Advisor: Dr. Timothy Piper
Email: TJ-Piper@wiu.edu
Phone: 309-298-1981

Student Investigator: Alexis Betker
Email: aa-betker@wiu.edu

Consent:

I have read the above information, and I have received a copy of this form. I agree to participate in this study.

_____

Participant's Printed Name Signature Date

_____

Investigator's Printed Name Signature Date

Appendix D: PAR-Q / Health History

Physical Activity Readiness Questionnaire: PAR-Q / Health History

For most people, physical activity should not pose any problem or hazard. PAR-Q has been designed to identify the small number of adults for whom physical activity might be inappropriate or those who should have medical advice concerning the type of activity most suitable for them.

Common sense is your best guide in answering these few questions. Please read them carefully and check the yes or no opposite the question if it applies to you.

YES	NO	
☐	☐	Has your doctor ever said you have heart trouble?
☐	☐	Do you frequently have pains in your chest?
☐	☐	Do you often feel faint or have spells of severe dizziness?
☐	☐	Has your doctor ever said your blood pressure was too high?
☐	☐	Has your doctor ever told you that you might have a bone or joint problem such as arthritis that has been aggravated by exercise, or might be made worse with exercise?
☐	☐	Is there a good physical reason not mentioned here why you should not follow an activity program even if you wanted to?
☐	☐	Are you over age 65 and not accustomed to vigorous exercise?

If you answered YES to one or more questions....

If you have not recently done so, consult with your personal physician by telephone or in person before increasing your physical activity and/or taking a fitness test.

Programs: After medical evaluation, seek advice from your physician as to your suitability for:

- Unrestricted physical activity starting off easily and progressing gradually.
- Restricted or supervised activity to meet your specific needs, or at lease on an initial basis. Check in your community for special programs or services.

If you answered NO to one or more questions....

If you answered PAR-Q accurately, you have reasonable assurance of your present suitability for:

- A GRADUATED EXERCISE PROGRAM -- A gradual increase in proper exercise promotes good fitness development while minimizing or eliminating discomfort;
- A FITNESS APPRAISAL – the Canadian Standardized Test of Fitness (CSTF).

Postpone ....

If you have a temporary minor illness, such as a common cold.

Appendix E

**********Basic Pertinent Health History**********

- Is your doctor currently prescribing you drugs or medication?
  ☐ Yes ☐ No
- If yes, what are those drugs or medications?

_____

- Do you currently drink more than the average amount of alcohol per week (21 units for men and 14 units for women?
  ☐ Yes ☐ No
- Do you currently smoke?
  ☐ Yes ☐ No
- Are you, have you ever been, or is there any possibility that you might be pregnant?
  ☐ Yes ☐ No
- Do you know of any reason why you should not participate in a program of physical activity?
  ☐ Yes ☐ No

Appendix F: Demographics Questionnaire

Pain Tolerance and Sensitivity

Demographics Questionnaire

Name: _____

Age: ___ years Height: ___ ft. ___ inches

Weight: _____ pounds Biological sex: ☐ Male ☐ Female

Natural Hair Color: ☐ Red ☐ Brunette ☐ Blonde

Sports History (Check all sports in which you competed in high school or college)

☐ Wrestling ☐ Basketball ☐ Football ☐ Soccer ☐ Baseball ☐ Softball

☐ Swimming ☐ Track & Field ☐ Cheer ☐ Lacrosse ☐ Volleyball

☐ Other:_____

Injury/Illness: Check all musculoskeletal injuries you have sustained that might impact your paint sensitivity or tolerance)

☐ Sprained Ankles ☐ Knee injuries ☐ Whiplash ☐ Concussion

☐ Shin Splints ☐ Broken bones ☐ Spinal disc injuries ☐ Joint dislocations

☐ Tendinitis ☐ Pulled muscles ☐ Contusions/Bruises

Appendix G: Aggregate Data Collection Sheets

Aggregate Data Collection Sheet

Red Heads

Participant Number	Threshold (V)	Rating (1-10)	Tolerance (V)	Rating (1-10)
R-1				
R-2				
R-3				
R-4				
R-5				
R-6				
R-7				
R-8				
R-9				
R-10				
R-11				
R-12				

Appendix H

Aggregate Data Collection Sheet

Brunettes

Participant Number	Threshold (V)	Rating (1-10)	Tolerance (V)	Rating (1-10)
Br-1				
Br-2				
Br-3				
Br-4				
Br-5				
Br-6				
Br-7				
Br-8				
Br-9				
Br-10				
Br-11				
Br-12				

Appendix I

Aggregate Data Collection Sheet

Blondes

Participant Number	Threshold (V)	Rating (1-10)	Tolerance (V)	Rating (1-10)
Bl-1				
Bl-2				
Bl-3				
Bl-4				
Bl-5				
Bl-6				
Bl-7				
Bl-8				
Bl-9				
Bl-10				
Bl-11				
Bl-12				

Appendix J

Pain Scale