Supplementary S1: Informed Consent Form

Informed Consent

A Comparative Study of Median Nerve Pressure Reduction with Different Gloves

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You are being asked to take part in a research study. The box below highlights key information about this research for you to consider when deciding whether or not to take part. Carefully consider this information and the more detailed information provided below the box. Please ask questions about any of the information you do not understand before you decide whether to take part.

Key Information for You to Consider
• **Voluntary Consent**. You are being asked to volunteer for a research study. It is up to you whether you choose to participate or not. There will be no penalty or loss of benefits to which you are otherwise entitled if you choose not to participate or discontinue participation. • **Purpose**. The purpose of this research is to evaluate the pressure reduced on the median nerve, the nerve located in the wrist just below the hand, when wearing gloves designed for carpal tunnel (further referenced as Glove B). The activity chosen to evaluate pressure reduction is kneeling biking. This data will be compared to normal biking gloves (further referenced as Glove A) and bare hands. • **Duration.** It is expected that testing will last 1-1.5 hours for a one-time session. • **Procedures and Activities**

- You will have selected physical measures such as height, weight, and hand circumference.
- You will statically perform a kneeling position with your hands on the floor in front of you for 30 seconds. The kneeling position will be held for three conditions bare hands, Glove A, and Glove B.
- You will perform a low-intensity biking warm-up for three minutes where no activity will be monitored.
- You will perform three trials of biking. Each trial will consist of three one minute biking sessions keeping pace with a metronome. The metronome keeps pace with low-intensity biking. This totals nine minutes of biking where data will be collected.
- Within each trail, the three conditions, bare hand, Glove A, and Glove B will be tested randomly.
- Between each trial will be a 5 minute break.
- **Risks.** Some of the foreseeable risks or inconveniences of your participation may include discomfort while biking due to hand placement on the sensor.
- **Benefits**. You will not receive any direct benefit.
- **Alternatives.** Taking part in this research is voluntary and the only alternative is to not take part.

Purpose

The purpose of this research is to understand how different gloves might mitigate the pressure applied to the median nerve, the nerve located in the wrist just below the hand, when worn during activities. This information may be used to prevent injury and improve training, performance, activities, and rehabilitation.

Reasons for Invitation

You are asked to volunteer because we want to improve our understanding of median nerve pressure reduction when wearing different gloves. To take part you will need to be medically and physically healthy.

Your eligibility will be determined by completing a self-assessment. You will be included if: 1) are between 18 and 65 years of age, 2) are right hand dominant and 3) able to do low-intensity biking for 20 minutes or more. 4) are able to get to the floor and support yourself on your hands and knees for 30 seconds and then stand up again independently. Participants will be excluded if they 1) wear size small in gloves, 2) have been previous diagnosed with carpal tunnel by a registered physician, 3) had any musculoskeletal injuries/impairments of the upper or lower extremities that required medical treatment within the past 12 months, 4) had a previous traumatic biking injury, 5) are currently pregnant, or, 6) are unable to get to the floor and support yourself on your hands and knees for 30 seconds and then stand up again independently.

Procedures

Testing will take place at the Biomechanics and Motor Performance Laboratory on GVSU campus. The testing session will take approximately 1-1.5 hours. You will be asked to wear active attire and usual active shoes.

Prior to data collection, you will be asked some questions about your medical health history and age, which will take about 5 minutes. Then physical measures will be taken including weight, height, and extremity length measurements which will be completed in 10 minutes. Your hand circumference will be measured to determine the appropriate glove size.

a)



b)



Figure S1 – Images of gloves to be worn, Glove A and B

There will be two phases of testing, the first phase involves kneeling across two force places, as seen in Figure S2. The force plates help the researchers ensure your weight is evenly distributed between your hands and your knees. You may be asked to shift your weight towards your hands or towards your knees as necessary to distribute your weight evenly. Once the researcher confirms your weight is evenly distributed, you will be asked to hold for 30 seconds as data is collected. You will be asked to do this three times in total. Once barehanded, then with Glove A, then with Glove B, the order of this will be randomized. When testing a gloved condition, you will be wearing a glove on both your right and left hand. You will be given a two minute break between each 30 second hold of the kneeling position.



Figure S2 – Kneeling position

The next phase of testing will occur on the exercise bike. First, the bike seat will be moved to a comfortable riding height based on your lower extremity length. The handlebars will be set level with the front end of the bike seat. Next, we will go over where your right hand will need to be placed during riding. Example hand placement can be seen in Figure S3. You will perform a three minute warm-up with your hand in the proper place and the bike at low

intensity. This is to get familiar with the hand placement. Once the warm-up is complete, you will complete a maximum of 20 minutes of low intensity biking through three trials testing three conditions randomly. Between each trial will be a 5 minute break. When testing a gloved condition, you will be wearing a glove on both your right and left hand.



Figure S3 – Hand placement on sensor

After we complete data collection, we will take a few minutes to check the data. Following our data checks, you will be free to leave. The participant is requested to attend this single session lasting approximately 1-1.5 hrs.

Risks

Only minimal risk is involved with this project. They are not expected but may include a mild muscle or joint strain. If injury occurs from biking or getting up and down from the floor, you will be referred to an appropriate medical care center.

Electronic data will be collected and/or stored for this research project. As with any use of electronic means to store data, there is a minimal risk that data could be lost or stolen.

Compensation for Harm

Emergency first aid will be provided to you, and you will be referred to an appropriate medical care center. Any costs for additional medical care that may be required are your responsibility and that of your medical insurance company.

Benefits to Society

A better understanding of the median nerve pressure reduction through the use of gloves. This may be used to prevent injury and improve training, performance, and rehabilitation in the less experienced biking athletes.

Privacy and Confidentiality

Your name will not be given to anyone other than the research team. All information collected from you or about you is for the sole purpose of this research study and will be kept private to the fullest extent allowed by law. In very rare cases specially authorized university or government officials may be given access to our research records for purposes of protecting your rights and welfare, or to make sure the research was done properly.

Identifying data will be linked to data as long as the study remains active but will be stored separate from actual data. This will be done so the possibility of linking the identifiers to the actual data will be decreased. Digital data will not be destroyed. All digital data will be stored in password protected computers in the Biomechanics and Motor Performance Laboratory (BMPL) at GVSU. This room is secured 24 hrs/day, 7 days/wk. and can be accessed only by students and faculty with GVSU Public Safety approved access cards.

After the study is over

After the study is over the research team will keep your research data to use for future research (with GVSU IRB approval). Future research will only use previously collected, but not analyzed data. Your name and other information that can directly identify you will be kept secure (BMPL) and stored (locked cabinets) apart from the research data collected as part of the project.

Research Study Results

If you wish to learn about the results of this research study you may request that information by contacting Dr. Wendy Reffeor (reffeorw@gvsu.edu).

Payment

There is no compensation for volunteering in this study.

Payment for Research Related Injuries

In the unlikely event of minor injury, first aid will be provided. If the injury is not caused by the negligence of the primary investigator of the study, further medical care will continue under the direction of your physician in accordance with your own particular financial arrangement.

Removal from Study

Your decision to voluntarily withdraw from this study will be accepted without question.

Agreement to Participate

By signing this consent form below you are agreeing to the following:

- The details of this research study have been explained to me, including what I am being asked to do and the anticipated risks and benefits;
- I have had an opportunity to have my questions answered;

- I am voluntarily agreeing to take part in the research as described on this form;
- I may ask more questions or quit taking part at any time without penalty.

Print Name: _

Sign Name (in ink): __

Date Signed:_

Contact Information

If you have any questions about this study you may contact: Dr. Wendy Reffeor

PHONE: (616) 331-6010; E-MAIL: reffeorw@gvsu.edu.

If you have any questions about your rights as a research participant, please contact the **Office of Research Compliance & Integrity** at Grand Valley State University, 1 Campus Drive, Allendale, MI. Phone: 616-331-3197. E-mail: rci@gvsu.edu.

This research protocol has been approved by the Institutional Review Board at Grand Valley State

University. Study No. 24-113-H. Approved December 20th, 2023.

Supplementary S2: Screening Questionnaire



Participant Screening Questionnaire

Experiment Date: _____/_____/_____ Participant ID#: _____

Age: _____ Dominant Hand: ☐ Right ☐ Left

1. How familiar are you with riding a bike?

☐ never ridden before

☐ casually ride a bike when an opportunity presents

☐ some long distance riding

☐ serious long distance rider our mountain biking

2. How long have you been biking?

_____ ☐ days☐ weeks ☐ months ☐years

3. How often do you bike?

_____ times per ☐ day ☐week ☐month ☐ year

4. Are you able to pedal a stationary bike at low resistance for 20 minutes?

☐ yes

☐ no

5. Have you had a previous bike injury?

☐ yes; what? _____

☐ no

6. Do you normally wear gloves while biking?

☐ yes; what? _____

☐ no

7. Do you have an activity in your day-to-day that requires you to wear gloves?

☐ yes; what activity? _____

☐ no

8. If the answer to question above is yes, what kind of gloves?

☐ yes; what? _____

☐ no

9. What size Glove Are you?

☐ S

☐ M

☐ L

☐ XL

10. Are you right hand dominant?

☐ yes

☐ no

11. Are you able to get to the floor and support yourself on your hands and knees for 30 seconds and then stand up again independently?

☐ yes

☐ no

12. Have you ever experienced any tightness/ weakness in your thumb, pointer, or middle finger?

☐ yes; when? _____

☐ no

13. Have you ever experienced any numbness in your wrist, thumb, pointer, or middle finger?

☐ yes; when? _____

☐ no

14. Do you ever experience any discomfort in your wrist or hand while performing activities?

☐ yes; what activities? _____

☐ no

15. Have you previously been diagnosed with carpal tunnel?

☐ yes; what? _____

☐ no

16. Have you had any musculoskeletal injuries/impairments of the upper or lower extremities that required medical treatment within the last 12 months?

☐ yes; what? _____

☐ no

17. Do you have any known cardiopulmonary conditions you are currently being treated for?

☐ yes; what? _____

☐ no

18. Have you previously been diagnosed with a neurological condition?

☐ yes; what? _____

☐ no

19. Are you currently pregnant?

☐ yes

☐ no

20. Do you have anything else to disclose that may affect your ability to participate in this study?

☐ yes; what? _____

☐ no

Contact Information

If you have any questions about this study you may contact: Dr. Wendy Reffeor

PHONE: (616) 331-6010; E-MAIL: reffeorw@gvsu.edu

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Supplementary S3: Participant Information Form



Participant Information Form

Date Information Taken: _____/_____/_____

Participant ID#: _____

Age: _____

Gender: ☐ Male ☐ Female ☐ Non-binary ☐ Prefer not to say

Dominant Hand: ☐ Right ☐ Left

Weight (lb):

Dimension	**Measurement (in)**	**Description**
Height		From floor to top of head
Upper extremity length		From carpals to acromion
Lower extremity length		From medial malleolus to greater trochanter
Distance to Median Nerve		From metacarpal and phalangeal joint on the thumb to crevice in palm

Right Hand Circumference		Circumference at the hand below the metacarpal and phalangeal joint

Glove Size: ☐ M ☐ L ☐ XL

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Supplementary S4: Subject Information

Participant	1	2	3	4	5	6	7	8	9	10	11	12	13
Sex	M	F	M	F	F	F	F	F	M	M	F	M	M
Dominant Hand	R	R	R	R	R	R	R	R	R	R	R	L	R
Age	24	23	29	18	20	25	23	21	31	28	20	24	26
Weight (lb)	186	150	209	117	134	157	195	142	187	174	149	241	188
Height (in)	70.1	65.7	70.5	62.0	65.7	67.1	72.1	66.1	74.8	71.5	64.8	74.8	73.0
Upper Extremity Length (in)	21	20	20	20	21	21	23	20	24	22	20	24	23.5
Lower Extremity Length (in)	35	35	35	32.5	34.5	33	33	33	37	34.5	33.5	38	35
Distance to Median Nerve Horizontal (mm)	63.5	57.2	63.5	57.2	63.5	57.2	60.3	63.5	63.5	63.5	57.2	63.5	57.2
Hand Circumference (in)	7.5	6.9	7.9	6.8	6.8	6.8	7.3	7.0	7.6	7.5	6.8	8.8	7.6
Glove Size	M	M	L	M	M	M	M	M	M	M	M	XL	M
Bike Seat Level	7	7	7	4	7	6	7	7	8	11	8	10	8
Bike Seat Height (in)	35.8	35.8	35.8	33.3	35.8	35.0	35.8	35.8	36.5	39.0	36.5	38.0	36.5

Handlebar Height from Floor (in)	38.3	38.3	38.3	37.0	38.3	38.3	38.3	38.3	39.3	40.0	39.3	40.0	40.0
Distance to Center of Hand on Bike (cm)	6	6	6	5	6	6	6	6	7	8.5	7	7	7

Supplementary 5: Data Collection Sheet

Experiment Date: _____/_____/_____ Participant ID#: _____

Researcher Initial: _____

Time Start: _____

Kneeling Position		
Trial Name	**Task**	**Notes**
	Bare Hand	
	Glove A	
	Glove B	

Time End: _____

Time Start: _____

Biking		
Trial Name	**Task**	**Notes**
	Bare Hand	

	Glove A	
	Glove B	
	Bare Hand	
	Glove A	
	Glove B	
	Bare Hand	
	Glove A	
	Glove B	

Time End: _____

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Made by Genevieve Wisby