

Laboratory 3: Physiological and perceptual responses to exercise in the cold

Aim/s of the session

1. To compare the physiological and perceptual responses to exercise in the cold with those observed in temperate and hot conditions (collected in the previous laboratory class).
2. To investigate the cold-induced vasodilatory response to cold exposure.
3. To investigate the effect that cold exposure has on manual dexterity.

You will use some of the techniques introduced in the previous laboratory classes so you may wish to consult those handouts again.

Learning outcomes

By the end of this session you should:

- Know how the following variables respond to exercise in cold conditions:
 1. Heart rate
 2. Sweat rate
 3. Thermal sensation
 4. Thermal comfort
- Know the peripheral blood flow responses to acute cold exposure
- Have an understanding of the effect that acute cold exposure has on manual dexterity
- Have a greater understanding of the background physiology relating to the measurements

Once the data are collected, please enter them in to the spreadsheet. In your own time, please plot the changes over time observed for each variable.

Station 1: Physiological and perceptual responses to exercise in the cold

Last week we investigated the effects of temperature and convective cooling on the physiological and perceptual responses to exercise. This week we will repeat the experiment but in cold conditions.

Your participants will undertake 15 min of submaximal cycling (90 – 105 W) in cold conditions. The protocol and variables measured will be the same as last week to facilitate comparisons between the environmental conditions (this means that you cannot “layer up”/wear more clothing!). Two participants from each group will perform the task. I have provided a partially complete data sheet for this week.

Physiological and perceptual data sheet

	To calculate sweat loss/rate			HR responses to exercise				“What” your participant feels				“How” your participant feels			
	Variable?		?	Heart rate				Variable?	Variable?			Variable?			
	kg	kg	kg	bpm				0 – 8				1 – 4			
Time	When?	When?	When?	0	5	10	15	0	5	10	15	0	5	10	15
Temperature = _____ °C; Airflow = _____ Units?; Approximate wind-chill = _____															
Participant 1 initials															
Participant 2 initials															

Notes E.g. Definitions for the bold underlined terms; Measurement considerations; Physiological explanation for observations

Environment Canada Wind Chill Chart

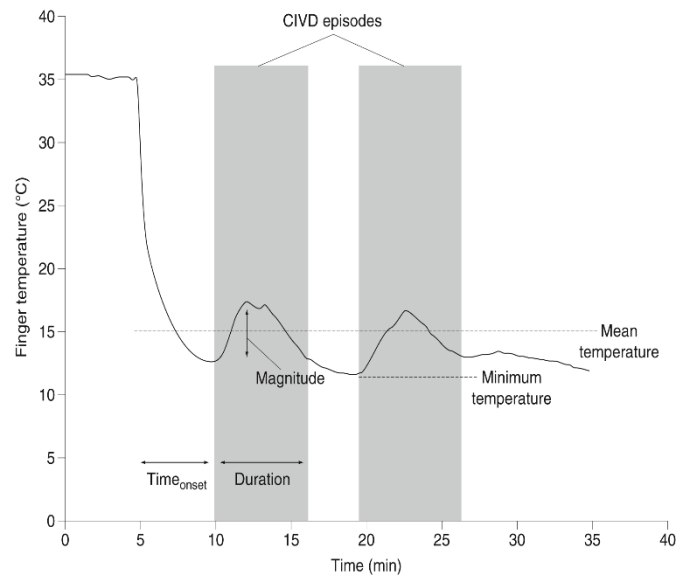
		Actual Air Temperature T_{air} (°C)										
Wind Speed V_{10m} (km/h)	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45	-50
5	4	-2	-7	-13	-19	-24	-30	-36	-41	-47	-53	-58
10	3	-3	-9	-15	-21	-27	-33	-39	-45	-51	-57	-63
15	2	-4	-11	-17	-23	-29	-35	-41	-48	-54	-60	-66
20	1	-5	-12	-18	-24	-30	-37	-43	-49	-56	-62	-68
25	1	-6	-12	-19	-25	-32	-38	-44	-51	-57	-64	-70
30	0	-6	-13	-20	-26	-33	-39	-46	-52	-59	-65	-72
35	0	-7	-14	-20	-27	-33	-40	-47	-53	-60	-66	-73
40	-1	-7	-14	-21	-27	-34	-41	-48	-54	-61	-68	-74
45	-1	-8	-15	-21	-28	-35	-42	-48	-55	-62	-69	-75
50	-1	-8	-15	-22	-29	-35	-42	-49	-56	-63	-69	-76
55	-2	-8	-15	-22	-29	-36	-43	-50	-57	-63	-70	-77
60	-2	-9	-16	-23	-30	-36	-43	-50	-57	-64	-71	-78
65	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-79
70	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-80
75	-3	-10	-17	-24	-31	-38	-45	-52	-59	-66	-73	-80
80	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67	-74	-81

where
 T_{air} = Actual Air Temperature in °C
 V_{10m} = Wind Speed at 10 metres in km/h (as reported in weather observations)

Station 2: The peripheral blood flow responses to acute cold exposure

When exposed to cold temperatures, the body responds in a number of ways to try to conserve heat. One of the responses involves the **vasoconstriction** of **peripheral blood vessels**, which redirects the warmer blood to the core and restricts the amount of heat lost to the environment.

Prolonged reductions in peripheral blood flow could potentially be problematic (**Why? To what?**) and so in most situations the initial vasoconstriction is followed by a cyclical vasodilation/vasoconstriction response termed "**cold-induced vasodilation**" (CIVD). The figure to the right shows a "perfect" CIVD response and is from the recommended paper written by Cheung and Daanen (2011).



CIVD is typically assessed by immersing the fingers and/or toes in cold water (8°C) for ~30 minutes and measuring the localised skin temperature of the immersed digit(s) (working on the basis that changes in skin temperature are representative of changes in skin blood flow). Today you will undertake an abridged version of the CIVD test.

Task

- Fix a skin thermistor to the fingertip (to the side of the finger nail) of your index finger
- Rest your hand on the table and measure skin temperature every minute for 3 min (0, 1, 2, 3)
- Immerse your index finger in to the cold water for 17 min recording skin temperature every 1 min (4 – 20)

Finger (skin) temperature response to cold-water immersion

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
P1																						
P2																						
P3																						
P4																						
P5																						
P6																						
P7																						
P8																						

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Station 3: The effect that acute cold exposure has on manual dexterity

Manual dexterity is an important skill but it can be impaired in cold conditions. This reduction in dexterity can have negative effects on sporting performance but the consequences in other situations (e.g. military, avalanche) can be fatal. There are a number of dexterity tests used (including functional tests such as lock and key tasks and zip opening); however, today you will use the most well-known test - the **Purdue Pegboard Test**. The test can be used to assess dexterity and assembly but we will focus on dexterity today.

Task

- Using your right hand, have 5 practice goes moving the pins in to the holes (one at a time), starting at the top.
- When ready, record the number of pins moved from the cup to the holes (again one at a time and starting at the top) in 30 seconds.
- Repeat for the left hand.
- Immerse both hands in to the cold water for at least 5 min, dry your hands, and repeat.

While participants have their hands immersed, you can collect the baseline data on other participants

Notes *E.g. Definitions for the bold underlined terms; Measurement considerations; Physiological explanation for observations*

	Right hand			Left hand			Right + left hand		
	Pre	Post	Change	Pre	Post	Change	Pre	Post	Change
P1									
P2									
P3									
P4									
P5									
P6									
P7									
P8									