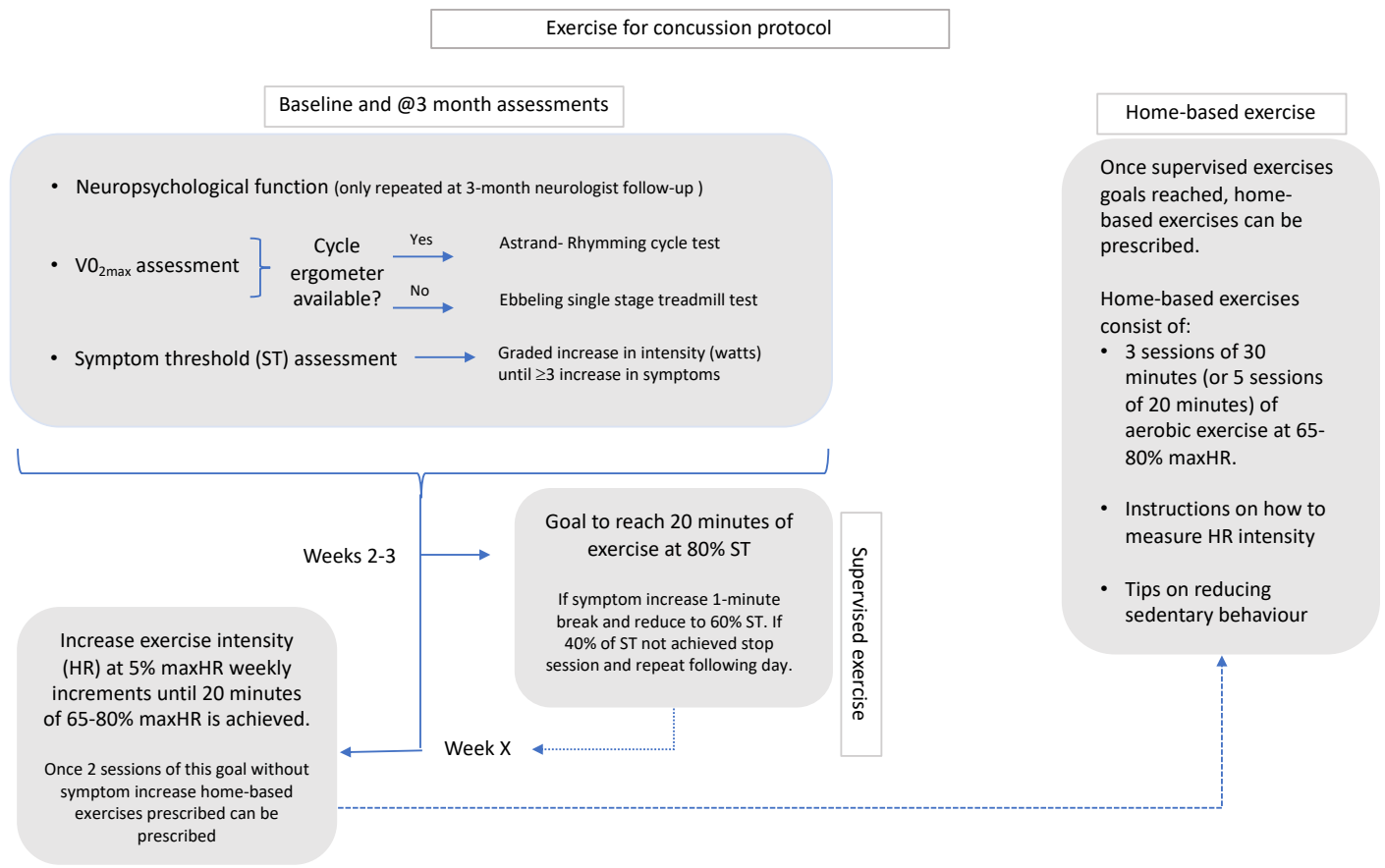


Timeline and decision tree of progressive aerobic exercise program and home-based exercises



Detailed procedures

Part 1: Astrand-Rhyming cycle test

- The subject will be fitted with a chest strap heart rate monitor, with resting heart rate, vital signs, weight and symptoms taken prior to beginning exercise. The cycle ergometer will also be adjusted to fit the subject. Explain to the patient that part 1 of the test involves a short (7 minute) warm-up, followed by 6 minutes at slow pace at a given resistance. You can say *“the test involves some effort but it is mild-to- moderate in intensity”*. The second part of the test will involve a graded increase in resistance until certain criteria are reached (see part 2). The participant can be told *“Upon completing the cycle test, you will stay on the bike and complete part 2 which involves progressive increases in effort”*.
- **Baseline vital signs and symptoms (Visual analog scale, see appendix [1]) are to be taken prior to beginning any exercise. Additionally, HR, Borg and symptom check are to be taken every minute throughout the test. Record weight (needed for resistance calculations)**
- Calibrate bike (ensure participant does not have feet on pedals). Line up the white plastic gauge so that the 0 is in line with the line on the silver metal pendulum. Un screw whit fly nut to move plastic panel and re-tighten once adjusted.
- The participant will begin cycling for 7 minutes to become familiar with the ergometer and warm-up. There are no restrictions on resistance or rpm during the warm-up.
- After warming up, set the work rate of the bike according the participants weight. The formula for choosing the resistance is as follows:

$0.04Kp * \text{weight}$. Then round up to the nearest 1 Kp for men and the nears 0.5 kp for women.

- Ask the participant to cycle at **50 rpm**. Turn the blue handle clockwise until the pendulum reaches the desired kp (on the mechanical scale and Kp gauge to left of screen. Begin the stopwatch once the participant has become comfortable with the **50rpm** rhythm (no more than 30 seconds).
- Adjust the electronic Kp (on screen) to match those on the pendulum swing/ Kp gauge. I.e if the resulting work rate (calculated from the equation) is 3Kp, then the pendulum, Kp gauge and electronic Kp should all read 3. After adjusting electronic Kp, press the watts/calorie button to reveal the resulting watts. Record the kp and resulting watts values on the flow sheet. *To convert watts to kg/min, times by 6.12 and round to nearest 10 (needed for nomogram estimation)*
- After 2 minutes, if the heart rate is not within 120-170 bpm adjust the resistance (by turning the blue handle) accordingly (here you are adjusting the Kp and so must now re-record the resulting watts- after adjusting the electronic Kp, on the flow sheet). Either increase or decrease the resistance and then re-start the stop watch. We have essentially re-started the test. Record the new resistance (in watts and kp) on flow sheet.

- If the heart rate in the 5th to 6th minute of the test is steady (no significant variations of ± 10 bpm) then record average HR in that final minute (take HR at 5mins and at 6 mins) and the VO₂max portion of the test is done.
- If symptom threshold was not reached in this first part of the test, part 2 (see below) can begin.

Part 2: Identifying symptom threshold HR

- Part 2 consists of a graded increase in resistance until either **significant symptom increase ≥ 3 symptoms above baseline** or **voluntary exhaustion (18 on Borg RPE scale)**. See below for further stopping criteria.
- Participants stay on the bike after the completion of the cycle test for VO₂max. The instructor informs the participant that they are now going to *“gradually and progressively increase the resistance”*
- The resistance is to be increased every 30 seconds by 1 half turn clockwise of the blue handle.
- Everyone 2 minutes record symptoms, HR and Borg.
- The test is stopped when a significant exacerbation of symptoms occurs (increase of ≥ 3 points on GSC from baseline), when 85% of age-predicted HR_{max} is reached or when perceived exhaustion is reached (18 on Borg scale of perceived exertion).
- Record time to symptom threshold, symptoms and HR at test cessation. Calculate 80% of this and record on flowsheet.

Other indications to stop test

- Subject requests to stop
- Physical or verbal manifestation of severe fatigue
- Signs of poor perfusion: light-headedness, confusion, ataxia, pallor, cyanosis, nausea, cold or clammy skin
- No increase in HR with increased workload
- Subject cannot maintain specified pedal cadence (**50 RPM**)
- Onset of angina or angina-like symptoms
- Shortness of breath: wheezing, leg cramps
- Noticeable change in heart rhythm by palpitation

Contraindications to exercise testing

Individuals with known cardiovascular, pulmonary, or metabolic disease; signs and symptoms suggestive of cardiovascular or pulmonary disease; or individuals aged >45 years who have more than one risk factor that include: 1) family history of myocardial infarction, coronary revascularization, or sudden death before 55 yr of age; 2) cigarette smoking; 3) hypertension; 4) hypercholesterolemia; 5) impaired fasting glucose; or 6) obesity (body mass index >30). Or SBP >140 mm Hg or DBP >90 mm Hg.

Appendix

1. Graded symptom checklist

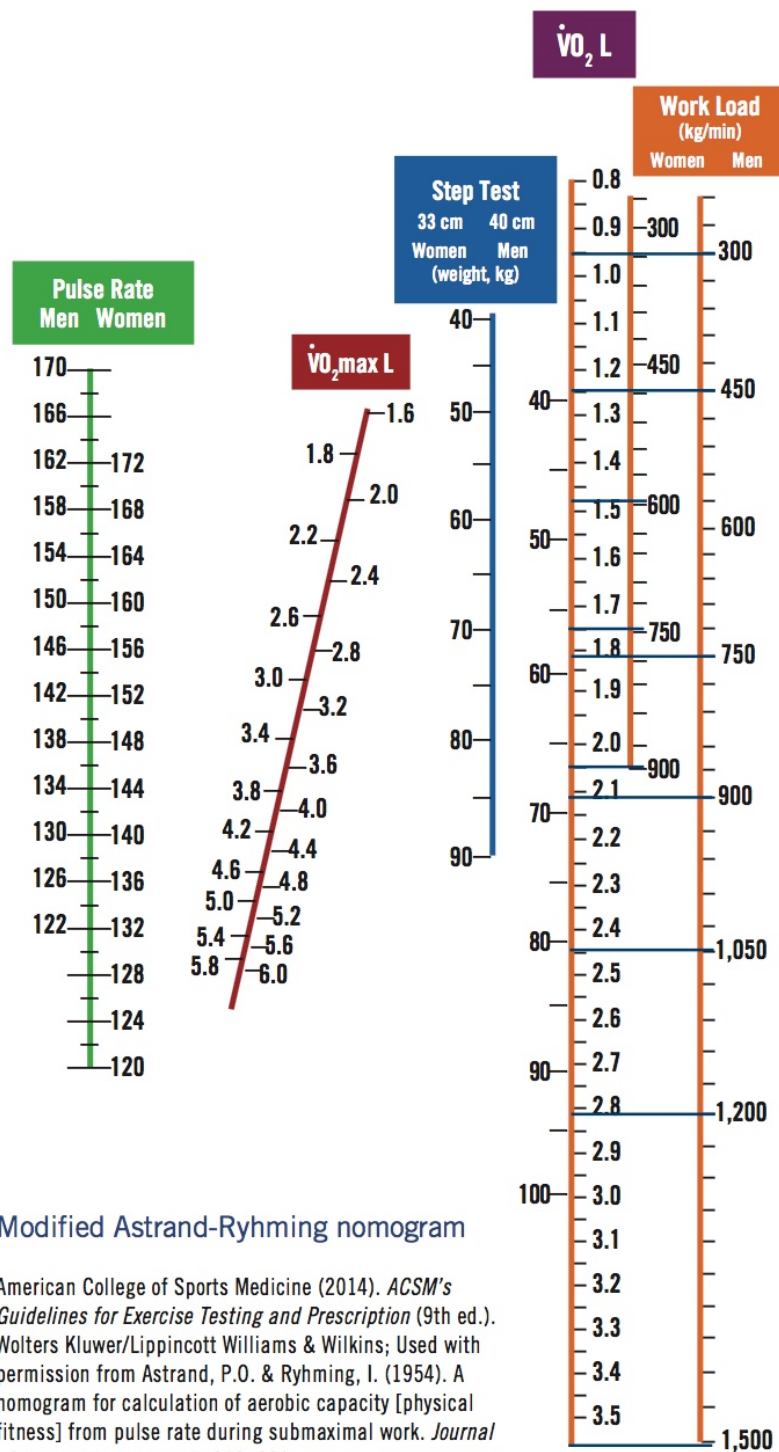
	None Mild Moderate Severe						
Headache	0	1	2	3	4	5	6
"Pressure in head"	0	1	2	3	4	5	6
Neck Pain	0	1	2	3	4	5	6
Nausea or Vomiting	0	1	2	3	4	5	6
Dizziness	0	1	2	3	4	5	6
Blurred Vision	0	1	2	3	4	5	6
Balance Problems	0	1	2	3	4	5	6
Sensitivity to light	0	1	2	3	4	5	6
Sensitivity to noise	0	1	2	3	4	5	6
Feeling slowed down	0	1	2	3	4	5	6
Feeling like "in a fog"	0	1	2	3	4	5	6
"Don't feel right"	0	1	2	3	4	5	6
Difficulty concentrating	0	1	2	3	4	5	6
Difficulty remembering	0	1	2	3	4	5	6
Fatigue or low energy	0	1	2	3	4	5	6
Confusion	0	1	2	3	4	5	6
Drowsiness	0	1	2	3	4	5	6
Trouble falling asleep	0	1	2	3	4	5	6
More emotional than usual	0	1	2	3	4	5	6
Irritability	0	1	2	3	4	5	6
Sadness	0	1	2	3	4	5	6
Nervous or Anxious	0	1	2	3	4	5	6
TOTAL SUM OF EACH COLUMN	0						
TOTAL SYMPTOM SCORE (<i>Sum of all column totals</i>)							

2. Borg scale of perceived exertion from Borg

Rating	Perceived Exertion
6	No exertion
7	Extremely light
8	
9	Very light
10	
11	Light
12	
13	Somewhat hard
14	
15	Hard
16	
17	Very hard
18	
19	Extremely hard
20	Maximal exertion

Table 1. The Borg Rating of Perceived Exertion Scale

3. Astrand-Ryhming Nomogram (for cycle ergometer $\dot{V}O_{2\max}$ estimation).



Correction factor for age

Age	Correction factor
15	1.10
25	1.00
35	0.87
40	0.83
45	0.78
50	0.75
55	0.71
60	0.68
65	0.65

Sample $\dot{V}O_2$ max Calculation

Determine $\dot{V}O_2$ max for a 45-year-old female, weighing 115 pounds (52.3 kg), who completed the Astrand-Ryhming cycle ergometer test at 450 kgm/min (75 watts). Her exercise HR was 142 bpm at the fifth minute and 146 bpm at the sixth minute. The average HR is 144 bpm.

According to the nomogram, her $\dot{V}O_2$ max is 2.6.

After multiplying by the age-correction factor, her adjusted $\dot{V}O_2$ max is 2.028 L/min ($2.6 \times 0.78 = 2.028$). To classify her effort, convert L/min to mL/min: $2.028 \text{ L/min} \times 1000 = 2,028 \text{ mL/min}$. Now divide 2,028 mL/min by her bodyweight of 52.3 kg to yield her $\dot{V}O_2$ max in mL/kg/min: $2.028 \text{ L/min} / 52.3 \text{ kg} = 38.8 \text{ mL/kg/min}$, which ranks her in the 80th percentile for women of her age.

American College of Sports Medicine (2014). *ACSM's Guidelines for Exercise Testing and Prescription* (9th ed.). Wolters Kluwer/Lippincott Williams & Wilkins.

4. Flow sheet

Session #

Date

Name

Patient ID

Weight in lbs:

Weight in kg:

Baseline vitals

HR:

BP:

Symptoms:

#:

Cycle test

Formula to calculate resistance: $0.04 * \text{weight(kg)} = \text{kp}$. (Round up to nearest 1 for men, 0.5 for women).

Resistance; kp:

watts:

Borg min	Baseline	2	3	4	5	6
Symptoms min	Baseline	2	3	4	5	6
HR min	Baseline	2	3	4	5	6

Vo₂_{max} (l/min) _____

Graded increase to symptom threshold

Borg min

Baseline	2		4		6
	8		10		12

Symptoms min

Baseline	2		4		6
	8		10		12

HR min

Baseline	2		4		6
----------	---	--	---	--	---

	8		10		12
--	---	--	----	--	----

Note: Boxes above refer to post-V02max test, and so baseline= borg/hr/symptom at minute 6.

HR at symptom threshold (or voluntary exhaustion/other indications to stop test): _____

80% of HR at symptom threshold: _____

Time to symptom threshold: _____