92553 Complex Exercise Management

Laboratory Manual 2025

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Overview

Test

This laboratory manual has been compiled to be an integral component of course content for 92553 Complex Exercise Management. It is designed to be an interactive learning resource, so please bring it to every class either on a device or printed as a hard copy. We will work through various issues associated with a range of chronic diseases, with a view to exploring some of the practical elements of these topics.

There are Pre-Lab Activities published each week on Canvas, which are designed to be undertaken prior to attending class. These are also available at the start of each respective chapter of the lab manual. The activities are designed to test your understanding of the content, and encourage critical thinking about the content that you are about to engage with in class.

The content in this subject will provide you with a foundation of knowledge for applying clinical exercise physiology concepts and methods across a variety of populations. This will recall and develop skills acquired in prior subjects, including Strength & Conditioning, Exercise Physiology, and Exercise Prescription. The activities completed in each lab class will contribute further knowledge relevant to practice in clinical exercise physiology.

This laboratory manual itself does not form part of your assessments for Complex Exercise Physiology. However, it will contribute to the development of understanding of the key concepts and considerations in each topic by guiding your engagement with the activities and discussions conducted in class. The manual will provide an excellent revision resource for your Mid-semester and Final Exams.

Please ensure that you arrive to each class prepared to participate. You must wear enclosed footwear to enter laboratory spaces. Food and drink is not permitted in laboratory spaces, except water bottles or where provided as part of lab activities.

I encourage you to be actively involved in lab classes, whether it be through sharing your opinion in discussion, operating testing equipment, or volunteering to perform exercise. As I'm sure you've experienced in previous subjects, classes become much more rewarding when we have engaging discussions and activities with people readily contributing.

I look forward to working with you all, and hope you enjoy Complex Exercise Management.

Antony

Lab Schedule

Week	Monday	Topic
1	17 Feb	No Classes - Online Only
2	24 Feb	Functional Musculoskeletal Testing
3	03 Mar	Physical Activity Tracking & Adherence
4	10 Mar	Cardiac Responses to Exercise (ECG)
5	17 Mar	Lipids & Blood Chemistry
6	24 Mar	Cardiovascular Case Studies
7	31 Mar	Exercise & Mental Health
8	7 Apr	Mid-semester Exam
MSB	14 Apr	No Classes - Mid-semester Break
9	21 Apr	No Classes - Mid-semester Break
10	28 Apr	Exercise & Cancer
11	5 May	Exercise & Ageing
12	12 May	Neuromuscular Rehabilitation
13	19 May	DXA & Exercise Modification
14	26 May	No Classes - Study Leave

Week 2 - Functional Musculoskeletal Testing

Assessments for Complex Cases and Special Populations

Pre-Lab Activity

Please complete the brief quiz to refresh your thinking about some general concepts covered in Exercise Physiology. This quiz is also available in your Canvas modules.

Please also watch the Canvas content on the profession of Accredited Exercise Physiology.

1. An exercise contraindication is defined as:
   _____
2. Training for hypertrophy focuses on the concept of time-under-_____ and uses an approximate rep/set range of _____-_____ sets of _____-_____ reps
3. List at least 4 factors that are defined as positive risk factors in the risk stratification profile
   _____
   _____
   _____
   _____
   _____
   _____
4. Subjective ratings of exertion can be assessed via the _____ scale which was devised by _____. There are two commonly used scales, with one scale ranging from _____-_____ and the other ranging from _____-_____.
5. Stretching has been demonstrated to conclusively improve exercise performance
   TRUE / FALSE
6. Blood pressure is assessed by listening for the _____ sounds. A 'normal' blood pressure score is _____/_____ whereas a 'borderline high' score is _____/_____.
7. FITT stands for _____, _____, _____ & _____.
8. A BMI score of 34.2 is classed as _____
9. For a given power output, the Heart Rate response will be HIGHER / LOWER for upper body exercise when compared to lower body exercise.
10. An electrocardiogram provides information about:
    _____

Lab Session

Introduction

There are many different methods to assess strength and functional capacity in individuals with chronic diseases. The gold standard of strength and power assessment is performed on an isokinetic dynamometer. You may have witnessed testing on this device previously (in 92533 Exercise Physiology) or and have seen footage of this testing procedure for different joints of the body. It is possible to determine strength at certain velocities and certain angles which are related to performance in numerous tasks. Further, by looking at rate of force development, exercise scientists can examine power output which is strongly related to exercise performance and risk of falling.

In addition to the examination of strength and power, it is important to determine functional capacity. Functional capacity is integrally related to quality of life, and is perhaps a stronger indicator of life satisfaction than specific measures of muscle strength. There are unique tests that can monitor balance, the ability to rise from a chair, walking performance, stair climbing ability and many other facets of daily life. In today's lab, you will perform some different types of tests that relate to functional performance, and also look at some methods to improve performance in these tests.

Assessment of functional ability in special populations

Functional performance is proportionally related to quality of life. There are many ways that exercise scientists can assess functional performance in special populations. One must consider the intensity of the testing and the actions undertaken, however, these types of tests are typically of a lower intensity than traditional tests such as maximal treadmill tests, and therefore safety is less of a concern. Regardless, it is still important to complete the appropriate screening questionnaires and obtain informed consent to participate. Correct technique can be an issue, especially in frail individuals, however, the simple nature of the tests generally permit high levels of reliability and validity.

Methods

Equipment

- Cones x 5
- Stopwatches x 15
- Chairs x 3
- Measuring tape

Tests

The following tests are examples of methods to assess functional capacity and could be used for any sub-population, especially those who are frail, have a chronic disease or a disability.

1.6 km Walk Test

To estimate VO2max and investigate self-selected walking speed, a 1.6 km walk test has been shown to be valid and reliable. It is typically conducted around a standard 400 m grass athletic oval. Participants are instructed to cover the distance "walking as fast as comfortably possible." This test is often selected as exertions of this intensity are ideal for individuals with chronic diseases and older adults. Heart rate is recorded at the completion of the walk, along with time to complete the distance. Average walking speed may be calculated for analytical and comparative purposes. VO2max can be reliably estimated from the 1.6 km walking test, with the following equation shown to yield the least standard error (0.325 L/min; Kline et al., 1987):

> *VO_2max (L/min) = 6.9652 + (0.0091 × body mass) – (0.0257 × age) + (0.5955 × gender[female=0, male=1]) – (0.2240 × time) – (0.0115 × heart rate)*

The reliability of this test has been previously established (r=0.71–0.97) among many age groups.

Sit-to-Stand Test

The sit-to-stand (STS) test measures the time taken to rise from a chair (and sit back down) five times, as fast and as safely as possible (Runge et al., 2000). This test is administered on a chair without arms and a seat height of approximately 40 cm. The chair is fixed to the ground to avoid movement during the test. A standardized position is used for each test that includes being seated in the middle of the chair, back straight, arms folded across the chest, and feet approximately shoulder width apart. A total of three trials are generally performed with 2 min rest between trials with the mean of the best two trials used for analysis. The total time is often measured using pressure pads fixed to the seat, with results recorded and calculated on a computer after each trial. The repeatability of this test is excellent, with interday reliability of the STS test being 0.96. A recent appraisal of the STS test compared to a leg press exercise demonstrated the functionality of the assessment (Alcazar et al., 2018).

Timed-Up and Go-Test

The timed-up and go-test (TUG) involves standing up from a chair, walking 3 m as quickly and as safely as possible, crossing a line marked on the floor, turning around, and then walking back to sit back down in the chair (Bruyere et al., 2005). The participant is initially seated in a 40 cm-high chair without arms, with his or her back flush against the backrest. The time taken is typically calculated by pressure pads secured to the centre of the seat. Turning time, the time to turn around at the 3-m mark can also be measured if that measure is of interest to the tester. The researcher gives a verbal cue to begin the test, and the times for three trials are recorded, with 2 min rest between trials. The mean of the best two trials is used for analysis. This test also displays excellent interday reliability, with intraclass correlations of the TUG test being 0.90.

Fast Walk

This test requires participants to walk as fast as possible over 10 m. The time taken is calculated using timing gates positioned at 5-m and 10-m intervals from the start line. The starting position involves feet placed together, 30 cm behind the first timing gate. Once ready, participants are allowed to commence the test at their own discretion. It is a requirement of the walking test that one foot be kept in contact with the ground at all times (to prevent running). Three fast-walk trials are usually performed, with a 2 min rest period between trials. The mean of the two best trials is used for analysis. Interday reliabilities of the 5-m and 10-m fast-walk test are 0.95 and 0.98, respectively.

Stair Mobility Test

The stair mobility task involves participants climbing and descending five steps (approximately 20 cm high and 25 cm deep). The test measures the time taken to complete this task twice. Participants are required to ascend and descend one stair at a time and avoid using a handrail. Stair mobility can be assessed by a video camera (recording at 50 Hz) placed 2 m perpendicular to the stairs. In this manner, contact time on each step can be assessed. In today's lab, you will not be assessing the contact time, rather, you will just assess the total time to complete the task. A total of three trials are generally conducted, with a 2-min rest period between efforts. Interday reliability of the stair mobility task is 0.98.

One-Legged Postural-Steadiness / 3-Dimensional Balance Assessment

One legged postural steadiness (OLPS) is assessed during a one-legged stance, analysing the patterns of ground reaction force variability. The starting position involves feet being placed shoulder width apart with weight evenly distributed and eyes facing forward. The subjects are instructed to stand for as long as possible (up to 15 sec) during OLPS, attempting to keep arms by the body for balance. The participants are informed that a touchdown by the non-stance leg is acceptable, yet should be corrected immediately. A touchdown on the force platform contributes to the force variability, which is consistent with using variability of the signal to quantify postural steadiness. Three trials of OLPS are usually completed for both legs. The ground reaction forces are measured on a three-dimensional force plate, with 2 forces measured: medial/lateral and vertical. As the initial weight transfer occurs laterally, anterior/posterior forces are disregarded.

To enable comparisons between subjects, the amplitude of each force signal is normalized for body mass, expressed as a percentage of body weight (%BW). The variability of forces during OLPS is analysed as the mean and standard deviation of these force signals during five intervals:

1) 0-0.49 sec; 2) 0.5-0.99 sec; 3) 1-4.99 sec; 4) 5-9.99 sec; 5) 10-15 sec (Jonsson et al., 2005). The test-retest reliability of OLPS has been reported to be 0.78 for vertical and 0.79 for lateral force variability (Rees et al., 2008).

Note: In today's lab, we will not be performing OLPS testing, due to the complex nature of the analysis.

15-second Balance Assessment

This test involves shifting the body mass in an anterior/posterior plane, and examines the number of times an individual requires the use of the non-testing leg to regain balance. The subject commences standing with feet shoulder width apart and weight evenly distributed. They step forward approximately 30 cm and transfer their mass to one leg, and remain on one leg for as long as possible (up to a maximum of 15 sec). If the subject loses their balance, they are permitted to briefly touch down on the ground with their non-stance foot to regain postural control. The number of ground touches of the non-stance foot are counted and recorded. Further, the time elapsed until the first touch down is recorded, as this is noted as being significantly related to falls risk. The test is performed with eyes open in the first instance, and repeated with eyes closed (eyes closed condition is only undertaken by capable subjects).

Other tests

There are many other functional tests to be found in the literature. You might come across the 6 minute walking test, tandem stand, the centre-of-pressure test, overhead reaching, Functional Movement Screen, ladder climb, tandem backwards walk, floor rise to standing, functional reach test, and many others. Research that examines their validity and reliability is abundant and there are many applications across a range of non-healthy clients.

Results

In small groups, conduct each of the tests and record your results below.

Activity: Conducting Tests

Dynamic Tests

Test	Trial 1 (secs)	Trial 2 (secs)
Sit-to-Stand		
Timed Up and Go		
10m Fast Walk (5-metre time)		
10m Fast Walk (10-metre time)		
Stair Test		

15-second Balance Tests

Trial	Trial 1 (Foot Touchdowns)	Trial 2 (Foot Touchdowns)
Right Foot, Eyes Open		
Left Foot, Eyes Open		
Right Foot, Eyes Closed		
Left Foot, Eyes Closed		

Circle/highlight the best trial result in each test

1.6km Walk Test

In the interest of time, you do not need to complete this test during the lab (typical duration 10-16 minutes). You can use the following values to calculate the estimated VO_{2max} using the equation above.

Mass (kg)	**Age (yr)**	**Gender [0/1]**	**Time (min)**	**HR (bpm)**	**EstVO_{2max} (absolute - L.min^{-1})**	**EstVO_{2max} (relative - ml.kg^{-1}.min^{-1})**
77	54	1	13:45	137		

Discussion

1. Which of the tests that you performed today would exhibit correlations/relationships between each other?

2. List some of the limitations when performing the 15 sec eyes open/closed balance tests.

3. What are the benefits of performing the 6-minute walk test over the 1.6km walk test? What are the limitations?

4. How does muscle strength relate to functional performance and the performance of activities of daily living?

5. How does muscle power relate to the risk of falling?

Week 3 - Physical Activity Tracking & Adherence

Pre-Lab Activity

Task 1

Before this week's lab, find and watch a TED talk that provides some relevant information on the topic of cardiovascular disease. Send the link to the talk you watch to the subject coordinator by 8am on the Monday prior to the tutorial. The links will be compiled into a large list and posted on Canvas for the entire class to see.

Task 2

You will also need to conduct a brief review of two different types of activity logging devices (e.g., Fitbit, Garmin, Apple Watch, or relevant phone apps), including their main features and how they work.

The in class activities require the use of a health and fitness phone app that is able to record activity/step count. If you do not currently have one installed, please take the time to find a suitable app so that you can participate in class. The *Health* or *Fitness* apps are simple options for iOS users.

Write your notes from the talk you chose AND the activity logging devices you reviewed below.

Lab Session - Part A

Questionnaires to Assess Functional Capacity, Barriers to Exercise, and Adherence to Exercise

Introduction

Exercise adherence is an important consideration in any program. There are many contributory elements to this complex issue, and while research continually builds around the topic, societal exercise habits about exercise participation are not improving. This tutorial content presents a range of questionnaires that provide non-physical methods to assess fitness, health and functional capacity along with some of the typically reported barriers to exercise.

The questionnaires are included for you to become familiar with by reading and completing them with the persona of an individual with a chronic condition. Please pick a range of symptoms that would typically be present in an individual with a cardiopulmonary, metabolic, musculoskeletal or neuromuscular condition.

Some of these questionnaires might be appropriate for you to include as part of the testing battery for your assignment.

Please also see the Appendices of this lab manual for some additional questionnaires that are relevant for a number of chronic diseases.

Questionnaires

Godin Leisure-Time Exercise Questionnaire (LTEQ)

The LTEQ is designed to quantify voluntary exercise participation and provide a guide to current activity levels.

Godin Leisure-Time Exercise *Questionnaire*

During a typical **7-Day period** (a week), how many times on the average do you do the following kinds of exercise for **more than 15 minutes** during your free time (write on each line the appropriate number).

Weekly leisure activity score = (9 × Strenuous) + (5 × Moderate) + (3 × Light)

	Times per week		Totals
a) **STRENUOUS EXERCISE (HEART BEATS RAPIDLY)** (e.g., running, jogging, hockey, football, soccer, squash, basketball, cross country skiing, judo, roller skating, vigorous swimming, vigorous long distance bicycling)		**X9**	
b) **MODERATE EXERCISE (NOT EXHAUSTING)** (e.g., fast walking, baseball, tennis, easy bicycling, volleyball, badminton, easy swimming, alpine skiing, popular and folk dancing)		**X5**	
c) **MILD/LIGHT EXERCISE (MINIMAL EFFORT)** (e.g., yoga, archery, fishing from river bank, bowling, horseshoes, golf, snow-mobiling, easy walking)		**X3**	
WEEKLY LEISURE-TIME ACTIVITY SCORE			

EXAMPLE
Strenuous = **3** times/wk
Moderate = **6** times/wk
Light = **14** times/wk
Total leisure activity score = (9 × **3**) + (5 × **6**) + (3 × **14**) = 27 + 30 + 42 = 99

Godin Scale Score	Interpretation
24 units or more	Active
14 – 23 units	Moderately Active
Less than 14 units	Insufficiently Active/Sedentary

Adapted from: Godin, G. (2011). The Godin-Shephard leisure-time physical activity questionnaire. Health & Fitness Journal of Canada, 4(1), 18-22.

ONS® Oncology Nursing Society

Figure 1: The Godin Leisure-Time Exercise Questionnaire

Screening Questionnaire for Cardiovascular Risk

This link provides a simple online cardiovascular disease risk assessment tool developed by the Heart Foundation in association with the Australian Chronic Disease Prevention Alliance.

cvdcheck.org.au

The site also provides useful guidelines and resources for health professionals and the general public.

Lab Question 1

Are questionnaires such as this valuable to the general population? List some positive and negative aspects of undertaking such a quiz below

Positives: _____

Negatives: _____

> ℹ While completing the remaining lab activities, put yourself in the shoes of an individual with a chronic disease

Duke Activity Status Index (DASI)

The Duke Activity Status Index is a self-administered questionnaire that measures a patient's functional capacity. It can be used to estimate a patient's peak oxygen uptake. Please note that this test is for the non-healthy population, therefore, results for the healthy population will be under-estimated.

Item	Activity	Yes	No
1	Can you take care of yourself (eating dressing bathing or using the toilet)?	2.75	0
2	Can you walk indoors such as around your house?	1.75	0
3	Can you walk a block or two on level ground?	2.75	0
4	Can you climb a flight of stairs or walk up a hill?	5.5	0
5	Can you run a short distance?	8	0
6	Can you do light work around the house like dusting or washing dishes?	2.7	0
7	Can you do moderate work around the house like vacuuming sweeping floors or carrying in groceries?	3.5	0
8	Can you do heavy work around the house like scrubbing floors or lifting and moving heavy furniture?	8	0
9	Can you do yardwork like raking leaves weeding or pushing a power mower?	4.5	0
10	Can you have sexual relations?	5.25	0

Item	Activity	Yes	No
11	Can you participate in moderate recreational activities like golf bowling dancing doubles tennis or throwing a baseball or football?	6	0
12	Can you participate in strenuous sports like swimming singles tennis football basketball or skiing?	7.5	0

Read each question in the *Activity* column and circle the value corresponding to your response in the *Yes/No* columns.

Once complete, sum the values circled and write it below. You can then use this number to calculate estimated peak oxygen uptake (VO_{2peak}).

Total of DASI questionnaire: _____

Estimated VO_{2peak} (ml/kg/min) = *0.43* × *DASI Score* + *9.6* = _____

Lab Question 2

What are some limitations to the use of the DASI?

_____

The Activities-Specific Balance Confidence (ABC) Scale

For each of the activities below, use the number line and associated descriptors to rate your confidence that you will not lose your balance or become unsteady (Powell & Myers, 1995).

If you do not currently do the activity in question, try to imagine how confident you would be if you had to do the activity. If you normally use a walking aid to do the activity or hold onto someone, rate your confidence as if you were using these supports.

0	10	20	30	40	50	60	70	80	90	100
Cannot do at all										Certain can do

How confident are you that you will not lose your balance or become unsteady when you:

Walk around the house	____
Walk up and down the stairs	____
Bend over and pick up a slipper from the floor	____
Reach for a small can off a shelf at eye level	____
Stand on your tiptoes and reach for something	____
Stand on a chair to reach for something	____
Sweep the floor	____
Walk outside to a nearby car	____
Get in and out of a car	____
Walk across a parking lot	____
Walk up and down a ramp	____
Walk in a crowded mall where people rapidly walk past you	____
Are bumped into by people as you walk through the mall	____
Use an escalator holding the rail	____
Use an escalator not holding the rail	____
Walk outside on wet sidewalks	____
Total	____

Self-Efficacy for Exercise (SEE) Scale

This scale is a self-report of exercise self-efficacy (Resnick & Jenkins, 2000). There are 9 items to consider, with the total score is calculated by summing the responses to each question. This scale has a range of total scores from 0-90. A higher score indicates higher self-efficacy for exercise. The internal consistency has been reported as 0.92. When considering validity, the mental and physical health scores on the SF-12 questionnaire predicted efficacy expectations as measured by the SEE Scale. Furthermore, SEE efficacy expectations predicted exercise participation.

How confident are you right now that you could exercise three times per week for 20 minutes if:

	Not Confident										Very Confident
1. The weather was bothering you	0	1	2	3	4	5	6	7	8	9	10
2. You were bored by the program or activity	0	1	2	3	4	5	6	7	8	9	10
3. You felt pain when exercising	0	1	2	3	4	5	6	7	8	9	10
4. You had to exercise alone	0	1	2	3	4	5	6	7	8	9	10

	Not Confident										Very Confident
5. You did not enjoy it	0	1	2	3	4	5	6	7	8	9	10
6. You were too busy with other activities	0	1	2	3	4	5	6	7	8	9	10
7. You felt tired	0	1	2	3	4	5	6	7	8	9	10
8. You felt stressed	0	1	2	3	4	5	6	7	8	9	10
9. You felt depressed	0	1	2	3	4	5	6	7	8	9	10

SEE Total Score: _____

Exercise Benefits/Barriers Scale

Below are statements that relate to ideas about exercise. Please indicate the degree to which you agree or disagree with the statements by circling SA for strongly agree, A for agree, D for disagree or SD for strongly disagree (Sechrist et al., 1987).

1. I enjoy exercise.	SA	A	D	SD
2. Exercise decreases feelings of stress and tension for me.	SA	A	D	SD
3. Exercise improves my mental health.	SA	A	D	SD
4. Exercising takes too much of my time.	SA	A	D	SD
5. I will prevent heart attacks by exercising.	SA	A	D	SD
6. Exercise tires me.	SA	A	D	SD
7. Exercise increases my muscle strength.	SA	A	D	SD
8. Exercise gives me a sense of personal accomplishment.	SA	A	D	SD
9. Places for me to exercise are too far away.	SA	A	D	SD
10. Exercising makes me feel relaxed.	SA	A	D	SD
11. Exercising lets me have contact with friends and persons I enjoy	SA	A	D	SD
12. I am too embarrassed to exercise.	SA	A	D	SD
13. Exercising will keep me from having high blood pressure.	SA	A	D	SD

14. It costs too much money to exercise.	SA	A	D	SD
15. Exercising increases my level of physical fitness.	SA	A	D	SD
16. Exercise facilities do not have convenient schedules for me.	SA	A	D	SD
17. My muscle tone is improved with exercise.	SA	A	D	SD
18. Exercising improves functioning of my cardiovascular system.	SA	A	D	SD
19. I am fatigued by exercise.	SA	A	D	SD
20. I have improved feelings of wellbeing from exercise.	SA	A	D	SD
21. My spouse (or significant other) does not encourage exercising.	SA	A	D	SD
22. Exercise increases my stamina.	SA	A	D	SD
23. Exercise improves my flexibility.	SA	A	D	SD
24. Exercise takes too much time from family relationships.	SA	A	D	SD
25. My disposition is improved by exercise.	SA	A	D	SD
26. Exercising helps me sleep better at night.	SA	A	D	SD

27. I will live longer if I exercise.	SA	A	D	SD
28. I think people in exercise clothes look funny.	SA	A	D	SD
29. Exercise helps me decrease fatigue.	SA	A	D	SD
30. Exercising is a good way for me to meet new people.	SA	A	D	SD
31. My physical endurance is improved by exercising.	SA	A	D	SD
32. Exercising improves my self-concept.	SA	A	D	SD
33. My family members do not encourage me to exercise.	SA	A	D	SD
34. Exercising increases my mental alertness.	SA	A	D	SD
35. Exercise allows me to carry out normal activities without becoming tired.	SA	A	D	SD
36. Exercise improves the quality of my work.	SA	A	D	SD
37. Exercise takes too much time from my family responsibilities.	SA	A	D	SD
38. Exercise is good entertainment for me.	SA	A	D	SD

39. Exercising increases my acceptance by others.	SA	A	D	SD
40. Exercise is hard work for me.	SA	A	D	SD
41. Exercise improves overall body functioning for me.	SA	A	D	SD
42. There are too few places for me to exercise.	SA	A	D	SD
43. Exercise improves the way my body looks.	SA	A	D	SD

Simple Benefits/Barriers Assessment

What do you see as the benefits of exercise?

1. _____
2. _____
3. _____

What do you see as being barriers to exercise?

1. _____
2. _____
3. _____

Lab Question 3

From your personal perspective, what are the five greatest barriers to exercise participation?

1. _____
2. _____
3. _____
4. _____
5. _____

Exercise Adherence Assessments

Many functional status questionnaires are completed prior to and following an exercise intervention in order to examine any changes that may have occurred as a result of the training period. Naturally, it is important to concurrently report the participant's compliance to the program to ensure that any changes were due to this intervention rather than any extraneous variables.

Participant compliance to a program may be calculated using a simple formula:

Compliance = Number of sessions completed / Number of sessions available

There are several methods of assessing program compliance, however, the level of scrutiny depends on the required level of enquiry. Some researchers/practitioners only need information about the number of sessions that the client has performed, whereas others require more detailed information about session intensity, duration and rate of progression. In most circumstances, it is best to develop a questionnaire based on the needs of the client.

Additionally, the term 'adherence' better encapsulates a more holistic buy-in from the participant. An individual who adheres to the program has input to the weekly activities, is involved with setting goals, and tends to have a level of involvement that requires a qualitative set of measures to assess. Please consider the similarities between compliance and adherence when implementing the formula to compute either variable.

Lab Question 4

List four possible methods to improve exercise adherence for a group of three friends - asthmatic, young adult females - who started an exercise program in a group as a new year's resolution. Their current adherence rate is 50-60%.

They commenced the program in an attempt to lose weight and improve their breathing function so they did not feel so out of breath as often throughout the day. They meet at the local park on 4 mornings per week and perform a variety of 'bootcamp' style exercises under the watchful eye of a personal trainer.

1. _____
2. _____
3. _____
4. _____

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Lab Session - Part B

Accuracy of Daily Activity Monitors

Introduction

Physical inactivity is a primary cause of the major metabolic diseases. Whilst there are many confounding factors that contribute to these diseases, including genetics, dyslipidaemia and cardiovascular disease, sedentary behaviour is perhaps the primary cause of obesity and impaired insulin sensitivity. With the introduction of physical activity into daily life, individuals with metabolic diseases can significantly reduce the risk of mortality and improve their quality of life.

Physical activity is a proven method of achieving and maintaining a negative energy balance (to attain an ideal body mass). Monitoring physical activity is important in two main ways:

1. Physical activity measures are used diagnostically to **assess** current physical activity patterns.
2. Physical activity measures are used as a **prescriptive** tool, with a target distance to cover/number of steps per session being prescribed. In this way, the pedometer can also act as an incentive for participants to cover a set amount of work in a day.

It is common for practitioners to prescribe physical activity to clients with metabolic diseases, however, this activity must be prescribed on an individual basis. Current physical activity status, aerobic fitness, exertional distress and any injuries must be considered when prescribing an exercise program. For monitoring purposes, daily activity logs are often compiled by patients/clients, however, inaccurate responses are very common among patients with obesity and other metabolic diseases. Equipment such as pedometers, accelerometers and global positioning system (GPS) units provide objective measures of the amount of activity performed on any given day, and are accordingly far more reliable than other recording methods.

The objectives of this lab activity are to:

- Gain experience using standard items to assess daily physical activity
- Examine the effectiveness of using physical activity monitors

Methods

Equipment

- GPS monitor
- 2 x Pedometers (1 x basic unit; 1 x phone-based unit)
- Measuring tape or trundle wheel

Pedometers

Pedometers are electronic devices that are used to measure the number of steps taken over a given time period. Usually worn at the hips, the quality of measurement varies between units, however, these counters can provide valuable information regarding movement patterns. Generally, pedometers are used to monitor or prescribe the number of steps for an individual, rather than directly attempting to quantify distance. However, there may be merit in attempting to obtain distance data from these units, as step length can be used to calculate distance.

When considering daily step counts, the following guidelines represent different activity classes:

- Fewer than 5,000 steps per day = sedentary
- 5,000–7,499 = low active
- 7,500–10,000 = somewhat active
- 10,000–12,499 = active
- 12,500+ steps per day = highly active

Due to individual differences in metabolic rate and intensity of walking, it is difficult to calculate energy expenditure from number of steps taken per day. However, energy expenditure may be approximated from the data obtained, with a greater number of steps correlating with a greater energy expenditure.

Some pedometers allow the entry of physical data such as height, body mass, or other characteristics to provide a more accurate estimate of energy expenditure. Whilst providing a guide to energy expenditure, these measures need to be treated with caution due to their lack of direct physiological measurement.

A large scale research project incorporating physical activity prescription using pedometers is the 10,000 steps program based in Rockhampton, QLD. The project has attempted to increase physical activity in a regional town in an attempt to offset the growing obesity crisis. Participants are encouraged to wear a pedometer and undertake a minimum of 10,000 steps per day, through either incidental exercise during the day, or formal sport/exercise participation. In an attempt to maximise adherence, support is available to participants via phone calls and online resources. Researchers have determined that this quantity of physical activity (10,000 steps) approximates the guidelines for general health, although a greater number of steps per day is encouraged.

For more information about this program, go to 10000steps.org.au. In January 2025, they report that 685,547 members have logged a grand total of 432,606,819,172 steps! Similar gamification or reward models exist, for example Qantas Wellbeing.

Accelerometers

Accelerometers can provide a better measure of activity compared to pedometers as they can distinguish between walking, running, and even more explosive movements (e.g., jumping). Rather than a binary outcome offered by a pedometer (step or no step), accelerometers offer information about the magnitude/intensity of movement. Complex algorithms can also separate movement derived from skeletal muscle force output and movement generated outside the human capability, such as that recorded from riding in a car. Due to their precision and reliability, accelerometers are often used to validate pedometer step counts and are, therefore, a gold standard method for measuring physical activity.

Accelerometers operate by measuring acceleration along a given axis. They are typically triaxial (i.e., coronal, vertical, and anteroposterior), enabling measurement of movement in multiple planes (frontal, sagittal, and transverse). Mechanistically, the accelerometer sensor converts movements into electrical signals (counts) that are proportional to the muscular force responsible for producing motion (Melanson & Freedson, 1996). These counts are summed over a specified period of time and stored. This period is often 24 hours, or can be up to 2-3 full months depending on battery and storage capacity. Segmenting accelerometer data enables the determination of activity patterns which leads to deeper analyses, e.g., sleep vs awake time, and can provide information about temporal patterns of exercise.

> For a review of this technology see Yang & Hsu (2010). A review of accelerometry-based wearable motion detectors for physical activity monitoring. *Sensors*, *10*(8): 7772-7788. doi.org/10.3390/s100807772

GPS monitors

GPS (Global Positioning System) technology has revolutionised the way that exercise scientists are able to track athletes and research subjects. Small GPS chips are very affordable and user-friendly, with many different models available for <$300. GPS units obtain position data from up to 31 currently-orbiting satellites that, with clear skies and an open area, can provide accurate location data to within 30 cm with modern mobile phones (typically closer to 5 m). Military and engineering applications can achieve sub-millimeter accuracy. Most GPS units measure position once per second (1 Hz), however some can log data at much higher frequencies, e.g., 5, 10, or 100 Hz, increasing accuracy (and file size).

Together with GPS data, most monitors also record heart rate to provide a more accurate measure of energy expenditure. This has obvious benefits for quantifying training loads and volumes. GPS monitors have been shown to accurately record distance and speed, however some factors can increase measurement error. Low measurement frequency can result in missed movements where faster movement patterns have greater error due to rapid changes in latitude/longitude. Additionally, the built and natural environment (buildings, trees, clouds) can also obstruct line-of-sight between the GPS unit and satellites. You may have noticed on your Strava map that the GPS trace sometimes goes wandering all over the road. This error can lead to overestimation of distance covered (about 5%). This represents a clear limitation of GPS-based tracking, which makes it unsuitable in some scenarios. Indoor positioning systems have been developed with very high accuracy (2 cm), which may make this less of a limitation (Serpiello et al., 2018; Spinney et al., 2015).

When considering the use of GPS for tracking of humans, a pioneering article by Duncan et al. (2007) stated that:

> GPS measures position, distance, and speed based on the time taken to receive a signal from orbiting satellites; manufacturers report commercially available GPS to be accurate to within 15 m. High levels of precision were demonstrated by Wide

> Area Augmentation System (WAAS)-enabled Garmin GPS (Garmin Ltd., Olathe, KS) while the unit was stationary, with **99% of all points falling within 20 m of the actual location.** GPS also recently has been used to assess a variety of human activities, making GPS an attractive alternative to self-report and other objective measures currently available to assess active transport travel distance, although this is largely unstudied. Previous research has demonstrated that physical activity can be assessed without substantial changes to behaviour attributable to the measurement process or measurement reactivity; therefore, GPS also may be used to assess active transport without bias introduced by measurement reactivity. Given the importance of distance as a barrier to active transport, it is imperative to gain accurate measures of distance travelled, to understand how the likelihood of active transport engagement varies by distance.

Despite being more than a decade old, the paper highlights the potential use of GPS tracking when assessing daily physical activity. Participants are more likely to undertake their standard levels of movement as the devices are unobtrusive, and individuals may even develop a sense of forgetting that they are being monitored. Sensor technology improves each year, with high precision sensors being standard features in smart watches and phones. Common GPS units used in sport are from Catapult Sports (catapultsports.com) and Garmin (garmin.com).

The reliability of pedometers and GPS monitors have been published previously. In today's lab session, we will be considering their accuracy relative to a criterion measure, with a view to considering their use in exercise prescription.

Procedure

1. Set up subject with GPS unit and 2 x pedometers.
2. The subject is required to perform the following:
    a. 1 lap of the field at a slow walking speed
    b. 1 lap of the field at a fast walking speed
    c. 1 lap of the field running
3. Measure the number of steps from each of the pedometers and calculate approximate distance for each activity. Record the distance from the GPS unit for each activity. Reset each unit after each trial.
4. Calculate the percentage difference between the criterion measure and the pedometers and GPS units.

Write the results of the data collection in the table below

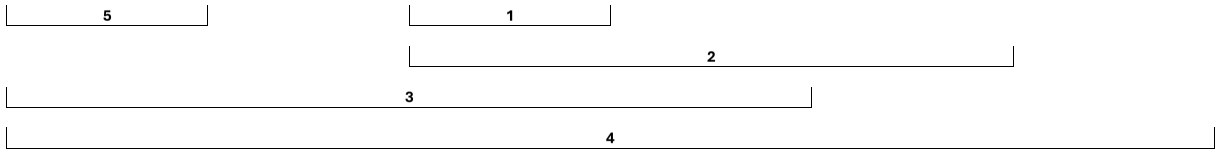
Name_____ **Approx. step lengths** Slow walk (3.6 km/h or 1.0 m/s) _____

Age _____ Fast walk (6.0 km/h or 1.7 m/s) _____

Running (10 km/h or 2.8 m/s) _____

Activity	Criterion **Measured Distance** Distance for 1 lap of the track	GPS **Reported Distance**	Actual **Counted Steps** Number of steps as counted by testers	"Cheap" Pedometer **Reported Steps**	 **Calculated Distance**	Phone Pedometer **Reported Steps**	 **Calculated Distance**
Slow walk	____m	____m			____m		____m
Fast walk	____m	____m			____m		____m
Running	____m	____m			____m		____m

Perform these comparisons



Explanation of terms

- Criterion/Measured Distance is assessed from the tape measure/actual distance
- GPS reported distance is taken from the GPS unit at the completion of each trial
- Actual counted steps is the number of steps visually counted in each trial
- Pedometer reported steps is taken from the pedometer at the completion of each trial
- Pedometer distance is the calculated value of pedometer reported steps x approximate step length

Calculate the percentage differences between the criterion measure (actual steps or actual metres) and each of the other measurement units.

> To calculate the percentage difference you need to use the following formula:
> %diff = *(device measurement - actual measurement) / actual measurement × 100*

Percentage difference	Slow Walk	Fast Walk	Running
1 Cheap Pedometer-reported steps vs Actual steps			
2 Phone Pedometer-reported steps vs Actual steps			
3 Cheap Pedometer distance vs Actual distance			
4 Phone Pedometer distance vs Actual distance			
5 GPS distance vs Actual distance			
Cheap Pedometer vs Phone Pedometer steps			

Discussion

1. Does the data support the use of pedometers in approximating distance covered on a daily basis?

2. Explain why pedometers are considered to be useful for general health.

3. Is the level of error produced by the GPS monitor acceptable? What recommendations would you make to improve the quality of the data? Would you recommend the use of a GPS monitor in the determination of distance covered on a daily basis? Why or why not?

4. Discuss the role of physical activity in the:
    a. **Prevention** of cardiopulmonary and metabolic conditions?

    b. Discuss the role of physical activity in the **treatment** of cardiopulmonary and metabolic conditions.

5. Prescribe a training program for an obese individual with type 2 diabetes who is looking to lose ~20kg over a 10 month period? Explain distances, intensity, modality, frequency etc. Would you encourage the use of a pedometer or GPS unit? If so, in what way would it be included?

6. Now consider what programming variables would be different for prescribing exercise for individuals with arthritis or osteoporosis. Would you encourage the use of a pedometer or GPS unit? If so, in what way would it be included?

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Week 4 - Cardiac Responses to Exercise

Pre-Lab Activity

Watch the ECG content in your Canvas modules to learn important foundational knowledge about the activities in this week's lab class.

If you have not done so yet, complete the Canvas quiz relating to pulmonary conditions from the Week 2 modules.

Lab Session

Introduction

12-lead electrocardiograms (ECG or EKG – German spelling is Electrokardiogram) are commonly used in clinical settings to screen for cardiac abnormalities, particularly electrical conduction defects, in both resting and exercise states. In today's lab, you will learn the principles of using a 12-lead ECG at rest and during exercise.

The objectives of this lab are to:

- Demonstrate an ability to obtain a 12-lead ECG recording at rest
- Demonstrate an ability to obtain a 12-lead ECG recording during exercise
- Understand the various components of the waveform of an electrocardiogram at rest and during exercise
- Discuss the accuracy and limitations of instrumentation in the interpretation of test results

> ⚠ While this lab provides a valuable introduction to the use and interpretation of ECG, it does not qualify you in any way to use ECG for clinical practice or to provide clinical cardiology advice.

Cardiac Conduction

A 12-lead ECG is the gold standard of cardiovascular assessment. A typical trace, with key segments and intervals labelled, is shown below. Each wave, including its magnitude, frequency, and shape can provide valuable diagnostic and prognostic information for cardiologists and qualified clinicians about an individual's cardiac health.

A typical resting ECG shows electrical cardiac events, which allow us to determine many different structural and contractile problems that might exist by comparison to a 'normal' profile. However, the mechanics of these assessments are quite intensive and require detailed reading to fully understand.

In the example of a normal adult ECG below, the top 3 rows display the 12 leads outputs (I, II, III, aVR, aVL, aVF, and V1-V6), while the lowest row(s) display an extended output for a selected channel - in this case, Lead I. The horizontal gridlines indicate the magnitude of electrical signal (10 mm/mV). The vertical gridlines indicate time, where each major grid is 0.2 seconds (i.e., 1 second = 5 grids).

Placement of Electrodes

When referring to 'leads' in an ECG reading, we are not referring to the cables attached to the patient, but to **a combination of electrodes that form imaginary lines in the body along which the electrical signals, or the differences in electrical potential, are measured**. In fact, when we set up a 12-lead ECG, we actually only require **10** electrodes and cables.

The first 6 leads (precordial; V1-V6) are unipolar and are measured directly from the 6 electrodes placed immediately around the heart at standardised positions on the chest. The remaining 4 electrodes provide bipolar (I, II, III) or augmented unipolar (aVF, aVL, aVR) limb leads. The

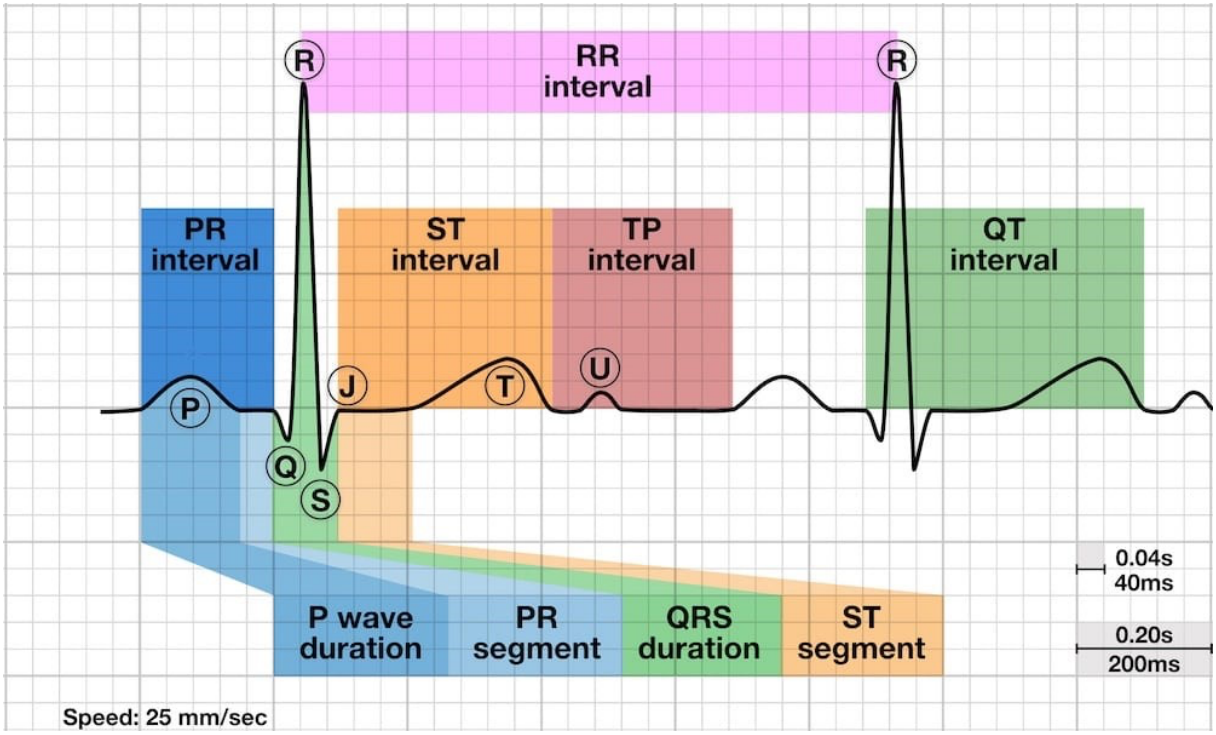


Figure 1: ECG components - waves, intervals, and segments

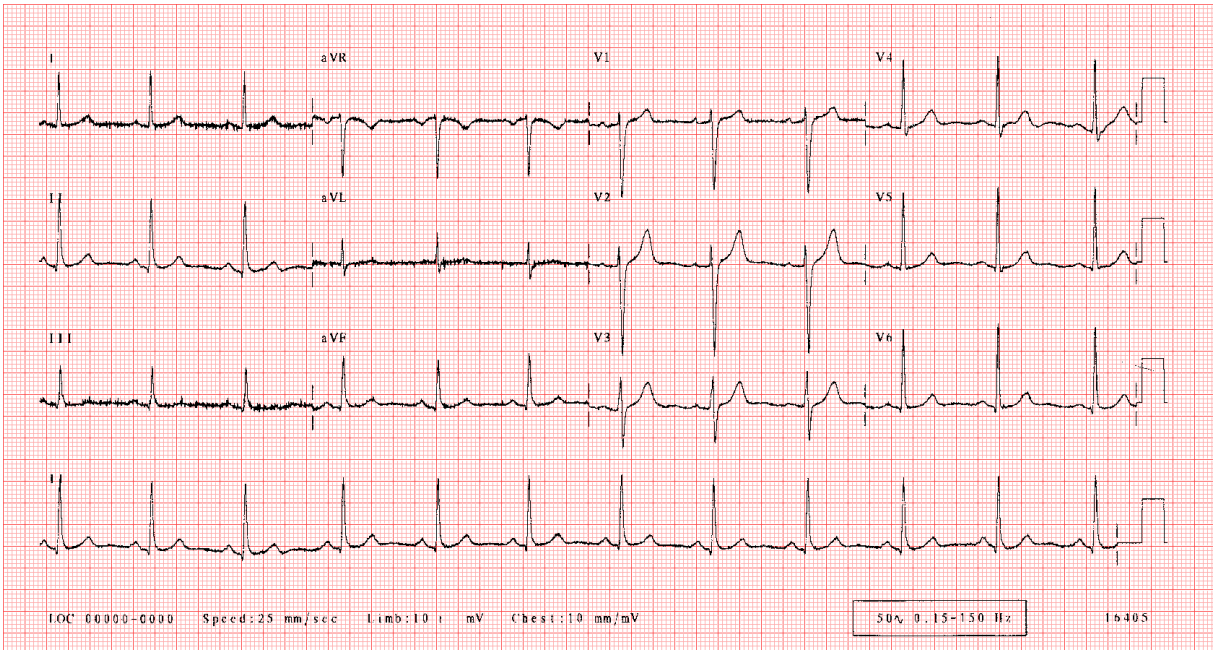


Figure 2: A normal adult 12-lead electrocardiogram (ECG); a normal ECG diagnosis is made by excluding any recognisable abnormalities in each panel, which makes the description of observed responses quite lengthy

positioning of the limb electrodes (RA, RL, LA, LL) depends on the nature of the test. For a resting ECG, these electrodes are placed on the frontal surface of each wrist and ankle. For an exercise ECG, each electrode is relocated proximally, with arm electrodes placed on the frontal aspect of each shoulder, inferior to the acromioclavicular joint, and leg electrodes placed on the oblique musculature, anterior and superior to the iliac crest.

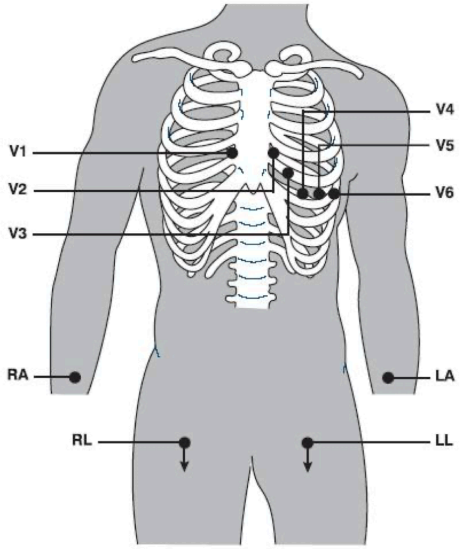
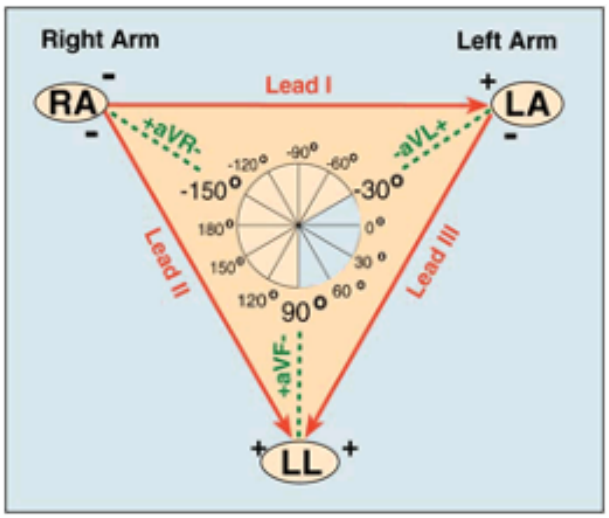


Figure 3: 12-lead ECG electrode placement - note: limb leads may be modified depending on nature of test

In the ECG chart above, you will notice that the QRS complex is not always positive in the leads. Each lead reads (differences in) electrical activity in a specific axis and direction between two or more electrodes, which results in negative voltages in some leads reflecting the orientation of the electrical gradient being measured. Einthoven's triangle describes the positive-negative electrical relationship (polarity) of the leads and how they produce their respective lead views.



(a) Einthoven's triangle demonstrating polarity between electrodes and origin of limb leads

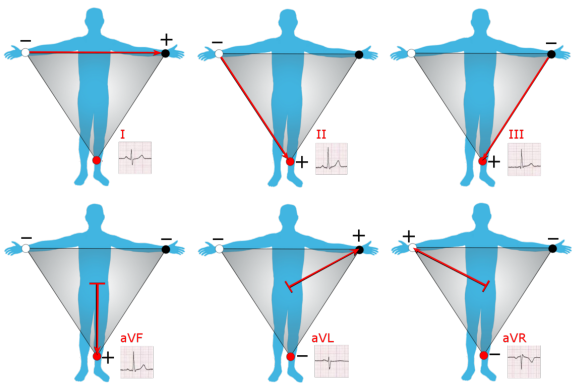


Table 1: Lead formation during 12-lead ECG, including their polarity, plane, location, and view

Lead	Type	Plane	Location	View of Heart
I	Bipolar	Frontal (Lateral)	Reads from Right Arm to Left Arm	Lateral wall of left ventricle
II	Bipolar	Frontal (Inferior)	Reads from Right Arm to Left Leg	Inferior wall of left ventricle
III	Bipolar	Frontal (Inferior)	Reads from Left arm to Left Leg	Inferior wall of left ventricle
aVF	Augmented Unipolar	Frontal (Inferior)	Reads from heart centre to Left Leg	Inferior wall of left ventricle
aVL	Augmented Unipolar	Frontal (Lateral)	Reads from heart centre to Left Arm	Lateral wall of left ventricle
aVR	Augmented Unipolar	Frontal (Lateral)	Reads from heart centre to Right Arm	Basal aspect of septum
V1	Unipolar	Horizontal (Septal)	Fourth intercostal space, right of sternum	Ventricular septum (interventricular)
V2	Unipolar	Horizontal (Septal)	Fourth intercostal space, left of sternum	Ventricular septum (interventricular)
V3	Unipolar	Horizontal (Anterior)	Midway between V2 and V4	Anterior wall of left ventricle
V4	Unipolar	Horizontal (Anterior)	5th intercostal space on midclavicular line	Anterior wall of left ventricle
V5	Unipolar	Horizontal (Lateral)	5th intercostal space midway between V4 and V6 (anterior axillary line)	Lateral wall of left ventricle
V6	Unipolar	Horizontal (Lateral)	5th intercostal space on midaxillary line	Lateral wall of left ventricle

The quality of ECG signals depends greatly on electrode placement on the patient. Body hair must be removed at each site to ensure good contact between skin and electrodes.

The Electrical Activity of a Sinus Rhythm

In order to conduct a 12-lead ECG it is important to understand the cardiac events that you are monitoring. Importantly, sections of the heart undergo depolarisation and repolarisation across

the heart's contraction cycle. **Depolarisation is the process by which a resting cell becomes more positive and contracts**, as an impulse from the sinus node is propagated. During this time, a muscle cell may go from its resting charge of -90 mV to a positive charge that may briefly reach +30 mV.

Repolarisation is the process where a cell is returned to its resting electrical state. Repolarisation begins immediately after depolarisation, and after a plateau at 0 mV, the cell quickly returns to a charge of -90 mV. The plateau at 0mV allows a refractory period in which the cell cannot be depolarised again. Similar to muscle cells, both depolarisation and repolarisation are controlled by the sodium-potassium ATP pumps located within the cardiac tissue. **An ECG measures these voltage changes at different locations and from different aspects of the heart.**

The sinus rhythm displayed on an ECG trace replicates the depolarisation-repolarisation activity at different locations of the heart. Research has given an insight to the cardiac electrical events which are represented by different components of a sinus rhythm. The electrical events of the heart and the ECG components as represented by Lead I are shown in Figure 1B below.

1. The first half of the P wave represents the SA node activation of the right atrium, and the signal reaching the AV node.
2. As the P wave is completed, both the left atrium and AV node have been activated. The peak of the P wave represents the activation of the AV node. P wave distortion may represent an abnormality in the morphology of either atrium. The P-R segment represents the electrical current reaching the Bundle of His and Purkinje fibres.
3. The first ventricle activation occurs in the intraventricular septum from left to right (hence the negative Q amplitude). AV conduction is measured throughout the PQ Interval (beginning of P wave to Q).
4. The activation of the two ventricles is represented as a tall positive spike (QRS complex). Note that despite the current flowing in both positive and negative directions the stronger current is flowing in a positive manner due to the larger thickness of the left ventricular wall. The polarity of the QRS complex may change depending upon which lead is being viewed. In leads I, II, and V3 to V6, the QRS complex is positive to neutral, whereas it may be positive, negative, or neutral in aV_L or aV_F. The aV_R lead shows a negative QRS complex due to its orientation.
5. The repolarisation of the ventricles is represented within the ST segment and T wave. The point at which the QRS complex is complete and the ST segment begins is deemed the J point. Depression of the ST segment may be interpreted as problems in the depolarisation-repolarisation cycle within the ventricles. The T wave is the result of the rapid repolarisation of the ventricles. The T wave may be represented as positive in leads I, II and V2-V6. It also appears positive in aV_L and aV_F, but may be inverted if the previous QRS complex is less than 6 mm tall. The aV_R lead shows an inverted T wave, whereas leads III and V1 show a varied polarity of the T wave. Whilst T wave changes may be the most sensitive measure of MI, it is also considered the least specific.

R-R Interval, Heart Rate, and Heart Rate Variability

The R-R Interval - the time between two successive R-waves in the QRS complex - can be used to easily calculate the heart rate using the vertical grid lines shown on a typical ECG chart. By dividing 300 by the number of major (thick) grid lines that appear during each R-R Interval, we can quickly calculate instantaneous heart rate. The minor (thin) grid lines occur at increments

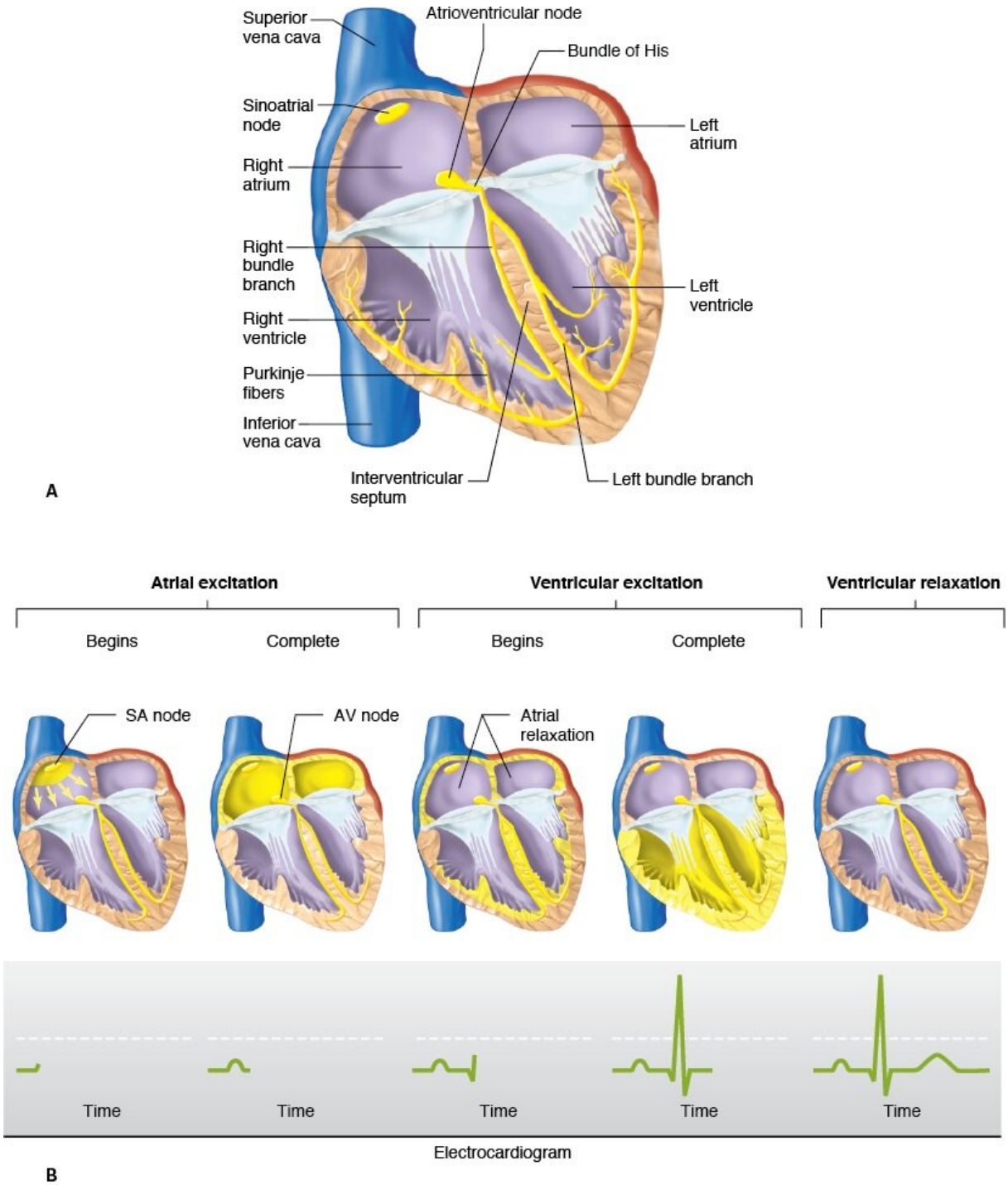


Figure 5: A) Cardiac anatomy, including location and extent of critical nodes for electrical conduction across the heart; B) Heart contraction phases and the conduction pathways resulting in atrial and ventricular contraction, along with their reflection in electrocardiogram (ECG) trace (source: Ganong's Review of Medical Physiology)

of 0.2, so these can be included in the calculation if required. Alternatively, count the number of R-waves that occur in the ECG rhythm strip and multiply by 6 to give the average beats per minute.

Your heart rate, even at rest, is not a perfectly constant rhytm. It fluctuates by fractions of a second with each beat in response to autonomic factors such as electrical impulse and breathing. This phenomenon is referred to as Heart Rate Variability (HRV), and is a completely normal and natural occurrence. HRV has been demonstrated to provide diagnostic value, for instance sinus arrythmia where HRV exceeds 0.12 seconds. HRV can be used to identify changes in sympathetic and parasympathetic nervous system activity that may indicate increased physiological or psychological stress, which may make it suitable for identifying your body's responsiveness and resilience to stress at a point in time. Typically, higher HRV indicates higher adaptability, while lower HRV is observed with higher heart rates, which may be an indication of high stress or health problems.

Methods

Equipment

- Metabolic Cart (MedGraphics CardiO2)
- 12-Lead Electrocardiogram Module (Mortara)
- Ergometer (treadmill or bike)
- Electrodes
- Gloves
- Razors
- Alcohol swabs
- Fine sandpaper
- Adhesive tape

Procedure

Using the MedGraphics CardiO2 ECG Module

In today's practical you will be using the MedGraphics CardiO2 ECG Module to perform a resting ECG. This is a clinical system which is used to perform diagnostic 12-lead ECG testing. The unit can record ECG results and search for trends and abnormalities in the data. In this manner, either electronic or manual identification of abnormalities is possible. Despite having sophisticated software to detect problems, manual checking to ensure accuracy of interpretation is recommended.

Electrodes are placed as follows:

1. Select electrode sites over soft tissues or close to bone, using the Lab Manual or CardiO2 software for reference
2. Prepare the electrode site by rubbing gently with fine sandpaper, then wipe with alcohol swabs to clean the site of any skin fragments, sweat, or oil; *If the patient has body hair at any electrode site, you must first remove the hair in the area using a shaver before following with sandpaper and alcohol swabs
3. Once the alcohol has dried, remove the adhesive cover from an electrode then apply the electrode firmly to the skin at each site, trying not to overlap the adhesive gel surfaces of the electrodes
4. Referring to the Lab Manual or CardiO2 software, gently press each clip-on ECG cable onto its respective electrode, making sure to check that each clip is applied at the correct location and has been clipped on securely
5. Secure each wire to the body using a small amount of tape in a position out of the way of moving limbs and place the ECG module in its holster or away from the client

> **!** You may be making physical contact with patients/peers' bodies during this lab activity, so exercise professional conduct at all times - ask for consent before touching, and always explain what you are doing.
> For female patients, electrodes must not be placed on top of the breast unless you cannot gain access to the normal electrode placement position. If you have to apply electrodes onto the breast, make a note on the recording. If you are required to shift the breast to correctly place the electrodes, use the back of your hand to do so.

Resting ECG Measurement

Once the patient details have been entered into the system and the electrodes have been correctly applied, a resting ECG can be recorded.

A resting ECG will identify any resting cardiac abnormalities, and may pick up morphological changes such as ventricular hypertrophy. The system requires a high quality signal to determine any problems, so proper skin preparation is vital.

The subject is to be seated comfortably or lying down. In today's lab we will have the patient lying down. The patient needs to be instructed to remain still for the entirety of the measurement with no talking, as limb or chest movement may result in movement artefact on the ECG trace. Ask the patient to cough and note what happens to the ECG trace.

Perform a resting ECG on 3 students, and then analyse the printout in detail. You can refer to the sample traces of various conditions in the appendix for comparison.

Exercise ECG Measurement

To identify any cardiac abnormalities during increased work intensity, it is important to place the heart under cardiac stress. If any abnormalities exist, it is likely that they will become evident during maximal testing. However, maximal stress testing or a graded exercise test (GXT) should only be performed after extensive health screening, and a diagnostic need for the maximal test has been established.

Exercise ECG testing requires similar electrode placement as the resting ECG, with the exception that limb leads are always truncated for the duration of the test. Rather than sometimes being placed on the ankles and wrists (as evident in some resting protocols), the upper limb leads are placed immediately inferior to the distal 2/3 segment of the clavicle (avoiding the muscle mass) and the lower limb leads are placed on the oblique musculature, immediately superior to the anterior superior iliac spines.

Constant monitoring of the ECG from the GXT should be performed for three reasons:

1. To ensure safety of the performer during GXT and training
2. To measure accurate heart rates
3. To diagnose cardiovascular disease

The first two objectives can be fulfilled by trained non-medical personnel, whereas the last is the responsibility of the supervising physician. Thus performing GXT is often a combination of exercise and medically trained professionals. However, both should be aware of the dangers of GXT and indications that the test should be terminated.

When considering the formulation of an appropriate protocol for a test you will need to consider the activity level of the participant, the test duration, the rate of progression, and other factors. Some relevant information about ramping/non-ramping protocols, exercise modality, claudication pain, and specific examples of protocols are presented on page 67-69 of your textbook. Some example protocols are also included in the appendix for this lab class.

In today's lab you will have one participant perform 2 x 3-minute stages of work on a bicycle ergometer, then 2 x 3-minute stages of work on a treadmill. This will showcase the typical fluctuations in ECG signal quality once exercise is introduced. The starting and subsequent-stage exercise intensities should be relevant to each participant's level of fitness, but are not

designed to be maximal (remember, the pre-screen tool only enables them to perform light-moderate intensity exercise if they are not already engaged in more than 150 minutes of exercise per week).

Record an example of the ECG trace for each stage and observe the difference from rest to exercise. This will form part of the discussion in class.

Analysis

1. Raw Measurements - usually made in frontal plane leads
    - Heart rate, PR interval, QRS duration, QT interval, QRS axis in frontal plane
2. Rhythm Analysis
    - State basic rhythm (e.g., “normal sinus rhythm”, “atrial fibrillation”); identify additional rhythm events if present
3. Conduction Analysis
    - “Normal” conduction implies normal sino-atrial (SA), atrio-ventricular (AV), and intra-ventricular (IV) conduction; if abnormalities present, consider SA Block, AV Block?
4. Waveform Description
    - Carefully analyse the 12-lead ECG for abnormalities in each of the waveforms in the order in which they appear
    - P-waves: are they too wide, too tall, look strange (e.g., are they ectopic?)
    - QRS complexes: look for pathologic Q-waves, abnormal voltages
    - ST segments: look for abnormal ST elevation and/or depression
    - T-waves: look for abnormally inverted T-waves

The ACSM has guidelines defining criteria for a quick and convenient assessment to determine if an ECG test is abnormal, and are listed below. Exercise physiologists will typically examine for each of these issues as data comes to hand.

1. Exercise induced ST depression or elevation of ≥ 1 mm relative to the Q-Q line, lasting 0.06 sec from the J point
2. Ventricular tachycardia (≥ 3 consecutive premature ventricular contractions or >30% frequency)
3. Exercise induced left or right bundle branch block
4. Sustained supraventricular tachycardia
5. R-on-T premature ventricular contraction
6. Exercise induced second or third degree AV block
7. Post exercise U-wave inversion
8. Inappropriate bradycardia

Common Diagnoses

- ST segment depression - cardiac ischaemia
- Prolonged Q-T Interval - repolarisation abnormality and ventricular arrhythmias
- Prolonged QRS Complex - abnormal conduction velocity, bundle branch block

After the lab class you are encouraged to examine the wealth of information available online and in textbooks to improve your understanding of the ECG profile. Naturally, it takes time to become an expert in ECG interpretation, however, exercise physiologists and clinicians are increasingly exposed to this information, so it is an important area of understanding.

Discussion

1. Were any cardiac irregularities noted in the 12-lead ECG rhythm strip from the patient you tested at rest? If so, what were they and where are they likely to originate from?

2. Discuss any special considerations and limitations to ECG testing in:
    - Patients with hypertension
    - Females
    - Patients recovering from a myocardial infarction

3. Briefly describe how the 12 leads on an ECG are determined from only 10 electrodes.

4. List 3 procedures that can be undertaken to ensure a good quality ECG signal during exercise.

5. What is one main **similarity** and one main **difference** between the waveforms of the resting ECG output and the ECG output obtained during exercise? Use Lead I/Lead II and V4/V5 for this analysis

6. If you were required to test a sedentary 55 year old male with exertional dyspnea, borderline hypertension and a family history of heart disease, which treadmill protocol would be the most appropriate to select, and why?

References

- American College of Sports Medicine (2021). Guidelines for Exercise Testing and Prescription, 11th edn, Lippincott, Williams & Wilkins, Philadelphia, USA.
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- Julian, D.G. & Cowan, J.C. (2005). Cardiology, 8th ed. Bailliere Tindall: London.
- Coombes, J., Burton, N. & Beckman, E. (2021). ESSA's Student Manual for Exercise Prescription, Delivery and Adherence, Elsevier, Sydney, Australia.
- The Cardiac Society of Australia and New Zealand. (2003). Safety and performance guidelines for clinical exercise stress testing.

Appendix

Appendix 1 - Common Cardiac Abnormalities

There are many conditions which manifest in unusual electrical activity in the myocardium. Clinical exercise physiologists are trained to observe abnormalities in ECG profile, with subtle differences in the PQRST waveform reflecting important cardiac deficiencies. A few typical abnormalities are described below, with some containing a sample abbreviated profile of the ECG trace for such conditions. For further information on such conditions, consult the reference list at the end of this lab.

For each of the following example ECG charts, try to calculate the heart rate by dividing 300 by the number of major gridlines between each R-wave peak (the minor gridlines are in 0.2 increments). Alternatively, count the number of R-wave peaks in the entire ECG strip (6 seconds) and multiply by 10 for the average beats per minute.

A Normal Sinus Rhythm is shown here for comparison against the other conditions.

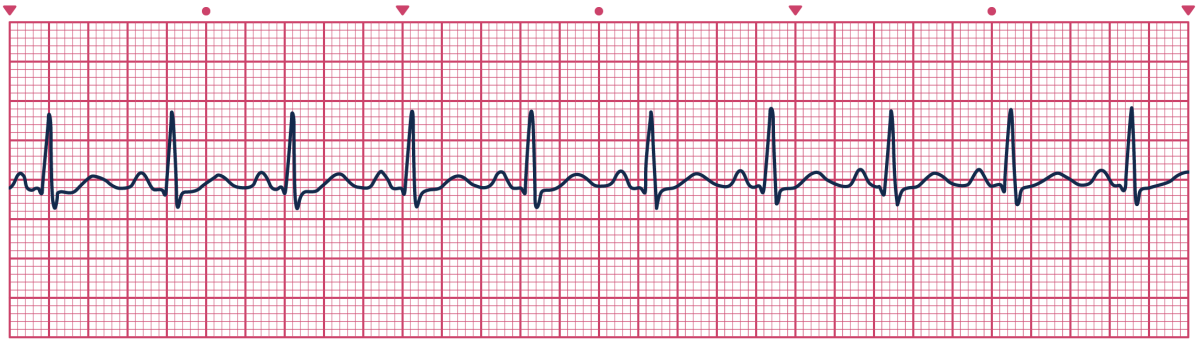


Figure 6: Normal Sinus Rhythm

Sinus Arrhythmia: a normal ECG rhythm with a P wave, and between 50-100 bpm. The difference in RR interval duration between predominant beats is greater than 15%, and no premature atrial complexes are detected.

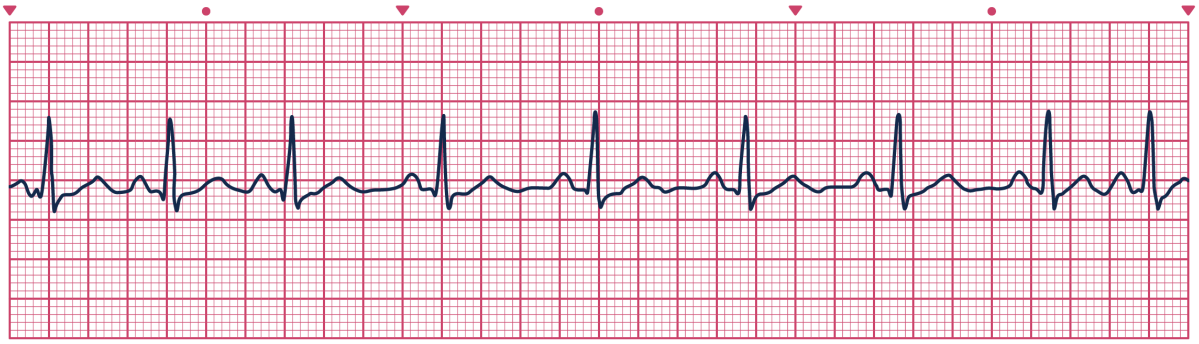


Figure 7: Sinus Arrhythmia

Sinus Bradycardia: a normal ECG rhythm with a P wave with a heart rate of less than 50 bpm.

Figure 8: Sinus Bradycardia

Sinus Tachycardia: a normal ECG rhythm with a P wave with a heart rate of greater than 100 bpm.

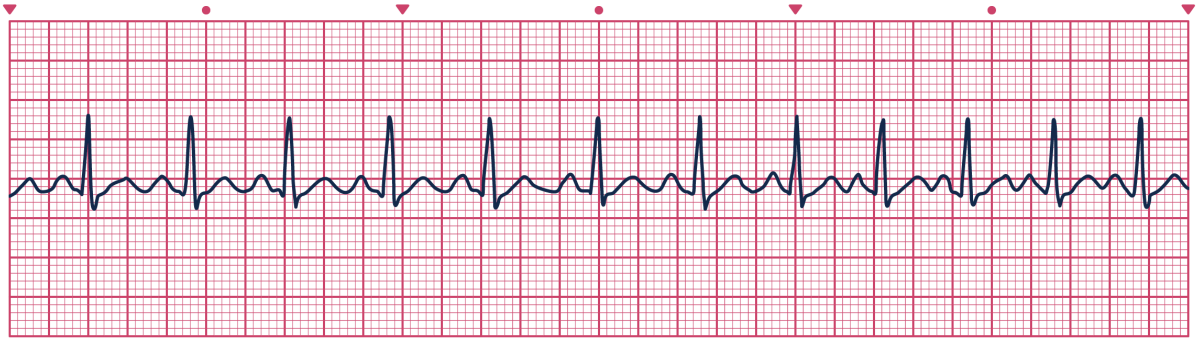


Figure 9: Sinus Tachycardia

Atrial Fibrillation: an abnormal ECG rhythm with no P wave, and a heart rate ≤100bpm. The difference in at least one RR intervals between the predominant beats is <15%.

Figure 10: Atrial Fibrillation

ST Elevation: an abnormal ECG in which the ST elevation in leads V1-V6 is ≥1mV, and ST elevation in at least 2 of leads V1-V6.

ST Depression: an abnormal ECG in which the depression of the ST segment, and is best noted by 1mm depression for 0.06 sec in the lateral leads I, V4, V5, and V6. Exercise induced

ST depression between 1-2mm reflect a moderate risk, however a greater risk is associated with >2mm depression. ST depression is indicative of myocardial ischemia and blockage of a major coronary artery. An example of ST depression is given below (note leads I, V4, V5 and V6).

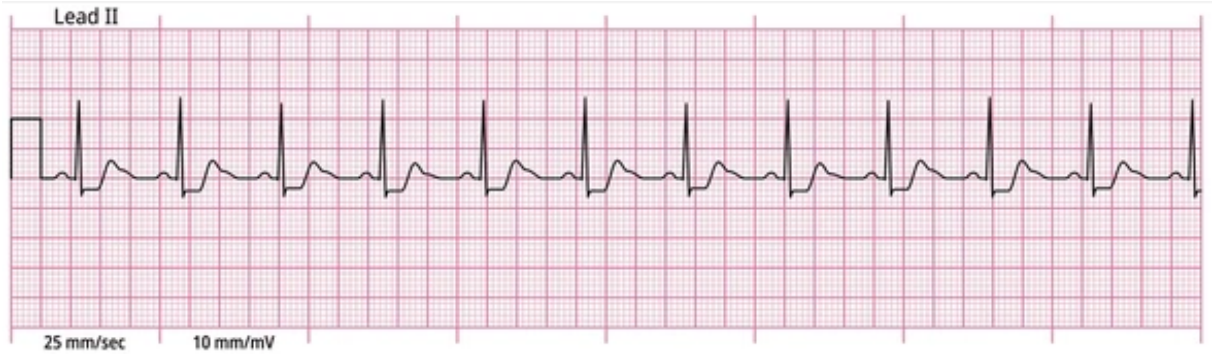


Figure 11: ST Depression

Ectopic beats: In some circumstances, the heart can undergo electrical conduction that is stimulated from outside the SA node. These irregularities are called ectopic beats. Ectopic beats are recognised by the abstract shapes produced within the ECG rhythm as they do not follow the normal conduction system of the heart. There are two basic types of ectopic beats: premature and escape. Premature ectopic beats are caused by irritable areas of the heart (commonly the atrium, AV junction or ventricles) that discharge before the signal from the SA node has been received. They are recognised by new waveforms/complexes that come early in the cardiac cycle (before next scheduled beat arrives). Escape ectopic beats arise from the same areas as the premature beats, and are considered a safety feature to prevent the heart going into complete arrest. They are often the end-product of the SA node failing to fire in a rhythm. The escape beats differ to the premature beats in the sense that they arrive late in the cardiac cycle, or preceded by a long pause.

Figure 12: Ectopic Beat - Premature Ventricular Contraction

Appendix 2 - Common exercise protocols for cardiac stress testing

There are a number of different protocols used to perform cardiac stress testing, and the choice of which test may depend upon the nature of the patient visit, pre-existing orthopaedic or metabolic condition, or simply the technician's personal choice.

Commonly, stress tests are performed on either a treadmill or cycle ergometer due to their popularity, convenience, and safety. Stress tests are typically incremental in nature to provide the ability to monitor cardiac activity during lower intensity workloads prior to introducing greater workloads.

Importantly, cardiac stress tests often maintain a low velocity, but rely on increases in either gradient or resistance to increase exercise intensity. These test modifications are necessary as the majority of patients requiring cardiac stress testing will be of low athletic ability and may risk either physical or cardiac injury by running at high speeds or cycling at a high cadence.

The introduction of performing stress tests through chemical stimulation as opposed to exercise methods may provide a safer manner of testing due to the lack of physical movement, however this is commonly reserved for patients who are at risk but are unable to perform substantial physical movement.

Listed below are a number of common protocols employed in cardiac stress testing for treadmill ergometers from chapter 5 of your textbook:

Table 2: Bruce Protocol; the Modified Bruce Protocol skips the first two stages and has additional stages at higher speeds and grades

Stage	Duration (min)	Speed ($km \cdot h^{-1}$)	Grade (%)
1	3	2.7	0
2	3	2.7	5
3	3	2.7	10
4	3	4.0	12
5	3	5.4	14
6	3	6.7	16
7	3	8.0	18
8	3	8.8	20

Table 3: Balke-Ware Protocol

Stage	Duration (min)	Speed ($km \cdot h^{-1}$)	Grade (%)
1	1	5.3	2
2	1	5.3	3
3	1	5.3	4
4	1	5.3	5
5	1	5.3	6
6	1	5.3	7
7	1	5.3	8
8	1	5.3	9
9	1	5.3	10

Table 4: Naughton Protocol

Stage	Duration (min)	Speed ($km \cdot h^{-1}$)	Grade (%)
1	2	1.6	0
2	2	3.2	0
3	2	3.2	3.5
4	2	3.2	7.0
5	2	3.2	10.5
6	2	3.2	14.0
7	2	3.2	17.5

Table 5: Ellestad Protocol

Stage	Duration (min)	Speed ($km \cdot h^{-1}$)	Grade (%)
1	3	2.7	10
2	3	4.8	10
3	3	6.4	10
4	3	8.0	10
5	3	8.0	10
6	3	9.6	10

Keteyian, S. & Zuhl (2023), Graded Exercise Testing, in: Ehrman, J., K., Gordon, P. M., Visich, P. S. & Keteyian, S. J. Eds, *Clinical Exercise Physiology 5th edn*, Human Kinetics, Champaign IL., USA.

Week 5 - Lipids & Blood Chemistry

Pre-Lab Activity

Read Chapter 9 of the textbook which relates to the topic of obesity.

Revise your notes from 92533 Exercise Physiology relating to blood sampling techniques.

Lab Session

Introduction

The objectives of this week's lab are to:

- Gain experience assessing cholesterol and triglycerides in the blood
- Gain experience using normative scores for blood lipid profiles
- Hypothesise about methods to reduce cases of hyperlipidemia or hypercholesterolemia

Dyslipidemia refers to a disruption to the normal blood lipid profile. Most cases of dyslipidemia are hyperlipidemia (high concentration of blood lipids), which refers to a sustained period of high serum lipid concentration. Such a condition can lead to many serious health complications.

Dyslipidemia is often the result of several lifestyle factors that relate to hypokinesia, and can manifest in a chronic condition (in particular, cardiovascular disease) which can dramatically affect risk of mortality and quality of life. Of each of the modifiable risk factors for cardiovascular disease (including smoking, cholesterol, physical inactivity, hypertension, and diabetes) high levels of serum cholesterol appears to be the most critical factor.

Elevated concentration of low density lipoproteins (LDL-C) is directly related to an increased risk of coronary heart disease and other cardiovascular diseases. An elevated LDL-C measure may lead to an increase in the development of atherosclerotic plaques in the arteries, thus affecting blood flow dynamics and central and peripheral blood pressures.

Lab Question 1

What are some foods that are high in LDL-C?

In contrast to the negative effects of LDL-C, elevated concentration of high-density lipoproteins (HDL-C) is positively associated with cardiovascular health. In this way, it is ideal to have HDL-C scores as high as possible, and LDL-C scores as low as possible. There is a large body of literature stating the beneficial effects of HDL-C, as it acts as a scavenger molecule in the arterial network, assisting in the removal of atherosclerotic deposits.

Lab Question 2

List some foods that are high in HDL-C and are therefore beneficial to include in a healthy diet.

The concentration of total cholesterol is directly proportional to mortality rate, and lifestyle and medical interventions have shown that these elevated values are reversible. With this in mind, it is important for patients with hypercholesterolemia and high LDL-C to modify their associated risk factors, in particular, diet and exercise.

The measure of Triglycerides provides information pertaining to the level of circulating fatty acids. Elevated triglyceride levels are directly associated with atherosclerosis, therefore, attempts should be made to minimise the consumption of foods that contain high amounts of fat. It is common to witness elevated triglyceride concentration in conjunction with elevated LDL-C concentration. Triglyceride concentration is not as important as the LDL:HDL ratio, however, it remains an extremely important measure as far as cardiovascular health is concerned. The TC:HDL ratio is also an important marker of the type of cholesterol. Discuss whether a high or low TC:HDL ratio is preferred for optimal health…

Blood chemistry is often assessed in a fasted state. This removes the acute nature of changes in certain hormones (especially insulin) which can affect blood chemistry and provides a more accurate representation of current health status. Each of the variables that you will be assessing today may be affected by pre-test diet. Triglyceride levels often remain relatively high for a sustained period after eating (6-8 hours) as food is digested.

Table 1: Normative Values for Blood Cholesterol and Triglycerides

Variable	Ideal	Borderline High	High Risk
Total Cholesterol	≤ 5.18 mmol/L (200 mg/dL)	5.19-6.20 mmol/L (200-239 mg/dL)	≥ 6.21 mmol/L (240 mg/dL)
HDL Cholesterol (Note: Higher values are better)	≥ 1.55 mmol/L (60 mg/dL)		≤ 1.04 mmol/L (40 mg/dL)
LDL Cholesterol	≤ 2.59 mmol/L (100 mg/dL)	2.60-4.20 mmol/L (100-160 mg/dL)	≥ 4.21 mmol/L (160 mg/dL)
Triglycerides	≤ 1.70 mmol/L (150 mg/dL)	1.71-2.25 mmol/L (150-200 mg/dL)	≥ 2.26 mmol/L (200 mg/dL)

Methods

Equipment

- Cardiochek PA analyser
- PTS Lipid panel test strips
- Blood sampling equipment (gloves, alcohol wipes, lancets, gauze, tissues)

Procedure

We will be using CardioChek PA analysers for the assessment of lipid profiles. You will divide into groups of 8-10 students, and within those groups, you will be placed in pairs and work as a team. One person will perform the testing, and one will play the role of the client.

You are required to treat the client with respect, as if they are a paying customer of a clinic, and obtain a brief background from them, including family history of hypercholesterolemia, heart disease/other conditions, recent exercise history, and any other pertinent information that may be relevant to this type of testing.

The subject will (ideally) be in a fasting state, having not consumed any food within the preceding 12 hours. Recent eating can dramatically alter blood cholesterol readings, rendering them a poor reflection of fasting values. Within your groups, preferably test only the individuals that have fasted to ensure good quality data.

Following this testing, you will formulate a hypothetical patient and work through some issues.

You are required to assess the following:

1. Total cholesterol
2. HDL cholesterol
3. LDL cholesterol
4. Triglycerides
5. TC:HDL ratio

Blood Sampling Technique

1. Select the puncture site (practice on either the fingertip or ear)
2. Warm/hyperaemise the area with massage and/or Finalgon cream
3. **Clean the site** using an alcohol pad in a circular motion and allow to dry. Wipe site with a cotton pad.
4. Hold the site **firmly** and make the puncture in one continuous, deliberate, perpendicular motion. Punctures in the fingertip should be into the pulp and across rather than parallel to the fingerprint. Punctures in the earlobe should be in the flesh, avoiding any cartilage.

> **!** This is the most important part of drawing a good blood sample. You need to make sure the puncture is performed with sufficient pressure or you may not be able to draw enough blood.

5. **Wipe away the first drop of blood** using a clean cotton pad or tissue, as it may be contaminated with other body fluids.
6. Apply moderate pressure to ensure adequate blood flow, but **do not squeeze vigorously**. This avoids collection of interstitial fluid in addition to blood.
7. Collect the blood into the appropriate container, i.e., the capillary tube. **Make sure you allow the blood to form a droplet first**.
8. If further samples are required, or if the subject has to immediately return to exercise, cover the wound with surgical tape. Otherwise, apply light pressure with a cotton pad or tissue until the bleeding stops, then cover with tape or band-aid.
9. **Dispose of all contaminated material into the appropriate container**.

> **!** Once an item has been used it is considered contaminated whether blood is visible or not, and hence must be disposed of, or sterilised if intended for re-use. Equipment such as lancets and tissues must be used only once and then disposed of even when making repeated measurements on the same subject.

CardioChek PA Technique

1. Switch the unit on with the arrow button on the right hand side
2. Ensure the **strip code** you are using matches the code on the chip.
3. Slide the strip into the unit, ensuring that it is oriented in the correct direction.
4. Await the instructions on the screen and then place the blood sample onto the strip. Make sure you **cover the area fully**, ensuring an even spread of blood. You need to be quick when placing blood onto the test strip as analysis commences automatically when the first drop of blood touches the strip.
5. The analyser will take a moment to produce the results. When analysing Cholesterol/Triglycerides, press the arrow button to scroll through the different results.
6. Record all results. Note: For some values, you may receive a score preceded by "<" or ">", indicating that the score was less than or greater than the lower or upper limit for the testing device. Please make sure you pay attention to this when writing your scores down.
7. Once all results are recorded, remove the strip, clean the area as appropriate, and dispose of any materials used.

Some of the values are directly measured, whereas the following calculation is used to indirectly assess LDL cholesterol:

LDL = *Total cholesterol – HDL – (Triglycerides / 5)*

> **i** Please be careful with the analysers and strips – they are expensive pieces of equipment

Results

Patient Details

e.g., name, age, health history

Test Data

Variable	Result
Total Cholesterol	
Triglycerides	
HDL Cholesterol	
LDL Cholesterol	
TC:HDL Ratio	

Comments

Case Study

In your pairs, generate pre-post test data for a hypothetical patient who presents with hyperlipidaemia and hypercholesterolaemia prior to completing an 8-week exercise program. Estimate the effect of the exercise intervention on the patient's lipid profile.

Variable	Pre-Intervention	Post-Intervention
Total Cholesterol		
Triglycerides		
HDL Cholesterol		
LDL Cholesterol		
TC:HDL Ratio		

Write an exercise management plan for this patient, taking into account diet, lifestyle, exercise, and medications. Use internet searches or GenAI to identify some common medications. Provide some examples of exercise sessions you would include to provide a sufficient stimulus to improve their cardiovascular and metabolic fitness, and describe why these would be effective for improving the patient's lipid profile.

Discussion

1. How do the results of the class member that you tested compare to the normative scores? Within the range? Outside the range? Can you identify any reasons for these results?

2. What are some of the important dietary considerations when dealing with hypercholesterolemia and hyperlipidemia

3. Discuss the exercise programming issues when considering exercise as a form of treatment for patients with hyperlipidemia and hypercholesterolemia. Include mention of the safety concerns.

4. Why is LDL cholesterol such an important physiological parameter to measure?

Week 6 - Cardiovascular Case Studies

Pre-Lab Activity

Complete the short Diabetes Quiz in your Canvas Modules.

Lab Session

Introduction

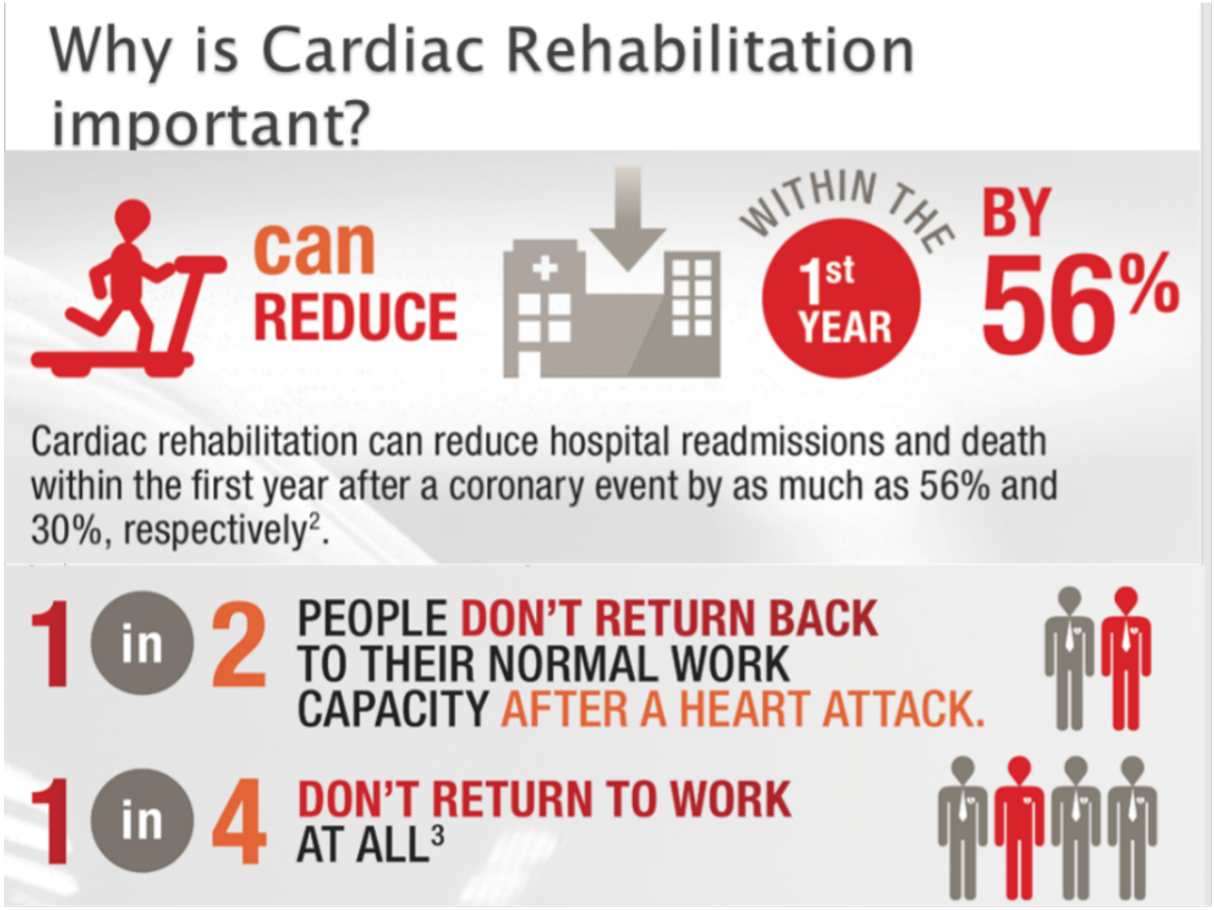
Within this tutorial you will learn how cardiac rehabilitation programs are implemented. Specifically, you will learn how to assess, screen and prescribe programs for patients with cardiovascular disease through case studies. There will be a discussion about various precautions and contraindications for exercise prescription for CVD. Students will undertake a series of health screening protocols and discuss their relevance and importance to the safety aspects of clinical exercise physiology along with the need to work within the scope of practice.

The objectives of this lab are to:

- Gain a detailed understanding of treatment strategies for cardiovascular conditions
- To undertake screening exercises and appropriate questionnaires in the context of patients with cardiovascular disease
- To consider the clinical aspects and logistical implications of implementing treatment for cardiovascular conditions
- To develop safe and effective cardiac rehabilitation programs for a range of case studies

Activity 1 - Cardiac Rehabilitation

Importance of Cardiac Rehabilitation



How Do Cardiac Rehab Programs Work?

Cardiac rehabilitation usually runs for 6 to 10 weeks. It often starts in hospital and continues when you go home. Programs can be implemented in different ways and places, for example:

- Face-to-face
- Over the telephone
- On the internet
- In a group or one-on-one
- In hospitals, community centres or clinics
- In your home

Cardiac Rehabilitation Process and Education

The following are the Heart Foundation's essential steps in the cardiac rehabilitation process.

Initial assessment	
1	Comprehensively assess the CR participant's needs and develop an individualised care plan. This initial assessment should include: • socio-demographic information • clinical history • exercise capacity • lifestyle risk factors (physical activity, diet, smoking, alcohol) • psychosocial health (depression, anxiety) • medications.
2	Following the initial assessment, encourage and support participants to set achievable goals.
Heart education and self-management	
3	Educate CR participants about self-management strategies.
Medication education and review	
4	Give CR participants medication education that includes basic indications and benefits of commonly prescribed medication therapy.
5	Encourage and support participants to adopt strategies that lead to medication adherence.
Managing medical risk factors	
6	Equip CR participants with the skills to self-manage or prevent hypertension.
7	Equip participants with the skills to self-manage or prevent dyslipidaemia.
8	Equip participants with the skills to self-manage or prevent diabetes.
Exercise and physical activity	
9	Give CR participants a tailored, progressive and supervised exercise training program.
10	Educate participants about strategies to increase general physical activity and reduce sedentary behaviour.
Healthy eating & weight management	
11	Focus advice on making healthy dietary choices to reduce total cardiovascular risk.
12	If resources allow, offer individualised consultation with a trained health professional to discuss diet. The goals are to understand the CR participant's current eating habits, and give personalised advice that is sensitive to culture, needs, socio-economic status, and capabilities.

Tobacco cessation and alcohol reduction	
13	Give CR participants who smoke a brief intervention for smoking cessation, using the Ask, Advice and Help model.
14	Encourage participants who continue to smoke to use a combination of nicotine replacement products (patch plus gum or spray or lozenge or inhalator) and/or to visit their doctor to discuss other 'stop smoking medications' to assist quitting.
15	Offer participants who are excessive drinkers brief advice/counselling to encourage reduction of alcohol intake.
Psychosocial wellbeing	
16	Screen CR participants for depression and anxiety at the beginning and end of the CR program using a validated tool.
17	Give participants an opportunity to discuss the typical emotional response to a heart event.
18	Educate participants about the signs and symptoms of depression and other mood disorders.
19	Assist participants to respond appropriately to ongoing psychological symptoms including when to seek help.
Activities of daily living	
20	Discuss driving restrictions with CR participants and help them to find further information.
21	Give participants an opportunity to discuss any concerns related to resuming sex after their cardiac event.
Reassessment and completion	
22	The post-program assessment should include, at a minimum: • exercise capacity • lifestyle risk factors (physical activity, diet, smoking, alcohol) • psychosocial health (depression, anxiety) • medications
23	Review CR participants' goals at the completion of the program.
24	Give the participant and their general practitioner and cardiologist a discharge or summary letter.

Figure 1: Essential cardiac rehabilitation best practice statements

An example brochure for a Sydney-based Cardiac Rehabilitation program is included below for you to gain an insight to the types of activities. We are fortunate to be able to gain detailed insight into such a program from the lead Exercise Physiologist in class.

At Arcadia we provide an individualised cardiac rehabilitation program, facilitated by a friendly & professional multi-disciplinary team where patients can enjoy state of the art facilities. The comprehensive program adheres to the National Heart Foundation of Australia & Australian Cardiac Rehabilitation Association guidelines & standards, with a focus on patient centered care.

The Cardiac Rehabilitation Program comprises of a multidisciplinary team including: Cardiologists, Exercise Physiologists, Physiotherapists, Occupational Therapists, Dietitians, Rehabilitation Specialists and Nurses.

Exercise has been proven to reduce symptoms of heart disease, increase quality of life, improve confidence and reduce the number of hospital readmissions.

Eligible Patients

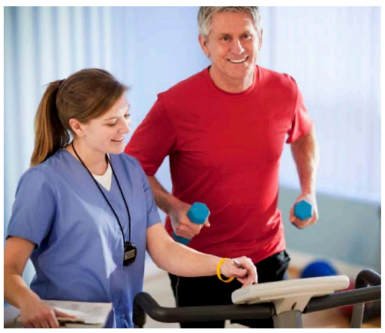
The core group of people eligible for cardiac rehabilitation are those who have had:

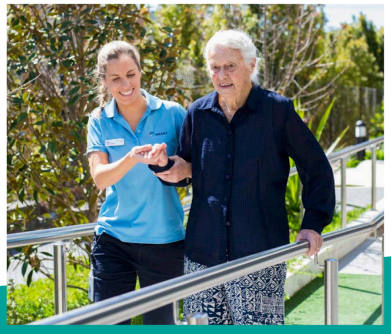
- Myocardial infarction (recent heart attack)
- Re-vascularisation & valve procedures
- Stable or unstable angina
- Controlled heart failure
- Other vascular or heart disease

INPATIENT CARDIAC REHABILITATION

Key: Mobilisation & Resumption of Activities of Daily Living

- Basic Information, Education & Counselling
- Reassurance & explanation of cardiac condition, treatment & procedures
- Psychological issues e.g. mood (depression), emotions, sleep disturbance
- Social factors
- Explanation of the inpatient activity (mobilisation) program
- Management of symptoms e.g. chest pain, breathlessness, palpitations
- Medications
- Identification and modification of risk factors
- Wound care (if applicable)
- Resumption of: physical, sexual and daily living activities (e.g. driving & return to work)
- Discharge planning, including referral to outpatient program





OUTPATIENT CARDIAC REHABILITATION

All patients will be scheduled for medical assessment by our rehabilitation specialists prior to participating in the cardiac rehabilitation program. The program includes:

- Cardiac Rehabilitation assessment, review & follow-up
- Program structure: Each session will include 1 hour of exercise & 1 hour education
- Attendance: twice weekly
- Program Length: 7 weeks (minimum 6 sessions)
- Gym sessions supervised by an Exercise Physiologist
- Patient cardiac education by the multidisciplinary team & take home resources
- Guidance in self-monitoring during physical activity

Education topics

- Heart anatomy & physiology
- Effects & risk factors of heart disease
- Behaviour change & maintenance
- Healthy eating in practice
- Return to activities of daily living
- Cardiac exercise recommendations & guidelines
- Psychological issues & social factors
- Symptom management
- Medications
- Cardiac investigations & procedures
- Cardiac health beliefs & misconceptions

What to bring

- Referral from either your; GP, specialist, surgeon or discharging hospital
- If required, your partner or support person, so they can learn about your condition & how to support you
- A list of current medications & medical history.
- Any required equipment such as walking aids, portable oxygen, & reading glasses
- Loose-fitting, comfortable clothing and suitable shoes (joggers) should be worn each time

What happens when I finish the program?

Continuing to exercise after the program will ensure you maintain improvements and allow you to continue to progress. A maintenance wellness program is available after you have completed the program.

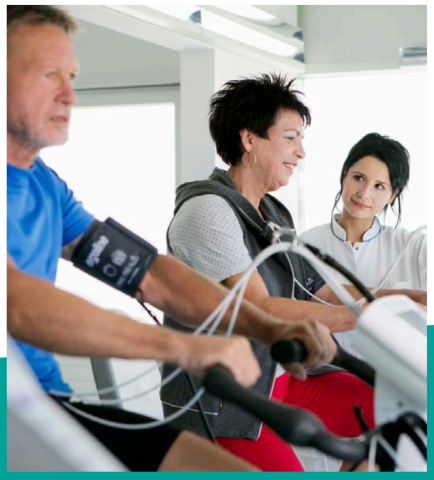
There are also a number of community organisations that offer a variety of exercise opportunities. These include:

- Gym-based programs
- Group exercise classes
- Community walking groups
- Balance classes
- Tai Chi

More information on a suitable exercise venue near you can be obtained on completion of the Day Rehabilitation program.

Will there be any follow up?

Your initial tests will be repeated when you complete the program, and a follow-up appointment with our rehabilitation specialist will be arranged after the program. This allows you to monitor your progress and to seek advice relevant to your condition.



Heart Foundation Recommendations for Initial Assessment Measures and Tools

- All the major cardiac rehabilitation guidelines recommend that individualised assessments should be provided in the initial stages of a program and re-assessed prior to completion.
- Collaborative goal-setting and shared decision-making is essential to fostering self-care in a chronic disease population. This process should commence at the initial assessment and continue to be reviewed throughout the program.
- Cardiac Rehabilitation involves a multidisciplinary team: rehabilitation specialists, cardiologists, cardiothoracic surgeons, nursing, exercise physiologists, physiotherapists, occupational therapists, dieticians and social workers.

The Heart Foundation provides a large range of resources for practitioners which outline aspects of assessing patients, exercise prescription, healthy eating and psychological well-being.

Below are some examples from the Heart Foundation cardiac rehabilitation program content.

Initial Assessment

CR programs should undertake a comprehensive initial assessment that enables the needs of the CR participant to be understood and leads to an individualised care plan.
Essential components of the initial assessment include:

- socio-demographic information
- clinical history
- exercise capacity
- lifestyle risk factors (physical activity, diet, smoking, alcohol)
- psychosocial health (depression, anxiety)
- medications

Other **desirable components** to consider at the initial assessment include:

- adiposity (waist circumference)
- medical risk factors (blood pressure, lipids, blood glucose)
- quality of life
- return to activities of daily living

Example Content

Table 1. Core elements to include in an initial patient assessment common to all clinical conditions adapted from Piepoli et al. (2014)[3] and Woodruffe et al. (2015)[2]

Socio-demographics	Including name, medical record number, gender, residential postcode, date of birth, living circumstance, culturally and linguistic diverse background, language spoken at home, Aboriginal or Torres Strait Islander status, employment status, education level, social support.
Clinical history	Principal referral diagnosis, cardiac interventions/ complications, past and current medical history, symptom and wound pain review (frequency, severity, management, medical review required), sternal instability, required aids: hearing aids, glasses, gait aids. **Tool option:** Sternal instability: sternal instability scale.
Exercise capacity	**Assessment:** Symptom-limited exercise testing, either on bicycle ergometer or on treadmill, may be considered. Other options include sub-maximal exercise evaluation and/or Six-Minute Walk Test or Incremental Shuttle Walk Test. Mobility/physical limitations that impede exercise should be assessed. If feasible, peak exercise capacity assessment may be considered.
Adiposity	**Assessment:** Measure waist circumference (cm) **Target:** men: <94cm; women <80cm
	Medical risk factors
Lipid management	**Assessment:** Total cholesterol, low density lipoprotein (LDL), high density lipoprotein (HDL), Triglycerides. • **Target: Secondary prevention targets in CVD: Low-density lipoprotein cholesterol (LDL-C) < 1.8 mmol/L** • **High-density lipoprotein cholesterol (HDL-C) > 1.0 mmol/L** • **Triglyceride (TG) < 2.0 mmol/L.**
Blood pressure	**Assessment:** Blood pressure using the Heart Foundation hypertension guidelines. **Target:** <140/90mmHg.
Diabetes	**Screening:** Assess presence of diagnosed Type 1 or 2 diabetes. Document glycosylated haemoglobin (HbA1c) and fasting blood glucose level (BGL) where available. **Target:** HbA1c < 7mmol/L or individualised target set by healthcare provider based on duration of diabetes, presence of CVD and hypoglycaemic risk.

Lifestyle risk factors	
Physical activity	**Assessment:** domestic, occupational, and recreational needs; activities relevant to daily life; barriers to increased physical activity, upper limb assessment. **Tool option:** Validated self-report: e.g., EPIC Physical Activity Questionnaire; Objective measures: physical activity monitors and Apps (e.g. Fitbit, Apple watch), step counters (e.g. pedometry). Difficulty Questionnaire (FDQ) for upper limb ADLs. **Target:** Minimum of 150mins/week of moderate intensity physical activity.
Diet/nutrition	**Screening:** Assessment of nutritional status. **Tool option:** Healthy Eating Quiz (University of Newcastle), Mini Nutritional Assessment. **Target:** Adoption of a healthy dietary pattern.
Tobacco use	**Screening:** History of tobacco use. Determine if current smoker (within 1 month of assessment); Ex-smoker (quit >1 month); or never smoked; previous attempts at quitting. **Target:** Tobacco cessation.
Alcohol use	**Screening:** History of alcohol intake. **Target:** < 2 standard drinks per day.
Illicit substances	**Screening:** History or current use of illicit substance use.
Psychosocial health	
Depression	**Screening:** Past history of depression; screen for current signs of depression using a validated tool. **Tool option:** Initial screening tools such as PHQ-2. Participants who screen positive should have further evaluation with the longer form (PHQ-9). Alternatively, use nominated screening tool of health service or consider Cardiac Depression Scale (CDS), Hospital Anxiety and Depression Screener (HADS), BDI-II.
Anxiety	**Screening:** Past history of anxiety, screen for current signs of anxiety using nominated screening tool of health service.
Quality of life	**Use nominated screening tool of health service or consider** WHOQOL-BREF, AQoL (e.g. AQoL-4D), EQ-5D-5L.
Medications	
Medications	**Assessment:** List all cardiac medications (dose and frequency); assess adherence to pharmacotherapy and understanding of medications.

In pairs, answer the following questions.

Lab Question 1

List 2 essential components of a Cardiac Rehabilitation Initial Assessment:

Lab Question 2

What are two clinical exercise capacity assessments you could apply in a CR setting?

Activity 2 - Screening, Lifestyle Risk Factors, and Risk Stratification

There are many different methods of screening individuals for medical conditions. Screening activities and questionnaires must be able to elucidate the issues associated with the ACSM table below. Typically, questionnaires aim to probe the patient/client to remembering any family history of illness or disease, any previous complications, and other conditions that may be present. Risk stratification is essential when working with individuals with chronic disease.

Atherosclerotic Cardiovascular Disease Risk Factor Thresholds for Use With ACSM Risk Stratification

Positive Risk Factors	Defining Criteria	Points
Age	Men ≥45 years Women ≥55 years	+1
Family History	Myocardial infarction, coronary revascularization, or sudden death before age 55 in father or other first-degree male relative, or before age 65 in mother or other first-degree female relative	+1
Smoking	Current smoker or those who quit within the previous six months, or exposure to environmental smoke	+1
Sedentary Lifestyle	Not participating in at least 30 minutes of moderate-intensity physical activity (40 to <60% VO_2r) on at least three days/week for at least three months	+1
Obesity	Body mass index ≥30 kg/m^2 or waist girth >102 cm for men and >88 cm for women	+1
Hypertension	Systolic blood pressure ≥140 mmHg and/or diastolic blood pressure ≥90 mmHg, confirmed by measurements on at least two separate occasions, or currently on antihypertensive medications	+1
Dyslipidaemia	Low-density lipoprotein (LDL) cholesterol ≥130 mg/dL (3.37 mmol/L), or high-density lipoprotein (HDL) cholesterol <40 mg/dL (1.04 mmol/L), or on lipid-lowering medication; if total serum cholesterol is all that is available, use serum cholesterol ≥200 mg/dL (5.18 mmol/L)	+1
Prediabetes*	Fasting plasma glucose ≥100 mg/dL (5.55 mmol/L), but ≤125 mg/dL (6.94 mmol/L), or impaired glucose tolerance (IGT) where a two-hour oral glucose tolerance test (OGTT) value is ≥140 mg/dL (7.77 mmol/L), but ≤199 mg/dL (11.04 mmol/L), confirmed by measurements on at least two occasions.	+1
Negative Risk Factors	**Defining Criteria**	**Points**
HDL Cholesterol#	≥60 mg/dL (1.55 mmol/L)	-1

*If the presence or absence of a CVD risk factor is not disclosed or is not available, that CVD risk factor should be counted as a risk factor except for prediabetes. If the prediabetes criteria are missing or unknown, prediabetes should be counted as a risk factor for those ≥45 years old, especially for those with a body mass index (BMI) ≥25 kg/m^2 and additional CVD risk factors for prediabetes. The number of positive risk factors is then summed.

#High HDL is considered a negative risk factor. For individuals having high HDL ≥60 mg/dL (1.55 mmol/L), one positive risk factor is subtracted from the sum of positive risk factors.

VO_2r = VO_2reserve

Risk Stratification

RISK LEVEL	CRITERIA
Low	Men <45 AND no more than one risk factor Women <55 and no more than one risk factor.
Moderate	Men >45, Women >55 Individuals with >2 risk factors
High	Known cardiovascular or pulmonary disease Metabolic disorders (diabetes, thyroid). Symptoms with exercise (shortness of breath, chest pain, dizziness, heart murmur)

	LOW RISK	MODERATE RISK	HIGH RISK
Moderate Exercise 40-60% of VO2 Max	Not Necessary	Not Necessary	Recommended
Vigorous Exercise >60% of VO2 Max	Not Necessary	Recommended	Recommended

Figure 2: ACSM Recommendation for physician/medical examination or supervision is needed to perform either moderate or vigorous exercise.

Screening in the Australian Context: The Adult Pre-Exercise Screening System (APSS)

The APSS is accepted in Australia as the industry standard pre-exercise screening system as it is endorsed by the peak bodies of exercise in the country - Exercise and Sports Science Australia (ESSA), Sports Medicine Australia (SMA), and Fitness Australia.

There is a user guide to frame how each question should be approached and the screening tool consists of two stages. Both the user guide and screening tool are available at the ESSA website. It is also available in the Appendix for this lab.

Stage 1, which can be self-administered by the client, consists of six questions which are answered YES or NO, and are designed to identify individuals with signs or symptoms of underlying disease, or who may be at higher risk of an adverse event during exercise.

- If the individual answers NO to all six questions, then the individual notes their exercise levels and is free to undertake light-moderate intensity exercise, but importantly, not high intensity exercise unless they are already undertaking >150 minutes per week. Definitions of exercise intensities using a range of objective and subjective criteria are clearly specified in the APSS documentation.
- Ticking YES to any Stage 1 question identifies the individual being at “higher risk”, which then requires a referral to an appropriately qualified allied health professional, such as AEP or a GP for additional guidance and assessment prior to undertaking exercise.

Stage 2 of the APSS is to be conducted by a qualified exercise professional and consists of additional questions on cardiac risk factors and medical history.

When considering the Case Studies below, use the APSS as part of your screening process.

Activity 3 - Exercise Precautions and Contraindications

Exercise Precautions and Monitoring

When conducting exercise with patients with known and unknown low, moderate, or high risk of coronary heart disease you must always monitor exercise intensity and abnormal signs of symptoms, e.g., chest tightness/pain, dizziness, nausea. With resistance exercises it is important to avoid the Valsalva manoeuvre for all cardiac patients.

You will already be familiar with some common exercise monitoring methods. They may be objective or subjective measurement tools, and some are more accessible than others. Examples of these include:

- RPE (Borg Scale)
- Blood Pressure & Heart Rate
- Talk Test
- Self Monitoring - always teach patient how to do this
- Symptoms (e.g., Angina Scale)
- METs
- Pulse Oximeter
- ECG
- General Observation

Monitoring should be done **before, during, and after sessions** to ensure no adverse outcomes. It's important to make sure the patient (and the person supervising) knows their limits.

Contraindications to Exercise

It's important to be aware of and understand the contraindications to exercise - conditions that suggest we should avoid exercise.

Absolute Contraindications

- A recent significant change in the resting ECG suggesting significant ischemia, recent myocardial infarction (within 2 days) or other cardiac event
- Unstable coronary heart disease
- Uncontrolled cardiac arrhythmias causing symptoms or hemodynamic compromise
- Severe symptomatic aortic stenosis
- Uncontrolled symptomatic heart failure
- Acute pulmonary embolus
- Acute myocarditis or pericarditis
- Suspected or known dissecting aneurysm
- Acute infection

Relative Contraindications

- Left main coronary stenosis
- Moderate valvular stenosis
- Electrolyte abnormalities (hypokalemia, hypomagnesemia)
- Systolic blood pressure at rest over 200 mmHg, diastolic over 120 mmHg
- Tachyarrhythmias or bradyarrhythmias
- Hypertrophic cardiomyopathy or other forms of outflow tract obstruction
- Neuromuscular, musculoskeletal, or rheumatic disorders that are exacerbated by exercise
- High degree atrioventricular block
- Ventricular aneurisym
- Uncontrolled metabolic disease

Sternal Precautions Post Coronary Artery Bypass Graft (CABG)

- No flexion/abduction past 90 degrees
- No weight-bearing through the upper extremities
- No lifting >5-10 lb (max 4.5kg).
- No unilateral reaching posteriorly
- Sternal cracking/popping/clicking/clunking/pain could be sternal instability (***6-8 weeks for the sternum to heal***)

Cardiac Exercise Prescription

Below are some refresher examples of appropriate prescription for cardiac rehabilitation.

Modes	Goals	Intensity	Time to Goal
Aerobics • Large muscle activities (arm/leg ergometry)	• Increase aerobic capacity • Decreased BP & HR response to sub max exercise	• Borg RPE 12- 14 • 40-85 VO2max/ HRR • Intensity to be kept below ischaemic threshold • 3-7 days a week • 20-60 mins continuous exs • 5-10 mins warm up/down	• 4-6 months
Strength • Circuit training	• Increase ability to perform leisure, occupational & daily living activities • Increased muscular strength	• 40-50% maximal voluntary contraction (avoid vasalva) • 2-3 days/ week • 1-3 sets, 10-15 repetitions • Resistance should be gradually increased over time (1-2 lbs)	• 4-6 months
Flexibility • Upper & lower body ROM	• Decreased risk of injury • Improved ROM in post sternotomy	2-3 days/ week	• 4-6 months

Lab Question 3

List 2 absolute and 2 relative contraindications to exercise

Lab Question 4

What are two precautions for a patient 3 weeks post CABG?

Activity 4 - Case Studies

For the following case studies, work in pairs to perform a mock cardiac assessment. Nominate one assessor and one mock patient.

Screen the patient, complete the sample cardiac assessment form, highlight any precautions, and create an exercise management plan (EMP) for the case study. The EMP should include short- and long-term SMART goals, a couple of exercise capacity assessments, and 4 weeks of exercise prescription with a 2-week progression.

The following are provided below and in the Appendix for this Lab to help you complete each case study:

- An APSS form
- A Cardiac Assessment form
- An Exercise Management Plan template

Case Study 1

Cathy is a 62-year old female with Coronary Artery Disease.

Cathy attends your Cardiac Rehabilitation program 3 weeks post-operation for a double bypass. In her discharge summary from hospital you read the following findings: LDL 1.6 mmol/L; waist circumference 85 cm; resting BP 135/85; and, resting HR 65bpm. Medications on discharge: Atorvastatin (Lipitor – cholesterol lowering medication), Captopril (ACE inhibitor – BP lowering medication), and Sertraline (Selective Serotonin Reuptake Inhibitors – Antidepressant). On another GP letter you find further information on her history of sedentary behaviour due to a busy corporate career as a lawyer and depression since her mother recently passed away from a heart attack.

Exercise Management Plan

Risk Category:

Precautions/Monitoring Methods:

Pre and Post Exercise Capacity Assessments:

SMART Goals	
Short Term	Long Term

Exercise Goal	**Aerobic**			
Max HR	bpm			
Week	**1**	**2**	**3**	**4**
Days per Week				
Warm up + Cool down	**Type** **Intensity** HR RPE **Time**	**Type** **Intensity** HR RPE **Time**	**Type** **Intensity** HR RPE **Time**	**Type** **Intensity** HR RPE **Time**
Type/Mode				
Intensity	HR RPE	HR RPE	HR RPE	HR RPE
Time				

Exercise Goal	**Strength**			
Week	**1**	**2**	**3**	**4**
Upper Body				
Exercises	**Intensity** RPE/RIR Load% **Sets** **Reps**	**Intensity** RPE/RIR Load% **Sets** **Reps**	**Intensity** RPE/RIR Load% **Sets** **Reps**	**Intensity** RPE/RIR Load% **Sets** **Reps**
Lower Body				
Exercises	**Intensity** RPE/RIR Load% **Sets** **Reps**	**Intensity** RPE/RIR Load% **Sets** **Reps**	**Intensity** RPE/RIR Load% **Sets** **Reps**	**Intensity** RPE/RIR Load% **Sets** **Reps**
Core				
Exercises	**Intensity** RPE/RIR Load% **Sets** **Reps**	**Intensity** RPE/RIR Load% **Sets** **Reps**	**Intensity** RPE/RIR Load% **Sets** **Reps**	**Intensity** RPE/RIR Load% **Sets** **Reps**
Functional				
Exercises	**Intensity** RPE/RIR Load% **Sets** **Reps**	**Intensity** RPE/RIR Load% **Sets** **Reps**	**Intensity** RPE/RIR Load% **Sets** **Reps**	**Intensity** RPE/RIR Load% **Sets** **Reps**
Flexibility (before every session)				
Exercises	Time Reps RPE/RIR	Time Reps RPE/RIR	Time Reps RPE/RIR	Time Reps RPE/RIR

Case Study 2

Lisa is a 76-year old female with hypertension and suspected Coronary Artery Disease.

Lisa attends a Cardiac Centre for a health and risk factor assessment. Her sedentary lifestyle had her concerned that the history of heart disease in her family might turn into something worrying. Assessment findings included: resting heart rate 84 bpm; blood pressure 172/68 mmHg; height 163 cm; weight 79 kg; waist-hip ratio 0.75; body fat (est. from skinfolds) 42%. Lipid profile included: total cholesterol 6.5 mmol/L; HDL 0.8 mmol/L; LDL 5.1 mmol/L; TC:HDL ratio 8.125; and, triglycerides 3.0 mmol/L. Fasting glucose was 7 mmol/L. Medical history included hypothyroidism, arthritis, insomnia, and a long-standing history of ankle edema. The patient also reported symptoms of sleep apnea.

What would the cardiac risk factors entail for this patient and please provide a plan for improving health outcomes without relying upon medication in the first instance.

Exercise Management Plan

Risk Category:

Precautions/Monitoring Methods:

Pre and Post Exercise Capacity Assessments:

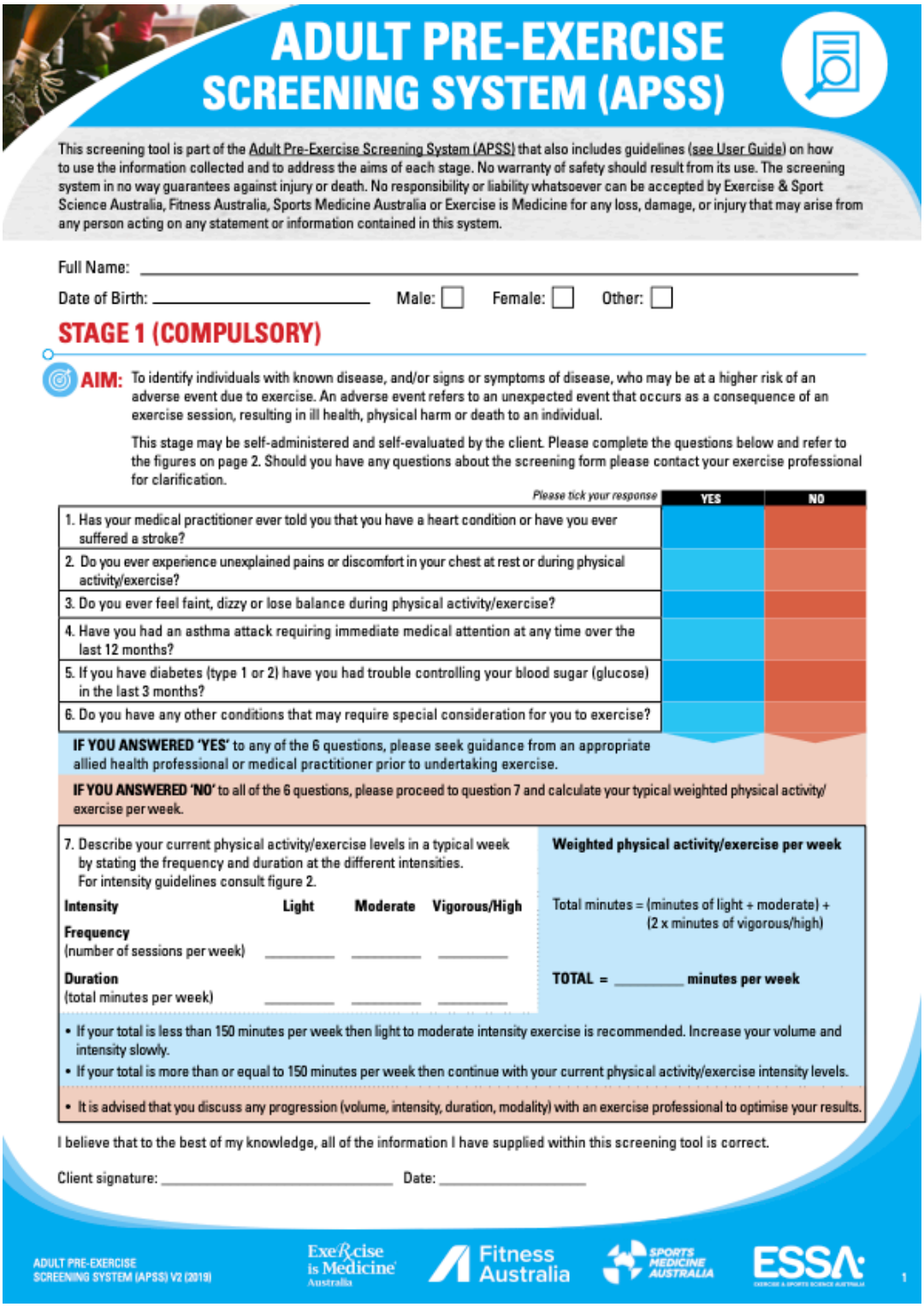
SMART Goals	
Short Term	Long Term

Exercise Goal	**Aerobic**			
Max HR	bpm			
Week	**1**	**2**	**3**	**4**
Days per Week				
Warm up + Cool down	**Type** **Intensity** HR RPE **Time**	**Type** **Intensity** HR RPE **Time**	**Type** **Intensity** HR RPE **Time**	**Type** **Intensity** HR RPE **Time**
Type/Mode				
Intensity	HR RPE	HR RPE	HR RPE	HR RPE
Time				

Exercise Goal	**Strength**			
Week	**1**	**2**	**3**	**4**
Upper Body				
Exercises	**Intensity** RPE/RIR Load% **Sets** **Reps**	**Intensity** RPE/RIR Load% **Sets** **Reps**	**Intensity** RPE/RIR Load% **Sets** **Reps**	**Intensity** RPE/RIR Load% **Sets** **Reps**
Lower Body				
Exercises	**Intensity** RPE/RIR Load% **Sets** **Reps**	**Intensity** RPE/RIR Load% **Sets** **Reps**	**Intensity** RPE/RIR Load% **Sets** **Reps**	**Intensity** RPE/RIR Load% **Sets** **Reps**
Core				
Exercises	**Intensity** RPE/RIR Load% **Sets** **Reps**	**Intensity** RPE/RIR Load% **Sets** **Reps**	**Intensity** RPE/RIR Load% **Sets** **Reps**	**Intensity** RPE/RIR Load% **Sets** **Reps**
Functional				
Exercises	**Intensity** RPE/RIR Load% **Sets** **Reps**	**Intensity** RPE/RIR Load% **Sets** **Reps**	**Intensity** RPE/RIR Load% **Sets** **Reps**	**Intensity** RPE/RIR Load% **Sets** **Reps**
Flexibility (before every session)				
Exercises	Time Reps RPE/RIR	Time Reps RPE/RIR	Time Reps RPE/RIR	Time Reps RPE/RIR

Appendix

Appendix 1 - Adult Pre-Exercise Screening System



ADULT PRE-EXERCISE SCREENING SYSTEM (APSS)

This screening tool is part of the Adult Pre-Exercise Screening System (APSS) that also includes guidelines (see User Guide) on how to use the information collected and to address the aims of each stage. No warranty of safety should result from its use. The screening system in no way guarantees against injury or death. No responsibility or liability whatsoever can be accepted by Exercise & Sport Science Australia, Fitness Australia, Sports Medicine Australia or Exercise is Medicine for any loss, damage, or injury that may arise from any person acting on any statement or information contained in this system.

Full Name: _____

Date of Birth: _____ Male: ☐ Female: ☐ Other: ☐

STAGE 1 (COMPULSORY)

AIM: To identify individuals with known disease, and/or signs or symptoms of disease, who may be at a higher risk of an adverse event due to exercise. An adverse event refers to an unexpected event that occurs as a consequence of an exercise session, resulting in ill health, physical harm or death to an individual.

This stage may be self-administered and self-evaluated by the client. Please complete the questions below and refer to the figures on page 2. Should you have any questions about the screening form please contact your exercise professional for clarification.

Please tick your response	YES	NO
1. Has your medical practitioner ever told you that you have a heart condition or have you ever suffered a stroke?		
2. Do you ever experience unexplained pains or discomfort in your chest at rest or during physical activity/exercise?		
3. Do you ever feel faint, dizzy or lose balance during physical activity/exercise?		
4. Have you had an asthma attack requiring immediate medical attention at any time over the last 12 months?		
5. If you have diabetes (type 1 or 2) have you had trouble controlling your blood sugar (glucose) in the last 3 months?		
6. Do you have any other conditions that may require special consideration for you to exercise?		

IF YOU ANSWERED 'YES' to any of the 6 questions, please seek guidance from an appropriate allied health professional or medical practitioner prior to undertaking exercise.

IF YOU ANSWERED 'NO' to all of the 6 questions, please proceed to question 7 and calculate your typical weighted physical activity/exercise per week.

7. Describe your current physical activity/exercise levels in a typical week by stating the frequency and duration at the different intensities. For intensity guidelines consult figure 2.

Intensity	Light	Moderate	Vigorous/High
Frequency (number of sessions per week)	_____	_____	_____
Duration (total minutes per week)	_____	_____	_____

Weighted physical activity/exercise per week

Total minutes = (minutes of light + moderate) + (2 x minutes of vigorous/high)

TOTAL = _____ minutes per week

- If your total is less than 150 minutes per week then light to moderate intensity exercise is recommended. Increase your volume and intensity slowly.
- If your total is more than or equal to 150 minutes per week then continue with your current physical activity/exercise intensity levels.
- It is advised that you discuss any progression (volume, intensity, duration, modality) with an exercise professional to optimise your results.

I believe that to the best of my knowledge, all of the information I have supplied within this screening tool is correct.

Client signature: _____ Date: _____

ADULT PRE-EXERCISE SCREENING SYSTEM (APSS) V2 (2019)

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1

FIGURE 1: Stage 1 Screening Steps

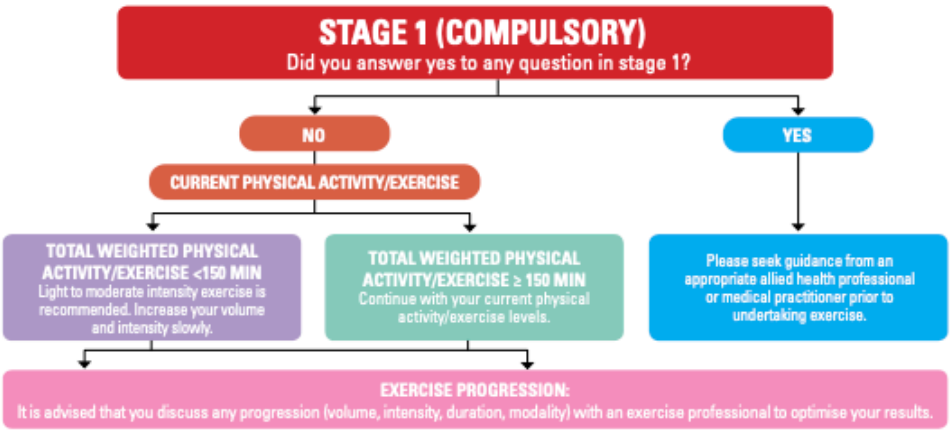

FIGURE 2: Exercise Intensity Guidelines

INTENSITY CATEGORY	HEART RATE MEASURES	PERCEIVED EXERTION MEASURES	DESCRIPTIVE MEASURES
LIGHT	40 to <55% HRmax*	VERY LIGHT TO LIGHT RPE# 1-2	• An aerobic activity that does not cause a noticeable change in breathing rate • An intensity that can be sustained for at least 60 minutes
MODERATE	55 to <70% HRmax*	MODERATE TO SOMEWHAT HARD RPE# 3-4	• An aerobic activity that is able to be conducted whilst maintaining a conversation uninterrupted • An intensity that may last between 30 and 60 minutes
VIGOROUS	70 to <90% HRmax*	HARD RPE# 5-6	• An aerobic activity in which a conversation generally cannot be maintained uninterrupted • An intensity that may last up to 30 minutes
HIGH	≥ 90% HRmax*	VERY HARD RPE# 7	• An aerobic activity in which it is difficult to talk at all • An intensity that generally cannot be sustained for longer than about 10 minutes

* HRmax = estimated heart rate maximum. Calculated by subtracting age in years from 220 (e.g. for a 50 year old person = 220 - 50 = 170 beats per minute).

= Borg's Rating of Perceived Exertion (RPE) scale, category scale 0-10.

Modified from Norton K, L. Norton & D. Sadgrove. (2010). Position statement on physical activity and exercise intensity terminology. J Sci Med Sport 13, 496-502.

ADULT PRE-EXERCISE SCREENING SYSTEM (APSS) V2 (2019)

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2

STAGE 2 (RECOMMENDED)

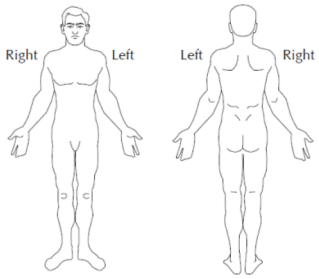
AIM: This stage is to be completed with an exercise professional to determine appropriate exercise prescription based on established risk factors.

CLIENT DETAILS	GUIDELINES FOR ASSESSING RISK
8. Demographics Age: _____ Male ☐ Female ☐ Other ☐	Risk of an adverse event increases with age, particularly males ≥ 45 yr and females ≥ 55 yr.
9. Family history of heart disease (e.g. stroke, heart attack)? Relationship (e.g. father) Age at heart disease event _____ _____ _____ _____ _____ _____	A family history of heart disease refers to an event that occurs in relatives including parents, grandparents, uncles and/or aunts before the age of 55 years.
10. Do you smoke cigarettes on a daily or weekly basis or have you quit smoking in the last 6 months? Yes ☐ No ☐ If currently smoking, how many per day or week? _____	Smoking, even on a weekly basis, substantially increases risk for premature death and disability. The negative effects are still present up to at least 6 months post quitting.
11. Body composition Weight (kg) _____ Height (cm) _____ Body Mass Index (kg/m²) _____ Waist circumference (cm) _____	Any of the below increases the risk of chronic diseases: BMI ≥ 30 kg/m² Waist > 94 cm male or > 80 cm female
12. Have you been told that you have high blood pressure? Yes ☐ No ☐ If known, systolic/diastolic (mmHg) _____ Are you taking any medication for this condition? Yes ☐ No ☐ If yes, provide details _____	Either of the below increases the risk of heart disease: Systolic blood pressure ≥ 140 mmHg Diastolic blood pressure ≥ 90 mmHg
13. Have you been told that you have high cholesterol/ blood lipids? Yes ☐ No ☐ If known: Total cholesterol (mmol/L) _____ HDL (mmol/L) _____ LDL (mmol/L) _____ Triglycerides (mmol/L) _____ Are you taking any medication for this condition? Yes ☐ No ☐ If yes, provide details _____	Any of the below increases the risk of heart disease: Total cholesterol ≥ 5.2 mmol/L HDL < 1.0 mmol/L LDL ≥ 3.4 mmol/L Triglycerides ≥ 1.7 mmol/L

CLIENT DETAILS	GUIDELINES FOR ASSESSING RISK
14. Have you been told that you have high blood sugar (glucose)? Yes ☐ No ☐ If known: Fasting blood glucose (mmol/L) _____ Are you taking any medication for this condition? Yes ☐ No ☐ If yes, provide details _____	Fasting blood sugar (glucose) ≥ 5.5 mmol/L increases the risk of diabetes.
15. Are you currently taking prescribed medication(s) for any condition(s)? These are additional to those already provided. Yes ☐ No ☐ If yes, what are the medical conditions? _____	Taking medication indicates a medically diagnosed problem. Judgment is required when taking medication information into account for determining appropriate exercise prescription because it is common for clients to list 'medications' that include contraceptive pills, vitamin supplements and other non-pharmaceutical tablets. Exercise professionals are not expected to have an exhaustive understanding of medications. Therefore, it may be important to use common language to describe what medical conditions the drugs are prescribed for.
16. Have you spent time in hospital (including day admission) for any condition/illness/injury during the last 12 months? Yes ☐ No ☐ If yes, provide details _____	There are positive relationships between illness rates and death versus the number and length of hospital admissions in the previous 12 months. This includes admissions for heart disease, lung disease (e.g., Chronic Obstructive Pulmonary Disease (COPD) and asthma), dementia, hip fractures, infectious episodes and inflammatory bowel disease. Admissions are also correlated to 'poor health' status and negative health behaviours such as smoking, alcohol consumption and poor diet patterns.
17. Are you pregnant or have you given birth within the last 12 months? Yes ☐ No ☐ If yes, provide details _____ _____ _____	During pregnancy and after recent childbirth are times to be more cautious with exercise. Appropriate exercise prescription results in improved health to mother and baby. However, joints gradually loosen to prepare for birth and may lead to an increased risk of injury especially in the pelvic joints. Activities involving jumping, frequent changes of direction and excessive stretching should be avoided, as should jerky ballistic movements. Guidelines/fact sheets can be found here: 1) www.exerciseismedicine.com.au 2) www.fitness.org.au/Pre-and-Post-Natal-Exercise-Guidelines
18. Do you have any diagnosed muscle, bone, tendon, ligament or joint problems that you have been told could be made worse by participating in exercise? Yes ☐ No ☐ If yes, provide details _____ _____	Almost everyone has experienced some level of soreness following unaccustomed exercise or activity but this is not really what this question is designed to identify. Soreness due to unaccustomed activity is not the same as pain in the joint, muscle or bone. Pain is more extreme and may represent an injury, serious inflammatory episode or infection. If it is an acute injury then it is possible that further medical guidance may be required.

Appendix 2 - Cardiac Assessment Form

Cardiologist:	**Date of Surgery: / /**
Surgeon:	**Date of Cardiac Event: / /**
GP:	**Date of Specialist Follow-up: / /**

Current Medical Condition/Reason for Referral:		
Cardiac/Heart Failure History:		
Current symptoms:		
□ Orthopnoea □ PND □ SOB □ Palpitations □ Dizziness □ Angina □ Oedema □ Incontinence □ Other:		
Previous Cardiac History:		
□ HF □ IHD/ angina □ STEMI NSTEMI □ PCI □ CABG □ Valve disease	□ Valve surgery □ AF / other □ HT □ ICD/ PPM/ BiV □ Device setting □ Other:	
Other Medical History:		
Smoking History:		
□ Current Smoker	□ Ex smoker (no smoking in 6 months)	□ Never smoked
Medications:	**Visual or Hearing Limitations**	**Hydrotherapy Clearance**
		YES / NO N/A
Social:		
Living situation: ADL supports: Current Mobility:	Physical activity patterns (barriers/limitations): Occupation:	
Summary of Risk Factors Total:	**Risk Category: Low Moderate High**	
□ Smoking □ Diabetes □ Hypercholesterolaemia	□ Hypertension □ Obesity □ Family history	□ Physical Inactivity □ Depression
Musculoskeletal Limitations	**Sternal Assessment**	
	**Sternal stability** ☐ 0 Normal ☐ 1 Slight ↑movement ☐ 2 Mod ↑movement ☐ 3 Marked instability ☐ 4 Complete instability	

PHYSIOLOGY MEASURES						
Initial	BP		HR		Sp02	
Final	BP		HR		Sp02	
%HR Max	Pred HR Max:		70%:	75%:	80%:	85%:

OUTCOME MEASURES									
		INITIAL		**DATE:**		**FINAL**		**DATE:**	
6MWT:	**Min**	HR	Sp02	BP	RPE	HR	Sp02	BP	RPE
	0								
	2								
	4								
	6								
	2'' post								
	Distance								
	Aid								
	Limit Factor								

BMI (wt/ht²) **Height:**	Weight: kg	BMI:	Weight: kg	BMI:
Waist: Waist at umbilicus	Waist: cm		Waist: cm	

IMPAIRMENT	**SMART GOALS**	**GOALS ACHIEVED Y/N**

THERAPIST/SIGNATURE		**DATE**	

Week 7 - Exercise & Mental Health

Pre-Lab Activity

Read Chapter 34 of the textbook which relates to the topic of Depression.

Read the following paper, available in your Canvas Modules or by following the link below

> Vella, S. A., Aidman, E., Teychenne, M., Smith, J. J., Swann, C., Rosenbaum, S., … & Lubans, D. R. (2023). Optimising the effects of physical activity on mental health and wellbeing: A joint consensus statement from Sports Medicine Australia and the Australian Psychological Society. *Journal of Science and Medicine in Sport*, *26*(2), 132-139. https://www-sciencedirect-com.ezproxy.lib.uts.edu.au/science/article/pii/S1440244023000014

Lab Session

Introduction

> **!** The topic and content covered in this lab session may cause discomfort or distress for some individuals in the class. Please be considerate of your peers and, if you are experiencing discomfort or distress during the lab, please feel free to let a tutor know and take time outside of the class - we are happy to talk at a time and place that is comfortable for you.

Mental Health is…

The objectives of this lab are to:

- 1
- 2
- 3

Mental Health vs Mental Illness

Text

Key Definitions

- 1
- 2
- 3

Prevalence in the Australian context

Mental Illness is

Links between Mental and Physical Health

Evidence base

Gaps to close

Green & Blue Prescription

Physical and Social Environment effect on responses to exercise

Indigenous connections to country, land, water - relevance to prescription and community initiatives

Activity 1 - Evidence Search

Effects of different types of exercise on Mental Health Disorders (assigned to each group)

Research in small groups

Identify recommendations

Consider strengths, weaknesses, and barriers to each type/mode

Brief overview of findings presented by each disorder research group

Activity 2 - Case Study

Design a program for a veteran with reference to Vella et al., 2023 - SMA/APS consensus statement

- Depressive symptoms, PTSD (flashbacks, social avoidance, night terrors)

SOAP structure

- Specific questions or information needed from client or other health professionals (collateral information, e.g., trauma responses and 'catalysis for exacerbation')
- "Triggers" (and appropriateness of this terminology)

Discussion

1. Q1
2. Q2

Future Learning Opportunities

- MHFA
- Beyond Blue
- Black Dog
- ESSA CPD Training
- The Mental Wellbeing Podcast with Indi Dissin
- Masters of Clinical Exercise Physiology
- Research - Oscar

Week 8 - Midsemester Exam

Pre-Lab Activity

This week is the Midsemester Exam, which is conducted in your regular class time.

The exam includes multiple choice and short answer questions covering online and lab content from Weeks 2 to 6 (inclusive).

The exam is completed online, on Canvas, under standard exam conditions. Canvas logs browser tab and extension activity.

Please ensure you have studied all subject content in preparation for the exam.

Week 10 - Exercise & Cancer

The Role of Exercise in the Treatment and Management of Cancer

Pre-Lab Activity

Read chapter 22 of the textbook which relates to the topic of cancer.

Complete the Pre-Lab Quiz on cancer in your Canvas Modules.

Lab Session

Introduction

Cancer is a rather unique disease in that it can develop in any organ system, spread to other organs, and has several potential causes. It can affect anyone, regardless of age, ethnicity, or sex. Half of all Australian men and women will be diagnosed with cancer at some point in their life. The direct health system costs of cancer in Australia is more than $4.5 billion. The indirect costs, including the psychosocial and emotional stress it can cause is difficult to quantify.

The most common cancers in Australia are prostate, colorectal (bowel), breast, melanoma (skin), and lung cancer, accounting for >60% of all diagnoses. The main carcinogenic factors are: environment (including behaviour), genetics, oncogenes, hormones, and impaired immune system function. Cancers typically form when one or more of these factors are present.

Most of us have either experienced, or know someone close who has experienced, cancer in their lifetime. Untreated, cancers are typically fatal. But, there are treatments available for many forms of cancer, with many more being developed. Exercise can play a therapeutic role for cancer patients, and there is a growing body of clinical research on the benefits of exercise to counteract the negative effects of cancer and play an important role in its prevention, treatment, and survivorship.

The objectives of this lab are to:

- Examine the pathophysiology of cancer and its effects on patients' health and well-being
- Explore the role of exercise in the prevention and treatment of cancer
- Develop an understanding of exercise prescription considerations in cancer care settings

Impacts of Exercise in Cancer Care

The following figure and table from the Hojman et al. (2018) article present an overview of known impacts and effectiveness of exercise in the prevention, treatment, and survivorship of cancer.

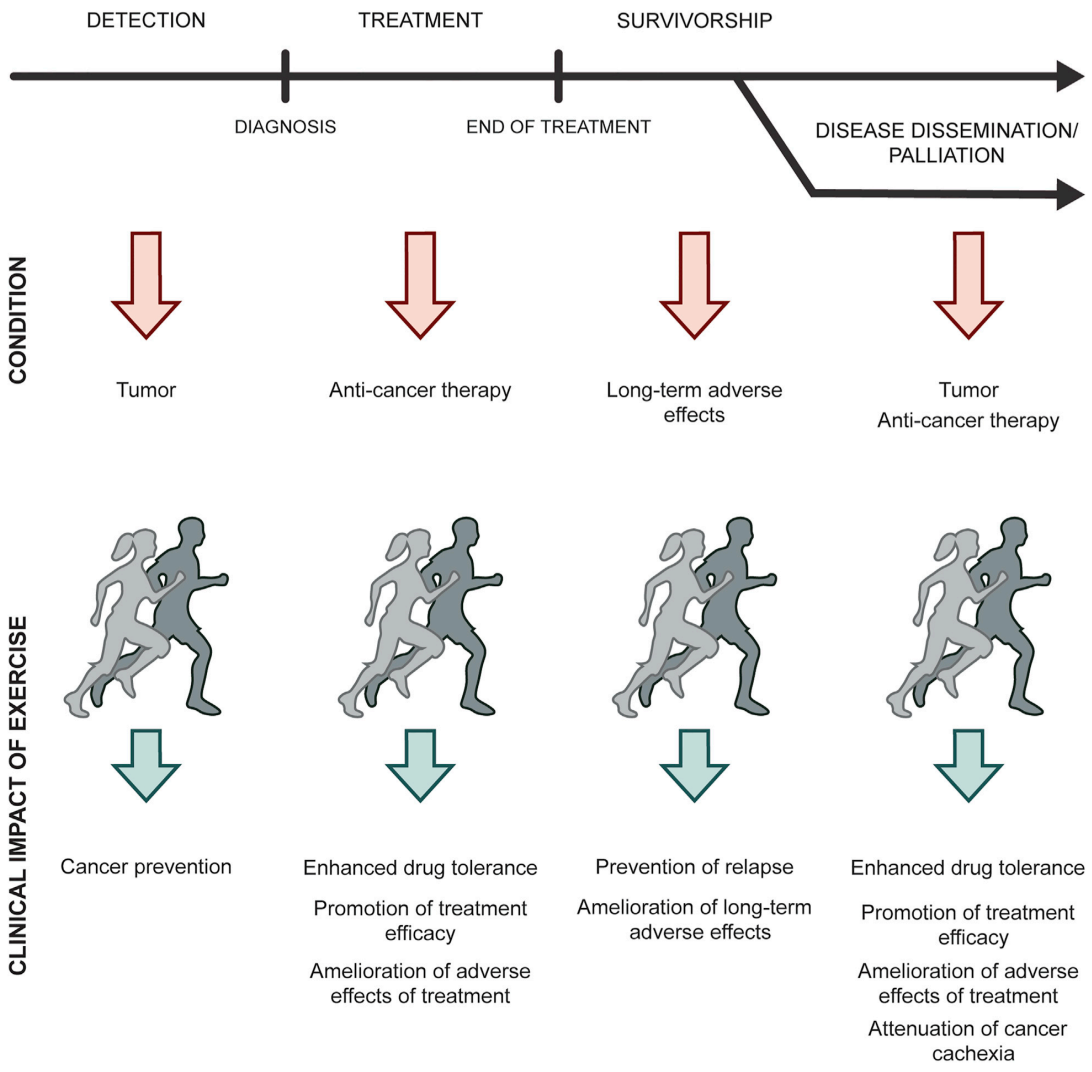


Figure 2. Running from Cancer at All Stages
The cancer continuum comprises detection, treatment, survivorship, and disease dissemination and palliation. Each stage is characterized by different pathological conditions (presence of tumor, anti-cancer therapy, long-term adverse effect, and those in combination), and exercise training may play different roles across the cancer continuum: reducing the risk of cancer in the pre-diagnostic period; improving drug tolerance and efficacy during treatment; preventing relapse, controlling adverse effects post-primary anti-cancer treatment, and reducing risk of comorbidities; and doing all of the above in advanced-stage cancer patients.

Figure 1: From Hojman, et al. (2018). Molecular Mechanisms Linking Exercise to Cancer Prevention and Treatment. Cell Metabolism, 27(1), 10–21. https://doi.org/10.1016/j.cmet.2017.09.015

Table 1. Adaptive Responses to Endurance and Resistance Training in Cancer Patients

Exercise Adaptions		Aerobic Training	Resistance Training
Whole-Body Adaptations			
Cardio-pulmonary exercise test (CPET)			
	Fitness ($Watt_{max}$)	↑↑	↑
	VO_{2peak}	↑↑	↔ ↑
Walking capacity (6 min/400 m)		↑↑	↑↑
Body mass index		↔	↔
Fat mass		↓ ↔	↔
Bone mineral density		↔	↔ ↑
Muscle Adaptations			
Muscle strength (1-RM)		↑	↑↑↑
Muscle mass		↔	↑
Muscle fiber size (cross-sectional area)		NA	↔ ↑
Muscle fiber type composition		NA	↔
Capillary density		NA	↔
Mitochondrial function and density		NA	NA
Neural adaptations		NA	NA
Systemic Adaptations			
Glucose		↔	↔
Lipids		↓ ↔	↔
Inflammatory markers			
	CRP	↓[a]	↔
	TNF-α	↔	↔
	IL-6	↔	↔
Sex hormones		↓ ↔	↔
Metabolic hormones			
	Insulin	↓ ↔[b]	↔
	Leptin	↓ ↔[b]	↔
Growth factors (GH, IGF-1)		↔	↔
Health-Related Quality of Life			
Symptom status (e.g., lower fatigue)		↑↑↑	↑↑↑
Functional status (e.g., lower depression)		↑↑	↑↑
General health perception (e.g., improved life satisfaction)		↑	↑

The table summarizes the adaptive responses to endurance and resistance training in cancer patients based on the large amount of literature available from clinical training intervention studies. ↑ indicates an increasing effect on the parameter, ↓ indicates a decreasing effect on the parameter, and ↔ indicates no effect. The number of arrows represents the magnitude of the effect. NA, not assessed.

[a]Changes in inflammatory markers are primarily seen after long (>16 weeks) interventions.

[b]Changes in metabolic hormones are primarily seen if the interventions are associated with weight loss.

Figure 2: From Hojman, et al. (2018). Molecular Mechanisms Linking Exercise to Cancer Prevention and Treatment. Cell Metabolism, 27(1), 10–21. https://doi.org/10.1016/j.cmet.2017.09.015

Exercise Testing for Cancer Patients

Table 22.4 Summary of Exercise Testing for Patients With Cancer

Test type	Mode	Protocol specifics	Clinical measures	Clinical implications	Special considerations
Maximal cardiorespiratory	Treadmill Cycle ergometer Arm ergometer	Individualized protocols, based on physical activity history and comorbidities	Peak oxygen consumption METs Peak workload Heart rate Respiratory exchange ratio Treadmill time	Provides basis for determining starting point for exercise training. Used to stratify presurgical risk. Used to evaluate response to training program.	Cancer treatment may result in cardiomyopathy, pulmonary fibrosis, or neuropathy.
Submaximal cardiorespiratory	Cycle ergometer Walking path	6 min walk Constant workload	Distance Heart rate Perceived exertion	Used to evaluate response to training program.	Sensitivity to detect changes may be reduced in more fit individuals.
Muscle strength and endurance	Machine weights	One-repetition maximum (1RM) Multiple-repetition maximum	Kilograms	Provides basis for determining starting point for exercise training. Used to evaluate response to training program.	Modify or avoid 1RM tests with lymphedema or recent surgery.
Flexibility	Goniometry	Active stretching	Degrees	Used to evaluate response to training program.	Avoid pain; assess upper extremity range of motion postmastectomy.

Figure 3: From Ehrman, J. K., Gordon, P. M., Visich, P. S., & Keteyian, S. J. (Eds.). (2023). Chapter 22. Clinical exercise physiology: Exercise management of chronic diseases and special populations (5th Ed). Human Kinetics.

Exercise Prescription Guidelines

Table 22.5 Summary of Exercise Prescription for Patients With Cancer During Treatment

Training method	Frequency	Intensity	Time (Duration)	Type (Mode)	Progression	Important considerations
Cardiorespiratory	3 d/wk	60%-80% of heart rate reserve or oxygen uptake reserve, or RPE of 11-14	30 min	Walking, stationary bike, or other exercises that use large muscle groups	As tolerated, although linear progression is not always possible during treatment.	Adjust for the following symptoms: • Anxiety: Consider more vigorous intensity. • Depression: Consider longer duration (>30 min). • Fatigue: Reduce intensity (40%-60% HRR).
Resistance	2 d/wk	60%-75% 1RM	2-3 sets 8-15 reps	Body weight, free weights, weight machines, resistance bands		Patients with metastatic bone disease should avoid excessive weight-bearing exercises and seek medical approval because of increased fracture risk. Consider lower intensity for patients reporting fatigue.
Range of motion	Insufficient evidence beyond recommendations for healthy adults			Yoga has shown some benefit		With approval from surgeon, pay special attention to shoulder mobility stretches in breast cancer survivors.

Note: Guidelines for cancer survivors after treatment are the same as for healthy adults.

Figure 4: From Ehrman, J. K., Gordon, P. M., Visich, P. S., & Keteyian, S. J. (Eds.). (2023). Chapter 22. Clinical exercise physiology: Exercise management of chronic diseases and special populations (5th Ed). Human Kinetics.

! The above table provides general guidelines for patients undergoing cancer treatment. However, all cancers are unique, so please refer to specific guidelines for the cancer being treated prior to developing exercise programs.

Activity - Case Studies

In small groups, develop an Exercise Management Plan for each for the following Case Study patients.

Case Study 1

Samara is a 47-year old female with breast cancer.

Samara is 10 weeks post surgery (double mastectomy), and is completing her first cycle of chemotherapy. She will then commence radiation therapy and hormone therapy.

Consider the following:

Objectives/goals of the exercise program for this patient

General health considerations

Health implications of surgery, chemotherapy, radiotherapy

Breast cancer-specific health considerations

Medical assessments prior to exercise

Case Study 2

Dev is a 28-year old male with colon cancer.

Dev is 12 weeks post surgery (ostomy), and is undergoing both chemotherapy and radiotherapy.

Consider the following:

Objectives/goals of the exercise program for this patient

General health considerations

Health implications of surgery, chemotherapy, radiotherapy

Colon cancer and ostomy-specific health considerations

Medical assessments prior to exercise

Case Study 3

Meriva is a 73-year old female with bone cancer

Meriva is currently undergoing chemotherapy and radiotherapy.

Consider the following:

Objectives/goals of the exercise program

General health considerations

Health implications of surgery, chemotherapy, radiotherapy

Bone cancer-specific health considerations

Medical assessments prior to exercise

Discussion

Throughout the lab we will be viewing and discussing content related to the prevention and treatment of cancer. You can write any notes related to the content, discussions, and case study activities below.

Week 11 - Exercise & Ageing

Exercise Assessment, Programming, and Delivery for Older Individuals

Pre-Lab Activity

Read Chapter 33 of the textbook which relates to the topic of older aged populations.

Read the following articles, available in your Canvas Modules or by following the links below

> Hunter, G. R., McCarthy, J. P., & Bamman, M. M. (2004). Effects of resistance training on older adults. *Sports medicine*, *34*, 329-348. https://doi-org.ezproxy.lib.uts.edu.au/10.2165/00007256-200434050-00005

> Levinger, P., Sales, M., Polman, R., Haines, T., Dow, B., Biddle, S. J., … & Hill, K. D. (2018). Outdoor physical activity for older people—The senior exercise park: Current research, challenges and future directions. *Health Promotion Journal of Australia*, *29*(3), 353-359. https://doi-org.ezproxy.lib.uts.edu.au/10.1002/hpja.60

Complete the Pre-Lab Quiz on ageing in your Canvas Modules.

Lab Session

Introduction

Medical and lifestyle advances have allowed us to live longer and enjoy greater quality of life as we age. As a result, nations' populations of older adults has increased greatly; the number of Australians aged over 65 will more than double in the next 40 years (Intergenerational Report, 2023). That brings challenges that we must overcome.

While our general health and well-being will be improved across our lifespan, there is no escaping the ageing process, which results in reduced functional capacity due to age-associated cardiovascular, respiratory, and musculoskeletal disease (among others). Many of these diseases are interactive and compounding. Ultimately, it can result in an inability to perform activities of daily living (ADLs) and, eventually, a loss of independence, becoming more reliant on others for care.

By now, we should all appreciate the incredible impact of exercise and physical activity on our health and well-being. We know it can improve our functional capacity, and that is true regardless of age. As such, exercise can play an important role in delaying the onset or degree of age-related disease, and maintain our independence and quality of life as we get older.

As with any clinical population, there are important considerations to make when assessing, prescribing, and delivering exercise programs for older individuals. The objectives of this lab are to:

- Explore the effects of ageing on our health and functional capacity, including typical age-related diseases
- Examine the evidence for exercise to support healthy ageing and improve quality of life
- Develop an understanding of exercise prescription considerations in ageing populations

Age-related Physiological Changes

Between the ages of 20 and 80, there is typically a 50% decrease in Maximal Aerobic Capacity. The factors contributing to this remarkable decrease in cardiorespiratory fitness include: decreased a-vO_2 difference, heart rate, and cardiac output, increased systemic vascular resistance and end-diastolic volume, and decreased cardiac contractility and ejection fraction. Overall, these result in increased blood pressure, less cardiac efficiency, and less ability to supply oxygen to the working muscles.

Table 33.1 Physiologic Aging Effects on Organ Systems

Organ system	Effects of aging	Clinical significance
Skeletal muscle	↓ mass of ~1.2 kg/decade from fifth to ninth decade ↓ muscle strength, contractile speed, and power Greater loss of fast-twitch fibers Relative ↑ in slow myosin isoform	↓ ability to perform strenuous activities
Bone Cartilage and connective tissue	Loss of calcium, leading to ↓ bone mass and density, especially in women ↓ thickness, elasticity, and tensile strength; degenerative changes	↑ fracture risk ↑ joint and tendon injury Arthritis
Body composition	↓ lean mass and total body water ↑ % body fat	↓ volume of distribution of water-soluble drugs
Cardiovascular	Arterial stiffening and thickening ↓ vasodilator capacity ↑ left ventricular wall thickness ↓ early left ventricular diastolic filling rate ↓ maximal heart rate and arteriovenous oxygen difference ↓ peak aerobic capacity	Hypertension Diastolic heart failure ↓ ability to perform strenuous activities
Respiratory	↑ chest wall stiffening ↓ vital capacity ↑ residual volume and dead space ↓ maximal voluntary ventilation	Chronic lung disease
Metabolic	↓ resting metabolic rate ↓ insulin sensitivity ↓ glucose tolerance ↓ liver size and blood flow	Obesity Diabetes ↓ metabolism of many drugs
Thermoregulation	↓ thirst sense ↓ skin blood flow ↓ sweat production per sweat gland	↑ risk of dehydration and heatstroke
Renal	Glomerulosclerosis ↓ kidney size ↓ renal blood flow ↓ glomerular filtration rate	↓ renal excretion of drugs Electrolyte disturbances
Central nervous system	↓ β-adrenergic sensitivity ↓ cholinergic sensitivity ↓ brain volume Degenerative brain changes ↓ balance, coordination, hearing, and vision	↓ maximal heart rate ↓ heart rate variability ↓ cognitive function and memory ↑ falls

↓ = decrease; ↑ = increase.

Figure 1: From Hojman, et al. (2018). Molecular Mechanisms Linking Exercise to Cancer Prevention and Treatment. Cell Metabolism, 27(1), 10–21. https://doi.org/10.1016/j.cmet.2017.09.015

Functional Capacity Assessments

Table 33.2 Pretraining Evaluation for Frail Older Adults

Test	Measurement	Outcome	Indicators of risks with testing
Chair stand	Stand from a chair of standard height, unaided and without using arms	Ability Time required	Inability >2.0 s
Step-ups	Step-ups onto a single 23 cm step in 10 s	Ability Number of times	Inability Less than three in 10 s
Walking speed	4 or 5 m walk, starting from rest	Time Gait abnormalities such as asymmetry	<0.8 m · s^{-1}
Tandem walk	Walking along a 2 m line, 5 cm wide	Number of errors (off line, touching examiner or another object)	More than eight errors
One-leg stand	Stand on one leg	Ability Time	<2 s
Functional reach	Maximal distance a subject can reach forward beyond arm's length while maintaining a fixed base of support in the standing position	Inches	<6 in. (15.2 cm)
Sit to stand	Maximum number of times a subject can stand up and sit down (without using hands to push up) on a regular chair over 30 s	Number of sit-to-stand maneuvers	<8
Five times sit to stand	Time taken to perform 5 sit-to-stand maneuvers	Time	>13.7 s
Timed Up and Go	Stand up from standard chair, walk distance of 3 m, turn, walk back to chair, and sit down again	Time	>13.5 s
Range of motion	Goniometer used to assess shoulder abduction (SA), flexion (SF), extension (SE); elbow flexion (EF), extension (EE); hip flexion (HF), extension (HE); knee flexion (KF), extension (KE); ankle dorsiflexion (DF), plantar flexion (PF)	Degrees	<90° (SA), <150° (SF), <20° (SE), <140° (EF), <20° (EE), <90° (HF), within 10° (HE), <90° (KF), not within <10° full KE, inability to perform DF and PF

Adapted from E.F. Binder et al., "Peak Aerobic Power is an Important Component of Physical Performance in Older Women," *Journal of Gerontology* 54A, (1999): M353-356; W.J. Chodzko-Zajko and K.A. Moore, "Physical Fitness and Cognitive Function in Aging," *Exercise in Sport and Science Review* 22, (1994): 195-220; R.J. Kuczmarski et al., "Increasing Prevalence of Overweight Among U.S. Adults," *Journal of the American Medical Association* 272, (1994): 205-211; M.C. Nevitt et al., "Risk Factors for Recurrent Non-Syncopal Falls," *JAMA* 261, (1989): 2663-2668; M.L. Pollock et al., "Resistance Exercise in Individuals With and Without Cardiovascular Disease: Benefits, Rationale, Safety, and Prescription. An Advisory From the Committee on Exercise, Rehabilitation, and Prevention, Council on Clinical Cardiology, and the American Heart Association," *Circulation* 101, (2000): 828-833.

Figure 2: From Hojman, et al. (2018). Molecular Mechanisms Linking Exercise to Cancer Prevention and Treatment. Cell Metabolism, 27(1), 10–21. https://doi.org/10.1016/j.cmet.2017.09.015

Exercise Prescription for Older Patients

Table 33.3 Exercise Prescription Review

Training method	Frequency	Intensity	Time (Duration)	Type (Mode)	Progression	Important considerations
Cardiorespiratory	Moderate-intensity exercise 5 times per week Vigorous-intensity exercise 3 times per week General physical activity performed daily	Moderate: 50%-70% HRR or 5-6 on the 10-point exertion scale Vigorous: >70% HRR or 7-8 on the 10-point exertion scale General physical activity (ADLs) at comfortable intensity	Moderate intensity: 30-60 min intervals, but may be as short as 10 min Vigorous intensity: 20-30 min	Walking, cycling, seated recumbent, pool activity, seated aerobics	As tolerated, with a goal of the upper end of duration and total minutes per week. Typically increase duration before intensity.	Incorporating aerobic activities into daily routines can help achieve these goals. See relevant chapters for further special considerations.
Resistance	2 or more times per week Never on consecutive days	5-6 (moderate) or 7-8 (vigorous) on a 10-point exertion scale	8-12 reps for each muscle group, usually targeting 8-10 muscle groups	Multistation machine-type equipment (e.g., Keiser pneumatic) provides greatest safety. Elastic bands and free weights are less costly and often more available.	Add small amounts of weight as tolerated while maintaining the appropriate intensity.	Frail or deconditioned adults critically benefit from strength training. See chapters that review heart diseases, osteoporosis, and arthritis for further special considerations.
Range of motion	Minimally 2 times per week, but daily is desired	Moderate Mild stretch discomfort without inducing pain	5-30 min total, with two 30 s static stretches or dynamic movements for each major joint	Nothing required. May use the aid of a towel or band to increase and control stretch.	Progress stretch range based on lack of discomfort experienced.	Involve multiple muscle groups (neck, shoulders, arms, lower back, quadriceps, hamstrings, calves, ankles). See chapters that review osteoporosis and arthritis for further special considerations.

HRR = heart rate reserve; ADLs = activities of daily living.

Figure 3: From Hojman, et al. (2018). Molecular Mechanisms Linking Exercise to Cancer Prevention and Treatment. Cell Metabolism, 27(1), 10–21. https://doi.org/10.1016/j.cmet.2017.09.015

Activity - Gym-based Training

Along with cardiorespiratory and flexibility training, resistance training has wide-ranging benefits for older individuals. When prescribed and performed correctly, resistance training induces valuable acute and chronic responses and there are few (if any) individuals who should be advised against performing this type of training. However, safety is essential and will be a focus in this lab session.

In this activity, you will use and extend your knowledge and practical skills developed in *Strength & Conditioning* and *Exercise Prescription* to prescribe and deliver gym-based exercises that consider the needs and abilities of older patients. Your tutor will provide various examples of gym-based exercises for older patients, especially those with chronic disease. It's your job in groups to make additional considerations that call upon your resistance training and coaching knowledge to develop appropriate training programming and exercises. This activity will take place in the Exercise Physiology Clinic (Level 2) and Resistance Training (Level 4) Gyms.

1. In your lab groups of 5-7 people, you will select 5 key lifts that you are familiar with, including one:
    - Upper body free weight exercise,
    - Upper body machine weight exercise,
    - Lower body free weight exercise, and
    - Lower body machine weight exercise
2. For each exercise chosen, have one person perform 10 reps as a young, healthy individual, while the group observes form and considers the key movement concepts
3. After completing the set, spend 2-3 minutes as a group considering appropriate exercise modifications to allow an older adult (~75 years old) to complete the exercise safely
4. Have 2-3 people perform 10 reps of your modified exercise while the rest of the group observes movement replication, safety, and suitability (i.e., for individual ability and to achieve tissue stress)
5. Once the set is complete, reflect on the modified exercise, including how the 'patients' felt performing the movement, and any further adjustments you would make

Notes

Activity - Outdoor Exercise

Exercising outdoors can provide physical and mental health benefits for all ages. Many local governments are installing outdoor gyms as a health promotion investment to encourage physical activity and exercise among the community. However, these outdoor gyms may not consider the needs and abilities of older individuals, which poses safety risks and limits the effectiveness and health impact of these initiatives.

In this activity, you will work within your groups to design a 'Seniors Park' that includes various types of gym-like equipment to perform callisthenic type resistance training in an outdoor exercise space. Your design must consider older individuals' functional abilities and needs to ensure users can safely perform activities that induce sufficient challenge physiologically and for motor control.

- Consider the layout, surfaces, equipment, and safety in your design
- Develop some ideas for custom outdoor resistance training equipment that will enable specific joint movements for older individuals - make sure you include activities that provide upper- and lower-body challenges
- Be creative in the types of equipment you include, such as benches, beams, bars, and ropes
- In pairs, write a description of one of your designed activities so that a new park user can understand what the exercise is, what muscles it uses, how to perform the activity safely, and what Activities of Daily Living it would be useful for

Once completed, work together in your groups to design an outdoor exercise circuit using basic fitness equipment provided in class

- Create suitable and safe activities for use in an outdoor environment, e.g., at a park or beach, that make use of simple, cheap, and portable equipment
- Consider appropriate work and rest durations and intensities for older patients, and think about special safety considerations you will need to make, e.g., environment and equipment
- Discuss appropriate progressions to make each exercise more challenging, physically and technically
- Discuss additional equipment that may be useful for this context, or alternative types of exercise that could be considered

Notes

Discussion

Throughout the lab we will be viewing and discussing content related to exercise and healthy ageing. You can write any notes related to the content, discussions, and case study activities below.

Week 12 - Neuromuscular Rehabilitation

Electromyostimulation for Rehabilitation and Recovery

Pre-Lab Activity

Read the following articles, available in your Canvas Modules or by following the links below

> Enoka, R. M., Amiridis, I. G., & Duchateau, J. (2019). Electrical stimulation of muscle: electrophysiology and rehabilitation. *Physiology*. https://doi-org.ezproxy.lib.uts.edu.au/10.1152/physiol.00015.2019

Complete the Pre-Lab Quiz on neuromuscular conditions in your Canvas Modules.

Lab Session

Introduction

To contract a muscle, your nervous system sends an electrical nerve impulse (action potential) to a motor unit, along motor neurons to the neuromuscular junction (NMJ) where a cascade of physiological events result in muscle contraction and relaxation (from sarcoplasmic reticulum release and re-uptake of calcium ions, respectively). In some individuals, this process may be impaired or inhibited due to local or possibly more global neuromuscular deficits or injury.

Electrical muscle stimulation (or, electromyostimulation; EMS) therapy allows the generation of neural activity that can stimulate muscle activity via electrodes, either implanted or attached to skin. The electrical currents stimulate activation signals at the intramuscular axons (rather than directly in muscle fibres) in a manner that allows the downstream physiological events to occur, and work to be performed. Muscles cannot tell the difference between a voluntary contraction triggered by the brain, and an electrically-induced contraction.

EMS may be used to either augment (make larger) or replicate the typical electrical signals your brain sends to motor units to generate muscle activity and force production. As such, it can provide a valuable adjunct stressor to induce physiological strain, resulting in adaptation. Such treatments can be beneficial for individuals with neuromuscular deficits, injuries, or pain, e.g., spinal cord injury, stroke, musculoskeletal strain or surgery. A major research focus of EMS has been musculoskeletal rehabilitation (e.g., muscle atrophy).

In this lab, we will be experimenting with Compex EMS devices, applying electrodes to various muscles to elicit muscular contractions. As with any training modality or tool, a practitioner should understand what it is, how it works, and why it is useful. Knowing what it feels like is a valuable experience so that you can properly explain to a client or patient what they will experience, and the potential benefits of it. This activity will help you to understand practical considerations when assessing the appropriateness before prescribing and implementing in practice. The objectives of this lab are to:

- Examine various clinical neuromuscular conditions and their impact on physiology and movement
- Explore the potential role and impact of EMS in rehabilitation and recovery
- Consider opportunities to use EMS in clinical, general, and athletic populations, and any ethical considerations that may be relevant

Electromyostimulation

EMS-based rehabilitation protocols typically involve electrodes applied to the skin adjacent to the target muscle and its nerve branches. The neuromuscular activation is limited by the electrical current applied and the transmission of signal through various tissues (skin, adipose, muscle). As such, the closer the electrodes are to the target muscle nerves, and the stronger the electrical current, the larger the impulse and muscle activation. Currents are conducted both across (transverse) and along (longitudinal) the target muscle, although the longitudinal distribution will be more effective as it remains superficial (i.e., less attenuation by tissue). It's also clear that the positioning and orientation of electrodes is an important factor to maximise signal-to-activation effect. Some evidence logically suggests that the closer electrodes are to a motor unit, the more likely it is that action potentials will be able to propagate to every motor neuron and muscle fibre it innervates, maximising the effect of the stimulus on the target muscle.

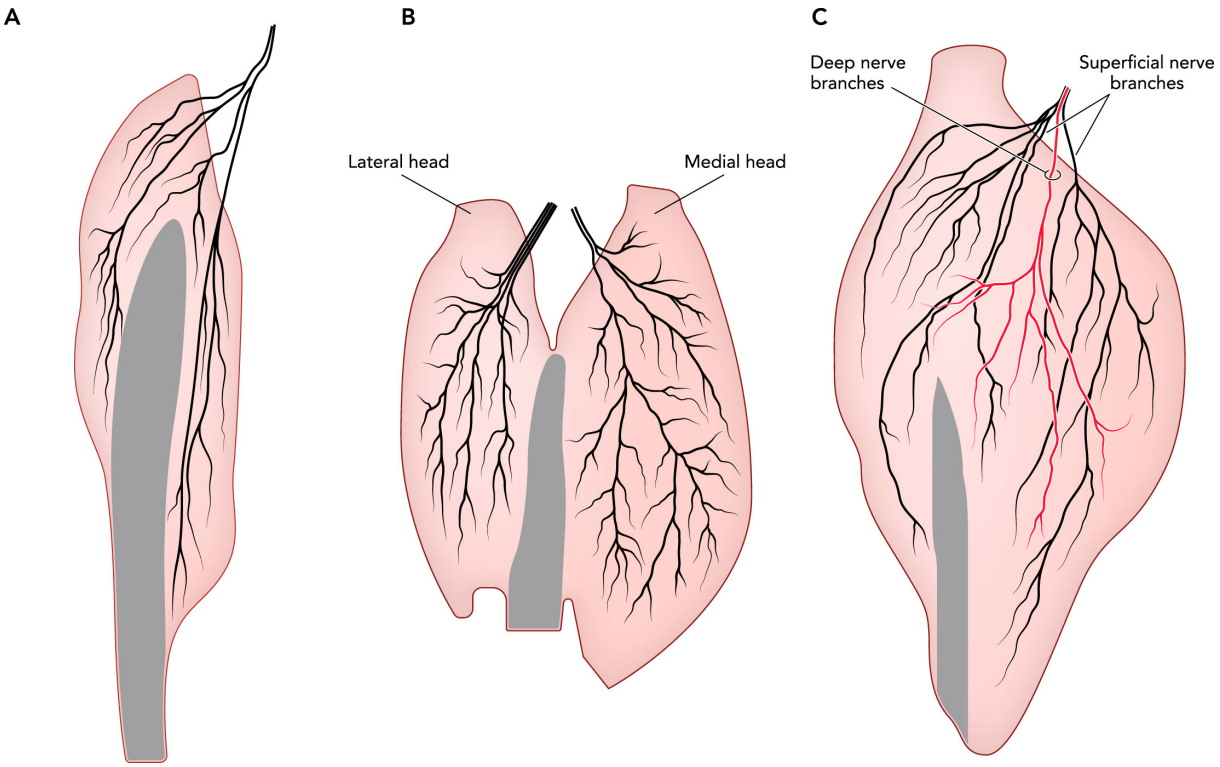


Figure 1: The neural branch supply to three muscles, A) tibialis anterior by the deep fibular nerve, B) gastrocnemius by the tibial nerve, and C) soleus by the tibial nerve branching into superficial and deep compartments; from Enoka et al. (2019)

A primary goal of EMS is to provide acute and/or chronic therapeutic effects. The effect that is achieved can depend on the type of electrical stimulation applied. Common variants include:

- Neuromuscular Electrical Stimulation (NMES) where high-intensity, intermittent electrical stimuli generate relatively large muscle contractions, it is commonly used for neuromuscular rehabilitation or strength training
- Functional Electrical Stimulation (FES) where moderate-intensity, cyclical electrical stimuli generate functional movements similar to voluntary contractions, it is commonly used to restore lost function
- Transcutaneous Electrical Nerve Stimulation (TENS) where low-intensity, continuous electrical stimuli are applied to cutaneous nerve fibres with little muscle contraction, it is commonly used for acute and chronic pain treatment

Table 1. Common variants of peripheral electrical stimulation

Type of stimulation	Typical intent	Typical frequency range	Typical intensity
NMES	Activation of sensory and motor axons for diverse purposes	1–100 Hz	At or above motor threshold
FES	Activation of both sensory and motor axons with the specific goal of assisting motor function	20–60 Hz	Above motor threshold
EST	Activation of both sensory and motor axons with the specific goal of preventing muscle weakness	35–100 Hz	Above motor threshold
TENS	Activation of sensory axons for the goal of pain relief.	>50 Hz	Below motor threshold

EST, electrostimulation strength training; FES, functional electrical stimulation; NMES, neuromuscular electrical stimulation; TENS, transcutaneous electrical nerve.

Figure 2: Common variants of peripheral electrical stimulation, from Carson & Buick (2021)

FES and TENS have been successfully integrated into clinical rehabilitation settings (Maffiuletti et al., 2018). Evidence is growing for the use of NMES, and it has clear potential to be used in various populations and contexts, including maintenance (e.g., during disuse), restoration (e.g., after disuse), or improvement (e.g., athletic training) of neuromuscular function. The expected effects of NMES therapy are demonstrated in the figure below.

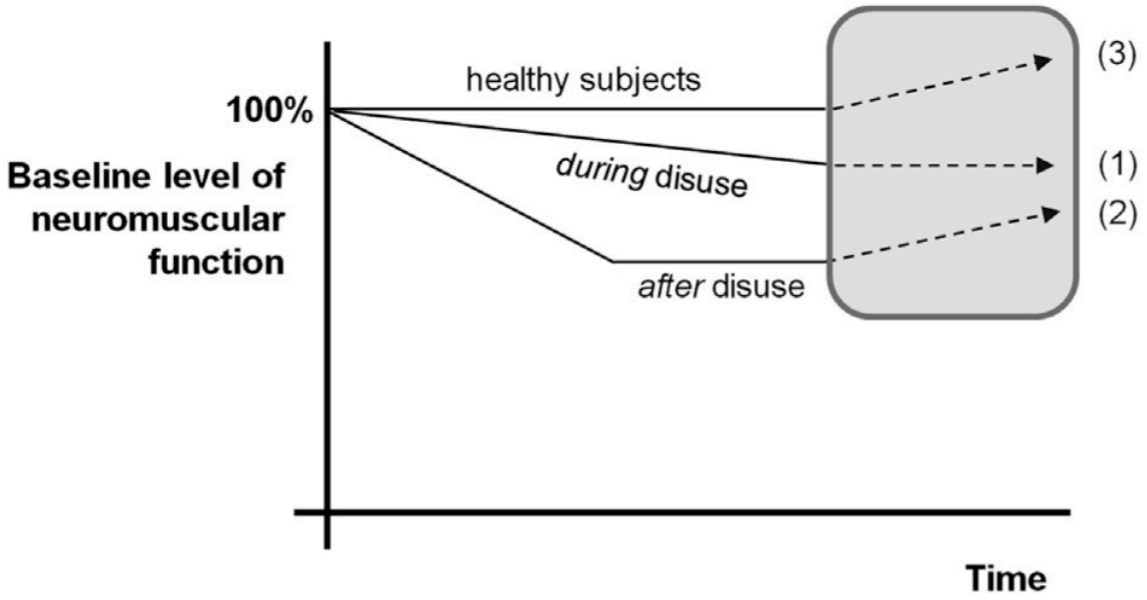


Figure 3: Expected effects of NMES therapy (shaded area) for improving (healthy), maintaining (during disuse), or restoring (after disuse) neuromuscular function, from Maffiuletti et al. (2018)

Clinical Conditions

Studies have shown that EMS can be beneficial for individuals affected by Spinal Cord Injury, Stroke, Brain Injury, Multiple Sclerosis, Cerebral Palsy, and Arthritis. The primary goals of this modality are to prevent atrophy or secondary disease resulting from lack of movement/physical activity, improve physical and mental well-being, and maintain local blood circulation and cardiopulmonary fitness.

The objective of EMS is not necessarily to induce movement from muscle contractions, in which case TENS may be the more appropriate modality, used to prevent or treat problems (i.e., secondary disease) associated with SCI or MS. These may include:

- Deep Vein Thrombosis (DVT; blood clots)
- Pressure sores
- Spasticity (uncontrolled contractions)
- Contractures (joint ROM impairment)
- Tremor (involuntary shaking)
- Osteoporosis (loss of bone mineral density)
- Atrophy
- Male sexual dysfunction

EMS has also been shown to be effective in preparation for and recovery from exercise (e.g., to complement a warm up or cool down protocol), injury and post-surgical rehabilitation, and to provide additional physiological stress during training.

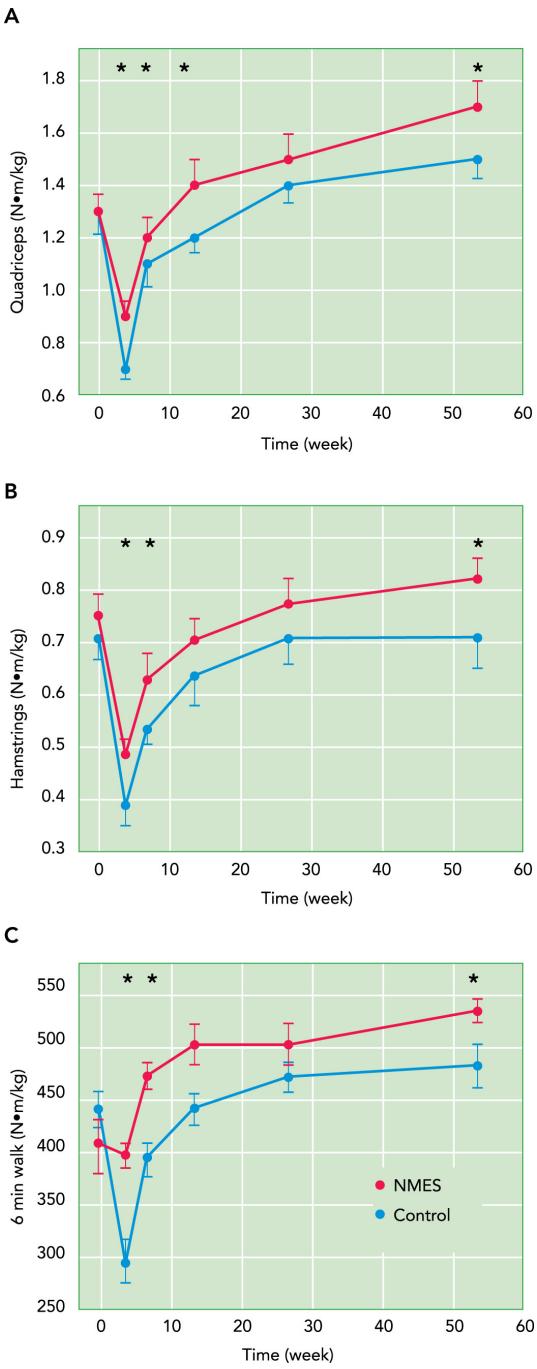


Figure 4: A study by Stevens-Lapsley et al. (2012) Physical Therapy demonstrates the potential benefit of NMES compared to control in rehabilitation from Total Knee Arthroplasty

Methods

Equipment

- Compex Electrical Muscle Stimulator
- Electrodes
- Gloves
- Razors
- Alcohol swabs
- Fine sandpaper
- Adhesive tape
- Massage table

Procedure

We will be using Compex EMS devices for neuromuscular stimulation. This activity involves guided discovery where, in groups of 6-8 students, you will experiment with location and orientation of electrodes to induce electrical stimulation of various muscles, making subjective assessments of contraction responses. You are allowed to perform the tests on multiple individuals within your group and, ideally, everyone should experience what EMS feels like (if you are comfortable doing so). As always, treat your 'patient' with respect and care.

Electrode Placement

1. Have the patient lie down or sit on the edge of a massage table to prepare for electrode placement; the patient may need to remove outer layers of clothing to enable easy access to electrode sites
2. Prepare the electrode site by rubbing gently with fine sandpaper, then wipe with alcohol swabs to clean the site of any skin fragments, sweat, or oil; *If the patient has body hair at any electrode site, you must first remove the hair in the area using a shaver before following with sandpaper and alcohol swabs
3. Once the alcohol has dried, remove the adhesive cover from an electrode then apply the electrode firmly to the skin at each site, referring to the Compex Guide for locations and orientations, and trying not to overlap the adhesive gel surfaces of the electrodes
4. Referring to the Compex Guide, press each clip-on cable onto its respective electrode, making sure to check that each clip is applied at the correct location and has been clipped on securely
5. Plug the wires into the Compex device then switch the device on to select a program, referring to the Compex Guide to choose the appropriate program and intensities
6. During the EMS bout, perform active and passive joint movements to assess contraction strength, and seek subjective feedback from the patient to support your observations
7. Adjust electrode positioning if required before re-testing, or select a new target muscle and repeat steps above

> **!** Do not throw out electrode pads - they are reusable
> Do not apply electrodes to the face, neck, near the heart or spine, or on genitals

Results

Make notes below about the target muscles chosen, positioning of electrodes, and the objective and subjective assessments made during your EMS trials

Lab Question 1

Now that you've had a chance to play around with the EMS devices, what considerations would you make before implementing this tool in practice?

Lab Question 2

Think about some creative ways that this tool could be used in clinical, general, or athletic populations - what settings would you be interested in researching to see if EMS can be useful for improving, maintaining, or restoring function?

Discussion

Throughout the lab we will be viewing and discussing content related to muscle stimulation for neuromuscular rehabilitation. You can write any notes related to the content, discussions, and practical activities below.

References

Carson, R. G., & Buick, A. R. (2021). Neuromuscular electrical stimulation-promoted plasticity of the human brain. *The Journal of Physiology*, *599*(9), 2375–2399. https://doi.org/10.1113/JP278298

Enoka, R. M., Amiridis, I. G., & Duchateau, J. (2019). Electrical stimulation of muscle: electrophysiology and rehabilitation. *Physiology*. https://doi-org.ezproxy.lib.uts.edu.au/10.1152/physiol.00015.2019

Maffiuletti, N. A., Gondin, J., Place, N., Stevens-Lapsley, J., Vivodtzev, I., & Minetto, M. A. (2018). Clinical Use of Neuromuscular Electrical Stimulation for Neuromuscular Rehabilitation: What Are We Overlooking? *Archives of Physical Medicine and Rehabilitation*, *99*(4), 806–812. https://doi.org/10.1016/j.apmr.2017.10.028

Resources

Compex Electrode Placement Guide

https://s3.amazonaws.com/assets.compex.com/fr/compex-electrode-placement-EN-NL-PT-SV-RU.pdf

Week 13 - DXA & Exercise Modification

Bone & Body Composition, and Chronic Diseases

Pre-Lab Activity

Read Chapter 25 of the textbook which relates to the topic of osteoporosis.

Watch the DXA content in your Canvas modules to learn important foundational knowledge about bone and body composition, providing important context for DXA use in various populations and the the activities in this lab.

Lab Session

Introduction

The majority of bone mass is accrued during childhood and adolescence, with peak bone mass occuring and maintained throughout an individual's 20s, Osteoporosis is a disease that is characterised by loss of bone mineral content (BMC) and density (BMD), resulting in reduced bone strength and an increased risk of fracture. The loss of BMC is often associated with ageing, postmenopausal hormone changes, secondary factors (e.g., immobility, medications), or a combination of these factors. Other metabolic factors can play a role, including vitamin (esp. Vit D) and mineral (esp. Calcium) deficiencies. In general, peak bone mass is achieved around the age of 30, after which bone mineral breakdown tends to exceed its formation. As such, maximising bone mass in the teens and early adulthood is valuable for maintaining bone health in your older age by delaying the onset of clinically-relevant osteoporosis.

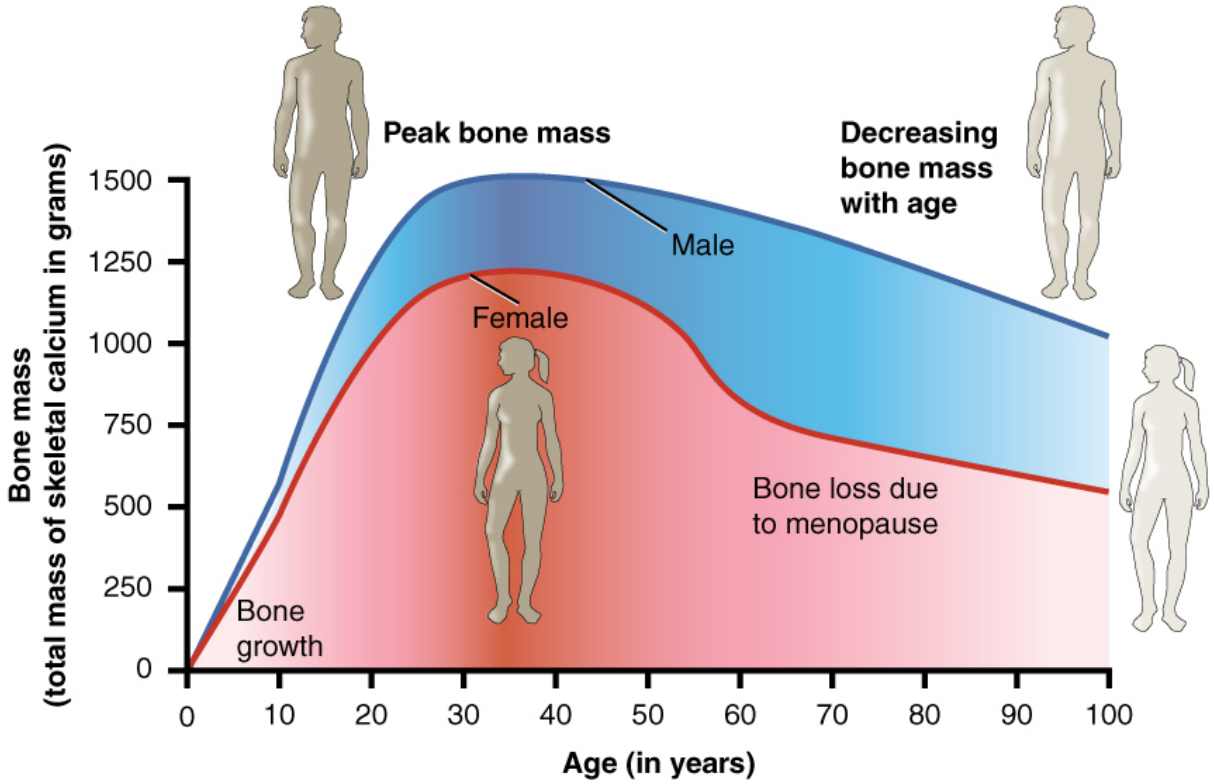


Figure 1: Relationship between age and bone mass for males and females, from Betts et al. (2013)

Dual-energy X-ray Absorptiometry (DXA) is a quick, valid, and reliable method for the measurement of bone mineral density (BMD). DXA is a valuable tool for the diagnosis of osteoporosis or low bone mass (osteopenia). Through one-off or longitudinal measurement of bone mineral content (BMC) and area at various sites with increased fracture risk, clinicians can calculate BMD and compare that to normative data to estimate differences to young and age-matched populations, and fracture risk. It can also assist clinicians in identifying rapid changes in bone mass that may be an indication of secondary bone loss or other metabolic factors. By identifying these changes early, clinicians can prescribe interventions (medications, exercise) that can help to halt the loss of bone mass before fracture.

The most common sites for DXA assessment of bone mineral content are the lumbar vertebrae (L1-L4, Antero-Posterior Spine) or hip (femoral neck and total proximal femur) as these sites encounter a large proportion of all vertical loading during activities of daily living and become more prone to fracture with low bone mass. The forearm forearm (radius) is less commonly used.

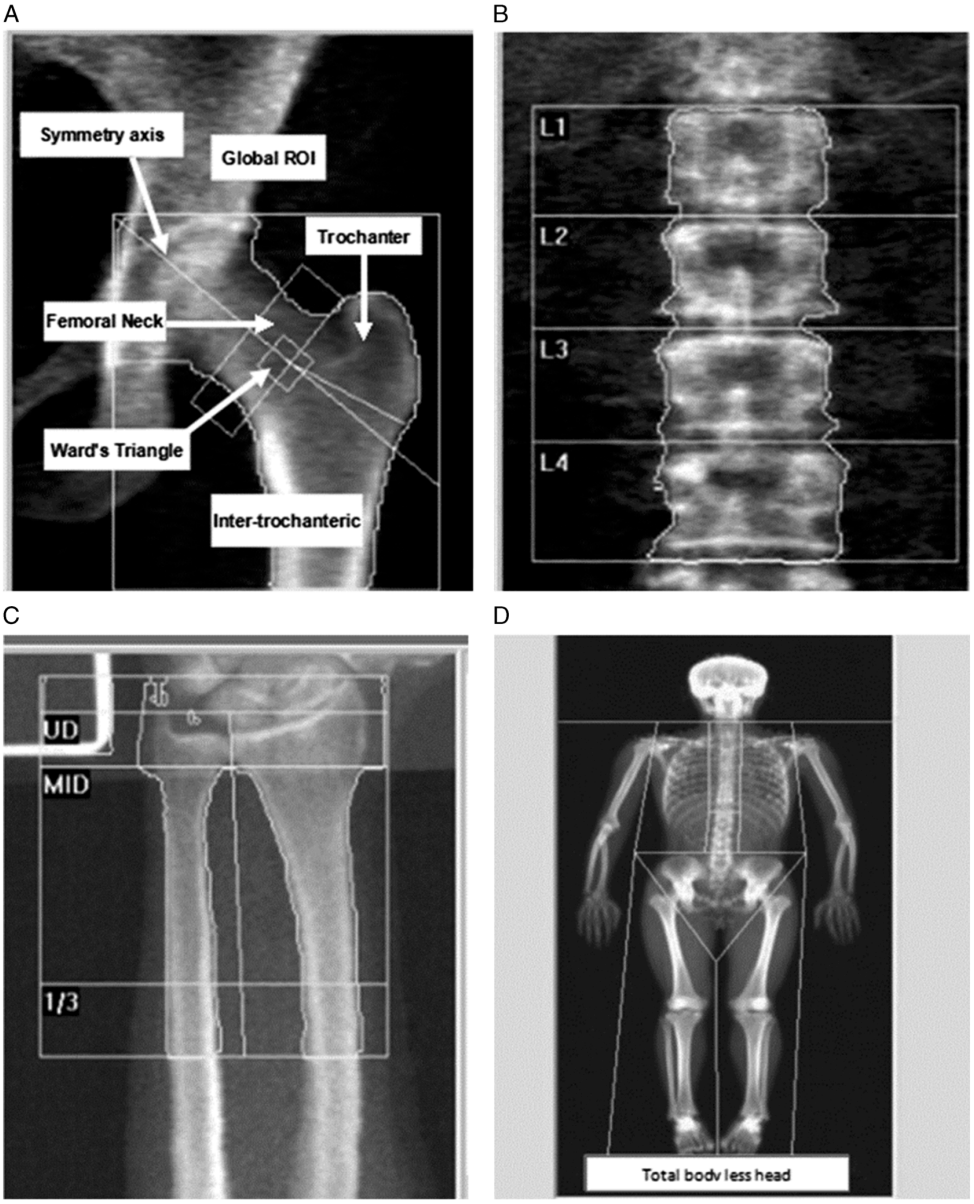


FIGURE 2. Correct positioning and analysis of the proximal femur (**A**), L1–L4 spine (**B**), distal radius (**C**), and total body less head for pediatric age group (**D**).

As per the WHO Classification, determination of low bone mass (osteopenia) is made when BMD Z-score is at least 2 standard deviations below the age-matched mean or the T-score is between -1 and -2.5 SD below the young adult mean, which indicates a possible secondary cause of accelerated bone loss. A determination of osteoporosis is made when the T-score ≤ -2.5 SD.

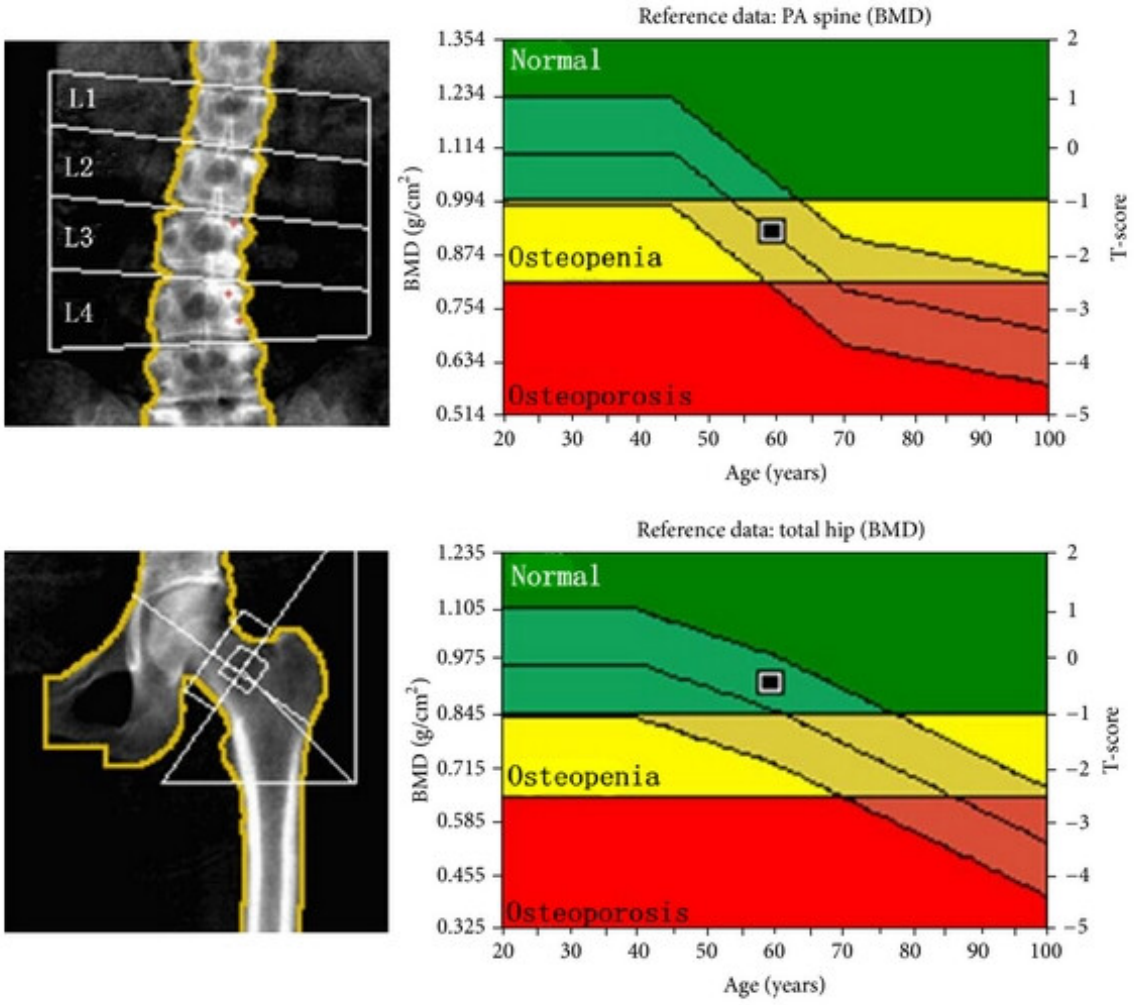


Figure 2: AP Spine and Proximal Femur DXA Scans with Densitometry Reference Charts indicating patient's BMD relative to young adult mean (T-score) and diagnosis thresholds

DXA can also be used for total body composition scanning to measure lean and fat mass. This is a useful tool for assessing body composition in most populations, especially as a way to monitor longitudinal changes in response to lifestyle changes, e.g., diet and exercise. In the UTS Clinical Imaging Lab (Level 4, Moore Park) our accredited DXA technicians frequently perform body composition scans for elite athletes from sports clubs across Sydney. The lab also performs scans for the general public to assess bone and body composition for their own personal interest and health goals.

The first part of this lab provides background on DXA assessment for bone and body composition. We will cover principles of DXA measurement and interesting cases.

The second part of this lab will be a practical activity integrating your knowledge developed throughout the subject in prescribing and modifying exercises for individuals with various chronic clinical conditions. These are critical skills for Accredited Exercise Scientists and anyone wanting to pursue a career as an Accredited Exercise Physiologist.

As with any clinical population, there are important considerations to make when assessing, prescribing, and delivering exercise programs for clinical populations. The objectives of this lab are to:

- Examine the role of DXA for the determination of low bone mass - osteopenia and osteporosis
- Develop an understanding of exercise prescription considerations for various clinical conditions

Activity - Exercise & Chronic Disease

Throughout this subject we have explored the clinical considerations for exercise prescription in individuals with chronic disease. This has included various assessments of functional capacity, and home- and gym-based training programming. In this lab, we will focus on planning and modifying exercise in a gym-based setting to provide physiological stress that is appropriate for the client and the clinical condition they are living with.

You will be presented with a series of case conditions that you will work through to prescribe and then modify exercises for the case individual. It's your job in groups to make additional considerations that call upon your resistance training and coaching knowledge to develop appropriate training programming and exercises. This activity will take place in the Exercise Physiology Clinic (Level 2) and Resistance Training (Level 4) Gyms.

You will select 3-4 case conditions from the table below, and spend ~20 minutes working on each, following the instructions below.

Condition	Patient Considerations
Hypertension	BP is 165/100
Myocardial Infarction	6 weeks post CABG Surgery
Heart Failure	Reporting high level of fatigue
Peripheral Vascular Disease	Leg claudication upon exertion
Stroke	Right side partial hemiparesis
Osteoporosis	Affected at the spine and has stooped posture
Rheumatoid Arthritis	Affected at hand and wrist - unable to grip
Parkinsons Disease	Wrist and hand tremor and bradykinesia
Spinal Cord Injury	L2 Paraplegic
Cerebral Palsy	Foot drop and sever wrist spasticity
Multiple Sclerosis	Arm and hand tremor
Diabetes	Type 2 peripheral neuropathy
Chronic Obstructive Pulmonary Disorder	Exertional dyspnoea
Breast Cancer	8 weeks post-surgery - double mastectomy
Bone Cancer	Recently completed 3rd round of chemotherapy and radiation therapy

1. In your lab groups of 5-7 people, you will select an exercise that you are familiar with and move to that equipment
2. For each exercise chosen, have two people perform 10 reps as a young, healthy individual, while the group observes form and considers the key movement concepts, target muscles, and safety considerations
3. After completing the set, spend 5-10 minutes as a group considering appropriate exercise modifications to allow an individual with your case condition to complete the exercise safely, considering:
    a. Safe alternative exercises that target the same muscles
    b. Change in positioning or technique to minimise stress on affected body parts
    c. Appropriate progressions to make the exercise more technically or physically challenging if the patient finds it too easy

   d. Appropriate regressions to make the exercise less technically or physically challenging if the patient finds it too hard

4. Have two people perform 10 reps of your modified exercise (assuming the role of the case patient) while the group provides coaching cues and assists/spots during completion of exercise, and observes movement replication, safety, and suitability (i.e., for individual ability and to achieve tissue stress)
5. Once the set is complete, reflect on the modified exercise, including how the 'patients' felt performing the movement, and any further adjustments you would make
6. All groups will briefly summarise and discuss their modifications with the class
7. Select a different case condition and modify the same exercise for the new case patient, repeating steps 3-6
8. Once you have completed step 7, move to a different gym equipment/exercise and repeat steps 2-7

Notes

Exercise 1 _____

Case Condition 1 _____

Case Notes

Case Condition 2 _____

Case Notes

Exercise 2 _____

Case Condition 3 _____

Case Notes

Case Condition 4 _____

Case Notes

Discussion

Throughout the lab we will be viewing and discussing content related to muscle stimulation for neuromuscular rehabilitation. You can write any notes related to the content, discussions, and practical activities below.

Appendices

The following resources may be used in laboratory sessions throughout the semester or be useful for your group assignment

National Health and Nutrition Examination Survey (NHANES) Functional Status Survey

The NHANES survey is an established and routinely performed questionnaire that is designed to assess the health and nutritional status of adults and children in the United States through interviews and direct physical examinations. This particular survey focuses on functional status.

Instructor to ask: "I am going to read out some activities with which some people have some difficulty. Please tell me if you have **no difficulty, some difficulty, much difficulty, are unable to do** or **never do** these activities, when you are by yourself and without the use of aids" (read choices, probe if necessary).

Difficulty Codes

0 = No Difficulty | 1 = Some Difficulty | 2 = Much Difficulty | 3 = Unable to Do | 4 = Never Do | 5 = Don't Know | 6 = Inappropriate

NHANES Survey

Question	Category	Question	Score
1	DRESSING	Dress yourself including tying shoes, working zippers, and doing buttons?	
2	ARISE	Stand up from an armless straight chair (such as a dining room chair)?	
3	ARISE	Get in and out of bed?	
4	EATING	Prepare meals?	
5	EATING	Cut your meat?	
6	EATING	Lift a full glass or cup to your mouth?	
7	EATING	Open a new milk carton?	
8	WALK	Walk a quarter mile (2-3 blocks)? If code = 0 go Q13	
9	WALK	Walk from one room to another (on the same floor)?	
10	WALK	Walk up and down at least 2 steps?	
11	HYGIENE	Get in and out of a bathtub?	
12	HYGIENE	Wash and dry your whole body?	
13	HYGIENE	Get on and off the toilet?	
14	DRESSING	Comb your hair?	
15	REACHING	Reach and get down a 5lb object (bag of sugar) from just above your head?	
16	REACHING	Bend down and pick up clothing?	
17	GRIP	Open jars that have been previously opened?	
18	GRIP	Use a pen or pencil to write with?	
19	ERRANDS	Get in and out of a car?	
20	ERRANDS	Run errands and shop?	
21	ERRANDS	Do light chores such as vacuuming?	
22	ERRANDS	Lift and carry a full bag of groceries?	
23	ERRANDS	Do heavy chores around the house or yard (washing windows, walls, and floors)?	

NHANES Scoring

The category score is the **worst** score the participant has for the questions in that category. For example,

- Question 1: 1
- Question 14: 2

Category score for Dressing (Q1, Q14) = **2**

Any score of 4, 5, or 6 automatically becomes a score of 3 for the category scores. For example,

- Question 2: 4 »> 3
- Question 3: 1

Category score for Arise (Q2, Q3) = **3**

> **!** The Disability score is the average of the 8 categories, therefore the maximum disability score is 3

Category	Questions	Score (0-3)
Dressing	1, 14	
Arise	2, 3	
Eating	4, 5, 6, 7	
Walking	8, 9, 10	
Hygiene	11, 12, 13	
Reach	15, 16	
Grip	17, 18	
Errands/Chores	19, 20, 21, 22, 23	
Disability Score	**Average of 8 Categories**	

Incidental and Planned Exercise Questionnaire

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INCIDENTAL AND PLANNED EXERCISE QUESTIONNAIRE (VERSION WA*)

Q1-Q4. In the past three months, how much time did you spend in the following activities on average per week?

Never ( ) Please go to question 5

Exercise type	Number of times /week	Number of minutes per session <30	30-45	45+	1-2hrs	2-4hrs
Exercise class	_____	( )	( )	( )	( )	( )
Home Exercise (e.g. stationary bicycle, stretching)	_____	( )	( )	( )	( )	( )
Other Exercise 1 (please specify)	_____	( )	( )	( )	( )	( )
Other Exercise 2 (please specify)	_____	( )	( )	( )	( )	( )
Other Exercise 3 (please specify)	_____	( )	( )	( )	( )	( )

Examples of other activities: bowls, golf, tennis, swimming, dancing, jogging, bicycling, etc.

Q5. During the past three months, how often have you been on walks specifically for exercise on average per week? (i.e. walking in the park, in the streets, cross-country walking, walking the dog etc).

Every day ( )
3-6 times/week ( )
Twice/week ( )
Once/week ( )
Less than once/week ( )
Never ( ) Please go to question 7

Q6. In these walks for Exercise, how long did you walk for?

Less than 15mins/day ( )
15mins to less than 30mins/day ( )
30mins to less than 1 hour/day ( )
1 hour to less than 2 hours/day ( )
2 hours to less than 4 hours/day ( )
4 or more hours/day ( )

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Q7. During the past three months, how often have you been on other walks (i.e. walk to general practitioner, pharmacy, or store) on average per week?

Every day	( )	
3-6 times/week	( )	
Twice/week	( )	
Once/week	( )	
Less than once/week	( )	
Never	( )	Please go to question 9

Q8.. In these other walks, how long did you walk for?

Less than 15mins/day	( )
15mins to less than 30mins/day	( )
30mins to less than 1 hour/day	( )
1 hour to less than 2 hours/day	( )
2 hours to less than 4 hours/day	( )
4 or more hours/day	(..)

Q9. In the past three months, in addition to the walking you mentioned above, how much time did you spend each day out of your house doing other physical activity such as house maintenance and gardening? (Excluding housework and activities inside the house).

Never (i.e. no garden)	( )
Less than 15mins/day	( )
15mins to less than 30mins/day	( )
30mins to less than 60mins/day	( )
1 hour to less than 2 hours/day	( )
2 hours to less than 4 hours/day	( )
4 or more hours/ day	( )

Q10. In the past three months, how many hours did you spend on your feet each day indoors at home doing tasks like housework, self care or care for another person?

Never (i.e. living in hostel, assisted living)	( )
Less than 15mins/day	( )
15mins to less than 30mins/day	( )
30mins to less than 60mins/day	( )
1 hour to less than 2 hours/day	( )
2 hours to less than 4 hours/day	( )
4 or more hours/day	( )

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SUMMARY CALCULATIONS

Question	Response	CODE
Q1, Q3	Never	0
	Once/week	1
	Twice/week	2
	Three times/week	3
	Four times/week	4
	Five times/week	5
	Six times/week	6
	Seven times/week	7
Q2, Q4	Never	0
	less than 30mins	0.250
	30-45 mins	0.625
	more than 45mins	1.000
	1-2 hrs	1.500
	2-4 hrs	3.000
Q5, Q7	every day	7.000
	3-6 times/week	4.500
	twice/week	2.000
	once/week	1.000
	Less than once/week	0.000
	Never	0
Q6, Q8, Q9, Q10	Never	0
	Less than 15mins	0.125
	15-30 mins	0.375
	30 mins - 1hr	0.750
	1-2 hrs	1.500
	2-4 hrs	3.000
	4 hrs +	5.000

Total time spent is summed across all components and expressed as hours per week. The score is derived from multiplying frequency score and duration score to create a total duration for the week score
Total activity = (Q1*Q2) + (Q3*Q4) + (Q5*Q6) + (Q7*Q8) + (Q9*7) + (Q10*7)

Several activity subscores can be derived by summing only those questions that are relevant to your research question.
Examples:
Incidental activity = (Q7*Q8) + (Q9*7) + (Q10*7)
Walking activity = (Q5*Q6) + (Q7*Q8)
Planned activity = (Q1*Q2) + (Q3*Q4) + (Q5*Q6)
Planned walking activities = (Q5*Q6)
Planned sport activities = (Q1*Q2) + (Q3*Q4)

Reference:
Delbaere K, Hauer K, Lord SR. Evaluation of the incidental and planned exercise questionnaire (IPEQ) for older people. British Journal of Sports Medicine. 2010;44(14):1029-1034.

Mini Balance Evaluation Systems Test

Mini-BESTest: Balance Evaluation Systems Test

ANTICIPATORY ***SUB SCORE:*** /6

1. SIT TO STAND
Instruction: "Cross your arms across your chest. Try not to use your hands unless you must. Do not let your legs lean against the back of the chair when you stand. Please stand up now."
(2) Normal: Comes to stand without use of hands and stabilizes independently.
(1) Moderate: Comes to stand WITH use of hands on first attempt.
(0) Severe: Unable to stand up from chair without assistance, OR needs several attempts with use of hands.

2. RISE TO TOES
Instruction: "Place your feet shoulder width apart. Place your hands on your hips. Try to rise as high as you can onto your toes. I will count out loud to 3 seconds. Try to hold this pose for at least 3 seconds. Look straight ahead. Rise now."
(2) Normal: Stable for 3 s with maximum height.
(1) Moderate: Heels up, but not full range (smaller than when holding hands), OR noticeable instability for 3 s.
(0) Severe: ≤ 3 s.

3. STAND ON ONE LEG
Instruction: "Look straight ahead. Keep your hands on your hips. Lift your leg off of the ground behind you without touching or resting your raised leg upon your other standing leg. Stay standing on one leg as long as you can. Look straight ahead. Lift now."

Left: *Time in Seconds Trial 1:_____Trial 2:_____*
(2) Normal: 20 s.
(1) Moderate: < 20 s.
(0) Severe: Unable.

Right: *Time in Seconds Trial 1:_____Trial 2:_____*
(2) Normal: 20 s.
(1) Moderate: < 20 s.
(0) Severe: Unable

To score each side separately use the trial with the longest time.
To calculate the sub-score and total score use the side [left or right] with the lowest numerical score [i.e. the worse side].

REACTIVE POSTURAL CONTROL ***SUB SCORE:*** /6

4. COMPENSATORY STEPPING CORRECTION- FORWARD
Instruction: "Stand with your feet shoulder width apart, arms at your sides. Lean forward against my hands beyond your forward limits. When I let go, do whatever is necessary, including taking a step, to avoid a fall."
(2) Normal: Recovers independently with a single, large step (second realignment step is allowed).
(1) Moderate: More than one step used to recover equilibrium.
(0) Severe: No step, OR would fall if not caught, OR falls spontaneously.

5. COMPENSATORY STEPPING CORRECTION- BACKWARD
Instruction: "Stand with your feet shoulder width apart, arms at your sides. Lean backward against my hands beyond your backward limits. When I let go, do whatever is necessary, including taking a step, to avoid a fall."
(2) Normal: Recovers independently with a single, large step.
(1) Moderate: More than one step used to recover equilibrium.
(0) Severe: No step, OR would fall if not caught, OR falls spontaneously.

6. COMPENSATORY STEPPING CORRECTION- LATERAL
Instruction: "Stand with your feet together, arms down at your sides. Lean into my hand beyond your sideways limit. When I let go, do whatever is necessary, including taking a step, to avoid a fall."

Left
(2) Normal: Recovers independently with 1 step (crossover or lateral OK).
(1) Moderate: Several steps to recover equilibrium.
(0) Severe: Falls, or cannot step.

Right
(2) Normal: Recovers independently with 1 step (crossover or lateral OK).
(1) Moderate: Several steps to recover equilibrium.
(0) Severe: Falls, or cannot step.

Use the side with the lowest score to calculate sub-score and total score.

SENSORY ORIENTATION ***SUB SCORE:*** /6

7. STANCE (FEET TOGETHER); EYES OPEN, FIRM SURFACE
Instruction: "Place your hands on your hips. Place your feet together until almost touching. Look straight ahead. Be as stable and still as possible, until I say stop."
Time in seconds:_____
(2) Normal: 30 s.
(1) Moderate: < 30 s.
(0) Severe: Unable.

8. STANCE (FEET TOGETHER); EYES CLOSED, FOAM SURFACE
Instruction: "Step onto the foam. Place your hands on your hips. Place your feet together until almost touching. Be as stable and still as possible, until I say stop. I will start timing when you close your eyes."
Time in seconds:_____
(2) Normal: 30 s.
(1) Moderate: < 30 s.
(0) Severe: Unable.

9. INCLINE- EYES CLOSED
Instruction: "Step onto the incline ramp. Please stand on the incline ramp with your toes toward the top. Place your feet shoulder width apart and have your arms down at your sides. I will start timing when you close your eyes."
Time in seconds:_____
(2) Normal: Stands independently 30 s and aligns with gravity.
(1) Moderate: Stands independently <30 s OR aligns with surface.
(0) Severe: Unable.

DYNAMIC GAIT ***SUB SCORE:*** **/10**

10. CHANGE IN GAIT SPEED
Instruction: "Begin walking at your normal speed, when I tell you 'fast', walk as fast as you can. When I say 'slow', walk very slowly."
(2) Normal: Significantly changes walking speed without imbalance.
(1) Moderate: Unable to change walking speed or signs of imbalance.
(0) Severe: Unable to achieve significant change in walking speed AND signs of imbalance.

11. WALK WITH HEAD TURNS – HORIZONTAL
Instruction: "Begin walking at your normal speed, when I say "right", turn your head and look to the right. When I say "left" turn your head and look to the left. Try to keep yourself walking in a straight line."
(2) Normal: performs head turns with no change in gait speed and good balance.
(1) Moderate: performs head turns with reduction in gait speed.
(0) Severe: performs head turns with imbalance.

12. WALK WITH PIVOT TURNS
Instruction: "Begin walking at your normal speed. When I tell you to 'turn and stop', turn as quickly as you can, face the opposite direction, and stop. After the turn, your feet should be close together."
(2) Normal: Turns with feet close FAST (≤ 3 steps) with good balance.
(1) Moderate: Turns with feet close SLOW (≥4 steps) with good balance.
(0) Severe: Cannot turn with feet close at any speed without imbalance.

13. STEP OVER OBSTACLES
Instruction: "Begin walking at your normal speed. When you get to the box, step over it, not around it and keep walking."
(2) Normal: Able to step over box with minimal change of gait speed and with good balance.
(1) Moderate: Steps over box but touches box OR displays cautious behavior by slowing gait.
(0) Severe: Unable to step over box OR steps around box.

14. TIMED UP & GO WITH DUAL TASK ***[3 METER WALK]***
Instruction TUG: "When I say 'Go', stand up from chair, walk at your normal speed across the tape on the floor, turn around, and come back to sit in the chair."
Instruction TUG with Dual Task: "Count backwards by threes starting at ___. When I say 'Go', stand up from chair, walk at your normal speed across the tape on the floor, turn around, and come back to sit in the chair. Continue counting backwards the entire time."

TUG:_____seconds; Dual Task TUG:_____seconds
(2) Normal: No noticeable change in sitting, standing or walking while backward counting when compared to TUG without Dual Task.
(1) Moderate: Dual Task affects either counting OR walking (>10%) when compared to the TUG without Dual Task.
(0) Severe: Stops counting while walking OR stops walking while counting.
When scoring item 14, if subject's gait speed slows more than 10% between the TUG without and with a Dual Task the score should be decreased by a point.

TOTAL SCORE: _____/28

Mini-BESTest Instructions

Subject Conditions: Subject should be tested with flat-heeled shoes OR shoes and socks off.
Equipment: Temper® foam (also called T-foam™ 4 inches thick, medium density T41 firmness rating), chair without arm rests or wheels, incline ramp, stopwatch, a box (9" height) and a 3 meter distance measured out and marked on the floor with tape [from chair].
Scoring: The test has a maximum score of **28** points from **14 items** that are each scored from 0-2.
"0" indicates the lowest level of function and "2" the highest level of function.
If a subject must use an assistive device for an item, score that item one category lower.
If a subject requires physical assistance to perform an item, score "0" for that item.
For **Item 3** (stand on one leg) and **Item 6** (compensatory stepping-lateral) only include the score for one side (the worse score).
For **Item 3** (stand on one leg) select the best time of the 2 trials [from a given side] for the score.
For **Item 14** (timed up & go with dual task) if a person's gait slows greater than 10% between the TUG without and with a dual task then the score should be decreased by a point.

1. SIT TO STAND	Note the initiation of the movement, and the use of the subject's hands on the seat of the chair, the thighs, or the thrusting of the arms forward.
2. RISE TO TOES	Allow the subject two attempts. Score the best attempt. (If you suspect that subject is using less than full height, ask the subject to rise up while holding the examiners' hands.) Make sure the subject looks at a non-moving target 4-12 feet away.
3. STAND ON ONE LEG	Allow the subject two attempts and record the times. Record the number of seconds the subject can hold up to a maximum of 20 seconds. Stop timing when the subject moves hands off of hips or puts a foot down. Make sure the subject looks at a non-moving target 4-12 feet ahead. Repeat on other side.
4. COMPENSATORY STEPPING CORRECTION-FORWARD	Stand in front of the subject with one hand on each shoulder and ask the subject to lean forward (Make sure there is room for them to step forward). Require the subject to lean until the subject's shoulders and hips are in front of toes. After you feel the subject's body weight in your hands, very suddenly release your support. The test must elicit a step. NOTE: Be prepared to catch subject.
5. COMPENSATORY STEPPING CORRECTION - BACKWARD	Stand behind the subject with one hand on each scapula and ask the subject to lean backward (Make sure there is room for the subject to step backward.) Require the subject to lean until their shoulders and hips are in back of their heels. After you feel the subject's body weight in your hands, very suddenly release your support. Test must elicit a step. NOTE: Be prepared to catch subject.
6. COMPENSATORY STEPPING CORRECTION- LATERAL	Stand to the side of the subject, place one hand on the side of the subject's pelvis, and have the subject lean their whole body into your hands. Require the subject to lean until the midline of the pelvis is over the right (or left) foot and then suddenly release your hold. NOTE: Be prepared to catch subject.
7. STANCE (FEET TOGETHER); EYES OPEN, FIRM SURFACE	Record the time the subject was able to stand with feet together up to a maximum of 30 seconds. Make sure subject looks at a non-moving target 4-12 feet away.
8. STANCE (FEET TOGETHER); EYES CLOSED, FOAM SURFACE	Use medium density Temper® foam, 4 inches thick. Assist subject in stepping onto foam. Record the time the subject was able to stand in each condition to a maximum of 30 seconds. Have the subject step off of the foam between trials. Flip the foam over between each trial to ensure the foam has retained its shape.
9. INCLINE EYES CLOSED	Aid the subject onto the ramp. Once the subject closes eyes, begin timing and record time. Note if there is excessive sway.
10. CHANGE IN SPEED	Allow the subject to take 3-5 steps at normal speed, and then say "fast". After 3-5 fast steps, say "slow". Allow 3-5 slow steps before the subject stops walking.
11. WALK WITH HEAD TURNS-HORIZONTAL	Allow the subject to reach normal speed, and give the commands "right, left" every 3-5 steps. Score if you see a problem in either direction. If subject has severe cervical restrictions allow combined head and trunk movements.
12. WALK WITH PIVOT TURNS	Demonstrate a pivot turn. Once the subject is walking at normal speed, say "turn and stop." Count the number of steps from "turn" until the subject is stable. Imbalance may be indicated by wide stance, extra stepping or trunk motion.
13. STEP OVER OBSTACLES	Place the box (9 inches or 23 cm height) 10 feet away from where the subject will begin walking. Two shoeboxes taped together works well to create this apparatus.
14. TIMED UP & GO WITH DUAL TASK	*Use the TUG time to determine the effects of dual tasking. The subject should walk a 3 meter distance.* *TUG:* Have the subject sitting with the subject's back against the chair. The subject will be timed from the moment you say "Go" until the subject returns to sitting. Stop timing when the subject's buttocks hit the chair bottom and the subject's back is against the chair. The chair should be firm without arms. *TUG With Dual Task*: While sitting determine how fast and accurately the subject can count backwards by threes starting from a number between 100-90. Then, ask the subject to count from a different number and after a few numbers say "Go". Time the subject from the moment you say "Go" until the subject returns to the sitting position. Score dual task as affecting counting or walking if speed slows (>10%) from TUG and or new signs of imbalance.

PDQ-39 Questionnaire

PDQ-39 QUESTIONNAIRE

Please complete the following

Please tick one box for each question

Due to having Parkinson's disease, how often during the last month have you....		**Never**	**Occasionally**	**Sometimes**	**Often**	**Always** or cannot do at all
1	Had difficulty doing the leisure activities which you would like to do?	☐	☐	☐	☐	☐
2	Had difficulty looking after your home, e.g. DIY, housework, cooking?	☐	☐	☐	☐	☐
3	Had difficulty carrying bags of shopping?	☐	☐	☐	☐	☐
4	Had problems walking half a mile?	☐	☐	☐	☐	☐
5	Had problems walking 100 yards?	☐	☐	☐	☐	☐
6	Had problems getting around the house as easily as you would like?	☐	☐	☐	☐	☐
7	Had difficulty getting around in public?	☐	☐	☐	☐	☐
8	Needed someone else to accompany you when you went out?	☐	☐	☐	☐	☐
9	Felt frightened or worried about falling over in public?	☐	☐	☐	☐	☐
10	Been confined to the house more than you would like?	☐	☐	☐	☐	☐
11	Had difficulty washing yourself?	☐	☐	☐	☐	☐
12	Had difficulty dressing yourself?	☐	☐	☐	☐	☐
13	Had problems doing up your shoe laces?	☐	☐	☐	☐	☐

*Please check that you have ticked **one box for each question** before going on to the next page*

Due to having Parkinson's disease, how often <u>during the last month</u> have you....		***Please tick <u>one</u> box for each question***				
		Never	**Occasionally**	**Sometimes**	**Often**	**Always** or cannot do at all
14	Had problems writing clearly?	☐	☐	☐	☐	☐
15	Had difficulty cutting up your food?	☐	☐	☐	☐	☐
16	Had difficulty holding a drink without spilling it?	☐	☐	☐	☐	☐
17	Felt depressed?	☐	☐	☐	☐	☐
18	Felt isolated and lonely?	☐	☐	☐	☐	☐
19	Felt weepy or tearful?	☐	☐	☐	☐	☐
20	Felt angry or bitter?	☐	☐	☐	☐	☐
21	Felt anxious?	☐	☐	☐	☐	☐
22	Felt worried about your future?	☐	☐	☐	☐	☐
23	Felt you had to conceal your Parkinson's from people?	☐	☐	☐	☐	☐
24	Avoided situations which involve eating or drinking in public?	☐	☐	☐	☐	☐
25	Felt embarrassed in public due to having Parkinson's disease?	☐	☐	☐	☐	☐
26	Felt worried by other people's reaction to you?	☐	☐	☐	☐	☐
27	Had problems with your close personal relationships?	☐	☐	☐	☐	☐
28	Lacked support in the ways you need from your spouse or partner?	☐	☐	☐	☐	☐
	If you do not have a spouse or partner tick here		☐			
29	Lacked support in the ways you need from your family or close friends?	☐	☐	☐	☐	☐

*Please check that you have ticked **one box for each question** before going on to the next page*

Due to having Parkinson's disease, how often <u>during the last month</u> have you....		***Please tick <u>one</u> box for each question***				
		Never	**Occasionally**	**Sometimes**	**Often**	**Always**
30	Unexpectedly fallen asleep during the day?	☐	☐	☐	☐	☐
31	Had problems with your concentration, e.g. when reading or watching TV?	☐	☐	☐	☐	☐
32	Felt your memory was bad?	☐	☐	☐	☐	☐
33	Had distressing dreams or hallucinations?	☐	☐	☐	☐	☐
34	Had difficulty with your speech?	☐	☐	☐	☐	☐
35	Felt unable to communicate with people properly?	☐	☐	☐	☐	☐
36	Felt ignored by people?	☐	☐	☐	☐	☐
37	Had painful muscle cramps or spasms?	☐	☐	☐	☐	☐
38	Had aches and pains in your joints or body?	☐	☐	☐	☐	☐
39	Felt unpleasantly hot or cold?	☐	☐	☐	☐	☐

*Please check that you have ticked **one box for each question** before going on to the next page*

Thank you for completing the PDQ 39 questionnaire

Other Resources

These are some important web resources that you might use:

Home Exercise Program

hep2go.com

Lancet series on Obesity

thelancet.com/series/obesity-2017

Lancet series homepage

thelancet.com/clinical/series

CardioChek user manual (Lipids Lab)

ptsdiagnostics.com/wp-content/uploads/2018/09/ps-002461-en_rev._4_user_guide_cardiochek_pa.pdf

Compex

compex.com/au/