KIN 4370: Exercise Testing and Prescription Lab Manual

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MELISSA MARKOFSKI

Contents

Introduction

MELISSA MARKOFSKI

This is the laboratory manual for KIN 4370, Exercise Testing and Prescription. It is for use during the weekly lab class meetings. Please read the chapter for each week ahead of attending class. The questions for each chapter are not graded, but will help prepare you for your lab report.

This book is designed to be used electronically, but can also be downloaded as a PDF. Please be aware that there are activities imbedded in the electronic text that will not work in the PDF download. However, if you would like to download the chapters (or print them) for use during class, that is acceptable. It is advisable that in order to maximize the learning experience that the student returns to the electronic version to complete the activities and material not in the PDF.

Exam questions will include questions from the lab–both the protocols and the interpretation of the results. Please remember to study the materials in this manual.

CHAPTER 1

Chapter 1: Pre-test screening and assessment

MELISSA MARKOFSKI

BACKGROUND

PRE-PARTICIPATION SCREENING

Physical exercise places physiological demands on the body, especially the cardiorespiratory and skeletal muscle systems. This increases the chance for an individual to experience an injury or cardiovascular event. In symptom-limited maximal exercise testing, the rate of cardiac event is about six events per 10,000 tests. It is expected that sub-maximal exercise testing would have an even lower event rate.

To minimize this risk, we perform pre-participation screenings. Ideally, these screenings include a health history and physical activity readiness questionnaire. In this course we will use the PAR-Q+ as our self-guided pre-participation screening questionnaire. http://eparmedx.com/wp-content/uploads/2022/01/ParQPlus2022ImageFile.pdf

ACSM ATHEROSCLEROTIC CARDIOVASCULAR DISEASE RISK (CVD) FACTOR AND DEFINING CRITERIA

Criteria used to determine elevated risk for CVD risk. Summary from course textbook (ACSM's Resources for the Exercise Physiologist 3rd ed)

Criteria	Definition	Additional notes
Age	Males: > 44 Females: > 54	
Family history	History of cardiovascular events (myocardial infarction, coronary revascularization, sudden cardiac death)	Risk factor is met when one of these three events occurred before 55 years of age in a male or 65 years of age in a female first degree relative
Tabacco use	Current tobacco user, quit within the last 6 months, or regularly exposed to secondhand smoke	No current criteria for vaping tobacco exposure, but results from recent and on-going research studies supports that vaping tobacco causes changes in endothelial cells consistent with CVD
Physical activity	Sedentary lifestyle	Not participating in 30 mins of moderate exercise at least 3 times per week
Body weight	Obesity BMI >29.9 kg/m^2 or a waist circumference >102 cm in males or >88 cm for females	If person has BMI >/= 30 and high waist circumference, it counts as one risk factor
Blood pressure	Hypertension SBP >129mmHg and/or DBP >79mmHg	These are the most recent AHA guidelines! Use these! (ACSM-EP exam uses these)
Blood lipids	Dyslipidemia: client is taking blood lipid-lowering medication or LDL>129 mg/dL HDL<41 mh/dL	If total cholesterol is the only measure available, use >199 mg/dL as the criteria instead
Glucose metabolism	Diabetes Fasting glucose >125 mg/dL or 2 hr OGTT >199 mg/dL Or HbA1c >6.4%	Test is usually repeated to confirm, or blood glucose and HbA1c are used together to diagnose diabetes
HDL cholesterol (Negative risk factor)	HDL cholesterol >59 mg/dL	Negative risk factor: subtract 1 risk factor from the above positive risk factors

HEART RATE AND PULSE RATE

Heart rate is a measurement of the contraction of the heart. It is most commonly measured by a device that can sense the electrical activity of the heart, such as an electrocardiogram (ECG/EKG) or

a sensor worn over the heart (Polar monitor). Although the terms "heart rate" and "pulse rate" are used interchangeably, there are circumstances where the two numbers will vary. It is unlikely to observe a difference in these numbers in healthy individuals, but there are health issues that can result in differences between heart rate and pulse. For example, if someone had some sort of arterial occlusion or severe injury to a major artery, the pulse rate may vary (or even be absent) in the affected limb.

Additional optional reading: Polar "Difference between heart rate and pulse"

BLOOD PRESSURE MEASURES AND CLASSIFICATIONS

All participants should have their blood pressure measured to help assess risk. Pre-2017 ACSM guidelines recommended blood glucose and cholesterol screening, but this recommendation was removed from the latest guidelines. Exercise will increase the individual's systolic blood pressure (SBP) while they are exercising. This transient increase in SBP is not of concern. However, if the participant's SBP is high prior to an exercise session the exercise session could increase SBP to an excessively high level.

AHA BLOOD PRESSURE RECOMMENDATIONS

American Heart Association (AHA) recommended blood pressure levels. Updated 2017: Be sure to use these thresholds. Adapted from https://www.heart.org/-/media/data-import/downloadables/pe-abh-what-is-high-blood-pressure-ucm_300310.pdf

Blood pressure category	Systolic BP		Diastolic BP
Normal BP	<120 mmHg	AND	<80 mmHg
Elevated BP	120-129 mmHg	AND	<80 mmHg
Stage 1 hypertension	130-139 mmHg	OR	80-89 mmHg
Stage 2 hypertension	140+ mmHg	OR	90 mmHg or higher
Hypertensive crisis (call medical provider immediately)	>180 mmHg	AND/ OR	>120 mmHg

PRE-PARTICIPATION SCREENINGS

When reviewing the pre-participation screening documents, one of the things we are looking for is risk for cardiometabolic diseases. We want to identify people who may have contraindications to exercise. Exercise reduces the risk of developing cardiometabolic diseases, and individuals who are at an elevated risk should be encouraged to exercise if it is safe to do so (they may need to check with their medical care providers to confirm any exercise restrictions).

Individuals who are regularly exercising and have no diagnosis, signs, or symptoms of a cardiometabolic or renal disease have little restrictions on their exercise testing and prescription plan. It is recommended that individuals who are not participating in regular exercise and have a cardiometabolic or renal disease, or signs and symptoms of a cardiometabolic or renal disease, not participate in exercise testing or training until they receive medical clearance. If the person does not have cardiometabolic or renal disease, or any signs or symptoms, they may start with light to moderate exercise.

EXERCISE RECOMMENDATIONS FOR INDIVIDUALS WHO

ARE NOT CURRENTLY EXERCISING

Summary of current ACSM guidelines recommendations for physical activity for people who are not currently exercising but would like to start

	Medical clearance recommended?	**General exercise plan**
No diagnosis, signs, or symptoms of cardiometabolic or diseases	Not recommended	Start with light to moderate exercise and progress as recommended by ACSM guidelines
Known cardiometabolic or renal disease but no signs or symptoms	Recommended	After medical clearance is received, start with light to moderate intensity exercise and may progress if tolerated
Signs and/or symptoms of cardiometabolic or renal disease	Recommended	After medical clearance is received, start with light to moderate intensity exercise and may progress if tolerated

CLASS ACTIVITY

ACTIVITY 1: BLOOD PRESSURE MEASURES

Equipment: Stethoscope, sphygmometer

Participant: Partner up so that everyone has a chance to 1) have their blood pressure read; and 2) practice blood pressure readings

Additional reading: More in-depth instructions can found here: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3936692/pdf/jceh_26_84_076.pdf

Videos: This is a good video for technique (in a healthy person, you do not need to automatically pump the cuff up to 200. 20 above the last sound you hear is acceptable) https://www.youtube.com/watch?v=Gmic13mvsgo

This is a good video for common sources of error in BP measures: https://www.youtube.com/watch?v=gUHALsLeeoM

Instructions for resting BP measures:

Note: do not put the stethoscope in your ears until you are sure the stethoscope head is not going to bump or rub against anything

1. Have the participant sit in a chair, with legs uncrossed, feet on the floor, and measurement arm outstretched and relaxing on the table at about the level of the heart. Refrain from speaking with the participant during the measurement.
2. Selected the sphygmometer with the cuff that fits the participant. When the cuff is wrapped around their bare upper arm (1-2" above the crease of the elbow), it should fit within the guidelines of the cuff
3. Place the stethoscope head over the participants brachial artery near the cubital fossa. If you need to hold it in place, be sure you use your fingers and not your thumb.
4. Pump up the cuff. You should pump it up about 20mmHg past where you hear the last sound
5. Slowly release the pressure from the cuff. Note the number that corresponds to the first sounds you hear (this is SBP) and the last sound you hear (this is DBP)
6. Fully deflate the cuff
7. Remove the cuff and inform the participant of their blood pressure

Exercise blood pressure: Repeat the seven steps above, but either immediately after the person does 20 jumping jacks, or while they are actively cycling on the stationary bicycle.

ACTIVITY 2: HEART RATE AND PULSE RATE MEASUREMENTS

Equipment: Polar HR monitor (watch and chest strap)

Participant: Partner up so that everyone has a chance to practice pulse readings

Additional reading: HR strap placement (with pictures!) from Polar https://support.polar.com/en/support/tips/How_to_wear_a_heart_rate_sensor_with_textile_strap

Instructions for heart rate measure using a Polar HR monitor:

1. Have the participant fit the strap around their ribcage at the point just below the pectoral muscles. If their skin is dry or the weather is dry, the person may need to wet the strap electrodes with water or ECG gel
2. Turn on the Polar watch, hold within 3 feet of the participant, and make sure the watches received a signal.
3. Once a signal is received, it will take about 10-15 seconds for the reading to appear

Instructions for radial pulse measure:

1. Use two fingers to palpate the participant's wrist along the radius (in *most* people, the radial artery runs approximately on top of the radius)
2. When you feel the pulse, start your count for 15 seconds
3. Multiple your 15-second count by four to calculate beats per minute (BPM)

ACTIVITY 3: PAR-Q+

Equipment: PAR-Q+ (or PARmed-X for pregnant individuals)

Participant: Everyone will complete their own PAR-Q+ or PARmed-X

Additional reading: PAR-Q+: http://eparmedx.com/wp-content/uploads/2022/01/ParQPlus2022ImageFile.pdf

PARmed-X (for pregnancy): https://vancouver.ca/files/cov/par-q-plus-form-for-pregnancy-before-exercising.pdf

Instructions: Complete your PAR-Q+ or PARmed-X and place it facedown in the red basket. This counts as your data collection sheet for the day.

QUESTIONS

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https://uhlibraries.pressbooks.pub/kin4370labmanual/?p=25#h5p-4

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://uhlibraries.pressbooks.pub/kin4370labmanual/?p=25#h5p-5

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://uhlibraries.pressbooks.pub/kin4370labmanual/?p=25#h5p-6

CHAPTER 2

Chapter 2: Foundations of assessment techniques

MELISSA MARKOFSKI

BACKGROUND

TEST VALIDITY VERSUS RELIABILITY

When selecting exercise tests, we want the test to be **valid** and **reliable**. It is possible for tests to be one but not the other. If a test is valid, it measures what we want it to measure. If a test is reliable, the results are consistent and stable.

For example, someone could decide they want to measure relative body fat to estimate people's fitness. They could use an established method to measure relative body fat, repeat the test three times, and produce results of 18.1%, 17.9%, and 18.1%. These results have little variability, and for a measurement like body fat we would consider these to be reliable results—these measures are consistent. In addition, people who are fit generally have lower relative body fat than people who are not fit. Therefore, there is a relationship between relative body fat and fitness.

However, measuring someone's relative body fat does not provide us with information to determine the fitness level of the individual. We all probably know someone who meets exercise recommendations, but has higher relative body fat than someone else who is thin and does not exercise very much. This means the example of using relative body composition is a reliable measurement (the results were consistent and stable), but it is not a valid test to determine fitness. However, it would be a valid (and reliable!) test of body composition—and indeed we do use relative body fat as a measure of body composition.

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https://uhlibraries.pressbooks.pub/kin4370labmanual/?p=5#h5p-1

An interactive H5P element has been excluded from this version of the text. You can view it online here:

https://uhlibraries.pressbooks.pub/kin4370labmanual/?p=5#h5p-2

RELATIVE VERSUS ABSOLUTE

You probably noticed in the text above the term “relative body fat”, as opposed to the shorter “body fat”. There is a distinction between a measurement that is relative or absolute, and especially in exercise science it can make a difference in interpreting results and prescribing an exercise training plan. When we are using a test or prescription that is in reference to some other physiology this is a relative measurement. In the example above, 18.1% body fat is relative to the whole person (100%). If we know the person’s body weight, we can also express body composition in absolute terms. If the person who is 18.1% had a body weight of 80kg, then they have 14.48kg of body fat. The 14.48kg measure is an absolute term—it is not relative to anything else. In exercise prescription, we frequent use relative load guidelines. For example, prescribing someone to walk on a treadmill at 50% of heart rate maximum.

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https://uhlibraries.pressbooks.pub/kin4370labmanual/?p=5#h5p-3

CLASS ACTIVITY

ACTIVITY 1: VALIDITY, RELIABILITY, RELATIVE, AND ABSOLUTE

Equipment: Two items provided by the instructor (items will vary by group)

Participant: One person in your group will be measured

Instructions: You will receive two items from your instructor, and will be instructed to measure something. Use each item to measure the something three times. Record your values in absolute or relative terms (you decide as a group which is best). Once all groups have completed the activity, the instructor will lead a discussion on the measures.

ACTIVITY 2: CALIBRATE TREADMILL

Equipment: Treadmill, measuring tape, chalk

1. Measure the length of the entire belt (not just the length on the top of the deck!)
2. Turn the treadmill on a low speed
3. Time how long it takes for the treadmill to complete 10 revolutions
4. Noticeably increase the speed of the treadmill
5. Time how long it takes for the treadmill to complete 10 revolutions at this second speed
6. Calculate the speed of the treadmill (see equation below)
7. Compare the calculated speed with the programmed

speed of the treadmill

To calculate the speed of the treadmill:

The distance of the TM belt should be IN METERS. Multiply distance in meters*number of revolutions, then divide this number by the time in SECONDS. This will give you the speed in m/s, but the TM is in mph. To covert m/s to mph, multiple your number by 2.23694

(distance in meters * # of revolutions) / time in sec = (TM speed in m/s)

(TM speed in m/s)* (2.23694) = TM speed in mph

CHAPTER 3

Chapter 3: Assessing general skeletal muscle function

MELISSA MARKOFSKI

BACKGROUND

ASSESSING GENERAL SKELETAL MUSCLE FUNCTION

Skeletal muscle strength is of great interest to a wide range of people. It is commonly used by people wishing to improve their fitness, as a goal for athletes, and to assess decline in clinical and aging populations. This is a wide range of applications, and as such there are a wide range of tests that can be performed. This lab will cover three different assessments: skeletal muscle endurance, strength, and static (isometric) strength.

Skeletal muscle strength can be measured by isometric, isokinetic, or isotonic testing. Some populations, such as unfit older adults or other groups at a high risk of injury, are often tested with isometric exercises. Athletic and young, healthy populations are typically tested with isotonic exercises. As with aerobic endurance testing, muscular strength testing can be a maximal effort, or a

submaximal test that will estimate maximal strength. For this lab, we will assess skeletal muscle endurance and strength with isotonic and isometric tests.

CLASS ACTIVITY

ACTIVITY 1: UPPER BODY SKELETAL MUSCLE STRENGTH AND ENDURANCE (PUSH-UP TEST)

Push-up tests are a simple method for testing skeletal muscle strength and endurance in healthy individuals. This test requires little equipment and space, and can be conducted as either a one-on-one test or as a field test. However, it is not well-suited for all age ranges or people with shoulder injuries.

Research spotlight: Researchers followed male firefighters for 10 years. Those who could perform 40 push-ups at the start of the observation period had the lowest risk of cardiovascular disease. Read more: https://jamanetwork.com/journals/jamanetworkopen/fullarticle/2724778

Equipment: Workout mat

Participant: Each person (who is cleared for activity and does not have shoulder concerns) will participate in the activity

Additional reading: Your textbook figure 4.4 has additional instructions and pictures. Use this table to interpret the

results: https://canadacollege.edu/fitnesscenter/assess-muscle-endurance.php

Instructions: (*abbreviated from your textbook)*
Notes: only count complete push-ups in the correct form

1. Stand in the push-up "down" position. Men: start in the standard push-up position. Women: start on knees, with lower legs on the floor and feet planter flexed and laying on top of the mat
2. Raise the body by straightening the elbows to just before they lock, then return to the staring "down" position. This is one repetition.
3. Continue with good technique (back straight, arms fully extended) until the participant is unable to maintain the correct technique for two repetitions. After the first incorrect pus-up technique, give a warning to the participant. Although this is not a cadence test, if the participant requires a rest of more than ~3 seconds between repetitions the test can be terminated for excessive rest.
4. Compare your results with the table inch link above.

ACTIVITY 2: YMCA BENCH PRESS SKELETAL MUSCLE ENDURANCE TEST

At least one person per group will complete this test (ideally, everyone). This test uses an absolute weight for the strength assessment, based on identity of man or woman (non-binary can use whichever weight they are more comfortable lifting, but unfortunately there is not a norms table for comparison).

Equipment: Bench press set, spotter

Safety note: You MUST have a spotter who knows what they are doing for this exercise. If you do not, please ask your instructor to spot for this test.

Participant: At least one person per group who is cleared for strength testing will complete this test. If you have shoulder concerns, please have someone else from your group be the participant.

Instructions:

1. Men will lift 36kg and women 16kg.
2. Count how many repetitions can be safely completed.
3. Compare your results to the table in Blackboard.

ACTIVITY 4: WALL SIT

Equipment: Wall, timer

Participant: Everyone cleared for lower body testing.

Instructions:

1. Find a wall that you can easily rest against at a 90 degree angle (you may wish to go into the hallway outside the lab).
2. Sit against the wall, with knees at 90 degrees and feet in

line with knees.

3. Time how long you can sit against the wall, without breaking form.
4. Compare your results (in seconds) to the table posted in Blackboard.

ACTIVITY 5: STATIC LEG STRENGTH

Equipment: Goniometer, static strength platform

Participant: Everyone cleared for weight training will participate. If you have a knee, ankle, or back concern please use your best judgement and talk to an instructor if you are unsure. A partner is needed to check the joint angle prior to the start of the test.

Instructions:

1. Have the participant stand on the platform in a partial squat while holding the hand bar across their thighs. Using a goniometer, confirm that the participant's knees are flexed at an angle between 130-140° and adjust the length of the chain as needed.
2. After a brief post-setup rest, the participant holds the hand bar with a pronated grip and rests the bar across their thighs.
3. Using only the legs (not the back), slowly extend the knees and exert as much force as possible.
4. The participant will do two attempts with a one minute rest in between. Record the highest attempt.
5. Convert to kg and use table in the Blackboard folder for this lab to look up strength classification (use "leg strength" column for this test).

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://uhlibraries.pressbooks.pub/kin4370labmanual/?p=31#h5p-7

BONUS ACTIVITY: PLANK HOLD

Equipment: Padded exercise mat, timer
Participant: Everyone cleared for exercise testing.
Instructions:

1. Place exercise mat on the floor.
2. Get into a plank position (on elbows and feet) and start timer.
3. Compare your time, in minutes, to the table posted in Blackboard.

CHAPTER 4

Chapter 4: Methods for estimating cardiorespiratory fitness

MELISSA MARKOFSKI

BACKGROUND

ESTIMATING CARDIORESPIRATORY FITNESS

To classify cardiorespiratory fitness (CRF), we measure maximum oxygen consumption (VO_{2max}). It is well accepted that the gold standard method of measuring VO_{2max} is by using a gas analyses system. However, these gas analyses systems are costly and take time to calibrate for each test. In addition, only one person at a time can be tested.

Field tests for CRF avoid all three of this cons: they are inexpensive, requirer a shorter time than a gas analyses system test, and more than one person at a time can be tested. There are cons of field tests, the biggest one being that it is an estimation

method. Another is that if the method is conducted outside, the environmental conditions can introduce variability into the test.

Another option for measuring VO_{2max} besides a gas analysis system or a field test method is a sub-maximal VO_{2max} estimation test. These tests are typically completed on a treadmill or bike, are shorter in time than using a gas analyses system, but usually only one person at a time is tested. One advantage over a field test is that they can be conducted inside in a temperature controlled room.

Estimation methods–whether using a field test or a sub-maximal test–can estimate VO_{2max} because during sub maximal work there is generally a linear relationship between oxygen update and heart rate. The slope of the line changes with the state of physical fitness; that is, a fit person is able to transport the same amount of oxygen at a lower heart rate than an unfit person.

Because many of the estimation methods rely on the relationship between oxygen uptake and heart rate, it is crucial that the method to measure heart rate (or pulse rate) is as accurate as possible. It is essential to follow the test instructions if the measure is a heart rate, pulse rate, or recovery.

CLASS ACTIVITY

ACTIVITY 1: THE FORESTRY STEP TEST

Equipment: Step bench and risers, stop watch, metronome (or metronome app on phone), scale to measure body weight, tables posted on Blackboard

Participant: Everyone will complete this activity, unless someone has an orthopedic or other reason to not be a participant. If you are not a participant, make sure you record the information of your partner so you can practice using the data in the tables.

Instructions: Prior to starting the test, be sure you can locate pulse rate on your partner. *Do not use a heart rate monitor, and be sure to count the pulse for the fun 15 seconds.*

1. The participants stands facing the step bench (height = 40 cm for men, 33 cm for women).
2. The technician starts metronome, which is set for 90 beats per minute (step rate = 22.5 steps per min)
3. Start the timer as soon as the participant steps up on the bench. Have the person continue stepping for exactly 5 minutes (test time 0:00-5:00).
4. The participant should should straighten back and legs at top of step, and make sure to plant the entire foot on the step.
5. At the end of the five minutes, the participant stops stepping.
6. Immediately after ending the test, the participant sits down on the bench or a chair next to the bench for a 15 second rest (test time 5:00-5:15). The technician needs to use this time to find the participant's pulse.
7. Count the pulse rate for 15 seconds, 15 seconds after subject stops stepping. (test time 5:15-5:30)
8. Record the 15-sec use rate. (*do not multiply by 4*)
9. Estimate VO_{2max} using the Forestry heart rate tables 13.5 and 13.6. (find tables in the Blackboard folder for this lab)
10. If the participant is not 25 years ±2.5 years, use table 13.7 adjust VO_{2max} for age.
11. Use the table 3.2 in your REP textbook to determine CRF classification.

ACTIVITY 2: TWO-STAGE TREADMILL TEST

Note: This test frequently appears on the ACSM-EP exam. The metabolic equations will be provided during the test, but conversions are not. Expect the same on your exams for this course.

Equipment: Treadmill, heart rate monitor and watch

Participant: Each group will have one person perform this test. The other members of the group will need to monitor the test to adjust TM speed as needed.

Instructions: It is important to follow the instructions exactly as written. If the heart rates are not in the zones listed, the test will not be accurate and it will be difficult to interpret.

This test consists of two stages of 3 minutes each. The test works best if the heart rate is between about 110 and 150 BPM for both stages, with at least a 20-30 BPM difference between stages, and a 3-5% point grade difference between stages. The person can run or walk for the test, but be sure to use the correct equations for walking or running. The results work best if the person does the same exercise (walking or running) for both stages.

1. Stage 1: start treadmill at 0% grade and 3.5 mph. (suggested. Please discuss with your participant their fitness and determine if they need to perform this as a running test instead)
2. After one minute look at HR. If needed, adjust TM grade/speed to be at the lower end of the 110-150 BPM recommendation. (i.e. 110±10 BPM)
3. Record HR during the last 15 seconds of stage 1. Also record TM grade and speed.
4. Stage 2: increase TM grade by 3-5 percentage points.

5. After one minute look at HR. If needed, adjust TM grade/ speed to be at least 20 BPM higher than the end of stage 1 (and 30 BPM higher is better) and at the higher end of the 110-150 BPM recommendation. (i.e. 140-150 BPM)
6. Record HR during the last 15 seconds of stage 2. Also record TM grade and speed.
7. After the last HR reading, lower grade to 0% and decrease speed to a slow walk. Allow the subject to cooldown for 2-3 minutes. (HR should noticeably drop from stage 2 and ideally be lower than the end of stage 1)
8. Use equations below to calculate estimated VO_{2max}.
9. Compare your results with REP textbook table 3.2.

Calculations

1. Calculate estimated VO_2 for *each* stage.

Change speed mph to m/min by multiplying speed in mph by 26.8. Be sure to use incline value as a decimal.

Calculated walking VO_2= 3.5 + (speed*0.1) + (speed*incline*1.8)
Calculated running VO_2= 3.5 + (speed*0.2) + (speed*incline*0.9)

2. Calculate the slope of the line between the two stages

b = (VO_2 stage 2 – VO_2 stage 1) ÷ (HR stage 2 – HR stage 1)

3. Use the slope to calculate estimated VO_{2max}

VO_{2max} = VO_2stage 2 + (b * (estimated HR_{max}– HR stage 2))

Self-test your comprehension

An interactive H5P element has been excluded from this version of the text. You can view it online here:
https://uhlibraries.pressbooks.pub/kin4370labmanual/?p=47#h5p-8

CHAPTER 5

Chapter 5: Measuring VO2peak

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BACKGROUND

Aerobic metabolism utilizes oxygen in the degradation of carbohydrates and fats; therefore, oxygen consumption (VO_2) can be considered a measure of aerobic metabolism. Aerobic (cardiorespiratory) fitness can be measured when the participant gradually exercises toward maximal effort (VO_2max). It reflects the body's ability to extract and use oxygen at the cellular level as well as the ability of the cardiovascular and respiratory systems to transport this oxygen to the cell.

During exercise there are differing amounts of aerobic and anaerobic metabolism occurring depending primarily on the intensity and duration of the activity. Measurement of carbon dioxide production (VCO_2) and calculations of the respiratory quotient or respiratory exchange ratio (RER) helps determine the aerobic and anaerobic contributions towards the energy expenditure of the activity.

You may find it helpful to think about the Fick equation: $VO_2 = Q * a\text{-}vO_2diff$ And cardiac output: Q = SV * HR

CLASS ACTIVITY

MEASURING VO_2MAX (VO_2PEAK)

PRE-EXERCISE INSTRUCTIONS: If you are considering/planning on volunteering to be the participant for the VO_2 test, please come to class having not eaten for at least 2 hours before the test, no heavy meals for at least 4 hours before the test, and hydrated (0.5-1.0L of water 2-4 hours before the test).

Equipment: motor-driven treadmill, gas analyzers and computer (commonly referred to as "metabolic cart", because on the cart is all the equipment needed)

Participants: one participant to have their VO_2 measured, plus one student for each of these tasks: time master, RPE collector,

HR collector, computer watcher, TM speed adjustor, TM incline adjustor, and recorder

Instructions:

One subject will walk/run on a treadmill until voluntary exhaustion. There are many protocols that can be used; please follow the instructions from your course instructors of which test will be used.

Safety first! The participant will use hand signals to communicate during the test. Pay attention to why they are communicating, and also look out for potential problems. For example, are they creeping too far towards the back of the treadmill?

During the test, the participant will be monitored with a HR monitor and metabolic cart. There are sevenother students who will assist with data collection. RPE should be collected at 30 seconds remaining in the stage, and HR with 15 seconds remaining.

Please be sure you copy down the data from the test so that you can practice the calculations and graphs that you will need to do for the lab report.

After the test, you will use the collected variables to practice calculating VO_2 by hand. The point of this calculation practice is to help students understand where the values “come from” i.e. what variables change and how this impacts VO_2. Check your calculated values against what the computer calculated, as the values should be very similar.

This lab has an accompanying handout to help you collect data

from the lab. It is provided as a Word document so you can use it either electronically or print it out to use.

CALCULATIONS

F = fraction; V = volume; I = inspired; E = expired

VO_{2} = VIO_{2} – VEO_{2} =(VI \times FIO_{2}) – (VE \times FEO_{2})

FIO_{2}\ =\ \ 0.2093\ \ \ \ \ FEO_{2} can be measured

VI or VE (only one) can be measured by the metabolic cart. Whichever one is not measured has to be calculated.

The amount of N_2 inspired is equal to the amount of N_2 expired. This allows us to calculate VI if VE is measured, or VE if VI is measured.

$$VI \times FIN_2 = VE \times FEN_2$$
$$FIN_2 = \ 0.7904$$

FEN_{2}\ = [1 – (FEO_{2 }+ FECO_{2})]

After substituting:

\ \ VI \times 0.7904\ =\ VE \times [1 – (FEO_{2} + FECO_{2})]

Therefore:

$$VI = \frac{VE \times [1-(FEO-2 + FECO-2)]}{0.7904}$$

Or:

VE = \frac{VI \times 0.7904}{(1 – (FEO_{2} + FECO_{2}))}

*To calculate VO_2 if VE is measured:

[VO_{2}=VE \times \{ [(\frac{(1 – (FEO_{2}+ FECO_{2}))}{0.7904}) \times 0.2093] -FEO_{2} \}

*To calculate VO_2 if VI is measured:

$$VO_2 = VI \times \{0.2093 - [\frac{0.7904 \times FEO_2}{(1 - (FEO2_2 + FECO_2))}]\}$$

CALCULATING CARBON DIOXIDE CONSUMPTION

VCO_{2}\ =\ (VI \times FICO_{2}) – (VE \times FECO_{2})

Since the CO_2 in inspired air is 0.03%, it can be considered negligible (or zero), so the first part of the equation drops out. Therefore, to calculate VCO_2:

*If VI is measured:

VCO_{2}= \{ \frac{VI \times 0.7904}{[1- (FEO_{2} + FECO_{2})]} \} \times FECO_{2}

*If VE is measured:

VCO_{2} = VE \times FECO_{2}

HELPFUL TABLE OF GASES

A table with inspired and expired gases
(Note: Pressbooks cannot do subscript in a table)

In the inspired gas:	In the expired gas:
FIN2 = 0.7904	FEN2 = [1-(FEO2 + FECO2)]
FIO2 = 0.2093	FEO2 = measure
FICO2 = 0.0003	FECO2 = measure

CHAPTER 6

Chapter 6: Skeletal muscle strength and power

MELISSA MARKOFSKI

BACKGROUND

SKELETAL MUSCLE STRENGTH AND POWER TESTING

Skeletal muscle strength and power testing is of interest for a wide range of individuals. It can be used to evaluate the effectiveness of a training plan, or the potential next season performance of an athlete. For example, several of the tests in the NFL combine are evaluations of skeletal muscle strength and power.

The vertical leap is a test of skeletal muscle power. The gold standard method of measuring skeletal muscle power from a vertical leap is to use a motion analyses system and measure the distance the participant's center of gravity travels from standing to the highest point of the jump. However, motion analyses systems are costly and require specialized training to use and analyze the results. Simple analog systems (like the Vertec) that can measure distance jumped have decent reliability when compared to motion

capture systems and are frequently used instead. However, in this class we will use an electronic system called "Just Jump". Just Jump will measure the time off the ground to calculate the jump height. The Just Jump system has a higher correlation coefficient than the Vertec system, and although it costs more than a Vertex system it is still much less than a motion analyses system. Unlike a Vertec system, there are no bars to reset and therefore Just Jump is a very quick measurement and set-up.

There are several methods to evaluate skeletal muscle strength and power. The tests are specific to the muscle groups being tested and the specific protocol. For example, a test of upper body skeletal muscle strength at a low velocity will not indicate the same performance of the lower body to at a high velocity.

In this lab, we will use a variety of methods to measure or estimate skeletal muscle strength and power. Some of these measurements, like 1RM, are useful for evaluating resistance training program effectiveness *and* for setting training loads. Other tests, such as the vertical jump, are used to measure skeletal muscle power.

CLASS ACTIVITY

ACTIVITY 1: ONE REPETITION MAXIMUM (1RM) AND 8RM TESTING

Equipment: bench, barbell, weight plates

Participant: one person from your group (ideally someone who knows approximately how much weight they can bench press)

Instructions:

1. Warm up. When conducting a 1RM test, a proper warm up is important for reducing injury and for obtaining a good

effort on the test.

2. Begin with a weight of approximately 50% of 1RM, and have the participant perform 8 repetitions.
3. Move to a heavier weight and have the participant perform 5 repetitions.
4. As we are also doing an 8RM test, at this point ask the participant how many more repetitions they think they could have performed at that weight.
5. Adjust the weight as needed.
6. Have the participant attempt their 8RM.

a. If the participant cannot perform eight repetitions, lower the weight and try again,

b. If they do eight repetitions and state they are able to do more, increase the weight and try again.

7. After the 8RM test, use the 1RM estimation equation (below) to estimate 1RM. Calculate a weight ~10% lower as a starting weight for the 1RM test.

8. Adjust the weight as needed until the participant can only lift the weight one time. The participant should have 2-3 minutes rest between each attempt.

<u>To estimate 1RM from 8RM</u>:

There are several different equations that can be used to estimate 1RM, and each one will result in a slight variation of 1RM prediction. For the purpose of this lab, we are using the Epley 1985 equation. This equation assumes the participant could lift 3% more weight for every repetition that was completed.

((Weight lifted for 8RM) * 0.03 * 8)+weight lifted for 8RM = estimated 1RM

ACTIVITY 2: BARBELL VELOCITY

Equipment: bench, barbell, plate weights, stopwatch, Open Barbell barbell velocity measuring device

Participant: One person from your group (the same person who volunteered for 1RM testing) will perform the test, and other members of the group will collect measurements and set up the weights.

Instructions:

1. Perform 3 single repetitions with 40% of 1RM. Use the Open Barbell device to measure (and record!) barbell velocity.
2. Perform 3 single repetitions with 60% of 1RM. Use the Open Barbell device to measure (and record!) barbell velocity.
3. Use the average of the average velocities for each intensity (40% and 60%) calculate power. (below)

P= Fv (Power= Force * velocity)
F=MA (Force = Mass * Acceleration)
A=v/t (Acceleration = velocity / time)

Notes:

The Mass of the barbell is given (convert pounds to kilograms).

Velocity is measured by the Open Barbell.

Time is the measured time of each squat's concentric portion.

Short promo video of the Open Barbell unit we will use in the class (optional watching)

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://uhlibraries.pressbooks.pub/kin4370labmanual/?p=45#oembed-1

ACTIVITY 3: VERTICAL LEAP

Equipment: Just Jump system

Participant: Everyone (without exercise limitations) participates

Instructions:

1. Select mode of operation by pressing push-button switch while the appropriate mode is flashed on the display.
2. From a standing feet together position, leap into the air as high as possible. Do not move off the mat until the numbers are read.
3. The unit will display two numbers: your air time and your vertical jump (in inches).
4. Three attempts, with one minute rest between attempts. Use your best attempt to determine your power percentile (see table in Blackboard folder) and peak power (in Watts) using the Sayers 1999 equation (below).

Peak power (W) = (60.7 * jump height) + (45.3 * body mass) – 2055
Units: jump height (cm) and body mass (kg)

Note: there are several equations to calculate peak power from the vertical jump

Video on how to use the Just Jump system and positioning for an effective countermovement jump.

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://uhlibraries.pressbooks.pub/kin4370labmanual/?p=45#oembed-2

ACTIVITY 4: STANDING LONG JUMP

Equipment: Long jump mat

Participant: Everyone (without exercise limitations) participates

Instructions:

1. Start with the toes just behind the starting line (not in the feet!)
2. Perform a countermovement and jump as far forward as possible
3. Measure from the back of the heel. If the person falls down, the trial is repeated
4. Record three trials to the closest 0.5 inch
5. Compare your best jump to the table in the Blackboard folder

QUESTIONS

Think about these questions, and be sure you understand these answers before you attempt the lab report.

1. Observe the speed of the barbell when the person is performing a 1RM test and the velocity testing. What is the order of average velocity (from slowest to fastest) of a 1RM test, 60% 1RM test, and 40% 1RM test?
2. If the velocity is the same for both the 40% 1RM and 60% 1RM tests, how does that affect force and power?

CHAPTER 7

Chapter 7: Interval training

MELISSA MARKOFSKI

BACKGROUND

INTERVAL TRAINING FOR CRE

Interval training is a common technique used to increase a person's CRF. Often the goal is to increase lactate threshold or lactate tolerance. It can be a very effective method of training, in part due to the participant pushing themselves to a high level of work. They are able to do this because it is a relatively short amount of time that they need to sustain the high level of work.

Interval training is also a currently popular fitness trend. One of its appeals is that it can be successfully completed by people with a wide range of fitness. This is because interval training often uses an intensity relative to a person's fitness. Many people find exercise that intervals with instructions such as "run or walk at a pace that you cannot hold a conversation at for one minutes then a one minute recovery" more obtainable than "run for three miles".

In class, we discussed three approaches for prescribing interval intensity. Two of these methods involved lactate threshold, and

one is an estimation based on percent of total power. The intensity guideline is usually set so that the last repetition is difficult but doable. This means that it is likely that the first few repetitions will feel easy to the participant.

For any of the three methods we discussed, the intensity is selected based on the energy system we want to stress. For example, if we want to stress the phosphogen energy system the exercise duration will be about 5-10 seconds (usually 50-100 meters).

System stressed	Percent of maximum power	Typical work interval	Typical work to rest ratio
Phosphogen	90-100	5-10 seconds	1:12-1:20
Fast glycolysis	75-90	15-30 second	1:3-1:5
Fast glycolysis and oxidative	30-74	1-3 minutes	1:3-1:4
Oxidative	20-30	>3 minutes	1:1-1:3

Depending on which case study you select, you may find the lab this week very useful

CLASS ACTIVITY

ACTIVITY 1: DESIGNING A CRE INTERVAL TRAINING SESSION

Equipment: Area to run, timer, tape measure, cones
Participant: Everyone will participate in the design
Instructions:
Working together, decide:

1. What system you want to train
2. The length* (distance or time) the work intervals need to be to train this system
3. The length** (distance or time) the rest intervals need to be to revoker while training this system
4. The number of repetitions

*Hint 1: For this class, distance works better for shorter intervals and time for longer intervals

**Hint 2: For this class, time works better for rest intervals to keep everyone on the same set

ACTIVITY 2: PARTICIPATING A CRE INTERVAL TRAINING SESSION

Equipment: Area to run, timer, tape measure, cones

Participant: Everyone who does not have an orthopedic or medical limitation will participate

Instructions: Execute the interval training session designed in “activity 1”

CHAPTER 8

Chapter 8: Flexibility and agility testing

MELISSA MARKOFSKI

BACKGROUND

FLEXIBILITY

Flexibility is one of the five components of physical fitness. When prescribing an exercise prescription that includes exercises to increase flexibility, the exercises can be static, ballistic, or proprioceptive neuromuscular facilitation. Flexibility can be influenced by many factors, including muscle properties, physical activity and exercise, anatomical structure, age, and sex.

To test flexibility, goniometers, sit-and-reach tests, and functional movement screenings are the most commonly used methods. Testing for flexibility is highly specific, meaning it only relates to the specific joint being tested. For this reason, a comprehensive flexibility assessment will include several measures. For the purpose of this lab, we will use some of the more popular methods to conduct a limited assessment of flexibility.

A note: the current ACSM Guidelines (11th edition) no longer recommend using the sit and reach test to test flexibility. This is due to there being many variations of the sit and reach test (which can lead to confusion), questionable relationship to hamstring flexibility, and it being an indirect linear measurement of ROM. Instead, ACSM recommends using goniometer testing for a direct measure of joint ROM. The downside to using a goniometer is that it does require more skill and practice to do correctly and is difficult to test a large number of people quickly. For this class, we will acknowledge the weaknesses of the sit and reach test but, due to the ease of administering the test correctly, also use the sit and reach test.

AGILITY

Agility relates to effectively changing direction, velocity, or mode in response to a stimulus. It is an important skill for many sports activities. For example, in football and soccer the ability to quickly change directions is a desirable skill. Some of the tests used to test agility, such as the hexagon test, can also be used as a drill to improve agility.

CLASS ACTIVITY

ACTIVITY 1: GONIOMETER MEASURES

Equipment: Goniometer

Participant: Everyone will have the ROM of at least one joined measured. Those without orthopedic limitations will perform sit-and-reach tests, agility tests, and functional movement testing.

Additional reading: Textbook REP chapter 5 and tables referenced in these pages

Instructions:

1. Using a goniometer and the instructions in REP Table 5.1, measure hip flexion, hip extension, or glenohumeral flexion. Table 5.1 will instruct you on where to place the goniometer.
2. Measure twice and calculate the average.
3. If the two measures differ by more than 3 degrees, collect a third measurement.

ACTIVITY 2: ASSESS HIP AND HAMSTRING FLEXIBILITY USING A STANDARD SIT-AND-REACH TEST

Equipment: Sit-and-reach box

Participant: Everyone will participate. Those without orthopedic limitations will perform the sit-and-reach test. If there are concerns about the back and/or hamstring, a modified test can be used instead (bend one knee to form a “4”)

Additional reading: Textbook REP chapter 5 and tables referenced in these pages

Instructions:

1. Sit on the floor with back against the wall, knees extended, and feet flat against the inside of the box and the medial edges of the feet six inches apart from each other.
2. Keeping knees fully extended and arms stretched in front of the body, reach as far as possible along the top of the box.
3. The hands must be flat and pronated (can overlap or just touch) and stay parallel to the ground.
4. Attempt three times (no bouncing between attempts!) and use the best of the three measures to compare to the table posted in Blackboard.

ACTIVITY 3: T-TEST

Equipment: Stopwatch, cones

Participant: Everyone who does not have a relevant orthopedic limitation will participate.

Additional reading: This website has an illustration of the set-up for the T-test and the norms data table you will use to categorize your result: https://www.professionalsoccercoaching.com/agility-drills/t-test-agility

and this is a nice video demonstration of the test:

One or more interactive elements has been excluded from this version of the text.

You can view them online here: https://uhlibraries.pressbooks.pub/kin4370labmanual/?p=39#oembed-1

Instructions:

Note: Every participant runs two trials of the T-test. Before the two times trials, run one or two T-tests at submaximal effort to warm-up and familiarize yourself with the test. The position for the test is always facing the top part of the T (no rotating) and touching the base of the cones.

1. Start at cone A and face cone B.
2. When told to start, run forward and touch the base of cone B.
3. Shuffle to the left and touch the base of cone C.
4. Shuffle to the right and touch the base of cone D.
5. Shuffle to the left and touch the base of cone B.
6. Run backwards and past cone A.
7. The clock should be stopped when the participant runs past cone A.

ACTIVITY 4: HEXAGON TEST

Equipment: Stopwatch, hexagon tape outline in MEL 223

Participant: Everyone who does not have a relevant orthopedic limitation will participate.

Additional reading: This is a nice video on how to conduct (and participate in!) the test:

One or more interactive elements has been excluded from this version of the text. You can view them online here: https://uhlibraries.pressbooks.pub/kin4370labmanual/?p=39#oembed-2

Instructions:

Note: Everyone does this test twice, once each at clockwise and counterclockwise rotation. Warm-up by practicing the test in both directions at a submaximal effort. For the test, if you fail to jump over the line (or land on it) or take an extra step, the test is stopped and restarted after time for recovery.

1. Start in the middle of the hexagon.
2. Starting with the line in front of you, jump over the line and back to the center.
3. Continue by jumping over the next line in the clockwise or counterclockwise rotation.
4. The timer is stopped after the participant has jumped over *all six sides three times* (three complete passes) and returns to the center.
5. Compare your clockwise and counterclockwise times to each other and this table (numbers listed are seconds): https://wiki.ubc.ca/

File:Normative_Data_(National_Norms)_for_the_Hexagon_Agility_Test.png

ACTIVITY 5 (IF TIME ALLOWS): AGILITY DRILLS

If time allows, participate in one of these two agility drills

Agility practice with ladder

Run through the ladder twice for each of these, alternating lead foot or direction (as appropriate): double run (run through ladder, and both feet have to be in the box before running to the next box), side jumps (face the side of the ladder and jump through each box), and in and out (face side of ladder, and jump in and out of the boxes—over the red line).

Agility practice with agility balls.

- Stand ~ 10 feet from your partner. Throw the ball about halfway between the two of you, and the other person must “catch” the ball.

CHAPTER 9

Chapter 9: Estimating body composition

MELISSA MARKOFSKI

BACKGROUND

BODY COMPOSITION AND ANTHROPOMETRIC MEASURES

There are many ways to assess body composition and anthropometric measures. Some of these methods require expensive, highly specialized equipment, while other methods are simple and use inexpensive equipment. When evaluating a person's progress and taking measurements before, during, and after a training program, the method does not matter as much as using the same method for all timepoints and being accurate (reliable) in your measurements.

Anthropometric measures are: height, weight, BMI, body circumferences, and skinfold thickness. It is important to make the distinction that skinfold thicknesses are anthropometric measures,

but when the skinfold thickness measures are used to calculate an estimation of body fat then body fat measurement is not an anthropometric measure.

Anthropometric measurements are simple, easy measurements that can help additionally classify a person's health. The waist to hip ratio is calculated from measurements of the circumference of the waist (narrowest point of midsection) and hips (widest circumference around pelvis). A ratio of greater than 0.95 for males and 0.86 for females is considered an increased risk for CVD.

Circumference anthropometric measurements can also be used to track fitness. It can be used as a crude estimate of fat loss and/or muscle gains. These measurements are typically taken around the belly of the muscle group of interest, such as the thigh or upper arms.

Regardless of the method for assessing body composition, each method is *estimating* body composition. We are not physically dividing the body into lean mass and non-lean mass and weighing it. Care also needs to be taken to decide if the estimated body composition measures should be expressed as absolute or relative values.

CLASS ACTIVITY

Estimated body composition

ACTIVITY 1: AIR DISPLACEMENT PLETHYSMOGRAPHY (BODPOD GAR 124)

ADP measures body volume and body density to estimate body

composition. You will watch a demonstration of the BodPod on one person.

ACTIVITY 2: BIOELECTRICAL IMPEDANCE (BIA)

BIA uses resistance of an electrical current to estimate body composition. Muscle contains more water than adipose tissue, and therefore muscle will resist the electrical current less than adipose tissue. However, hydration status is an important factor in obtaining an accurate measurement.

To use the BIA, you will need to be barefoot. The machine will walk you through the input.

1) Turn on unit with on/off button

2) Enter clothes weight (typically 2 lbs)

3) Enter sex and body type by pressing the corresponding key. Use "athletic" if you are involved in at least 10 hours of intense physical activity a week, or have a lifetime of fitness (have had this level of activity for 5+ years, but are not presently reaching this amount of activity).

4) Enter age, in years

5) Enter height in feet then inches

6) Step on scale and be still until the unit prints your results.

7) Clean the scale (spray paper towel with cleaner—not the BIA!—and wipe the contacts).

ACTIVITY 3: SKINFOLD CALIPERS

Skinfold calipers can also be used to calculate relative body fat. In class today we will use the three site method, with specific locations for males or females. You may wish to review the "How to Measure

Skinfolds" box on page 194 of your text prior to starting the measurements.

1. Collect measurements of basic body dimensions (height and weight)
2. Use the skinfold calipers to measure skinfold thickness (mm) For men measure chest, abdomen, and thigh. For women measure triceps, suprailiac crest, and thigh.
3. Collect each measurement three times from each sit (rotate sites i.e. collect all of the three sites once, then again, then a third time).
4. Use your textbook table 7.7 to refresh your memory of where the specific sites are located, paying attention to the orientation of the measurement (horizontal, diagonal, etc.).
5. Calculate body density (sum3 = sum of the three skinfold sites)

Calculation of body density (D_b) to 5 significant figures:

Skinfold Thickness (Jackson & Pollock): D_b= _____gm/cc

males = 1.109380 – (0.0008267 x sum3) + (0.0000016 x sum3^2) – (0.0002574 x age)

Females = 1.0994921 – (0.0009929 x sum3) + (0.0000023 x sum3^2) – (0.0001392 x age)

6. Calculation of relative body fat (Siri) males: **(495 / D_b) – 450 = _____%**

Calculation of relative body fat (Siri) females: **(509 / D_b) – 450 = _____%**

7.Calculation of fat weight (FW): **body weight x % fat**

8. Calculation of fat free weight (FFW): **body weight – fat weight**

9. Calculation of optimal or desirable body weight:
Target body weight = current fat free wt. / %FFM goal

Anthropometric measurements

ACTIVITY 4: CIRCUMFERENCE MEASUREMENTS

Use your textbook Table 7.3 to refresh your memory of how to conduct this measurement.

1. Take each measurement on one of your classmates twice. Collect measures of waist, hip, thigh, and upper arm.
2. If the sites differ by more than 2 cm, take a third and average the two within 2 cm.
3. Use the averages of the hip and waist to calculate the waist:hip ratio

Comparisons

ACTIVITY 5: COEFFICIENT OF VARIATION

There can be much variation in methods. The coefficient of variation is expressed as a percent and can help us determine the repeatability of the measurement (and precision). At the end of lab, calculate the coefficient of variation using your body compositions measurements (of the same person, hopefully you) from BIA and skinfold measurements.

coefficient of variation of sample = standard deviation of sample / mean of sample

Note: standard deviation of sample = square root of [(the variance)/(n-1)]

where n = number of samples

variance = add the squares of each difference between each sample and the mean

CHAPTER 10

Chapter 10: Lactate exercise testing

MELISSA MARKOFSKI

BACKGROUND

LACTATE TESTING

Our bodies are always using a variety of metabolic processes. This means that lactate is always being produced in a healthy human body. If we measured everyone in the class while they were seated at rest, everyone will have a detectable blood lactate concentration. During exercise, the proportion of which system is being predominantly used shifts. As exercise begins and exercise intensity increases, when the aerobic (oxygen) demands of exercise can no longer be met lactate will increase in circulation (the blood).

There is disagreement in

Blood lactate is a better predictor than VO_2max for exercise performance. It is also more accurate to prescribe exercise

intensity based on relative lactate threshold (LT) or maximal lactate steady state (MLSS) than heart rate. However, due to limitations in using lactate measures to prescribe exercise intensity (chiefly, the impractical aspects of lactate threshold testing everyone) heart rate is used to prescribe intensity for the average person exercising for health or to improve fitness.

The two blood lactate concentrations most frequently used to determine exercise performance are exercise intensity at LT and lactate produced at a specific intensity (for running protocols, usually 17km/hr). An individual who is "better-trained" will have a higher treadmill speed for their LT, and a lower blood lactate concentration at the specific intensity. These two measures can also be periodically re-tested to test performance improvement.

the exercise physiology and sports performance communities over the exact definition of LT and other terms used in this lab. For the purposes of this class, please be sure to use the definitions in this chapter.

Therefore, it is useful to measure blood lactate and use the measures to determine exercise intensity for the exercise training plan. The values most frequently used to determine exercise training intensity are lactate threshold (LT) and maximal lactate steady state (MLSS). LT is the point at which the body can no longer counter the rise in lactate, and there is a noticeable increase in blood lactate concentration. The body is not able to keep the amount of lactate low because of increasing exercise demands (an increase in anabolic metabolism) and the amount of lactate produced exceed's the body's buffering capacity. This results in a shift from a linear increase in blood lactate concentration to non-linear. There is a significant increase of blood lactate appearance in the blood. MLSS is the exercise intensity that corresponds to the highest exercise intensity achieved without an increase in blood lactate (i.e. the intensity at LT).

Another term that is frequently used is onset of blood lactate accumulation (OBLA). This value corresponds to 4.0mmol/L. Sometimes this is referred to as the second lactate threshold. Since it is an absolute number and does not require plotting lactate concentrations to find the change from a linear to non-linear rise in blood lactate concentration, some people prefer to use this value to determine exercise performance improvements.

CLASS ACTIVITY

BLOOD LACTATE CONCENTRATION TESTING (LACTATE THRESHOLD TEST)

PRE-EXERCISE INSTRUCTIONS: If you are considering/planning on volunteering to be the participant for the VO_2 test, please come to class having not eaten for at least 2 hours before the test, no heavy meals for at least 4 hours before the test, and hydrated (0.5-1.0L of water 2-4 hours before the test).

Equipment: treadmill, blood lactate analyzer, fingerstick blood collection supplies

Participant: one person from each lab section will be the participant. Other students are needed for these tasks: time master, RPE collector, HR collector, TM speed adjustor, and recorder

Instructions: One participant will walk/run on a treadmill until voluntary exhaustion. We will be using a discontinuous exercise protocol. There are many adjustments that can be used; please follow the instructions from your course instructors on what to do for this test.

During the test, the participant will be monitored with a HR monitor. There are other students who will assist with data collection. RPE should be collected at 30 seconds remaining in the stage, and HR with 15 seconds remaining. Your instructor will briefly stop the treadmill to collect a small blood sample to use in the blood lactate analyzer.

Please be sure you copy down the data from the test so that you can practice the graphs that you will need to do for the lab report.

This lab has an accompanying handout to help you collect data from the lab. It is provided as a Word document so you can use it either electronically or print it out to use.

Note: The figures and tables used in the lecture that corresponds to this lab are located in the folder for the lactate lab

CHAPTER 11

Chapter 11: Older adult fitness testing

MELISSA MARKOFSKI

BACKGROUND

OLDER ADULT FITNESS TESTING

Physical ability testing of older adults is done for several reasons. It can be done for the same reasons as testing younger adults—to evaluate an exercise training program—or for other reasons. These other reasons include evaluating disease risk or diagnosis, pre- and post-surgery testing, or evaluating frailty and/or the ability to live independently. For example, testing walking speed will assist with a sarcopenia or frailty diagnosis.

Many of these tests are also commonly used in special populations. For example, the six minute walk test (6MWT) is validated in patients with pulmonary disease and is also commonly used in research in cancer patients and survivors.

Most of these tests should be easy for healthy, young adults. To help us understand challenges faced by older adults, there are suggested modifications. For at least two of these tests, do under a modified technique (half weighted vest, straw and nose clip, spin, and/or heel lift). Some modifications work better with some tests than others. See the specific activities for suggestions for which modification works best for which test.

CLASS ACTIVITY

ACTIVITY 1: 30 SECOND CHAIR STAND TEST

Equipment: chair without arms, stopwatch

Participant: everyone who is able to do the movement without limitation or restriction

1. Put a chair against the wall.
2. The participant starts in a sitting position in the chair.
3. Instruct the participant to start the test, and at the same time start the stopwatch.
4. For 30 seconds, the participant comes to a full stand and sits back down. Count the number of times the person stands. At the end of 30 seconds, if the person is at least

halfway to a stand count it as a stand.

5. Use table 6.16 to compare yourself to 60-64 year old.

Suggested modification: spinning around to simulate medication side effects

ACTIVITY 2: TIMED UP AND GO (8' VERSION)

Equipment: chair without arms, stopwatch, tape measure

Participant: everyone who is able to do the movement without limitation or restriction

1. The participant starts seated on a chair
2. The participant stands up, walks around a cone placed 8' away, and returns to a seated position.
3. Start the stopwatch as soon as the person attempts to stand, and stop it as soon as they sit.
4. Look up your results in Table 12.3

Suggested modification: spinning around to simulate medication side effects

ACTIVITY 3: 10M WALK WITH AND WITHOUT CARRY

Equipment: stopwatch, tape measure, various small hand weights

Participant: everyone who is able to do the movement without limitation or restriction

There are three options for this test, and we are going to do all three. Usually the test is conducted at a "comfortable" pace and either a "comfortable" pace with a weight or an accelerated pace. Mark out a 10M course, plus 2M on each side for acceleration and deceleration (total course = 14M). Have the subject do all three conditions one time each:

1) **Comfortable pace**: Instruct the subject to walk at a comfortable walking pace. Give the command that they have somewhere to be, but are not in a hurry.

2) **Accelerated pace**: Instruct the subject to walk at an accelerated pace. Give the command that they have a bus to catch and cannot be late, but do not want to run to the bus stop.

3) **Walk with carry:** Instruct the subject to repeat the comfortable walking pace, but this time they are carrying 10% of their body weight.

Use the Bohannon 1997 (25' test) table to interpret your results.

Suggested modification: breathing through a straw (while using a nose clip) to empathize with people with COPD

ACTIVITY 4: HANDGRIP STRENGTH

Equipment: handgrip dynamometer

Participant: everyone who is able to do the movement without limitation or restriction

1. Adjust the dynamometer so that it is comfortable for the participant. Make sure the dial marker is set to "0."
2. One at a time, test both hands of the participant. While standing, keep your arm at your side with the shoulder slightly abducted**.
3. Squeeze the dynamometer as hard as the participant is able to squeeze it. After the participant releases the dynamometer, read the dial marker.
4. Administer the test three times with a one minute rest in between attempts. Record the highest attempt and compare to table 6.2.

**When testing older adults, the test is typically conducted with the elbow at a 90° angle. However, the norms Table 6.2 relates to

measurements with the elbow extended so that is the method we will use in this lab.

ACTIVITY 5: ARM CURL TEST

Equipment: 5lb and 8lb hand weights, stopwatch, chair without arms

Participant: everyone who is able to do the movement without limitation or restriction

1. Subject sits in a chair, with a 5 lb (women) or 8 lb (men) weight in their dominant hand in a neural grip. Their feet are on the floor, and the upper arm must remain in contact with the upper body
2. Count how many complete repetitions the subject can perform in 30 sec
3. Compare your results to Table 6.15

ACTIVITY 5: SIX MINUTE WALK TEST (6MWT)

Equipment: cones, tape measurer, stopwatch

Participant: everyone who is able to do the movement without limitation or restriction

Set-up: Ideally, a 25 by 5 yard rectangle course or a 20-30 yard straight path (like in a hallway, if that is all that is available) with marks every 5 yards is set up for this test.

1. The subject walks around the course for six minutes, and

the number of yards competed to the nearest 5 yards is recorded. The test should be done individually and not walked with another person. Instruct the person that this is a walking (not running) test, they should walk at a comfortable pace that they can walk for six minutes, breaks are permitted, and notify them each time one minute has passed ("There are five minutes remaining in this test" etc.) as well as a fifteen second warning prior to the end of the test ("in 15 seconds I will tell you to stop, and please stay where you are until I come to you.")

2. Compare your results to the provided table

Suggested modification: breathing through a straw (while using a nose clip) to empathize with people with COPD, half-weighted vest, heel lift

Notes for this class: Each gray tile in the big gym is 1 foot. For the sake of time in this lab, you may have multiple students on the course but stagger your start time so that you are not walking with each other, and for test accuracy please try to not compete with each other

Additional notes for testing older adults: No warm-ups prior to starting the test. If the person usually walks with a cane or walker, they will use it for this test. Breaks are permitted, but the clock keeps running. If the person is unsteady, walk behind them and try to not influence their pace.

CHAPTER 12

Chapter 12: Applied exercise prescription principles

MELISSA MARKOFSKI

BACKGROUND

APPLIED EXERCISE PRESCRIPTION PRINCIPLES

At this point in the class you have learned the FITT-PV for CRE and RT, and how to apply these guidelines to a variety of both healthy individuals and special populations. You will now be applying this knowledge in this lab and will need to recall the specifics of the FITT-PV for this lab.

CLASS ACTIVITY

You will be designing a circuit training session, with the equipment available to you in the classroom.

Equipment: laminated suggested exercises, equipment available in the teaching room, interval timer

Participants: everyone who is healthy will participate (if an exercise needs to be modified or substituted, that can be done)

Instructions: this lab will be done as a class

1. Decide the goal(s) of the exercise session
2. Select exercises to match the goal(s) of the session
3. Specify the order of the exercises
4. Specify the work and rest intervals to match the goal(s) of the session
5. Specify the number of rotations through the circuit to match the goal(s) of the session
6. Set the interval timer
7. Participation in the session you designed!