The Canadian Physical Activity, Fitness and Lifestyle Approach

Supplement to the third edition

The documents in this package supplement the third edition of the CPAFLA manual with updated forms and protocols that will be included in the fourth edition. This is a temporary solution until the fourth edition of the CPAFLA is published sometime in 2011.

Contents of Insert Package:

These documents can also be downloaded from the CSEP website. Visit www.csep.ca and follow the links to *Professional Certifications*, then to *CSEP Certified Personal Trainer®*

REVISED PROTOCOL FOR MEASUREMENT OF WAIST CIRCUMFERENCE

The article by McGuire and Ross describes an important advancement in current international waist circumference measurement guidelines. As outlined by the authors, compelling literature indicates that the specific waist circumference protocol does not change the well-established relationships between waist circumference and the risk of premature mortality and chronic disease (such as cardiovascular disease and diabetes). These relationships appear to be consistent across sex, race and ethnicity.

This article has significant implications for CSEP-certified health and fitness practitioners. The authors advocate the use of the National Institutes of Health method to measure waist circumference rather than the World Health Organization (WHO) measurement currently employed in the CPAFLA (i.e., the midpoint between the lower border of the rib cage and the iliac crest). The NIH method consists of measuring waist circumference at the superior border of the iliac crest. It is anticipated that the use of a bony landmark will improve the reliability of waist circumference measurements during self-assessments and appraisals by CSEP health and fitness practitioners.

The CSEP Health and Fitness Program has officially accepted the recommendations of Dr. Ross and colleagues in an attempt to standardize the measurement of waist circumference. Therefore, effective immediately all CSEP-certified health and fitness practitioners are recommended to use the NIH method to assess waist circumference (as outlined in the article by McGuire and Ross). ***It is important to note that health and fitness practitioners will be able to continue to use the current body composition tables in the CPAFLA****. It is anticipated that the differences between assessment techniques are within the range of error of measurement. More importantly, the measurement site does not appear to affect the relationship with the risk for chronic disease and premature mortality.*

It is hoped that these actions will improve the ease of administration and reliability of the waist circumference measurement in the CPAFLA appraisal. In a subsequent revision of the CPAFLA, the CSEP Health & Fitness Program will update the waist circumference measurement section to reflect this important change.

■ BACKGROUND

Waist circumference (WC) is commonly used to assess abdominal obesity and has been established as a predictor of increased morbidity and mortality independent of body mass index[1]. Individuals with increased WC values are more likely to have hypertension, type 2 diabetes, dislipidemia, and the metabolic syndrome than individuals with normal WC values regardless of weight status[2]. In addition, WC predicts the development of diabetes beyond that explained by commonly evaluated cardiometabolic risk factors including blood pressure, lipoproteins, glucose levels, and body mass index[3].

Despite the literature establishing WC as an independent predictor of morbidity and mortality, there is currently no consensus on the optimal protocol for measurement of WC; furthermore there is no scientific rationale for any of the protocols currently recommended by leading health authorities. Common measurement sites are the visible narrowing of the waist, the last rib, top of the iliac crest or the midpoint between the last rib and iliac crest. Recently, a panel of experts convened to evaluate the influence of the measurement protocol on the relationships between WC with morbidity from cardiovascular disease and type 2 diabetes, and with mortality from all causes and from cardiovascular disease[4]. The findings indicated that WC protocol had no substantial influence on the relationships between WC and morbidity of cardiovascular disease and diabetes and all-cause mortality and cardiovascular disease mortality. Moreover, similar associations were observed across sex, race, and ethnicity.

In the absence of a clear biological rationale, the panel recommended the protocol that was the most practical and would facilitate adoption by both the general public and the practitioner. The protocol of choice was required to have two fundamental features: 1) the use of a bony landmark and, 2) ease of measurement. These features would help to ensure reliable measures, promote adoption by both practitioner and lay public, and facilitate training and instruction. It was recognized that the protocols of the National Institutes of Health (NIH) (superior border of the iliac crest) and the World Health Organization (WHO) (midpoint between the lower border of the rib cage and the iliac crest) are both based on the use of bony landmarks to identify the proper WC location. However, the panel's consensus opinion was that the general public would be more likely to adopt the NIH protocol as it requires only a single palpation of the iliac crest whereas the WHO protocol requires the measurement of distance and calculation of the midpoint between two bony landmarks. Thus, the NIH protocol might be more feasible for self-measurement.

In support of the recommendations from the expert panel, the *2006 Canadian clinical practice guidelines on the management and prevention of obesity in adults and children*[5] recently suggested that practitioners utilize the NIH method to obtain a measurement of WC. In an attempt to standardize the measurement protocol and avoid confusion between practitioners and the general public alike, CSEP has now adopted the NIH measurement protocol.

■ MEASUREMENT OF WAIST CIRCUMFERENCE

Equipment

K-E Anthropometric tape or equivalent

Procedure

Clear the client's abdomen of all clothing and accessories. Position the client with feet shoulder width apart and arms crossed over the chest in a relaxed manner. Take a position to the right side of the client's body on one knee.

Using the NIH protocol, the waist circumference measurement should be taken at the top of the iliac crest. To find this landmark, palpate the upper right hipbone of the client until you locate the uppermost lateral border of the iliac crest. Draw a horizontal line at this landmark at the midline of the body.

Position the tape directly around the abdomen so that the inferior edge of the tape is at the level of the landmarked point. Use a cross-handed technique to bring the zero line of the tape in line with the measuring aspect of the tape. Ensure that the measuring tape is positioned in a horizontal plane around the abdomen. Apply tension to the tape to ensure it is snug, without causing indentation to the skin. At the end of a normal expiration, take the measurement to the nearest 0.5cm.

■ REFERENCES

[1]Janssen I, Katzmarzyk P, Ross R. Waist circumference and not body mass index explains obesity-related health risk. *Am J Clin Nutr.* 2004;79:379-84.

[2] Janssen I, Heymsfield S, Allison D, Kotler D, Ross R. Body mass index and waist circumference independently contribute to the prediction of nonabdominal, abdominal subcutaneous, and visceral fat. *Am J Clin Nutr.* 2002;75:683-8.

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This article was written by K. Ashlee McGuire and Robert Ross, Queen's University, Kingston, Ontario, for the Canadian Society for Exercise Physiology and it is endorsed by the CSEP Knowledge Translation Committee. Introduction courtesy of Dr. Darren E.R. Warburton, University of British Columbia, Vancouver BC.

This document is also located in the *Knowledge Translation* section of the CSEP website, www.csep.ca/forms

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THE GOLD STANDARD IN EXERCISE SCIENCE AND PERSONAL TRAINING

I, the undersigned, do hereby acknowledge:

- my consent to perform a health-related fitness appraisal consisting of the evaluation of:
  - ❑ Standing Height
  - ❑ Weight
  - ❑ Waist Circumference Skinfolds (5 sites)
  - ❑ Modified Canadian Aerobic Fitness Test (mCAFT)
  - ❑ YMCA Cycle Ergometer Submaximal Protocol
  - ❑ Ebbeling Submaximal Treadmill Protocol
  - ❑ Rockport (1 mile walk)
  - ❑ Grip Strength (R/L)
  - ❑ Push-Ups (max #)
  - ❑ Sit and Reach
  - ❑ Partial Curl-Ups
  - ❑ Vertical Jump/Leg Power
  - ❑ Back Extension
  - ❑ Submaximal Resistance Training Load Determination
- my consent to answer questions concerning my current levels of physical activity participation and my lifestyle;
- my understanding that my heart rate and blood pressure will be measured prior to and at the completion of the appraisal;
- my consent to the appraisal measures conducted by a CSEP Certified Personal Trainer® who has been trained and certified to administer the Canadian Physical Activity, Fitness and Lifestyle Approach protocols;
- my understanding that the results from my health-related fitness appraisal will assist in determining the type and amount of physical activity most appropriate for my level of fitness;
- my consent to perform a supervised exercise training session (if desired) based on the findings of my fitness appraisal, consisting of a warm-up, cardiovascular training, musculoskeletal training, flexibility exercises and a cool-down;
- my consent to have my blood pressure and heart rate measured periodically during my supervised exercise training session(s);
- my understanding that there are potential risks during exercise (i.e., episodes of transient lightheadedness, loss of consciousness, abnormal blood pressure, chest discomfort, leg cramps, and nausea), in rare instances heart rhythm disturbances or heart attacks, and that I assume willfully those risks;
- my obligation to immediately inform the CSEP Certified Personal Trainer® of any pain, discomfort, fatigue, or any other symptoms that I may suffer during and immediately after the appraisal and/or exercise training session;
- my understanding that I may stop or delay any further exercise if I so desire and that the CSEP Certified Personal Trainer® may terminate the exercise session upon observation of any symptoms of undue distress or abnormal response;
- my understanding that I may ask any questions or request further explanation or information about the procedures at any time before, during, and after exercise;
- it is my understanding that all nutritional advice provided will be based on Canada's Food Guide;
- that I have read, understood, and completed the Physical Activity Readiness Questionnaire (PAR-Q) and answered NO to all the questions and/or received clearance to participate in unrestricted physical activity/exercise from a physician.

This form must be completed, signed and submitted to the CSEP Certified Personal Trainer®, along with the completed PAR-Q, at the time of the appraisal. The form must also be witnessed at the time of signing and the witness must be of the age of majority and independent of the organizations administering the appraisal.

I AGREE THAT I HAVE READ AND UNDERSTAND THIS DOCUMENT

Printed Name of Client	Signature of Client	Date
Printed Name of Witness	Signature of Witness	Date

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I, the undersigned, do hereby acknowledge:

- my consent for my dependent to perform a health-related fitness appraisal consisting of the evaluation of:
  - ❑ Standing Height
  - ❑ Weight
  - ❑ Waist Circumference Skinfolds (5 sites)
  - ❑ Modified Canadian Aerobic Fitness Test (mCAFT)
  - ❑ YMCA Cycle Ergometer Submaximal Protocol
  - ❑ Ebbeling Submaximal Treadmill Protocol
  - ❑ Rockport (1 mile walk)
  - ❑ Grip Strength (R/L)
  - ❑ Push-Ups (max #)
  - ❑ Sit and Reach
  - ❑ Partial Curl-Ups
  - ❑ Vertical Jump/Leg Power
  - ❑ Back Extension
  - ❑ Submaximal Resistance Training Load Determination
- my consent for my dependent to answer questions concerning his/her current levels of physical activity participation and lifestyle behaviours;
- my understanding that heart rate and blood pressure of my dependent will be measured prior to and at the completion of the appraisal for the purpose of health screening and to monitor recovery after aerobic exercise after the appraisal;
- my consent for my dependent to participate in appraisal measures conducted by a CSEP Certified Personal Trainer® who has been trained and certified to administer the Canadian Physical Activity, Fitness and Lifestyle Approach protocols. It is also my understanding that the results from the health-related fitness appraisal will assist in determining the type and amount of physical activity most appropriate for my dependent's level of fitness;
- my consent for my dependent to perform a supervised exercise training session (if desired) based on the findings of his/her fitness appraisal, consisting of a warm-up, cardiovascular training, musculoskeletal training, flexibility exercises and a cool-down;
- my consent to have my dependent's blood pressure and heart rate measured periodically during his/her supervised exercise training session(s) for safety purposes;
- my understanding that there are potential risks during exercise (i.e., episodes of transient lightheadedness, loss of consciousness, abnormal blood pressure, chest discomfort, leg cramps, and nausea), in rare instances heart rhythm disturbances or heart attacks, and that I, on behalf of my dependent, assume willfully those risks;
- my obligation of my dependent to immediately inform the CSEP Certified Personal Trainer® of any pain, discomfort, fatigue, or any other symptoms that he/she may suffer during and immediately after the appraisal and/or exercise training session;
- my understanding that my dependent may stop or delay any further exercise if he/she so desires and that the CSEP Certified Personal Trainer® may terminate the exercise session upon observation of any symptoms of undue distress or abnormal response at any point in time;
- my understanding that I and my dependent may ask any questions or request further explanation or information about the procedures at any time before, during, and after exercise;
- my understanding that all nutritional advice provided to my dependent will be based on Canada's Food Guide;
- that I have read, understood, and completed the Physical Activity Readiness Questionnaire (PAR-Q) and answered NO to all the questions regarding my dependent or received clearance to participate in unrestricted physical activity/exercise from my physician for my dependent to participate.

This form must be completed, signed and submitted to the CSEP Certified Personal Trainer®, along with the completed PAR-Q, at the time of the appraisal. The form must also be witnessed at the time of signing and the witness must be of the age of majority and independent of the organizations administering the appraisal.

I AGREE THAT I HAVE READ AND UNDERSTAND THIS DOCUMENT

Printed Name of Dependent	Signature of Parent/Guardian	Date
Printed Name of Witness	Signature of Witness	Date

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Physician Referral Letter

Dear Physician,

Your patient has consulted a CSEP Certified Personal Trainer® (CSEP CPT) for a health and fitness assessment and/or personal training services. The CSEP CPT is certified and sanctioned by the Canadian Society for Exercise Physiology (CSEP) to administer appropriate submaximal appraisal protocols to apparently healthy individuals, interpret appraisal results, develop a specific health-related program of exercise for the appraised individual, and act as a personal trainer. All assessment and prescription is conducted at submaximal intensities. (More information about the CSEP CPT can be at **www.csep.ca** or on the following page).

Your patient answered "YES" to the following question(s) on the Physical Activity Readiness Questionnaire (PAR-Q):

____

____

Consequently, your patient requires clearance from you, their doctor, before completing the physical testing and/or training. Please sign and complete the Physical Activity Readiness Conveyance/Referral Form – detachable from Page 4 of the PARmed-X enclosed – and indicate any necessary restrictions and **give it to your patient** to bring back to their CSEP CPT (health and fitness professional).

If you have any questions regarding any part of the fitness assessment or exercise prescription or the use of the PARmed-X, please contact the referring CSEP CPT.

Name of referring CSEP CPT: ____

Contact information: ____

Encl. PARmed-X

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About the CSEP CPT Health and Fitness Assessment/Prescription

The health and fitness assessments conducted by a CSEP Certified Personal Trainer® are exclusively those outlined in the Canadian Physical Activity, Fitness and Lifestyle Approach (CPAFLA). The CPAFLA protocols and manual were created by the Canadian Society for Exercise Physiology (CSEP), with funding assistance from the Centre for Health Promotion – Public Health Agency of Canada. When administered by a trained CSEP Certified Personal Trainer® or CSEP Certified Exercise Physiologist®, the appraisal can provide important information to individuals which may motivate them to increase their physical activity and develop healthy lifestyles.

The CPAFLA evaluates physical activity habits and lifestyle behaviours using simple questionnaires. The fitness component of the appraisal involves a series of physical tests and measurements. Some of these (height, body mass, waist circumference, and skinfold measurements) require no physical exertion and may already be complete. The tests that evaluate aerobic fitness and musculoskeletal fitness require physical exertion and are briefly outlined below. All CPAFLA fitness appraisals must be preceded by the participant signing an informed consent form.

■ PROTOCOLS USED BY A CSEP CPT TO EVALUATE AEROBIC FITNESS

Aerobic fitness is predicted via the completion of one of four possible submaximal exercise protocols: the modified Canadian Aerobic Fitness Test (mCAFT), the Rockport Walking Test, the Single Stage Treadmill Walking Test, and the YMCA Cycle Ergometer Submaximal Test. Post-exercise blood pressure and heart rate are monitored after each test to ensure an appropriate recovery has occurred.

■ PROTOCOLS USED BY A CSEP CPT TO EVALUATE MUSCULOSKELETAL FITNESS

Seven simple tests are performed to evaluate musculoskeletal fitness. *Muscular strength* can be determined for the major muscle groups using a submaximal protocol that involves determining the weight that a participant can lift for up to 10 times. Strength is also evaluated using a hand dynamometer. *Muscular endurance* is determined using push-ups, curl-ups, and a back extension test. *Flexibility* is evaluated using a sit and reach protocol. *Muscular power* is determined from the vertical jump test.

■ EXERCISE PRESCRIPTION PROGRAM GUIDELINES

All exercise prescriptions must adhere to the guidelines established by the CSEP and Health Canada including those outlined in Canada's Physical Activity Guides. Specifically, it is recommended that adults engage in 30-60 minutes of moderate intensity aerobic exercise on most (preferably all) days of the week. Moderate-intensity aerobic exercises are equivalent to a brisk walk (9-12 min•km^{-1}) or approximately 3–6 MET. (MET = metabolic equivalent, where 1 MET = 3.5 mL•kg^{-1}•min^{-1}). In terms of musculoskeletal fitness, it is currently recommended that adults perform resistance training and flexibility exercises at least twice a week. It is advocated that adults engage in 1-2 sets of 8-10 different resistance exercises with large muscle groups for 8-12 (moderate intensity) repetitions using proper form. Persons over 60 years of age and/or more frail individuals may engage in 1 set of 10-15 repetitions (at an intensity of moderate to comfortably hard) owing to the risk for orthopaedic injury.

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The following description of bioelectrical impedance analysis (BIA) is provided as background information for users of the CPAFLA manual.
This technique is not being advocated by the CSEP Health & Fitness Program

The BIA technique provides a simple-to-use, non-invasive estimation of % body fat. There are a number of BIA devices available commercially but unfortunately these devices provide a range of % fat values for the same participant. However, unlike skinfold measurements, participants do not perceive this technique to be intrusive on their privacy and therefore it is generally acceptable to participants who are overfat.

The BIA device passes a low level electrical current through the participant's body and measures the impedance or resistance to the flow of electricity. The higher the amount of water in the body the less resistance there is to the electrical current. Because fat tissue has a lower water content than fat free tissue, the higher the % fat in the body, the greater the resistance to the electrical current. Conversely, fat free tissue provides less resistance to the electrical current. By entering the measured resistance to the electrical current into standard equations (which differ among BIA devices) it is possible to estimate the fat free mass and fat mass and hence the % body fat.

The estimation of % body fat from bioelectrical impedance is based on the assumptions that; **i)** the electrical current follows the path of least resistance through the body and **ii)** both the body and its various segments conform to a 'typical' cylindrical shape. The equations based on these assumptions can therefore introduce errors into the estimation of % body fat.

An even greater potential source of methodological error comes from the fact that the measurement of resistance is affected markedly by the level of hydration of the participant. Dehydration from such sources as heat exposure, exercise or alcohol consumption can affect the estimated % body fat considerably. In fact, because hydration level affects endurance performance and because bioelectrical resistance is so sensitive to changes in the level of hydration, the BIA device is also marketed to endurance athletes in another form as a hydration monitor. Hence, users of BIA devices should be skeptical of the estimated % body fat value when measured on a one-time-only basis. On the other hand, if close attention is paid on measurement days to the hydration level of the participant, the % body fat from the BIA can be useful as a long-term indicator of changes in % body fat. This is especially true in obese individuals who can experience considerable scale weight loss but are reluctant to have their skinfolds measured, although they will allow the BIA measurement. Conversely, there are those individuals whose body mass is already 'healthy' but wish to increase their fat free mass via an appropriate exercise program. These individuals would likely have little or no change in scale weight, so that tracking sum of 5 skinfolds (SO5S) employed in the CPAFLA would be more appropriate than using BIA measurements.

Even if the above potential methodological errors are minimized, perhaps the biggest shortcoming of the BIA technique is the fact that it only provides a total % body fat value with no indication as to where the fat is located. Percent body fat (no matter how it is estimated) provides less useful information for predicting health risks than waist circumference (WC). Hence, the BIA technique is not as useful for the health-related interpretation of body composition as the CPAFLA technique using the body mass index (BMI) refined by SO5S along with the WC.

The following description of hydrostatic weighing is provided as background information for users of the CPAFLA manual.
This technique is not being advocated by the CSEP Health & Fitness Program

The use of hydrostatic weighing to determine body density and % body fat involves weighing the participant both on land and while submerged in water. Corrections are made for the volume of air remaining in the lungs after a maximal expiration (residual volume; RV) and for the volume of air present in the gastrointestinal tract (trapped gas). The RV can be measured, but generally the values utilized for both the RV and trapped gas are estimated. Using Archimedes' principle and a series of equations, body density is determined, then fat mass and fat free mass are calculated.

For several decades, hydrostatic weighing was regarded as the 'gold standard' for determining % body fat. In fact, during this period, many formulae that were developed for estimating % body fat from skinfold measurements were validated by comparisons to % fat on the same subjects determined by hydrostatic weighing.

The methodology for conducting hydrostatic weighing has always been problematic, with errors introduced by i) failure to liberate the air trapped in the bathing suit or body hair, ii) failure to exhale to true RV, iii) inaccurate estimations of residual volume, faulty estimation of trapped gas and iv) inability of the participant to remain motionless while submerged. However, it was not known until recently that a major assumption upon which the calculation of body density (and % body fat) is based is incorrect. The calculation of body density and hence % body fat is derived from an equation in which there is one fixed value for the density of the fat mass and one fixed value for the density of the fat free mass. This assumption is now known to be erroneous and the range of the true density values for the fat mass and fat free mass among participants introduces considerable error into the calculation of % body fat. These same assumptions and errors are also inherent in the BOD POD which measures air displacement rather than water displacement as in hydrostatic weighing.

Nevertheless, it is perhaps more important than the above shortcomings to point out that even if hydrostatic weighing did provide an accurate value for % body fat, it does not provide any information about the distribution of fat. That is, hydrostatic weighing provides no information about that component of body composition that is the most accurate predictor of health risk.

Therefore, in light of the difficulties encountered in conducting hydrostatic weighing and the errors introduced by utilizing a standard (fixed) density value for the fat mass and for the fat free mass in the calculation of body fat, this technique can no longer be regarded as the 'gold standard' for % body fat determination. For the health-related assessment and interpretation of body composition, the CPAFLA approach using BMI refined by SO5S along with WC is more informative.

THE SINGLE STAGE TREADMILL WALKING TEST (EBBELING ET AL. 1991)

The single stage treadmill walking test is a submaximal aerobic fitness test that estimates VO_2max. It is suitable for low risk, apparently healthy, non-athletic adults 20-59 years of age. The walking pace required throughout the test also makes it appropriate for participants who experience problems such as knee pain when exercising at a jogging pace. The test can be administered to moderate sized groups of participants with low to moderate fitness levels and requires only a treadmill and a HR monitor.

Protocol

The walking speed for the test is individually determined based on the participant's gender, age, and fitness level.

1. Briefly explain the purpose of the test and how it is conducted.

2. Estimate the participant's age-predicted HRmax (220-age) in bpm then calculate 50% bpm and 70% bpm of his/her HRmax.

3. Have the participant warm up for 4 minutes at a 0% grade and a walking speed that brings the HR to between 50% and 70% of his/her HRmax. (The recommended walking speed is from 3.4 to 4 mph). If the HR is not in this range after the first minute, adjust the speed accordingly.

4. Following the warm-up, keep the participant at the same speed for an additional 4 minutes at a grade of 5%, then record the steady-state HR (SS HR) from the average of the final 30 sec of the last two minutes at the 5% grade. (Note: to achieve steady-state, the HR from the last two minutes must not differ by more than 5 bpm. If the HR differs by more than 5 bpm, extend the test by an additional minute and record the SS HR from the new final two minutes.)

5. Enter this SS HR into the equation below to estimate VO_2max ($mL \bullet kg^{-1} \bullet min^{-1}$).

6. Allow the participant to cool down at a slow walk and 0% grade for 2-5 min. Monitor and record the HR in bpm every minute.

Interpretation

VO_2max is estimated using the following equation:

Estimated VO_2max (in $mL \bullet kg^{-1} \bullet min^{-1}$) = 15.1 + (21.8 x speed in mph) - (0.327 x SS HR in bpm) - (0.263 x speed x age in years) + (0.00504 x SS HR in bpm x age in years) + (5.98 x gender: female = 0, male = 1)

To obtain the Health Benefit Zone Rating from Figure 7-12, multiply the estimated VO_2max by 10.

Use Tool #16a, Ebbeling Single-Stage Treadmill Walking Test Data Collection Form, to track and calculate results

EXAMPLE

Client is a 30-year-old male who walked at 3.6 mph at a grade of 5% with a SS HR of 159 bpm.

HRmax = 190 bpm;
50% HRmax = 95 bpm;
70 % HRmax = 133 bpm:

Estimated VO_2max

= 15.1 + (21.8 x 3.6) - (0.327 x 159) - (0.263 x 3.6 x 30) + (0.00504 x 159 x 30) + 5.98 (1)
= 43.2 ($mL \bullet kg^{-1} \bullet min^{-1}$)

Aerobic Fitness Score

= 10 x VO_2max
= 432

Health Benefit Zone: *Good*

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■ THE YMCA CYCLE ERGOMETER SUBMAXIMAL TEST (GOLDING ET AL. 1989)

This submaximal exercise test uses a cycle ergometer to estimate VO_2max for men and women. The protocol uses three or more consecutive 3-minute workloads that are designed to raise the HR to between 110 bpm and a HR that is near 85% of the age-predicted HRmax for two consecutive workloads.

The pedaling rate is 50 rpm and the initial workload is 150 kpm • min^{-1} (25W). The HR during the last minute of the first workload determines the loading sequence of subsequent workloads. For example if the HR is 80-89 bpm or 90-100 bpm, the respective workloads for the second stage would be 600 or 450 kpm • min^{-1}, respectively. Note: One watt (W) = 6 kpm • min^{-1}.

The subsequent workloads are then set according to the progression in each column in Figure s4-1.

Procedure

1. Briefly explain the purpose of the test and how it is conducted.

2. Estimate the participant's age-predicted HRmax (220-age), then calculate 85%______ of HRmax.

3. Set the first workload at 150 kpm/min (0.5 kp).

4. If the HR in the third minute is:

- < 80 bpm, set the second load at 750 kpm•min^{-1} (2.5 kp);
- 80-89 bpm, set the second load at 600 kpm•min^{-1} (2.0 kp);
- 90-100 bpm, set the second load at 450 kpm•min^{-1} (1.5 kp);
- > 100 bpm set the second load at 300 kpm•min^{-1} (1.0 kp)

5. Set the third, fourth, etc. workloads (if required) according to the progression in Figure s4-1. Measure the HR during the last 15 seconds of minutes 2 and 3 at each workload. If these HR differ by more than 5 bpm, extend the workload an extra minute until the HR stabilizes. The test is terminated when the participant's steady-state HR is within 10 beats of 85% HRmax.

HR_1 = HR at Second-Last Workload = ____ bpm

HR_2 = HR at Last Workload = ____ bpm

Use Tool #16b, YMCA Cycle Ergometer Test Data Collection Form, to track and calculate results

FIGURE s4-1

Heart Rate and Loading Sequence for Different Stages of the YMCA Cycle Ergometer Test

1st Workload	150 kpm•min^{-1} (0.5 kp or 25 W)			
Subsequent Workloads:	**Heart Rate during last minute of previous workload** *< 80 bpm*	***80-89 bpm***	***90-100 bpm***	***> 100 bpm***
2nd	750 kpm•min^{-1} (2.5 kp or 125 W)	600 kpm•min^{-1} (2.0 kp or 100 W)	450 kpm•min^{-1} (1.5 kp or 75 W)	300 kpm•min^{-1} (1.0 kp or 50 W)
3rd	900 kpm•min^{-1} (3.0 kp or 150 W)	750 kpm•min^{-1} (2.5 kp or 125 W)	600 kpm•min^{-1} (2.0 kp or 100 W)	450 kpm•min^{-1} (1.5 kp or 75 W)
4th	1050 kpm•min^{-1} (3.5 kp or 175 W)	900 kpm•min^{-1} (3.0 kp or 150 W)	750 kpm•min^{-1} (2.5 kp or 125 W)	600 kpm•min^{-1} (2.0 kp or 100 W)
etc.	*If additional workloads are required to achieve within 10 bpm of 85% HRmax, add 150 kpm•min^{-1} (0.5 kp or 25 W) to the previous workload.*			

6. For each of the last two workloads, calculate the oxygen cost (VO_2) in $mL \bullet kg^{-1} \bullet min^{-1}$ using the following equation:

$$VO_2 = \left(\frac{Workload\ (W)}{Body\ \ mass\ (kg)} \times 10.8\right) + 3.5 + 3.5$$

SM_1 = VO_2 at Second-Last Workload

SM_2 = VO_2 at Last Workload

7. From these two oxygen cost (VO_2) values estimate the VO_2max in $mL \bullet kg^{-1} \bullet min^{-1}$ using the equations for the multistage model to calculate the slope of the line based on the HR response to the last two workloads.

Slope (**b**) $= \dfrac{\mathbf{SM_2 - SM_1}}{\mathbf{HR_2 - HR_1}}$

VO_2max = **SM_2** + [**b x** (HRmax - **HR_2**)]

8. To obtain the Health Benefit Zone Rating from CPAFLA Figure 7-12, multiply the estimated VO_2max by 10.

■ EXAMPLE

A 20 year old female who weighed 62 kg completed the YMCA Cycle Ergometer Test. (Age-predicted HRmax = 200 bpm; 85 % of HRmax = 170 bpm).

Her test results are as follows:

Workload #	Workload amount	Time (mins)	HR (bpm)
1	150 kpm• min^{-1} 25 W	0-1	86
		1-2	90
		2-3	92
2	450 kpm• min^{-1} 75 W	3-4	120
		4-5	135
		5-6	139
3	600 kpm• min^{-1} 100 W	6-7	151
		7-8	159
		8-9	163

HR1 = (135 + 139)/2
= 137 bpm

HR2 = (159 + 163)/2
= 161 bpm

SM1 $= \left(\frac{75}{62} \times 10.8\right) + 3.5 + 3.5$
= 20.06 $mL \bullet kg^{-1} \bullet min^{-1}$

SM2 $= \left(\frac{100}{62} \times 10.8\right) + 3.5 + 3.5$
= 24.42 $mL \bullet kg^{-1} \bullet min^{-1}$

Slope (**b**) $= \dfrac{\mathbf{SM_2 - SM_1}}{\mathbf{HR_2 - HR_1}}$
$= \dfrac{24.42 - 20.06}{161 - 137}$
= 0.182

Estimated VO_2max
= SM_2 + [**b** x (HRmax - HR_2)]
= 24.42 + [0.182 x (200 - 161)]
= 31.5 $mL \bullet kg^{-1} \bullet min^{-1}$

Aerobic Fitness Score
= 10 x Estimated VO_2max
= 315

Health Benefit Zone: Needs Improvement

Source: Golding, L. 2000. The "Y's" way to Physical Fitness. Human Kinetics, Champaign, IL.

■ THE ROCKPORT ONE MILE WALKING TEST (ROCKPORT WALKING INSTITUTE, 1986)

The Rockport Walking Test is a sub-maximal field test to estimate VO_2max in males and females 20 to 69 years old. The participant is required to walk one mile (1.6 kilometers) as quickly as possible. The test is easily administered and is well suited for sedentary and/or older individuals.

Equipment

One mile (1.6 km) track (not on a treadmill) and stopwatch(es)

Procedure

1. Briefly explain the purpose of the test and how it is conducted.

2. A level, one mile (1.6 km) course is required. The inside lane of a one mile (or 400 m) track is preferred, but any uninterrupted course of precisely one mile (1.6 km) is suitable.

3. Participants should wear appropriate clothing plus shoes and perform 5-10 min of light stretching before commencing the walk.

4. Instruct the participant to walk the one mile as quickly as possible (but not speed walking).

5. Record the participant's heart rate (HR) immediately upon the completion of the mile. It is preferable to have the participant wear a heart rate monitor for this measurement but the assessment of HR via palpation (using a 15 sec. count from the radial or carotid artery) is a suitable alternative.

6. Estimate the participant's VO_2max using the following formula, which incorporates his/her body weight (lb), age (yr), gender (males = 1, females = 0), time to complete one mile (min), and postexercise heart rate (bpm):

Estimated VO_2max (in $mL \bullet kg^{-1} \bullet min^{-1}$) =
132.853 – (0.0769 x weight) –
(0.3877 x age) + (6.315 x gender) –
(3.2649 x time) – (0.1565 x HR)

To obtain the Health Benefit Zone Rating from Figure 7-12, multiply the estimated VO_2max by 10.

Use Tool #16c, Rockport Walking Test Data Collection Form, to track and calculate results

■ EXAMPLE

As an example, if a 33-year-old male (who weighed 160 lbs) completed the walk in 11:20* and had a post-exercise HR of 160 bpm, his estimated VO_2max would be 52 $mL \bullet kg^{-1} \bullet min^{-1}$ (as calculated below):

**It is important to note that completion time must be converted to minutes. This is accomplished by dividing the number of seconds by 60 and adding this value to the whole value for minutes. In the above example, the total time was 11 minutes and 20 seconds. When expressed as minutes, this equals 11 min + (20/60 sec) or 11.33 min.*

Estimated VO_2max

= 132.853 – (0.0769 x 160) –
(0.3877 x 33) + (6.315 x 1) –
(3.2649 x 11.33) – (0.1565 x 160)

= 52 $mL \bullet kg^{-1} \bullet min^{-1}$

Aerobic Fitness Score

= 10 x Estimated VO_2max
= 520

Health Benefit Zone: Excellent

Source: *Rockport Walking Institute. Rockport fitness walking test. Malboro, MA:Rockport Walking Institute, 1986.*

Tool #16a EBBELING SINGLE-STAGE TREADMILL WALKING TEST

Data Collection Form

Name:	**Date:**
Resting HR: bpm	**Resting BP:** mmHg
Age: yrs **Gender** M or F	**Body Mass:** kg
85% predicted HRmax: bpm	**Warm-up HR Training Zone:** **50% predicted HRmax =** bpm **70% predicted HRmax =** bpm

Time (min)		**Speed (mph)**	**Grade (%)**	**HR (bpm)**	**RPE**
Warm-up	1		0		
	2		0		
	3		0		
	4		0		
Workload	1		5		
	2		5		
	3		5		
	4		5		
	5*		5		
Recovery (reduce walking speed)**	1		0		
	2		0		
	3		0		
	4		0		
	5		0		

* 5th minute only required if HR during the 3rd and 4th minute is not at steady state (within 5 bpm)
** An active recovery period of 2-5 minutes should immediately follow this test. Once the client has completed the active recovery, proceed to post-test HR and BP measurements. These can be taken in the seated position.

Post-Test Measurements

Time (min)	**HR (bpm)**	**BP (mmHg)**
1		
3		
5		

Equation to Predict VO_2max for Ebbeling Single Stage Treadmill Protocol

- *speed = mph*
- *HR = bpm*
- *age = years*
- *gender = 1 for males and 0 for females*

VO_2max = 15.1 + (21.8 x speed) – (0.327 x HR) – (0.263 x speed x age) + (0.00504 x HR x age) + (5.98 x gender)

= 15.1 + (21.8 x ______) – (0.327 x _____) – (0.263 x _____ x _____) + (0.00504 x _____ x _____) + (5.98 x ___)

= 15.1 + (_____) – (_____) – (_____) + (_____) + (_____)

= _____ $mL•kg^{-1}•min^{-1}$

Aerobic Fitness Score

= 10 x VO_2max

= 10 x _____ $mL•kg^{-1}•min^{-1}$

= _____

CPAFLA Health Benefit Zone: (See CPAFLA Figure 7-12)

- ❑ Excellent
- ❑ Very Good
- ❑ Good
- ❑ Fair
- ❑ Needs Improvement

YMCA CYCLE ERGOMETER TEST

Data Collection Form

Name:	**Date:**
Resting HR: bpm	**Resting BP:** mmHg
Age: yrs **Gender** M or F	**Body Mass:** kg
85% predicted HR max (-10 bpm): bpm	**Seat Height:**

Time (min)		**Resistance (kg or watts)**	**Cadence (rpm)**	**HR (bpm)**	**RPE**
First Workload	1				
	2				
	3				
	4*				
Second Workload	1				
	2				
	3				
	4*				
Third Workload	1				
	2				
	3				
	4*				
Fourth Workload	1				
	2				
	3				
	4*				
Recovery (reduce resistance)**	1				
	2				
	3				
	4				
	5				

*4th minute for each workload only required if HR during 2nd and 3rd minute are not at steady state (within 5 bpm)
** An active recovery period of 2-5 minutes should immediately follow this test. Once client has completed the active recovery, then proceed to post-test HR and BP measurements. These can be taken in the seated position.

Post-Test Measurements

Time (min)	HR (bpm)	BP (mmHg)
1		
3		
5		

Equation to Predict VO_2max for YMCA Cycle Ergometer Test

1. **Determine power output for each workload using ACSM Metabolic Equation for Cycle Ergometry:**

   - *1 W = 6 kpm•min^{-1}*
   - *1 kg = 2.2 lbs*
   - *SM_1 = sub-maximal VO_2 at second-last workload*
   - *SM_2 = sub-maximal VO_2 at last workload*

$$VO_2 = \left(\frac{Workload\ (W)}{Body\ \ mass\ (kg)} \times 10.8\right) + 3.5 + 3.5$$

$$\mathbf{SM_1} = \left(\frac{\_\_\_\_\_}{\_\_\_\_\_} \times 10.8\right) + 3.5 + 3.5$$

= ______

$$\mathbf{SM_2} = \left(\frac{\_\_\_\_\_}{\_\_\_\_\_} \times 10.8\right) + 3.5 + 3.5$$

= ______

2. **Determine slope of the line of best fit using Multi-Stage Slope Prediction:**

$$b = \frac{\mathbf{SM_2 - SM_1}}{\mathbf{HR_2 - HR_1}}$$

$$= \frac{\_\_\_\_\_ - \_\_\_\_\_}{\_\_\_\_\_ - \_\_\_\_\_}$$

= _____

3. **Determine VO_2max**

   VO_2max = $\mathbf{SM_2}$ + [*b* x (HRmax - $\mathbf{HR_2}$)]

   = _____ + [_____ x (_____ - _____)]

Aerobic Fitness Score

= 10 x VO_2max

= 10 x _____ mL•kg^{-1}•min^{-1}

= _____

CPAFLA Health Benefit Zone:
(See CPAFLA Figure 7-12)

- ❑ Excellent
- ❑ Very Good
- ❑ Good
- ❑ Fair
- ❑ Needs Improvement

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Data Collection Form

Name:	**Date:**
Resting HR: bpm	**Resting BP:** mmHg
Age: yrs **Gender** M or F	**Body Mass:** kg
Time to Complete One Mile: (minutes:seconds)	
Immediate Post-Exercise Heart Rate bpm	

** An active recovery period of 2-5 minutes should immediately follow this test. Once client has completed the active recovery, then proceed to post-test HR and BP measurements. These can be taken in the seated position.

Post-Test Measurements

Time (min)	HR (bpm)	BP (mmHg)
1		
3		
5		

Equation to Predict VO_2max for Rockport 1-Mile Walk Test

- *body mass = pounds*
- *age = years*
- *gender = 1 for males and 0 for females*
- *time = minutes*
- *HR = bpm*

VO_2max = 132.853 – (0.0769 x body mass) – (0.3877 x age) + (6.315 x gender) – (3.2649 x time) – (0.1565 x HR)

= 132.853 – (0.0769 x _____) – (0.3877 x _____) + (6.315 x _____) – (3.2649 x _____) – (0.1565 x _____)

= 132.853 – (_____) – (_____) + (_____) – (_____) – (_____)

= _____ $mL \cdot kg^{-1} \cdot min^{-1}$

Aerobic Fitness Score

= 10 x VO_2max

= 10 x _____ $mL \cdot kg^{-1} \cdot min^{-1}$

= _____

CPAFLA Health Benefit Zone: (See CPAFLA Figure 7-12)

- ❑ Excellent
- ❑ Very Good
- ❑ Good
- ❑ Fair
- ❑ Needs Improvement

Tool #16d **MODIFIED CANADIAN AEROBIC FITNESS TEST (mCAFT)**

Data Collection Form

Name:	**Date:**
Resting HR: bpm	**Resting BP:** mmHg
Age: yrs **Gender:** M or F	**Body Mass:** kg
85% predicted HRmax: bpm	**85% predicted HRmax:** b/10 sec

Starting Stage Number	**HR (bpm):** ☐ **Auscultation** ☐ **Palpation** ☐ **Electronic HR Monitor**	**RPE**
1st stage		
2nd stage		
3rd stage		
4th stage		
5th stage		
6th stage		
7th stage		
8th stage		

* An active recovery period of 2-5 minutes should immediately follow this test. Once client has completed the active recovery, then proceed to post-test HR and BP measurements. These can be taken in the seated position.

Post-Test Measurements

Time (min)	**HR (bpm)**	**BP (mmHg)**
1		
3		
5		

Equation to determine Aerobic Fitness Score for mCAFT Step Test

- *O_2 cost is determined from CPAFLA Figure 7-11*
- *body mass = kg*
- *age = years*

Aerobic Fitness
Score = 10 x [17.2 + (1.29 x O_2 cost of the last completed stage) – (0.09 x Body mass) – (0.18 x age)]

= 10 x [17.2 + (1.29 x _____) – (0.09 x _____) – (0.18 x _____)]

= 10 x [17.2 + (_____) – (_____) – (_____)]

= 10 x [_____]

= _____ $mL \cdot kg^{-1} \cdot min^{-1}$

CPAFLA Health Benefit Zone: (See CPAFLA Figure 7-12)

- ❑ Excellent
- ❑ Very Good
- ❑ Good
- ❑ Fair
- ❑ Needs Improvement