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SUPERVISION OF FITNESS TESTING (CARDIORESPIRATORY ENDURANCE)

A joint project of the Australian Sports Medicine Federation (ASMF) and the Australian Association for Exercise and Sports Science (AAESS)

INTRODUCTION

This paper addresses the need for standardizing guidelines for fitness testing in a variety of venues across Australia. It will specifically address and make recommendations on two main issues:

- (1) guidelines for determining the appropriate type of fitness test for a given individual; and
- (2) qualification for personnel involved in pre-participation screening, fitness testing and exercise prescription.

This paper incorporates some material presented in earlier draft discussion papers as well as information from the current literature in exercise science. The issues and recommendations presented in this paper rely heavily on the 1991 Guidelines for Exercise Testing and Prescription of the American College of Sports Medicine (ACSM).

In principle, this paper advocates the adoption, with some modifications of the ACSM Guidelines for several reasons:

- (1) The ACSM is an internationally recognized leader in the fields of exercise science and sports medicine;
- (2) the ACSM Guidelines are based on several decades of scientific and clinical research performed throughout the world and are frequently updated to reflect advances in the literature;
- (3) the ACSM Guidelines and certification procedures are internationally accepted professional standards for organizations and personnel involved in exercise testing; and
- (4) similarities between Australian and North American data on issues important to exercise testing and prescription (eg. morbidity and mortality due to major lifestyle diseases such as cardiovascular disease and cancer, and exercise patterns among the population) justify the use of guidelines developed overseas.

Adoption of the ACSM Guidelines would ensure maintenance of the highest international professional standard throughout Australia, enhancing the credibility of our programs within and outside Australia, as well as the transfer of credentials between Australia and other countries.

This paper will first define different types and purposes of fitness testing, followed by a summary of the ACSM Guidelines, suggested pre-participation screening, ASMF/AEISS recommended risk classification; risks of fitness testing, and discussion of the qualifications needed by personnel involved in fitness testing and health risk screening specifically for fitness testing. The paper will conclude with specific recommendations for supervision of fitness testing.

DEFINING FITNESS TESTING

Fitness testing provides a means to assess physical fitness; physical fitness usually refers to "health-related physical fitness" in the context of disease prevention and health promotion (ACSM Guidelines, p 35). Health-related physical fitness has been defined by the ACSM as "a state characterized by

- (a) an ability to perform daily activities with vigour, and
- (b) demonstration of traits and capacities that are associated with low risk of premature development of the hypokinetic diseases (ie. those associated with physical inactivity)."

As used in this paper, fitness testing is distinct from exercise testing. The latter denotes the use of an exercise tolerance (or stress) test in the detection, diagnosis or treatment of cardiovascular disease in the clinical setting. Clinical diagnostic exercise testing is clearly a medical procedure to be conducted by a qualified practitioner, ie. a cardiologist or a medical practitioner trained in cardiology and exercise testing. This paper will address only issues related to non-diagnostic physical fitness testing.

The ACSM Guidelines (p 36) identify four main purposes of fitness testing:

- (1) to generate data for development of exercise prescriptions;
- (2) to provide a baseline for further assessment and comparison;
- (3) to motivate participants by establishing goals; and
- (4) to educate participants about the concept of physical fitness.

Fitness testing usually entails a variety of physical measurements including cardiorespiratory endurance or work capacity, body composition, muscle and joint flexibility, muscular strength and endurance, and sometimes lung function. This paper will address only tests of cardiorespiratory endurance specifically as used in physical fitness testing or physiological profiling.

Cardiorespiratory endurance (CRE) is defined by the ACSM as the "ability to perform large-muscle, dynamic, moderate-to-high intensity exercise for prolonged periods" (ACSM Guidelines p 39). Cardiorespiratory endurance is important to health-related fitness because low CRE is associated with increased risk of certain diseases such as cardiovascular disease.

For fitness testing purposes, tests of CRE can be categorised as either maximal or submaximal, ie. the subject exercises to maximal physical work capacity (maximal) or to some pre-determined end point which is less than maximal (submaximal). Measurement of maximal oxygen consumption (VO_2max) is the most widely accepted criterion measure of CRE.

Maximal fitness testing is used in situations in which an accurate and reproducible measure of fitness level (VO_2max) is required, eg. for high performance athletes or for research purposes.

Because of the cost and specialized equipment required for maximal testing and direct measurement of VO_2max alternative tests have been developed to estimate VO_2max using submaximal protocols. Many submaximal tests have been developed and validated against direct measurement of VO_2max ; most of these tests are based on the linear relationship between heart rate (HR), oxygen consumption and workrate during exercise. Examples of submaximal fitness tests include: submaximal cycle ergometer protocols (eg. Astrand-Ryhming, YMCA cycle tests), bench stepping tests, and field tests such as distance runs (eg. 1.5 mile run, 12 min run) or walking tests (eg. 1 mile walk, Rockport Fitness Walking Test). Other sport-specific submaximal tests have been developed (eg. shuttle run for basketball).

Submaximal fitness testing is appropriate when accurate and sensitive measures of physical fitness or work capacity are not essential, when resources preclude use of maximal fitness testing, or when maximal fitness testing is contraindicated. Examples of such settings include, but are not limited to, the following: appraisal of fitness level in lower risk and asymptomatic individuals as performed in community, worksite and commercial fitness programs and centres; mass testing, such as community programs or research studies; field testing or frequent assessment of athletes; and school sport or physical education programs.

Determination of the appropriate fitness test (maximal vs submaximal) depends on several factors including the objectives and purpose of testing; age, gender, and fitness level of the individual to be tested; degree of risk for cardiovascular disease; medical or other physical conditions; available resources and personnel; and the number of people to be tested.

In most health-related fitness settings (eg. community, work-site or commercial fitness programs), a submaximal test provides sufficient information for evaluation of physical fitness level, and is preferable because of its relative simplicity and lower risk to the individual to be tested. Maximal protocols should be performed only after careful consideration of the purpose of the test (ie. the need for precise measurement of VO_2 max) and the fitness level of the individual to be tested.

Over the years, the ACSM has developed and refined its Guidelines to aid in determining the appropriate test for a given individual. A summary of these Guidelines is provided in the following section.

SUMMARY OF THE ACSM GUIDELINES FOR FITNESS TESTING

The ACSM Guidelines (pp 5-10) classify individuals by age, gender, risk factors, and signs or symptoms of, or diagnosed, cardiovascular disease. There are three broad categories:

- (1) apparently healthy individuals,
- (2) individuals at higher risk and
- (3) individuals with known disease.

The first category is further divided according to age, and the second category according to the presence or absence of signs or symptoms. Determination of the appropriate course of action for a given individual (ie. the need for medical examination or diagnostic exercise test prior to participation; type of fitness test) is then based on three factors:

- (1) the individual's risk status,
- (2) type of test, and
- (3) type of exercise to be undertaken.

This system provides a flexible, practical and specific method to determine the appropriate exercise test environment for a given individual.

A. Specific definitions used in the ACSM Guidelines

Submaximal fitness testing denotes testing up to 75% of age-predicted maximal heart rate ($APMHR = 220 - \text{age}$).

Moderate exercise includes activities at an intensity equivalent to 40-60% VO_2 max which are within the individual's current exercise capacity and can be comfortably sustained for an extended period of time (eg. 60 min).

CHART CODES FOR FLOW CHART 1 (pg. 20)

E.S.P.

Exercise Science Professional (ESP) - tertiary trained with a minimum of a Bachelor Degree in Exercise Science - related discipline (Human Movement Studies or Science, Exercise or Sports Science), completing an ASMF/AEISS approved course, or completing additional approved training either in an elective/module, or a post graduate diploma, in appropriate areas (ASMF/AEISS approved). The courses must provide the necessary additional training in the areas outlined in the document.

1. Cleared and/or assessed as apparently healthy with one or less coronary risk factor (CRF) following screening via Table 5 by ESP. However, in certain cases, even if only one risk factor is present; if the risk factor is grossly abnormal eg. blood pressure greater than 180/120, then it would be up to the discretion of the ESP, whether this constituted sufficient grounds to classify the subject as "higher" risk.
2. As above but found/assessed as having two or more CRFs.
3. As above but assessed as having significant symptoms or established disease.
4. Pre-exercise medical (see ACSM Guidelines pp 56-57) emphasis on:
 - CVS
 - Respiratory
 - Metabolic and musculoskeletal including - blood lipids plus other blood pathology as indicated.
 - resting ECG (> 35 for men and >45 for women intending to undertake vigorous exercise) or where indicated other measures/tests, eg. lung function, where indicated

Subjects with prior heart disease, requiring non medically supervised exercise, it is suggested that their pre-exercise medical would incorporate the above, and more specifically follow the guidelines set in the draft guidelines by the National Heart Foundation NSW division 1993 (Appendix 1).

5. Age division
 - Males < 35 years
 - Females < 45 years - some discrepancy with ACSM Guidelines. The stated figures are consistent with the National Heart Foundation Guidelines.
6. Fitness Testing - if indicated or desired for specific reasons as outlined in document. May involve submaximal test (see definition in document) or maximal test (see definition in document).

Test to be conducted and supervised by ESP and possibly with medical practitioner present depending on indications as outlined in flow sheet.

 - Medical practitioner should have specific skills and training.
 - ESP should have specific skills and training.
 - Resuscitation equipment should be available such as defibrillator, oxygen and emergency drugs, and IV for medical use.
7. Medical Examination - See D4.
8. Exercise ECG - to be conducted by medical practitioner with skills and experience in area, and with resuscitation equipment available.

NO not necessary, but does NOT mean should not be done
 YES recommended
 YES⁽¹⁾ recommended, particularly if not "active" (see⁽¹⁾ below)
 ESP Exercise Science Professional - see attached
 Dr Medical practitioner

9. Level of Exercise

Moderate Exercise - exercise intensity 40-60% $\dot{V}O_{2max}$ generally can be sustained for 1 hour.

Vigorous Exercise - exercise intensity > 60% $\dot{V}O_{2max}$ would normally lead to fatigue in 20 minutes.

"Active" - aerobic type activity 20-30 minutes 2-3 days per week for a minimum of 3 months.

10. Exercise ECG should be strongly considered in subjects previously "inactive" and with "very high" risk factors.
11. Note maximal fitness testing involves maximal $\dot{V}O_{2max}$ testing as well as anaerobic energy assessment; anaerobic threshold, $\dot{V}O_{2max}$ workload relationship, or time to fatigue or comparable maximal effort type tests.

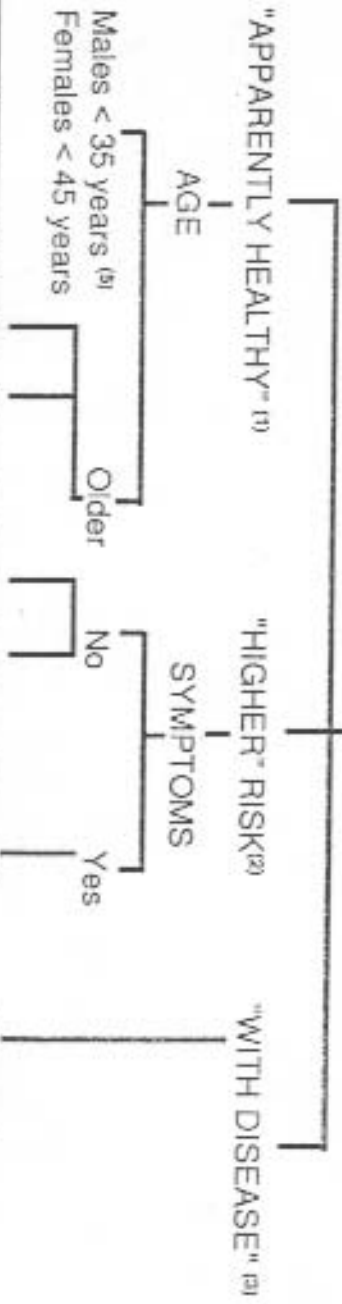
FLOW CHART 1

PRE-EXERCISE - NON MEDICAL PERSONNEL

SUBJECTS

EXERCISE SCIENCE PROFESSIONAL (ESP) -- SCREEN USING TABLE 5.

Modt = Moderate exercise
Vig = Vigorous exercise



Level of exercise (9)	Any	Modt	Vig	Modt	Vig	Any	Any
1. Pre-exercise Medical Screening (4)							
i Medical OE (7)	No	No	Yes	Yes	Yes	Yes	Yes
ii Exercise ECG (8)	No	No	Yes	Yes (10)	Yes	Yes	Yes
2. Fitness Testing (6)							
i Submaximal	ESP	ESP	ESP	ESP	ESP	ESP	ESP/Dr
ii Maximal (11)	ESP(3)	ESP/Dr	ESP/Dr	ESP/Dr	ESP/Dr	ESP/Dr	ESP/Dr

N.B. See page 21 for information on the codes used.

Vigorous exercise includes exercise at an intensity above 60% VO_2max which would normally lead to fatigue within 20 minutes.

Major risk factors ⁽¹⁾ (see footnote) for cardiovascular disease include:

- diagnosed hypertension or systolic blood pressure > 160 or diastolic blood pressure > 90 mm Hg on at least two occasions or on antihypertensive medication
- serum cholesterol > 6.20 mmol.L⁻¹
- cigarette smoking
- diabetes mellitus (those with IDDM > 30 years of age > 15 years duration, or NIDDM > 35 years of age are treated as individuals with disease)
- coronary or other atherosclerotic diseases in parents or siblings prior to age 55. (See pp 5-10, ACSM Guidelines 1991, for further detail).

Major signs or symptoms suggestive of cardiovascular disease include:

- apparently ischemic chest pain or discomfort
- unaccustomed shortness of breath or shortness of breath on mild exercise
- dizziness or syncope
- orthopnea/paroxysmal nocturnal dyspnea
- ankle oedema
- palpitations or tachycardia
- claudication
- known heart murmur.

(See pp 5-10, ACSM Guidelines 1991, for further detail).

Risk classification

This section details the ACSM system for cardiovascular disease risk classification. See Table 1.

The ACSM Guidelines (ACSM Guidelines 1991 p 8) are cautious in noting that, although a specific test may not be deemed necessary, this does not mean that the test should not be performed.

The ACSM has also developed detailed lists of information recommended for inclusion in full medical screening and contraindications for fitness and exercise testing (see pp 56-58, ACSM Guidelines).

- (1) Australian medical practitioners consulted about this paper expressed concern over the values for blood pressure and serum cholesterol specified in the ACSM Guidelines, and the National Heart Foundation of Australia have in fact stricter guidelines relating to cholesterol and identify elevated triglyceride levels as major risk factors. It is noted that there has been a recent trend towards recommending lower levels for all these variables. These suggestions have been incorporated into the recommendations at the end of this paper.

RECOMMENDED SCREENING PRIOR TO FITNESS TESTING

Pre-participation screening serves to classify individuals by risk category in order to determine the appropriate type of fitness test and exercise program. The ACSM Guidelines (pp 36-37) identify four specific purposes of pre-participation health screening:

- (1) to identify and exclude individuals with medical contraindications to exercise;
- (2) to identify specific medical conditions for referral to a medically supervised diagnostic exercise test or exercise program;
- (3) to identify individuals with disease risk factors and symptoms who should receive further medical evaluation prior to beginning exercise, and
- (4) to identify individuals with special needs for safe fitness testing and exercise prescription (eg. pregnancy).

All potential participants should undergo a basic "pre-participation screening by qualified personnel" (see section VIB), in order to be accurately stratified with regard to their risk status. The basic screen should incorporate a combination of a PAR-Q questionnaire (Table 2); major symptoms or signs questionnaire (Table 3); coronary risk factor classification (Table 4); blood lipid, particularly cholesterol value within the past 12 months, (optional for under 35 year old men and under 45 year old women) and these could be incorporated into the suggested general health and lifestyle questionnaire (Table 5) which could be administered as a simple screening procedure by the appropriately qualified personnel (see Section VI b.) to assess subjects' risk status.

Pre-participation screening for cardiovascular disease risk factors should be consistent with the risk classifications derived from the ACSM Guidelines and put forward in this paper. Thus, the minimum information which should be obtained in pre-participation screening includes: age, gender, height, body mass, resting blood pressure, serum cholesterol, past and current smoking habits, family history of coronary disease, presence and type of diabetes, musculoskeletal or other physical conditions which may limit exercise capacity, presence of symptoms or signs of heart disease, and past and current activity habits. This information should be current, with measures such as cholesterol taken within the past year.

PRE-EXERCISE SCREENING - NON MEDICAL

Appropriately qualified personnel, designated for the purpose of this document as Exercise Science Professionals (ESP), should screen all subjects pre-participation along the lines described above for accurate risk classification (See Flow Chart 1).

PRE-PARTICIPATION EXERCISE SCREENING - MEDICAL

The pre-exercise medical examination, should be along the guidelines suggested by the ACSM Guidelines (pp 56-57) and ideally there should be a proforma developed, incorporating these guidelines; the health and lifestyle questionnaire (Table 5) and the suggested medical questionnaire developed for subjects with prior heart disease (Appendix 1), in order to ensure that there are no cardiovascular, respiratory, metabolic or musculoskeletal condition that may adversely affect any fitness testing or any exercise program.

The medical evaluation should include testing for blood lipids including HDL cholesterol, and any other blood pathology that may be indicated such as fasting blood sugar.

Other measures and investigations such as spirometry, should be performed where indicated.

ASMF - AAESS RECOMMENDED RISK CLASSIFICATION

Recommendations put forward in the ASMF-AAESS paper are based on the ACSM system, with some modifications. See Flow Chart 1.

1. Apparently healthy individuals are defined as asymptomatic individuals with no more than one risk factor for, or sign or symptom of, cardiovascular disease. This group is further subdivided by age and gender:
 - (a) Men 35 years or younger and women 45 years or younger in this category may begin moderate or vigorous exercise programs without prior medical examination or diagnostic exercise testing, provided the programs are scientifically based, and begin and progress gradually. For these individuals neither submaximal nor maximal fitness testing require the presence of a medical practitioner provided tests are conducted by qualified personnel (see section VI.b. below for a definition of qualified personnel). Most athletes, except masters athletes, would fall into this category.

- (b) Apparently healthy men over 35 years and women over 45 years of age with no more than one risk factor of cardiovascular disease may begin moderate exercise programs without prior medical examination but do not require diagnostic exercise testing. Submaximal fitness testing may be performed up to 75% APMHR without the presence of a medical practitioner provided tests are conducted by qualified personnel; however, maximal fitness testing should be conducted with a medical practitioner present. For individuals in this category, medical examination and diagnostic exercise testing are recommended prior to beginning a vigorous exercise program. Many masters athletes may fall into this category.
2. Higher risk individuals are defined as those with signs or symptoms suggestive of possible cardiovascular, pulmonary or metabolic disease and/or two or more coronary risk factors. This group is further subdivided according to the presence or absence of signs or symptoms:
- (a) Asymptomatic individuals (i.e. with two or more risk factors but no symptoms) require a prior medical examination before undertaking a submaximal fitness test and a moderate exercise program. The submaximal fitness test can be performed without a medical practitioner present provided the test is conducted by qualified personnel. Diagnostic exercise testing is not required providing the exercise program is "prescribed" by qualified personnel (see Section VI B.) and begins and progresses gradually. As with older apparently healthy individuals, medical examination and diagnostic exercise testing is recommended prior to beginning a vigorous exercise program, and a medical practitioner should be present for maximal fitness testing. Some masters athletes may fall into this category.
 - (b) Individuals with symptoms of cardiovascular, pulmonary and metabolic diseases should undergo a thorough medical examination and diagnostic exercise test prior to beginning any exercise program or undertaking any type of fitness test. Submaximal fitness testing should be performed under supervision of a medical practitioner.
3. Individuals with known disease include those with diagnosed cardiovascular, pulmonary or metabolic diseases such as diabetes, thyroid, liver or kidney disease. Full medical examination and diagnostic exercise testing are recommended prior to beginning any exercise program. Submaximal fitness testing should be performed in the presence of a medical practitioner. It is possible that a few athletes (eg. diabetic athlete) may fall into these latter two categories.

RISKS OF EXERCISE TESTING

Both maximal diagnostic exercise testing and maximal and submaximal fitness testing are relatively safe procedures provided personnel are appropriately trained and emergency equipment are available for diagnostic clinical testing. Data presented in the ACSM Guidelines (p 4) indicate a death rate of 0.5 per 10,000 maximal diagnostic exercise tests under a variety of conditions. As expected, the risks of submaximal fitness testing appear to be lower than for diagnostic testing, with no deaths or medical complications reported from over 100,000 submaximal cycle ergometer tests (p 5, ACSM Guidelines).

STANDARDS FOR FACILITIES AND SUPERVISION OF FITNESS TESTING

A. Facilities and Programs

To date, physical fitness testing as normally performed in Australian institutions and sports performance units has not resulted in any reported cases of significant medical problems. However, there are potential risks, albeit minimal, inherent in both submaximal and maximal fitness testing. Organizations and individuals involved in fitness testing are necessarily concerned with safety and relevant legal issues such as professional liability. Adoption of consistent recommendations across Australia would provide professional standards which may help clarify some of the safety and legal issues involved in fitness testing.

As noted above, clinical exercise testing (ie. for diagnostic or rehabilitative purposes) is undisputably best conducted in an appropriately supervised environment in which a medically qualified practitioner (eg. cardiologist or a medical practitioner with cardiac testing experience) and full emergency equipment are directly available.

Non-diagnostic fitness testing (eg. submaximal or maximal testing of apparently healthy and asymptomatic higher risk individuals; maximal testing of athletes) may be performed in non-clinical settings such as fitness centres, schools and universities, sports institutes, etc. As detailed above, a medical practitioner need not be present provided individuals are appropriately screened (see above) prior to testing, and fitness tests and exercise programs are scientifically based and conducted by qualified personnel (ESP).

B. Qualifications of Personnel Involved in Screening and Non-diagnostic Exercise Testing

At present, there are no standards regarding qualifications of personnel involved in non-diagnostic fitness testing and exercise prescription. There are, however, discussions currently taking place concerning the development of professional industry-wide competency-based standards, and in particular the question of who may perform fitness testing and exercise prescription.

It is the view of ASMF and AAESS that non-diagnostic submaximal and maximal fitness testing, exercise prescription and health risk screening specifically for these purposes should be performed only by tertiary trained individuals with a minimum of a bachelors degree in an exercise science-related discipline (eg. human movement studies or science, exercise or sports science), who have successfully completed a course approved by ASMF and AAESS.

Pre-participation screening, fitness testing and exercise prescription are fundamentally inter-related activities in the development of proper and safe exercise programs on an individual basis. Personnel involved in pre-participation risk screening and fitness testing are usually the initial contact for individuals beginning an exercise program, thus it is essential for personnel to be knowledgeable in a wide range of topics related to exercise and health related fitness, and be specifically trained to work with adult "at risk" subjects as well as young children. It is important that approved appropriate courses should incorporate these areas. Consequently, these functions should only be performed by individuals with approved tertiary training who have successfully completed approved courses as outlined above, or have successfully completed a post graduate diploma in exercise and sports science approved by ASMF and AAESS or individuals with appropriate alternate tertiary qualifications recognised by ASMF and AAESS.

In addition to the tertiary degree described above, personnel involved in fitness assessment screening and exercise prescription must be able to demonstrate specific knowledge and skills which include the ability to:

- (a) Accurately assess health risk status and recognise symptoms of disease, and hence any contra-indications or limitations to fitness testing or exercise programming.
- (b) Liaise directly with medical and other health professionals.
- (c) Accurately address questions and concerns by the client about fitness testing and exercise prescription.
- (d) Properly administer and interpret fitness test data.

- (e) Use information gained in screening and testing to prescribe exercise and to educate and motivate clients.
 - (f) Be able to recognise early warning signs and/or symptoms of potential problems during fitness testing and during an exercise program (cardiovascular respiratory and musculoskeletal).
2. It is recognised that coaches may administer various sport-specific fitness tests as part of the normal training of athletes under their guidance, and that some coaches may not be tertiary trained. This specific example may be excepted from the recommendation stated above.

In many instances school teachers responsible for the conduct of physical education lessons do not fulfil the above training requirements but may also wish to assess the fitness of primary and secondary school children. Given the nature of the population (ie. young and asymptomatic) and the type of tests involved (ie. performance tests) such assessments should also be exempted from the above recommendation (provided they are supervised by a trained physical education teacher).

- (g) Use CPR; have CPR training (and regular update); and have basic training in ECG physiology and be able to recognise major problems such as common arrhythmias and ST segment changes that may occur during fitness testing.
- (h) In an emergency, if properly qualified and legally approved under state laws use a defibrillator (if medical personnel are not present).
- (i) Manage acute musculoskeletal injuries - PRICER, ASMF Sports Trainers Course.
- (j) Monitor, instruct and supervise less qualified personnel in conducting fitness testing and exercise programs.
- (k) Safely prescribe and monitor exercise programmes for children and other special sub groups such as the elderly, the pregnant, subjects with arthritis etc.

It is our recommendations that ESP would be responsible for pre-participation screening and conducting submaximal and maximal exercise testing, as well as exercise prescription, and supervision of an exercise program. Non-tertiary qualified personnel such as Fitness Leaders, could assist with fitness testing, and monitor exercise programs under the supervision of the ESP.

Regular exercise is now considered an integral part of a healthy lifestyle by most major health education and health promotion agencies (eg. Government health departments, National Heart Foundation, etc), as well as the public. Credibility among the public, medical and other health professionals, Government, and



insurance providers depends on maintaining the highest international standards. A high level of credibility will become especially important as providers seek status for exercise-related services (eg. non-diagnostic fitness testing, exercise prescription) as claimable benefits from private health insurers.

It is recommended that those States or institutions without appropriate tertiary courses in this field, should seek to establish either these courses or appropriate electives/modules.

SUMMARY AND RECOMMENDATIONS

1. Both maximal and submaximal fitness testing are relatively safe procedures, provided testing is preceded by appropriate screening and performed by qualified personnel in appropriate settings.
2. "Health risk screening" should be conducted by appropriately qualified personnel (the Exercise Science professional ESP) prior to any fitness testing or exercise program and all information in Table 5 must be available and considered by the ESP in order to best determine cardiovascular diseases risk category, whether medical evaluation and diagnostic exercise testing are needed prior to fitness testing or exercise prescription; and to determine the appropriate type of fitness test and exercise prescription.
3. The 1991 ACSM Guidelines for Exercise Testing and Prescription, along with modifications as detailed below, should be endorsed by the ASMF and AAESS for use by medical practitioners and exercise physiologists/health and fitness specialists in determining the appropriate type of fitness test and exercise program for a given individual.
4. For most individuals, submaximal testing is adequate for assessment of cardiorespiratory fitness and exercise prescription for health-related fitness programs. Submaximal fitness tests are preferable to maximal protocols because of the relative ease of administration and lower risk to the individual. Maximal fitness testing of untrained, middle-aged or higher risk individuals should be performed only when a precise measure of fitness level is required (eg. for trained athletes or for research purposes), and only under appropriate supervision as detailed in this paper.
5. All individuals should have a medical examination prior to a fitness test and exercise program, apart from those classified as "young" apparently "healthy" (males younger than 35 years and females younger than 45 years) or apparently healthy old individuals, who are prepared to participate in a "moderate" intensity exercise program.

6. Individuals considered apparently healthy (no more than one risk factor), who are 35 years or younger for men and 45 years or younger for women, may undertake moderate or vigorous exercise without prior medical examination or diagnostic exercise testing, provided individuals have been pre-screened for risk factors and the programs are scientifically based and progress gradually. These individuals may perform fitness tests using either submaximal or maximal exercise protocols without a medical practitioner, provided testing is supervised by qualified personnel.
7. Individuals considered apparently healthy (no more than one risk factor), who are older than 35 years for men or 45 for women, may undertake moderate exercise without prior medical examination or diagnostic exercise testing. These individuals may perform submaximal fitness testing without a medical practitioner. A full medical examination and diagnostic exercise testing are required prior to beginning a vigorous exercise program; maximal fitness tests should be conducted in the presence of a medical practitioner.
8. Individuals deemed at higher risk (2 or more risk factors) but without symptoms of cardiovascular disease require medical examination prior to a submaximal fitness test, and require a diagnostic exercise test prior to either undertaking a maximal fitness test, or a "vigorous" exercise program.
9. Although not specifically required according to the ACSM Guidelines, this paper recommends that apparently healthy individuals over 35 for men and 45 for women, and higher risk asymptomatic individuals of any age, consult their general practitioners prior to beginning any exercise program.
10. All personnel responsible for submaximal and non-diagnostic maximal fitness testing, exercise prescription, and health risk screening specifically for these purposes should be tertiary trained with a minimum of a bachelors degree in an exercise science-related discipline (human movement studies or science, exercise or sport science), in a course approved by ASMF / AAESS.
11. All personnel responsible for submaximal and non-diagnostic maximal fitness testing should have current certifications in basic first aid and cardiopulmonary resuscitation, and be able to recognize abnormal physiological responses to exercise.
12. All sports science laboratories should have full emergency equipment for resuscitation, including defibrillator, oxygen therapy, suction and the availability of resuscitation drugs (when medical practitioner is present).

13. Clinically diagnostic exercise testing (stress testing) must be conducted under the supervision of an appropriately qualified medical practitioner eg. cardiologist or a medical practitioner with appropriate training and experience; and with full resuscitation facilities available.

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Table 1
 ACSM GUIDELINES FOR EXERCISE TESTING AND PARTICIPATION

	APPARENTLY HEALTHY				HIGHER RISK	
	Younger ≤ 40 yrs (men) ≤ 50 yrs (women)	Older	No symptoms	Symptoms	With Disease	
Medical exam and diagnostic exercise test recommended prior to:						
Moderate exercise	No	No	No	Yes	Yes	Yes
Vigorous exercise	No	Yes	Yes	Yes	Yes	Yes
Physician supervision recommended during exercise test:						
Submaximal testing	No	No	No	Yes	Yes	Yes
Maximal testing	No	Yes	Yes	Yes	Yes	Yes

TABLE 2.

**PHYSICAL ACTIVITY READINESS
QUESTIONNAIRE ***

For most people, physical activity should not pose any problems or hazard. PAR-Q has been designed to identify the small number of adults for whom physical activity might be inappropriate or those who should have medical advice concerning the type of activity most suitable.

1. Has your doctor ever said you have heart trouble?
2. Do you frequently suffer from pains in your chest?
3. Do you often feel faint or have spells of severe dizziness?
4. Has a doctor ever said your blood pressure is too high?
5. Has a doctor ever told you that you have a bone or joint problem such as arthritis that has been aggravated by exercise, or might be made worse with exercise?
6. Is there a good physical reason not mentioned here why you should not follow an activity program even if you wanted to?
7. Are you over age 65 and not accustomed to vigorous exercise?

If a person answers yes to any question, vigorous exercise or exercise testing should be postponed. Medical clearance may be necessary.

* Reference: PAR-Q Validation Report. British Columbia Department of Health, June 1975 (Modified Version). (ACSM Guidelines p 37).

TABLE 3.

**RISK FACTOR CLASSIFICATION FOR FITNESS TESTING
AND EXERCISE PRESCRIPTION**

(modified from ACSM Guidelines for Exercise Testing and Prescription,
1991)

1. Diagnosed hypertension or systolic blood pressure > 140 or diastolic blood pressure > 90 mm Hg on at least two separate occasions, or on antihypertensive medication.
2. Serum cholesterol > 5.5 mmol.L⁻¹.
3. Serum triglyceride > 2.0 mmol.L⁻¹.
4. Cigarette smoking.
5. Diabetes mellitus. Individuals with insulin dependent diabetes mellitus (IDDM) who are over 30 years of age, or have had IDDM for > 15 years, and persons with non-insulin dependent diabetes mellitus (NIDDM) who are over 35 years of age are classified as "with disease" for the purpose of fitness testing and exercise prescription.
6. Family history of coronary or other atherosclerotic disease in parents or siblings prior to age 55.

TABLE 4.

**MAJOR SYMPTOMS OR SIGNS SUGGESTIVE OF
CARDIOPULMONARY OR METABOLIC DISEASE ***

1. Pain or discomfort in the chest or surrounding areas that appears to be ischemic in nature.
2. Unaccustomed shortness of breath or shortness of breath with mild exertion.
3. Dizziness or syncope.
4. Orthopnea/paroxysmal nocturnal dyspnea.
5. Ankle oedema.
6. Palpitations or tachycardia.
7. Claudication.
8. Known heart murmur.

* These symptoms must be interpreted in the clinical context in which they appear, since they are not all specific for cardiopulmonary or metabolic disease.(ACSM Guidelines p 6).

TABLE 5.

GENERAL HEALTH AND LIFESTYLE QUESTIONNAIRE

1. Does subject have medical clearance?
2. Did subject have a resting ECG? Was there any significant abnormality in resting ECG?
3. History and/or evidence suggestive of cardiopulmonary or metabolic disease?
 - Chest pain/discomfort particularly with exercise?
 - Undue and/or unaccustomed shortness of breath, particularly with exercise?
 - Dizziness, feeling faint, or syncope particularly with exercise?
 - Palpitations, "racing" or "missing" heart beats at rest or with exercise?
 - Known heart murmur?
 - Leg or calf pain with exercise (claudication)?
4. Are you at present on any blood pressure medication or has subject been on any such medication in the last 12 months?
5. Does subject have a family history of heart disease? (mother, father or first degree relative with history or death of heart disease - particularly prior to age 55 years?)
6. Does subject have any major coronary risk factors such as:
 - Smoking? (cigarettes)
 - Resting blood pressure? (>140/90 mm Hg)
 - Cholesterol? (> 5.5 mmol.L⁻¹).
 - and/or triglyceride? (> 2.0 mmol.L⁻¹).
7. Does subject have a history of:
 - High blood pressure?
 - Diabetes?
8. Does subject have a bone or a joint problem (such as damaged ligaments, or arthritis) which might be made worse by exercise?
9. Does subject have any physical or medical condition that would restrict him/ her from participating in physical activity? (eg. diabetes, pregnancy, severe asthma etc.).
10. Is subject obese? Quetelet Index (or Body Mass Index kg.m⁻²)>27 and/or Waist to Hip Ratio >0.85 females and >1.0 males.
11. Does subject regularly participate in aerobic activity? (eg. jogging or swimming 2 or 3 times a week for a minimum of 3 months).