DEVELOPMENT OF WORKPLACE HEALTH AND SAFETY FITNESS STANDARDS

FINAL REPORT

March, 1999

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Executive Summary

The Workplace Health and Safety Fitness Standards project had four purposes:

1. to examine the current physical fitness of QFRA operational firefighters
2. to establish the physical demands of firefighting
3. to suggest a series of work capacity tests able to be used to monitor the workplace health and physical fitness of QFRA operational personnel and recruits
4. to suggest workplace health and physical fitness standards aimed at maximising QFRA recruits, QFRA operational firefighters and the public's safety.

Current QFRA Physical Fitness Levels

Physical fitness tests on 81 operational firefighters from both Metropolitan and Central Queensland revealed that:

- QFRA operational firefighters possess higher body fat than age-matched Australians suggesting poor health status
- QFRA operational firefighters possess lower hip and lower back flexibility levels than age-matched Australians
- QFRA operational firefighters possess aerobic endurance levels equal to that of age-matched Australians despite being in an occupation that, at times, demands high levels of endurance

The Physical Demands of Firefighting

Heart rate monitoring of 35 metropolitan firefighters during HAZMAT simulations, Lytton Training Centre training exercises and a two-week period on shift revealed that:

- QFRA operational firefighters fire suppression activities are generally of low to medium intensity with periods of intermittent high intensity work periods
- The older and more at risk firefighters work at a higher percentage of their maximum heart rate than younger firefighters

Health and Physical Fitness Tests and Standards

Based on the following document, the following key recommendations are made to the QFRA "Fitness Committee" and QFRA Executive.

A. The QFRA appoint a Workplace Health and Fitness Coordinator (WHFC) with University qualifications in Human Movement Science or Health Promotion

B. Each QFRA region appoint an operational firefighter to act as regionally-based WHFC's with a minimum *Fitness Leader* qualification from the Queensland Fitness Accreditation Association

C. Each QFRA firestation appoint an operational firefighter to act as station-based WHFC's with a minimum *Fitness Leader* qualification from the Queensland Fitness Accreditation Association

D. The QFRA implement a statewide physical activity and wellness program

E. The QFRA WHFC's , under the guidance of the state QFRA WHFC, conduct twice yearly tests of the physical work capacity of operational firefighters.

F. The QFRA implement a battery of physical fitness tests similar to those used in the current project and follow the test guidleines outlined by Gore and Edwards (1992) in the attached booklet.

OR

G. The QFRA implement, **and maintain throughout a firefighter's operational lifetime**, the battery of work capacity tests used currently in QFRA recruit training or those recommended recently by the AFAC *Physical Performance Assessment for Firefighters* draft guidelines. If the current QFRA recruit tests are retained, it is recommended that the Multistage Fitness Test ("Beep Test") minimum benchmark be raised to Level 8: Shuttle 7 for all recruits in 2000 and gradually lifted to that same standard for operational firefighters by 2005.

H. The QFRA operational firefighters undertake, at QFRA expense, a medical assessment based on the Sports Medicine Australia - Australian Association for Exercise and Sports Science Guidelines attached (Appendix 3) every two years.

I. QFRA operational firefighters undertake, at QFRA expense, musculo-skeletal screening by trained physiotherapists every two years.

J. QFRA adopt a policy of no age or gender standards on all physical fitness tests.

K. If recommendation J above is not adopted, it is recommended that the test benchmarks be raised gradually over a 5-7 year period.

L. Failure of physical fitness tests be non-punitive in the short term with peer support, mentoring and station-based WHFC interventions encouraged over the long term.

M. Time on shift be allocated for physical activity or physical fitness activities, subject to such activities not affecting "callout" times.

It is appreciated that the above recommendations require a culture shift in the QFRA. However, it is the opinion of the author of this document that, based on a duty of care to both firefighters and the public, combined with a commitment to the long term health of its workforce, that the QFRA needs to implement the above recommendations with the full support of all stakeholders.

Introduction

Firefighting is at times a physically demanding occupation requiring high levels of aerobic fitness and both muscular strength and muscular endurance (Haisman, 1995). For both long term health and on-the-job firefighting effectiveness, aerobic fitness is an essential requirement of firefighting activities. These activities include long duration fire suppression activities and intermittent high intensity activities such as carrying equipment, climbing stairs, and pulling hoses. Such activities require the firefighter to recover quickly, minimise fatigue, and to maintain concentration under psychological and physical stress.

Muscular strength and muscular endurance are also critical for successful firefighting activities. For example, lifting and carrying hoses and pipes, breathing apparatus, removing debris, and carrying patients all require high levels of both upper and lower body muscle strength and endurance.

Purpose of the Project

The purpose of the current project was fourfold. First, to examine the current physical fitness standards of a sample of metropolitan and rural Queensland Fire and Rescue Authority (QFRA) personnel relative to an age-matched Australian population. Secondly, to establish the actual physical demands of firefighting through an analysis of work intensities in a variety of firefighting activities. Thirdly, to suggest a series of work capacity tests that should be used to regularly monitor the health and fitness of both QFRA recruits and operational firefighters. Finally, the project aims to suggest health and fitness standards that the QFRA should aspire to in order to maintain operational workplace health and safety efficiency.

It is the intention of this document to take the AFAC *Physical Performance Assessment for Firefighters* draft guidelines into consideration. Indeed the following document strongly supports the AFAC guidelines focus on the need for health monitoring, health promotion and rehabilitation strategies by strongly recommending the appointment of:

- A QFRA-appointed Workplace Health and Fitness Coordinator (WHFC) with University qualifications in Human Movement Science or Health Promotion
- Regionally-appointed operational firefighters to act as regionally-based WHFC's with a minimum *Fitness Leader* qualification from the Queensland Fitness Accreditation Association
- Station-appointed operational firefighters to act as station-based WHFC's with a minimum *Fitness Leader* qualification from the Queensland Fitness Accreditation Association

However, it is felt the AFAC guidelines have failed to address the issues of physical performance standards such as the exact standards expected. It is the intention of this document to fill this need.

PHASE 1: CURRENT FITNESS STANDARDS OF QFRA PERSONNEL

The purposes of phase 1 of the project were to:

a) determine the physical fitness of Queensland Firefighters relative to "normal" Australians of a similar age; and

b) determine maximal heart rates in a controlled laboratory setting in order to examine "on-the-job" work intensities as a percentage of the pre-determined maximum heart rates.

Two groups of QFRA operational firefighters were tested by university-trained personnel. Fifty Brisbane-based volunteers undertook a standard fitness test battery at the Human Performance Laboratory at The University of Queensland in late 1996. In late 1997, 31 Central Queensland firefighters from Mackay, Rockhampton, Gladstone and Bundaberg were tested on-site in air-conditioned settings.

In general, the battery of fitness tests implemented were those used to establish the Australian Fitness Norms (Gore & Edwards, 1992). The only exception to the Gore and Edwards (1992) testing protocol was the test of maximal aerobic power employed on the 50 Brisbane-based firefighters. These persons underwent a maximal graded exercise test (GXT) to exhaustion on a treadmill using gas analysis. This test was conducted under the supervision of Peter Reaburn PhD and a medical practitioner. The GXT was designed to establish maximal heart rates for each of the personnel involved in phase 2 of the project – analysing the work rates on-the-job in actual firefighting settings or while standing down at the fire station.

In order to establish the relative physical fitness levels of the 81 QFRA personnel involved with the project, the data collected was compared against the "normal" values obtained by Gore and Edwards in 1992.

A summary of the results of phase 1 appears over the page (Table 1) with individual test graphs appearing in Appendix 1.

Table 1: Results of physical fitness tests conducted on 50 Metropolitan QFRA personnel (City) and 31 Central Queensland QFRA personnel (CQ) with results compared to Australian (Aust) standards (Gore & Edwards, 1992).

Component	20-29 QFRA City	20-29 QFRA CQ	20-29 Aust	30-39 QFRA City	30-39 QFRA CQ	30-39 Aust	40-49 QFRA City	40-49 QFRA CQ	40-49 Aust	50-59 QFRA City	50-59 QFRA CQ**	50-59 Aust
Height (cm)	178.3	180.0	178.6	177.8	175.0	178.0	176.5	175.0	175.4	176.9	171.0	175.4
Weight (kg)	84.5	82.7	76.2	85.5	78.1	78.9	84.6	81.2	79.7	86.9	95.4	80.6
BMI (kg/m^2)	26.5	25.7	23.9	26.9	25.3	24.9	27.3	26.4	25.9	27.8	32.8	26.2
Blood Pressure (mm Hg)#	129/78	120/75	< 140/85	132/81	123/76	< 140/85	132/83	123/79	< 140/85	131/81	175/105	< 140/85
Skinfolds (mm)	88.0	82.4	71.7	92.6	79.7	84.4	93.3	96.1	92.2	103.3	152.2	89.3
Waist : Hip	0.85	0.83	0.86	0.89	0.83	0.90	0.92	0.89	0.92	0.94	0.94	0.94
Grip Strength (kg)	53.0	47	50.0	50.2	45.1	51.6	47.7	49.2	49.4	48.2	47.0	46.3
Abdom Strength	4.2	4.0	3.4	3.7	3.9	2.9	3.2	2.8	2.4	1.9	2.0	2.2
Sit & Reach (cm)	25.6	30.5	43.4	21.2	32.9	42.7	29.0	20.5	40.5	27.7	20.5	37.8
VO_2max (ml/kg)	47.8	42.7	45.5	44.0	39.2	41.5	39.7	34.8	37.9	33.3	29.0	33.6

** Only one (1) person tested

Australian standards given are National Heart Foundation recommendations for blood pressure

In summary, the results of Phase 1 physical fitness testing strongly suggest that:

a) Queensland firefighters are, for their age, heavier then "normal" Australians;
b) Metropolitan firefighters are, for heavier than their Central Queensland counterparts;
c) Queensland firefighters possess a higher Body Mass Index (a marker of weight for height and a strong indicator of morbidity) than "normal" Australians;
d) Metropolitan firefighters possess a higher Body Mass Index their Central Queensland counterparts;
e) Queensland firefighters possess a higher body fat (a strong indicator of morbidity) than "normal" Australians;
f) Queensland firefighters possess greater abdominal strength than "normal" Australians;
g) Queensland firefighters possess poorer hip and lower back flexibility than "normal" Australians; and crucially,
h) Queensland firefighters possess maximal aerobic power values no better than "normal" Australians.

A strong relationship exists between high body fat and poor health (Norton & Olds, 1996). Moreover, poor hip/lower back flexibility and low abdominal strength have been related to lower back injury (Gore & Edwards, 1992). Finally, high levels of aerobic fitness positively affects both firefighting performance and general health (Haisman, 1995).

The above physical fitness test results of QFRA operational firefighters showed high levels of body fat, poor hamstring and lower back flexibility, poor abdominal strength and aerobic fitness levels only equal to that of "normal" Australians. These results strongly suggest the need for both a physical fitness and wellness program within the QFRA.

A program should involve:

- an educational role (nutrition, stress management etc.)
- regular monitoring of physical fitness of each operational firefighter
- regular monitoring of general health
- time available on shift for physical activity and training

Development of such a program demands the appointment of state-level, and both regional- and station-based Workplace Health and Physical Fitness Coordinators. Furthermore, appointment of such personnel demonstrates both a commitment to firefighter wellness and a duty of care to all operational firefighters.

PHASE 2: EVALUATION OF THE PHYSICAL DEMANDS OF FIREFIGHTING

In order to evaluate the physical demands of firefighting a sample of volunteers from the original 50 metropolitan firefighters tested at The University of Queensland volunteered to wear *Polar* heart rate monitors continuously during training exercises at the *HAZMAT* facility in Brisbane, undertaking training at the Lytton Training Centre, and while on shift at their individual firestations.

Heart rates are commonly used in exercise science as a non-invasive measure of aerobic work intensity (Ali & Farrally, 1991; McArdle, Katch & Katch, 1996). This is due to their being a linear relationship between heart rate and oxygen consumption and heart rate and workload (Astrand & Rodahl, 1986). Furthermore, a number of previous overseas studies have used heart rates to measure firefighting work intensity and stress levels (Gledhill & Jamnik, 1992; David et al., 1991; Kamal et al., 1991; Scott, 1988).

The heart rate monitors were attached to the chests of each firefighter who was shown by trained university-trained personnel how to use the device. Heart rates were collected automatically via a chest-mounted transmitter and wrist watch receiver worn by each firefighter. Watches were then collected and the heart rates downloaded onto a computer for analysis of work intensities relative to the previously determined maximum heart rates. Historically, maximal heart rates have been determined using the formula 220-age (Astrand & Rodahl, 1986; Gore & Edwards, 1992). The maximal exercise tests conducted at The University of Queensland under medical supervision revealed that the individual maximal heart rates (MHR) were different to those estimated using the formula above (Table 2).

Table 2: Estimated (220-age) and actual measured maximal heart rates (MHR) of 50 QFRA personnel determined using a maximal treadmill test under medical supervision.

Age Group (yr)	Mean Age (yr)	Estimated MHR	Measured MHR
20-29	27.2	193	196
30-39	34.3	186	191
40-49	45.0	175	170
50-59	53.2	167	170

For the purpose of this project, the measured heart rates were divided into four heart rate zones:

- Low (< 75% MHR)
- Moderate (75-85% MHR)
- High (85-95% MHR)
- Maximum (>95% MHR)

1) *Wearing BA at HAZMAT*

Twenty-two of the original 50 firefighters had heart rates monitored at 15-second intervals during a standard simulation within an unlit, heated and humidified (35 degree WBGT), smoke-filled, four-story training facility. Each of the firefighters was dressed in full 'turnout' gear after which BA was donned and a training exercise commenced. The exercise was approximately 23 minutes long and involved a combination of climbing stairs, crawling through tunnels, and ascending and descending ladders in a confined space.

The results of the simulation appear in Table 3 below and suggest that while most of the training exercise was conducted in the low heart rate zone, there were periods of moderate, high and maximum work intensities.

Table 3. Percentages of heart rates spent in each training zone during the HAZMAT simulation.

Heart Rate Zone	% of Time
Low	57.6
Moderate	24.7
High	14.4
Maximum	2.2

The above results strongly suggests that firefighting is intermittent in nature with periods of low intensity work interspersed with periods of high work intensities. A high aerobic fitness level for QFRA personnel will not only allow firefighters to better cope with these periods of high intensity work but, importantly, recover more quickly from the hard work, reduce fatigue, improve concentration and enhance the ability to make decisions when fatigued.

The average heart rates during the simulation were also averaged for each age group and expressed as a percentage of previously determined maximal heart rate (Figure 1 below).

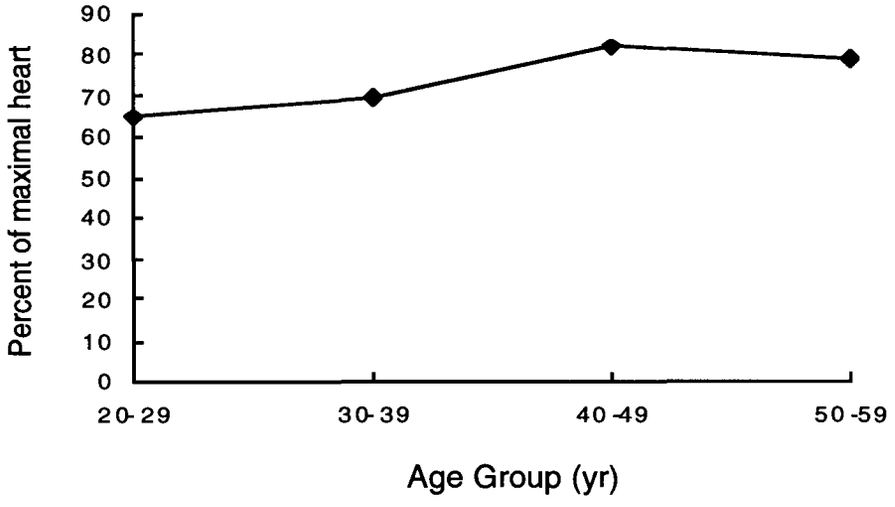

Figure 1. Average heart rates (% MHR) during training simulation for each age group.

The results suggest that as the firefighters age, they are working at a higher percentage of their heart rate. Previous research on older exercisers strongly supports this finding (Reaburn et al., 1994). This is due to an observed age-related decrease in aerobic capacity leading to a higher heart rate in older persons for any set work rate such as that experienced during the training exercise above.

When the highest heart rates recorded during the training exercise were expressed as a percentage of MHR for each age group were graphed, a similar pattern of increasing workloads with age was observed (Figure 2)

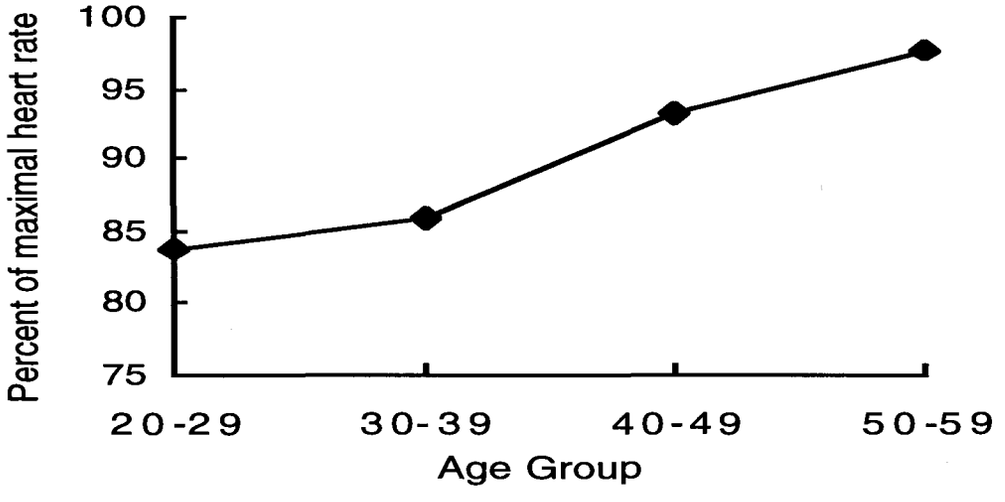

Figure 2: Highest heart rates recorded during simulations as a percentage of maximum heart rates for each age group.

These results suggest that the older firefighter is more at risk during high intensity firefighting activities as they may be working at a much higher relative intensity despite being more at risk of coronary heart disease due to increased age, increased body fat and reduced aerobic fitness.

2) *Firefighting Simulations at Lytton Training Centre*

Heart rate monitoring was undertaken during a number of firefighting simulations at the QFRA Training centre at Lytton with ten of the original 50 QFRA volunteers from a range of age groups taking part. As with the HAZMAT simulations, heart rates were collected at 15-second intervals, downloaded onto a computer and divided into zones as above. The results appear in Table 4 below.

Table 4: Percentages of heart rates spent in each training zone during the Lytton Training Centre simulations.

Heart Rate Zone	% of Time
Low	38.5
Moderate	40
High	20
Maximum	1.5

Again, the results from the Lytton Training Centre study suggest the majority of fire suppression activities involves low to moderate work intensities interspersed with periods of high to maximum work intensities. These results confirm the earlier finding during the HAZMAT simulations.

Taken together, these results strongly suggest that a high aerobic fitness level is required by QFRA personnel in order to meet the demands of firefighting. A high aerobic fitness level will not only allow firefighters to better cope with periods of high intensity work but more importantly recover quickly from periods of high intensity work, reduce fatigue during firefighting, but will improve concentration and enhance the ability to make decisions when fatigued.

3) *"On shift" at each volunteer's station.*

The final method used to assess work intensities during firefighting was to give heart rate monitors to 35 QFRA personnel randomly chosen from the original 50 test volunteers. The heart rate monitors were worn on shift for a period of two-three weeks. The monitors recorded heart rates over each shift. These heart rates were then downloaded to a computer through a computer interface unit to produce the results below (Table 5).

Table 5. Percentages of heart rates spent in each training zone during "On Shift" work.

Heart Rate Zone	% of Time
Low	90
Moderate	2.5
High	6
Maximum	1.5

While a number of "turnouts" were experienced during this time, no "jobs" were experienced, thus preventing any conclusive evidence being drawn from the findings. However, previous studies examining work intensities in firefighters during summer bushfires and using hand tools (Budd et al., 1995) suggest a moderate work intensity of 152±14 bpm as the average work intensity. This equates to approximately 74±9% of the firefighters aerobic capacity and is in agreement with a previous study undertaken during urban firefighting duties (Sothmann et al., 1992). Indeed, Sothmann and others (1992) collected heart rate data during actual firefighting emergencies and observed that firefighters worked at a work intensity of 88±6% of MHR, similar to those observed during the HAZMAT simulations.

In summary, the data collected from Phase 2 of the project (Evaluating the physical demands of firefighting) strongly suggests that the aerobic system is a major contributor to energy production during fire suppression activities. This is supported by both the heart rates recorded during this study and previous research where heart rates were monitored during actual firefighting emergencies.

Of concern is that the results of the fitness tests undertaken on 81 QFRA volunteers in this project suggests that the aerobic fitness of current QFRA personnel is only similar to "normal" Australians. That is, it is not commensurate with the aerobic fitness levels required for the demands of firefighting which can demand long periods of physical work, high intensity intermittent work requiring quick recovery, and an ability to maintain mental concentration and minimise fatigue.

Thus, it again is strongly recommended that the QFRA examine the possibility of implementing a statewide physical fitness and wellness program aimed at improving the health and physical fitness of QFRA operational personnel. Development of a QFRA Wellness Program would demand the employment of a centrally-located, ideally University-educated Workplace Health And Physical Fitness co-ordinator. The Workplace Health And Physical Fitness Co-Ordinator would be responsible for monitoring the physical fitness and general health of all operational firefighters, developing a statewide wellness educational program, and coordinating these programs with both region- and station-appointed Workplace Health and Fitness Coordinators.

PHASE 3: SUGGESTED PHYSICAL FITNESS AND HEALTH MONITORING TESTS

A number of options are available to regularly monitor the physical fitness of QFRA operational firefighters. These are:

a) Implement annual non-specific physical fitness testing using the complete battery of tests used in this project (Gore & Edwards, 1992 – Appendix 2) in order to compare the physical fitness of QFRA personnel to "normal" Australians. These tests separately measure the physical fitness capacities used in firefighting (aerobic endurance, strength etc) but not using tests specific to the task of firefighting. The benefit of such tests are they are standardised. However, they require trained personnel and specialised equipment to implement. Such testing demands a QFRA centrally-appointed University graduate to implement.

b) Implement and maintain annual physical fitness testing that is currently used during recruit training only. These tests include:

- Ladder Climb
- Beam Walk
- Tunnel Crawl
- Hose Coupling
- Ladder Raise and Lower
- Hose Drag, Advance & Hold
- Tower Climb and Container Haul
- Victim Rescue
- Multistage Fitness Test

Each of the suggested tests measures job-specific fitness while undertaking actual firefighting tasks. It is recommended that such tests be implemented twice annually throughout a firefighters operational life.

The only change recommended to the tests listed above is to raise the current level expected for the Multistage Fitness Test to Level 8: Shuttle 7. Previous research has suggested that an aerobic power level of 42 mls O_2/kg/min is required during firefighting activities (see Hiasman, 1995 for review). The Multistage Fitness Test level required to achieve this level of aerobic power is Level 8: Shuttle 7 (Leger et al., 1988).

As suggested below, it is recommended that, every two years, each QFRA firefighter undertake a medical assessment based on the Sports Medicine Australia / Australian Association for Exercise and Sports Science guidelines attached (Appendix 3). Briefly, these suggest that males over 35 years (females over 45 years) with one or more cardiac risk factor (BP>140/90, Cholesterol > 5.5 mmol.L^{-1}, triglycerides > 2.0 mmol.L^{-1}, smoking, diabetes or family history of cardiac disease) should be screened by a medical practitioner prior to embarking on vigorous exercise such as firefighting or the proposed aerobic tests.

Below is a Table that summarises the advantages and disadvantages of either Job-Related Tests (dummy drag etc) or physical fitness capacity tests. Discussions with existing QFRA personnel and observations from reading overseas literature, would suggest the physical fitness capacity tests are the preferred method of testing physical fitness.

TEST	ADVANTAGES	DISADVANTAGES
Job-Related Tests (eg. hose pulling, stand carrying, dummy drag)	• Mimic firefighting work	• Seen by firefighters as "more training" • Favours more skilled and experienced firefighter • Difficult to set-up and control • Tests strength, endurance and anaerobic capacity as one entity without separating them • Difficult to train for at the station or in own time • Recruits won't have equipment to train
Fitness Capacity Tests (eg "beep test", push-ups, girth tape measures)	• Easily implemented at station level • Easier to train for both current and prospective personnel • allow self monitoring • Minimal skill required • Minimal equipment required • Tests physical capacities needed in firefighting (endurance, speed, strength, strength endurance)	• Doesn't actually test firefighting fitness • Tests physical capacities needed in firefighting as separate capacities rather than as a whole

The Need for Annual Medical Tests

In keeping with the AFAC guidelines, it is strongly recommended that a regular medical examination be undertaken by a qualified medical practitioner. Such examinations are based on workplace health and safety issues such as duty of care and overall firefighting staff wellness considerations. Medical examinations should be conducted prior to the initial fitness test and then every two years following. It is recommended that the costs of these tests for

current staff should be covered by the QFRA. It is recommended that recruits cover the costs of the medical examination themselves.

The medical examination recommended is similar to the Medical Standards expected for QFRA recruitment. Again, as with the need for physical fitness tests, it is recommended that such medical examinations be undertaken not only during the recruitment phase, but maintained every two years during operational service with the QFRA.

The medical examination recommended is based on existing and well accepted standard guidelines (Sports Medicine Australia and Australian Association for Exercise and Sports Science, 1994 - *Guideline 6 for Supervision of Fitness Testing*) (Appendix 3)

The medical exam must be undertaken by a qualified medical practitioner and should include tests of the following:

- *Coronary risk factors*:
    * Smoking
    * Resting blood pressure >140/90 mm Hg or on antihypertensive medication
    * Cholesterol (>5.5 mmol/L)
    * Triglyceride (>2.0 mmol/L)
    * Diabetes mellitus. Individuals with insulin dependent diabetes mellitus (IDDM) who are over 30 years of age or have had IDDM for longer than 15 years, and those with non-insulin dependent diabetes mellitus (NIDDM) who are over 35 years of age.
    * Family history of coronary or other atherosclerotic disease in parents or siblings prior to age 55.

- *Major symptoms or signs suggestive of cardiopulmonary or metabolic disease*
    * Pain or discomfort in the chest or surrounding areas that appears ischaemic in nature.
    * Unaccustomed shortness of breath or shortness of breath with mild exertion
    * Dizziness or syncope (fainting)
    * Orthopnea (difficulty breathing when lying flat) / paroxysmal dyspnea (breathlessness attacks during sleep)
    * Ankle oedema (swelling)
    * Palpitations or tachycardia

* Claudication (limping or pain in the leg or calf bought on by poor blood supply)
* Known heart murmur

- *Measure of obesity*

  * Body Mass Index (kg / m^2) of greater than 27 and / or a Waist to Hip Ratio of greater than 0.85 in females or greater than 0.95 in males.

- *Any other condition that may restrict his or her involvement in physical activity*

  * Pregnancy
  * Bone or joint problem (arthritis or damaged ligaments) that may be made worse by exercise
  * Severe asthma
  * Palpable mass or hernia

- *Respiratory system*

  * Peak flow rate or FEV (Forced Expiratory Volume) within 25% of predicted value for age, gender and height.

- *Vision*

  * Is visual correction for distance required?
  * Standard Snellen Chart at six (6) metres with and without correction (glasses / contact lenses)
  * Colour Vision by Isiharra test

- *Hearing*

  * Any abnormality of auditory canals, eustachian tubes or ear drums
  * Can hear conversational voice at two (2) metres

If the suggested medical screening protocol above is unacceptable to the QFRA for financial or other reasons, the minimum requirement is that the Workplace Health and Fitness Coordinators complete a screening of *Coronary risk factors* including:

* Smoking
* Resting blood pressure >140/90 mm Hg or on antihypertensive medication
* Cholesterol (>5.5 mmol/L)
* Triglyceride (>2.0 mmol/L)
* Diabetes mellitus. Individuals with insulin dependent diabetes mellitus (IDDM) who are over 30 years of age or have had IDDM for longer than 15 years, and those with non-insulin dependent diabetes mellitus (NIDDM) who are over 35 years of age.
* Family history of coronary or other atherosclerotic disease in parents or siblings prior to age 55.

If the Workplace Health and Fitness Coordinator has concerns then follow-up by medical practitioners at a regional level is recommended.

Musculo-Skeletal Screening

Examination of Workcover data (Richardson, Personal Communication, 1998) strongly suggests numerous musculo-skeletal injuries (strains, sprains, hernias) within QFRA personnel. Prior to the initial fitness tests and following the medical examination, a physiotherapist is recommended to conduct a musculo-skeletal screening of operational firefighters every two years.

All firefighters require strength to lift, push and pull, and flexibility, particularly in the lower back, to manoeuvre in confined spaces. Lifting and manhandling heavy equipment, as well as twisting and turning in confined spaces, require a great deal of trunk stability together with strength and flexibility in the trunk, lower back and both limbs. A full musculo-skeletal screening by a qualified physiotherapist is essential for each firefighter to:

- objectively identify individual weaknesses in strength and flexibility related to firefighting tasks
- help treat and / or prevent lower back and lifting-related injuries
- enable potential injuries to be identified given these individual weaknesses enable preventative exercises (strength and flexibility) to be prescribed for each individual candidate by a trained professional.

Specifically, it is recommended, from both an occupational health and safety and work-related fitness point of view, that the physiotherapist should screen the following:

- abdominal strength and stability
- lower back and gluteal strength
- shoulder girdle strength (rotator cuff and scapula stabilisers)
- posture
- job-specific flexibility (Lower back, neck, hamstrings, trunk, and neural in particular)

Cost of such a visit would be approximately $50 / firefighter with a possible follow-up visit required and paid for by QFRA if recommended by the physiotherapist.

The QFRA should cover the costs of both the medical examination by a doctor and the musculo-skeletal screening by a physiotherapist, as well as one follow-up visit to the physiotherapist if needed (total cost $150-200 / person / two years).

Age and Gender Issues

While this may be a policy issue to be discussed at a higher level, I strongly recommend that the proposed fitness tests above should assess a person's ability to complete a physical task, regardless of gender or age.

If it is decided to introduce fitness capacity tests, then the issue of age-related standards must be addressed. For example, previous research has suggested that fire suppression activities require an aerobic capacity of between 42 and 45 millilitres of oxygen for every kilogram of body weight per minute (Haisman, 1995). Such a capacity can be easily measured using the "beep test" with Level 8, Shuttle 7 or above giving this aerobic capacity. However, compared to "normal" Australians, a level of 42-45 ml/kg/min for males is average for 18-29 yr olds, average to above average for 30-39 yr olds, above average for 40-49 yr olds and excellent for 50 plus year olds. This is due to an age-related decline in aerobic capacity. It could thus be argued that implementing one standard for all, regardless of age (or gender), discriminates against older firefighters (and females who have a lower aerobic capacity than males of the same age).

Firefighters, regardless of age, need to be able to successfully and safely complete a task, regardless of age. Not being able to safely and efficiently complete a fire and / or rescue task due to poor aerobic fitness places the public, property and fellow firefighters at risk of both personal damage and litigation. It is recommended that NO age-related standards be introduced in the proposed test batteries but need policy support in such a recommendation.

If age- and gender-standards are to be developed, they must be developed by AFAC nationally or the QFRA Workplace Health and Fitness Coordinator or Fitness Committee in consultation with exercise professionals. The benchmark standards should be reviewed annually and gradually lifted over a five (5) to seven (7) year period.

Failure of Tests

Initially, it is strongly recommended that failure of the physical fitness tests be non-punitive in the short term.

Ideally, it would be recommended that operational QFRA personnel that fail the physical fitness tests be given a period of six (6) weeks to train for and successfully complete the fitness test. Six weeks is a long enough time period to see training adaptations without jeopardising operational efficiency. It is hoped that the QFRA monitor the physical fitness standards of all operational firefighters and annually review and lift the benchmark standards over time.

Another option may be the need for the Workplace Health and Fitness Coordinators to establish an individualised contract with personnel who fail the physical fitness tests. Moreover, a peer support program might be put in place with the station-based and district-based Workplace Health and Fitness Coordinators working together to ensure firefighters who fail the test are given support. A decision needs to be made at a policy level regarding repeat failures of the fitness tests.

How often to test?

It is recommended that the physical fitness tests should be conducted twice per year to keep the issue of physical fitness high on the agenda of all operational firefighters. Furthermore, it is recommended that the medical examinations and physiotherapy screenings take place initially in the first year and then every two years.

Workplace Health and Fitness Coordinators

It is strongly recommended that the QFRA appoint a Workplace Health and Fitness Coordinator at a state level to:

- Implement a statewide physical fitness testing program
- Monitor the benchmark standards for physical fitness tests
- Coordinate the development of a statewide health education program (nutrition, lifestyle education – quit smoking, stress management etc)
- Collate the physical fitness test and medical examination results

- Work with regionally-appointed and station-appointed Workplace Health and Fitness Coordinators in implementation of the above.

It is strongly recommended that the state-appointed WHFC be a University graduate in Human Movement Science or equivalent

It is further recommended that each region and station appoint an operational firefighter as workplace health and fitness coordinator whose responsibilities it will be to:

- Implement the fitness tests using a standardised method
- Forward results to the state-appointed WHFC coordinator
- Facilitate and encourage physical training and wellness within each station and the QFRA as a whole.

The state-appointed Workplace Health and Fitness Coordinator has the responsibility of training regional and station-based WHFC's in test implementation, result collation, physical training principles and, importantly, health and lifestyle issues.

Both the regional and station-based Workplace Health and Fitness Coordinators should have a minimum qualification of Fitness Leader from the Queensland Fitness Accreditation Association or other states equivalent.

Time On Shift For Physical Activity

It is strongly recommended that time should be allocated on shift for physical activity and physical training, subject to such activities not affecting 'callout' times. Such activities could be directed by the station-based WHFC and would not only strongly contribute to improved work performance and job safety, but staff morale. Thought must also be given to the issue of Worker's Compensation if an injury occurs during such activity, particularly given that the staff will be undertaking physical training for work performance.

Conclusion

In summary, the present study strongly suggests that QFRA operational firefighters are no "fitter" than the "normal" Australian. However, data from the present study also suggests that fire suppression activities demand a higher level of aerobic fitness than seen in current QFRA personnel. It is therefore recommended that the QFRA implement a statewide physical activity and wellness program under the direction of a University-trained Workplace Health and Physical Fitness Coordinator. The key features of such a program should include:

- Twice yearly physical fitness testing using standard physical fitness tests or work-related tests.

- Monitoring of QFRA operational firefighter's health through both medical examinations by medical practitioners and musculo-skeletal screening by physiotherapists every two years.
- Time on shift allocated for physical activity and physical training.

References

These are available from the author upon request.

APPENDIX 1
Physical Fitness Test Results

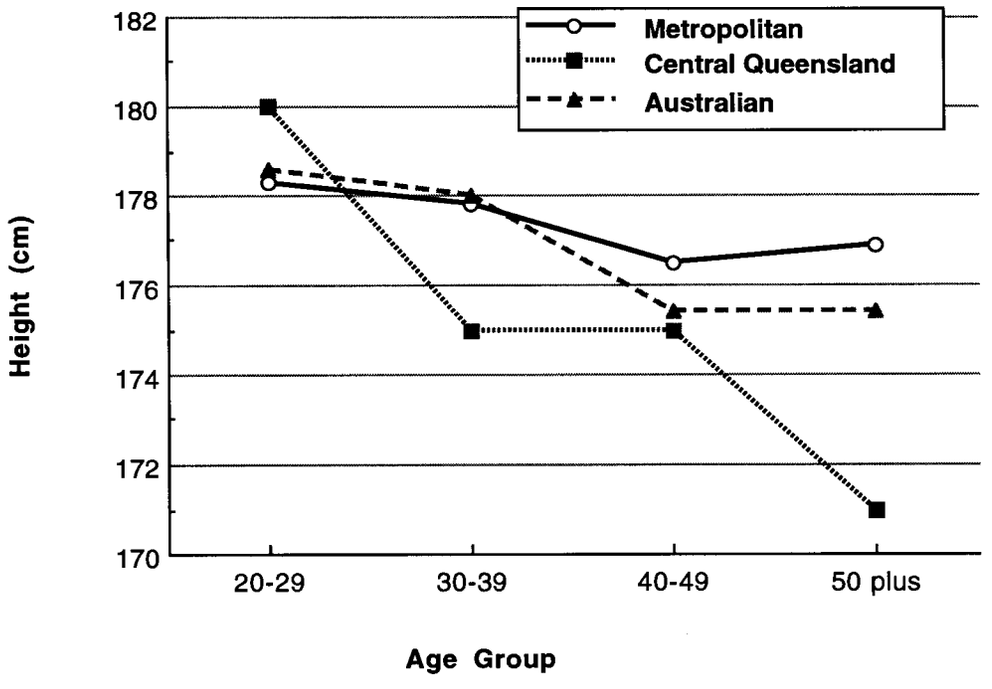

Figure 1: Height (cm) of 81 QFRA personnel (50 Metropolitan and 31 Central Queensland) by age and location compared to Australian standards (Gore & Edwards, 1992).

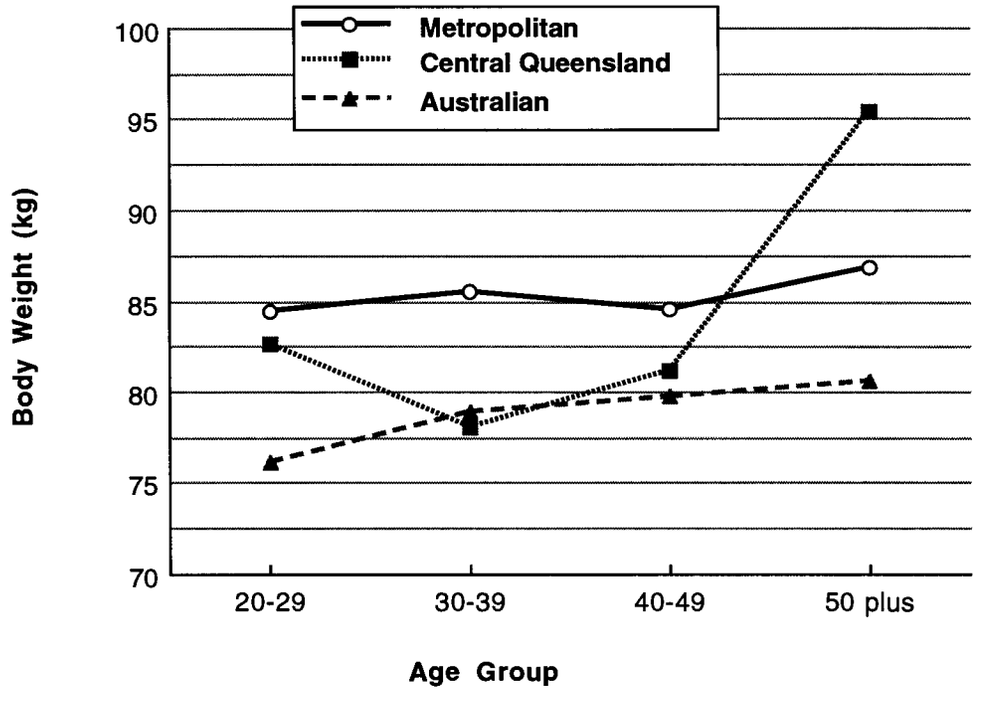

Figure 2: Body weights (kg) of 81 QFRA personnel (50 Metropolitan and 31 Central Queensland) by age and location compared to Australian standards (Gore & Edwards, 1992).

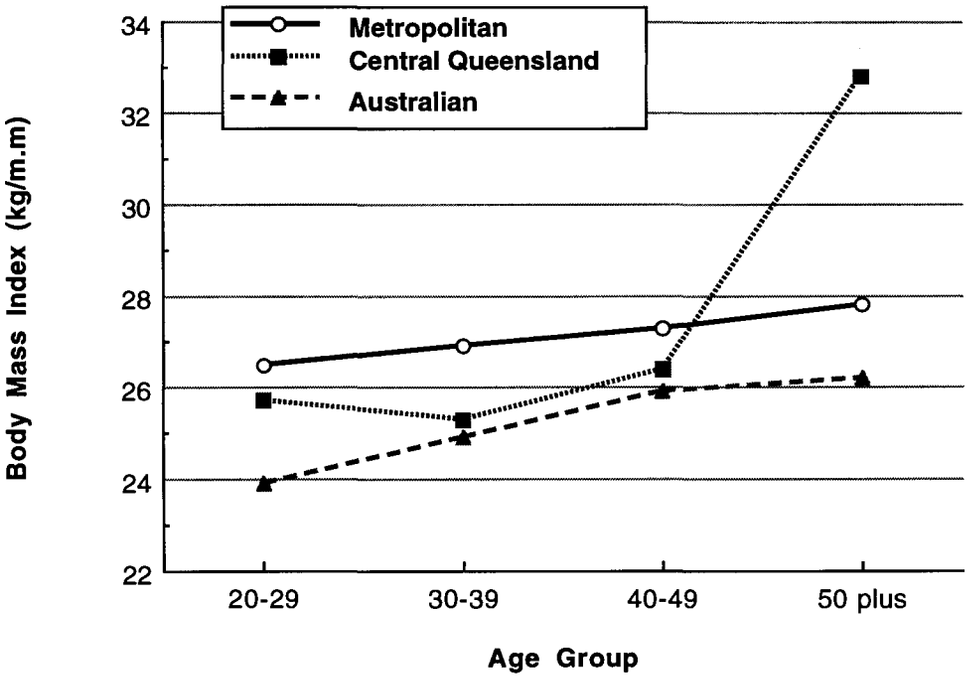

Figure 3: Body Mass Index (kg/m^2) of 81 QFRA personnel (50 Metropolitan and 31 Central Queensland) by age and location compared to Australian standards (Gore & Edwards, 1992). The lower the Body Mass Index the better.

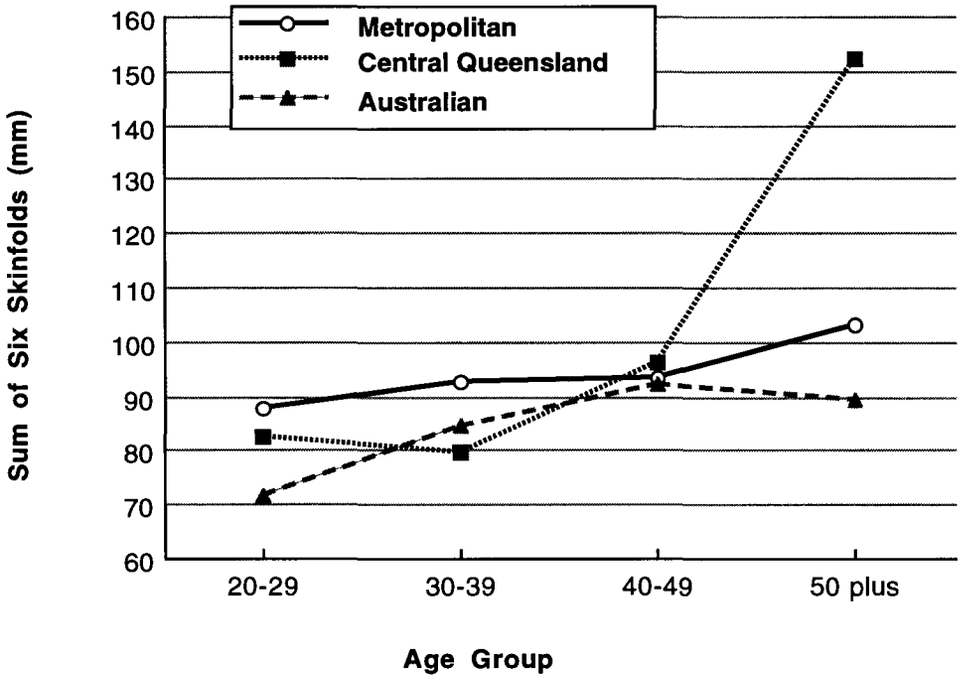

Figure 4: Sum of six skinfolds (mm) of 81 QFRA personnel (50 Metropolitan and 31 Central Queensland) by age and location compared to Australian standards (Gore & Edwards, 1992). The lower the skinfold total the better.

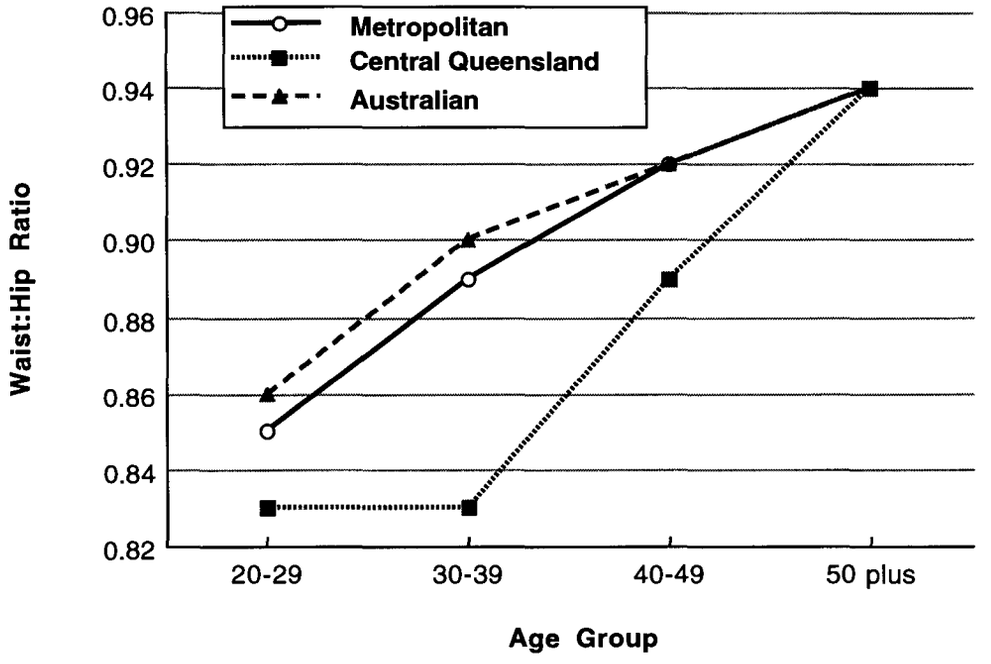

Figure 5: Waist : Hip Ratio of 81 QFRA personnel (50 Metropolitan and 31 Central Queensland) by age and location compared to Australian standards (Gore & Edwards, 1992). The lower the waist:hip ratio the better.

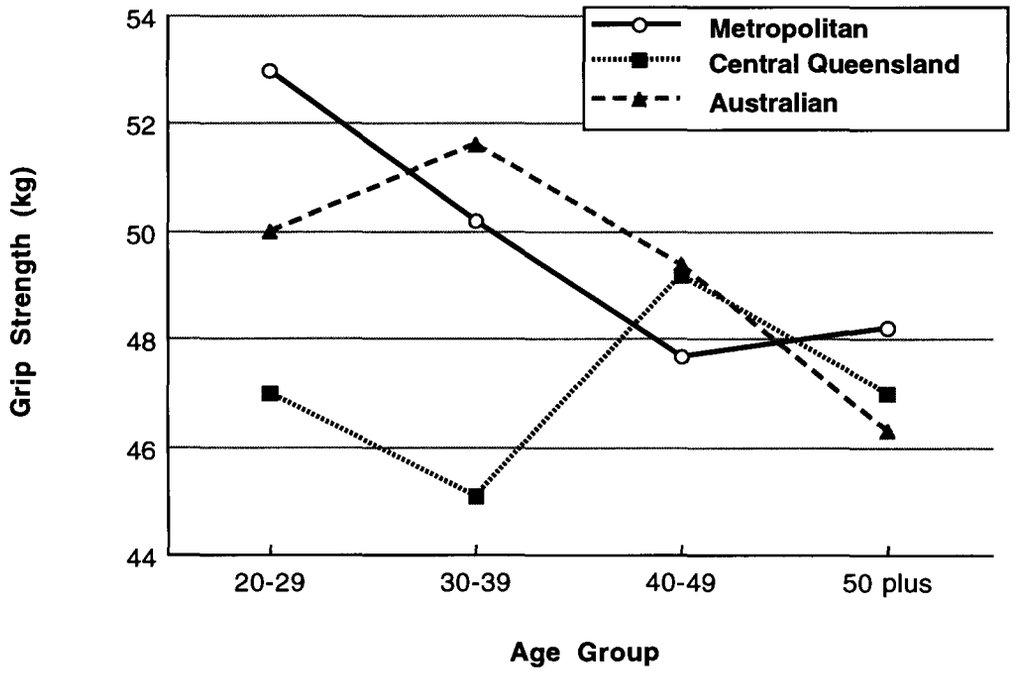

Figure 6: Grip strength (kg) of 81 QFRA personnel (50 Metropolitan and 31 Central Queensland) by age and location compared to Australian standards (Gore & Edwards, 1992). The higher the grip strength the better.

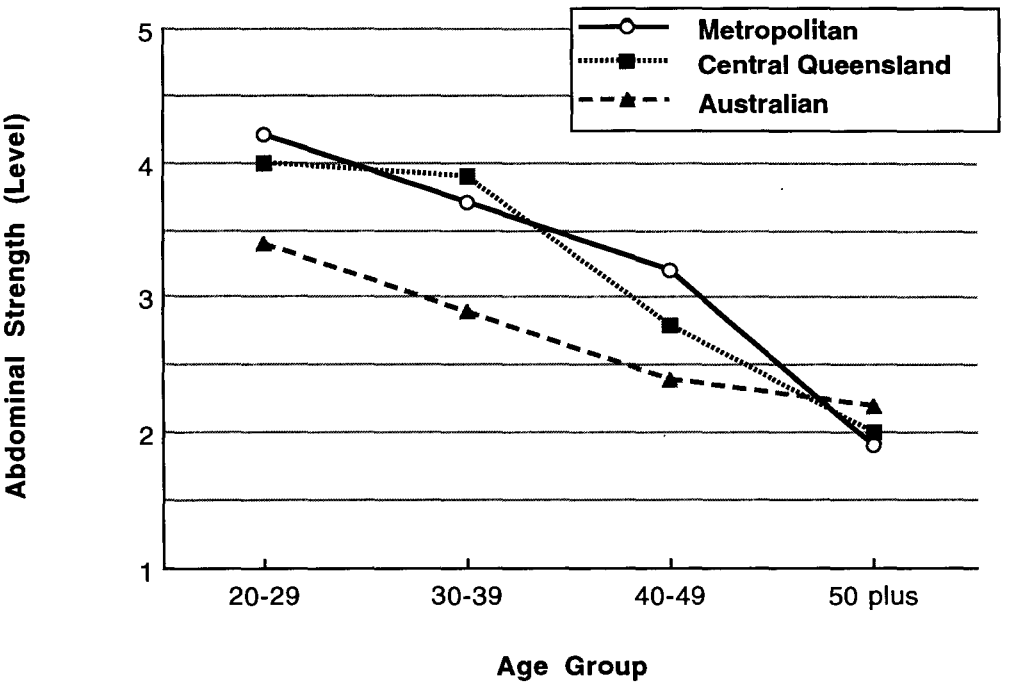

Figure 7: Abdominal strength (level) of 81 QFRA personnel (50 Metropolitan and 31 Central Queensland) by age and location compared to Australian standards (Gore & Edwards, 1992). The higher the abdominal strength the better.

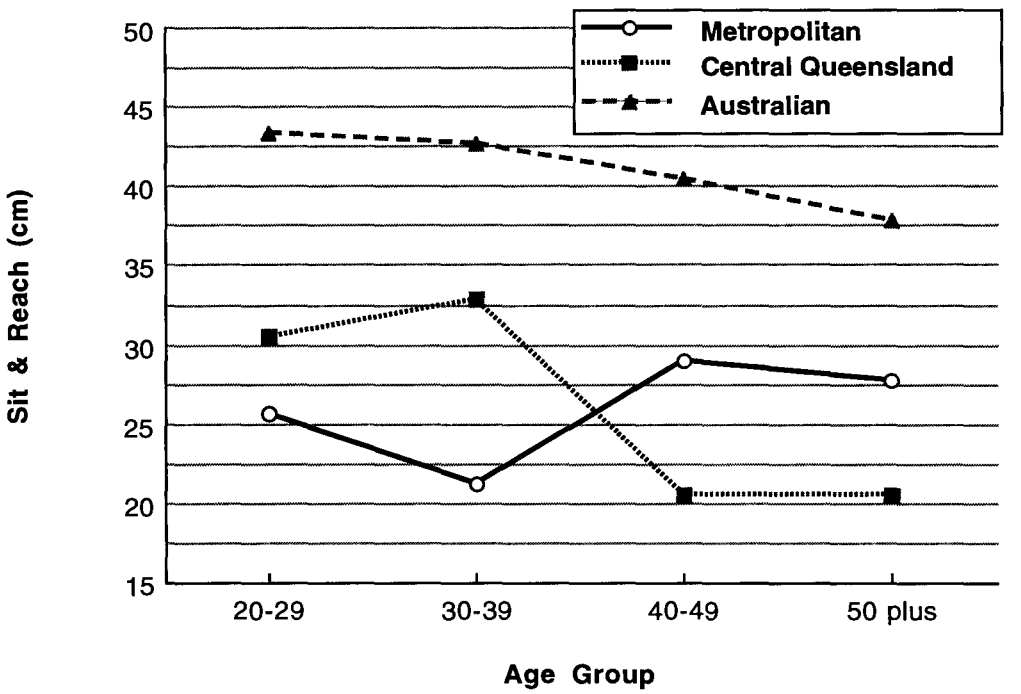

Figure 8: Sit and Reach flexibility test (cm) of 81 QFRA personnel (50 Metropolitan and 31 Central Queensland) by age and location compared to Australian standards (Gore & Edwards, 1992). The higher the sit and reach score the better.

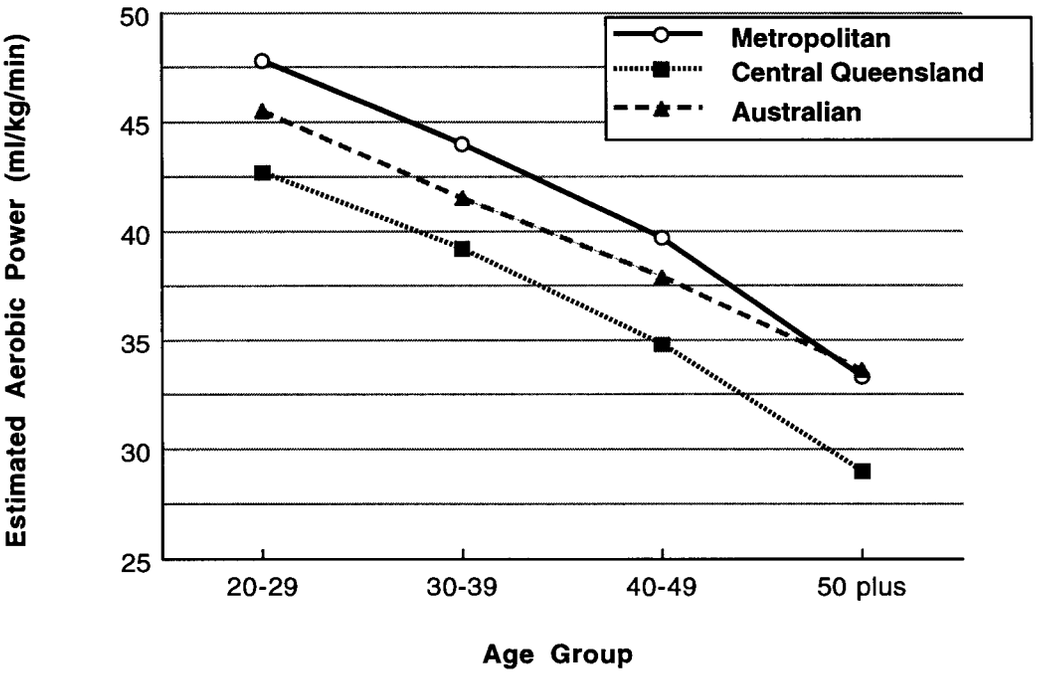

Figure 9: Maximal aerobic power (ml/kg/min) of 81 QFRA personnel (50 Metropolitan and 31 Central Queensland) by age and location compared to Australian standards (Gore & Edwards, 1992). The higher the score the better for work performance and general health.

APPENDIX 2

Details on Gore & Edwards (1992)

AUSTRALIAN

FITNESS NORMS

A Manual for Fitness Assessors

The Health Development Foundation

First published 1992 by
The Health Development Foundation
8th floor, Samuel Way Building
Adelaide Children's Hospital
72 King William Road
North Adelaide SA 5006

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Acknowledgements:
This manual was prepared with permission from the Commonwealth Department of the Arts, Sport, the Environment and Territories to access the data from the 1991 Pilot Survey of the Fitness of Australians.

The percentile tables included in this manual would not have been possible without the planning and scientific management of Dr Neville Owen of the Department of Community Medicine at the University of Adelaide and Dr Adrian Bauman of the Department of Public Health at the University of Sydney. Nor could they have been produced without the work of Arul Mylvaganam, who designed and co-ordinated the data entry systems, and Dr Michael Booth, who conducted the analyses.

A special thank you to Associate Professor Garry Scroop, Mr Peter Vanderpeer, Dr Bob Withers and Ms Nancy Whittingham for providing editorial comment and advice.

Thank you also to Yvonne Deegan, Christine Morris, Helen Smith and Peter Wilson, who acted as models for the illustrations.

This manual was written and compiled by Dr Christopher J Gore, Senior Project Officer on the Pilot Survey, and David A Edwards, Field Staff Co-ordinator for the Pilot Survey.

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Word Processing by Ilona Mann and Lyla Howley

National Library of Australia
ISBN 0 7038 1992 2

HDF Catalogue Number F400B

APPENDIX 3

Guideline 6 (SMA / AAESS)

Supervision of Fitness Testing (Cardiorespiratory Endurance)

Guideline Six

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/AAESS 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_2max) 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-age).

Moderate exercise includes activities at an intensity equivalent to 40-60% VO_2max which are within the individual's current exercise capacity and can be comfortably sustained for an extended period of time (eg. 60 min).

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
- claudicaton
- 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 progammes 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.

REFERENCES

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Approved for release February 1994
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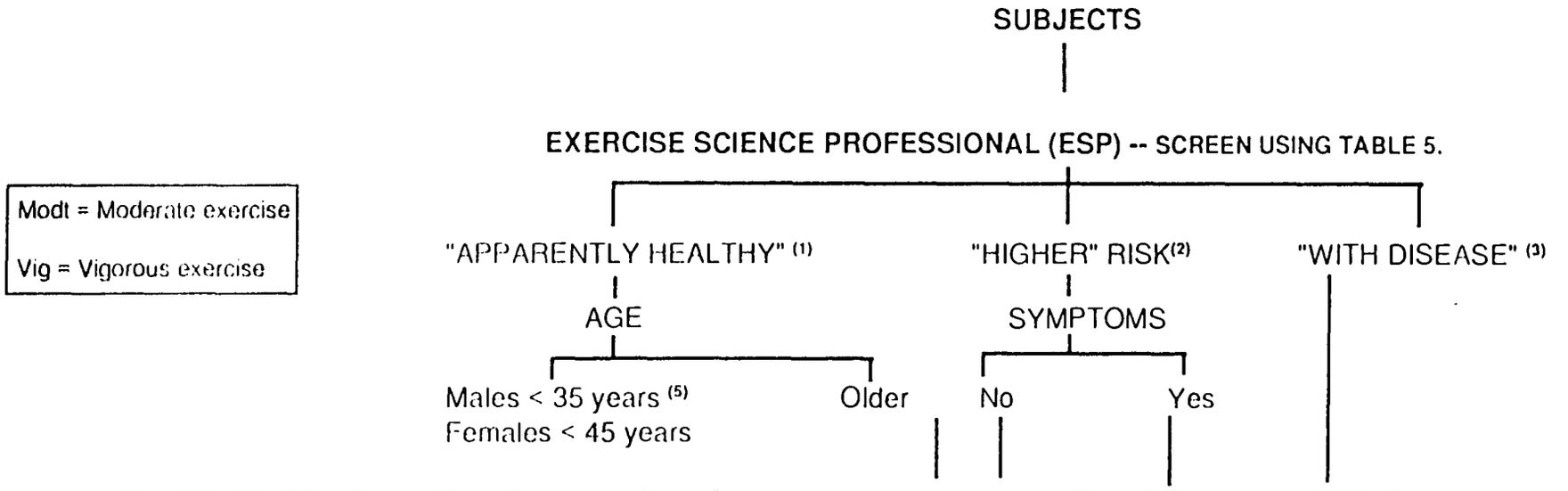
FLOW CHART 1

PRE-EXERCISE - NON MEDICAL PERSONNEL



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.

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
Vigorous exercise	No	Yes	Yes	Yes	Yes
Physician supervision recommended during exercise test:					
Submaximal testing	No	No	No	Yes	Yes
Maximal testing	No	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).

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/AAESS approved course, or completing additional approved training either in an elective/module, or a post graduate diploma, in appropriate areas (ASMF/AAESS 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 *	recommended particularly if not "active" (see * below)
ESP	Exercise Science Professional - see attached
Dr	Medical practitioner

9. Level of Exercise

   Moderate Exercise - exercise intensity 40-60% VO_2max generally can be sustained for 1 hour

   Vigorous Exercise - exercise intensity > 60% VO_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 VO_2max testing as well as anaerobic energy assessment; anaerobic threshold VO_2max workload relationship, or time to fatigue or comparable maximal effort type tests

APPENDIX 1

Medical Referral Form

This must be completed and signed by the physician or cardiologist, who is currently attending the applicants cardiac care.

CARDIOVASCULAR HEALTH SUMMARY FOR EXERCISE

Name of Client: _____

Address of Client: _____

_____

_____

Section A

- ☐ AMI
- ☐ CABG
- ☐ Unstable Angina
- ☐ Chest Pain
- ☐ High Risk Group

Date of Event (if applicable): _____

Blood Pressure: _____

Resting Heart Rate: _____

Stress Test Result: _____

Heart Rate Max: _____

Functional Capacity: _____ mets

Section B

Current Medication

Drug	Amount	Route	Frequency	Effects of Exercise

Section C

1. Risk Factors for Heart Disease

- ☐ Hypertension
- ☐ Hypercholestrolaemia (Total Cholesterol)
- ☐ Diabetes - NIDDM/IDDM
- ☐ Overweight
- ☐ Smoking (Pack/Years)
- ☐ Family History
- ☐ Inactivity
- ☐ Cardiovascular Disease (eg. Stroke, Intermittent Claudication; Other _____)

2. Criteria for Low Risk Patients

1. No ST segment elevation or depression present on maximal exercise stress test.
2. EF> 50% (estimated).
3. Absense of Mulifocal VEB's.
4. Functional capacity > 2 mets.
5. Little to no ischaemic chest pain experienced on current medication.
6. Predicted ≤ 60% blockage of any coronary artery.

Section D

I, Dr _____ in my professional capacity, deem

_____ a low risk cardiac patient and thus refer him to

_____ for a "moderate" exercise programme; which I
(name of institution)

believe will follow the guidelines set down by the National Heart Foundation.

_____ _____

(Signature) (Contact Number)

Go To Section E

I, Dr _____ in my professional

capacity, deem _____ a moderate/high risk

cardiac patient. and do not wish this person to partake of an exercise programme at

_____
(name of institution)

_____ _____

(Signature) (Contact Number)

Section E

Exercise Prescription Guide

- ☐ Weight Training/Circuit Training
- ☐ Aerobic Exercise
- ☐ Low Resistance ie. 20 repetitions
- ☐ Moderate Resistance ie. 1-15 repetitions
- ☐ High Resistance ie. 5-10 repetitions

Target Heart Rate: _____

Comments and Further Instructions:

_____

_____

_____

_____

_____

_____