

# Readiness for Physical Activity

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ORIGINALLY PUBLISHED AS SERIES 1, NUMBER 5, OF THE PCPFS *RESEARCH DIGEST*.

## HIGHLIGHT

“The risk that exercise will induce a cardiac catastrophe is low and many screening tests are costly and time consuming. The revised PAR-Q has shown remarkable success as an exercise screening procedure and is recommended for symptom-free adults with no more than one major cardiac risk factor.”

Current practice in physical education and sports medicine emphasizes the twin goals of reducing the risk of illness and increasing quality-adjusted life expectancy through the development of health-related fitness (Bouchard et al., 1990; Bouchard et al., 1994; US Surgeon General, 1996). The average city-dweller currently takes insufficient habitual physical activity to realize these goals, but involvement in a regular, well-designed program of aerobic training, supplemented by moderate resisted muscle exercises, could satisfy both objectives (American College of Sports Medicine (ACSM), 1991; ACSM, 1993). What are the risks of engaging in such activity, and how can a person determine if he or she is ready to undertake such a program?

## RISKS OF EXERCISE

Excessive physical activity can provoke a variety of musculoskeletal injuries, but the big fear, highlighted by such events as the sudden death of Jim Fixx and other high-profile exercisers, is that the program will provoke a fatal heart attack. Studies from our own laboratory and elsewhere (Cobb & Weaver, 1986; Northcote & Ballantyne, 1984; Sadaniantz & Thompson, 1990; Shephard, 1974, 1981, 1995; Siscovick, 1990; Thompson & Fahrenbach, 1994; Vuori, 1995) show that (at least in symptom-free men) the risk of fatal and nonfatal heart attacks during physical activity is from 4 to 56 times higher than it is while sitting at home reading a book. The issue of hypertrophic cardiomyopathy and sudden death is controversial (Maron, Isner, & McKenna, 1994; Rost & Hollman, 1992; Shephard, 1996a, b). Maron et al. (1986) suggested that the main causes of sudden death in exercisers under 35 years of age were hypertrophic cardiomyopathy (48%: particularly a thickening of the septum between left and right ventricles) and unexplained enlargement of the left ventricle (18%). However, the norms of wall thickness are still not agreed upon, and the prevalence of the disorder is so low that routine electrocardiographic and/or echocardiographic screening of young adults is not warranted; indeed, such an approach yields many false positive diagnoses, with resulting anxiety and iatrogenic invalidism (Shephard, 1996a, b). In those over the age of 35 years, 80% of exercise-related deaths were attributed to disease of the coronary arteries. The overall risk that vigorous physical activity will provoke a cardiac emergency is quite low, about one death per 400,000 hours of jogging (Thompson et al., 1982), and furthermore the risk seems even lower in regular than in occasional exercisers (Siscovick et al., 1984).

## IMPLICATIONS FOR PRE-EXERCISE SCREENING

Ideally, regular physical activity should be conceived as a simple, safe, and natural part of healthy living, a lifestyle to which the human body has adapted over many centuries of evolutionary struggle as a hunter and primitive agriculturalist (Shephard, 1993), rather than as a dangerous medical intervention that requires extensive, high-technology pre-exercise evaluation.

For a long period, physicians in the United States adopted a somewhat restrictive approach to exercise prescription, suggesting that a stress electrocardiogram was needed in all men over the age of 35 years who wanted to increase their habitual physical activity (Cooper, 1970). Their starting point was the now largely discredited assumption (Shephard, 1984; Siscovick et al., 1991) that echocardiography and/or a medically supervised exercise stress ECG could predict and thus avert the occasional exercise-induced cardiac arrest. Northcote and Ballantyne (1984) have pointed out that it would cost \$13 billion to screen even current athletes over the age of 35 years; moreover, it would be necessary to screen 10,000 potential exercisers to find one who might die, and four other individuals who had been cleared by exercise stress testing would die unexpectedly while exercising (Epstein & Maron, 1986). Finally, the stress test itself has a significant morbidity and mortality (Van Camp, 1988), and a heavy emotional, financial, and medical burden is generated by the high proportion of false positive test results.

The need for extensive preliminary screening is particularly questionable, given that moderate exercise decreases rather than increases a person's overall risk of cardiac death (Siscovick et al., 1984). The Swedish physiologist P. O. Astrand has often suggested in his lectures that it would be more logical to focus detailed medical attention on sedentary people than on those who are about to enter a conditioning program. Nevertheless, potential exercisers can be offered some practical advice that will reduce the likelihood of an exercise catastrophe. A review of such incidents (Johnson, 1992; Shephard, 1974, 1981, 1995) suggests that risks are increased if:

1. There is a history of fainting or chest pain during exercise.
2. There is a family history of sudden death at a young age.
3. The intensity and duration of activity are much greater than the subject has recently experienced.
4. Competition, publicity, or pride encourages persistence with exercise in the face of warning symptoms.
5. The individual exercises while under pressure of time, or when oppressed by business or social problems.
6. The activity involves heavy lifting or prolonged isometric effort.
7. The weather is unduly hot or cold.
8. The participant has a viral infection, senses chest discomfort or cardiac irregularity, or feels "unwell."
9. Exercise soon after rising from bed (Willich, 1995).

The corresponding precautions are all matters of common sense, readily understood by the general public, but rarely discussed in the course of the usual clinical examination. There has thus been increasing acceptance of the Canadian viewpoint (Shephard, 1976, 1988, 1994), that (in symptom-free people from adolescence through to early old age) simple advice and self-administered questionnaires provide the most appropriate method of determining readiness for a modest increase of physical activity.

## Current U.S. Screening Recommendations

The current U.S. recommendation for pre-exercise screening has moved much closer to the Canadian position (Table 1.1). It looks at the age of the subject (males >40 and females >50 years, American College of Sports Medicine, 1991, p. 37), the proposed intensity of effort, and associated symptoms or major cardiac risk factors.

**TABLE 1.1**

Indications for preliminary medical screening among those who wish to increase their habitual physical activity (based on the recommendations of the American College of Sports Medicine, 1991; see original article for details).

Variable	Indication for Medical Screening
Known disease	Yes, if cardiac, pulmonary, or metabolic
Symptoms or signs	Yes, if cardiac, pulmonary, or suggesting disease <sup>a</sup> metabolic
Major cardiac risk	Yes, if two or more factors <sup>b</sup>

Vigorous exercise<sup>c</sup> Yes, if man >40 yr or woman >50 yr

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<sup>a</sup>Pain or discomfort in chest, shortness of breath with mild exertion, dizziness or sudden loss of consciousness, shortness of breath while sleeping, swelling of the ankles, palpitations or racing heart beat, pain in the calves on walking, or known heart murmur.

<sup>b</sup>Blood pressure higher than 160 mm Hg systolic or 90 mm Hg diastolic on two occasions, or use of medication to reduce blood pressure; serum cholesterol higher than 6.2 mmol/L (240 mg/dL); cigarette smoking; diabetes mellitus; family history of coronary or atherosclerotic disease in parents or siblings before the age of 55 years.

<sup>c</sup>Exercise that represents a substantial challenge; usually higher than 60% of maximal oxygen intake, and causing fatigue within 20 minutes or less.

If the subject is planning no more than a moderate increase of habitual activity (an intensity of less than 60% of peak aerobic effort, which the person can sustain comfortably for an hour or longer), is symptom-free and has no more than one major coronary risk factor, then a preliminary medical examination is no longer recommended. Indications for medical advice are (1) the presence of disease, (2) the intent to undertake vigorous exercise above the specified age limit, and (3) two or more major risk factors, or symptoms suggestive of cardiopulmonary or metabolic disease.

## Simple Approaches to Screening

Although the expense and anxiety associated with a formal medical examination are unwarranted for the great majority of people who plan to begin a simple exercise program, there remains merit in simple screening procedures, either self-administered or carried out by the staff of a fitness center.

Bailey et al. (1976) first suggested such an approach when screening candidates for the Canadian Home Fitness Test. In the following year, Chisholm and associates (1975, 1978) surveyed 1,253 apparently healthy adults who were attending an exhibition. They evaluated a potential list of some 19 self-administered screening questions against a medical examination that included a physical examination, the measurement of resting blood pressure, and recordings of resting and exercise electrocardiograms. As a result of this research, a brief self-administered questionnaire (the Physical Activity Readiness Questionnaire, or PAR-Q) was developed. This incorporated the seven questions they judged had been the most effective in identifying individuals who needed a medical examination prior to exercise testing or conditioning.

The original version of the PAR-Q was quickly endorsed by the Canadian federal government fitness agency (Fitness Canada), and it has since been widely used, both in Canada and abroad (Shephard, 1986). Indeed, the American College of Sports Medicine recently recommended adoption of the PAR-Q procedure for healthy adults (men >40, women >50 years) who wish to increase their habitual physical activity (American College of Sports Medicine, 1991). Nearly two decades of experience has shown that the original PAR-Q procedure is remarkably safe (Shephard 1988, 1991). Given the low inherent risk of exercise for the healthy adult, and the fact that even clinical examination and an exercise stress ECG provide a rather dubious “gold standard” of exercise readiness, it is difficult to assess the sensitivity (the percentage of subjects unready for exercise who are detected) and the specificity (the percentage of individuals who are screened needlessly) of the PAR-Q procedure. Sensitivity seems adequate, since the PAR-Q has been used to screen as many as half a million people, without any reported adverse events in subsequent exercise testing or programs. On the other hand, about 20% of would-be exercisers “fail the test” by responding positively to one or more questions (Shephard et al., 1981), and in those aged 60–69 years, as many as 55% are “screened out” (Fitness Canada, 1983; Shephard, 1986). Moreover, subsequent examination of the medical records, blood pressure readings, and electrocardiograms on positive responders suggests that at all ages from adolescence onward, many of the PAR-Q exclusions are unnecessary (Shephard et al., 1981).

Accordingly, the detailed wording of individual PAR-Q questions has recently been reviewed and revised by an expert committee of Fitness Canada (Figure 1.1). Given the absence of any clear gold standard of exercise readiness, the rewording was agreed through the Delphic process of circulating repeated drafts of the questionnaire for critical comment. The principal objective was to increase specificity without an undue sacrifice of sensitivity. The revised wording of the questionnaire reduced the overall number of individuals who were “screened out” from 17% to 12%. In all, 7.3% who had originally made positive responses were cleared by the rPAR-Q, but 2.3% of new candidates were cautioned about exercising (Shephard, Thomas, & Weller, 1991).

## FIGURE 1.1

### Revised physical activity readiness questionnaire (rPAR-Q).

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Yes No

1. Has a doctor said that you have a heart condition and recommended only medically supervised activity?
2. Do you have chest pain brought on by physical activity?
3. Have you developed chest pain in the past month?
4. Do you tend to lose consciousness or fall over as a result of dizziness?
5. Do you have a bone or joint that could be aggravated by the proposed physical activity?
6. Has a doctor ever recommended medication for your blood pressure or a heart condition?
7. Are you aware through your own experience, or a doctor’s advice, of any other physical reason against your exercising without medical supervision?

NOTE: If you have a temporary illness, such as a common cold, or are not feeling well at this time—  
POSTPONE.

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From Shephard, R.J., Thomas, S., & Weller, I. (1991). “The Canadian Home Fitness Test: 1991 Update,” *Sports Medicine*. 1: page 359, used by permission.

The trend was for the revised format to allow exercise in a higher proportion of elderly subjects. The largest change of response patterns occurred on the question relating to blood pressure, which had been a major cause of erroneous exercise exclusions when using the original PAR-Q (Shephard et al., 1981).

## Current Evaluation of Screening Questionnaires

The specificity of any screening test can only be improved at the price of some loss of sensitivity. A further decade of usage will be needed to decide whether the shift in this balance has been gauged correctly in the rPAR-Q, although preliminary data are encouraging in this regard. Unfortunately, there are major obstacles to an objective comparison of the two questionnaire wordings. Cost is a significant barrier, given the required sample size, but the cost/effectiveness of a validation against clinical examination is also questionable, given the lack of agreement between doctors on appropriate criteria for exclusion from conditioning programs, and the high proportion of false positive stress ECGs in symptom-free adults (Shephard, 1981). Physician-exclusion rates can range from 1% to 15% in comparable samples of the general adult population (Shephard, 1988). Moreover, high physician exclusion rates apparently lack validity, since they do not reduce the number of electrocardiographic abnormalities and other minor complications that are encountered during exercise testing.

When developing the original PAR-Q, Chisholm et al. (1975, 1978) did attempt to validate their list of 19 potential questions against physician records, blood pressures and electrocardiographic tracings. The final, reduced list of seven questions did not receive any formal clinical validation. Nevertheless, less direct validation has been possible, coupling the International Classification of Diseases (ICD) codings reported in a national health survey (Health & Welfare, Canada, 1982) with PAR-Q responses. Trial of this approach has shown remarkable success (Arraiz et al., 1992). Over a seven-year follow-up, 1,644 of 31,668 subjects died. PAR-Q responses were divided into three categories: pass (no positive responses), conditional pass (positive response about hypertension, not under treatment or supervision for elevated blood pressure), and failure (other positive response). In those failing the test (Table 1.2), the crude overall mortality risk ratio was 2.2 (or 2.1, after adjustment for age, sex, body mass index, and smoking behavior). Moreover, the relative risk of cardiovascular death was 9.1 (or 7.8 after adjusting for age, sex, body mass index, and smoking behavior). Interestingly, the relative risk was moderately greater than that associated with a poor performance on the Canadian Home Fitness Test, and was much greater than would have been obtained by use of an exercise stress ECG. Siscovick et al. (1991) found a relative risk of only 2.6 when asymptomatic hypercholesterolemic men with exercise-induced ST segmental depression were followed for a seven-year period. The PAR-Q responses remained of prognostic value when cases with known heart disease, stroke, and high blood pressure were deleted (Table 1.2).

### TABLE 1.2

Validation of the original PAR-Q test against a 7-year prospective study of data from the Canada Health Survey (data abstracted from the paper of Arraiz et al., 1992).

Source of Risk	Relative Risk if Failed PAR-Q	
	Crude	Adjusted

All causes	2.2	2.1
Cardiovascular disease	9.1	7.8
CVD (omitting if	5.4	history of CVD)
CVD (omitting if history	2.9	of CVD, stroke, HBP)
Cancer	2.1	1.6
Other causes	2.4	2.1

When the Canadian governmental committee revised the PAR-Q, changes from the original format were deliberately held to minor clarifications of wording, and the number of questions was unchanged. It already seems a very useful screening tool. However, the questionnaire may pass through several further revisions and refinements of wording before all of its potential has been realized. Issues that remain to be addressed include the need for age-specific questionnaires for children and for the very old, the level of certification needed by paramedical professionals who are now urged to discuss client responses to questions 5 and 6, the need to caution those cleared by the rPAR-Q against large and sudden increases in habitual activity, the value of additional questions, and the potential to add information about lifestyle and conditioning techniques to the back of the questionnaire.

## SUMMARY

The risk that exercise will induce a cardiac catastrophe is low, and a medically supervised exercise ECG is not a cost-effective approach to the preexercise screening of symptom-free adults. However, a questionnaire (whether self-administered, or completed by fitness center staff) is a useful safety precaution. The Canadian Physical Activity Readiness Questionnaire (PAR-Q) has proven a very safe screening tool, and comparison of responses with findings from the Canada Health Survey has shown remarkable success in detecting potential contraindications to exercise. Nevertheless, the PAR-Q also “screens out” an excessive proportion of apparently healthy older adults. To reduce unnecessary exclusions, the questionnaire wording has now been revised (rPAR-Q). The balance of sensitivity to specificity is apparently improved in the revised questionnaire, particularly in regard to the question about an elevation of blood pressure. The rPAR-Q is thus the currently recommended method of determining exercise readiness in symptom-free adults with no more than one major cardiac risk factor.

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