Exercise Prescription for Physical Fitness

Michael L. Pollock, Matthew S. Feigenbaum, and William F. Brechue

In this paper, the current guidelines on exercise for physical fitness are examined, and important issues that may influence the updating of the ACSM exercise statement are identified. The current ACSM position stand (1990) on exercise for fitness has been criticized for failing to emphasize that health benefits may result from participation in lower intensity/volume physical activities. The primary difference between exercise prescription for fitness and physical activity for health is that fitness-oriented programs encompass health benefits, whereas guidelines designed specifically to elicit health benefits often do not incorporate the intensity or volume of training necessary to bring about improved fitness. Research is needed to provide more precise recommendations concerning the progression of training and how much should be included in warm-up and cool-down periods. Current and future guidelines will continue to emphasize factors that result in permanent lifestyle change and encourage a lifetime of physical activity.

Physical activity is important for fitness; it increases functional capacity through improvements in maximal oxygen consumption ($\text{VO}_2\text{max}$), body composition, muscular strength and endurance, and flexibility. Exercise training is also an important component of preventive and rehabilitative programs designed to address metabolic and cardiovascular diseases, as well as orthopedic injuries and musculoskeletal disorders. Physical activity has been shown to substantially reduce the risk of several controllable and degenerative diseases and to improve both the quality of life and longevity. Research has shown that regular physical activity significantly reduces the risk of morbidity and mortality from coronary artery disease (CAD) (Blair et al., 1989; Caspersen, 1987; Cooper et al., 1976; Gibbons, Blair, Cooper, & Smith, 1983; LaPorte et al., 1984; Morris, Pollard, Everitt, Chave, & Semmence, 1980; Paffenbarger, Hyde, Hsieh, & Wing, 1986; Paffenbarger, Hyde, Wing, & Hsieh, 1986; Paffenbarger et al., 1993; Powell, Thompson, Caspersen, & Kendrick, 1987), hypertension (American College of Sports Medicine [ACSM], 1993; Hagberg, Montain, Martin, & Ehsani, 1989; Jennings, Deakin, Dewar, Laufer, & Nelson, 1989; Martin, Dubbert, & Cushman, 1990), Type II diabetes mellitus (Bjorntorp &
Krotkiewski, 1985; Helmrich, Ragland, Leung, & Paffenbarger, 1991; Kemmer & Berger, 1984; Koivisto & Defronzo, 1984; Manson, et al., 1992), several forms of cancer (Blair et al., 1989; Paffenbarger, Hyde, & Wing, 1987), and osteoporosis (Allen, 1993; Aloia, Cohn, Ostuni, Cane, & Ellis, 1978; Eisman, Sambrook, & Kelly, 1991; Kanders, Dempster, & Lindsay, 1988; Martin & Houston, 1987; Pocock, Eisman, Yeates, Sambrook, & Eberl, 1986; Riggs & Melton, 1992; Smith, Reddan, & Smith, 1981; Smith & Raab, 1986).

It has been estimated that more than 250,000 deaths per year in the United States are directly related to physical inactivity and that hypokinetic diseases substantially contribute to the $900 billion spent annually on health care (McGinnis & Foege, 1993). In 1992, the American Heart Association (AHA) identified physical inactivity as a primary risk factor for the development of CAD, joining hypertension, smoking, and lipid abnormalities (Fletcher et al., 1992). Thus, recognizing the strong inverse relationship between regular aerobic exercise and degenerative disease development, physical activity is recommended as an effective modality in both primary and secondary prevention (ACSM, 1991; Fletcher et al., 1995; Pollock & Wilmore, 1990).

The updated versions of the position stand for exercise training (ACSM, 1990), the Guidelines for Exercise Testing and Prescription (ACSM, 1991) developed by ACSM, and the revised Exercise Standards of the AHA (Fletcher et al., 1995) serve as the foundation for most recommendations regarding physical activity program design (Table 1). These guidelines/statements reflect the scientific-based research conducted to determine minimal and optimal levels of exercise needed to induce fitness-related adaptations in the cardiovascular-respiratory and musculoskeletal systems. Although the ACSM guidelines (1991) and AHA Exercise Standards (Fletcher et al., 1995) deal with both healthy and cardiovascular disease populations, the intent of this paper will focus mainly on physical activity of healthy adults.

Recently, there has been an important distinction made between the physical activity recommendations needed to attain physical fitness versus that needed to improve the health status of sedentary adults (Blair, Kohl, & Gordon, 1992; Blair, 1993; Haskell, 1994; Pate et al., 1995). LaPorte et al. (1984) first pointed out this distinction, indicating that significant health benefits have been attained while exercising at a lower intensity than the guidelines established in the 1978 ACSM position statement (Table 1). Taking into consideration the criticism of the original ACSM position statement (1978), the revised ACSM position stand (1990) and guidelines text (1991) contain clear statements recognizing that the exercise stimulus necessary to elicit health benefits can differ from what is needed to elicit fitness benefits. These health benefits are usually associated with lower levels of intensity than recommended for fitness.

If one were to compare the exercise statements produced by the ACSM in their position stand (1990) and guidelines (1991) in a cursory fashion, a contradiction in recommendation may be concluded (see Table 1). The fact is that both statements were developed during the same time period with each of their primary authors in direct contact so that contradictions would be avoided. As alluded to earlier, the guidelines statement was developed for broader usage than the position stand on fitness. The 1991 guidelines statement attempted to incorporate both the health and fitness objectives into one statement. Since ACSM position stands are based on comprehensive research, it was decided by ACSM in 1988 to develop two different statements on the recommended amount of exercise: one for physical fitness and one for health. The latter was never completed because of the lack of consensus on
Table 1 Standards, Guidelines, and Position Statements Regarding Physical Activity for Adults

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Intensity</th>
<th>Duration</th>
<th>Mode</th>
<th>Weight training</th>
</tr>
</thead>
<tbody>
<tr>
<td>1978 ACSM position statement</td>
<td>3-5 days/wk</td>
<td>60-90% HRmax or 50-85% VO$_2$max or HRmax reserve</td>
<td>15-60 min continuous</td>
<td>Traditional aerobic activities</td>
</tr>
<tr>
<td>1990 ACSM position stand</td>
<td>3-5 days/wk</td>
<td>60-90% HRmax or 50-85% VO$_2$max or HRmax reserve</td>
<td>20-60 min continuous</td>
<td>Aerobic activities</td>
</tr>
<tr>
<td>1995 ACSM guidelines</td>
<td>3-5 days/wk</td>
<td>50/60-90% HRmax; 40/50-85% VO$_2$max or HRmax reserve</td>
<td>20-60 min continuous; 20-30 min minimum</td>
<td>Aerobic activities (expanded)</td>
</tr>
<tr>
<td>1995 AHA exercise standards$^b$</td>
<td>Minimum 3 days/wk</td>
<td>50-60% VO$_2$ max or HRmax reserve</td>
<td>Minimum 30 min</td>
<td>Health promotion activities</td>
</tr>
<tr>
<td>1995 CDC/ACSM public health statement$^b$</td>
<td>Daily</td>
<td>Moderate</td>
<td>Accumulate 30 min/day</td>
<td>Health promotion activities</td>
</tr>
</tbody>
</table>

*Note.* ACSM = American College of Sports Medicine; AHA = American Heart Association; CDC = Centers for Disease Control and Prevention. VO$_2$max = maximum oxygen consumption; HRmax = maximum heart rate; rep = repetitions.

many issues related to the quality and quantity of exercise necessary to improve various health parameters. Some information was available concerning exercise and cardiovascular disease risk and thus was incorporated into the 1991 guidelines statement. Since that time ACSM has published separate position stands on exercise and hypertension (ACSM, 1993) and for patients with CAD (ACSM, 1994). The companion paper in this text by Blair (1995) focuses on the issue of physical activity for health. This paper will concentrate on the fitness benefits.

The questions still exist as to “How much exercise is enough?” and “What type of exercise is best for developing and maintaining fitness?” In this paper we will review historically how the current position statement and guidelines were derived and formulated. Next, the issue as to whether the current statement on exercise for physical fitness is still in vogue will be addressed. Finally, important issues that may influence the change or updating of the current position stand for fitness will be discussed. For example, does the current ACSM position stand (1990) accurately reflect the amounts and types of exercise necessary for fitness-related adaptations in young, middle-age, and elderly participants, and furthermore, should resistance training be given greater emphasis and be more balanced with the time spent performing aerobic endurance training?

Physical Fitness

Physical fitness is defined as the ability to perform moderate to vigorous levels of physical activity without undue fatigue and the capability of maintaining such ability throughout life (Wilmore, 1990). The term physical fitness encompasses several individual yet integrated components, including cardiovascular-respiratory fitness, muscular strength and endurance, flexibility, and body composition. Traditionally, exercise programs have been evaluated according to their effect on VO\(_2\)\(_{\text{max}}\), body composition (body weight, fat, and muscle mass), and muscular strength and endurance. As mentioned earlier, the ACSM exercise statement (1990) was designed to improve these parameters, but has been criticized for failing to emphasize that health benefits may result from participation in lower intensity physical activities. The primary difference between exercise prescription for fitness versus physical activity for health is that fitness-oriented programs encompass health benefits, whereas guidelines designed specifically to elicit health benefits do not consistently incorporate the level of intensity or volume of training necessary to induce the central and peripheral adaptations associated with improved fitness.

The ACSM position stand (1990) was based on the fact that regular aerobic exercise performed at moderate to high intensity increases VO\(_2\)\(_{\text{max}}\) by as much as 15 to 30% over a 3 to 6 month period, depending on participants’ initial levels of fitness and training volume (Pollock & Wilmore, 1990). These improvements result from increases in maximal cardiac output (stroke volume) and oxygen extraction in skeletal muscle. Moderate alterations in body composition, particularly decreased body weight (1–2 kg) and percent body fat (1–3%), are also generally associated with cardiorespiratory (aerobic) endurance exercise training (Wilmore, 1983). It is important to note that lower doses of exercise may induce alterations in VO\(_2\)\(_{\text{max}}\), especially for individuals with low initial levels of fitness.

Physical inactivity is associated with the deterioration of strength and fat-free tissue, including bone and muscle mass (Holloszy & Coyle, 1984; Peck, Riggs, & Bell, 1988; Rogers & Evans, 1993; Stone, 1988). In recent years, musculoskeletal
fitness achieved through a combination of resistance training and flexibility exercises has regained recognition as an essential component of the comprehensive fitness program.

Resistance training is imperative for proper musculoskeletal development and maintenance. Strength is needed for improving physical functional capacity and quality of life, especially in the elderly or more frail low-fit persons (Fiatorne et al., 1990; Fiatorne et al., 1994; Fleck & Kraemer, 1987). Muscle and connective tissue atrophy and resultant functional capacity deterioration commonly associated with aging have been directly linked with physical inactivity. Inadequate muscular strength and flexibility can lead to serious musculoskeletal disorders, which are becoming increasingly prevalent as people live longer. Muscular weakness is one of the primary determinants of low back pain, and an increasing prevalence of osteoporosis, bone fractures, and reduced musculoskeletal functional capacity are often the result of the degenerative process associated with physical inactivity and aging. Fortunately, musculoskeletal disorders can be attenuated through properly designed comprehensive personal fitness programs. Recognizing this fact, the ACSM has included a resistance training component in the 1990 position stand.

Unquestionably, the adaptations associated with a well-rounded exercise program can improve fitness and substantially contribute to an improved quality of life and increased longevity, the ultimate goals of all professional health organizations. The ACSM (1990) exercise guidelines are appropriate for the majority of the general population, are based on the present body of knowledge, and will continually be updated to incorporate new scientific findings.

**Historical Perspective: A Comprehensive Fitness Program**

The evolution of the ACSM exercise guidelines and a comprehensive fitness program concept can be traced back to the emergence of organized competitive athletics at the turn of the century. Prior to the World War II era, structured physical fitness programs consisted predominantly of calisthenics and sport-specific exercises conducted for the improvement of athletic performance or military service. Exercise guidelines originated, in part, from early dumbbell and free weight exercise programs in which trial and error experimental combinations of training volume factors (frequency, intensity, duration) were measured as a means to improve muscular fitness and enhance body image. However, resistance training did not gain formal acceptance as an effective fitness or rehabilitative modality until 1945, when army physician DeLorme incorporated heavy progressive resistance exercises in rehabilitation programs designed for orthopedically disabled veterans (DeLorme, 1945). DeLorme and Watkins (1948) emphasized the use of heavy resistance and a low number of repetitions to develop muscular strength, and light resistance and a high number of repetitions to develop muscular endurance. After gaining formal recognition in the medical community, resistance training has become an integral component in the comprehensive fitness program, joining traditional calisthenics and aerobic endurance activities.

Between 1940 and the mid-1960s, Cureton (1969) emphasized the importance of designing a well-rounded program that included warm-up, aerobic fitness, resistance training, and tapering components. In 1956, the basis for exercise guidelines and the importance of comprehensive fitness gained national recognition when Wolfe, founder of the ACSM, gave a historic presentation on the benefits associated
with physical activity, "A National Program of Fitness," to the National Conference of Physical Fitness hosted by President Eisenhower (Haskell, 1994).

During the 1950s, 1960s, and early 1970s, a growing body of epidemiological research indicated a strong link between aerobic endurance activities and the development of cardiovascular disease (Cooper et al., 1976; Epstein, 1973; Fox & Skinner, 1964; Froelicher & Oberman, 1972; Kannel, 1970, 1974; Morris et al., 1973; Paffenbarger & Hale, 1975). We feel that this information, in addition to the publication of *Aerobics* (Cooper, 1968), Frank Shorter winning the 1972 Olympic marathon, and the development of Masters Track and Field (first national meet in 1971), popularized aerobic endurance exercise to the general public. Unfortunately, health and fitness became synonymous with aerobic exercise, and the perceived need for strength and flexibility training declined.

In 1978, the ACSM issued its original position statement titled "The Recommended Quantity and Quality of Exercise for Developing and Maintaining Fitness in Healthy Adults." Reflecting the trends of the time, the focus of the statement was on establishing exercise guidelines for developing and maintaining cardiorespiratory fitness and body composition. The lack of research quantifying the amount of resistance training needed for the average adult was the main reason for its omission in the 1978 ACSM statement, not because it was felt unimportant. It was and is the current policy of the ACSM that position stands must be accompanied by research documentation. Unfortunately, the omission of resistance training information was interpreted as a lack of importance. In 1980, the American Alliance for Health, Physical Education, Recreation and Dance (AAHPERD) published its new *Health Related Fitness Test Manual* (AAHPERD, 1980). Unfortunately, the manual excluded upper body strength test items, implying their lack of importance.

In the early 1980s, professional associations, universities, private health clubs, and YMCA-type organizations recognized the impact of resistance training on athletic performance and body image. By the mid-1980s, the medical community began recognizing the potential health value of resistance training on functional capacity and other health-related factors (e.g., bone health, basal metabolism, weight control, and low back health). At this time, research concerning resistance training and its quantification for the average participant intensified. In 1989, AAHPERD added upper body strength training and testing as an integral component in the Physical Best Program (McSwegan, Pemberton, Petray, & Going, 1989). In 1990, ACSM recognized the importance of the comprehensive fitness program and added a resistance training component to the previously published 1978 position statement. Cureton’s (1969) comprehensive fitness program had revolved full circle from 1960 to 1990 (see Figure 1). It is interesting to note that the AHA exercise standards (Fletcher, Froelicher, Hartley, Haskell, & Pollock, 1991) recognized the importance of a well-rounded exercise program (aerobic endurance, muscular strength and endurance, and flexibility) but clearly emphasized the aerobic component and gave no specifics on strength training. The AHA’s exercise standards update includes specific recommendations for resistance training (Fletcher et al., 1995). Finally, the Centers for Disease Control and Prevention (CDC)/ACSM statement on the recommended amount of exercise from a public health view recognizes the importance of strength training as an integral part of their physical activity recommendation, but clearly at a lower priority (Pate et al., 1995). A final note concerns the YMCA’s of America: They have continually supported the concept of the well-rounded program (Golding, Myers, & Sinning, 1973, 1989; Myers, Golding, & Sinning, 1982).
Exercise Prescription for Physical Fitness in Healthy Adults

Improvements in fitness are generally characterized by changes in VO$_2$max, body composition, muscular strength and endurance, and flexibility. The ACSM position stand (1990) states that these adaptations can be stimulated through the safe progressive application of the principle of overload, specifically the frequency, intensity, and duration of training, and considerations of the mode of activity and the initial level of fitness. As a whole, the current guidelines have been well accepted and adopted for use in the general population.

Intensity is often considered the most difficult and controversial aspect of exercise prescription, and the question has again been raised as to what exactly is the optimal intensity level required to induce the fitness-related adaptations. The ACSM (1990) and the AHA (Fletcher et al., 1991) indicate that the minimal intensity of training for young healthy adults should be 60% of maximum heart rate (HR$_{max}$), or 50% of VO$_2$max or HR$_{max}$ reserve. Although this minimal standard for prescribing exercise intensity is widely accepted, it must be noted that this guideline was derived from studies using a small sample of young participants (Åstrand, Åstrand, Christensen, & Hedman, 1960; Hollman & Venrath, 1963; Karvonen, Kentala, & Musta, 1957). Shephard (1969) and more recently Wenger and Bell (1986) pointed out that the threshold value can fluctuate significantly and that participants’ initial levels of fitness should also be given serious consideration when designing personalized exercise programs. Unequivocally, the ACSM guidelines (1990, 1991) clearly recognize the importance of individualizing exercise prescriptions and that participants’ initial levels of fitness are certainly important considerations. Clearly, partici-
pants with initially low fitness levels improve fitness when exercising at lower intensities.

It should also be emphasized that although higher intensity activities may be associated with more rapid improvements in VO\textsubscript{2}max, comparable benefits result from combinations of moderate intensity activities with longer durations or increased frequencies (Pollock & Wilmore, 1990). Knowing that the intensity and duration of training are interrelated, fitness-related programs should emphasize the total amount of work accomplished (kilocalories). As long as participants train above their minimal intensity threshold and adjust the duration or frequency to match total kilocalories of expenditure for higher intensity programs, the improvements in aerobic capacity are similar.

The current trend is characterized by moderate intensity (50 to 70% HR\text{max} reserve) activities performed for slightly longer durations (30 to 50 minutes). Interestingly, not only is this type of exercise program prescription proving to be effective in eliciting fitness and health-related benefits, but it also appears to be associated with an increased rate of program compliance and a reduced incidence of injuries (Carroll et al., 1992; Pollock, 1988). Training intensities that approach VO\textsubscript{2}max or HR\text{max} become less effective because rapid fatigue may reduce the volume of training and increase the likelihood of injury (Pollock et al., 1977). Although high-intensity training is essential to competition and peak performance, it is also related to an increased incidence of musculoskeletal injuries, cardiac complications, and can be psychologically detrimental to the noncompetitive athlete (Fletcher et al., 1995; Pollock, 1988).

Although high-intensity programs have been associated with greater numbers of injury, most of these studies have not taken into account the effect of the mode of activity. A recent study by Carroll and colleagues (1992) clearly showed that the impact produced by the activity was the factor associated with a higher incidence of injuries. Thus, high-impact activities such as jogging/running and aerobic dance cause significantly higher rates of injury than low-impact activities such as walking or cycling. In the Carroll et al. study (1992), participants trained at high (85%) or moderate (70%) HR\text{max} reserve intensities using low impact exercise (walking uphill on a treadmill), and low (14%) and similar injury rates were found between groups.

Our studies have also shown a four- to fivefold increase in the number of orthopedic/musculoskeletal injuries with aerobic exercise training in postmenopausal women compared to similarly aged men (Pollock & Wilmore, 1990; Carroll et al., 1992). Two factors that appear related to this phenomenon are the lack of muscle mass/strength and the greater Q angle found in females compared to males. The injury–gender differences occurred in studies using either high-impact (Pollock et al., 1990) or low-impact (Carroll et al., 1992) activities. Whether a period of resistance training prior to initiating a traditional aerobic training program will help alleviate injuries is not known. Future research is necessary to evaluate this important problem.

Training session duration and frequency are dependent on exercise intensity, and as previously stated, the current trend in exercise prescription for fitness appears to be shifting to moderate intensity activities performed more frequently and/or for longer durations. The current ACSM guidelines (1990) reflect a number of closely controlled studies that indicate exercise intensity does not significantly influence the extent of training adaptations when the total amount of work is held constant (Blair, Chandler, Ellison, & Langley, 1980; Burke & Franks, 1975; Gaessner & Rich, 1984; Pollock & Wilmore, 1990; Sharkey, 1970).

The important relationship between the frequency of training and improvements in cardiorespiratory fitness and body composition are also emphasized in the
ACSM position stand (1990). The guidelines reflect the existing literature, which indicates that although training fewer than 3 days/week at high intensities (80–90% HRmax) can produce significant effects on VO2max, the alterations in body composition are not significant compared to programs that train persons 3 to 5 days/week (Pollock, Miller, Linnerud, & Cooper, 1975). Thus, the minimum standard frequency of 3 days/week has been recommended by all groups (Table 1).

**Current Issues in Exercise Prescription for Fitness**

Although there is a general acceptance of the ACSM position stand on exercise for healthy adults, the guidelines lack precision in recommending flexibility exercises. An update and/or more research is needed in the areas of (a) intensity prescription by HR for elderly participants compared to young and middle-aged participants, (b) resistance training, and (c) reduced training and maintenance of fitness. More research is also necessary in the areas of exercise adherence, training progression, and warm-up and cool-down activities.

**Exercise Intensity**

Of the various components of the exercise prescription, intensity of training and its estimation is the most complex. The use of VO2 and the specified percentage of maximum is the standard for estimating intensity of training. Since it is not realistic to measure VO2 during exercise training, HR and more recently the rating of perceived exertion (RPE; Borg, 1982; Borg, Hasserman, & Lagerstrom, 1987) have been used as indirect estimates of exercise intensity. Table 2 shows a classification of intensity based on 30 to 60 minutes of aerobic endurance training that has been adopted for use by both ACSM (1990) and AHA (Fletcher et al., 1995). The categories developed can be used for markers of intensity and self-monitoring of the exercise prescription.

**Table 2 Classification of Intensity of Exercise Based on 30 to 60 Minutes of Endurance Training**

<table>
<thead>
<tr>
<th>Relative intensity (%)</th>
<th>VO2max or HRmax reserve</th>
<th>Rating of perceived exertion</th>
<th>Classification of intensity</th>
</tr>
</thead>
<tbody>
<tr>
<td>HRmax</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;35</td>
<td>&lt;30</td>
<td>&lt;10</td>
<td>Very light</td>
</tr>
<tr>
<td>35–59</td>
<td>30–49</td>
<td>10–11</td>
<td>Light</td>
</tr>
<tr>
<td>60–79</td>
<td>50–74</td>
<td>12–13</td>
<td>Moderate (somewhat hard)</td>
</tr>
<tr>
<td>80–89</td>
<td>75–84</td>
<td>14–16</td>
<td>Heavy</td>
</tr>
<tr>
<td>≥90</td>
<td>≥85</td>
<td>&gt;16</td>
<td>Very heavy</td>
</tr>
</tbody>
</table>

The above classification system seems valid for use with young and middle-aged participants, but certain limitations have been shown in its use with the elderly. Based on the work of Davis and Convertino (1975), the percentage of HRmax reserve (a percentage of the difference between HRmax and resting HR is calculated, and the derived value is added to the resting HR [Karvonen et al., 1957]) is thought to be closely related to the same percentage of \( VO_2 \). The percentage of HRmax has been shown to overestimate the percentage of \( VO_2 \) and HRmax reserve by 10 to 15 beats/min (5–10%). These basic assumptions have been accepted for use in the calculation of exercise intensity and formulate the basis for Table 2.

Recent studies (Malley, Kohrt, Coggan, Ehsani, & Holloszy, 1990; Panton et al., 1992; Whaley, Kaminsky, Dwyer, Getchell, & Norton, 1992) have shown that the percentage of HRmax reserve underestimates the percentage of \( VO_2 \) during submaximal exercise in the elderly. The study of Panton et al. (1992) showed that the HRmax reserve method underestimated the true \( VO_2 \) by 5 to 10% over the range of 50–85% and that the HRmax technique more closely represented the true \( VO_2 \) and provided a more precise estimation of exercise intensity in this population. Thus, it appears that Table 2 should be modified and the intensity range for HRmax reserve changed to 40 to 80% for the elderly.

**Resistance Training**

The addition of resistance training as a component of fitness and part of a comprehensive fitness program was an important inclusion by ACSM (1990). As shown in Table 1, the AHA (Fletcher et al., 1995; Fletcher et al., 1991) and CDC/ACSM (Pate et al., 1995), as well as the American Association of Cardiovascular and Pulmonary Rehabilitation (AACVPR; 1991, 1995) all recommend strength training as part of a well-rounded fitness program for both healthy and diseased populations. At first glance, the ACSM recommendation for resistance/strength training may appear minimal. These minimal standards for strength training were based on the following premises. ‘First, the time it takes to complete a comprehensive, well-rounded program is important. Programs lasting more than 60 minutes per session are associated with higher dropout rates (Pollock, 1988). Second, although greater frequencies of training (Braith et al., 1989; Fleck & Kraemer, 1987; Gillam, 1981) and additional sets or combination of sets and repetitions elicit larger strength gains (Berger, 1962; DeLorme, 1945; Fleck & Kraemer, 1987; Hettinger, 1961; Sale, 1987), the magnitude of difference is usually small’ (ACSM, 1990). Taking these assumptions into consideration, we feel that the minimal standard is acceptable. It is interesting to note that both ACSM (1991, 1995) and AACVPR (1995) have reduced their recommendation for number of sets from two-three to one (minimal standard) in their latest statements.

Even though the current minimal standard recommended by ACSM (1990) seems appropriate, most of the research used to formulate this guideline was based on data from healthy adults under 50 years of age. Recent recommendations for strength training in elderly (Pollock, Graves, Swart, & Lowenthal, 1994) and cardiac patients (AACVPR, 1995; Fletcher et al., 1995) advocate lesser intensity resistance training for more fragile or diseased populations. This would include the use of a lighter weight performed with 10–15 (Fletcher et al., 1995; Pollock et al., 1994) or 12–15 repetitions (AACVPR, 1995). Although resistance training exercise has been shown to be a safe procedure in regards to precipitating a cardiovascular event (Debusk, Houston, Haskell, Fry, & Parker, 1979; Gordon et al., in press; McCartney,
McKelvie, Haslam, & Jones, 1991), much variance exists among recommendations as to the level of fatigue (moderate to maximum) required in such programs (AACVPR, 1995; ACSM, 1990; Fletcher et al., 1995; Pollock et al., 1994). Most of the current research is based on maximal efforts; thus, the results of varying levels of fatigue/intensity have not been carefully studied. As research becomes available, a clearer statement/recommendation concerning the quality and quantity of strength training for various segments of the population needs to be incorporated.

Finally, how much emphasis should be placed on doing strength training compared to aerobic training in daily regimens? Should the emphasis be different among the young, middle-age, and elderly, and diseased and nondiseased segments of the population? As the evidence mounts concerning the importance of resistance training for both fitness and health, a more balanced program related to comprehensiveness (aerobic endurance, muscular strength and endurance, and flexibility exercise for all major muscle groups) will be incorporated for all age groups. The total time available for training will continue to be a major consideration because of adherence and injury problems related to programs of greater frequency and duration (Pollock, 1988; Pollock et al., 1977). Health/fitness professionals, as well as the participants, will have to make value judgments concerning the time available to accomplish their goals. We believe that there are enough data available now to warrant a shift to a 50-50 balance or at a minimum 60% aerobic and 40% strength and flexibility recommendation. Although the question of importance and emphasis is highly debatable, it seems prudent to increase the emphasis toward strength training as women reach menopause and people become older. Patients with cardiovascular disease also need a well-rounded program, but the emphasis should continue toward greater amounts of aerobic training.

Flexibility Exercise

In addition to resistance training, flexibility exercise has been considered essential for developing and maintaining joint range of motion and functional capacity (Pollock & Wilmore, 1990). The ACSM position stand (1990) acknowledges the importance of flexibility exercise as an integral component in the comprehensive fitness program. The lack of specific guidelines for flexibility exercise reflects the scarcity of research literature quantifying flexibility program parameters (i.e., static, dynamic, or active assistive exercise, frequency, volume, repetitions, and duration of training). The question as to how flexibility exercise should be incorporated into the comprehensive fitness program still needs to be addressed. For example, should flexibility exercise be integrated into the warm-up or cool-down, after strength or aerobic training periods, or some combination thereof? Interestingly, low back pain is one of the most common and costly medical problems in Western society, affecting approximately 80% of all United States citizens at one time or another (Colletti, Edwards, & Gordon, 1989; Holbrook, Grazier, & Kelsey, 1984), with muscle weakness and lack of flexibility presiding as the primary etiology. Recognizing that the current ACSM position stand (1990) provides only general guidelines for resistance training program parameters and is vague regarding flexibility-related exercise prescription suggests the need for further research.

Fitness Maintenance

The physiological adaptations contributing to improved fitness are usually rapidly lost with the cessation of training (Coyle et al., 1984). However, it has been shown that the adaptations to aerobic and resistance training may be retained for
several months when training is maintained at a reduced level, depending on the interaction of reductions in frequency, duration, and/or intensity of training (Coyle et al., 1984; Cureton & Phillips, 1964; Graves et al., 1988; Hickson, Foster, Pollock, Galassi, & Rich, 1985; Hickson, Kanakis, Davis, Moore, & Rich, 1982; Hickson, Overland, & Doughtery, 1984; Hickson & Rosenkoetter, 1981; Neufer, 1989; Neufer, Costill, Fielding, Flynn, & Kirwan, 1987). Results from these studies indicate that reductions of one to two thirds in training frequency and/or duration do not significantly alter VO_{2max} or submaximal endurance time, provided the intensity of the training is maintained. However, it should be noted that the majority of these studies were conducted over periods of less than 15 weeks, and additional research is needed to determine the long-term effects of reduced training on fitness maintenance.

Fleck (1994) stated that two training sessions a week are needed to maintain strength increases in conditioned athletes. Normal resistance training with an eccentric as well as a concentric component may maintain strength gains and muscle hypertrophy to a greater extent during reduced training periods. Furthermore, similar to aerobic/endurance training, the intensity of strength training must be maintained when the frequency is reduced (Fleck, 1994). In addition, Graves et al. (1988) showed that reduced training to even 1 day/week of high intensity exercise was enough to maintain strength in nonathletes.

Interestingly, recent studies indicate that adaptations to resistance training may vary between specific muscle groups. Graves et al. (1990) reported that training the lumbar extensor muscles one time per week elicited maximal gains in isometric strength compared to 2 and 3 days/week programs after 12 and 20 weeks of training. In a follow-up study measuring the effect of reduced training on lumbar extensor muscle strength, Tucci, Carpenter, Pollock, Graves, and Leggett (1993) demonstrated that groups that reduced their low back training regimen to once every 2 to 4 weeks were able to maintain their lumbar extension strength for up to 12 weeks. Recognizing that isolated muscle groups demonstrate different response rates depending on the neural, morphological, and biochemical adaptation capabilities, further research is clearly warranted to gain a better understanding of the implications of reduced frequency of resistance training on the development and maintenance of fat-free weight, as well as for long-term preventive and rehabilitative programs. Although the above-mentioned studies have added insight into the minimal level of exercise necessary to maintain fitness, further investigations are needed to determine the rate of increase and decrease in fitness in relation to level of fitness, age, and exercise program parameters.

Summary

The current physical fitness guidelines recommended by ACSM and other professional organizations have much in common (Table 1). Differences exist depending on whether the programs were designed to address health- or fitness-oriented goals in generally healthy adults (ACSM, 1990; Pate et al., 1995) or at-risk/diseased segments of the population (AACVPR, 1995; ACSM, 1991, 1993, 1994; Fletcher et al., 1995). Unquestionably, the initial low level of fitness of the latter group requires a lower intensity of training threshold to induce fitness-related adaptations. In general, recognizing that the guidelines developed by various health organizations (ACSM, AHA, CDC, AACVPR) were designed to address specific segments of the population (e.g., ACSM, 1978, 1990; “The Recommended Quantity and Quality
of Exercise for Developing and Maintaining Cardiorespiratory and Muscular Fitness in Healthy Adults”), the current fitness statements continue to be in vogue. The current trend of the comprehensive fitness program including aerobic endurance, muscular strength and endurance, and flexibility exercises has been shown to be important for developing both fitness and health. An attempt to update the guidelines for fitness should certainly address adaptations associated with age differences and initial fitness levels. Further, research focusing on the areas of resistance training, flexibility, and exercise intensity (HR vs. VO₂ relationship) for younger compared to older participants is necessary to provide more accurate prescription guidelines. Research also is needed to provide more precise recommendations concerning the progression of training and what and how much should be included in warm-up and cool-down periods.

Working cooperatively, all of the above-mentioned health organizations recognize that the most important factor is designing individualized programs that provide the appropriate amount of physical activity to attain maximal benefit at the lowest risk. Current and future guidelines will continue to emphasize factors that result in permanent lifestyle change and encourage a lifetime of physical activity.

References


