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YEAR BOOK OF SPORTS MEDICINE® 1989

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The Year Book of SPORTS MEDICINE®

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Acta Physiologica Scandinavica
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Publisher's Preface

We are delighted to welcome Roy J. Shephard, M.D., Ph.D., D.P.E., as Editor-in-Chief of the YEAR BOOK OF SPORTS MEDICINE. An Editor of the YEAR BOOK since its second edition in 1980, Dr. Shephard now assumes the larger role of defining the overall scope of the volume, refining its organization as changes develop in the field, and recruiting new members of the Board of Editors, all as necessary. We welcome him in this capacity and extend our sincere appreciation for his excellent efforts with the 1989 edition.

We are also pleased to welcome John Sutton, M.D., and Edward R. Eichner, M.D. as new board members. Drs. Sutton and Eichner selected and commented on material related to general medicine, replacing in this capacity Lewis J. Krakauer, M.D., who retired with the 1987 edition.

Finally, we owe another thanks to Dr. Shephard for his good humor and understanding about our unfortunate misspelling of his name on the cover of the 1988 YEAR BOOK. What a way to welcome an Editor-in-Chief! Our sincere apologies.

Introduction

It is exciting to be serving my first full year as Editor-in-Chief of the YEAR BOOK OF SPORTS MEDICINE. I have been particularly pleased during my first year of office to have the continuing strong and experienced support of Col. James Anderson in the area of sports biomechanics, Dr. Joseph Torg in the area of sports injuries, and Frank George in the field of athletic training. It has also been a pleasure to welcome two new members to the editorial team, both well-recognized and accepted among sports physicians throughout the world: Dr. John Sutton in the area of general medicine, and Dr. Edward Eichner in the areas of hematology and internal sports injuries. The editorial team now spans a broad spectrum of interests, opinions, and geographic representation.

The continuing strong demand for the series endorses both the vision of Dr. Krakauer in founding it and the wise guidance he gave to its early development. For the busy practitioner, to have such a ready and convenient access to 300–350 of the top current articles in sports medicine is an invaluable resource; the brief digests allow for speedy reading, and the critical comments from acknowledged experts bring to light potential criticisms of research that could easily have been overlooked by the generalist. It is also a pleasure to acknowledge here the major contributions made by Judy Plazyk and other members of the YEAR BOOK staff who have dealt so efficiently with the logistics of abstracting and assembling a truly international volume.

It would perhaps be invidious to attempt to single out the most interesting new developments in what continues to be an exponentially growing field of knowledge. However, I can mention some personal highlights. It has been exciting to see the rapid progress in our understanding of interactions between immune function and exercise, with potential applications in the treatment of both cancer and the acquired immunodeficiency syndrome. Illicit drug use has made depressing headlines over the year, and there continue to be important articles on steroids, human growth hormone, and blood doping, with an emphasis on methods of detection that can be applied on a large scale. Cardiac rehabilitation now concerns more than simply the myocardial infarction patient; the cardiac transplant patient must also be considered. Debate continues over the possible linkage between anorexia nervosa and compulsive running, and in the environmental field there has been exciting new work on simulated Everest climbs, hypothermia, and usage of glycogen stores. Other interesting areas include new concepts on warming up and rehabilitation of shoulder and back injuries; also, there is a variety of fascinating contributions from the orthopedic surgeons.

I hope you will find this year's research in sports medicine as interesting and as challenging as I have done. If you have any suggestions as to how future editions of the book can be shaped to meet your particular needs, I will be delighted to consider your suggestions; I look forward to hearing from you.

Roy J. Shephard, M.D., Ph.D., D.P.E.

Prescribing Exercise for the Senior Citizen: Some Simple Guidelines

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Introduction

As a person becomes older, the various body systems begin to lose their functional capacity (1) and guidelines for active recreation must become progressively more conservative. Nevertheless, too many senior citizens and their family physicians are influenced by the popular notions that it is time to "slow down" and "take a well-earned rest." Appropriately selected and prescribed active recreation not only remains possible for the older adult, but it can make an important contribution to sustenance of the waning physiologic capacity.

In this editorial, we will look at the older person's need of anaerobic power, muscular strength, and aerobic power; discuss the optimum training plan and the likely response of an older person; note the specific concerns aroused by an adverse environment; and comment on the need for detailed laboratory testing and medical supervision. The comments will relate mainly to the "young-old" who continue to function with little physical restriction of their activity; however, brief comments will also be made on activities suitable to the "middle-old" and the "old-old" who have some limitation of their daily activities.

Anaerobic Power and Strength

Younger individuals often enjoy exploiting their muscular strength, engaging in bouts of exercise in which their maximum anerobic power is deployed (for example, a vigorous sprint up several flights of stairs). The ability to undertake such activity diminishes with age, owing in part to a progressive wasting of the body muscles, with an associated decrease of lean body mass (2, 3). The coordination of muscle contraction also becomes less effective in the elderly, leading to slower and less efficient movements (4–6); enzyme changes may slow the speed of muscle contraction (7); and stiffness of the muscles and joints may sometimes lead to increasing dissipation of the available physical energy against internal resistance (8).

From a practical point of view, the prescription of anaerobic types of activity becomes progressively less desirable as a person gets older. Overvigorous twisting and turning or excessive straining can lead to various musculoskeletal injuries, including hernias and back problems. Moreover, during anaerobic effort the systemic blood pressure of an older adult increases to a greater extent than would be anticipated in a younger person (9); this represents an attempt to sustain blood flow through working muscles that are contracting at a large fraction of their maximum force, and the resulting increase of double-percent throws a heavy load on the aging heart (10). In the few patients in whom atherosclerosis has not developed, both peak heart rate and ventricular contractility are

surprisingly well maintained (11). However, if the coronary vessels are narrowed by atherosclerosis, as is more likely in an older person, the added cardiac burden may be sufficient to induce a reduction of peak heart rate and stroke volume, electrocardiographic signs of ischemia (12, 13), anginal pain, or even some form of "heart attack" (myocardial infarction or electrical failure) (14–16).

Nevertheless, if the exercise prescription places an undue emphasis on an aerobic form of exercise such as distance jogging rather than on muscle-building activities, an undesirable weakening of the muscles can develop, particularly in the arms. It is thus important for an older person to undertake sufficient muscular activity to counter the age-related tendency toward a progressive loss of contractile protein from the lean tissue compartment, thereby conserving sufficient strength in the major muscles to deal with occasional emergencies.

The rise of blood pressure during bouts of both isometric and heavy rhythmic activity is a progressive, time-related change that is dependent also on the fraction of the maximum voluntary force that the individual exerts (17). The safe approach to exercise prescription is thus to ensure that any isometric contractions are held for only a few seconds, that the carrying of excessive weights is avoided, and that rest pauses are introduced into any more sustained bout of isotonic muscular activity (14).

All-out sprinting carries additional risks of physical injury in an older person because of poor vision, deteriorating balance, and failure to allow a "warm-up" of muscles and tendons that are becoming progressively stiffer through organic changes in collagen molecules (18, 19). There is finally some evidence that all-out activity without a warm-up exacerbates the risk that exercise will precipitate a cardiac emergency (20).

Aerobic Power

The type of physical activity best suited to the overall health needs of an older person is aerobic exercise involving the large muscles of the body: brisk walking, vigorous swimming, and cross-country skiing, for example. The main determinant of the ability to undertake such types of activity is the maximum oxygen intake, i.e., the ability of the heart and lungs to transport oxygen from the atmosphere to the working tissues (21). The oxygen cost of walking is similar in young adults and in healthy older people (22), but problems of gait may increase the energy consumption in the more frail elderly at any given speed of movement (23).

The rate of loss of oxygen transport with aging is typically about 5% per decade of adult life (24); thus, a speed of walking that would be considered a very moderate exercise for a young person can become an effective training stimulus in an older person. On the other hand, an effective training program can boost the older person's maximum oxygen intake by as much as 20% (25), giving the senior citizen who has optimized personal fitness an exercise tolerance and functional capacity matching that of a sedentary person who is 10–20 years younger in terms of calendar

age. Plainly, exercise prescription for the elderly must take more account of functional than of calendar age.

Even if oxygen transport has developed to match that of a younger person, the elderly exerciser should approach most types of exercise more cautiously than would a young adult. For example, vigorous swimming remains an excellent source of large muscle activity; however, in recommending such a program, care must be taken to ensure that an older individual does not have a history of dizziness, loss of consciousness, or syncopal attacks caused by aortic stenosis or disorders of heart rhythm (26). Postural hypotension (27) can be a source of difficulty on leaving the pool, particularly if hypotensive drugs are being administered; also, an elderly person has an increased risk of slipping on a wet pool deck.

Similarly, cross-country skiing remains an excellent source of winter recreation for the elderly, providing large muscle exercise during the coldest months of the year; nevertheless, a greater vulnerability of the aged to cold (28) and a more ready fracture of bones that have already lost much of their calcium and organic matter through the processes of osteoporosis and osteopenia (29, 30) calls for care, particularly on icy slopes.

Moderate rates of cycling continue to provide a good stimulus to the heart and lungs, but deterioration of vision, hearing, and balance increase the risk of accidents and falls in many older people (31–33), whereas weakening of the thigh muscles can lead to an excessive rise of blood pressure (17) if an older person attempts to hurry the climb up a steep hill or forces the pace against a strong headwind. At the same time, the progressive loss of aerobic power makes fast walking a progressively more effective method of cardiorespiratory training for the elderly. Brisk walking has several advantages over jogging as far as the senior citizen is concerned. The mechanical impact that is sustained by the aging knees and vertebral column is only about a third as great when walking as when jogging, and there is much less danger that a walker will slip or fall. Stress ruptures of aging tendons and bones are also less likely.

Walking is an activity that can be combined with a variety of pleasurable outdoor relaxations, such as a study of the local fauna, flora, or architecture, and this increases the likelihood that motivation, always a problem in exercise prescription, will be sustained. Walking can also be incorporated into the normal weekly round of visits to the shops, library, and local church or synagogue, a technique that lessens the likelihood that the activity will be neglected. Further, the duration of individual walking bouts can be sufficient to help in creating a negative energy balance, thus making appreciable inroads on the middle-aged accumulation of body fat over exercise programs as short as 3 months (34).

In the frail elderly with problems of knee instability, potential alternatives to walking are exercises in a heated pool (35) and chair exercises (36).

Training Plan

Although a clear experimental proof of the optimal regimen has yet to be provided, most exercise physiologists seem agreed that an effective

training plan stresses an individual to at least 60% of maximum oxygen intake for 30 minutes or more per session (21); this implies increasing the heart rate of the exerciser about 60% of the way from the resting to the maximum value. If the intent of the program is to develop cardiorespiratory fitness, sessions are recommended 4–5 times per week, whereas at least 3 sessions per week are desirable for the maintenance of physical condition (37).

If these general principles of exercise prescription are applied specifically to elderly patients, some modifications may be necessary. If the person concerned has been inactive for many years, an exercise intensity equivalent to 60% of maximum oxygen intake may initially prove too vigorous; however, in such individuals, a slow training response may result from a surprisingly low intensity of exercise, perhaps as little as 50% of maximum oxygen intake (25). The patient may also find it difficult at first to sustain vigorous activity over a 30-minute session. An initial target prescription might thus be to cover a distance of 0.8 km (half a mile) in 15 minutes. The time allowed to walk this distance could be progressively shortened to 10 minutes over a couple of weeks; if this amount and intensity of effort are tolerated without difficulty, the measured distance could then be extended to 1.6 km (1 mile), to be covered in 20 minutes. The time allowed would next be reduced progressively to 15 minutes for the same distance, and the distance would then be extended to 2.4 km (1.5 miles). By prescribing alternately an increasing speed and an increasing distance, the patient could gradually be brought to the desired target of covering 3.2–4.0 km (2–2.5 miles) in 30 minutes on a regular basis (38). Occasional duplication of the exercise sessions on good walking days would soon enable the exerciser to enjoy a worthwhile country walk of 6.4–8 km (4–5 miles), provided that a generous lunchtime rest period was allowed.

Formal stretching and warm-up exercises are less essential for walking than for a jogging program. Nevertheless, the first few minutes of exercise should be kept to a moderate walking pace, with the patient picking up speed once the limbs have become comfortably warm. Likewise, if the body becomes hot over the exercise period (as it should do if an effective dose of training has been undertaken), the final few minutes of activity should be devoted to a "warm-down" at a progressively slower speed. The warm-down allows opportunity for a return of fluid from the legs to the central part of the circulation, reducing the likelihood that fainting or abnormalities of cardiac rhythm will develop during the recovery period (39). A warm-down also helps to remove lactate from muscles that have been working beyond their anaerobic threshold (40), and it lessens the chances that the active parts will develop stiffness and muscle pain. The ideal dose of exercise should leave the patient no more than comfortably tired the following day.

Training Response

There has been considerable discussion of the likely response of an elderly person to a training program. Some of the reactions associated with

effective training, such as a thickening of the ventricular wall and a development of limb muscle mass, plainly require the synthesis of new protein, and it might be imagined that such changes would proceed more easily in a young person than in an older person.

There is probably some truth to this view, and if gains of fitness are expressed in absolute terms, the response to a given dose of training is certainly reduced with aging (25, 41, 42). Nevertheless, senior citizens can make substantial gains of both oxygen transport and muscle strength in response to a vigorous and progressive training regimen. Indeed, in percentage terms, the gains are as large as would be anticipated in a young adult. Moreover, the flexibility of the joints is improved, much of the adult accumulation of subcutaneous fat is metabolized (34), and the loss of minerals from the limb bones is checked if not corrected (43, 44).

Although a master's class athlete ages at about the same rate as a sedentary person (24), the training effect is such that on any given birthday he or she has a functional capacity corresponding to that of a sedentary person who is 10 or even 20 years younger (1). Regular exercise does not increase the age at death by more than 1–2 years (45), but the period of independent living is likely to be substantially extended (46). This has enormous practical implications for both the happiness of the senior citizen and the budget of those who must ultimately provide any necessary institutional care (47).

Environmental Concerns

Age reduces the individual's ability to adapt to an adverse environment. The older person must thus be more cautious when exercising in extremes of either heat or cold.

It is well established that heat waves in the United States are associated with an increased death rate among the elderly (48–50). Under hot environmental conditions, it is necessary to direct blood flow to the skin (to dissipate heat) as well as to the working muscles; this requirement imposes an added workload on the heart at all ages, and a proportion of the more vulnerable individuals succumb to the added stress. The risks of the North American summer are still not sufficiently appreciated. However, a combination of a hot, humid afternoon, bright sunlight, and inadequate fluid replacement can severely tax the cardiac reserve of a senior citizen who has incurred some coronary atherosclerosis (14). A poor sweating response because of lack of recent training, obesity, and an unwillingness to wear minimal light clothing compound the problem.

Cold weather can be equally hazardous for the elderly. Poor peripheral circulation increases the chances of frostbite and other local cold injuries. Inhalation of cold air may provoke bronchial spasm, overloading respiratory muscles that are already hard-pressed by chronic chest disease. Stimulation of the nerve endings in the airway and vasoconstriction of the skin blood vessels may also induce anginal pain in a cold environment. Icy sidewalks add further danger to many types of outdoor activity during the winter months. Also, the elderly are particularly vulnerable to hypothermia (28), the cold-induced syndrome of confusion, irrational be-

havior, and death. If the weather is very cold, an older person often lacks the fitness that would allow him or her to exercise at a sufficient rate to sustain body temperature. Excessive body cooling arises not only from exposure to high winds and ultralow temperatures but also from a loss of insulation in clothing (as a result of soaking by sweat, rain, spray, and falls into icy lakes). The thickness of the clothing that is worn should be carefully matched to the intended rate of exercise to provide adequate insulation while avoiding an accumulation of sweat and thus a degradation of insulation during the more vigorous phases of an exercise prescription.

Testing and Detailed Supervision of Activity Programs

Excessive preliminary testing and detailed medical supervision of the elderly exerciser tend to be counterproductive. Most elderly patients are affected by 1 or more chronic disorders, and in younger persons these conditions might be regarded as relative or even absolute contraindications to participation in an unsupervised training program. However, with a very few exceptions, both elderly patients and their advisers are overcautious, and the need is to increase rather than to restrict their activity.

Provided that the patient is encouraged to do just a little more than has been habitual, and that this is accomplished without inducing symptoms, it is unlikely that the overall life expectancy is shortened by the prescribed exercise. Moreover, in terms of quality-adjusted life expectancy, prospects are greatly improved by regular exercise. A much broader range of interests is available to the active individual, and it is likely that the age of institutionalization will be set back by quite a number of years. Detailed laboratory testing, medical supervision, and possible restriction of activity are thus required only by (1) an occasional patient who wishes to train hard for master's competition, and (2) persons with major symptomatic disease.

Overall Recommendation

Despite traditional concerns about the safety of exercise programs for the elderly, moderate recreational activities such as regular brisk and sustained bouts of walking can do much to develop and to sustain the fitness of an older person. Aging tissue will not be replaced, nor is there any guarantee that the overall life span will be extended. Nevertheless, functional capacity will be increased by the equivalent of up to 10–20 years, with a corresponding increase of immediate life satisfaction and enhancement of the quality of the remaining years of survival. There is also likely to be some decrease in the period for which costly institutional care is required.

Design of an appropriate exercise prescription for the senior citizen must take due account of the individual's experience and training potential. It must also recognize any physical limitations, noting the risks of overrapid progression of training and vulnerability to extremes of heat and cold. However, physicians should accept that moderate physical ac-

tivity is a normal part of daily living for an older person, and they should encourage participation rather than constrain it by unnecessary restrictions, prohibitions, and the use of medical technology.

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