DOCUMENT RESUME

ED 180 976 SP 015 280

TITLE Implementation of Aerobic Programs.
INSTITUTION American Alliance for Health, Physical Education, Recreation and Dance (AAHPERD).
PUB DATE 79
NOTE 124p.; Papers presented at the Naticnal Conference on Aerobic Exercise: Scientific Basis and Implementation of Programs (Tulsa, OK, October 12-14, 1978)
AVAILABLE FROM American Alliance for Health, Physical Education, Recreation, and Dance, 1201 Sixteenth Street, N.W., Washington, D.C. 20036 ($5.50)

EDRS PRICE MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS Biomechanics; Business; Exercise (Physiology); *Health Education; Injuries; Jogging; *Physical Fitness; *Program Development; Public School Systems; Secondary Education; Sex Differences; *Teaching Methods; Testing
IDENTIFIERS *Aerobic Exercise

ABSTRACT

This information is intended for health professionals interested in implementing aerobic exercise programs in public schools, institutions of higher learning, and business and industry workplaces. The papers are divided into three general sections. The intrcductory section presents a basis for adhering to a health fitness lifestyle, using arguments drawn from previous research. The second section establishes a scientific basis fcr the physiological benefits of a carefully designed aerobic exercise program, and the third portion presents methods of program implementation. Differences between male and female physiological response to aerobic conditioning are discussed. (LH)

IMPLEMENTATION OF AEROBIC PROGRAMS

Presented at the National Conference on "Aerobic Exercise: Scientific Basis and Implementation of Programs" held at Oral Roberts University, Tulsa, Okla., 1978.

1201 Sixteenth Street, N.W.
Washington, D.C. 20036

$5.50
Stock No. 248-26474

Preface

These papers were presented at a national conference on "Aerobics Exercise: Scientific Basis and Implementation of Programs" which was cosponsored by the Physical Fitness Council of AAHPERS and Oral Roberts University. The conference was held on the campus of Oral Roberts University, Tulsa, Okla., October 12-14, 1978. It attracted 170 participants from the United States and Canada.

Many requests have been received from persons unable to attend the conference for papers and materials presented. This volume is an effort to consolidate information for those allied health professionals interested in implementing aerobic exercise programs in public schools, colleges and universities, and business and industry.

The physical fitness council played a major role in planning the conference with Raymond A. Ciszek, AAHPER staff liaison for the council, coordinating planning of the meetings and obtaining the necessary approvals from the alliance. Steve Blair, Russell Pate, David Cundiff, Paul Brynteson, and Kenneth Metz made significant contributions to the planning and arrangements. Special thanks to the Office of University Relations at ORU for editing, compiling, and printing this volume for publication by AAHPER.

The papers are in three general sections:

Section I: Introduction (presents the basis for adhering to a health fitness life-style)

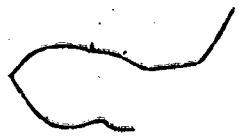
Section II: Scientific Basis (presents the physiological benefits of properly prescribed aerobic exercise)

Section III: Methods (presents methods of implementation of aerobic exercises in business and industry, public schools and colleges and universities)

David E. Cundiff, Ph.D.
Editor and Coordinator

Table of Contents

I. INTRODUCTION



A Total Health-Fitness Life-Style

By Steven N. Blair, P.E.D.
Professor of Health and Physical Education
University of South Carolina

Our human ancestors have been on this planet for perhaps 2 million years. For 99.5 percent of that time they existed as hunters and gatherers. The development of agriculture began some 10,000 years ago; we have had cities for about 8,000 years, and our dependence on fossil fuel came about only within the past few hundred years. Today's modern technological society with nuclear energy and computers has developed within our short lifetimes. The life-style of modern Americans is so different from that of our hunting and gathering ancestors that we can scarcely comprehend it.

Few hunting and gathering societies are left, but those still extant can tell us something about how our ancestors lived. The bushmen of the Kalahari have been studied and provide some insight into those earlier life-styles. Although their lives are difficult by our standards, particularly during the dry season, they appear to be healthy and happy. The major tasks, of course, are concerned with obtaining food and water. Shelter in their mild climate is not a problem. Clothing needs are few and simple (the fashion houses of Paris and New York are unknown and there is apparently no planned obsolescence). There is no mass advertising to create artificial needs for worthless products and no department stores for purchasing them, therefore their material possessions are few.

The hunting and gathering tasks are somewhat physically demanding, although not overly arduous. The duration, frequency, and intensity of this enforced exercise prescription is apparently adequate to maintain a lean body and appropriate levels of physical fitness.

The bushmen appear to have ample time and inclination for singing, dancing, and storytelling as leisure activities. They also spend considerable time resting in the shade in camp. By and large they appear to have a simple yet pleasant life. This is possible even though they have been pushed into one of the most inhospitable geographical areas of the globe. It is easy to imagine that the earlier hunters and gatherers, who had access to the lush savannas and semitropical areas full of game and vegetation, had an even more enjoyable existence.

It is occasionally fun to ask philosophical questions and let the mind play with answers. We frequently hear the term "quality of life." What does it mean? How can quality of life be defined? What is optimal quality of life? Are we really any better off than our hunting and gathering ancestors in terms of quality of life? Civilization has brought many advances for humankind, but there are also negative developments. The high technology that provides us with modern creature comforts has also provided the means to destroy the planet. It matters little whether this occurs suddenly in nuclear holocaust or by degrees in the form of resource depletion and pollution. The bushmen seem rather happy and well-adjusted; is our quality of life superior? Civilization has produced art, music, and literature for uplifting human spirit and intellect. It has also produced feminine-hygiene spray, dozens of plastic kitchen or home appliances advertised on late night TV, and a materialistic society that cries more, more.

My conclusion is that man's technology has outstripped his evolution. We simply are not meant to live as we do in highly developed, technological overkill that exists in the industrialized world. Of course, we cannot all suddenly become hunters and gatherers, nor do I advocate a destruction of civilization and a return to those simpler times. What I am suggesting, however, is that many of our current problems, and I will focus on health matters, can best be understood when interpreted in the perspective of historical anthropology. Perhaps some life-style changes can be made that will simplify our lives, improve our health, and at the same time permit continued enjoyment of the high culture produced by several thousand years of civilization.

Life-Style, Health Problems, and Health Status

Most of us learned some common-sense health rules from our parents, grandparents, and doting aunts and uncles. Don't eat between meals. Breakfast is the most important meal of the day. Smoking will stunt your growth. Don't get fat, and so on ad nauseum. As we became educated we began to doubt these statements as lacking scientific proof and dismissed them as old wives' tales. Now it appears that those concerned relatives and friends were right after all, and we can support those concepts with evidence.

Recent research from all three avenues of medical research (clinical, epidemiological, and experimental) implicate many health habits as etiological factors in a wide variety of major disease problems.

Cigarette smoking probably causes more morbidity and excess mortality each year than any other single health habit. This one habit has been convincingly implicated as a contributing cause to chronic lung disease, various types of cancer (especially lung), coronary heart disease (CHD), and other circulatory ailments. Literally hundreds of studies on smoking and health are published annually around the world, and summaries of this research are readily available.[2,3]

A second major health behavior specifically linked to various ailments is the broad category of diet. The eating pattern is admittedly one of the two major components to energy balance (the other being physical activity) and as such, a contributor to obesity. Obesity has been recognized as a major public health problem in the United States[4,5,6,7] and a contributor to various diseases.[8,9,10]

The eating pattern is also thought by many to be related to CHD. Research over the last two or three decades has shown that the high-calorie, high-fat, and high-cholesterol diet of Americans causes high levels of blood lipids, especially cholesterol. These lipid abnormalities are definitely related to the development of atherosclerosis, the major cause of heart attack and stroke.[11,12,13] These findings meet the criteria for determining causal relationships between risk factors and disease.[11] It is important that controlled experimental studies now provide us with reasonable explanations of pathogenetic mechanisms to support the earlier epidemiological and clinical findings.[14]

The American diet is also perhaps related to certain cancers. The second-leading cause of cancer mortality is colorectal cancer,[15] for which diet has been suggested as a cause.[16,17,18,19] Diet has also been tentatively linked to cancer of the stomach, breast, and uterus.[19]

A third major life-style component related to health is physical activity. Sedentary living produces low levels of physical fitness or physical work capacity (PWC).[20] Work physiologists frequently express PWC in METS. One MET equals the amount of energy expended in a resting state, 10 METS refers to an energy expenditure of 10 times resting. Sedentary adult Americans typically have a PWC of 7-9 METS.[20] Since sustained work capacity for 12-16 hours is probably limited to 15-20 percent of PWC,[22] the average sedentary person can average only 1.5-2.0 METS over the course of a day without fatigue. Trained persons not only have a higher PWC, they can use a greater fraction of it over long time periods. Thus, it seems reasonable to conclude that many sedentary persons are so unfit that it limits their ability to enjoy life. Numerous worldwide epidemiological studies have shown that more active groups tend to have less CHD.[23,24,25,26] Although these studies tended to have methodological flaws,[25,27] and additional work needs to be done, it appears that it is better to be active than sedentary.[28]

Regular physical activity has also been linked with a reduction in obesity,[28,29] prevention of low-back pain,[20] as an antidote for "stress,"[31,32] and "feeling better."[33]

Other life-style components can obviously affect health and well-being. Violent deaths due to accidents and homicides are a major problem.[34] Although many of the causes are difficult to identify, it is evident that lack of safety consciousness (failure to wear seat belts, for example) or drug abuse (especially alcohol) are prime candidates.

It is also difficult to ascertain how many Americans succumb to ennui or are "just in a rut." They drift through life without fully experiencing "joie de vivre." The causes of these symptoms are probably impossible to identify, but it is safe to say that persons in that condition are certainly not functioning at top social and emotional health. Are there life-style components related to these problems? Perhaps. Perhaps not. But it would be interesting to see if the symptoms would disappear if the other more tangible health behaviors discussed previously were practiced.

Several reports on the relationships between health practices and health status have been published by the California Human Population Laboratory.[35,36,37,38] More than 6,000 persons randomly selected from Alameda County (Oakland), California, were surveyed for health status (physical, mental, and social) and health practices. They were followed for 5 years to determine mortality rates. Summary findings from these studies indicate a definite relationship between health practices and longevity. Seven significant health practices were identified: (1) eating breakfast, (2) eating regularly with no snacks, (3) eating in moderation, (4) smoking abstinence, (5) moderation in alcohol consumption (if drinking at all), (6) engaging in regular physical exercise, and (7) regularly sleeping 7-8 hours a night. The researchers found that 45-year-old males who followed 0-3 of these habits could expect to live to age 67; those who followed 4-5 habits could expect to live to age 73; and those who followed 6-7 habits could expect to live to age 78. The data for 45-year-old women showed a similar trend; however, the difference in life expectancy between the top and bottom groups was 7 years rather than the 11 years for men.

These studies tend to support the notion of the relationship between health practices and health. This certainly seems clear and straightforward, but in science it is necessary sometimes to confirm the obvious.

Studies like the ones discussed previously have given a great impetus to the concept of preventive health practices. It appears to be an idea whose time has come. One can scarcely pick up a scientific journal from the health or medical disciplines without finding an article or editorial suggesting that CHD or cancer can and should be prevented.[35,39,50] Politicians have also joined this movement.[51,52]

The most comprehensive and organized approach to the issue of preventive health practices has been presented by the Canadians.[53,54,55] Their approach to "Operation Life-Style" states (among other things) that:

1. It is better to be slim than fat.
2. It is better not to smoke cigarettes.
3. Excessive use of medication is to be avoided.
4. Exercise and fitness are better than sedentary living and lack of fitness.
5. Alcohol is a danger to health, particularly when driving a car.

I have tried to show that there are readily identifiable common-sense health practices that should be followed. If this is done, it is reasonable to expect improved health and longer life. It is perhaps also necessary to point out the obvious, that the responsibility for these life-style changes rests with the individual. A recent editorial in the Journal of the American Medical Association states, "Perhaps the most promising potential for improving the public health resides in what people can be motivated to do for themselves."[56] That is sound advice.

Major societal issues are on the circumference of the circle. It is my contention that these issues are related in part to the major causes of morbidity and mortality listed in the first ring of the circle. These health problems are further related to the intermediate steps depicted in the next ring. Finally, I propose that the health practices listed in the center are major causative factors related to the health problems and issues displayed in the model. It is also perhaps possible to extend the reasoning at least one more step. The initiation, establishment, and maintenance of these health practices is complicated. They are probably dependent upon environmental, cultural, and personal factors and situations. Horn's model for Personal Choice Health Behavior is a theoretical example of how these factors interrelate.[57] The application of this and other models will be discussed later.

Efficacy of Prevention -- Developing a Healthful Life-Style

If one agrees with our previous arguments, it is clear that Americans would benefit from changing certain health behaviors. In the minds of many, however, that assumption meets a major stumbling block. A widely held pessimistic view is that persons are unable to change these habits of long standing. Folk wisdom indicates, "you cannot teach an old dog new tricks," "you cannot change human nature," "people will not change health habits," or "more people are smoking now than ever before." I recognize that health-habit changes are not easy, but neither are they impossible. Americans are becoming more and more health conscious, in my opinion, and are making changes in greater and greater numbers. I will present some of the available evidence on trends for some of these habits, but perhaps a personal observational example illustrates the concept just as well. I have lived at my current address in Columbia for 6 years. When we first arrived, my wife and I were essentially the only joggers in the neighborhood. Now you see joggers going down my street from 6 a.m. to 11 p.m. At any time I doubt that you would have to wait more than a few minutes to see the next one. I cannot quantify the amount of change in jogging behavior in my neighborhood, but I feel confident that it is simply astounding. It is also encouraging that all ages, sizes, ability levels, and both sexes are represented.

The proposition that people want to change health habits, are trying to change, and are being somewhat successful can be supported with hard evidence. It is clear that the studies reported represent isolated individual attempts at addressing the problem. We have not yet mounted a comprehensive, organized, and aggressive campaign, as has been proposed in Canada.[55] It is encouraging, however, that these individual projects are showing some positive results, and even more exciting to think about what can be done with an all-out effort.

One Swiss study offers hope for changing behavior in adolescence.[58] This 4-year prospective study involved 120 male apprentices in machine factories. The subjects were assigned to a control group (N=60) and an experimental group (N=60). The subjects in the experimental group received a program of health education consisting of lectures and exhibits. Leisure-time physical activities were also encouraged. The findings after 4 years were impressive as shown in Table 1.

Table 1
Changes in Health Behavior Over 4 Years

	Cigarette Smoking		Alcohol Use	
	Initially	At end	Initially	At end
Experimental group	24	25	26	33
Control group	28	47	29	55

These data clearly show that the health-education program did not cause smokers and drinkers to quit, but it did apparently prevent the experimental subjects from starting the habits. The participants also engaged in more physical activity, showed greater improvements in measures of physical fitness, and had fewer dental caries.

The Stanford University "Three-Community Study" has demonstrated that entire communities can be persuaded to change health behaviors.[59,60] In this study, one community was assigned as a control, one received health education via mass media, and the third received the mass-media campaign plus intensive intervention. The intensive intervention consisted of selecting 100 high-risk participants who were offered face-to-face intervention from behavioral scientists and dieticians. In the two experimental communities the mass-media campaign was directed by specialists in communications, medical science, and behavioral science.

The study design required a behavioral interview and a medical examination in all three communities. Surveys were conducted at baseline and repeat annual examinations for 2 years of follow-up. The behavioral interview consisted of a health knowledge component and also surveyed attitudes relative to health behavior change. The medical examination included measures of blood chemistry, blood pressure, weight, and ECG. A summary of the results after 2 years revealed no change in health knowledge or health behavior in the control community. The mass-media-only community had significant changes in both knowledge and behavior. The greatest knowledge and behavioral changes occurred in the community receiving the mass-media campaign plus intensive intervention.

The results of this study suggest that mass changes are possible and that they can be done inexpensively.

Although there has been no organized campaign, considerable effort has been expended in antismoking education. The surgeon general's report on smoking and health provided an impetus to smoking cessation efforts by voluntary health agencies and professional organizations.[61] Antismoking spots on television, community campaigns, and quit-smoking clinics have been used. The available data do not permit an analysis to determine specific causes for changes in smoking behavior, but significant changes have occurred.[62] National probability samples have been drawn and surveyed for smoking behavior for the National Clearinghouse for Smoking and Health. These surveys indicate that the prevalence of smoking in adults declined sharply from the mid-1960's to the mid-1970's. Smoking by adult men declined from 52 percent to 39 percent for a drop of 25 percent. For adult women the figures were 32.5 percent to 28.9 percent for a drop of 11 percent. Too many people are still smoking, but it is encouraging that significant decreases have occurred.

Data from the Hypertension and Detection Follow-up Program (HDFP) indicate an improvement in the treatment of hypertension.[63] Control of high blood pressure is demonstrably important but too few hypertensives are adequately treated. Only half the hypertensives are said to be aware of their condition, only half of those are being treated, and of those only half are adequately controlled. This "rule of the halves" predicts that only some 12 percent of the hypertensives are under adequate treatment. Recent studies cast doubt on that model. The HDFP survey found 38 percent of the hypertensives were controlled. Further evidence of this improved control of hypertension is available from Chicago,[64] where recent screening activities discovered only 12 percent previously undetected hypertensives compared to 57 percent 4 years earlier. Control of hypertension had also improved with 59 percent of the hypertensives under adequate treatment compared to only 12 percent 4 years earlier. Control of hypertension had also improved with 59 percent of the hypertensives under adequate treatment compared to only 12 percent 4 years before. These data indicate a remarkable public-health achievement, and demonstrate what can be done with professional education coupled with public emphasis on the dangers of hypertension and the necessity of treatment.

It seems to me that there is ample evidence that the American public is concerned about health matters, and that people are attempting to change undesirable health habits. The crucial question, however, is whether these changes have been meaningful. Evidence suggesting that they have is available in the mortality statistics for the United States for the past 25 years.[66] Total mortality has declined 23.7 percent and cardiovascular mortality has declined 29.7 percent. Most of the decrease in cardiovascular deaths has occurred since 1968. All four major races and both sex groups show similar declines in mortality. Although many possible explanations exist for these decreases, including improved medical and hospital care, it appears reasonable to assume that at least some of the improvement can be attributed to improved risk-factor status. An excellent and extensive review of risk-factor trends and changes in mortality has recently been published by Stamler.[11]

Health Behavior Change -- Why?

The question of what prompts health behavior change has intrigued scientists. What dynamic factors are operating when a smoker of two packs per day for 30 years stops or someone who has been sedentary for two decades since college starts jogging? It is stating the obvious to say, "man is a complex creature, whose behavior is affected by many factors." In order for health behavior change to occur, cognitive and affective components as well as social interactions and environmental conditions are important. Theoretical models attempting to explain these processes have been presented.

Numerous scientists have contributed to the development of the Health Belief Model.[68] This model predicts that preventive health behavior will occur under a specific set of circumstances. A person will attempt to avoid a disease if certain beliefs are held: (1) personal susceptibility, (2) that the disease would be severe, (3) that taking action would be beneficial, (4) that the action will not present significant psychological barriers such as inconvenience or pain. A further component of this model is that some cue to action is important.

A person might fervently hold the beliefs mentioned above and yet not make changes. Something is necessary to push him over the line. This cue to action might be the death of a friend or relative or something less traumatic such as a newspaper article about the disease and the target behavior. Other variables such as age, sex, ethnicity, social class, personality, etc., are also thought to play a role. Examples of the application of the Health Belief Model in behavior change research are available.[66,68]

A model on Encounter in Health Education has been developed by Burt.[56] This model includes a partnership between the health educator and participant. The participant is to evaluate selected life-style components, the health educator is to assist in an orderly evaluation. The major question about any particular life-style component is whether or not it is healthful, actualizing, and happiness promoting. Burt proposes that this evaluation proceed in a systematic fashion by progressing through a series of steps. These steps include separating knowledge from bias, rational from irrational thinking, examining hang-ups and priorities, confirmation or disconfirmation of a belief, and finally accepting or rejecting a particular life-style component. This particular model appears to place more emphasis on the role of the health professional as an agent of change.

A third model, Personal Choice Health Behavior (PCHB) has been presented by Horn.[57] This approach places more emphasis on a comprehensive view of health behavior, and is not limited to cessation of bad habits. According to Horn an individual proceeds through stages of initiation, establishment, and maintenance of a particular behavior. A behavior is more likely to be initiated if there is availability and an example to follow. It has been found, for example, that children of smokers are more likely to become smokers themselves.[70] The establishment of a behavior is influenced by such factors as costs-benefits analysis and psychological factors such as internal-external locus of control. The maintenance of a behavior is dependent, at least in part, or reinforcement, social support, and psychological utility. Cessation, or other modification, of PCHB involves some aspects similar to those presented in the Health Belief Model. Motivation for change may be influenced by one's values. Action may be taken if threat is perceived.

These models, and others similar to them, should help us begin to understand the complex interactions among individuals, their environment, and other demographic variables that relate to health behavior and health behavior change. It is clear to me that educators must move beyond the belief that the educational process will ensure the establishment of a healthful life-style in our students. Students do not stop using drugs after a lecture on drugs and the law by a local policeman. Venereal disease will not be controlled by showing films of syphilitic chancres. All teenagers will not stop smoking after seeing diseased lungs. We will not eliminate sedentary life-styles with lectures about CHD and low-back pain. I do not mean to denigrate the educational efforts that we are making. They are important and necessary, but they must be placed in perspective and fitted into a comprehensive pattern of developing a healthful life-style.

Health Behavior Change -- How?

It would be encouraging to see sweeping changes and comprehensive program recommendations for life-style adjustments come from our institutions. The

federal Government has the resources to implement integrated programs utilizing interdisciplinary support. Coordination of these efforts at higher levels of DHEW and a reordering of priorities would be necessary. Less emphasis, and less money, would need to be placed on treatment and more on preventive efforts. State or local governments through departments of public health, communications, and education could develop similar initiatives. Scholarly and professional associations from the medical, health, and behavioral sciences could also contribute. There are some signs that such developments are under way. News reports indicate that various institutes at NIH are beginning to place more emphasis on preventive health measures. Secretary Califano has made repeated statements regarding DHEW's efforts in smoking control.[71] A consortium of government, professional societies, private industry, and education could have a marked impact on Americans' life-styles, but such a group is unlikely to be formed. In the first place, there is hardly unanimous opinion that these programs should be started. Second, powerful interests such as the tobacco, egg, and dairy industries are likely to actively oppose preventive health programs. Third, the simple problem of overcoming inertia and organizing such a massive program is a Herculean task.

Should we then throw up our hands in despair, and wait for a more opportune time? I think not. The idea of preventing disease and achieving high-level wellness is an idea whose time has come. For example, approximately 90 percent of current adult cigarette smokers say that smoking is hazardous to health and that they would like to quit.[62] Furthermore, most smokers who have quit, did so without professional assistance.[72] Although the data are not available, I doubt that very many of the millions currently jogging began under professional supervision.

I am not suggesting that health professionals have had no effect on the health-behavior changes that have occurred. However, it seems likely that the effects have been indirect. Conducting an exercise class for adults may reach and influence a reasonably small number of people. There is probably a ripple effect as those participants talk to their friends, co-workers, and families, and as they begin to jog through their neighborhoods. Some of them may even start additional classes, or perhaps participate racing events. Professional influence is undoubtedly effective in other ways. Every newspaper interview or TV talk show reaches large numbers of people. Every speaking engagement at a service club, PTA, or other group reaches more. In at least some instances, those efforts may provide the cue to action described in the Health Belief Model.[66]

I would make several recommendations to professionals interested in promoting health-behavior change and high-level wellness.

1. Continue day-to-day responsibilities of teaching, counseling, and conducting research.
2. Keep in mind the niche these activities fill in a total health life-style model.
3. Seek to interrelate your own activities with others.
4. Be cognizant of the interdisciplinary nature of your work, and try to build on the strengths and abilities of others.
5. Utilize the theoretical models describing health-behavior change to plan future directions, new programs, and research.

6. Be a health activist and try to mobilize your community's resources to produce the integrated interdisciplinary programs of health-behavior change.

More specifically, for the worker in aerobic fitness programs, the following suggestions may be helpful.

1. We should attempt to integrate regular physical activity into a total life-style approach to good health. Advise participants in exercise programs about good nutrition, relaxation or stress management techniques, safety consciousness, and the benefits of smoking cessation.
2. Our exercise programs should be based on sound behavioral science principles. Several recent publications provide useful information on this point.[73,78]

   (a) Involve participants in the decision-making process relative to their personal health habits. Introspection and self-observation by the participant can identify potential pitfalls to success. Self-collected data on behavior can be useful in planning the change process.
   (b) Changes in health behavior should be done gradually. Few persons can completely reorganize their lives and change several habits at once. It may take months or even years to implement all desired changes. This slow but steady approach is more likely to produce lasting changes. It is also important to help participants set reasonable goals and understand that the change process will likely be lengthy.
   (c) Professional support over long periods of time is important. Many behavior change programs fail because of lack of follow-up. Maintain contact with participants via post cards, telephone, newsletters; have them keep a diary or log and send it to you; and have occasional reunion or booster meetings.
   (d) The health professional should work to develop and improve counseling and communication skills. Ask open-ended questions that elicit more than a yes or no response, be open, honest, and assume an assertive approach to the counseling session.
   (e) Finally, be liberal in the use of positive reinforcement and support. Seek ways to provide feedback. Help the participant to design intrinsic and extrinsic systems of support and reinforcement. Use families and friends to provide this support.

3. It may also be useful to base your approaches on some particular health behavior change model. Read the papers on models, think about the various approaches, and discuss them with your fellow workers. An example of how this approach might be used is given for Horn's PCHB model in relation to regular physical activity. In this case the application of the model is for developing a positive health habit, so only the first three stages are applicable.

If one were to design an existence in which persons were to be likely to initiate regular activity, what would you do? According to the PCHB model, opportunities for activity should be readily available, examples should be evi-

dent, and perhaps it should be rewarding (either physically or emotionally). To meet those criteria for our example, one approach would be to make it convenient to exercise. This could mean plenty of facilities such as tennis courts, bike and jogging trails, swimming pools, etc. It might also be possible to concomitantly make it less convenient not to exercise; for example, sidewalks and paths rather than streets leading to shopping and recreation areas. It is important to have highly visible examples. Adoption of a new or innovative behavior or practice follows an S-shaped, exponential growth curve.[79] As more people adopt a behavior, the more likely others are to adopt it, at least until most of the population has changed and only a few die-hards are left.

According to the PCHB model a behavior may become established as a result of a costs/benefits analysis. For the case of exercise, if persons begin to feel good (both physically and emotionally) about their participation, and if costs (giving up time or disrupting schedules) are minimal, then the activity is more likely to become established. A perceptual stereotype may also develop. If a person begins to see himself or herself as an exerciser and like other exercisers, the habit may continue. Various psychological factors may also be important. If one receives positive reinforcement, the exercise is likely to be more firmly established.

Maintenance

According to Horn, at some point in time either habituation or dependence becomes operative and the person is likely to maintain the behavior. I suppose that would be debatable as to whether regular runners become dependent or habituated. My feeling (in the absence of any data) is that they probably do both.

The foregoing discussion is a brief example of how a theoretical model may be used to plan and implement health behavior change projects. The creative and dedicated professional can think of many expansions and applications of some of the ideas.

Summary

I have tried to illustrate that the current American life-style contributes to our major health problems. In order for us to achieve high-level wellness certain health behaviors need to be changed. This message has been accepted by large numbers of Americans. Many beneficial changes have occurred in recent years and the mortality statistics show a decline. Organized programs for health behavior change have demonstrated success, but much remains to be done. Health status of Americans will improve if citizens take the responsibility for their own health and if dedicated health professionals serve as catalysts to promote changes in life-style.

Bibliography

1. Thomas, E.M.: The harmless people. New York, Vintage Books, 1959.

2. Department of Health, Education, and Welfare: The health consequences of smoking. Washington, U.S. Government Printing Office, 1975.

3. Department of Health, Education, and Welfare: Bibliography on Smoking and Health. Atlanta; Center for Disease Control, 1977.

4. Blair, S.N.: What does scientific research indicate in regard to overweight? SC J. Health Phys. Educ. Rec. 5:9-11, 1972.

5. Department of Health, Education, and Welfare: Obesity and health. Washington, U.S. Government Printing Office, 1966.

6. Mann, G.V.: Obesity -- the affluent disorder. So Med. J. 70:902-903, 1977.

7. Levinson, M.L.: Obesity and health. Prev. Med. 6:172-180, 1977.

8. Rabkin, S.W., Mathewson, F.A.L., Hsu, P.H.: Relation of body weight to development of ischemic heart disease in a cohort of young North American men after a 26-year observation period: The Manitoba study. Am. J. Cardiol. 39:452-458, 1977.

9. Fajans, S.S. (ed.): Diabetes mellitus. Washington, U.S. Government Printing Office, 1976.

10. Bray, G.A. (ed.): Obesity in perspective. Washington, U.S. Government Printing Office, 1973.

11. Stamler, J.: Life-styles, major risk factors, proof and public policy. Circulation 58:3-19, 1978.

12. Keys, A.: Coronary heart disease -- the global picture. Atherosclerosis 22:149-192, 1975.

13. Intersociety Commission for Heart Disease Resources: Primary prevention of the atherosclerotic diseases. Circulation 42:A55-A95, 1970.

14. Marx, J.L., Kolata, G.B.: Combating the No. 1 Killer. Washington, American Association for the Advancement of Science, 1978.

15. Levin, D.L., Devesa, S.S., Godwin, J.D. II et al.: Cancer rates and risks, 2nd ed. Washington, U.S. Government Printing Office, 1974.

16. Berg, J.W.: Diet, in Fraumeni, J.F., Jr. (ed.): Persons at high risk of cancer, New York, Academic Press, 1975, p. 201.

17. Wynder, E.L.: Overview: Nutrition and cancer. Prev. Med. 4:322-327, 1975.

18. Dunn, J.E., Jr.: Cancer epidemiology in populations of the United States -- emphasis on Hawaii and California -- and Japan. Cancer Res. 35:3240-3245, 1975.

19. Wynder, E.L., Gori, G.B.: Contribution of the environment to cancer incidence: An epidemiologic exercise. J. Natl. Cancer Inst. 58:825-832, 1977.

20. Pollock, M.L.: The quantification of endurance training programs, in Wilmore, J.H. (ed.): Exercise and Sports Sciences Reviews, Vol. 1, New York, N.Y., Academic Press, 1973, p. 155.

21. Falls. H.B.: The relative energy requirements of various physical activities in relation to physiological strain, in Parmley, L.F., Jr., Blair, S.N., Gazes, P.C., et al. (eds.): Proceedings of the national workshop on exercise in the Prevention, in the Evaluation, in the Treatment of Heart Disease. J. SC. Med. Assn. 65 (Suppl. 1), 1969.

22. Astrand, P.O., Rodahl, K.: Textbook of work physiology. New York, N.Y., McGraw-Hill, 1970.

23. Pate, R.R., Blair, S.N.: Exercise and the prevention of Atherosclerosis: Pediatric implications, in Strong, W. (ed.): Atherosclerosis: Its pediatric aspects. New York, Grune and Stratton, 1978.

24. Fox, S.M., Naughton, J.P., Haskell, W.L.: Physical activity and the prevention of coronary heart disease. Ann. Clin. Res. 3:404-432, 1971.

25. Froelicher, V.F., Oberman, A.: Analysis of epidemiologic studies of physical inactivity as a risk factor for coronary artery disease. Prog. Cardiov. Dis. 15:41-65, 1972.

26. Leon, A.S., Blackburn, H.: The relationship of physical activity to coronary heart disease and life expectancy, in Milvy, P. (ed.): The marathon physiological, medical, epidemiological, and psychological studies. New York, The New York Academy of Sciences, 1977.

27. Keys, A.: Physical activity and the epidemiology of coronary heart disease, in Bruner, D., Jokl, E. (eds.): Physical activity and aging. Baltimore, University Park Press, 1970, p. 250.

28. Montoye, H.J.: Physical activity and health: An epidemiologic study of an entire community. Englewood Cliffs, N.J., Prentice-Hall, 1975.

29. Oscai, L.B.: The role of exercise in weight control, in Wilmore, J.H. (ed.): Exercise and Sport Sciences Reviews, Vol. 1, New York, Academic Press, 1973, p. 103.

30. Kraus, H., Raab, W.: Hypokinetic disease. Springfield, Ill., Charles E. Thomas, 1961.

31. Fox, S.M. III: Is exercise an antidote for stress, in Hendrix, G.H., Caston, J.C., Irvin, C.W., Jr. et al. (eds.): Proceedings of the national conference on emotional stress and heart disease. J. SC. Med. Assn. 72:1-6, 1976.

32. Saunders, D., Williams, R., Jr., Miller, M. et al.: Intervention in emotional stress, in hendrix, G.H., Caston, J.C., Irwin, C.W., Jr. et al. (eds.): Proceedings of the National Conference on Emotional Stress and Heart Disease. J. SC. Med. Assn. 72:78-81, 1976.

33. Durbeck, D.C., Heinzelmann, F., Schacter, J. et al.: The National Aeronautics and Space Administration -- U.S. Public Health Service evaluation and enhancement program.. Summary of results. Am. J. Cardiol. 30:784-790, 1972.

34. National Center for Health Statistics: Vital statistics of the United States, 1970. Washington, U.S. Government Printing Office, 1970.

35. Breslow, L.: A quantitative approach to the World Health Organization definition of health: physical, mental, and social well-being. Int. J. Epidemiol. 1:347-355, 1972.

36. Breslow, L.: A policy assessment of preventive health practice. Prev. Med. 6:242-251, 1977.

37. Belloc, N.B., Breslow, L.: Relationship of physical health status and health practices. Prev. Med. 1:409, 1972.

38. Clark, H.H. (ed.): Health practices and physical health status. Phys. Fit. Res. Digest 6:1-11, 1976.

39. Gori, G., Peters, J.A.: Etiology and prevention of cancer. Prev. Med. 4:239-246, 1975.

40. Newell, G.R.: The challenge to cancer control. Prev. Med. 3:307-311, 1974.

41. Ball, K.P., Turner, R.: Realism in the prevention of coronary heart disease. Prev. Med. 4:390-397, 1975.

42. Blackburn, H.: Concepts and controversies about the prevention of coronary heart disease. Postgrad. Med. J. 52:417-423, 1976.

43. Blackburn, H.: Coronary disease prevention: Controversy and professional attitudes. Adv. Cardiol. 20:10-26, 1977.

44. Blackburn, H.: Coronary disease prevention: Practical approaches to risk factor changes. Adv. Cardiol. 20:1-9, 1977.

45. Dock, W.: Atherosclerosis: Why do we pretend the pathogenesis is mysterious? Circulation 50:747-749, 1974.

46. Haggerty, R.J.: Changing life-styles to improve health. Prev. Med. 6:276-289, 1977.

47. Hilbert, M.S.: Prevention. Am. J. Pub. Health 67: 353-356, 1977.

48. Ho'land, W.W.: Prevention: The only cure. Prev. Med. 4:387-389, 1975.

49. Turner, R., Ball, K.: The cardiologist's responsibility for preventing coronary heart disease. Am. Heart J. 91:139-147, 1976.

50. Arnold, C.B., Banta, H.D.: Forum: Social policy for the primary prevention of illness: Introduction: Lessons from the past, deliberations about the future. Prev. Med. 6:191-197, 1977.

51. Carter, J.: Address to APHA. The Nation's Health, Nov. 1976.

52. Kennedy, E.M.: Preventive medicine: What it can mean for you. Fam. Health pp. 40-42, 62-64, Jan. 1978.

53. Gellman, D.D., Lachaine, R., Law, M.M.: The Canadian approach to health policies and programs. Prev. Med. 6:265-275, 1977.

54. Lalonde, M.: Beyond a new perspective. Am. J. Pub. Health 67:357-360, 1977.

55. Lalonde, M.: A new perspective on the health of Canadians. Ottawa, Trigraphic Printing, 1975.

56. Aring, C.D.: On improving the public health. JAMA 239:2557-2558, 1978.

57. Horn, D.: A model for the study of personal choice health behavior. Int. J. Health Educ. 19:3-12, 1976.

58. Beiner, K.J.: The influence of health education on the use of alcohol and tobacco in adolescence. Prev. Med. 4:252-257, 1975.

59. Stern, M.P., Farquhar, J.W., Maccoby, N. et al.: Results of a two-year health education campaign on dietary behavior: The Stanford three-community study. Circulation 54:826-833, 1976.

60. Maccoby, N., Farquhar, J.W., Wood, P.D. et al.: Reducing the risk of cardiovascular disease: Effects of a community-based campaign on knowledge and behavior. J. Comm. Health 3:100-114, 1977.

61. Surgeon General of the United States: Smoking and health. Report of the Advisory Committee to the Surgeon General of the Public Health Service. Washington, U.S. Government Printing Office, 1964.

62. Department of Health, Education, and Welfare: Adult use of tobacco -- 1975. Washington, U.S. Government Printing Office, 1976.

63. Hypertension Detection and Follow-up Program Cooperative Group: Blood-pressure studies in 14 communities. JAMA 237:2385-2391, 1977.

64. Berkson, D.M., Brown, N.C., Stanton, H. et al.: The current status of hypertension detection and treatment in Chicago. Circulation 56:170 (Oct., part II), 1977.

65. National Heart, Lung and Blood Institute: Fifth report of the national heart, lung, and blood advisory council. DHEW # (NIH) 78-1418, 1977.

66. Becker, M.H. (ed.): The health belief model and personal health behavior. Thorofare, N.J., Charles B. Slack, 1974.

67. Becker, M.H., Maiman, L.A., Kirscht, J.P. et al.: The health belief model and prediction of dietary compliance: A field experiment. J. Health Soc. Behav. 18:348-366, 1977.

68. Becker, M.H., Nathanson, C.A., Drachman, R.H. et al.: Mothers' health beliefs and children's clinic visits: A prospective study. J. Comm. Health 3:125-135, 1977.

69. Burt, J.J.: Rational selection of life-style components. School Health Rev. 5:4-9, 1974.

70. Department of Health, Education, and Welfare: The smoking digest. Washington, U.S. Government Printing Office, 1977.

71. The Nation's Health. Washington, American Public Health Association, Feb. 1978, p. 1.

72. Department of Health, Education, and Welfare: The smoking digest. Washington, U.S. Government Printing Office, 1977.

73. Martin, G., Pear, J.: Behavior modification: What it is and how to do it. Englewood Cliffs, N.J., Prentice-Hall, 1978.

74. Enlow, A.H., Henderson, J.B. (eds.): Applying behavioral science to cardiovascular risks. New York, American Heart Association, 1975.

75. Shewchuck, L.A.: Smoking cessation programs of the American Health Foundation. Prev. Med. 5:434-474, 1976.

76. Zifferblatt, S.M., Wilbur, C.S.: Maintaining a healthy heart: Guidelines for a feasible goal. Prev. Med. 6:514-525, 1977.

77. Kaplun-Le Meitour, A., Erben, R. (eds.): Nutrition and physical activity: The role of health education. Cologne, The German Federal Centre for Health Education, 1976.

78. Weiss, S.M. (ed.): Proceedings of the National Heart and Lung Institute working conference on health behavior. Washington, U.S. Government Printing Office, 1976.

79. Green, L., Perrin, D.: Summary of discussions and recommendation related to diffusion of nutrition innovations and use of educational technology. In Tillotson, J.L. (coordinator): Proceedings of the nutrition -- behavioral research conference. Washington, U.S. Government Printing Office, 1976.

II. SCIENTIFIC BASIS

Medical Problems Encountered by Women in Aerobic Exercise*

By Dorothy V. Harris, Ph.D.
Professor
Pennsylvania State University

While females are generally 5 inches shorter, 30 to 40 pounds lighter, and 10 percent fatter on the average than males, they respond and adapt to chronic exercise and physical training much as do males. Efforts to determine the quantitative and qualitative differences in response to physical training of males and females have generally demonstrated that observed differences are not mediated by sex but by physical fitness. In short, the differences are influenced more by factors other than biological sex. More differences exist within a sex than between the sexes when fitness levels are controlled.

In spite of the fact that the female does respond to exercise in much the same pattern as the male, she performs at a substantially lower level in almost all athletic contests. In running events (based on 1977 records) the percentage of differences in performance was 9.62 in the 100 meters, 11.02 in the 400 meters, 13.0 in the 1,000 meters, 15.3 in the 2,000 meters, 18.15 in the 10,000 meters, and 17.0 in the marathon. Are these differences truly biological ones, are they only the result of sex differences, or are they reflective of social and cultural restrictions and expectations placed on the female?

Smaller, slower, weaker persons are discriminated against in selection for sports participation. Only about 20 percent of the body types are represented in the Olympics. Generally, there is less difference in the body types of males and females who excel in the same athletic events than there is between males and females in general or perhaps between males who are selected and males who are not. In other words, the high jumper, male or female, who uses the Fosbury flop will be quite similar in body type. Much the same can be said about the basketball player, the marathoner, and so on.

The female matures sooner than the male; 20 weeks after conception she is 2 to 3 weeks more mature and at birth she may be as much as 20 weeks ahead of the male's maturation. This is owing to the fact that the male must wait for "something to be added" or the Y chromosome to indicate that the gonads will be testicles. These cells must mature and multiply sufficiently to begin to produce androgen or the male hormone that will then begin to differentiate to male development. This lag behind the female in development is not closed until the male reaches age 20. Great variation exists in the maturation rate with this being more obvious in the male. Siedenfelt (1978) reported as much as 50 months' difference in maturation among 6-year-old boys and 72 months' difference in 13-year-old boys. Wide variation does not prevail among females, most of whom have reached their mature height and growth soon after the onset of menarche. One cannot recruit a girl from high school for basketball and assume that she will grow several more inches while in college. Most males, however, will continue to grow during those years.

*A similar paper was presented at the Sports Medicine Symposium, Hahnemann Medical School, Philadelphia, Sept. 10-14, 1978.

During late childhood the female may be bigger than her same aged male peer because of reaching her growth spurt sooner. During this time she may be faster and stronger and outperform boys in athletic feats provided she has had the opportunity to learn skills and has been reinforced in a positive manner for her performance and involvement. Once physical maturity has been reached, there are average differences between males and females that have specific implications for athletic performance.

Males, because they mature later, therefore grow longer and are generally bigger than females. The higher levels of androgens (male hormones) also influence development. Males have longer trunk length, broader shoulders, greater muscle development in the shoulder area, and less body fat. Higher estrogen levels (female hormones) in the female close off the epiphyses of the long bones sooner, resulting in lesser height. Body fat is increased with the female being 10 percent fatter than the male. Her hips are broader in relation to her shoulders, she has less muscle mass in the shoulder girdle, and tends to have a longer trunk in relation to length of leg. Body type is also influenced by genetics, nutrition, exercise, and other factors beyond those of the endocrine system.

As indicated, there are average differences between males and females that have specific implications for sport performance. Wilmore and Brown (1974) examined 78 female distance runners and found that 12 had less than 10 percent body fat, 32 less than 15 percent or under that of the average college male. These trained women were significantly less fat than their untrained female peers who have approximately 25 percent body fat. While low body fat may be a genetic endowment, high-intensity endurance-type exercise is also a significant factor. It appears that females can approach relative fat values of male athletes with strenuous training. It also appears that the average fat values of untrained females are higher than ideal; regular exercise could reduce those stores.

A greater percent of body fat in the female provides her with advantages for some activities. She is more buoyant in water and has better insulation in cold temperatures. This combined advantage has enabled females to better the world records in distance open-water swimming. A young Canadian woman swam the English Channel round trip in the fall of 1977 and knocked more than 10 hours off the male record. Dr. Joan Ullyot (1976) said that women "run off their fat," that the additional fat that women have provides them with extra fuel for energy. Women may be able to use their fat stores more efficiently than males. It is possible that they burn a higher percentage of fat mixed with glycogen, thus glycogen lasts longer and females feel better after running a marathon than do males. While the biochemical mechanisms have not been isolated, there appears to be a difference in the adaptation and coping to strenuous endurance-type exercise between males and females.

Strength differences between males and females have traditionally been acknowledged. However, Dr. Jack Wilmore stated that leg strength is nearly identical in the two sexes. When expressed relative to body size it is identical. In fact, when expressed relative to lean body mass, the females are slightly stronger! The difference between males and females in strength is greatest in the shoulders, somewhat less in the trunk, and appears to be similar in leg strength. The female responds to strength training in much the same manner as the male in terms of percent gained. While resistive weight training produces

During late childhood the female may be bigger than her same aged male peer because of reaching her growth spurt sooner. During this time she may be faster and stronger and outperform boys in athletic feats provided she has had the opportunity to learn skills and has been reinforced in a positive manner for her performance and involvement. Once physical maturity has been reached, there are average differences between males and females that have specific implications for athletic performance.

Males, because they mature later, therefore grow longer and are generally bigger than females. The higher levels of androgens (male hormones) also influence development. Males have longer trunk length, broader shoulders, greater muscle development in the shoulder area, and less body fat. Higher estrogen levels (female hormones) in the female close off the epiphyses of the long bones sooner, resulting in lesser height. Body fat is increased with the female being 10 percent fatter than the male. Her hips are broader in relation to her shoulders, she has less muscle mass in the shoulder girdle, and tends to have a longer trunk in relation to length of leg. Body type is also influenced by genetics, nutrition, exercise, and other factors beyond those of the endocrine system.

As indicated, there are average differences between males and females that have specific implications for sport performance. Wilmore and Brown (1974) examined 78 female distance runners and found that 12 had less than 10 percent body fat, 32 less than 15 percent or under that of the average college male. These trained women were significantly less fat than their untrained female peers who have approximately 25 percent body fat. While low body fat may be a genetic endowment, high-intensity endurance-type exercise is also a significant factor. It appears that females can approach relative fat values of male athletes with strenuous training. It also appears that the average fat values of untrained females are higher than ideal; regular exercise could reduce those stores.

A greater percent of body fat in the female provides her with advantages for some activities. She is more buoyant in water and has better insulation in cold temperatures. This combined advantage has enabled females to better the world records in distance open-water swimming. A young Canadian woman swam the English Channel round trip in the fall of 1977 and knocked more than 10 hours off the male record. Dr. Joan Ullyot (1976) said that women "run off their fat," that the additional fat that women have provides them with extra fuel for energy. Women may be able to use their fat stores more efficiently than males. It is possible that they burn a higher percentage of fat mixed with glycogen, thus glycogen lasts longer and females feel better after running a marathon than do males. While the biochemical mechanisms have not been isolated, there appears to be a difference in the adaptation and coping to strenuous endurance-type exercise between males and females.

Strength differences between males and females have traditibnally been acknowledged. However, Dr. Jack Wilmore stated that leg strength is nearly identical in the two sexes. When expressed relative to body size it is identical. In fact, when expressed relative to lean body mass, the females are slightly stronger! The difference between males and females in strength is greatest in the shoulders, somewhat less in the trunk, and appears to be similar in leg strength. The female responds to strength training in much the same manner as the male in terms of percent gained. While resistive weight training produces

large gains in strength in the female, concomitant gains in muscle bulk do not result. In the fall of 1977 a 114-pound female broke the males' lift record in that weight class by lifting 225 pounds. There is much to learn about factors relating to strength, strength development, and maximizing one's potential development in strength.

Efforts to determine qualitative and quantitative differences in the aerobic capacity of males and females have demonstrated that the female has a maximal oxygen uptake that is less than that of the male. In general the level of physical fitness overrides the effect of sex. Hermanson and Andersen (1965) reported that female cross-country skiers had an average of 55 ml/kg min while the average male had 44 ml/kg min. Female athletes have higher oxygen-carrying capacity than untrained male peers. While athletic males are noticeably superior, trained females are 25 percent more efficient than untrained males. Body composition and level of training generally explain the observed differences between males and females. Whether the lean body mass of the female can approach that of the male with the same training is a moot point. The female must deliver oxygen to her fat tissue as well as her working muscle as part of her work load; she cannot leave her fat tissue in the locker room!

In addition to body composition and level of training, other factors influence the maximal oxygen uptake. The female generally has a smaller heart, lungs, chest muscles, blood volume, etc. She compensates for these average differences with the ability to increase her heart rate to levels higher than that observed in most males. Another significant difference is observed in the percent hemoglobin with the female having as much as 10 percent less than the male (Harris, 1977). No significant differences are observed until puberty between males and females. The assumption has been that the female's hemoglobin is reduced through blood loss with menstruation. However, Lamb (1975) reported a 20 percent increase in hemoglobin in castrated male animals when testosterone was injected and concluded that testosterone promoted red blood cell production. It appears that males significantly increase their hemoglobin as testosterone increases and that females do not necessarily reduce theirs through normal menstruation. However, males have approximately one million more red cells than females and can store 850 mg of iron as compared to the female's 250 mg. Compensatory factors do not appear to adjust for this difference in males and females, therefore, some type of iron supplement is frequently recommended for the female athlete.

Russell Lane, M.D., reported in The Jogger, September 1978, that sports anemia in endurance exercise is a result of a training effect brought on by hypervolemia or increased fluid volume. It has been shown that the iron content of sweat during endurance exercise increases somewhat. The cardiac volume is up, and the red-cell mass changes to a lesser extent than either the volume or heart stroke volume. The important change is the increase in the circulating blood volume with the associated lowered blood viscosity and faster flow. The so-called "anemia" may in fact be beneficial to the athlete in providing more rapid delivery of oxygen. Furthermore, Lane suggested that the process must involve some genetic factor to explain the variable appearance and individual difference in response. In some athletes the process seems to outdo itself and lead to clinical and dysfunctional anemia that some have called "maladaptive" training effect. In summary of the issue, it does seem worthwhile to suggest to aerobic exercisers that low hemoglobin may be a positive factor and not necessarily a negative one. Those persons who appear

to be anemic without any symptoms may be members of a select group possessing genetic constitutions to witness this "training effect" in sport rather than needing iron pills for treatment.

Menstruation and factors relating to that process have probably produced more concern and misinformation than any other difference in males and females. Females have made and broken their own personal best performances at all phases of the menstrual cycle. It appears that there is no decrement in performance for females who have made a serious commitment to sport pursuits. However, it is possible that the population is biased toward these women who experienced no impairments. Those who did may have been systematically eliminated.

The 1970's have witnessed an awareness of another pattern of response in females who are training strenuously (Harris, 1977; Brozan, 1978). Perhaps 15 to 20 percent experience secondary amenorrhea or cessation of menstruation. Several theories attempt to explain this response. The percent body fat is the most often expressed rationale. Ullyot (1976) says that it is Nother Nature's way of protecting the female. Because of reduced body fat, for whatever reasons (starvation, disease, exercise, etc.) the body does not have sufficient fat storage to support a pregnancy so the system "shuts down." Frisch (1979) supports this theory to some extent. She developed a method for predicting age for onset of menarche by charting the height and weight of girls every year during their 9 to 13 age span. She concluded that the ratio of lean body weight to fat is an important determinant of sexual maturation in the female. However, this relationship is not a cause-effect one since increasing levels of estrogen cause the female to begin to store body fat as well as triggering the menstrual cycle. In essence, body fat and menarche are both caused by elevating levels of estrogen, therefore, increased body fat is not the cause of the onset of menarche. They coincide!

In several situations a significant decrease in body fat does appear to be related to secondary amenorrhea. Starvation, anorexia nervosa, and a drastic reduction in caloric intake, resulting in a rapid and significant weight loss, produce secondary amenorrhea. At the same time obesity can also cause cessation of menstruation. Other stressful situations such as being in a concentration camp, entering college, experiencing the loss of a loved one, divorce, fear of failure, etc., can also alter the menstrual cycle.

Since reduction of body fat does not hold in all cases of secondary amenorrhea reported, other explanations have to be explored. Females who are on the same training program, who have no significant differences in percent body fat, and who have not lost a significant amount of body fat can be on the same track team. Some of these women will expertence secondary amenorrhea while others will not. Individual differences in response to stress may be the explanation. Why some endure stress without any noticeable changes while others do not seems currently a medical mystery. As Selye suggests, "stress is stress." This may be the case whether that stress is exercise, quick reduction of body fat, emotional stress, competitive stress, or whatever. There is need to examine a whole array of responses to understand why some women experience secondary amenorrhea.

The magnitude of the problem has not actually been established. It appears that several different patterns occur. First, those who have had

normal cycles, then experience secondary amenorrhea with an increase in physical training and exercise, generally resume normal cycles with detraining. In many cases persons did not menstruate for 2 or more years, stopped hard training, resumed their cycles, and had normal pregnancies and deliveries of healthy babies.

Second, some women experiencing cessation of menstruation did not alter their training programs or replace the lost fat tissue, yet their cycles reappeared with time. This would suggest that the body adapted to the stresses placed upon it and accommodated them without long-term endocrine alteration. A 1978 survey study completed at Boulder, Colo., suggests that the percent of those experiencing secondary amenorrhea increases significantly as mileage increases. Running 60 or more miles a week may be the critical factor. At this point no one knows for sure whether exercise per se or low body fat causes the condition. As Dr. John Marshall, cochairman of New York Medical Society's Committee on the Medical Aspects of Sports, said, "The body-fat percentage is not the cause; all kinds of things we don't know about the delicate balance of hormones have an effect. It may have to do with the kind of training, it may be psychological." Certainly, the medical profession does not know.

In response to an article in WomenSports (Harris, 1977) nearly 200 letters relating case studies were received. I must say that I was dismayed at the medical treatment and guesswork that some women were subjected to, not to mention the almost total disregard of even considering that vigorous exercise had anything to do with their secondary amenorrhea. One woman spent 6 years with different physicians experimenting with various tests and theories. She underwent brain scans, injections of hormones, oral hormone medication, and exploratory surgery. Finally, it was concluded that she was "having identity problems and denying her femininity" since nothing irregular or abnormal appeared beyond the fact that she did not menstruate!

While alterations and changes in the female cycle are obvious, males may have similar alterations and not even know about them. A little-known 1973 Finnish study reported in the 1976 British Journal of Steroid Biochemistry involved hormonal assays before and after 11 males running a marathon. Statistically significant changes were observed in several hormones which impact on male sexuality. A rise or fall in their levels can adversely affect fertility, both in decreasing sex drive and lowering sperm count. Almost no one has examined this relationship. Dr. Mona Shangold, physician-endocrinologist, suggested, "There may be a relationship between reproductive problems and chronic exercise such as extensive training done by long-distance runners." She suggested further that if there is a correlation between very low body fat levels and fertility problems, this may mean that runners of both sexes will have to decrease their running if they wish to have children. For women, until their cycles return; for men, who knows? Shangold suggested that a male with a low sperm count who wished to restore it to normal may have to stop running for 74 days because it takes that long for sperm to mature.

To date there is nothing in the literature to support the belief that there is a high infertility rate among runners, male or female. The problem may be on a very small scale indeed because of great individual differences and responses to exercise and stress. The cardiovascular, psychological, and

other benefits of running far outweigh potential adverse effects on reproduction. Further, there is no evidence to suggest that any reproductive problems that develop while training are irreversible.

Another concern about which even less is known is the possibility of strenuous exercise delaying the onset of menarche. The New York Times quoted Dr. Jack Wilmore as saying, "We know there is a tendency for girls who participate in heavy competition before menarche to have onset delayed until they are 17 or 18 but we do not know whether that is good or bad." The average age of onset is between 12 and 13 years; however, beginning menstruation at age 15 or 16 is still considered normal. At a discussion of the issue at the American College of Sports Medicine meeting in Chicago in May 1977, physicians could not agree as to the age at which one should become concerned if the female has not begun to menstruate. At this point it is not known whether or not strenuous training prior to puberty can be detrimental to normal development of the endocrine or reproductive systems. No one knows whether it is possible to delay development and then make up for that delay with a decrease in training routine.

Apparently there is little reason to drastically alter one's exercise pattern with pregnancy if that pattern has been a part of one's life-style for some time. Pregnant athletes have accomplished all sorts of athletic feats during the early stages of their pregnancies. Lynn Blackstone, during her ninth month, ran twice around Central Park's reservoir, which is approximately 3 miles, each evening. She finished 58th out of 102 women in the 1977 Boston marathon. Mary Jones ran a half-marathon race at the Dallas White Rock Marathon in 2 hours and 5 minutes in December 1976 when she was nearly 9 months pregnant. She returned to marathon running 10 weeks after giving birth saying, "Pregnancy is not a disease. I listened to my body and let it dictate what I could do and I'm healthier for it." Many others report the same experience. Trina Hosmer, U.S. Olympic cross-country skier in 1972, ran 4 miles 2 hours before her first child was born. She barely had time to change and get to the hospital for delivery. While Trina may be exceptional, no evidence exists that regular exercise and running during pregnancy have to be discontinued if the female is used to regular exercise.

Osteoporosis is far more prevalent among women than men; several reasons may account for this. First, growing girls are not generally socialized to participate in vigorous exercise during those years when bones are developing and growing so that stresses placed on them during this time can result in stronger, denser bones. Second, estrogen levels decrease with aging and onset of menopause and the effect that estrogen has in stimulating bone maintenance is lost to some degree. Third, females do not exercise enough throughout their lives to stimulate bone maintenance. Running, jogging, or other types of regular exercise are especially important for aging women, yet the emphasis has been on males' getting exercise. The harmful effects of inactivity on bone tissue are well documented; long-term bed rest can lead to early osteoporosis. Even bones that are briefly in a plaster cast tend to become lighter because of mineral loss. The astronauts experienced alteration in bone metabolism during periods of weightlessness and physical confinement.

On the other hand, exercise stimulates bone growth and maintenance; one has only to examine one's dominant arm to compare the difference between it and the lesser-used one. Prevention and/or delay of osteoporosis appears to

be related to vigorous exercise during the growing years to maximize the skeletal development, then continued exercise throughout one's lifetime with some attention paid to the amount of calcium in the diet.

Females may be more efficient in heat dissipation, or less efficient than the male, depending on how the research is interpreted. Studies show that males do sweat sooner and more profusely than females in response to increased body temperatures. However, males may be prolific wasteful sweaters. The female may adjust her sweat rate more efficiently, that is, she can compensate for the observed differences. On the average, females have more sweat glands than males. Generally, her body temperature gets 2 to 3 degrees warmer than that of the male's before she begins to sweat. Females sweat less than males and can perform the same work loads with less water loss. Both males and females acclimatize to work or exercise in heat; however, females are able to do so without increasing their sweat rates. There may be some explanations that have not been examined. First, higher levels of estrogen in females tend to provide greater vascularization, therefore the female may be able to get more blood to the surface of her body for cooling which would delay the sweating process. This fact may allow her to compensate for her additional fat insulation and smaller body surface. Second, since the female has more active sweat glands than the male, her sweat is distributed more evenly over her body for maximal cooling by evaporation, again compensating for her smaller body surface.

While the male sweats sooner, the female may sweat better! Wells (1977) also suggested that women may regulate their body temperature more effectively than males do from her research in heat environments. Perhaps it is time to examine this response more carefully and stop perpetuating the notion that females may be less effective in heat dissipation. Once the next generation is socialized out of the notion that men sweat, gentlemen perspire, and ladies glow, we may observe a different response to heat stress!

In summary it appears that while the male and female do differ in many respects in terms of their response to vigorous exercise, there are more differences within a sex than between the sexes. The level of physical fitness mediates the difference to a greater extent than sex. Further, when differences are observed in trained males and females, in most cases the response is one of adapting and conditioning to chronic exercise. In many situations the female adapts differently in that she compensates for these differences. Or, we could say that the male compensates, as in the case of his having to sweat sooner in order to cool his body.

When training and conditioning are equal, there appears to be no difference in the injury predisposition between males and females. Statistics suggest that females are more vulnerable to leg and knee injuries. Again, the level of physical conditioning and fitness is more important than one's sex. As increasing emphasis is placed on this for female athletes, the injury statistics are associating more with the type of sport played rather than sex. In short, basketball players will experience similar types and rates of injuries that will not be sex linked. Much research is needed before full understanding and insight into just what differences do exist between the response of males and females to long-term strenuous exercise. Right now it appears that the sauce for the gander is good for the goose. The female gains all the benefits and pleasure of having as healthy fit body as the male and certainly the joys

and challenges of sport participation and competition are not sex-linked. From everything available in the literature, the responses are all positive in physiological and psychological ways.

REFERENCES

1. Brozan, Nadine. Training linked to disruption of female reproductive cycle. The New York Times, Apr. 17, 1978.

2. DeWijn, J. R., DeJongste, J. L., Mosterd, W., and Willebrand, D. Hemoglobin, packed cell volume, serum iron, and iron binding capacity of selected athletes during training. J. Sports, Med. Phys. Fit. 11:42-51, 1971.

3. Frisch, Rose E. A method of prediction of age of menarche from height and weight at ages 9 through 13 years. Pediatrics 53(3):384, March 1974.

4. Harris, Dorothy V. The anemic athlete. WomenSports 4(12):52, 1977.

5. Harris, Dorothy V. The monthly mystery. WomenSports 4(9):49, 1977.

6. Hermanson, L. and Andersen, K. L. Aerobic work capacity in young Norwegian men and women. J. Applied Physiol. 20:425-431, 1965.

7. Lamb, David R. Androgens and exercise. Medicine and Science in Sports 7(1):1, Spring 1975.

8. Lane, R. Sports anemia. The Jogger, Sept. 1978.

9. Morimoto, T., Slabochova, Z., Naman, R. K., et al. Sex differences in physiological reactions to thermal stress. J. of Applied Physiol. 22:526-532, 1967.

10. Scott, D. E. and Pritchard, J. A. Iron deficiency in healthy young college women. J. Amer. Med. Assn. 199:897-900, 1967.

11. Seefeldt, Vern D. Scope of youth sports programs in the state of Michigan. In Smoll, Frank L. and Smith, Ronald E. (ed.) Psychological Perspectives in Youth Sports. New York: John Wiley & Sons, 1978.

12. Ullyot, Joan. Women's Running. Mountain View, Calif.: World Publications, 1976.

13. Weinman, K. P., Slabochova, Z., Bernauer, E. M., et al. Reactions of men and women to repeated exposure to humid heat. J. Applied Physiol. 22:533-538, 1967.

14. Wells, Christine L. Sexual differences in heat-stress response. The Physician and Sportsmedicine 5(9):79, Sept. 1977.

15. Wilmore, Jack H. The female athlete. The Journal of School Health, Apr. 1977.

16. Wilmore, Jack H. and Brown, C. Harmon. Physiological profiles of women distance runners. Medicine and Science in Sports 6(3):178, Fall 1974.

17. Wyndham, C. H., Morrison, J. F., and Williams, C. G. Heat reactions of male and female Caucasians. J. of Applied Physiol. 20:357-364, 1965.

18. Yoshimura, H. Anemia during physical training (sports anemia). Nutr. Rev. 28: 251-253, 1970.

Psychological Benefits of Aerobic Exercise

By Dorothy V. Harris, Ph.D.
Professor
Pennsylvania State University

Exhilaration, euphoria, ecstasy, peak experience, getting high, being spacy, or whatever one labels it, the experience is basically the same for those persons who are physically fit and who pursue exercise as an end in itself. They are "tuned in" and "turned on" by exercise. They enjoy the psychological and physiological returns they get from such experiences and return again and again for these sensations. The pure joy of participation in physical activity can only be gained when the activity is viewed as nonpurposeful in a utilitarian sense. The body is not thought of as a machine or object requiring maintenance or something that works independently from the mind or feelings. Nor can exercise be viewed as something the body needs like medicine or a treatment if one wishes to experience all that exercise can offer.

This is not to say that one does not get involved in exercise initially to get into shape, to lose a few pounds, or to counter ill effects of a sedentary life. However, in the process of reaching these initial goals one may discover that other things happen. One person who had just gone through a traumatic divorce and knee surgery had this to say: "I was in a physical and psychological rut. Running seemed a logical way to get my knee back to normal. The unexpected dividend was that I got my head together, too."

Regular participation continues long after the original goals are reached. Persons discover that exercise is fun, that they experience a sense of total integration never reached before. They find that they are tuned into their bodies and discover things about themselves that are reinforcing in a most positive manner. Traditional physical education has been making claims such as these for years; however, little systematic evidence exists to support such an idea. Most of the early research in personality and sport was based on the notion that a "sound body ensured a sound mind." Conceptually, the questions being asked were correct ones; the method and instrumentation frequently prevented the investigator from finding real insight into such a relationship.

When one is out of touch with his body and his feelings, he cannot be a fully functioning, integrated being. As Alexander Lowen said in his book, Pleasure:

> Self-awareness is a function of feeling. It is the summation of all body sensations at any one time. Through his self-awareness a person knows who he is. He is aware of what is going on in every part of his body: in other words, he is in touch with himself. For example, he senses the flow of feeling in his body movements. But he is also aware of the muscular tensions that restrict his movement; for these too create sensations . . . Not being in touch with his body from within, it feels strange and awkward to him, which makes him feel self-conscious in his expression and movement.

Exercise and physical activity can provide opportunities to develop self-awareness through the integration of body, mind, and feelings. Becoming aware of what is happening within the body intensifies the experience and increases one's awareness. This awareness provides a type of feedback that produces a sense of mastery, control, and competence that can be reached in no other way.

Deci, in his book published in 1975, deals with human motivation. He presents a cognitive perspective in attempting to account for the "whys" of voluntary behavior. He works under the assumption that most behaviors are voluntary and that persons choose these behaviors because they desire the end result. Therefore, the person's perceptions and cognitions will be basic to his behavior. The operational definition of intrinsic motivation suggests that activities engaged in are ends in themselves as opposed to a means to an end. In other words, intrinsically motivated involvements are ones for which there is no apparent reward except the activity itself. As a result, persons participate in activities for the feedback they get in the process of being involved and not because the involvement leads to an extrinsic reward. Many activities are intrinsically rewarding; persons spend much time playing sports, solving puzzles, practicing skills, and so on because they produce certain types of internal conditions that they find rewarding.

Another basic premise upon which the notion of intrinsic motivation is based is that people tend to be motivated to reduce uncertainty and to feel capable of dealing effectively with the environment. The concept of competence proposed by White (1959), rejects the notion of a drive-reduction theory and emphasizes the importance of the interaction of the person with the environment. His concept of competence refers to one's ability to deal effectively with one's environment through a whole range of behaviors such as exploration, perception, cognition, manipulation, and so on. According to White, the competence motivation or effectance motivation is what directs these behaviors that are motivated by the intrinsic need to cope effectively with the environment. White explained that young children have patterns of undifferentiated effectance motivation. However, with additional experience, behaviors are more differentiated into specific motives for mastery, cognizance or achievement. Ellis (1973) indicated in his book that the proposition of White accounted for behavior beyond the arousal-seeking behavior that Ellis had used to explain children's play. That is, White's competence-effectance motive would explain the repetitious behavior that persists after the novelty has worn off; this behavior can be explained as manipulation to produce effects on the environment.

Deci proposed that one's need to feel competent and self-determining will produce two general classes of behavior. First, persons will seek out situations that provide a reasonable challenge; if one is bored, one will seek a challenge, if one is overchallenged, a different situation will be sought that will provide a challenge which can be handled. In essence, this suggests that the motivational mechanism operating will lead persons to situations where they are challenged to make optimal use of their abilities.

The second class of behaviors motivated by the need for competence and self-determination that Deci described were those needs to be successful in challenge situations. That is, persons are motivated to reduce dissonance when they encounter it or create it. Many create dissonance or incongruity just so they can have the challenge of mastering it.

Thrill addicts were once thought to have a death wish or an urge to self-destruction; however, research supports the fact that they are exceptional in their emotional health. Dr. Edward Stainbrook, head of the Human Behavior Department of the University of Southern California, said, "So much of life has become sedentary, inhibiting action. Thrill seeking expresses an almost desperate need for assertive mastery of something. In some cases, the aggressive defiance can be overdone and become a disguised suicidal drive. But more often, it's just a quest for control of self -- and for doing, rather than thinking."

"Action is the adolescent antidepressant," said Dr. Gerald Polin, a psychiatrist who has researched this phenomenon. He suggested that thrill sports may be a symptom of the depressed feelings that many adolescents have. Many persons of all ages express a periodic need for extending themselves to absolute physical, emotional, and intellectual limits in order to escape from the routine and boredom of everyday living.

In Beyond Boredom and Anxiety, Mihaly Csikszentmihalyi (1975), a psychologist at the University of Chicago, discusses the basis of experiencing enjoyment and fulfillment through activities for which the primary reward is in the experience of the activity rather than other outcomes. In activities of this type the person experiences an altered state of consciousness that he calls "flow" where one is aware of his actions but not aware of his awareness. Concentration is so focused on the process of doing that any thoughts of what one is doing or how one is doing would stop the "flow." In this state the integration of mind, body, and feelings is so focused that "flow" provides a dimension in the activity that cannot be reached intentionally; it just happens.

While athletes have known about these "altered states of consciousness" for some time, they have only recently begun to share their highly personal experiences. It is a nonverbal, almost overwhelming sensation. It can be felt during losing or during noncompetitive moments, too . . . by the parachutists in flight, by the skier, by the runner running alone. Dwight Stones talked about such an experience the day he broke the world high jump record at the Munich Olympics. "The realization of reaching 7-6½ startled me . . . I just lost control. I remember I couldn't wait to hit the pit . . .It seemed like an eternity. . . . The whole thing was so spontaneous, so unplanned. You know certain goals are within reach but you still explode when it comes off . . . it's such a mental climax."

One doesn't have to be an athlete to experience "flow"; continued participation is the key for young and old alike. The opportunity to reach altered states of awareness are created when you forget about gaining any external reward for your efforts. Once exercise is the end, not a means, sensations come through loud and clear and the body feels energetic, alive, tingling, and capable. When the body is "let go" in exercise, almost anything can happen.

Back in the early sixties when jogging was becoming the thing to do among some status groups, its benefits were measured in health and medical terms; one exercised to prevent a heart attack, or to develop a sexier body, or to lose a few extra pounds. However, the benefits were too far removed from the exercise to keep most persons motivated to continue. Those who did persevere discovered that in addition to doing fantastic things for the body, exercise did something for the head as well! From this point on, they no longer exercised for health; they exercised because they felt good! As a matter of fact, there is some

evidence to suggest that one can become addicted to exercise, that one feels less well without it and suffers withdrawal effects when it is missed. It is not surprising, then, to have persons feel deprived when they can no longer exercise!

Baekeland (1970) explored sleep and psychological reactions to exercise deprivation. He found it was difficult to recruit subjects who exercised regularly and were willing to give that up for a month or so. Even though they were offered good pay and knew that they would make a contribution to science, they were unwilling to deprive themselves of their regular exercise habits. Many said they would not stop exercising for any amount of money. Baekeland's subjects were persons who exercised three to four times a week. However, they too viewed the anticipated no-exercise period as exercise deprivation rather than as exercise restriction.

The subjects' sleep was studied for two nights several days apart while they were still exercising regularly. The no-exercise period was sampled at intervals of about 2, 7, 14, and 30 days after the last exercise bout. The EEG sleep records were scored for the conventionally defined stages of sleep. REM frequencies were also recorded. A questionnaire evaluated the psychological changes observed near the end of the no-exercise period. The findings reported indicated a change in sleep patterns suggesting increased anxiety over the no-exercise period. The subjects' subjective reports indicated a decrease in the quality of sleep at home, increased sexual tension, and an increased need to be with others.

In a book entitled Positive Addiction, Glasser (1976) reported that runners can become positively addicted to the euphoria of running and that this can provide a source of adaptive strength that can be transferred to other areas of life. Glasser indicated that there were six steps one has to follow in order for this positive addiction to take place. The physical activity pursued must be noncompetitive and one chosen voluntarily. It must be an activity that one can do easily, that does not require a great deal of mental effort, and at which one could spend an hour or so a day pursuing. It must be something that can be done alone or with others but not dependent on others. The participant must believe that it has some positive value, either physical, mental, spiritual, or all three. Further, the participant must believe that persistence will be rewarded by improvement. It should be noted, however, that only the participant will be the one to evaluate the improvement. Finally, the activity must be of a type that one can do without criticizing oneself; one must accept the self at whatever level of performance. Glasser suggested that these are the reasons why running has become so popular with many persons who have never done any other type of regular physical exercise.

Other writers (Andrews, 1976) report that there are definite psychological milestones that runners reach in the route to altered states of consciousness or heightened awareness. These milestones have more to do with how long one runs rather than how far one goes. Even the most accomplished and fit runner experiences general discomfort during the first 20 minutes or so and asks himself why he is doing this. After about 30 minutes he begins to feel a mild sort of euphoria. He has worked out the tensions and is being "lulled" by the rhythm of his breathing and running. After about 40 minutes he loses the ability to organize thoughts and ideas flash in and out without any conscious effort.

After about an hour of running one reaches an altered state. If running is continued, the runner feels a mystical unity with the surroundings and the Zen of running can really be enjoyed.

Kostrubala, a psychiatrist and a veteran marathoner, says that running is a natural form of psychotherapy. Few people can run and worry at the same time! Kostrubala has trained several of his assistants as "running therapists" and claims some success in using jogging as a treatment for depression, drug addiction, and other psychological problems requiring treatment. He said, "I think this is a new and powerful way of reaching the unconscious" and explains some of his philosophy in a recent book, The Joy of Running.

A British medical team headed by Dr. Malcolm Carruthers reported that running does change the hormones of the body. As little as 10 minutes of endurance exercise can double the body's level of norepinephrine. This neurohormone is associated with alertness, responsiveness, and a high level of mental and physical activity. This tends to reduce depression and anxiety for a period of time (Parker, 1978).

Several other investigators support the notion that "action absorbs anxiety," or that exercise is nature's own best tranquilizer. deVries and Adams (1973) studied 10 patients, 52-70 years old. One day they gave their patients a tranquilizer, and the next day had the patients walk vigorously enough to raise their heart rates over 100 beats per minute. The exercise produced a greater calming effect than the tranquilizer with positive rather than negative side effects. The paradox appears to be that one must exercise to relax. Traditionally relaxation has been associated with being sedentary yet all of the scientific evidence suggests just the contrary.

The mystique of jogging, along with the claim to work wonders for the body and soul, has begun to invade the domain of American psychiatry. Many are now prescribing exercise instead of pills for moderate depression. Writer Valerie Andrews, author of the forthcoming book, The Psychic Power of Running, argues that weekend jogging could well be the basis for the nation's first grass-roots movement in community health. UCLA psychiatrist Ronald M. Lawrence says, "Mild depression is more common than the common cold, but it can be markedly helped by slow endurance exercise." He said further, "Man was meant to be a moving animal, but he's become sedentary. Distance running can bring us back to the basics of what we're here for." While hard evidence is lacking, Ismail and Young (1977) observed significant relationships between changes in certain hormone levels of exercises and improvement in emotional stability.

Brown, Ramirez, and Taub (in press) have also produced evidence demonstrating a decrease in depression with exercise. Their first experiment involved 167 high school boys and girls who were participating in a variety of sports. They completed three psychological inventories: Zung Depression Scale, Eysenck's Introversion-Extroversion Scale, and the Human Figure Drawing. In addition they were asked to keep a journal of their physical activity, mood states, and sleep habits.

The second study by Brown, et al., attempted to control more variables and added several more inventories. There were three groups: a no-exercise, one running three times per week, and one running five times per week. Each treatment

lasted for 10 weeks. Several outcomes of these two studies were reported: (1) Subjects in the exercise group, depressed or not, showed increases in mental well-being. (2) The number of depressed subjects dropped from 37 to 14. (3) Psychological scores of the subjects in the nonexercise group did not change. Brown, et al., also found that the amount of exercise was significant; the more vigorous the activity, the more significant the change. No significant difference was observed in those persons participating in sports requiring low levels of physical activity. Brown, a psychiatrist at the University of Virginia, says that he has not observed anyone jogging on the track who ever appeared to be depressed. He finds that exercise works better than pills in controlling depression. Approximately 70 percent of his patients are depressed and all but about 15 to 20 percent show quick benefit after only a week of running.

Folkins, Lynch, and Gardner (1972) have also used physical activity as a treatment for psychological disorders with reported success. They used several adjective checklists to measure variables related to both depression and anxiety. Three college physical education classes formed the experimental and control groups; an archery class and a golf class were used as controls with a jogging class serving as the experimental group. Preliminary testing showed that the two groups differed on the psychological variables; the women in the experimental group were significantly less fit psychologically than the controls. They were more anxious, more depressed, less confident, and less well adjusted. After 15 weeks of running, these females had shown significant improvement in all these areas. The males also improved but not to the same extent. No changes were observed in the controls.

Driscoll (1976) used physical exercise to counter anxiety along with positive imagery and reported success, emphasizing the short time treatment took with exercise. Orwin (1973) used running to overcome phobias and demonstrated that physical exhaustion interfered with anxiety. Using this treatment he found that persons could become conditioned to their fears much more readily after vigorous exercise than without it. He concluded that some sort of physical exercise should be included in all therapies for anxiety.

In the late 1960's and early 1970's Morgan has produced more systematic evidence than any other investigator to date. He has completed a series of studies (Morgan, 1969, 1970; Morgan, et al., 1970) and concluded that differences in depressed persons' ability to perform physical tasks were psychological, not physical. In the second phase of one study (Morgan, et al., 1970), 101 subjects participated in 6 weeks of physical activity: circuit training, jogging, swimming, treadmill running, or bicycle ergometry. Through this phase Morgan reported that the depression scores of those subjects in the normal range did not change; however, those persons who were depressed changed significantly at the .01 level.

More recently Morgan (1976; Morgan and Pollock, 1976) has begun to make wider claims concerning depression as it is affected by regular physical activity. In one report he indicated that "acute and chronic physical activity of a vigorous nature offers a unique and effective method of reducing tension (state anxiety) and depression" (Morgan, 1976, p. 17). In another paper (Morgan & Pollock, 1976) similar claims are made; however, the writers caution one to keep in mind that this "improved sensation of well-being following acute and chronic exercise" (p. 3) may have other causes. The point is that when one decides to make a

change in one's life-style such as embarking on a regular exercise routine, this may influence one's psychological well-being in a positive manner. In addition, when one decides to exercise regularly, changes in other habits such as eating and sleeping frequently occur, resulting in a generally more healthy life pattern overall.

In summary, the literature search produced a significant amount of empirical evidence demonstrating the positive relationship between exercise and an improved sense of well-being. In general, this improved sense of well-being was attributed to a decrease in anxiety and depression. Without question, the universal testimony to regular exercise is "feeling better." This feeling better may also include other components such as more positive body image, a sense of self-efficacy, more energy, and so on. Obviously much more research is needed before better insight and understanding are reached.

There is a dearth of systematic research addressing these questions and the methodological problems are great. At the same time, the relationship has been demonstrated sufficiently through personal testimony and the few studies that are reported to encourage the participation in regular exercise to reduce psychological stress. While directions are lacking with regard to length of time one should exercise, the degree of effort that should be put forth, and how much one's perception of what is happening influences the outcome, the conclusion that regular exercise is associated with feeling better can be made. When one feels better, one behaves in a more positive manner; how one feels about one's body has much to do with how one feels about oneself. In short, the bottom line may be self-esteem associated with a sense of "I can do it" that produces the positive feedback. Whatever the cause-effect relationship, there appears to be enough evidence to associate psychological well-being with regular vigorous exercise.

Selected References: Psychological Benefits of Exercise

Andrews, Valerie. The Joy of Jogging. New York, 10:60-63, Dec. 1976.

Backeland, Frederick. Exercise deprivation. Arch. Gen. Psychiat., 22:365-369, April 1970.

Csikszentmihalyi, M. Beyond boredom and anxiety. San Francisco: Josey-Bass, Inc., 1975.

Deci, E. L. Intrinsic motivation. New York: Plenum Press, 1976.

deVries, H. A. & Adams, G. Study reported in Porter, D. Inner running. New York: Grosset & Dunlap, Inc., 1978.

Driscoll, R. Anxiety reduction using physical exertion and positive images. Psychological Review, 26 (1):87-94, 1976.

Ellis, M. J. Why people play. Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1973.

Folkins, C. H., Lynch, S., & Gardner, M. M. Psychological fitness as a function of physical fitness. Archives of physical medicine and rehabilitation, 53:503-508, 1972.

Glasser, W. Positive addiction. New York: Harper & Row, 1976.

Ismail, A. H. & Young, R. J. Effect of chronic exercise on the personality of adults. In Milvy, P., (ed.) The marathon: physiological, medical, epidemiological, and psychological studies. New York: New York Academy of Sciences, 1977. (ANYAA9 301 1-1090).

Kostrubala, T. The joy of running. New York: J. B. Lippincott, Co., 1976.

Morgan, W. P. Selected physiological and psychomotor correlates of depression in psychiatric patients. Research Quarterly, 1967, 39, 1037-1043.

Morgan, W. P. A pilot investigation of physical working capacity in depressed and nondepressed psychiatric males. Research Quarterly, 1969, 40, 859-861.

Morgan, W. P. Physical working capacity in depressed and nondepressed psychiatric females: A preliminary study. American Correctional Therapy Journal, 1970, 24, 15-16.

Morgan, W. P. Psychological consequences of vigorous physical activity and sport. Paper presented at the annual meeting of the American Academy of Physical Education, Milwaukee, Wis., 1976.

Morgan, W. P., Roberts, J. A., Brand, F. R., & Feinerman, A. D. Psychological effect of chronic physical activity. Medicine and Science in Sports, 1970, 2, 213-217.

Morgan, W. P., & Pollock, M. L. Physical activity and cardiovascular health: Psychological aspects. A paper presented at the International Congress of Physical Activity Sciences, Quebec City, July 12, 1976.

The Physiological Responses of Females to Endurance Exercise

By Harold B. Falls, Ph.D.
Professor, Health and Physical Education
Southwest Missouri State University

Since this conference focuses on aerobic exercise, I shall focus this presentation on female aerobic responses although performance in endurance exercise may require other qualities.

"Aerobic" implies metabolism with oxygen, i.e., the oxidative phosphorylation segment of the total metabolic process involved in degrading foodstuffs in the muscle cell. This would exclude the immediate energy that might be derived from (1) the splitting of adenosine triphosphate (ATP), or (2) glycolysis (the glycogen to lactic acid pathway). A high level of functioning as far as oxidative phosphorylation is concerned requires a high rate of oxygen delivery to the muscle cells. This is directly measured as the maximum oxygen consumption (max $\dot{V}_{O_2}$). Oxygen consumption, in turn, is a function of cardiac output ($\dot{Q}$) and arteriovenous oxygen difference (Δ A-$\bar{V}O_2$). Thus

(1) $\dot{V}_{O_2} = \dot{Q} \times \Delta$ A-$\bar{V}O_2$

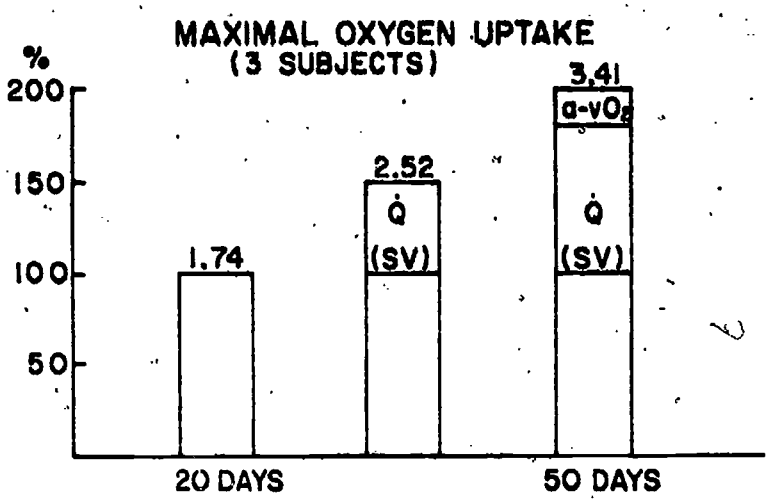
cardiac output is a product of heart rate (HR) and stroke volume (SV) of the heart.

(2) $\dot{Q}$ = HR X SV

As far as the health-related effects of exercise are concerned, epidemiologists have not been able to identify any adverse consequences of having a less than high Δ A-$\bar{V}O_2$, or even one that is somewhat below normal. They have, however, identified that there are probably some relationships between the development of circulatory diseases and certain levels of cardiac output below normal or perhaps below an optimum level that is yet to be identified. Thus in terms of the health aspects of aerobic exercise, emphasis should be on the cardiac output as the important function. However, if we are going to talk about physical performance in relating the events in winning the Boston marathon, we would also have to take into consideration Δ A-$\bar{V}O_2$.

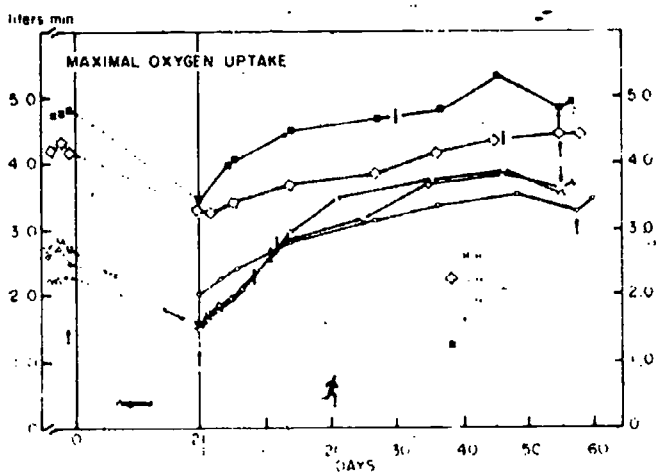
I disagree with one comment by Dr. Harris, a previous speaker. I think most of the literature indicates that there is not really a difference between males and females on maximum heart rate if they are in the same relative state of training. Therefore, maximum cardiac output differences between the sexes are primarily a reflection of differences in maximal stroke volume.

The responses of max $\dot{V}_{O_2}$, $\dot{Q}$, SV, and HR to aerobic exercise training and the reverse (sedentary habits) have been demonstrated by Saltin et al. (1968) (Figure 1).



Again, I am just trying to emphasize that from an aerobic-exercise standpoint, and especially from a health standpoint, we are dealing primarily with cardiac output and with stroke volume of the heart as far as maximum performance is concerned because if we compare males and females, there is very little difference in maximum heart rate and actually very little change in maximum heart rate with training.

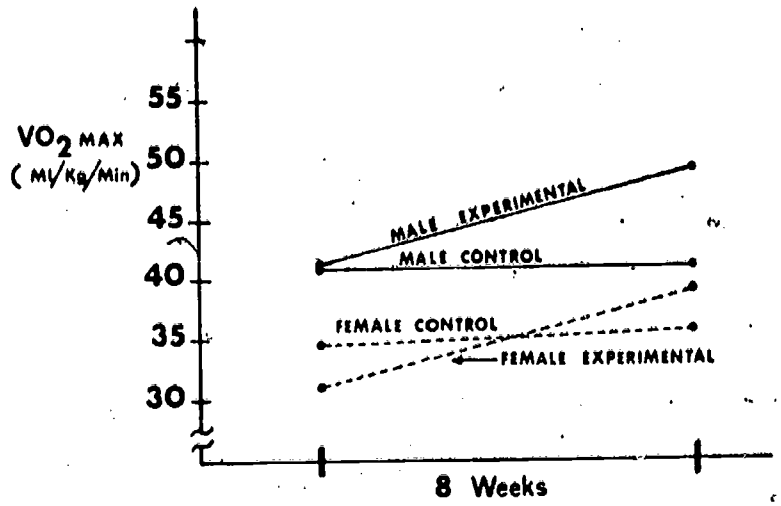
A legitimate question is, "Do males and females respond differently to exercise?" First, let's look briefly at the overall male response to both exercise training and sedentary habits, again from the work of Saltin et al. (1968) (Figure 2).



In the study represented by Figure 2, max $\dot{V}_{O_2}$ was measured before and after 21 days of bed rest in two trained and three sedentary young adult males. They were also measured during and after 8 weeks of exercise training that

followed the bed rest. It is easily seen that all the subjects decreased in aerobic capacity with bed rest and increased with training. In fact, compared with the beginning of the study, the sedentary subjects were about 33 percent higher on max $\dot{V}_{O_2}$ after the training. This is a general response to exercise in males verified by many other studies. If one is inactive or very sedentary, he will decrease in aerobic capacity, whereas if one trains, and the training program observes the proper mix of intensity, requency, and duration, $\dot{V}_{O_2}$ max will increase.

Similar data on females are limited, but many have become available over the past few years. One recent study by Burke (1977) (Figure 3) compared college-age male and female responses to an 8-week training program. There was also a control group. In both cases, the subjects were sedentary. Both males and females improved during the 8 weeks at approximately the same rate. The major apparent sex difference is that the females were about 20 percent lower than the males on max $\dot{V}_{O_2}$ at the beginning of the study, and this relative difference was maintained throughout.



Another recent study compared the effects of bed rest in both males and females. Although the females exhibited a 40 percent lower max $\dot{V}_{O_2}$ before bed rest, both groups decreased 9-10 percent on the measurement as a result of the period of bed rest, which was slightly shorter than in the study of Saltin et al. (1968) (Convertino et al. 1977).

Male-female aerobic-power changes have been compared longitudinally from the aging perspective by measuring max $\dot{V}_{O_2}$ at a 21-year interval (Table 1). There was a decrease in both sexes, and the rate of decrease was very nearly the same in both, whether one compares on max $\dot{V}_{O_2}$ in liters x min^{-1} or ml x kg x min^{-1}. Both males and females at age 42-46 were at about 80 percent of their max $\dot{V}_{O_2}$ values exhibited 21 years earlier at age 22-25.

Table 1. Maximum Oxygen Consumption in Male and Female Physical Education Students after a 21-year Interval

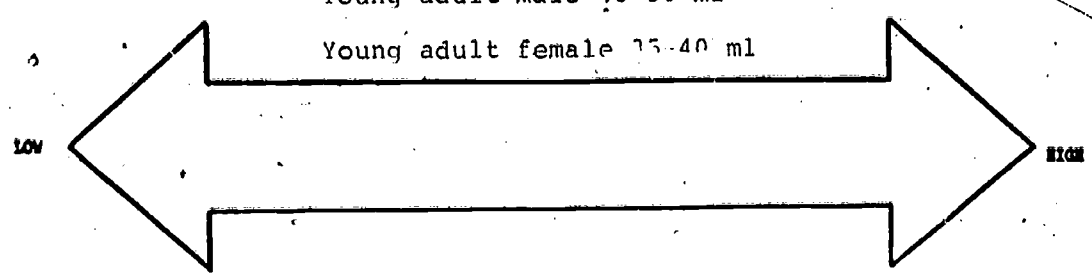
	$l \times min^{-1}$		$ml \times kg \times min^{-1}$	
	♂	♀	♂	♀
1949	4.09	2.83	58.5	47.3
1970	3.28	2.20	45.3	38.4

From data in: I. Åstrand, P.O. Åstrand, I. Hallbäck, and A. Kilbom: Reduction in maximal oxygen uptake with age. Journal of Applied Physiology. 35:649-654, 1973.

Similar results have been obtained by others. The studies cited above are merely good examples of the pattern of responses seen when males and females of similar fitness status are directly compared. The responses to exercise and training appear to be very similar. Differences do seem to be operating in regard to the degree of response between the sexes and in relative position on a continuum of aerobic capacity. In the remainder of this presentation, I want to focus on some of the factors I feel seem to explain those differences.

THE CONTINUUM OF AEROBIC POWER

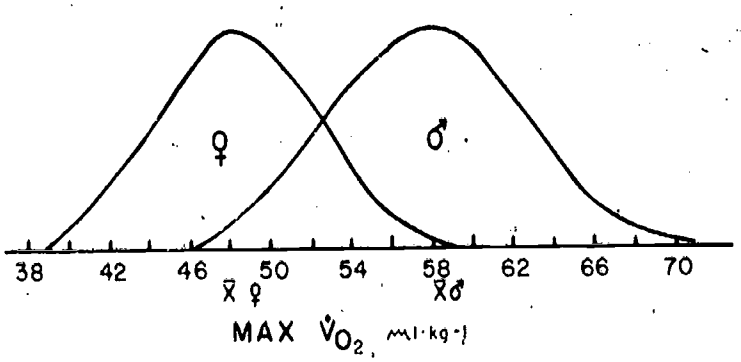
I feel very strongly that we can view the entire range of aerobic power as a continuum that includes both male and female values (Figure 4). Lowest values ($ml \times kg \times min^{-1}$) in the population would likely be about 10-15. Highest known values for males approach 95 $ml \times kg^{-1}$. The highest value of which I am aware for a female is 74 $ml \times kg^{-1}$. This value compares very favorably with many male marathon champions and other world-class long-distance runners and Nordic skiers.



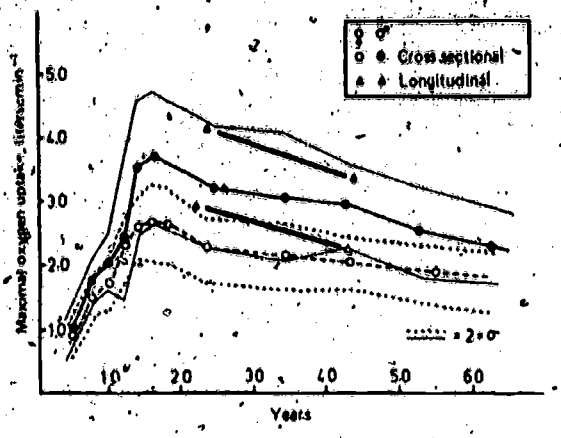
15 ml/kg
Lung disease
Sedentary habits
Old age
Circulatory disease
Poor nutrition

95 ml/kg
Good genetic stock
Participation in endurance sports
Excellent nutrition

Factors that contribute to high or low max $\dot{V}_{O_2}$ are shown in Figure 4. Population averages are about 45-50 ml x kg x min^{-1} for the male and 35-40 ml x kg x min^{-1} for the female. We see a difference in the highest known values, and we see a difference in the average values. However, I still think the trait can be viewed as a continuum, and I have tried to represent this in terms of normal distributions for aerobic power based on the means and standard deviations (SD) for Swedish young adult physical education students presented in Åstrand's classic 1949 work (Åstrand, 1952) (Figure 5). Mean values for aerobic power were 58 and 48 ml x kg x min^{-1} for males and females respectively. I think we can reasonably view his data as samples from a normal population and use the SD to roughly picture the way the separate male and female distributions would look when plotted out ± 3 SD from the respective means. What we then see is that the mean male value is included within the distribution for females, and the mean for females within the range of the distribution for males. There would be considerable overlap between the two distributions.



Further support for this concept comes from material in Åstrand and Rodahl's textbook on work physiology (Åstrand and Rodahl 1977) where they have presented the max $\dot{V}_{O_2}$ /age relationship (Figure 6). The more solid lines represent the mean max $\dot{V}_{O_2}$. Up to about age 20, there is essentially no difference in the male and female values. After that age, males continue to increase while females tend to level off, and then both sexes decrease as they continue to age up through the range of age shown in Figure 6. The lighter lines represent ± 2 SD for each of the distributions. Again, considerable overlapping of distributions is noted as in Figure 5. Viewing the overlapping of distributions in this way, it appears that the average female compares almost directly with the untrained male in terms of aerobic power. The questions that become of most interest then are (1) what physiological and anatomical differences explain the different relative positions of males and females on the continuum, and (2) what are the implications for aerobic exercise prescription?



ANATOMICAL AND PHYSIOLOGICAL DIFFERENCES

HEART SIZE

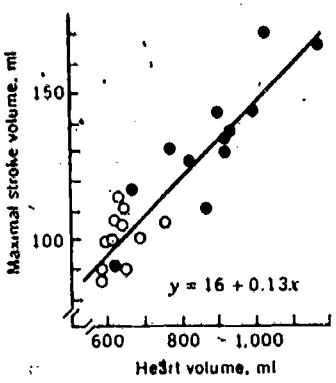
Table 2 presents data from a large study of heart size in the Soviet Union. It shows that the female heart is about 85 percent as large as that of the male when comparisons are made on absolute volume. There have been some arguments that if one corrects for body size, this difference disappears. Not so. When the heart size is expressed as ml x kg^{-1}, ml x m^2, or as a weight measure in gm x kg^{-1}, the female heart is still 80-90 percent as large as that of the male (Åstrand et al., 1964, Grande and Taylor 1965).

Table 2. Heart Volumes of Athletes and Nonathletes

	Males	Females
Athletes	860	725
Nonathletes	670	580

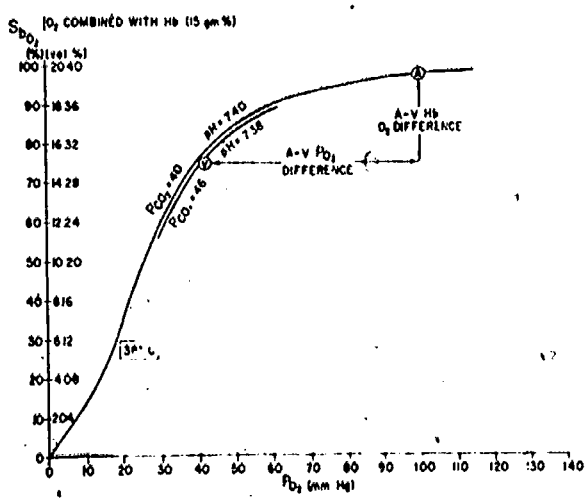
*Measurement in milliliters.
Adapted from data presented by K. A. Abramyan and R. A. Dzhuganyan. Athlete heart measurements. Theory and Practice of Physical Culture 12:27-29, 1969.

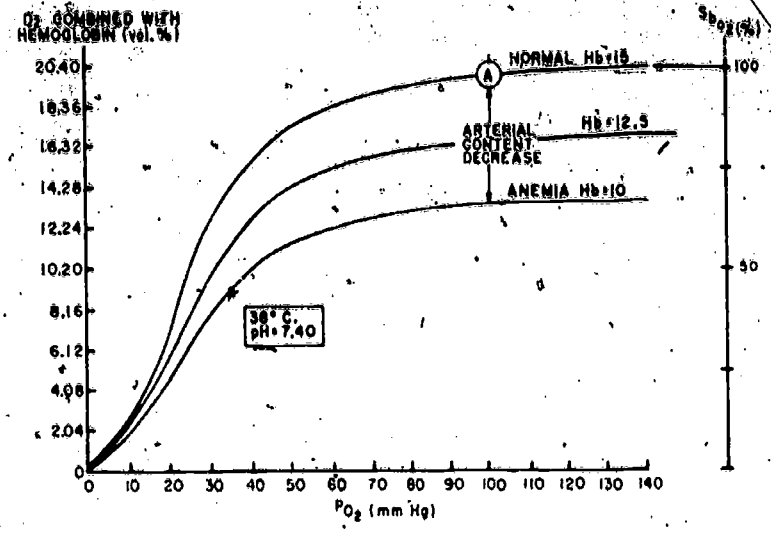
The maximum stroke volume is positively related to the heart size (Figure 7). In the young adult, the SV of the male is about one-third larger than in the female (Åstrand and Rodahl 1977). In younger persons, there doesn't appear to be a difference, or perhaps as large a difference. However, there really aren't enough data available on maximum SV in young females to be certain. If SV isn't smaller in young females compared with young males, it could mean there is also not a significant difference in heart size at those ages.

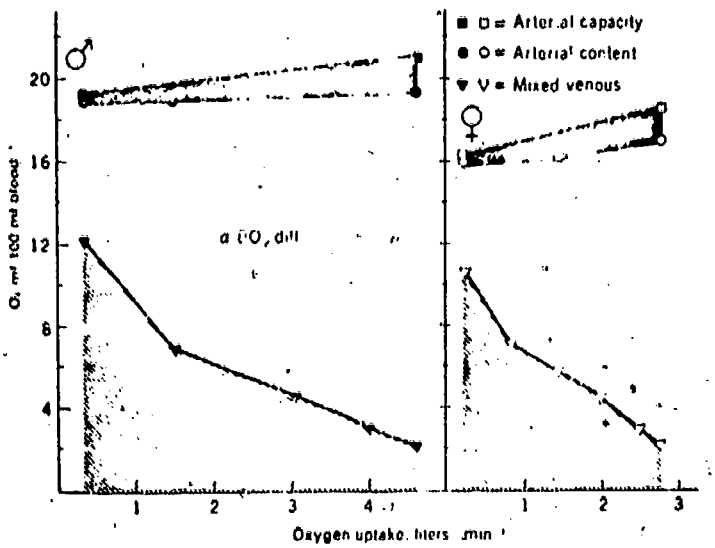


BLOOD HEMOGLOBIN

After about 11-12 years of age, there is a difference in the hemoglobin concentration of the blood in males (15 gm x 100 ml blood^{-1}) compared with females (12.5-13 gm x 100 ml blood^{-1}) (Altman and Dittmer 1971). Since each gram of hemoglobin (Hb) will carry about 1.34 ml O_2, this means a reduced oxygen-carrying capacity for her blood. Figure 8 shows the classical oxyhemoglobin dissociation curve usually found in physiology and exercise physiology textbooks. These curves are a representation of Δ A-$\bar{V}O_2$. Note that in most textbooks the curve presented is based on male values (15 gm Hb x 100 ml blood^{-1}). The female's blood does not reach 19-20 vol. percent for O_2 shown in these curves as it passes through the pulmonary capillaries. This is shown in Figure 9 where the normal female oxyhemoglobin dissociation curve (Hb = 12.5) is compared with the curve for a normal male (Hb = 15) and one typically found in anemia (Hb = 10). Since the venous O_2 content during maximal exercise is approximately the same in males and females (Åstrand and Rodahl 1977) (Figure 10), the net effect of reduced hemoglobin is a narrower Δ A-$\bar{V}O_2$ leading to a reduction of max $\dot{V}_{O_2}$ according to the relationship in Equation 1.



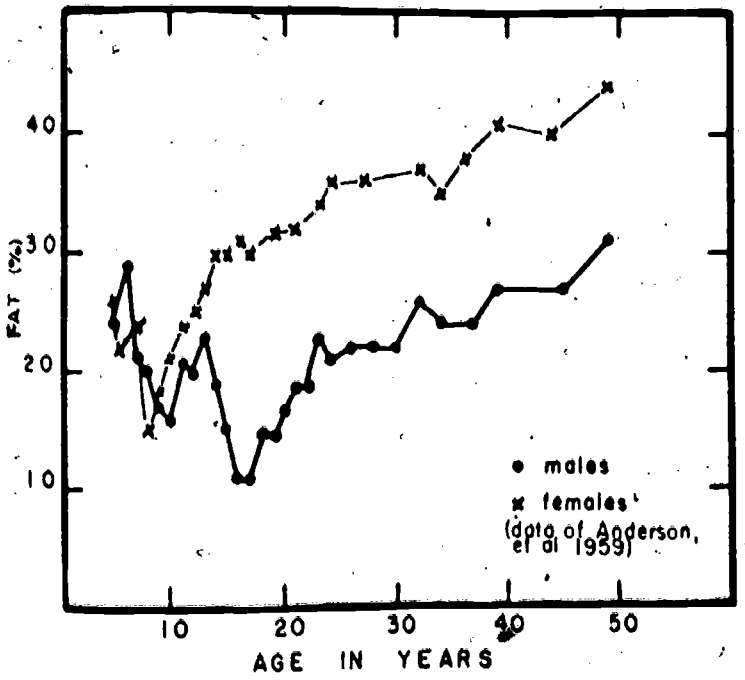

O2 COMBINED WITH HEMOGLOBIN (vol. %)
20.40
18.36
16.32
14.28
12.24
10.20
8.16
6.12
4.08
2.04
0
NORMAL Hb=15
A
ARTERIAL CONTENT DECREASE
Hb=12.5
ANEMIA Hb=10
38° C. pH=7.40
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140
PO2 (mm Hg)
SO2 (%)
100
90


■ □ = Arterial capacity
● ○ = Arterial content
▼ ▽ = Mixed venous
♂
♀
a-$\bar{v}O_2$ diff
O_2 ml/100 ml blood
20
16
12
8
4
1 2 3 4
1 2 3
Oxygen uptake, liters/min

Because of the lower max Δ A-$\bar{V}O_2$ the female's maximum performance in aerobic exercise is likely to suffer. If Δ A-$\bar{V}O_2$ in Equation 1 is reduced for a given $\dot{V}_{O_2}$, Q must be increased. It has been shown that at a $\dot{V}_{O_2}$ = 1.5 liters, the male can transport sufficient oxygen at a cardiac output of 12 liters x min^{-1} while 13.5 liters are required in the female (Åstrand and Rodahl 1977). Thus reduced Δ A-$\bar{V}O_2$ has a tremendous impact on the efficiency of using whatever cardiac output is available within a given individual.

PERCENTAGE BODY FAT

Another factor that has already been mentioned by Dorothy Harris is the body-fat differential between males and females. In a typical young adult male, fat comprises 12-15 percent of the total body composition. Similar values for the young adult female are 20-28 percent (Katch and McArdle 1977). As in the case of max $\dot{V}_{O_2}$, this difference becomes apparent at about age 10 and continues throughout the remainder of the life span (Figure 11).



In my opinion, extra body fat is a handicap, regardless of the claims by some persons that it provides a metabolic reserve for greater endurance. These claims are not supported by research. It also adds excess baggage to the body, and one has to expend extra energy to transport that excess baggage as the body moves from one place to another. It is very similar to taking an extra weight,

tying it on the body where the fat is located, and taking it along with you. Recent research has shown that even though the cardiopulmonary response at any given $\dot{V}_{O_2}$ is not increased by obesity, the oxygen required for any given workload is increased (Davies et al. 1975).

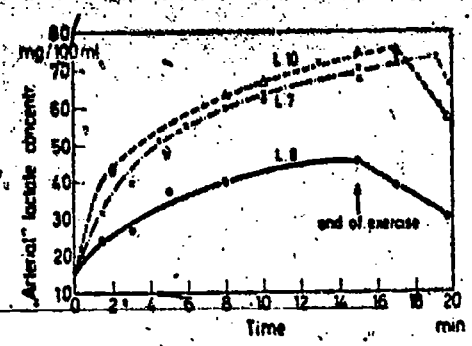
I do not mean to imply that the average female is obese compared to known or inferred health standards. That is certainly not the case, and there is evidence that a significant proportion of her fat is necessary for normal sexual and child-bearing functions (Frisch and McArthur 1974). However, there is a relative obesity when she is compared with the average male. This decreases her functional aerobic capacity since max $\dot{V}_{O_2}$ is divided by total body weight to arrive at the functional measure of max $\dot{V}_{O_2}$ in ml x kg x min^{-1}. Excess body fat reduces the size of this quantity. One of the things I tell my own students is that they can increase their max $\dot{V}_{O_2}$ in ml x kg x min^{-1} without exercising. All they have to do is lose a few pounds of extra fat!

MUSCULAR STRENGTH

For an equal body size the female has 5 to 10 percent less muscle mass relative to total body weight than the male (Behnke and Wilmore 1974). Therefore, the size of the musculature involved in a given exercise is less. For example, a female running, or otherwise using her legs in exercise, has a smaller muscle mass on those legs. She has less total strength in them than the male.

If the contractile force that must be exerted by a muscle is above about 20 percent of its maximum possible force, there is going to be at least some interference with blood flow. The greater the degree of necessary contractile force in comparison to that maximum possible force, the greater the cutdown of blood flow, and the more the person is going to have to resort to anaerobic metabolism in order to sustain the exercise (Lind and McNicol 1966, Whipp and Phillips 1970).

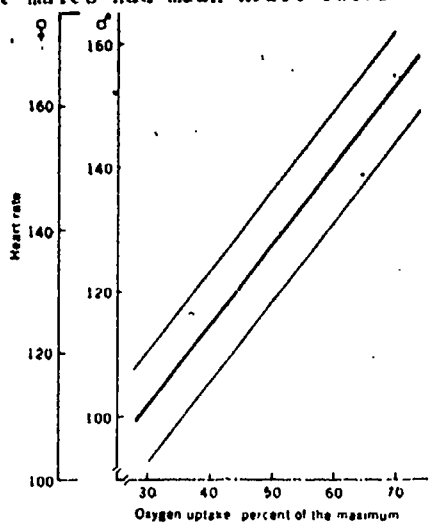
This problem is well illustrated by Figure 12. The upper two curves show lactate accumulation in a 15-minute bicycle ergometer ride in two low-strength males working at 80 percent max $\dot{V}_{O_2}$. The lower curve is from a strong male also working at 80 percent max $\dot{V}_{O_2}$. Lactate accumulation is much less in the stronger male, an indication that the weaker individuals were having to use anaerobic metabolism to a greater extent, even though they were all working at the same relative intensity. The weaker men were forced more into anaerobic metabolism not so much because they couldn't handle the exercise aerobically, but more because they didn't have the strength to effectively overcome the resistance of pushing the bicycle pedals around. The female is at the same disadvantage as the weaker males in Figure 12. Her lower strength levels will force her into anaerobic metabolism at a lower resistance than the male who is stronger.



IMPLICATIONS FOR AEROBIC EXERCISE PRESCRIPTION

INTENSITY OF EXERCISE

Intensity of exercise has been shown to be one of the important criteria in exercise prescription, and the American College of Sports Medicine (ACSM) recently issued a position statement recommending the minimum threshold for aerobic conditioning as 60 percent of maximum heart rate reserve [60% (max HR - Resting HR) + Resting HR] or 50 percent of max $\dot{V}_{O_2}$ (ACSM 1978). A shortcoming of these recommendations is that they are based primarily on research on male subjects. Very little research has been conducted on determining minimum or optimum intensity, duration, and frequency of conditioning exercise in females (ACSM 1978, Pollock 1973). Even though females respond to aerobic exercise in a manner similar to the male response, the anatomical and physiological differences noted above do result in a different heart rate/$\dot{V}_{O_2}$ relationship (Figure 13). Therefore, the $\dot{V}_{O_2}$ associated with a given heart rate in the female is different from that in the male. An example is easily obtained from the physical education students used in the construction of the classic Åstrand-Ryhming nomogram for estimation of max $\dot{V}_{O_2}$ from submaximal work (Åstrand and Ryhming 1954) At oxygen uptakes that were 50 and 70 percent of max, the males had mean heart rates of 128 and 154 respectively.



The corresponding pulse rates for the female subjects were 138 and 168---a difference of 10-14 beats x min^{-1}. These differences certainly indicate that more research on the female is needed in exercise prescription to determine if the guidelines currently used with males are equally applicable to females.

ANAEROBIC VS. AEROBIC EXERCISE

Because the female has lower strength, any prescribed aerobic exercise based on the ACSM guidelines will likely be more anaerobic in the female because of the greater occlusion of blood flow. This is another area requiring further research to provide a basis for any adjustments that might be necessary in the exercise prescription for female participants.

STRENGTH AND INJURY PREVENTION

A significant problem in most aerobic conditioning programs is keeping the exercise intensity at a level that will not predispose the participant to orthopedic injuries. Because of her lower strength, I think the female runs a greater risk of these injuries at any given intensity of exercise when compared with the male. Stronger muscles help to stabilize the joints better during movement and also during various activities requiring fixation of body segments. Stronger ligaments and tendons are usually also associated with stronger muscles. This is something that needs to be carefully considered when prescribing exercise for the female.

Harold B. Falls is professor of health and physical education and Director, Kinetoenergetics Laboratory, Southwest Missouri State University, Springfield, Mo.

LIST OF FIGURE LEGENDS

Figure Number — Legend

Figure 1. Maximal oxygen uptake during treadmill running for three subjects (1) after bed rest (= 100%), (2) when they are habitually sedentary, and (3) after intensive training, respectively. The higher oxygen uptake under sedentary conditions compared with bed rest is due to an increased maximal cardiac output. The further increase after training is possible due to a further increase in maximal cardiac output and a small increase in arteriovenous oxygen difference. The maximal heart rate was the same throughout the experiment. Therefore, the increased cardiac output was due to a larger stroke volume. (From Astrand and Rodahl 1977. Reprinted with permission of McGraw-Hill Book Co.)

Figure 2. Changes in maximal oxygen uptake, measured during running on a treadmill, before and after bed rest and at various intervals during training; individual data on five subjects. Arrows indicate circulation studies. Heavy bars mark the time during the training period at which the maximal oxygen uptake had returned to the control value before bed rest. (From Saltin et al. 1968. By permission of American Heart Association, Inc.)

Figure 3. Changes in aerobic power during 8 weeks of training in young adult males and females. (From Burke 1977).

Figure 4. The continuum for maximum oxygen uptake. Values are in ml x kg x min^{-1}.

Figure 5. Overlapping male and female distributions for max V_{O_2} when ± 3 standard deviations are considered. (Based on data presented in Astrand 1952.)

Figure 6. Mean values for maximal oxygen uptake measured during exercise on treadmill or bicycle ergometer in 350 female and male subjects four to sixty-five years of age (From Astrand and Rodahl 1977. Reprinted by permission of McGraw-Hill Book Co.)

Figure 7. Relationship between heart volume and maximal stroke volume of the heart. (From Astrand et al. 1964. Courtesy of the American Physiological Society.)

Figure 8. The oxyhemoglobin dissociation curve, showing the relationship of blood oxygen transport. The full curve applies to the arterial blood of healthy man at rest. The small section to its right applies to venous blood. Point a represents normal values for arterial blood, and point v, for venous blood.

Figure 9. The oxyhemoglobin curve for normal male, normal female, and in anemia.

Figure 10. Oxygen binding capacity and measured oxygen content of arterial blood, calculated oxygen content of mixed venous blood at rest and during work up to maximum in males and females 20 to 30 years of age. During maximal work, the arterial saturation is about 92 percent as compared with 97 to 98 percent at rest, and the venous oxygen content is very low and similar for women and men. (From Åstrand and Rodahl 1977. Reprinted by permission from McGraw-Hill Book Co.)

Figure 11. Average percentages of fat in the body as a function of age and sex. (From G. L. Rarick, H. J. Montoye and V. Seefeldt: Growth, development, and body composition. In H. J. Montoye (ed.). An introduction to measurement in physical education. Indianapolis. Phi Epsilon Kappa Fraternity, 1970.)

Figure 12. The course of lactate accumulation during 15 minutes of exercise at 80 percent of maximal aerobic power. Data are for one muscular (L 8) and two other subjects. (From C. Kay and R. J. Shephard: On muscle strength and the threshold of anaerobic work. European J Applied Physiology. 27:311-328, 1969.)

Figure 13. Relationship between heart rate during work (bicycle ergometer) and oxygen uptake expressed in percentage of subjects' maximal aerobic power. Left of ordinate, heart rates of women; right of ordinate, those of men. Thin lines denote one standard deviation. (From Åstrand and Rodahl 1977. Reprinted by permission from McGraw-Hill Book Co.)

References

P. L. Altman and D. S. Dittmer (eds.): Respiration and circulation Bethesda, Md. Federation of American Societies for Experimental Biology, 1971.

American College of Sports Medicine: Position statement on the recommended quantity and quality of exercise for developing and maintaining fitness in healthy adults. Sports Medicine Bulletin. 13(3):1, July 1978.

P.-O. Åstrand: Experimental studies of physical working capacity in relation to sex and age. Copenhagen. E. Munksgaard, 1952.

P.-O. Åstrand and I. Ryhming: A nomogram for calculation of aerobic capacity (physical fitness) from pulse rate during submaximal work. J. Applied Physiology 7:218-221, 1954.

P.-O. Åstrand, T. E. Cuddy, B. Saltin, and J. Stenberg: Cardiac output during submaximal and maximal work. J. Applied Physiology 19:268-274, 1964.

P.-O. Åstrand and K. Rodahl: Textbook of work physiology. New York. McGraw-Hill, 1977.

A. R. Behnke and J. H. Wilmore: Evaluation and regulation of body build. Englewood Cliffs, N.J. Prentice-Hall, 1974.

E. J. Burke: Physiological effects of similar training programs in males and females. Research Quarterly 48:510-517, 1977.

V. A. Convertino, R. W. Stremel, E. M. Bernauer, and J. E. Greenleaf: Cardiorespiratory responses to exercise after bed rest in men and women. Acta Astronautica 4:895-905, 1977.

C. T. M. Davies, S. Godfrey, M. Light, A. J. Sargeant, and E. Zeidiford: Cardiopulmonary responses to exercise in obese girls and young women. J. Applied Physiology. 38:373-376, 1975.

R. E. Frisch and J. W. McArthur: Menstrual cycles: fatness as a determinant of minimum weight for height necessary for their maintenance or onset. Science 185:949-951, 1974.

F. Grande and H. L. Taylor: Adaptive changes in the heart, vessels, and patterns of control under chronically high loads. In W. F. Hamilton (ed.) Circulation. Washington, D.C. American Physiological Society, 1965.

F. I. Katch and W. D. McArdle: Nutrition, weight control, and exercise. Boston. Houghton Mifflin Co., 1977.

A. R. Lind and G. W. McNicol: Muscular factors which determine the cardiovascular responses to sustained and rhythmic exercise. Canadian Medical Association Journal 96:706-715, 1967.

M. Pollock: The quantification of endurance training programs. In J. H. Wilmore (ed.). Exercise and Sport Sciences Reviews, Vol. 1. New York. Academic Press, 1973.

B. Saltin, G. Blomquist, J. H. Mitchell, R. L. Johnson, Jr., K. Wildenthal, and C. B. Chapman: Response to submaximal and maximal exercise after bed rest and training. Circulation 38: supplement 7, 1968.

B. J. Whipp and L. E. Phillips: Cardiopulmonary and metabolic responses to sustained isometric exercise. Archives of Physical Medicine and Rehabilitation 51:398-402, 1970.

How Much Exercise is Enough?

Michael L. Pollock, Ph.D.

Reprinted from THE PHYSICIAN AND SPORTS-MEDICINE,
Vol. 6, No. 6, June 1978 © McGraw-Hill, Inc.

How Much Exercise Is Enough?

Michael L. Pollock, PhD

Whether the patient is young or old, fat or thin, fit or flabby, long-term involvement in an exercise program can significantly affect health. Exercise prescriptions should be based on the present level of fitness as well as the individual's specific goals.

How much exercise is enough? How much exercise for what purpose? The answers to these questions are difficult and tentative.

The various reasons people exercise to become physically fit depend on age, sex, and current levels of fitness and health. For example, needs and goals differ for elementary school children, athletes, and middle-aged men and women. School children need a broad spectrum of sports and activities to kindle their interests and to provide them with a broad educational experience. The activities of most elementary school programs should provide for physical development, but many existing physical education classes do not. Athletes' programs are geared to competitive situations in which maximum skill and physiological and psychological effort is necessary. To prepare for such

events often requires two to three hours of rigorous training daily. Adults generally are concerned with maintaining strength and stamina, avoiding increases in body weight and fat, and avoiding potential health problems that occur with a sedentary life-style. Women often exercise for cosmetic reasons such as weight and figure control.

Physical fitness can be divided into three major categories: cardiovascular-respiratory fitness, physique, and motor function. Table 1 lists the major subcomponents of each category. Although this tabulation is considered comprehensive in the way it describes fitness, the various subcomponents are usually emphasized differently depending on age, needs, and goals.

Adult fitness programs should be designed to develop and maintain car-

continued

Dr. Pollock is director, Cardiac Rehabilitation and Center for the Evaluation of Human Performance in the cardiovascular disease section of the Department of Medicine at the University of Wisconsin-Mount Sinai Medical Center in Milwaukee. He is a member of the American College of Sports Medicine.

Table 1. Physical Fitness Categories

Cardiovascular-Respiratory	Physique	Motor Function
Heart	Body Type	Strength
Circulation	Composition	Endurance
Pulmonary (Lungs)	Bone	Flexibility
Working Capacity	Muscle	Power
	Fat	Agility
	Posture	Balance

Table 2. Recommendations for Exercise Prescription for Healthy Adults*

Frequency	3 to 5 days/week
Intensity	60% to 90% of maximum heart rate 50% to 80% of maximum oxygen uptake
Duration	15 to 60 minutes (continuous)
Mode (activity)	Run, jog, walk, bicycle, swim, or endurance sport activities
Initial level of fitness	High = higher work load Low = lower work load

*These factors can be applied to athletes as well as diseased persons. The prescription will differ in that the athlete will require more frequent and exhausting bouts of work and the diseased person a more conservative regimen with more interval work.

diovascular-respiratory fitness, flexibility, and muscular strength and endurance that is consistent with personal exercise goals and work requirements. These programs should include endurance activities such as running, fast walking, bicycling, swimming, skating, etc, which can be sustained for a 15- to 60-minute period. The exercise period should start with a 10- to 15-minute warm-up and muscle conditioning period, and end with a 5- to 10-minute cool-down. The length of the endurance period usually is dependent on the intensity of effort. The endurance program is designed to burn a minimum of approximately 300 calories per workout. Thus, if done often enough, it will trim body weight and fat and improve or maintain cardiovascular-respiratory fitness. The warm-up and muscle conditioning period should include stretching and conditioning exercises to develop and maintain flexibility, strength, and endurance of the major muscle groups.

To receive optimal health and fitness benefits, participants should start programs early in life and continue for a lifetime. Improvement with short-term experiments (three to six months) will not affect health-related factors as significantly as long-term involvement. Also, participants probably will not be able to develop or maintain full physiological potentials unless the training programs are initiated early in life and/or continued for a long time.

Strength and muscular endurance are necessary to maintain proper muscle tone and to protect against injury and low back pain. Flexibility exercises are important for similar reasons and should be practiced often. Reduced flexibility can lead to poor posture, fatigue, and injury. An endurance activity such as jogging can reduce the flexibility of the extensor muscles of the hip, leg, and ankle. Thus, avoiding proper stretching exercises for these areas could lead to low back, hamstring, or calf muscle problems.

The program prescribed for an adult depends on needs, goals, physical and health status, available time, equipment, and facilities. This information is available through medical history records, physical fitness and medical evaluations, and personal interviews. After a thorough evaluation, an exercise prescription is made.

Exercise Prescription

Exercise prescription is based on frequency, intensity, duration, mode of activity, and initial level of fitness. Table 2 lists guidelines for exercise prescription for average adult men and women. These recommendations are based on several factors:

1. The participants are adults who are not participating in athletic competition.

2. The participants are engaged in a general physical fitness program to develop and/or maintain cardiovascular-

respiratory fitness, body composition, muscular strength and endurance, and flexibility.

3. The participants are generally healthy and free from severe disease such as coronary heart disease, pulmonary disease (emphysema), or neuromuscular problems (muscular dystrophy, multiple sclerosis, etc).

The recommendations for exercise prescription shown in table 2 emphasize the endurance phase of a training program and focus on preventive health and cardiovascular-respiratory fitness. Flexibility and muscular strength and endurance activities are important aspects of a well-rounded comprehensive program, but the detailed rationale for only the cardiovascular-respiratory component will be described. The quantification is based on years of scientific investigation to find the optimal training prescription for adults. These recommendations are the best estimates available at this time, but more investigation is necessary before the final plan can be adopted.

Much of the evidence used to establish the recommendations in table 2 was based on a series of 20-week training experiments conducted on healthy (but sedentary) adult men. In these experiments, many physiological variables were evaluated, but for the purpose of this article, the justification of the recommendations will be based on the values for maximum oxygen uptake (which represents changes in cardiovascular-respiratory fitness), and body weight and fat (which represents changes in body composition). Good cardiovascular-respiratory function depends on efficient respiration (lungs) and cardiovascular (heart and blood vessels) systems. Other important factors include the quality of the blood (red blood cell count, blood volume, etc) and specific cellular components to help the body utilize oxygen during exercise.

The ability to utilize oxygen at maximum is the best representation of these factors. Maximum oxygen uptake (aerobic capacity) is the largest amount of oxygen that can be utilized under the most strenuous exercise. Because maximum oxygen uptake generally summarizes what is happening in the oxygen transport system (including cellular utilization) during maximum or exhaustive exercise and can be measured easily, it has been used as the measure most representative of cardiovascular-respiratory fitness. A larger person generally has more muscle mass, and thus the capability of using more oxygen. To more easily compare persons of different sizes, aerobic capacity is expressed in milliliters of oxygen per kilogram of body weight per minute (ml/kg/min).

A specific level of aerobic capacity for optimal health has not been determined.

Figure 1 shows a champion distance runner taking a treadmill test to determine maximum oxygen uptake. Figure 2 shows a comparison of maximum oxygen uptake values of young and middle-aged men of various fitness levels. The figure clearly shows the difference in aerobic capacity as related to status of fitness and age. Values for women are approximately 10% to 20% lower.

Is there a level of aerobic capacity necessary to attain and maintain an optimal level of health and cardiovascular-respiratory fitness? It is difficult to set a standard for optimal fitness because a specific level of aerobic capacity for op-

continued

Figure 1. The maximum oxygen uptake test is being administered to premier distance runner, Steve Prefontaine. At the time of this test, Prefontaine held ten American distance running records. His maximum oxygen uptake was 84.4 ml/kg/min, one of the highest values ever recorded for a runner. Breathing valve channels all expired air into a series of bags, which were later analyzed for O_2 and CO_2 content.

timal health has not been determined. As shown in figure 2, sedentary middle-aged males characteristically fall below 40 ml/kg/min of oxygen uptake. This value drops to 30 by age 50 or 60. Many experts feel that a person should maintain or develop his aerobic capacity to above 40 ml/kg/min. Until more evidence is available, the minimal threshold standard for optimal fitness seems to be oxygen uptake between 38 to 45 ml of oxygen per kg per minute for men 20 to 60 years of age.

The maximum oxygen uptake value is partially controlled by heredity; that is, a person of Olympic caliber who has a maximum oxygen uptake over 70 or 80 ml/kg/min is born with this characteristic. This does not mean that the champion athlete does not have to train hard to further develop this potential. For example, when Jim Ryun (at the time world record holder in the mile run) stopped training for approximately 18 months, his maximum oxygen uptake dropped from 81 to 65 ml/kg/min (20%) as a result of his reduced fitness and increased body weight. Even though he was out of shape, he continued to have a high maximum oxygen uptake. Maximum oxygen uptake varies approximately 20% when one is in or out of training. This can be further reduced with age; thus, the optimal level of improvement generally found in training programs is approximately 15% to 25%.

Figure 3 shows a person being measured for body fat by two methods, and figure 4 shows body fat values of various groups of men. The body fat of women averages 5% to 10% higher than men. As shown in figure 4, trained persons of various ages are less fat than their sedentary counterparts. The optimal level of fat is not known exactly, but most experts agree that men should stay below 16% to 19% and women below 23% to 25%.

Quantifying Results of Endurance Training Programs

Cardiovascular-respiratory fitness improves as a result of many factors. In general, the degree of improvement depends on the total work or energy cost of the exercise program. Energy cost can be measured by the number of calories expended. Improvement in aerobic capacity and body composition depends on the frequency, intensity, and duration

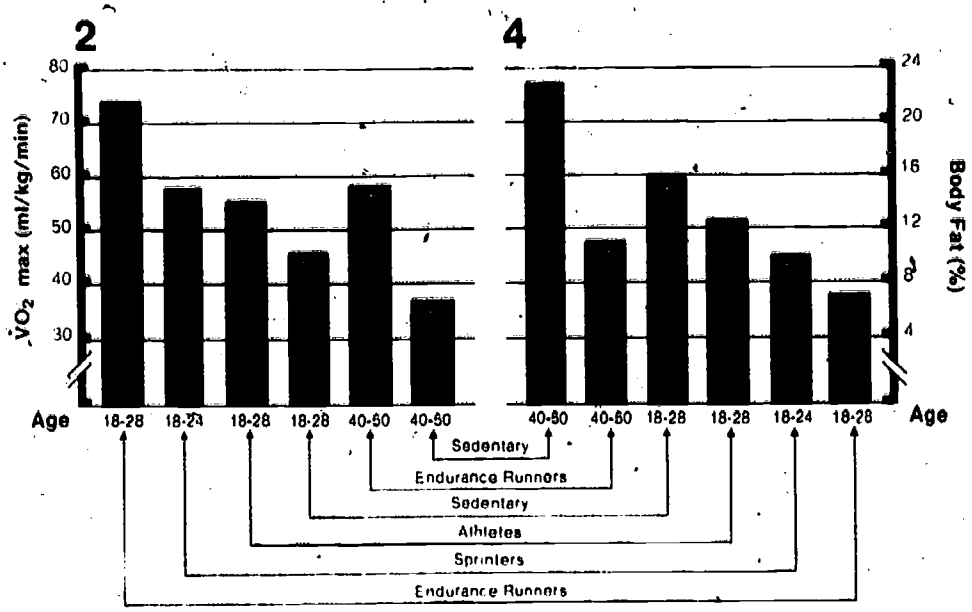


Figure 2. Comparison of maximum oxygen uptake of young and middle-aged men of various fitness levels

Figure 4. Percent body fat values of selected groups of men

Figure 3a. Body fat determination by the underwater weighing technique

Figure 3b. Body fat determination by the skinfold fat technique (This method correlates well with the underwater weighing technique.)

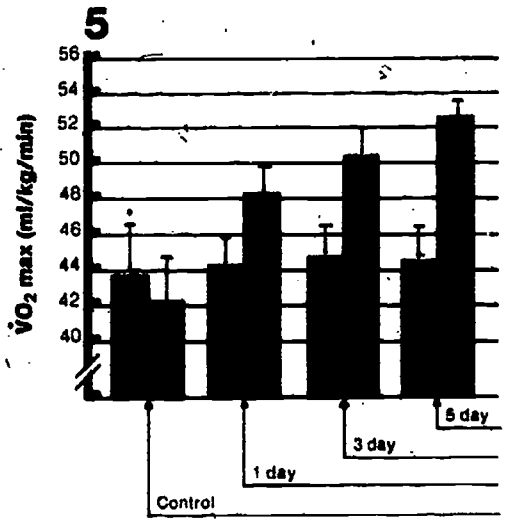
of the exercise program. Improvement is also related to the initial status of health and fitness, the mode of exercise (walking, running, cycling, skating, etc), the regularity of exercise, and age.

Frequency

To answer the question "How many days per week are necessary to develop fitness?" we designed an experiment to train men at either one, three, or five days per week. Intensity of training was standardized at 85% to 90% of maximum, with the men participating for 30 minutes each exercise session. Figure 5 shows that maximum oxygen uptake improves in direct relation to the frequency of training; that is, 8%, 13%, and 17%, for one, three, and five days per week, respectively. Another investigation we conducted comparing two and four days per week of training showed similar results. The two day per week program showed a significant improvement in aerobic capacity that was approximately equal to that found in the three day per week program.

One might ask, "Why recommend a minimum of three days per week, rather than two, if a person can get approximately the same amount of improvement?" First, the two-day studies were

continued



*Standard error of the mean

Figure 5. Effects of different training frequencies on maximum oxygen uptake

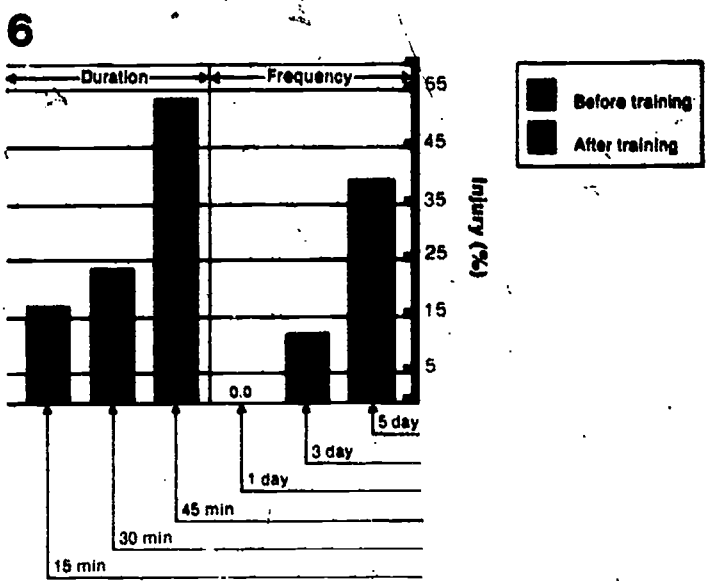


Figure 6. Effects of frequency and duration of training on incidence of injury

The injury rate increased dramatically when joggers trained more than three days per week.

of a high-intensity nature, which may not be suitable or enjoyable for adults. The second reason is that no body weight or fat loss occurred in the two-day program, but it did in the three day per week studies. Three subsequent investigations in which men trained two days per week (up to 4 miles per workout) also showed no changes in body weight or fat. Thus, it appears that the minimum of three days per week is necessary to develop cardiovascular-respiratory fitness and to show significant changes in body weight and fat.

How about training more than five days per week? Certainly, training more than five days per week is possible, but our experience finds it unrealistic. Most adults cannot fit more than three or four days a week into their busy schedules. In addition, the amount of improvement in exercising more than five days per week is minimal and probably not worth the added effort unless competition is involved. Most importantly, the injury rate related to the foot, ankle, and knee joints increased dramatically when joggers trained more than three days per week.

Figure 6 illustrates a study we conducted on young adult men who trained one, three, or five days per week. The rate of injuries for the five day per week group was three times that of the three day per week group. A participant with a jogging-related injury had to stop training for at least one week. The injury rate also increased significantly when the duration of training increased from 30 to 45 minutes per workout (3 1/2 to 5 1/2 miles). It appears that the body needs sufficient rest between workouts, and that a day's rest between the days of jogging may protect a participant from injury. If one wants to exercise more frequently, jogging activities should be interspersed with days of walking, bicycling, swimming, and other activities that do not cause the continual "pounding effect" on the legs. A soft jogging surface and shock-absorbent shoe insoles also help.

The injury study (both frequency and duration) relates to beginning joggers and should not be extrapolated to other situations. For the present, however, it gives enough information to recommend a day's rest between workouts and to recommend keeping the duration of endurance effort to less than 30 minutes for beginning joggers. More frequent and longer workouts may be tolerated as one gets in better shape.

It is not known at this time whether a five, six, or seven day per week program will elicit a more significant effect on other health-related variables such as high-density lipoproteins. If future research shows this to be the case, modifications to these recommendations must be considered.

Closely related to frequency of training is the regularity with which one participates and the subsequent effect on cardiovascular-respiratory fitness. If training is not continued, the improvement gained or maintained in a program diminishes rapidly. Significant reductions in fitness have been found after only two weeks of detraining. In one study, participants trained at equal eight-week periods of activity, nonactivity, and activity, with subsequent significant improvement, decrement, and improvement found in aerobic capacity. Also, studies in which subjects are put to bed for extended periods have shown decrements in aerobic capacity and related cardiovascular parameters.

To determine the effects of different levels of detraining, we reevaluated 22 middle-aged men after a 12-week detraining period. Participants originally trained by running 8 miles per week for 20 weeks. They were subsequently divided into three subgroups: Group A continued to train 8 or more miles per week, group B trained 3 miles per week, and group C was inactive. The results showed that members of group A maintained and/or improved their levels of fitness, while groups B and C regressed significantly. Group B lost approximately 40% of its original improvement and group C lost 50% after just 12 weeks. Another study showed a regression to sedentary normal after eight months of nontraining.

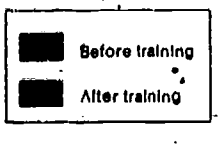
The dropout rate in a high-intensity interval training program was twice that of a continuous jogging program.

It is apparent from this review that training effects are both gained and lost quickly, and regular continued stimulation is necessary to maintain proper cardiovascular-respiratory fitness. Also, if persons refrain from exercise for any period, they must take precautions when resuming the program. Because of the reduced fitness caused by the layoff, these participants should start back slowly and gradually increase the training load to its original level.

Intensity

What is the optimal intensity level necessary to improve physical fitness? Two classic studies serve as practical guides for determining a minimal threshold level of intensity necessary for improving aerobic capacity. Both studies agree that the minimal threshold level for eliciting a training response is at a heart rate equal to 60% of maximum. The studies were conducted on younger men with training heart rate levels ranging from 130 to 150 beats per minute. For unfit, middle-aged, and older persons, the minimal training threshold may be as low as 100 to 120 beats per minute. A study conducted in Canada further substantiates the minimal threshold concept for eliciting a training effect and supports the idea that lower threshold levels exist for less-fit persons. They trained college men for ten minutes, five days per week for five weeks at heart rates of 120, 135, or 150 beats per minute. When groups were subdivided into high- and low-fitness levels, the high-fitness group showed no improvement at heart rates of 120 and 135 beats per minute while the unfit group did.

Although the minimal intensity threshold concept is generally well-accepted, it is also well-established that improvement in aerobic capacity is directly related to the intensity of training. If the training session duration is short (five to ten minutes), low-intensity programs may show little (up to 5%) or no improvement in aerobic capacity (hardly appreciable), while a high-intensity program may elicit up to a 15% to 20% increase. In general, the adult population does not seem to enjoy or tolerate a high-intensity program. Recent studies we conducted at the Aerobics Institute in Dallas showed that the dropout rate in a high-intensity interval training program was twice that of a continuous jogging program. The program was conducted over a 20-week period, and the workouts were equalized for total energy cost. The physiologic effects of the training programs were equal; both groups improved significantly in aerobic capacity and lost



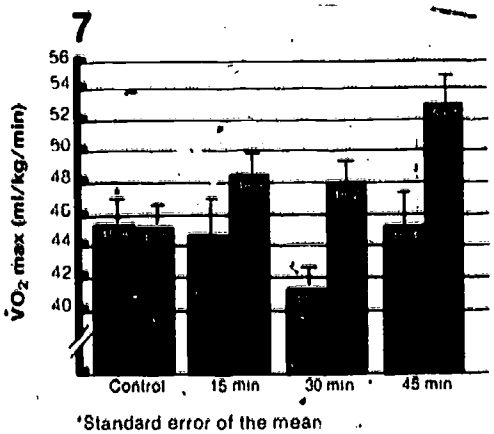


Figure 7. Effects of different training durations on maximum oxygen uptake (The moderate differences found among groups were not statistically significant.)

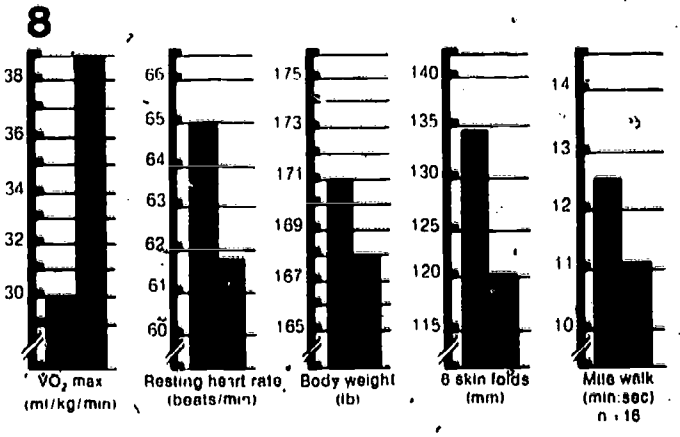


Figure 8. Effects of walking on the physical fitness of middle-aged men

body weight and fat. Another group of men in this experiment trained in interval training and jogging on alternate days and at the end of the study were asked which program they preferred. Ninety percent of this group preferred continuous jogging training to interval training. Also, more injuries were experienced with the interval training group. However, intensity of training usually depends on health status, level of fitness, and duration of training.

Duration

Improvement in cardiovascular-respiratory fitness is directly related to duration of training. Improvement in aerobic capacity has been shown with moderate- to high-intensity training lasting only five to ten minutes daily. However, the shorter duration programs of moderate intensity show a significantly lower training effect than programs of 30 to 60 minutes' duration. Figure 7 shows the results from a study we conducted on men 20 to 35 years of age for 20 weeks. The intensity was standardized at 85% to 90% of maximum, and the men participated three days per week. Improvement in maximum oxygen uptake was 8.5%, 16.1%, and 16.8% with 15-, 30-, and 45-minute duration groups, respectively.

It is important to reiterate that duration and intensity are interrelated and that the total amount of work (energy cost) accomplished in a training program is the most important factor for fitness development. For example, the energy cost of running is generally higher than walking, yet many men and women would rather walk than run. Since the intensity of walking is less than running, can one expect to get similar training effects by walking if the duration and frequency are increased? Several years ago we conducted a 20-week fast-walking study with men 40 to 57 years old. They walked for 40 minutes four days per week. The improvement in this program (figure 8) was equal to that in 30-minute, three day per week, moderate intensity jogging programs with men about the same age. The lower intensity of the walking program (65% to 75% of maximum) was offset by the increased duration and frequency of training. Thus, the energy cost of the walking program was equal to that of the jogging program.

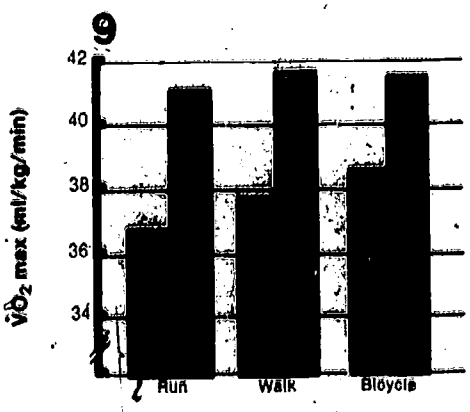


Figure 9. Effects of different modes of training on maximum oxygen uptake

To further illustrate this point, when we compared two jogging programs of different intensities (80% vs 90%), the results were similar when the total energy cost was equalized between them. This means that participants can slow down the pace, run several minutes longer (to make up for the lower calorie expenditure), and achieve approximately the same results. This is why the 15- to 60-minute duration range is recommended in table 2. If the minimum of 300 calories is recommended for an exercise program, then 15 minutes would require a fairly high-intensity effort, while walking may require 35 to 60 minutes.

The concept of the slower pace and longer duration has important implications for exercise prescription. First, compliance is an important factor in a training regimen. People participate in programs they enjoy. The lower-intensity effort makes the programs more enjoyable. Also, the musculoskeletal system can tolerate low-intensity work better than high-intensity work, which means that a participant can avoid unnecessary

Compliance is an important factor in a training regimen. People participate in programs they enjoy.

continued

No weight loss occurred unless the participants walked for more than 30 minutes daily.

injuries by working at a slower pace. Finally, it is often safer and more reasonable to exercise at a low to moderate intensity. This is particularly important for persons with reduced health status (suspect of coronary heart disease), middle-aged persons, and persons who are overweight.

One important point should be made concerning body weight and fat loss in relation to the exercise prescription. A study was conducted with obese women who exercised daily for one year or longer with no dietary restrictions. They lost weight in direct relation to the time spent walking. However, no weight loss occurred unless the participants walked for more than 30 minutes daily. It appears that a minimal threshold for weight reduction and fat loss by endurance training includes the following: continuous physical activity of 20 to 30 minutes' duration; sufficient intensity of exercise to expend 300 calories per session; and exercise frequency of at least three days per week. Because total energy expenditure is closely related to weight and fat reduction, increased frequency, intensity, and duration of training should elicit greater reductions.

Mode

Many people suggest that jogging or running is better than other endurance training programs. Is this true? If the total energy cost of the program is the most important factor, it seems that it would not matter which mode of training a person used as long as it burns the calories. To test this concept, about two years ago we conducted a study comparing running, walking, and bicycling training programs. In this study, frequency (three days per week), intensity (85% to 90% of maximum), and duration (30 minutes) of training were held constant for 20 weeks. To get the intensity level high enough with the walking program, the men trained by walking up a hill on a treadmill. The bicycle group rode resistance bicycles, which could be regulated to get the heart rates up to the required intensity. Changes in aerobic capacity (figure 9) and body composition showed similar improvements. Thus, it appears that a variety of aerobic activities can be interchanged for improving and maintaining physical fitness.

In general, activities with moderate to high energy cost, such as running (jogging), walking, swimming, bicycling, cross-country skiing, and game-type activities, show significant increases in cardiovascular-respiratory fitness and reductions in body weight and fat. In contrast, activities that are intermittent and low in energy cost (below the intensity threshold), such as golf, bowling, and moderate calisthenics, show no improvement.

What about weight lifting? We often hear about how tired a person is after a weight-training session. Also, the heart rate after a weight-training session seems to be quite high. Early studies testing the effect of weight training on cardiovascular-respiratory fitness showed no significant improvement. These programs often emphasized heavy weights with long periods of rest between exercises. Several studies have been conducted recently to evaluate the effect of weight training on aerobic capacity. In these experiments, men and women lifted moderate weights (approximately 50% to 60% of maximum) 10 to 15 times on 8 to 12 exercises using two to three sets (generally referred to as circuit weight training). The programs were as continuous as possible with little rest between exercises (15 to 30 seconds). The results were consistent. They showed large increases in muscular strength, but little (3% to 5%) or no change in aerobic capacity (figures 10 and 11). Therefore, weight training is not recommended for improving cardiovascular-respiratory fitness.

It should be noted that the heart rate/

continued

oxygen cost ratio is different for arm and leg work. For an equal heart rate, the oxygen cost of arm work is about 68% of that of leg work. Thus, the high heart rates in some weight-training activities may be misleading regarding energy cost.

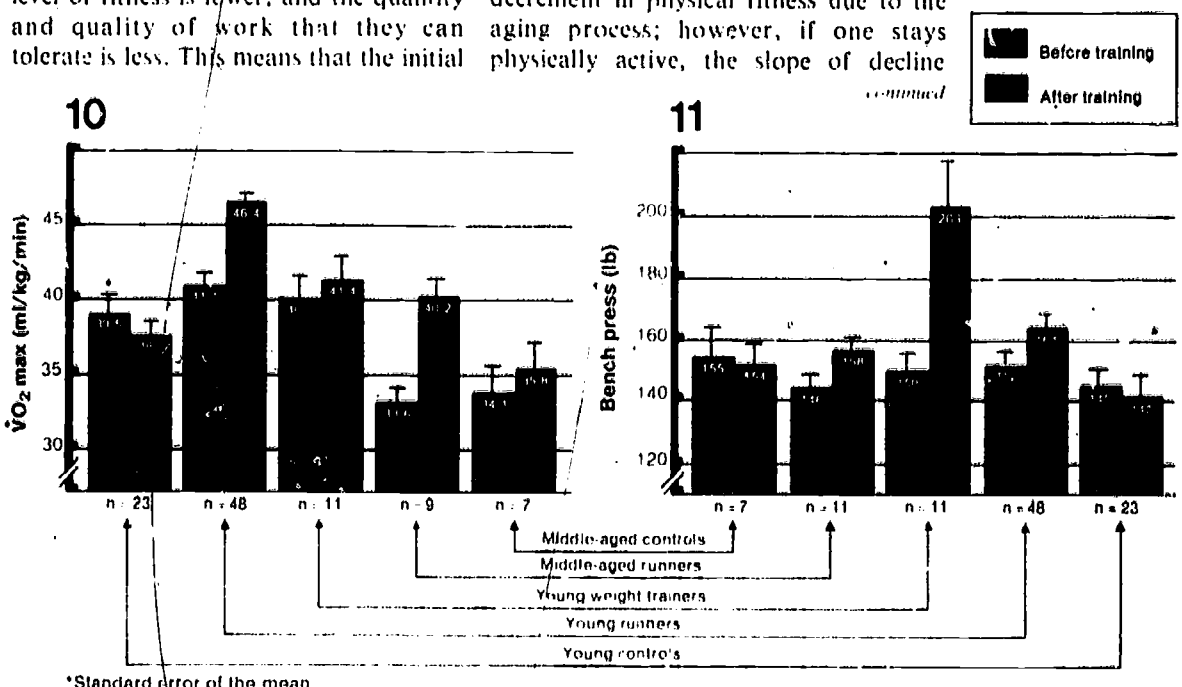
Initial Level of Fitness

The initial level of fitness is an important consideration in starting an exercise program. The threshold for improvement is lower with an unfit individual. What is the trainability of an older person? Is a person ever too old to get started? Age in itself is not a deterrent for participating in endurance work. Several studies have shown that middle-aged and old athletes can perform at high levels of work in their sixth, seventh, and eighth decades of life. Other reports on athletes who exercise regularly show similar results. The difference in beginning exercise programs for older individuals is that their initial level of fitness is lower, and the quantity and quality of work that they can tolerate is less. This means that the initial work loads (intensity) should be moderate and the rate of progression slower for older participants. To look at the trainability factor, we studied a group of men 49 to 65 years of age and found that their aerobic capacity improved 17% after 20 weeks of training. Other work conducted in gerontology centers has supported this conclusion. For every decade of age after 30, it takes about 40% longer for participants to progress in their training programs. That is, their adaptation to training is slower. For example, if one is involved in a walk/jog program and the distance ran progresses every two weeks for men 30 to 39 years of age, the interval for progression may increase to every three weeks for participants 40 to 49 years of age, and every four weeks for participants 50 to 59 years of age.

For every decade of age after 30, it takes about 40% longer to progress.

Does physical fitness automatically decrease with age? There appears to be a decrement in physical fitness due to the aging process; however, if one stays physically active, the slope of decline

continued



*Standard error of the mean

Figure 10. Effects of running and circuit weight training on maximum oxygen uptake

Figure 11. Effects of running (and moderate calisthenics exercises) and circuit weight training on one repetition bench press strength

may be less. In fact, recent evidence has shown that over a ten-year period when middle-aged men continued their training, they showed no decrement in aerobic capacity and body composition.[1] The men were 45 years old at the beginning of this study and continued to train approximately 60 minutes three days per week.

Summary

Research findings have shown that improvement in cardiovascular-respiratory fitness and reduction in body weight and fat is dependent on intensity, duration, and frequency of training. Intensity and duration of training were found to be interrelated, with the total calories expended during a workout being an important factor. Although there appears to be a minimal threshold level for improving cardiovascular-respiratory fitness (60% of maximum), programs of 15 to 60 minutes of continuous activity performed three to five days per week generally showed significant improvements in aerobic capacity and body composition. Age was not a deterrent to initiating or continuing an exercise program, but it is recommended that older participants and/or those with low initial levels of fitness begin their programs at a low-intensity level and progress at a slower rate. ■

This information is based on a book entitled Health and Fitness Through Physical Activity *by M. L. Pollock, J. Wilmore, and S. M. Fox. John Wiley and Sons, Inc, New York. (In press).*

A supplemental reading list is available upon request from THE PHYSICIAN AND SPORTSMEDICINE.

Reference

1. Kasch FW: The effects of exercise on the aging process. Phys Sportsmed 4:64-72, June 1976

III. IMPLEMENTATION OF AEROBIC EXERCISE

Teaching Physical-Fitness Concepts in Public Schools

By Russell R. Pate, Ph.D.
Assistant Professor
University of South Carolina

Introduction

Most physical educators would agree that a major aim of their profession is to promote physical fitness. However, in the typical public-school physical-education program, students receive a very restricted exposure to physical fitness. Commonly the student's experience with physical fitness is limited to participation in a few fitness activities and undergoing a physical-fitness test. In recent years some programs have adopted curricula through which students are systematically exposed to a broad range of lifetime fitness activities. But, tragically, it is only the rarest of physical-education programs that ensures that its students develop a thorough knowledge and understanding of the concepts related to physical fitness. The purpose of this paper is to draw attention to this deficiency and to suggest how it could be corrected.

The recent upsurge of interest in physical fitness among adults could be interpreted as a major success for the physical-education profession. Certainly it is true that physical educators have helped to initiate and promote the current fitness movement. However, certain aspects of this movement draw attention to a weakness of traditional physical education, i.e., the failure to educate students, in a cognitive sense, regarding physical fitness. Manifestations of this failure abound: the fitness marketplace is filled with bogus exercise gadgets and machines; bookstore shelves are crammed with phony weight-loss manuals; and "figure salons" sell costly memberships to persons who are promised that the "pounds will just melt away." Even among persons who select appropriate forms of exercise, a collective lack of knowledge seems apparent. In response, millions of adults have sought fitness information through the print media, and, as a result, publication of exercise books has become a growth industry.

These observations should be of concern to the physical-education profession for they prompt the obvious question: why did not the adult population acquire the fitness knowledge it needs in school? At the superficial level the answer to this question is equally clear: information regarding physical fitness has not been taught by physical educators or anyone else in the public schools. The solution to the problem would seem to be straightforward: let us begin to incorporate into our curricula cognitive material related to fitness.

Analysis of the Problem

At this point one is tempted to launch immediately into a series of specific recommendations. These will come. But, before attacking a problem, it is wise to try to understand it as fully as possible. Thus we should ask ourselves why it is that, during all of these years, we have essentially overlooked the cognitive domain in physical education. I feel that there are several explanations. First, in general, we have not perceived ourselves as having any responsibility in the cognitive area. We have seen ourselves as activity specialists

and have not felt compelled to "compete" with other school programs for a space in the cognitive domain. Also, many of us may have doubted our own mastery of physical-fitness information and therefore have willingly assigned it to the bottom of the curricular priority list. Certainly we must recognize that there has been no accountability whatsoever regarding the cognitive aspect of physical education. No principals, superintendents, or coordinators have been pushing us to teach fitness concepts, nor have we been evaluated on our effectiveness as facilitators of cognitive learning. And, finally, professional preparation programs should be indicted for their narrow and exclusive focus on the teaching of motor skills. College programs have not taught physical-education majors how to teach concepts or how to incorporate cognitive material into the physical-education curriculum.

Curriculum

If we are to begin dealing with fitness concepts in our physical-education programs, the first step is to decide what we are going to teach. That is, we must construct a curriculum. Table 1 presents the outline of a suggested curriculum. The concepts vary somewhat in difficulty of mastery. However, most can be introduced at the elementary-school level, expanded upon in the middle school, and dealt with in detail in the secondary school. The outline in Table 1 is not intended to be all-encompassing. On the contrary, it lists only the topics this author feels are the most critical.

Table 1. Outline of suggested curriculum on physical-fitness concepts.

I. Defining Physical Fitness
   - A. Fitness components - identify and define each
   - B. Health-related fitness components
   - C. Motor fitness (athletic) components

II. Cardiorespiratory Endurance
   - A. Definitions
   - B. Benefits
     1. Coronary heart-disease risk
     2. Everyday life - physical working capacity, vigor, use of leisure time
   - C. Evaluation
     1. Field tests - 12-minute run, mile run
     2. Stress testing
   - D. Methods of Improvement
     1. Identification of aerobic activities - jog, swim, cycle
     2. Frequency, intensity, duration of exercise
     3. Heart-rate, monitoring of exercise intensity
     4. Cooper's "Aerobics" system

III. Body Composition
   - A. Evaluation - skinfolds
   - B. Health factors related to obesity
   - C. Caloric balance
   - D. Weight-loss programs
     1. Role of diet
     2. Role of exercise
     3. Weight-loss myths

E. Consumer topics
   1. Fad diets
   2. Spot reduction
   3. "Long-haul approach" vs. rapid loss

IV. Flexibility
   A. Health factors - low-back pain
   B. Evaluation
      1. Sit-and-reach
      2. Kraus-Weber Battery
   C. Methods of Improvement
      1. Static stretching techniques
      2. Gymnastic, dance activities

V. Muscular Strength and Endurance
   A. Role in overall fitness and in athletic performance
   B. Health benefits of abdominal strength - low-back pain
   C. Evaluation
      1. Bent knee sit-ups, bar dips, flexed arm hang, pull-ups
      2. One repetition maximum - bench press
      3. Handgrip
   D. Methods of Improvement
      1. Calisthenics
      2. Resistance training - isotonic, isometric, isokinetic

Teaching Methods

The successful implementation of a curriculum depends on the creation and mastery of appropriate teaching strategies. In the present context this represents a significant hurdle because physical educators often are unaccustomed to teaching cognitive material. Also, we must recognize that the gymnasium, as a physical setting, is not particularly well adapted for traditional "classroom teaching techniques" (e.g., lecturing, reading, workbooks, etc.). In addition, students come to the physical-education class expecting action, not talk. These factors suggest that innovative teaching methods must be used. To be sure, specific methods must be created by the individual teacher to suit his or her personality and particular teaching situation. However, the following "Tips for Teaching Physical-Fitness Concepts" are presented for consideration. It is hoped that these suggestions will start the reader's creative juices flowing.

Tips for Teaching Physical-Fitness Concepts

1. Teach the concept through activity. Whenever possible build cognitive material into the activity setting. This can be done by using role playing, learning centers, and stop actions. There is no substitute for the alert teacher's seizure of the "teachable moment."

2. Keep lecturing to a minimum. Students react negatively to the lecture method in physical education. Lecture only when absolutely necessary and only when your students are most likely to be calm and attentive (usually after a period of vigorous activity).

3. Use audiovisual aids. Films, slide-tape sets, filmstrips, video tapes, and posters are available and can be used advantageously in the physical-education setting. Check with your local health department, Heart Association, and Lung Association.

4. Develop a physical education library. A corner of your gym, locker room, or office could be set aside for a reading area. This "library" can be stocked with appropriate nonfiction and fiction materials. Check with your school librarian on materials that may already be available to you.

5. Cooperate with science and health-education teachers. You may be able to coordinate certain aspects of your curriculum with the curriculum of other subject matters. Physical education can serve as the lab for certain topic areas in biology and health education.

6. Require or encourage homework or out-of-class projects. Who said that classroom teachers have a monopoly on term papers, required reading, and book reports? Also, how about giving credit to students who design and execute a behavior modification project.

7. Use fitness testing as a cognitive experience. When administering a physical-fitness test, take the opportunity to tell students why they are being tested, what the results mean, how the results will be used, and how the students can improve their performance.

8. Apply fitness concepts properly in your teaching. Be sure that the fitness activities you prescribe in class are in concert with the fitness concepts you want the students to master. That is, be sure that the students' practical experiences in class reinforce the proper concepts.

9. Don't overlook the "how to's" for popular fitness activities. There is something to learn about jogging (and other fitness activities) - don't assume that everyone knows how to jog, swim, or cycle for fitness.

10. Plan a long-range, progressive curriculum. If you systematically plan for the incorporation of cognitive material into your curriculum, a large amount of information can be disseminated using only 3-4 minutes per individual class period.

Note: 3 min. X 2 classes X 40 weeks X 10 years = 2,400 min.
class week year (40 hours)

Conclusions

To summarize, it seems clear that traditional physical education has overlooked the cognitive domain. The result is that students have graduated from our public schools essentially uneducated regarding the concept of physical fitness. The solution to this problem lies in the implementation of physical-education curricula that recognize the cognitive domain as coequal with the affective and psychomotor components of education. At present, such programs are being successfully instituted by a smattering of individual teachers who recognize the importance of cognition in physical-education and who are stimulated by the challenge to create a unique teaching method. It is hoped that the number of such teachers will increase rapidly enough to ensure that the next generation that passes into adulthood will do so having been, in a comprehensive sense, physically educated.

Note: A video tape entitled "Methods for Teaching Fitness Concepts" is available through the AAHPER/NASPE Media Resource Center. This tape shows physical educators in the actual practice of teaching physical-fitness concepts to students at the elementary, middle, secondary, and college levels. A copy of this tape may be obtained by sending a blank tape (3/4 in., 60-min. cassette) to the following address:

AAHPER/NASPE Media Resource Center
College of Health and Physical Education
University of South Carolina
Columbia, SC 29208

Fitness Testing in the Schools: Revision of the AAHPER Youth Fitness Test

By Sharon A. Plowman, Ph.D.
Northern Illinois University
and
Harold B. Falls, Ph.D.
Southwest Missouri State University

The ability to move well in numerous situations is one of the important objectives of physical education. Much time and effort are spent in attempting to help persons, especially children and youth, learn how to successfully engage in work, play, and fundamental types of movement requiring numerous specific skills. It was the apparent inferior ability of American youth to pass minimal fitness tests that caused concern about the "fitness" of American youth in the 1950's and 1960's.

While the concern for physical performance of children and youth has continued, there is increasing awareness that a fitness crisis of near-epidemic proportions exists in much of our world, including the U.S.A. Such maladies as obesity, coronary heart disease, and low-back pain have become the norm rather than the exception in the adult population. These health problems or their precursors are found in alarming percentages at early ages.

Concern over the lack of physical fitness in American youth in the "modern era" probably began with the research publications of Hans Kraus and his associates in which American children compared poorly with European children in tests of minimal muscular fitness. Alerted by these data, President Dwight D. Eisenhower called a National Conference in 1956 to consider the fitness of American youth. Following this conference, the American Alliance for Health, Physical Education, and Recreation (AAHPER) sponsored a national meeting on physical fitness in September 1956 to determine how to improve the level of physical fitness among American youth. One important result of this meeting was to set in motion the AAHPER Youth Fitness Project, an attempt to survey and encourage improvement in the fitness of U.S. boys and girls.

A committee of AAHPER Research Council members was charged with developing tests to be used in the national survey of fitness. This task began by first identifying the kinds of abilities physical educators sought to develop. The list was extensive and included balance, flexibility, agility, static strength, dynamic strength, explosive power, speed, endurance, etc. The development of a test battery to measure all of these variables was deemed administratively impractical. The criteria used by the committee to select the final seven test items were that each item:

(1) would be reasonably familiar,
(2) would require little or no equipment,
(3) could be administered to boys and girls,
(4) could be given to the entire age range of grades 5-12,
(5) would measure a component of fitness different from the other items, and
(6) would allow self-testing by the student.

Each individual test item was viewed as an indicator of a particular strength or weakness with little interest in a total test score. Thus pull-ups were deemed to measure arm and shoulder girdle strength; sit-ups, efficiency of the abdominal and hip flexor muscles; shuttle run, speed and agility; standing broad jump, explosive muscle power of the knee and hip extensors; the 50-yard dash, speed; and the 600-yard run/walk, cardiovascular efficiency. The softball throw for distance was the single exception. According to Paul Hunsicker, some members of the committee were reluctant to publish a test battery of fitness items only for fear that the public would conclude that physical education programs were designed only to improve fitness. The softball throw was included in the original battery as an indication that sport skills were part of physical education.

The original test battery was completed in February 1957, and a survey was launched the following autumn to determine the fitness of boys and girls grades 5-12 in the U.S. public schools. Thus the AAHPER Youth Fitness Test became the first such instrument ever to be developed by the physical education profession for which national norms were established.

Between 1958 and 1975 several changes were made in the test battery. The flexed arm hang was substituted for the modified pull-ups for girls; the softball throw for distance was deleted, and the sit-up was changed from an extended knee sit-up with a maximum number of 100 for boys and 50 for girls, to a 1-minute sit-up with the knees flexed. In 1976, optional distance runs of 9 minutes or 1 mile for ages 10-12 and 12 minutes or 1.5 miles for age 13 and over were included for use in assessment of cardiovascular endurance.

National surveys were conducted with the test items in 1958, 1965, and 1975 to assess the then-current status of youth fitness, determine if improvements had occurred (1965, 1975), and make comparisons with similar groups of youth in other countries.

The test and the goals it has represented have on the whole been well received over the years. The test has performed a valuable service in emphasizing the importance of physical fitness for all children and has provided an incentive for improvement in physical education programs throughout the country. In addition, its use has helped to fashion a strong link between the AAHPER and the President's Council on Physical Fitness and Sports (PCPFS). The PCPFS early on adopted and endorsed the use of the test, and it has continued to do so throughout the ensuing years. It is estimated that some 20,000,000 school children per year are currently tested with the instrument. A large proportion of these children participate in the PCPFS fitness award program.

Owing to the tremendous explosion of knowledge about physiological functioning during exercise that has occurred in the past 15 years, nagging doubts regarding the appropriateness and validity of certain of the test items began to surface. Agitation to systematically review and revise the test became increasingly vocal. Finally, in May 1975, a joint AAHPER committee for this purpose was appointed. The committee represented the Physical Fitness, Research, and Measurement and Evaluation Councils of the Association for Research, Administration, and Professional Councils and Societies (ARAPCS) of AAHPER. Members of the committee were B. Don Franks, University of Tennessee, Knoxville; Frank I. Katch, University of Massachusetts, Amherst; Victor L. Katch, University of Michigan, Ann Arbor; Sharon Ann Plowman, Northern Illinois University, DeKalb; and Margaret J. Safrit, University of Wisconsin, Madison. Andrew S. Jackson,

University of Houston, Houston, Tex., chaired the committee. Raymond A. Ciszek of ARAFCS attended all meetings and Ash Hayes from the President's Council on Physical Fitness and Sports attended several. Feedback from other professionals was solicited through AAHPER UPDATE and a national convention program, as the committee worked.

Rationale for Revision of the AAHPER Test. The charge was to study the problem and to prepare a position paper that would provide sound theory for the possible revision of the AAHPER Youth Fitness Test. The position taken was intended to reflect the best scientific research and empirical evidence relative to physical fitness measurement presently available.

To begin, the committee considered five items:

(1) the rationale for test revision,
(2) an operational definition of physical fitness,
(3) decision-making on the basis of test results,
(4) items that could be used to measure physical fitness, and
(5) the feasibility of using norm-referenced and criterion-referenced standards for defined groups.

The committee unanimously agreed that the test should be revised and after lengthy reading, writing, and debate came strongly to believe that now was the time to clearly differentiate physical fitness related to functional health from physical performance related primarily to athletic ability. It was toward this goal that all further work was directed.

Physical fitness was considered a multifaceted continuum which measured the quality of health ranging from death and diseases that severely limit activity to the optimal functional abilities of various physical aspects of life. Since physical fitness can be operationally defined by the particular tests used for its evaluation, specific criteria were necessary for choosing tests. Thus the committee recommended that a physical fitness test should:

(1) measure an area that extends from severely limited dysfunction to high levels of functional capacity,
(2) measure capacities that can be improved with appropriate physical activity, and
(3) accurately reflect a person's physical fitness status as well as changes in functional capacity by corresponding test scores and changes in these.

These criteria should not be interpreted to mean that health and physical fitness are being equated, for each is both more and less than the other, but that they are related in a manner that is important to the life of each person.

The areas that were identified as being of national concern in relation to dynamic functional health are:

(1) cardiorespiratory function,
(2) body composition, and
(3) abdominal and low-back musculoskeletal function.

Those three areas exhibit variations in capacity along the established continuum. Studies have indicated that they can be affected by physical conditioning. Sufficient data exist to suggest that regular physical activity can improve cardiorespiratory function and body composition. There are limited data and opinions that musculoskeletal dysfunction in the abdominal and low-back region is related to low-back pain and tension. Clinical evidence indicates that low-back pain and tension can be decreased by regular activity.

The logic and reasoning behind these statements are presented briefly as follows. Bibliographical information is available upon request.

Cardiorespiratory function. Cardiorespiratory function is extremely complicated and involves a multitude of steps from the delivery of oxygen by the respiratory system to its use on the cellular level. Within the genetic and anatomical limitations of each person, it has been proposed that improvements in the functioning of these factors are positively related to (1) endurance-type physical activity and (2) functional health, primarily a lowering of susceptibility to coronary artery disease.

The importance of this is obvious if one remembers that cardiovascular disease has reached near-epidemic proportions in this and many other countries. Coronary heart disease is our major killer, and many survivors are then limited in activity.

Obviously no one test can reflect all the components of cardiorespiratory function in all types of situations. It is also obvious that a battery of highly technical and time-consuming tests is not practical for the typical school situation. Therefore, relying on the fact that endurance running does reflect some undefined combination of components of cardiorespiratory function as well as genetics, body structure, and running ability, and that it can be quickly handled for large groups, it was felt justifiable to continue its use in testing. The 1-mile or 9-minute runs appear most feasible because they reflect some components of cardiorespiratory function, are related to maximal oxygen consumption, and are statistically supported as representing the variance accounted for by longer endurance runs.

Body composition. The major concern with body composition is obesity--an excessive enlargement of the body's total fat tissue. The upper limit of normalcy with regard to "desirable" levels of body fat are below 19 percent for males and below 25 percent for females. Desirable in this context refers to a value of fatness that is compatible with functional health status. Beyond this level there is complete saturation of adipose cells with lipids and further cellular proliferation leading to a larger body size.

Although it is not possible to state positively that obesity is detrimental to health, it seems to coexist with four types of hazards to health:

(1) disturbance of normal functions of the body--a reduced pulmonary capacity, accelerated wear and deterioration of joints, decreased flexibility, pancreatic dysfunction, and carbohydrate intolerance (diabetes),
(2) increased risk of developing certain diseases,
(3) detrimental effects on established diseases--diabetes, hypertension, heart, cerebral vascular, and gall bladder, and

(4) adverse psychological effects (suffering from prejudice and discrimination).

As with the cardiovascular disease problem, obesity has reached epidemic proportions in the United States. A conservative estimate is that 30-40 percent of the adult American population is overfat.

Ideally, body composition (percent fat) is determined by hydrostatic weighing, but this is a complicated, time-consuming task impractical for the masses in a school situation. Skinfolds, circumferences, and diameter measures can be used to estimate body fat. Unfortunately, these techniques are population specific and the committee could find no studies in which equations to predict percent fat were developed using anthropometric measurements for school-age children. Therefore, it was recommended that a nationwide study be conducted to do just this and that the results be used as part of the physical fitness battery.

Musculoskeletal function. The maintenance of minimal levels of trunk and hip strength/endurance and flexibility is believed to be important in the prevention and alleviation of low-back pain and tension. While there is little hard research in this area, clinical evidence and many physical fitness proponents, physical therapists, and orthopedic surgeons link the high incidence of low-back problems with a corresponding lack of exercise. The general logic is that weak muscles that are easily fatigued and/or strained cannot support the spine in proper alignment. Weak abdominals, in particular, allow the pelvis to tilt forward causing a concurrent and abnormal arch in the lower back. Shortened, inflexible muscles result in decreased mobility and increased possibilities of strain, spasm, and pain. When tense muscles shorten, lose elasticity, and are weakened by lack of exercise, the "low-back syndrome" follows.

Estimates of the magnitude of this problem range from approximately 16 percent of the population who have suffered the classical low-back pain syndrome to somewhere closer to 80 percent who have had "simple," but significant, backache. Low-back injuries may well account for more lost man-hours than any other occupational injury.

While many different tests for strength/endurance and flexibility could be used, the committee was not convinced of the validity and feasibility of any such test. The timed bent-knee sit-up was deemed marginally acceptable. This test, when the sit-up is executed properly, concentrates on abdominal strength/endurance and only minimally on back and hip flexibility.

Motor performance items. The present AAHPER Youth Fitness Test Battery includes additional tests of speed, agility, and power. Such tests measure task-specific aspects of motor performance rather than physical fitness as defined above. Since concepts are often developed and communicated through testing, the committee strongly recommended that motor performance items not be included in a physical fitness battery. Positive health, defined as physical fitness, is important throughout one's life. Conversely, the value of task-specific motor traits varies at different times.

The committee recognized the importance of athletic achievement to school-aged persons, as well as the need for selected abilities to handle the regular physical education classes. In these cases, it is suggested that the teacher use the basic physical fitness battery that is related to positive health and,

in addition, administer those task-specific motor performance items that he or she has identified as being important. The current AAHPER Youth Fitness Test Battery is one source for such tests.

AAHPER Action. The joint committee's recommendations were forwarded to the Board of Governors of AAHPER, and in late summer 1977 an AAHPER Task Force on Youth Fitness was appointed by AAHPER President LeRoy Walker. The Task Force was charged with following up on the joint committee's recommendations and revising the Youth Fitness Test. Task Force members are Steve Blair, University of South Carolina; Margaret Safrit, University of Wisconsin; Michael Pollock, Mount Sinai Medical Center, Milwaukee; B. Don Franks, University of Tennessee; and Andrew S. Jackson, University of Houston. Harold B. Falls, Southwest Missouri State University, is the chairman, and Raymond A. Ciszek is the AAHPER liaison.

The Task Force held a meeting in Springfield, Mo., February 3-4, 1978, and began working on the charges assigned to it. Members set several goals and classified these into immediate, short-term, and long-range. Immediate goals are those that the Task Force expects can be accomplished within about a year. Short-term goals are those estimated to take 1 to 3 years of work to accomplish, and long-term goals are those that will probably require 3 to 10 years. It was the consensus of the Task Force members that the Youth Fitness Test should be continually studied and updated as necessary (e.g., when new, important information on physical fitness becomes available).

An immediate goal is to pursue revision of the current Youth Fitness Manual to reflect an emphasis on health-related fitness but, at the same time, to retain a section on sports-related fitness similar to the current test. Although there is still some question in regard to the absolute validity of some of the suggested health-related items, and their applicability to very young children is not completely known, it was agreed that there is sufficient research support for moving ahead in this direction.

Developing an emphasis on health-related fitness is a key concept in revision of the youth fitness test, and this should be done as soon as possible. AAHPER is already lagging behind several of the individual states in this regard. The current Youth Fitness Manual conveys a misconception in that it does not emphasize health-related fitness to any extent. It is also lacking in the fact that it does not include sufficient material supporting the rationale for inclusion of the various items, nor does it adequately cover the technical aspects of their development. The Manual also lacks a section on suggestions to the teacher for making improvements among students who are shown to score less than desirable levels on the various tests.

Short-term goals were defined to include, but not necessarily be limited to, short finite research studies on reliability of test items, studies to further validate certain items against existing criteria, validity studies on alternate tests, and establishment of norms that currently do not exist. Long-range goals include continued studies on validity and reliability, studies to determine the specific relationships of test items to positive health, intervention studies to determine if improvement of specific test items has a positive effect on health status, determination of health-related validity, continued development of norms, including those for sub groups, and examination of sex differences in test performance, from both cultural and physiological standpoints.

Following the Springfield meeting, several meetings were sponsored during the AAHPER Convention in Kansas City. Two of these dealt specifically with the state of the art in assessment of body composition and cardiovascular fitness. Various researchers were invited to attend the meetings.

Another meeting was held in Washington, D.C., May 24, 1978, at which plans were completed for a working conference to be held in Springfield, Mo., at which the preliminary draft of the new fitness manual would be developed. Several other nationally recognized experts in physical fitness assessment were identified and invited to attend the conference. They are Charles O. Dotson, University of Maryland; L. Dennis Humphrey, Southwest Missouri State University; Tim Lohman, University of Illinois-Urbana; Russell Pate, University of Virginia, Charlottesville; Sharon Plowman, Northern Illinois University; and Glen Swengros, PCPFS, Washington, D.C.

The working conference, originally scheduled for early December 1978, but postponed due to weather conditions, was held January 7-9, 1979. Most of the time at the meeting was spent in completing the exact items to be included in the new fitness manual, identifying norm sources for each item, and establishing criterion-referenced standards for the items. Fitness components identified and discussed in the new manual are cardiorespiratory function, body composition (leanness/fatness), and musculoskeletal function in the low-back and hamstring muscle areas of the body. Specific test items that are being recommended for measurement of these components are the 1-mile or 9-minute run test with an option of 1½ miles or 12 minutes in the case of older children, a sum of two skinfolds (triceps and subscapular), a timed flexed-knee sit-up, and a sit-and-reach test. Normative data for the test items will come from:

(1) the Texas Physical Fitness Test,
(2) the South Carolina Physical Fitness Test,
(3) the Manitoba Physical Fitness Test,
(4) the National Health Examination Survey, and
(5) data yet to be collected from various locations throughout the United States.

Criterion-referenced standards for the various items will be included in the new manual. For skinfolds, below the 25th percentile on the norms from the National Health Examination Survey will be considered critical obesity. This corresponds roughly with one standard deviation below the mean and is an often-used standard of obesity. For the sit-up and sit-and-reach tests, criterion-referenced standards will represent the 50th percentile on the norms presented with the test items. Further discussion of the criterion-referenced standard for the distance run tests will be conducted at a meeting during the New Orleans national convention of AAHPER.

Five sections for the new manual have been outlined. They are: Introduction, Test Items, Guidelines for Development and Maintenance of Fitness, Technical Standards, and Appendices. A preliminary draft of each section was developed during the Springfield meeting, and these drafts were mailed after the meeting to each person in attendance. The Task Force will meet again in New Orleans to go over the revised draft and to edit and revise where necessary.

How to handle the current items in the Youth Fitness Test received much conference discussion. A decision was finally reached to recommend to the

AAHPER governing board that the old items, except for the sit-up, be placed in an appendix to the new manual so that they can be used by those teachers who still wish to use them. It was also recommended that the board appoint a new task force or committee to study the entire area of motor performance testing much as has been done with the physical fitness testing. Identification of students who are high or low on various general and specific motor performance test items is an important part of many physical education programs. The AAHPER and subgroups associated with measurement, fitness, and research have a responsibility to provide teachers with the most up-to-date information and test items. The Task Force is not convinced that the current items measure up. A new look at the whole area of motor performance testing is warranted to identify basic components based on latest research findings and to develop the best practical test procedures in each case.

A final recommendation to the AAHPER board was to eliminate the award system associated with the current youth fitness test items. This is a further aspect of the deemphasis of those items as the prime test of physical fitness in our profession. It should be noted that most of the performance differences on those items are due to hereditary differences and not to environmental factors such as development in physical education programs. It does not seem reasonable to give awards based primarily on heredity. Any future award programs should be based solely on the new test items. The Task Force in cooperation with the PCPFS will make recommendations later in regard to the form those awards should take.

The new manual will not be a final answer in youth fitness assessment. It will merely reflect our knowledge and expertise at this time. Much work will remain in regard to the establishment of absolute validity and reliability for some of the items. In addition, normative data, both criterion and norm-referenced, are lacking. The Task Force will presumably continue to work on these problems over the next several years and make upgrading of the Youth Fitness Test a continuous, ongoing process.

Sharon A. Plowman is a professor in the Department of Physical Education, Northern Illinois University, DeKalb, Ill., 60115. Harold B. Falls is professor of Health and Physical Education and Director, Kinetoenergetics Laboratory, Southwest Missouri State University, Springfield, Mo., 65802.

The draft for this article was prepared February 10-12, 1979. It is based on the following sources: (1) Plowman, S. A. and H. B. Falls, "AAHPER Youth Fitness Test Revision"; Journal of Physical Education and Recreation 49(9): 22-24, 1978.; (2) Falls, H. B., "History of Youth Fitness Testing and Status of Revision of the Test"; (3) proceedings of the joint national aerobics and Oklahoma AHPER conference, Tulsa, Okla., October 13, 1978.; (4) the introduction to the preliminary draft of the new AAHPER Physical Fitness Test Manual; and (5) the AAHPER Youth Fitness Task Force 1979 report to the AAHPER Board of Governors. Substantial portions of the JOPER article have been reprinted by permission of the American Alliance for Health, Physical Education, and Recreation.

Teaching Health-Related Fitness in the Secondary Schools

By Charles B. Corbin
Kansas State University
(Currently on sabbatical leave at Pennsylvania State University)

The focus of this conference is on aerobic exercise. You have heard or will hear from many different experts concerning the benefits of regular aerobic exercise, the latest information concerning the best methods for performing aerobic exercise, and some of the problems associated with this form of exercise, particularly jogging, a highly popular activity at the present time. A conference such as this is highly appropriate in a time of so much interest in health and fitness. A Gallup poll (1977) indicates that twice as many American adults are now participating in recreational exercise as were participating in 1961. Many, if not most, of the activities in which they participate are aerobic in nature. This should be encouraging news for educators for the data suggest that our programs may be effective in promoting the recent changes in behavior. However, a closer look indicates that our programs may not be responsible for the shift in activity patterns of Americans.

It seems that the most effective efforts to promote health-related physical fitness, including cardiovascular fitness which is the most direct byproduct of aerobic exercise, have come from outside physical education rather than from within. While medical doctors and journalists are spearheading the movement with books on the best-seller list and best-selling magazines, many physical educators are content to continue with their "sports as usual" programs. As George Sheehan recently noted, "there is a physical fitness and exercise bandwagon going on in our country; unfortunately the parade is passing physical education by." This is not to suggest that the purpose of physical education in the secondary school is exclusively physical fitness, but it is to suggest that physical education should consider some significant changes if it is to play a significant role in the future of public education.

In this particular paper the focus is on teaching the health-related aspects of physical fitness, namely, cardiovascular fitness, strength, muscular endurance, flexibility, and body fatness. There are several good reasons why these aspects of fitness should be emphasized. First, they are important because those who possess them are less likely to have hypokinetic diseases than those who do not possess them. This is not true for the skill-related aspects of fitness. Because the health benefits of exercise are quite well identified by other papers at this conference, this point will not be elaborated further here.

A second reason for emphasizing the health-related aspects, as opposed to the skill-related aspects of fitness (agility, balance, coordination, power, reaction time, and speed), is that all people, regardless of ability, can benefit from regular programs designed to promote these health-related components. On the other hand, there is a limit to the amount of improvement

possible for many people when it comes to skill-related fitness. The principal value of skill-related fitness is improvement in sports and other skills. It may just be that many persons feel that there is a limit to what can be gained from repeated exposure to programs that focus on skill-related fitness. Yet in most schools emphasis is placed on skill-related fitness. This is not to suggest that skill improvement is not important; indeed it is. However, these are not the only programs of importance to students in physical-education classes.

So, in addition to teaching sports and other motor skills, a need exists for more emphasis on the health-related aspects of fitness in school programs. As noted earlier, it is in activities designed to improve health-related fitness and in activities that do not require great amounts of skill that Americans have taken a great interest. These are the lifetime activities that we must teach about rather than talk about: As evidence, consider the fact that 63 percent of Americans interviewed concerning the value of their physical education experience 25 years after their formal schooling felt that what they learned in P.E. class was of little value later in life.[1] A recent Gallup poll on American education (1978) did not list physical education in the top 10 subjects rated for their usefulness in later life, though extracurricular activities including sports, drama, and band were rated in the top group. Apparently the lack of importance associated with physical education has resulted in deletion of physical education classes in some secondary schools across the country as evidenced by the fact the National Association for Sports and Physical Education recently established a "Save Physical Education Task Force" to help prevent such erosion.

As reported at this conference by Harold Falls, there is evidence that we are beginning to catch on. He reports that the latest revision of the AAHPER Youth Fitness Test will include only health-related fitness items. But while the testing of health-related fitness may be a step in the right direction, testing it will be of little value if we do not implement programs designed to teach for it. We must not go back to the old physical training of "PT" programs designed to force improvement in fitness. That would do little more than teach students how to hate physical activity and exercise. Fitness is important, especially health-related fitness, but sound educational programs must consist of more than exercising and achieving fitness.

Some years ago I developed a taxonomy of objectives that ranked these objectives from low to high in importance (see Table 1).

Table 1--A Taxonomy of Physical-Fitness Objectives[2]

1. Physical-Fitness Vocabulary
2. Exercising
3. Achieving Fitness
4. Patterns of Regular Exercise
5. Evaluating Physical Fitness
6. Fitness and Exercise Problem Solving[2]

All of these objectives are important! The point is that when lower-order objectives have been met, our job is not done. It should be our purpose to help all people achieve all levels of objectives including those of the highest order.

As seen in Table 1, exercising and achieving fitness are relatively low-order objectives. They are important, but we should not sacrifice higher-order objectives in meeting these. I think specifically of the teacher who runs mass calisthenics, and uses physical exercises as punishment. Students may achieve fitness in doing these things but they also may choose not to exercise later in life because of these experiences. Further, as they do exercise, students may learn little about why they are doing what they are doing. They may "get fit" for the short term but may learn little that will be used over the long haul.

In recent years colleges and universities have implemented courses called lecture-lab or concepts approaches to physical education. For convenience, they will be called concepts programs for the remainder of this paper. These programs focus on the higher order physical fitness objectives. Listed below are three basic purposes claimed for these programs.[4]

.WHY--One purpose is to help students learn that health-related fitness is important. Learning the why of physical fitness and exercise is necessary as part of the process of learning to solve personal exercise and fitness problems.

.WHAT--A second purpose is to help students learn what their fitness needs are. Evaluating fitness is a higher-order objective and something people must be able to do if they are to become effective problem solvers.

.HOW--The third purpose is to help students learn how to exercise correctly. There is a correct way to exercise. To learn the value of specific exercises is essential to developing patterns of regular exercise and solving exercise problems.

Concepts programs have been most successful at schools such as Kansas State University, Mercer County Community College, the University of Toledo, Missouri Western University, and Oral Roberts University to name but a few. But why wait until college? Are secondary school students not capable of learning higher order physical education objectives? Indeed they are! It is my opinion that the what, why, and how of physical activity are best taught in our junior and senior high schools.* The college programs are remedial and necessary only until secondary schools have shown that they are effectively helping students meet higher-order objectives.

Already many junior and senior high schools have implemented the concepts approach in their curriculums. Some unusual features of the programs instituted in the programs at these schools are listed below. Many of these features represent significant departures from normal operating procedures used in physical education.

* Actually we must begin to meet these objectives in the elementary schools. This reference simply means that even the highest order objectives can be met by the students in our secondary schools.

.Lecture or Class Discussions. In this type of course some class periods or part of certain class periods are devoted to lectures, class discussions, films, or slide presentations designed to teach the facts about fitness and exercise.

.Textbook. A textbook is used to supplement the information given in class concerning fitness and exercise and to provide self-evaluation as well as sample exercise program information. These materials present information that can be used for a lifetime.

.Self-Evaluations. To help students better understand their own fitness needs much time is spent in the self-testing of health-related and skill-related physical fitness.

.Sample Exercise Programs. Many different exercise programs are tried out, including such formal programs as aerobics and the West Point program; informal programs such as jogging and rope jumping, and sports of all types.

.Experiments. Students do experiments to help them discover information about fitness and exercise. Examples are experiments designed to help students learn the correct way to exercise and experiments designed to locate personal thresholds of training.

.Different Grading. It is important that grading not be based on low order fitness objectives such as achieving fitness. If higher order objectives are the concern, current levels of fitness based on personal fitness tests should not be the basis for grading. For suggestions on grading refer to the following reference.[5]

.Planning a Personal Fitness and Exercise Program. The culminating activity for the concepts class is the development and implementation of an exercise and fitness program that can be used for a lifetime.

.Different Topics. Some of the topics of the course are quite different from those normally covered in a physical education class. A sample from one secondary school concepts textbook is listed below:

.Fitness for All
.Parts of Fitness
.Threshold of Training
.Cardiovascular Fitness
.Strength
.Muscular Endurance
.Flexibility
.Exercise and Fat Control
.Exercise and Good Health
.Skill Related Fitness
.Correct Way to Exercise
.Physical Activity for a Lifetime
.Fitness Through Sports
.Planning Your Exercise Program
.Attitudes About Fitness[6]

The schools that have tried the concepts-type program at the high school and junior high school levels find there are at least three different organizational structures that seem to work well.[3] Because each school has its own unique needs, the best approach for a given school will vary. The organizational approaches and suggestions for each are listed below.[3,5]

.The Unit or Modular Approach. This is the approach used in most colleges. It seems to be most effective in schools with students of relatively high achievement orientation. In this approach a specific period of time is set aside, 6 weeks, 9 weeks, a semester, or a full year, exclusively for a concepts unit or module.

.The Integrated Approach. This approach merely integrates the what, why, and how into the regular physical education program. On specific days concepts material in the form of lectures, discussions, films, slides, self-evaluations, experiments, and sample exercise programs are used. On other days material from the more typical skill-oriented program is presented. This program seems to be quite effective for large schools and those which have been more traditional in their orientation prior to introducing the concepts approach. One highly successful integrated program is that of Topeka West High School in Topeka, Kans.

.The Mini Lecture Approach. This is a modified form of the integrated approach. The essential difference is that at no time is a full class period used for lecture or discussion. Rather, short segments of several periods are used for mini lectures or short presentations concerning important exercise and fitness topics. This approach seems most effective in schools in which students are lower in academic orientation than in the typical school.

As noted very early in this paper, the concepts approach to teaching higher order exercise and fitness objectives is not meant as a substitute for more traditional skill-oriented programs. It is meant to complement and supplement sound programs of lifetime sports. For those persons who implement the program there appear to be several important advantages.

.Accountability. In this age of cutbacks in spending, physical education programs in many schools are under attack. Apparently this is partly because many adults do not feel that physical education has much value for a lifetime. The concepts program offers physical educators the opportunity to become accountable for significant higher order objectives. Indeed, it offers physical educators the chance to lead the exercise and fitness parade rather than allowing it to pass them by.

.Coeducational Instruction. The concepts approach is and should be coeducational. In life people exercise coeducationally, and this is as it should be. The well-planned concepts class more than meets the guidelines of equal opportunity legislation such as Title IX.

Education for All People. The concepts program can easily be adapted to meet the needs of all kinds of special people including the physically handicapped. Perhaps more importantly, it can meet the needs of those people whom Roberts[9] labels as having "learned helplessness." These people feel that exercise, sports, and physical activity are not for them. They say, "I'm no good, P.E. is for the jocks, not for me." The concepts course can help all people learn that there is some form of exercise for everybody. (Incidentally, one good reason for not grading on fitness test scores is so as not to discourage those persons who already feel exercise is not for them.)

The concepts approach to physical education is not a cure for all of physical education's problems nor is it guaranteed to work in all situations. No program can be better than the people who teach, organize, and administer it. There is, however, evidence that this type of program that focuses on the health-related aspects of fitness, can be an effective program for helping American youth learn to exercise and be fit for a lifetime.

REFERENCES

1. Brunner, B. C. "How Will Today's Physical Education Classes Be Remembered in 1989?" JOPER. 40:42-44, 1969.

2. Corbin, C. B. Becoming Physically Educated in the Elementary School. Philadelphia: Lea and Febiger, 1976.

3. Corbin, C. B. "Changing Consumers Mean New Concepts." JOPER. 49:43, 1978.

4. Corbin, C. B. and Laurie, D. "Exercise for a Lifetime: An Educational Effort." The Physician and Sports Medicine. 6:50-55, 1978.

5. Corbin, C. B. and Lindsey, R. Fitness for Life: Physical Education Concepts. Glenview, Ill.: Scott, Foresman, 1979a.

6. Corbin, C. B. and Lindsey, R. Fitness for Life: Physical Education Concepts. (Teacher's Edition) Glenview: Scott, Foresman, 1979b.

7. Gallup, G. H. "Forty-Seven Percent of Americans Say They Exercise Daily," Minneapolis Tribune. October 7, 1977, p. 3B.

8. Gallup, G. H. "The 10th Annual Gallup Poll of the Public's Attitude Toward the Public Schools." Phi Delta Kappan. 60: 33-45, 1978.

9. Roberts, G. C. "Children in Competition: Assignment of Responsibility for Winning and Losing." Proceedings of the NCPEAM/NAPECW. 78: 328-340, 1977.

10. Wright, J. "Concepts in Physical Education-An Exciting Approach." Physical Education Newsletter. 95: 1-4, August 1978.

The Hope-Kellogg Health Dynamics Program*

By Richard A. Peterson, Ph.D
Director
Hope College
Holland, Mich.

*Funded through a health-promotion/disease-prevention grant from the W. K. Kellogg Foundation, Battle Creek, Mich.

The Hope-Kellogg Health Dynamics Program. Hope College is a modest-size undergraduate liberal arts college located in Holland, Mich. Characteristics that distinguish Hope College are its affiliation with the Reformed Church in America and a disproportionate number of students of Dutch ethnic background. Hope enjoys a superb academic reputation, particularly in the sciences. Its mission is to be influential in the development of the total person through a liberal arts education within the context of the Christian faith.

Hope recognizes that such a mission includes not only providing the finest possible education for the mind and a conducive atmosphere for the development of the spirit but also includes the best possible opportunities for the development and care of the physical self. Therefore, Hope College has always offered abundant opportunities in physical education and athletics.

Recent trends in American culture indicate that individual physical well-being may not be taken for granted. The physical demands of modern life are so minimal that a crisis of physical health would be unavoidable without nonessential physical activities. Many persons believe that such a crisis of physical well-being would have inevitable consequences on mental and spiritual health and would decrease society's availability of human resources. Current programs of health and physical education appear to have an obligation to meet this challenge in the most appropriate ways.

In addition to the decrease of physical demands in modern life, rather dramatic changes have occurred (1) in diet, where man seems more intent on eating for pleasure and social conformity than for health, (2) in emotional stresses and tensions, where fast pace and aggressive ambition appear to overpower perceived needs for rest and relaxation, and (3) in many other areas of life-style, where following lines of least resistance or the wish to comply with cultural convention have reduced health concerns to low priority. Programs concerned with the health benefits of physical activity seem remiss if they do not address these other interrelated aspects of life-style.

The Hope-Kellogg Health Dynamics Program represents Hope College's response to this need for innovative approaches to health and physical education. Those in charge are convinced that a strong relationship exists between life-style and health, and they are committed to providing for the physical health and fitness needs of the individual. The program combines, in a unique and innovative way, certain endeavors of the Physical Education Department, the College's Health Clinic, the Food Service, and the Office of Student Personnel Services to provide a comprehensive program of health and physical education, health care, and health promotion and advocacy.

Early on, in the conceptual stages of program development, the challenge of how best to fulfill this mission became apparent. College, viewed as a stage of life, exhibits many interesting, but often conflicting, characteristics. It represents a time when young adults are learning, questioning, analyzing, and making many decisions about their futures. Conversely it is often a time for indulging adolescent dreams about the good life within an atmosphere of new freedoms from restraint. It is often unpredictable which way the group psychology will react to new approaches to old subjects.

This is particularly true when one of the major objectives of the new approach is to affect actual health behaviors. College students have lived in mainstream American culture for many years; habits, attitudes, values, and priorities have largely settled in. Although the recommended life-style is not radically or dramatically different from the current cultural norm, still conscious, willful effort would be required to adopt changes, to overcome the inertia of life-style by habit, and entrench new patterns of life that are oriented at least obliquely to those most commonly followed.

On the other hand, college represents a period of flux in personal behavior for many. Persons experiment with life-styles that are perceived as chic and attractive according to the "Madison Avenue" model. Such images, and individuals' attempts to establish their position within those images, often conflict with both their role as serious students and with guidelines for healthful living patterns.

Thus a general pattern emerges that seems to hold more often than not within our society. Individuals learn and entrench a life-style as children, depart from that life-style briefly in young adulthood, and then return gradually to roughly the same life-style that was learned while growing up, with appropriate variations to account for changes in society at large. During this process, little thought is directed towards health and fitness and particularly towards the role of life-style in these important life qualities.

All of this takes place within an atmosphere of a societal preoccupation with matters of health. It would appear a logical paradox that so much stress is placed on health information in our culture yet only a small proportion of the population follows life-styles that really promote health, wellness, and fitness.

One of the first steps that a program must take if it is to be effective in influencing behavior patterns is to arouse the personal interest of the individual in his or her own health; to develop a conscious curious awareness so that learning, analysis, and decision-making may take place in a receptive environment. Certainly many educational strategies are recognized as effective in arousing interest. The challenge is to optimize the effectiveness of these techniques while minimizing obstacles to interest arousal as well as minimizing the generation of resistive interest. This was our intent when we began to establish the detailed plans for the accomplishment of our purposes. What follows is a description of the salient features of the Health Dynamics Program at Hope College.

Initial Health Screen. Prior to arrival on campus, each student completes an extensive questionnaire covering health history, health habits, self-image, and current health status. Upon arrival, further information is gathered about

health and fitness knowledge, attitudes, values, and priorities. This information is reviewed by Health Clinic staff and Program personnel for potential problems or concerns. If such problems surface, the Program provides appropriate attention to the concern. Those who have no apparent problems proceed into the basic freshman year experience.

In each case, careful note is taken of the information gathered. Those who have no apparent problems should not feel that there is no interest in their situation. Health information gathered, regardless of source, is summarized in several ways so that each student has an expanding personal health profile that may be added to and which forms the basis for the development of a personal health action plan. Since no two profiles are alike, no two health action plans could be the same. In this way individualization is achieved both in the process and the product.

Academic Component. One of the components of the freshman experience is academic in nature. The basic concepts of the relationships among exercise, diet, fitness, and health are explored. Such knowledge may be obtained through lectures, reading, media and/or other tools typical of the academic approach. Discussion is also encouraged through the use of discussion questions. Discussion is uniquely able to provoke personal thought involvement. Thus this component is expected to both inform and arouse interest.

Health information has increased in a nearly explosive fashion in recent years. There are probably many reasons for this, but it seems likely that the trend towards a more individualistically oriented society is strongly involved. In such an atmosphere, factual, accurate information is mixed with generous proportions of myth, partial truth, conjecture, and opinion in such a way that the individual exploring the milieu is often confused and frustrated. The intent of the Health Dynamics academic component is to not only provide a valid overview of information but also to provide the individual with the necessary analytic tools so that he may do his own literature resolution.

Assessment Component. A variety of assessments that have meaning for health and fitness are conducted during the freshman program. Testing is done in the exercise biology laboratory. Each student is given a graded exercise tolerance test on a bicycle or treadmill ergometer. Heart rate, blood pressure, and energy output level are monitored throughout. Each student also is hydrostatically weighed to determine body composition. Tests of pulmonary function, flexibility, strength, and power are also given in order to obtain a fairly comprehensive physiological fitness profile.

In addition to these laboratory tests, assessments of health-related behaviors are made. Persons are asked to record periodically behaviors such as diet, physical activity, alcohol and tobacco use, stress perception, rest, and bouts of illness. When the biologic functions and behavior information are added into the previously mentioned personal health profile, a composite emerges that includes health history, current health and fitness status, health behaviors, and health knowledge, attitudes, values, and priorities. The profile is characteristic of each person and when dealing with the profiles, an individual approach seems most appropriate.

Advising Component. Such a profile, although interesting from a "this is me" standpoint, is of little value unless made meaningful through some form of

follow-up . planation, and, where appropriate, recommendations for change. We do things by . eting with each student, getting to know him as a person as well as a profile, and giving him an opportunity to know us. In order to improve the program staff:student ratio, upper-division major students are enlisted to augment our staff. During the meeting, we share the meaning of the student's profile with him and explore the areas where change might be helpful. Although a one-on-one component such as this might not be possible everywhere, we feel it is one of the major strengths of our program.

Prior to this meeting, each student prepares a document that we label a "personal health action plan." This document summarizes the personal heal profile by pointing out areas of health strengths and weaknesses and also allows the person to voice feelings about plans for reinforcing strengths and accommodating weaknesses. The preparation of such a document has several advantages. It certainly improves the efficiency of the meeting; more gets done in less time. It also has tremendous value as a tool to focus on one's physical self. Additionally, it provides a framework for personal education to take place about health and fitness concepts. Thus, even if the person hasn't the inner resources to actualize his action plan, it has had value in accomplishing something significant for him.

Physical Activity Component. Each student participates in physical activities in accordance with the implications of his individual profile and in accordance with the particular goals and objectives he has expressed to us. The objectives of the physical activity are to provide activities strenuous enough that a training effect takes place, are enjoyable enough that the student perceives them as a positive experience, are in accordance with the principles of fitness for health, and are effective in laying the foundation for a lifetime of healthful exercise. Such goals certainly require not only selecting the appropriate activities, but also the correct teaching methods, philosophies, and attitudes. These, of course, must be mutually understood beforehand and adhered to.

The components described above are effectively handled within the context of college coursework. One of the more unusual features of the program, however, is what happens in the broader campus community. We don't believe that a true impact will take place in students' lives unless a conducive atmosphere or environment exists; the college must be with us in spirit and in action. Campus personnel not directly involved in the program must provide modeling and vocal support, not just to enhance the program but because they actually believe in what they are doing. Thus we direct efforts to the campus at large.

One campus activity that impacts strongly on health is residence hall dining. More than 75 percent of Hope's students dine on campus. We feel that this should be a healthful experience and, to that end, we have developed working relationships with the food service and the students. The food service provides meals that conform to health nutrition guidelines, complete nutrient analysis of all items served, and a dietitian consultant to answer questions and provide basic nutrition information. It also provides for the special needs of dieters, vegetarians, and others for whom the basic diet is not appropriate. Student committees are formed under the auspices of the Health Dynamics Program to advise the food service, to observe the eating habits of the students, and to serve as a link between the Program and the students. The Program provides basic nutrition education so that students are aware of health nutrition guidelines.

The role of the college's Health Service in initial screening has already been mentioned. The integration of the program with the Health Service goes beyond that, however, to a real partnership in caring for the health of Hope students. Cross-referrals are immediate whenever appropriate and a team approach to both preventive and restorative health care assures the student that his health concerns are important. Even in physical setting, the integration of these services is apparent. The Health Clinic, the Physical Therapy/Training Room, and the Exercise Biology Laboratory are all situated in the same complex and are interconnected.

One intangible factor that may not be left to chance is the attitude of the campus community. Fostering a higher visibility of health and fitness related concerns on a campus-wide basis is principally a public relations and communications task. The more students and faculty know about philosophies and intentions of the program as well as the actual implementation strategies, the more likely they will be to retain a supportive mind set. Such amenities as newsletters, fitness testing and consultation, and ready access to facilities go a long way toward entrenching positive feelings about health and about the Program.

Conclusion. We feel strongly that "Health Dynamics" is an idea whose time has come. Medicine is moving towards more emphasis on preventive approaches; health education is focusing more energy on the importance of life-style in health; and physical education is increasing its endeavors in health and fitness related activities. Health dynamics exists where these disciplines intersect. Health dynamics means doing something personal, positive, and appropriate about promoting one's own health, wellness, and fitness. The program at Hope College is designed to offer a means for such promotion.

The Aerobics Program at Oral Roberts University

By Paul Brynteson, D.P.E.
Oral Roberts University

When a physical-education program becomes a part of a college or university curriculum, it implies that the program has some reason for being, some purpose, some goal, some objectives. Too often physical-education programs have been hazy in articulating those goals and purposes and when called upon to defend why their program should be required as a part of the university curriculum, physical educators have often been unable to do so. The evidence is that in 1968, 87 percent of colleges and universities required physical education. In 1972 this had dropped to a 74 percent requirement, and by 1977 the requirement had further dropped to 57 percent of the colleges and universities requiring physical education.

I believe a significant reason for this trend has been the lack of direction by physical-education programs and people not understanding what physical education is all about.

Philosophy of Oral Roberts University

Oral Roberts University has a required physical-education program for three reasons. In the first place, it is consistent with the philosophy of the University. The founding philosophy of ORU is to provide an education that seeks to develop the whole person with equal emphasis on mind, spirit, and body. The college catalog states that ORU wants its graduates to be mentally alert, spiritually alive, and physically fit. ORU seeks to develop a life-style in its students conducive to the development of the whole person. President Oral Roberts, founder of the University, has said that "ORU is a life-style in which an education takes place."

When we think of the "education of the body" we think of the health and physical fitness of the body and the development of life-style patterns that will enhance the health and physical fitness of the body. The development of the body is not an end in and of itself; rather it is a means to an end. It is through a healthy and physically fit body that the mind can function at its peak and the spirit can have freedom to direct the whole person so as to be an effective, functioning member of our society.

As an implementation of that philosophy the Health, Physical Education, and Recreation Department at ORU has the responsibility for implementing the physical fitness goals of the University. Therefore, a requirement in physical education is totally consistent with the goals of the University.

The second reason why ORU has a physical education requirement is for medical and health goals. The major health problem in the United States today is cardiovascular disease. Fifty-four percent of all deaths are from this disease and it costs in excess of $20 billion a year. Research has identified the various factors that are related to this disease. Some of these are:

1. Factors we can't control such as sex, age, and heredity.

2. Factors for which we need medical assistance to control such as hypertension, diabetes, and hyperlipidemia.

3. Factors we can control such as smoking, obesity, diet, and physical activity.

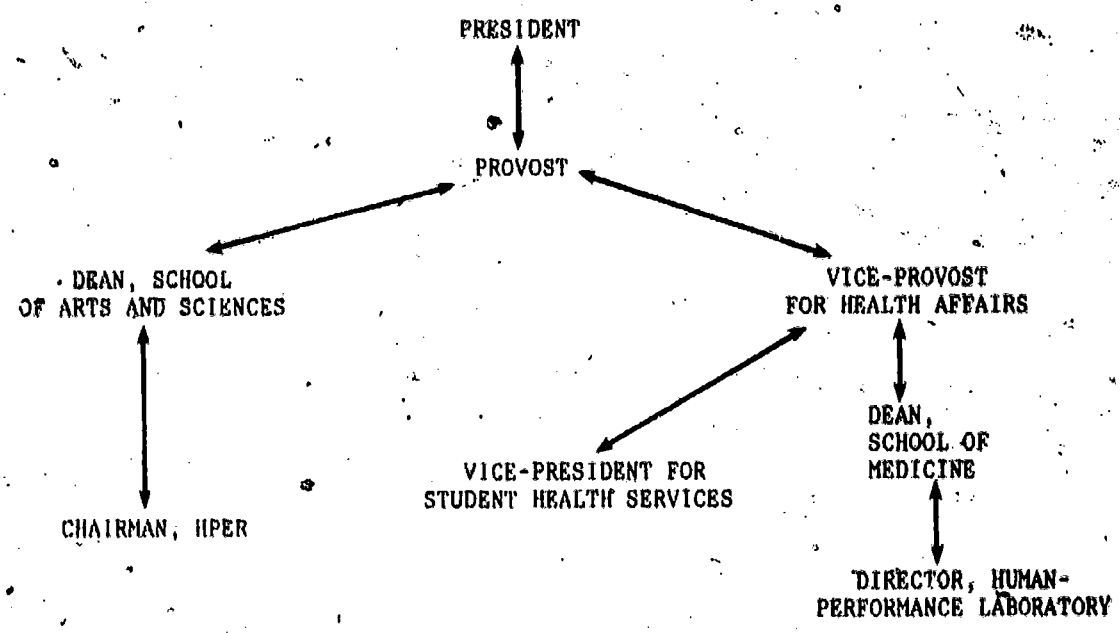
It is because we know that we can control some of the factors relating to this debilitating disease that physical education is required at ORU. We believe that the training received will enable our graduates to better control the factors relating to the disease, and thus reduce its incidence.

The third reason for the physical-education requirement at Oral Roberts University is a spiritual one. We believe the Bible teaches that man is the temple of God and that as the temple of God we're to take care of our bodies because the spirit of God dwells within our bodies (1 Corinthians 3:16-17 and 6:19-20). Therefore, we are not to abuse our bodies. The goal of our physical-education program is to educate our students on how to take care of their bodies.

Administration of ORU's Aerobics Program

On the basis of the philosophy just outlined and our knowledge about health factors related to various diseases, the Health, Physical Education, and Recreation Department, together with the Human Performance Laboratory and the Student Health Services, has developed a health and physical-fitness program directed towards controlling those factors we can control. The following charts indicate the administrative structure of the ORU aerobics program as well as the responsibilities of the HPER Department, the Human Performance Laboratory, and the Student Health Services as we work together to direct the aerobics program.

ORGANIZATION OF THE ORU AEROBICS PROGRAM



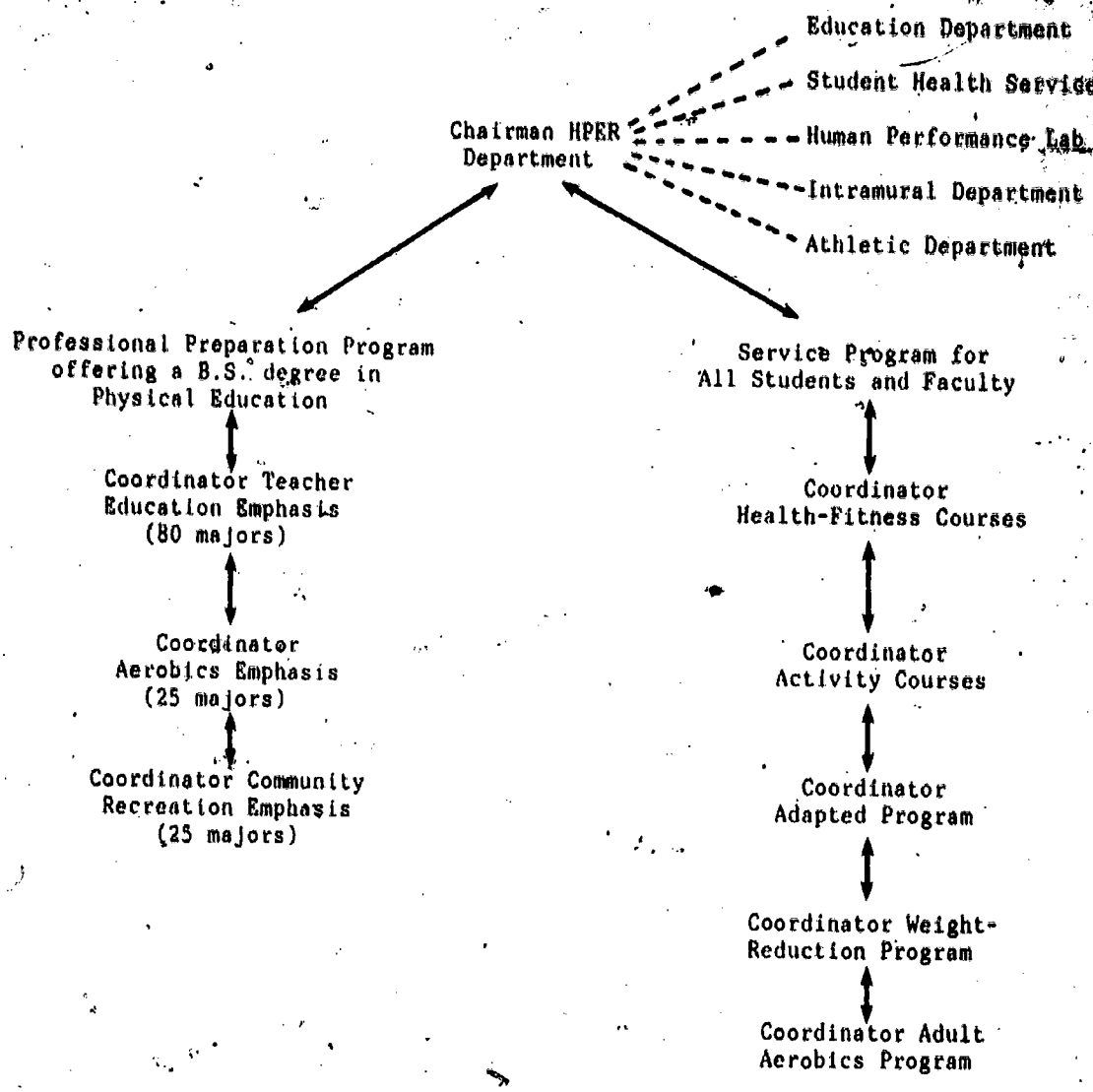
Responsibilities:

HPER Department: To provide the Aerobics Instructional and Activity Program

Student Health Service: To medically clear all students and faculty for exercise and make modifications in requirements for persons needing adaptations. These may be temporary or permanent.

Human Performance Laboratory: Provide support services to the HPER Department and the Student Health Services in terms of administering resting ECG's, blood pressures, graded exercise ECG tests, anthropometric tests, and blood analysis.

ORGANIZATION OF THE HEALTH, PHYSICAL EDUCATION, AND RECREATION DEPARTMENT.



Purpose of the HPER Department:

The purpose of the Health, Physical Education, and Recreation Department is to provide an atmosphere for understanding and appreciating the relationship of physical activity and fitness to optimal lifelong health and well-being so that the individual will select an appropriate personal life-style reflective of the whole person that Christ intended. The service program aims to accomplish this purpose for students and faculty at ORU. The professional preparation program aims to prepare professionals who can accomplish this purpose in schools, churches, YMCA's, recreation centers, businesses, industry, and similar settings.

University Aerobics Requirement

The aerobics program is a part of all health, physical education, and recreation-activity courses. The following are requirements all students must follow:

1. All full-time students must enroll in and pass an HPER activity course every semester. Failure to do so may result in suspension from the university.

2. Course sequence:

	Fall Semester	Spring Semester
Freshman	Health-Fitness I	Health Fitness II
Sophomore	Elective Team Activity	Elective Team Activity
Junior	Elective Activity	Elective Activity
Senior	Elective Activity	Elective Activity
Graduate Students	Elective Activity	Elective Activity

3. No full-time student is exempt from participation in the HPER activity courses for any reason. A student with a medical problem will participate in a modified aerobics program. It is the student's responsibility to see the University physician who will prescribe a special exercise program and to communicate this to his or her instructor.

4. Students who are not fulfilling ORU's physical-fitness requirements will be placed on physical probation or suspension. A student's progress will be evaluated at the end of each year and he or she will be placed on probation or suspension for (a) failing an HPER activity course, (b) failing to enroll in a specific activity class or classes as required by the HPER Department, (c) failing to report to the Human Performance Laboratory or the Student Health Service as required by the HPER Department, (d) failing to make satisfactory progress in physical-fitness criteria as prescribed by the HPER Department and the University physician.

Health Fitness I and Health Fitness II Courses

The purpose of these courses is to provide information in the form of lectures and laboratory experiences that the students can understand and develop a personal appreciation for the relationship of physical activity and fitness to health. As a result of this understanding and appreciation, we trust that the student will select an appropriate personal life-style necessary to produce optimal life-long health and well-being. The emphasis in the first course is on the concept of lifestyle, health, and physical fitness, the cardiorespiratory system, and nutrition and body composition. The emphasis in the second course is on the musculoskeletal system, a discussion of concepts related to health fitness such as quackery, smoking, and a practical experience for all the students to be certified in cardiopulmonary resuscitation (CPR).

The general goal of the course is that students should be able to answer the following questions:

General Questions

1. What is fitness?

2. How is fitness assessed?

3. How is fitness achieved?

Personal Questions

1. What is my level of fitness?

2. How much fitness do I need?

3. How much fitness do I want?

4. How do I achieve and maintain that level of fitness?

The students will be graded on the basis of four criteria in the health-fitness courses. A minimum standard must be achieved for each criterion to pass the course. The criteria are as follows: (1) knowledge as measured by tests and assignments equals 40 percent of the grade; (2) physical activity as measured by aerobics points equals 30 percent of the grade (the minimal standard to pass the course is an average of 15 aerobics points for men per week and 10 for women); (3) cardiorespiratory fitness as measured by the field test equals 20 percent of the grade (the minimum standard to pass the 1½-mile run for men and 1.25-mile run for women is 14:00 minutes for under age 30, 14:30 for 30-39, 15:15 for persons 40-49, and 16:15 for persons over age 50); (4) body-composition fitness as measured by percent fat equals 10 percent of the grade (minimum standard to pass the course is 26 percent fat for men and 36 percent fat for women).

The students are graded on the same criteria for Health Fitness II; however, the standards are slightly changed. The criteria are as follows: (1) knowledge -- 40 percent of the grade; (2) physical activity as measured by aerobics points -- 30 percent of the grade (minimum standard to pass the course is 20 aerobics points per week for men and 15 for women); (3) cardiorespiratory fitness is measured in two ways -- in the first place the field test is administered and the minimum standard to pass the course is 13:30 minutes for those under age 30; 14:00 for 30-39 age group, 14:45 for 40-49 age group, and 15:45 for ages 50 and over. In addition, students must meet minimum requirements for the 3-mile run. The minimum standards are 33:00 for men under age 30, 36:00 for 30-39, 40:00 for 40-49, and 44:00 for ages 50 and over. Three minutes are added to the standards for women. (4) Body composition as measured by percent fat -- 10 percent of the grade. Minimum standard to pass the course is 24 percent fat for men and 34 percent fat for women.

During the first two weeks of the Health Fitness I course, all new students are medically evaluated to determine their current health status by the Human Performance Laboratory and the Student Health Services. We do not require an entrance medical examination but rather test our students on (1) personal health

history, (2) family health history, (3) resting measures including blood pressure and 12-lead electrocardiogram, (4) physician's heart-lung examination and (5) anthropometric measurements including skinfolds, weight, height, and percent fat.

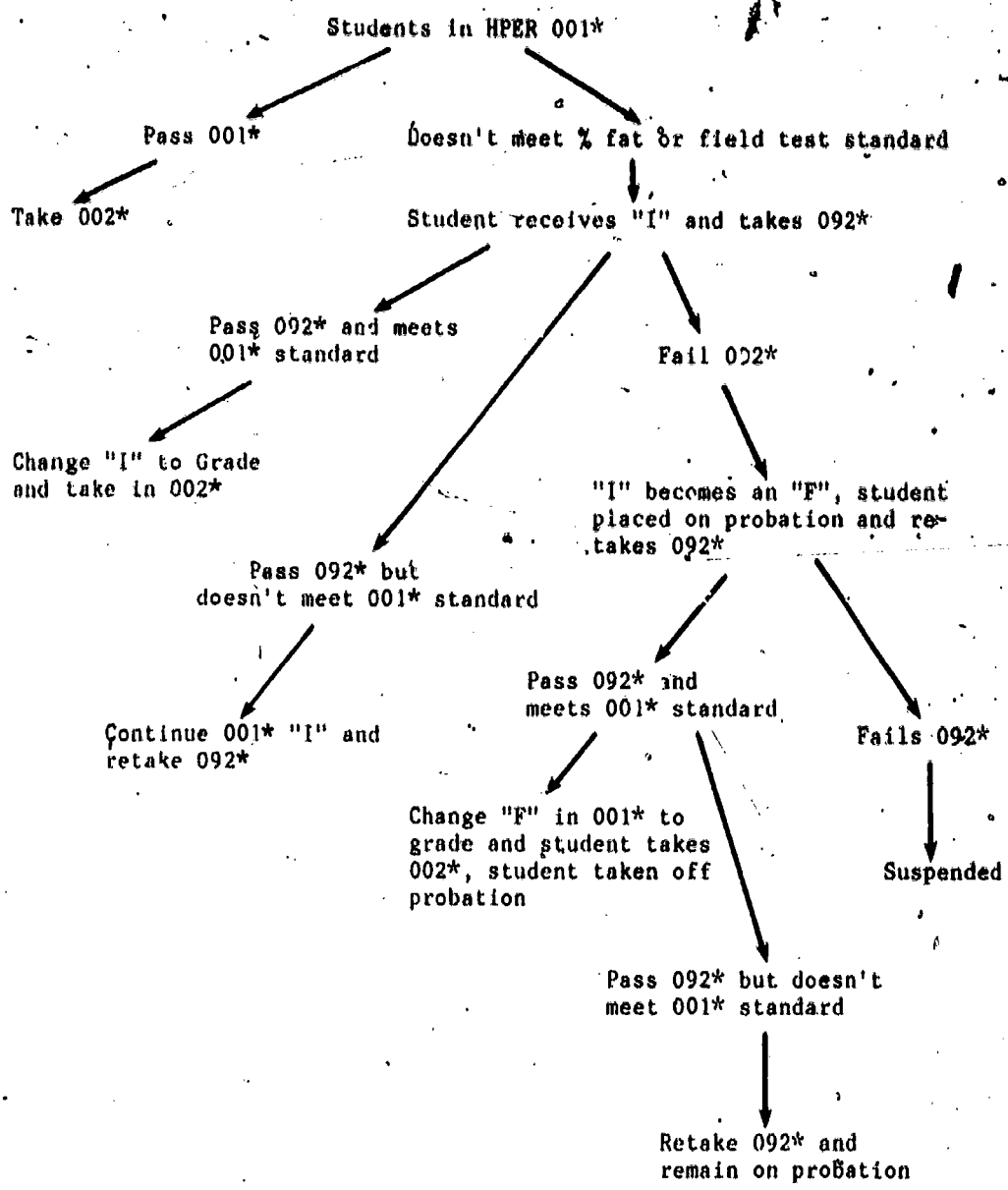
After the student has completed these tests, the results are fed into a computer and a printout summarizes the results of the tests and clears the student for exercise or indicates that the student is not cleared for exercise. A student not cleared for exercise will be required to return to the Student Health Services for further evaluation. This further evaluation may include a graded exercise ECG treadmill test, blood tests, or other tests that the physician deems appropriate. As a result of the additional tests, if necessary the student will be given a modified activity and physical fitness requirement and this will be communicated to his or her instructor.

Once the student has been completely cleared for exercise with or without modifications, the physical-activity portion of the health-fitness course begins. The basic structure of the health-fitness course is that the students meet once a week for 2 hours. The first hour of the course is in a classroom where a video cassette television tape is shown by the instructor which presents cognitive materials over various topics. Most of the video cassettes are approximately 20-30 minutes in length. At the completion of the tape, the instructor will lead the students in a discussion of that tape and introduce the laboratory session that is to follow. In most cases the laboratory session complements the tape.

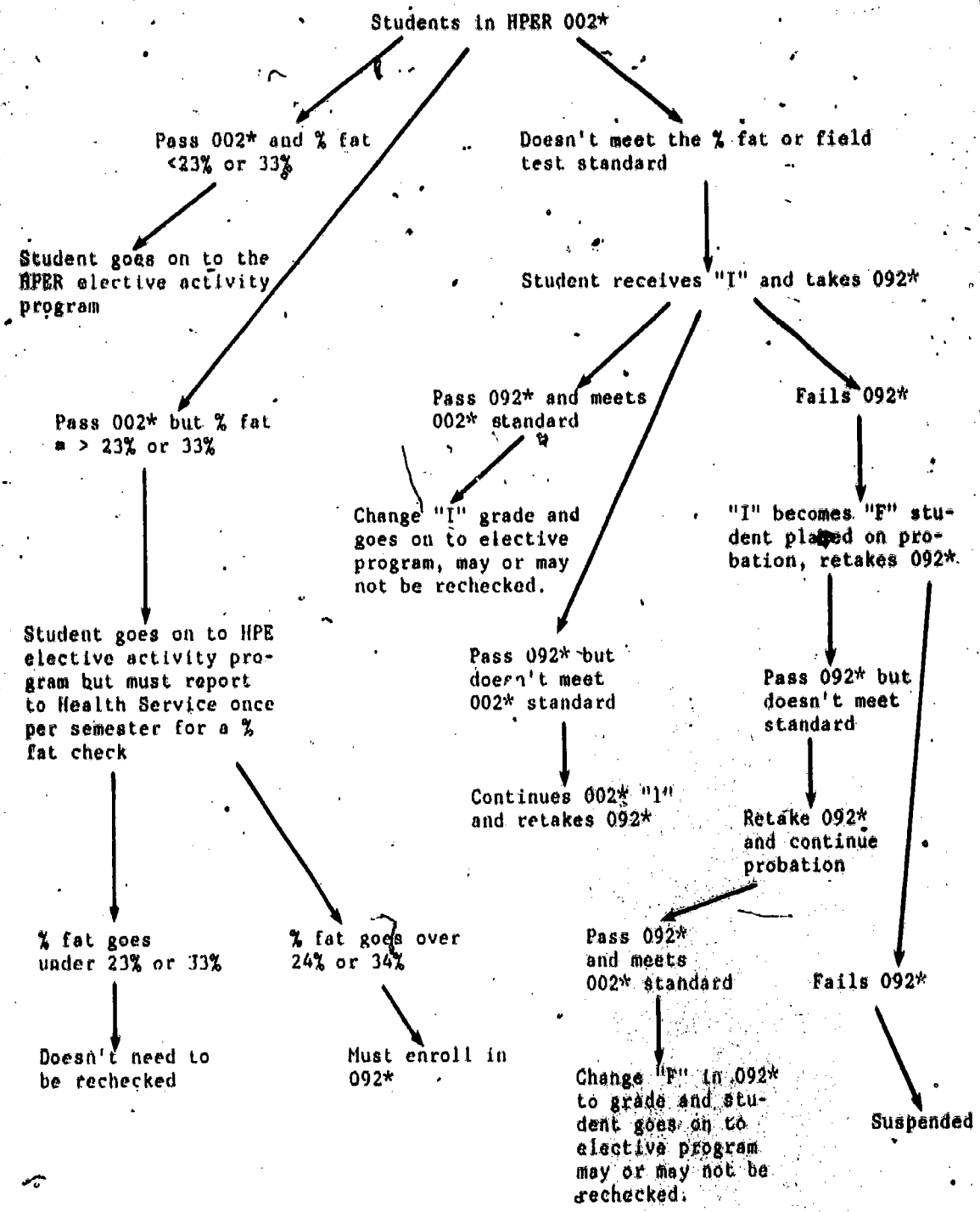
The second hour of the health-fitness course then is a laboratory phase where the students normally go to an exercise area, most often the track. It is here that the instructor will lead the students in developing a health-fitness life-style.

During the health-fitness course, fewer than 1 percent of the students do not meet the physical fitness standards that have been established by the University. In most cases, students who have difficulty achieving these standards are those who are significantly overweight. The next three charts indicate the administrative organization of how we attempt to assist persons who have difficulty meeting the physical-fitness standards.

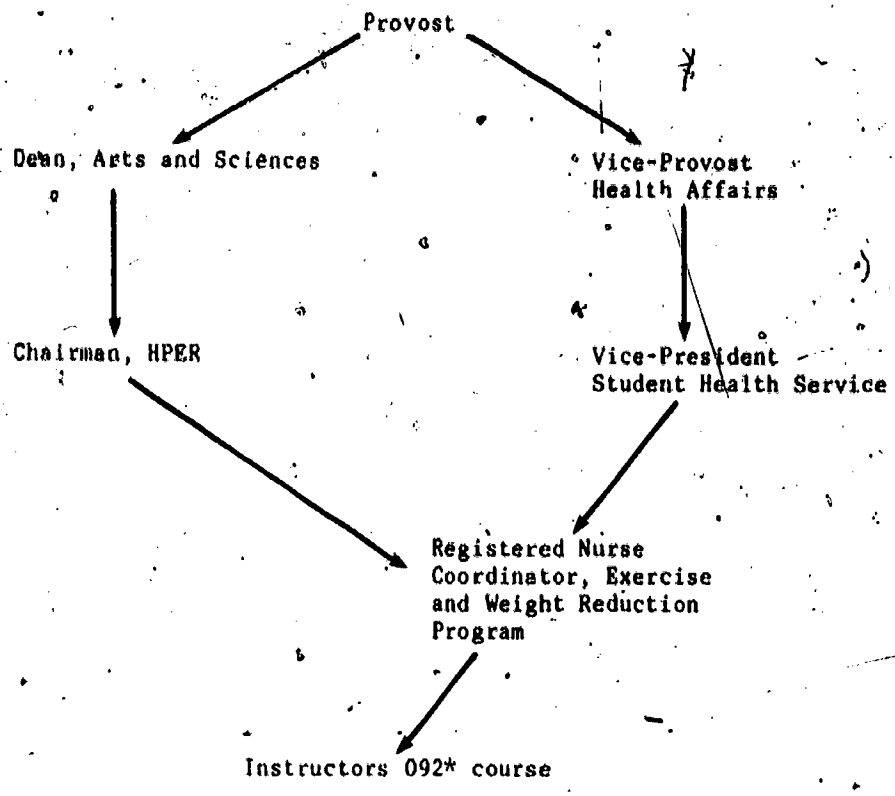
FLOW CHART FOR STUDENTS IN HPE 001* HEALTH FITNESS I



FLOW CHART FOR STUDENTS IN HPE 002* HEALTH FITNESS II



ADMINISTRATION OF EXERCISE AND WEIGHT CONTROL PROGRAM



Elective Activities

Students who successfully complete the Health Fitness I and Health Fitness II courses take elective individual or team activities the rest of their time at Oral Roberts University. Some of the activities offered in the individual and team activities include:

Advanced Lifesaving	Aerobics I	Aerobics II
Archery	Backpacking	Badminton
Baseball (T)	Basketball (T)	Beginning Swimming
Body Conditioning	Bowling	Cheerleading (T)
Cycling	European Team Sports (T)	Exercise and Weight Control
Fencing	Field Hockey (T)	Gymnastics
Flag Football	Golf	Karate
Intermediate Swimming	Judo	Recreational Activities
Korfball (T)	Racquetball/Handball	SCUBA Diving
Recreational Aquatics	Self-Defense	Softball (T)
Skin Diving	Soccer (T)	Trampoline & Tumbling
Tennis	Track and Field	Water Safety Instruction
Varsity Sports (T)	Volleyball (T)	
Wrestling	Aerobics for Grad. Students	

The basic objective of all elective activities is threefold: (1) physical fitness, (2) recreation skill, and (3) social participation. Students are graded according to these main objectives:

Physical Fitness	50%
As Measured by Aerobic Points	30%
As Measured by Field Test	20%
Recreational Skill	40%
Social Participation	10%
	100%

Although the activity course will be 50 percent graded on physical fitness, the total class will be devoted to developing the recreational skill of the course. The students earn aerobics points on their own time and fill out a computer card every time they exercise, turn it in to a box and each week the instructor receives a printout back for the aerobics participation of all students (see sample printout).

ENTER SOCIAL SECURITY NUMBER IN BOTH AREAS BELOW	ACT CODE	DISTANCE	DURATION (HRS MINS SECS)

NOTE: Activity code MUST be completed each time.

Codes 1 - 6 require entries in BOTH Distance AND Duration columns. All other codes require only a Duration entry.

ORAL ROBERTS UNIVERSITY EXERCISE LOG

This card is to be used to record ONLY one exercise activity. Complete one card for each activity you perform.

SPECIAL MARKING INSTRUCTIONS: Mark the appropriate positions under the proper headings. Never mark more than one position in any one column.

It is not necessary to darken any ZERO entries.

ACTIVITY CODES

1 Walk/Jog/Run
2 Stair-climbing
3 Stationary Running
4 Cycling
5 Stationary Cycling/Rowing
6 Swimming
7 Tennis/Badminton (Singles)
8 Tennis/Badminton (Doubles)
9 Basketball
10 Softball/Baseball
11 Gymnastics
12 Golf
13 Rope Skipping/Rhythmic Aerobics
14 Soccer/Field Hockey
15 Football
16 Skiing/Skating
17 Volleyball
18 Calisthenics/WT Training
19 Racketball/Handball/Squash
20 Wrestling/Judo/Karate

All Entries for Activities 01-06 will be Reported Only in the Units Indicated

1 – Miles
2 – Number of Steps Climbed
3 – Steps Per Minute
4 – Miles
5 – Heartbeats Per Minute
6 – Meters

Be Sure to Watch the Decimal Point Position on These Entries.

RECORDING TEMPORARY MEDICAL EXCUSES

If medically excused from aerobics, you must turn in ONE card per week during the excused period. Use the Activity Codes below to indicate the reason for the excuse.

91 Cold, flu
92 Mono
93 Other sickness

95 Ankle or foot injury
96 Shin splints or lower leg injury
97 Knee injury
98 Muscle injury
99 Other injury

Under DURATION column (HOURS heading), indicate how many days you are excused from exercise THIS week. Complete this entry for BOTH Sickness and Injury. It will allow your points per week to be adjusted accordingly.

Enter proper number of days in the HOURS column of the DURATION column.

If your excuse was from INJURY, use the DISTANCE column to indicate where the injury occurred.

1 00 HPE Activity Class
2 00 Intramurals
3 00 Individual Aerobic Workout
4 00 Intercollegiate Athletics
5 00 Other

AEROBIC ACTIVITY REPORT FOR WEEK ENDING : 4/20/79

196 CLINDTEF 091*A AEROBICS 11

WEEK NUMBER = 12

NAME OF PERSON REPORTING		NUMBER OF CARDS ACCEPTED	TOTAL POINTS THIS WEEK	TOTAL POINTS RUN, SWIM, CYCLE	AVERAGE POINTS PER WEEK	CUMULATIVE MILEAGE RUN	SWIM	CYCLE	
ASDIKIAN	DAVID	5	111.3	111.3	41.5	146.0	0.0	0.0	132
COLE	PHILIP	1	34.0	34.0	34.7	246.5	0.0	0.0	1298
CURTISS	JEFFERY	4	129.7	129.7	51.1	183.0	0.0	0.0	3111
FLETCHER	LORENE	1	24.5	24.5	26.3	126.0	0.0	0.0	3858
FREYMAN	JAMES	1	29.5	29.5	120.7	635.9	0.0	0.0	668
HANSEN	RAY	6	80.0	23.7	57.6	109.3	0.0	0.0	852
HENJUM	MARK	7	76.9	22.4	39.5	70.0	0.0	0.0	4010
KAZDA	CHERIE	3	38.1	38.1	29.3	106.7	0.0	0.0	271
LAWING	KEVIN	4	55.3	44.3	37.3	87.0	0.0	48.0	987
LOWRY	JOSEPH	2	73.6	73.6	79.2	241.5	0.0	0.0	397
MATTHEWS	JULIE	4	36.6	28.6	22.0	66.3	0.0	0.0	3458
PAYNE	BARBARA	3	41.5	41.5	49.5	258.9	0.0	0.0	597
PETTYGROVE	TODD	3	99.1	51.1	49.6	187.5	0.0	0.0	657
PILTINGSRUD	STEPHEN	0	0.0	0.0	53.0	169.2	0.0	0.0	3353
*CLAIMED MEDICAL EXCUSE FOR 7 DAYS									
ROTEN	SANDRA	0	0.0	0.0	42.2	50.0	0.0	0.0	1195
WILLIAMS	BEA	0	0.0	0.0	21.2	124.5	0.0	0.0	3489
ZIMMICH JR	HAROLD	5	82.9	82.9	40.3	156.1	0.0	0.0	2136
TOTALS FOR GROUP			873.0	737.2	46.3	2934.2	0.0	48.0	

NUMBER OF PERSONS ASSIGNED TO GROUP = 17
NUMBER WHO FAILED TO RECEIVE POINTS THIS WEEK = 3
AVERAGE NUMBER OF POINTS EARNED BY GROUP = 51.4
AVERAGE POINTS EARNED BY THOSE REPORTING = 62.4

PERCENT OF CLASS EARNING POINTS = 82.35

TOTAL NUMBER OF LOST DAYS 7

The field test is given twice during the semester and the better grade of the two tests is used for determining the student's grade. Therefore, in a 15-week semester, 14 weeks will be devoted to instruction in the activity and one class period at the beginning of the semester and 1 class period at the end of the semester will be devoted to giving the field test.

Results of the Aerobics Program

The results can be presented in various forms and in numerous terms, but let me present results in terms of attitudes and behaviors, since that is what we're trying to influence.

Recently we asked our current students the following two questions: "What contribution did your high school physical education program make towards your knowledge and attitudes about physical activity and fitness?" "What contributions did the ORU physical education program make towards your knowledge and attitudes about physical activity and fitness?" The results indicated thefollowing:

	Very Significant Contribution	High Contribution	Average Contribution	Low Contribution	No Contribution
High School Program	8%	10%	31%	30%	16%
ORU's Program	53%	32%	7%	1%	1%

We've also just completed the analysis of a questionnaire sent to alumni of ORU and two other institutions with very good required P.E. programs but without the aerobics emphasis. In response to the following question, "What contribution did your college physical education program make towards your knowledge and attitudes about physical activity and fitness?" the following results were recorded:

	Very Significant Contribution %	Moderately High Contribution %	Average Contribution %	Moderately Low Contribution %	No Contribution %
ORU	39	35	18	6	3
School A	11	23	38	17	11
School B	16	18	36	19	11

The above data support the contention that it's not just a required program that is important, but the program must have a health fitness thrust to affect attitudes.

Have we influenced our students' behavior? Field test results reveal our students are in excellent cardiorespiratory fitness.

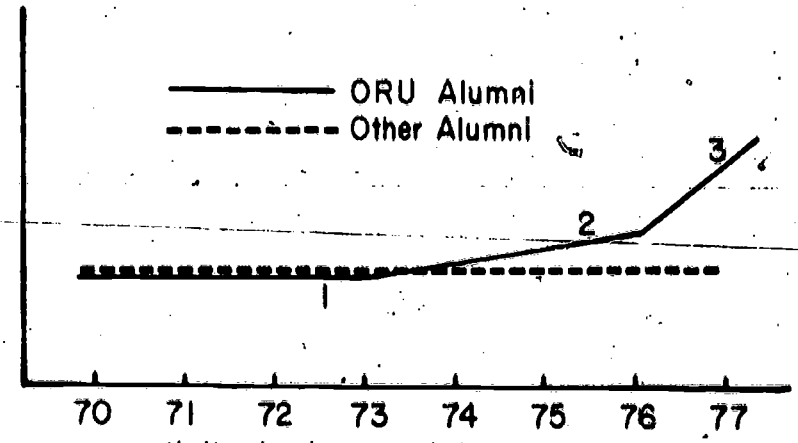
	Mean	Percent Who Completed Test Under 12:00
Men (1.50 miles)	9:53	98%
Women (1.25 miles)	10:31	91%

Three additional questions were asked current students:

1. Before you were accepted as a student at ORU, how many total miles did you jog on the average per week?
2. Currently, how many total miles a week do you jog?
3. When you graduate from ORU, how many miles a week do you plan to jog?

	Average Miles Per Week
Before	1.0
Current	5.1
After	5.4

I believe, however, the most significant support for a required physical education program with a health fitness emphasis is the results of a survey of our alumni. We plotted physical activity of alumni from 1970 to 1977.



1. Aerobics Program partially implemented in 1972-73.
2. Aerobics Program refined in 1974 75 with Health Fitness Course added.
3. Aerobics Program fully implemented in 1976-77 with medical screening.

Prevention of Orthopedic Injuries Related to Aerobic (Jogging) Exercise

By David Cundiff, Ph.D.
Associate Professor
Oral Roberts University

Introduction

In 1977, a Gallup poll asked Americans whether they participated in daily, nonwork-oriented physical activity designed to keep them physically fit and if they did, whether that daily activity included jogging. In 1961, when the same questions were asked, only 24 percent of the sample had replied affirmatively. In 1977 a surprising 47 percent gave a positive reply with almost no difference existing in the numbers of males (50 percent) and females (45 percent). Twenty-four percent of those who worked out daily were joggers, which was a projected 11 percent of all Americans and 74 percent of those joggers covered at least 1 mile a day.

The jogger or long-slow distance runner (LSD) who covers 30 miles/week plants each foot more than 1 million times a year. Fear of jogging injuries is becoming a major obstacle in convincing lay persons to start exercise programs and cause a high dropout rate in some programs. These stress-induced injuries are signaled by the onset of localized pain. In a study of the incidence of running injuries in 456 long-distance runners, the following percentages were reported:

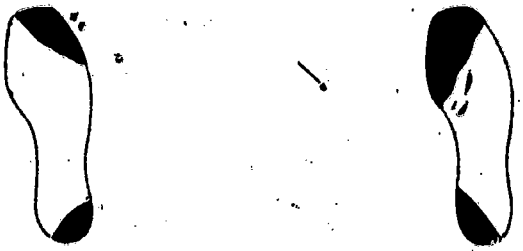
Calf 9%	Hip 11%
Hamstring 9%	Knee 35%
Achilles 18%	Shin 19%
Heel 14%	Ankle 23%
Arch 15%	Forefoot 22%

Eighty-three percent of the runners claimed one or more of these injuries.

Many joggers and LSD runners jeopardize their well-being by failing to recognize the basic mechanical causes of jogging injuries. The normal mechanics of distance running can be summarized by the term "heel-toe." The support phase of the typical jogging gait is divided into the following support phase mechanics:

1. Heel strike
   supination
   impact bearing
2. Mid-stance
   pronation
   stress dissipation
3. Toe off
   supination impact
   lever lifting

This typical gait will lead to the shoe-wear patterns depicted below:



Normal Wear (right foot)

Abnormal Wear (right foot) (caused by excessive pronation)

Figure 1. Normal and abnormal shoe wear

The proper approach to the prevention and/or management of jogging injuries must include attention to the following considerations: Determine whether there are structural foot and leg weaknesses, muscle imbalances, or lack of flexibility and the overuse syndrome.

Any abnormal foot plant or excessive leg rotation in the support phase may cause localized foot, leg, knee, or hip stress. Examples of improper support-phase mechanics are: femoral anteversion with external tibial rotation, and flat feet or forward varus (extreme pronation). Correction for faulty weight distribution and reduction of excessive rotational stress on the knee and hip can be done in two ways. Shoe control -- adequate heel width prevents hyper-pronation and snugly tied shoes will control heel movement at heel strike. Orthotic control -- a soft insert can be used to support mild foot plant de-rangement or a rigid orthosis with rear foot or forefoot post provides the best control of severe pronation or supination weaknesses. An attempt should be made to have a foot plant so that the big toe is inside the knee.

Muscle Imbalance and Lack of Flexibility. The posture of our sedentary lives leads to shortening of certain muscle groups such as the hamstrings. Muscle tightening and shortening in the resting state is a common response to running stress and leads to muscle imbalance. Running overstrengthens the antigravity muscles (psoas, hamstring, and calf), resulting in increased tension and work in the opposing muscle group (quadriceps, abdominal, and anterior tibialis). Corrective exercises involve stretching the strong, tight group as demonstrated below.

Figure 2. Stretching iliopsoas and quadricep muscles

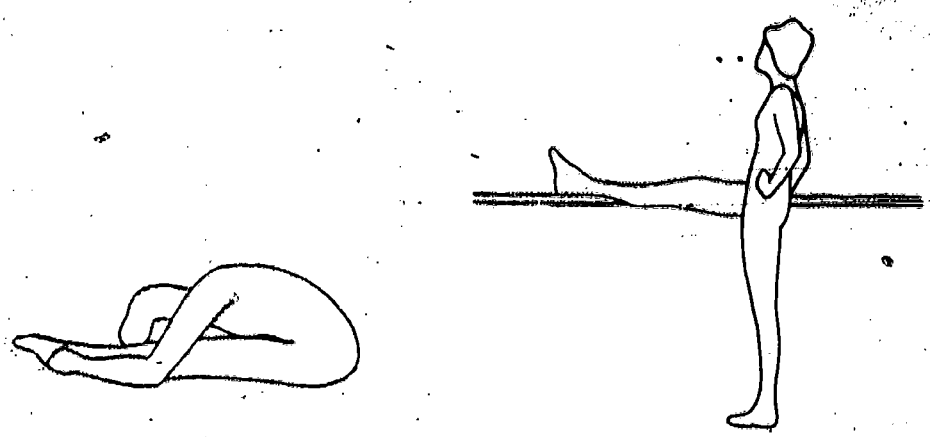


Figure 3. Stretching hamstring muscles

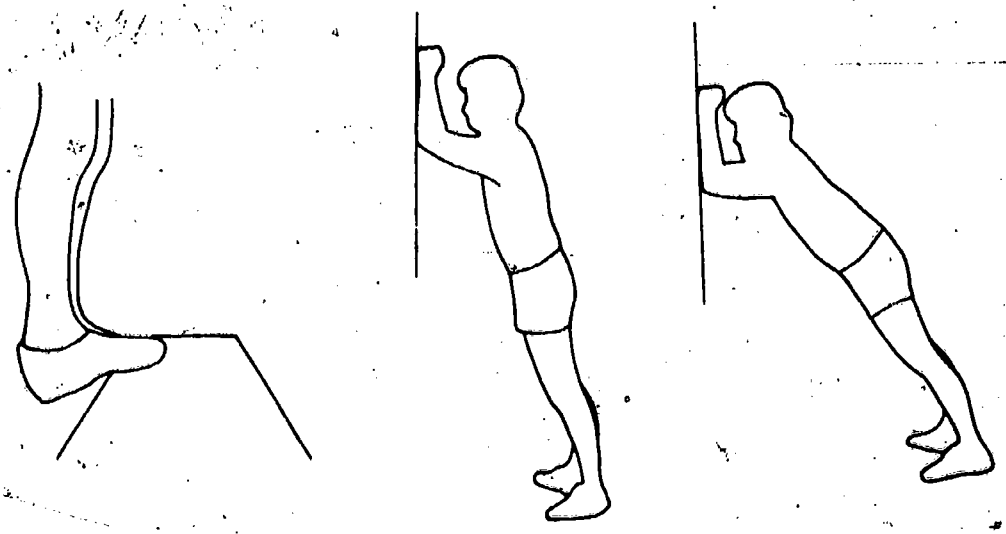


Figure 4. Stretching calf muscles.

Corrective exercises involve strengthening the weak, overworked muscle groups as illustrated.

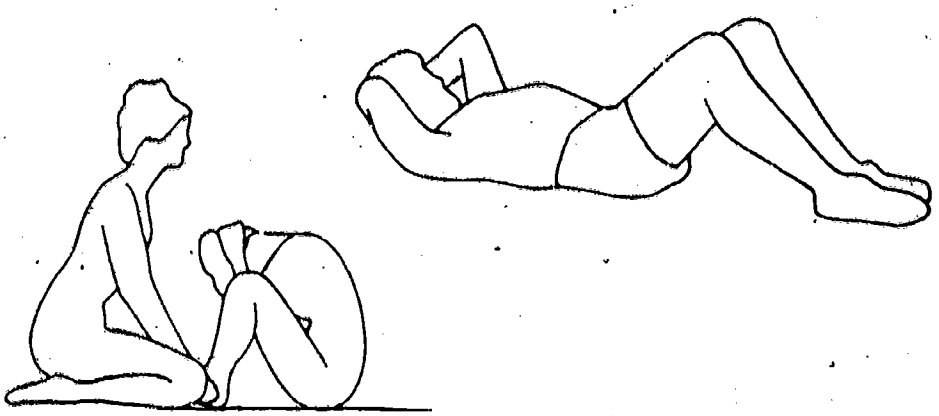
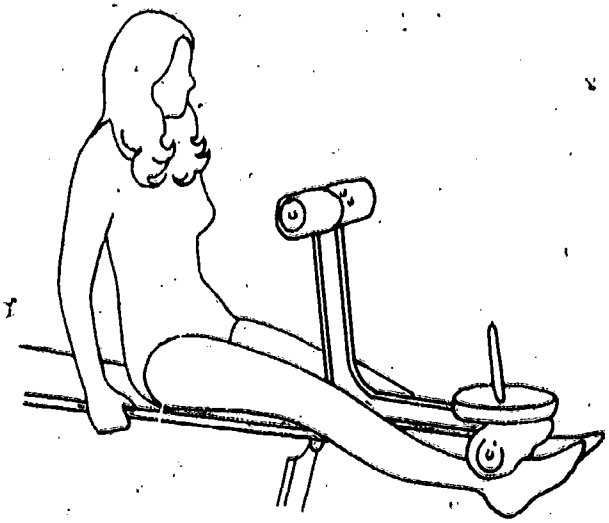


Figure 5. Strengthening abdominal muscles.

Figure 6. Strengthening quadricep muscles.



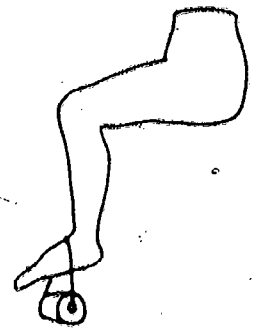
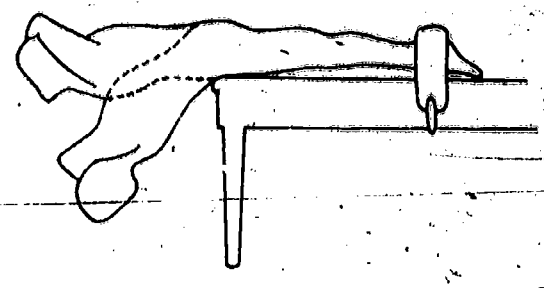
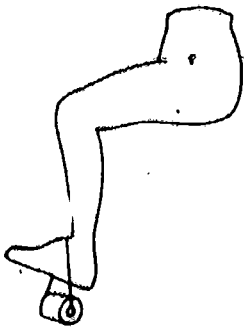


Figure 7. Strengthening anterior tibialis muscles.





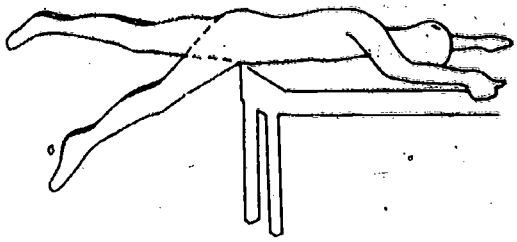


Figure 8. Strengthening erector spinae muscles.

Overuse Syndrome. When biomechanical weaknesses are present and one adds the excess stress of hard workouts, insufficient recovery periods and/or improper approaches to training, a breakdown can be manifested through localized pain and general fatigue. Gettman, Pollock, et al.[1] found that leg-muscle soreness and shin splints were more prevalent in joggers who trained in a 5-day-per-week group compared to 3 and 1-day groups. The leg soreness was chronic throughout the 20-week program for 6 of 13 persons in the 5-day group. The 5-day group produced the greatest improvements in cardiovascular function and body composition but they did not recommend a program of 5-day-per-week for beginning joggers. To avoid the effects of overuse syndrome, the body warning symptoms should be heeded by:

1) resting until localized pain subsides, and 2) modifying training routine.

Summary

1. The prevention and/or successful management of jogging injuries depends on the analysis of the static and dynamic aspects of the jogger's gait.

2. Treatment of the basic underlying muscle imbalance or structural weakness will improve or prevent most problems.
3. Shoe modifications can balance the foot and control rotational stress at the knee and hip. The even distribution of force in the mid-stance phase reduces foot strain.
4. Surgery or local injection should be used with caution. Response to brief rest and anti-inflammatory medication should be monitored and training patterns and/or shoe style should be altered.
5. No medical treatment can produce instant healing.
6. An ounce of prevention is the key.

REFERENCE

Gettman, L., Pollock, M., et al. "Physiological Responses of Men to 1, 3, and 5-Day Per Week Training Program." The Research Quarterly, 47 (4):638-646, 1977.

Incorporation of Aerobic Exercise into Health Maintenance Programs of Business and Industry

by Dennis Colacino

Pepsico, Inc.

The beginning and the organization of a corporate fitness program differs slightly from the beginning and organization of a university program or private commercial fitness program. Existing corporate fitness programs tend to be those of large multinational companies reflecting a major segment of the Fortune 500. Such companies are Exxon, Pepsico, Texaco, Boeing, Xerox, Prudential, Chase Manhattan, and Ford, to name a few. These programs vary in objectives and size. Basically they fall into two categories, medical or recreational; or a combination of the two types. Within this structure, eligibility for entrance into a program is based either on position grade/salary status (mainly executive programs) or, a program open to all employees. Many companies delineate this structure further into separate fitness programs: executive and employee. These fitness programs can be operated as company and in-house fitness programs where the facilities for exercise and changing are located within the company's physical plant or as an "out-of-house" program in which the facility is located in a YMCA or private health club. The latter type of program usually "contracts" with the company rather than the individual. In-house programs are either totally supported by the company or a nominal fee is charged from the participant's monthly check. The out-of-house program usually charges a flat corporate membership fee with slightly reduced rates when bought in multiples.

How have programs come into existence, and why the sudden growth? It would be nice if all programs were initiated because of health reasons but this, in most instances, is not the case. Some other reasons are: as a status symbol, or simply that the architect in designing a new building decided to put in an exercise facility, or a major competitor has one and therefore we'd better have one. Whatever the initial reason, be it a status symbol or a program on an experimental pilot basis, in most cases, after the program has developed the initial underlying philosophy no longer prevails. The now prevailing conviction is based on strong physiological data, medical benefits, and supportive psychological feelings. At this point, I would like to emphasize the dire need for good research on corporate fitness programs: program participation, fitness improvement, life-style modification, and cost effectiveness of the various fitness programs. Probably the common justification given for fitness programs is that physical fitness programs will increase work productivity and reduce absenteeism. This is a worthy goal, but it is my belief that a fitness program should go beyond that justification and try to change cultural norms. Norms are those behaviors expected, accepted, and supported by a group of people. This can be any type of group, but the people within any particular group will establish certain behaviors which will have a profound effect on the way we live our lives.

For example, the style of hair, the width of a lapel, or where we sit at dinner. These norms are not particularly bad or very important to us, but the norms that I wish to focus upon today are the negative cultural norms. Some of these norms can be a matter of life or death. For example, drinking while driving, eating a 2,000 calorie business lunch every day, the need to take a vacation, and the workload and stress build-up at the office. How common are

those pervasive negative norms, such as alcohol, drugs, obesity, motor accidents, safety, stress, smoking, nutrition, and inactivity, all of which are spawned by our society? The research of Robert Allen, Morristown, N.J., searches for the answers. When employees were asked whether these above-mentioned negative norms existed in their environment, 75 percent of the negative norms were checked by the respondents as existing. If there is a high instance of negative norms in our culture, what are the perceived differences in our present health culture? In other words, if you ask someone, what is the company doing about health norms and what should they be doing, the results would indicate a large norm gap of approximately 40 percent. Furthermore, when asked what is the perceived company support for good health habits, 80 percent of the respondents noted very poor or not enough support for a cultural change. Therefore it is on this framework that present fitness programs should be based to help participants cope with pervasive negative norms and the means to reach self-achievement life-style changes.

How to implement a fitness program: I think it is germane to understand the hierarchy of a corporate setting. The model presented represents this format.

CHIEF EXECUTIVE OFFICER (CEO)

PRESIDENT

SENIOR VICE-PRESIDENT(S)

VICE-PRESIDENT(S)

GENERAL MANAGER(S)

MANAGER(S) OF DEPARTMENT(S)
(PERSONNEL AND CORPORATE SERVICE)

MEDICAL DIVISION

CORPORATE FITNESS PROGRAM

In most instances, the corporate fitness program is under the auspices of the Vice-President of Personnel or Corporate Services in which the medical department is housed. It is within this department that most fitness programs operate. But regardless of the exact chain of command, the schema is a long, complex, hierarchical system usually resulting in a slow, tedious pathway by which to implement change. Having a highly ranked proponent of fitness can hasten the process.

Purposes and Beliefs: Here are some of the major purposes and beliefs that I believe should exist in corporate fitness programs.

A company sponsored fitness program should be conducted as an adjunct to the company's medical program.

Consideration should be given to programs of physical training, rehabilitation, and self-achieving life-style.

Physical fitness programs should be conducted on company time if at all possible, or within a flex-time work schedule.

Participants should not be placed in competition with one another in terms of efforts expended, goals obtained, or strength increased. It is more of a life-style change rather than peaking to run the New York or Boston Marathon. Running a marathon may be a carry-over resultant goal of a program, but it is not the primary aim of a corporate fitness program.

All programs should be supportive, educational, and motivational, with an established feedback system to help each individual understand the exercise regime, stress-testing results, and behavioral modification techniques.

Administration: Each agency (government, university, or private) once having established a set of purposes and objectives can implement them into a functional operating program. The underlying code of operation is based on the allocated space, time commitment, cash outlay, and, unique to fitness programs, legal ramifications. When these are resolved, then operational procedures proceed on a day-to-day schedule. These include:

- Definite hours of operation for the facility should be established. If you do not establish strong guidelines, participants will abuse the hours.

- Participants should receive a specific training program coordinated to meet corporate policy, and in conjunction with the company's medical policy and the individual's best interest.

There should be a method for tracking compliance/adherence of participation. Research from Canada indicates the most important form of motivation for adherence to a fitness program was the "retest." When combined with some form of educational feedback, the adherence rate was markedly strengthened. Surprisingly, T-shirts ranked below retesting and educational feedback as a motivational technique for compliance/adherence to a fitness program.

There must be an establishment of strict safety rules in regards to use of equipment and strict enforcement of "exercise" training policies.

One should observe and comply with federal regulations, such as OSHA (Occupational Safety and Health Act) concerning exposed chains or moving belts and electrical safety codes.

Dress codes should be established. Within most corporations there is a logo, which can represent a feeling of belonging.

Research and evaluation should be conducted to determine the effect of the program and if stated objectives have been met.

Medical Provisions:

All candidates should obtain medical clearance for physical activity.

Medical emergency procedures should be established. Emergency buttons should be placed in the appropriate locations within the exercise area and locker room. The stress-testing room, as well as the exercise area, should have a defibrillator, oxygen, and drug cart available. The staff should be CPR trained. An operational plan should be devised and procedures practiced.

Results of the participant's progress in the corporate fitness program should be sent to the medical staff on a periodic schedule and also to the participant's own private physician, upon request.

AAHPER RESEARCH PUBLICATIONS

ABSTRACTS OF RESEARCH PAPERS*

Abstracts of research papers and research symposiums presented at AAHPER National Conventions

1979 (New Orleans	(248-26486)	$3 50
1978 (Kansas City)	(248-26228)	$3 00
1977 (Seattle)	(248-25978)	$3 00
1976 (Milwaukee)	(248-25606)	$3 00
1975 (Atlantic City)	(248-25696)	$2 75
1973 (Minneapolis)	(248-25436)	$2 50
1972 (Houston)	(248-25306)	$2 00
1971 (Detroit)	(248-25134)	$2 00

*No discount

BIBLIOGRAPHY OF RESEARCH INVOLVING FEMALE SUBJECTS

A compilation of theses and dissertations in physical education, health and recreation involving female subjects. Studies are categorized as follows motor learning, psychological and biomechanical aspects, sports study, physical education for the handicapped, health, teaching method/curriculum/administration, and recreation/leisure 1975 224 pp (243-25714) $3 00

COMPLETED RESEARCH IN HEALTH, PHYSICAL EDUCATION, AND RECREATION

Annual compilation of research published in over 100 periodicals and abstracts of master's and doctor's theses in these areas

1970 (Vol 21)	Available Fall 1979
1978 (Vol 20)	(248-26170) $7 00
1977 (Vol 19)	(248-26094) $8 00
1976 (Vol 18)	(248-25918) $6 50
1974 (Vol 16)	(248-25686) $6 95
1973 (Vol 15)	(248-25462) $4 25
1971 (Vol 13)	(248-25144) $3 50
1970 (Vol 12)	(248-25126) $3 50
1969 (Vol 11)	(248-25008) $3 50

HEALTH EDUCATION COMPLETED RESEARCH

A compilation of research in health education completed during the period 1970 through 1972, representing 312 theses and dissertations from 40 institutions 1974 412 pp paperback (244-25592) $13.75

NAGWS RESEARCH REPORTS II

The second volume in a series of research reports designed to provide the practitioner with scientific evidence on which to base decisions relating to programs of physical activity and athletics for girls and women. The content is applicable to all levels and can be easily understood by the person without a background in research and statistics 1973 160 pp (243-25472) $2 25

TOPICAL LIST OF THESES AND DISSERTATIONS IN HEALTH EDUCATION (VOLS. II AND III)

Combined in one publication. Volumes II and III supplement the first volume, published in 1970 and now out of print. Volume II lists theses and dissertations devoted to school health education published during the years 1960 through 1969. Volume III covers the years 1970-1972. Entries include author, title, degrees received, dates study accepted and/or degree received, advisor's name, and institution granting the degree 1978 160 pp. (244-26369) $7.00

NAGWS RESEARCH REPORTS III

The third volume in a series of research reports designed to provide the practitioner with scientific evidence on which to base decisions relating to programs of physical activity and athletics for girls and women. The 21 reports deal with such topics as endurance training, sports injuries, attitudes toward physical activity, physical sex difference, sport participation patterns, sociological perspectives, feminity within, social roles, swimming movements, and diet. The content is applicable to all levels and can be easily understood by the person without a background in research and statistics. 1977. 160 pp. (243-26004) $5.50

RELIABILITY THEORTY APPROPRIATE FOR MEASURES OF MOTOR PERFORMANCE

A monograph summarizing current thinking on reliability theory for motor performance measures. Sections deal with the historical development of reliability theory, sources of variability that might be identified in a measurable schedule, and generalizability theory as a liberalization of reliability theory. For the researcher, theoretician and graduate student in areas devoted to the study of motor performance. 1976 (245-25836) $4.50

RESEARCH IN DANCE II

An up-to-date listing of research studies, including projects and published articles, in all areas of dance. 1973. 96 pp. (243-25400) $3.50

RESEARCH IN OUTDOOR EDUCATION: SUMMARIES DOCTORAL STUDIES — 1978

Contains summaries of 121 dissertations, most of which were completed since 1972. It supplements the first volume by the same title, published by AAHPER in 1973, which is now out of print. Each summary consists of a brief statement of the problem, the procedure followed, and a resume of results and conclusions. 1978. 144 pp. (246-26172) $5.00

WHAT RESEARCH TELLS THE COACH ABOUT

BASEBALL 1971	48 pp. (241-25142)	$2.50
DISTANCE RUNNING 1968	56 pp. (241-07944)	$2.50
FOOTBALL 1973	48 pp. (241-25476)	$2.50
SPRINTING 1974	96 pp. (241-25660)	$4.25
SWIMMING 1967	56 pp. (241-07358)	$2.50
TENNIS 1975	64 pp. (241-25716)	$3.00

ORDER FROM:

AAHPER Publications-Sales, 1201 16th St., N.W., Washington, D.C. 20036. Schools, institutions, and organizations may elect to be billed if their order is submitted on an official purchase order form and amounts to a minimum of $10.00. Orders from individuals must be accompanied by payment (make check payable to AAHPER).

QUANTITY DISCOUNT: Orders for 10 or more copies of a single title are eligible for a 10% discount, except items marked with asterisk which carry no discount.