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ABSTRACT

This paper provides a brief review of theory, research, and educational implications for the role of exercise in controlling select biological and physiological changes which have traditionally been assumed to simply "happen" to the older adult. It is noted that recent research has suggested that many biological and physiological effects of growing older--the physical decline which occurs in many older adults--are primarily the result of such lifestyle factors as disuse or simply being "out of shape." Research reviewed in this paper points toward the critical role of lifestyle in the maintenance of health and the prevention of some of the disabling conditions often associated with age. Changes in attitudes towards physical fitness programs for older adults are discussed, and it is noted that, several years ago, medical experts, physiologists, and educators might have ignored or written off physical fitness programs for older adults as somewhat pointless. Cited research suggests that some of the symptoms of old age may be controlled or partially reversed through good physical conditioning. Implications for lifespan educational organization and design and for older adult educational programs are discussed. (Author/JM)

IS GROWING OLD INEVITABLE?
A SYSTEMS PERSPECTIVE TO BIOLOGICAL CHANGES AND EDUCATIONAL PRIORITIES IN LATER ADULTHOOD

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American Educational Research Association

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The major purpose of this paper is to provide a brief review of theory, research and educational implications for the role of exercise in controlling selected biological and physiological changes which have traditionally been assumed to simply "happen" to the older adult. Recent research has suggested that many of the biological and physiological effects of growing older--the physical decline which occurs in many older adults--are primarily the result of such lifestyle factors as disuse or simply being "out of shape" (Smith, 1981; DeVries, 1981; Schiamberg and Smith, 1982). If this is the case, what are the implications for lifespan educational organization and design and for older adult educational programs, in particular. This paper will address two major considerations:

1) First, a brief review of selected biological and physiological theory and research to determine the status of exercise as a lifestyle variable influencing the physical health of older adults. As indicated, an emerging and significant body of research is pointing toward the critical role of lifestyle in the maintenance of health and the prevention of some disabling conditions often associated with age (Smith, Reddan and Smith, 1981, DeVries, 1974; DeVries and Adams, 1972a, 1972b; DeVries and Hales, 1982; Friedman and Rosenman, 1974; Schiamberg and Smith, 1982). Whereas some 10-15 years ago medical experts, physiologists, and educators might have ignored or written off physical fitness or exercise programs for older adults as somewhat pointless, recent evidence suggests that some of the symptoms of old age may be controlled or partially reversed through good physical conditioning. On the other hand, it is

important to recognize that older adults do lose some functional capacity at the cellular, tissue, organ, and system levels. (For example, the blood pumping capacity of the heart declines by about eight percent per decade throughout adulthood.) This brief review of theory and research will clarify some areas of health which may be partially controlled by exercise as a lifestyle variable.

2) Second, a discussion of the implications of the lifestyle control hypothesis for lifespan educational programs and those specifically for older adults. What types of exercise programs are appropriate for older adults? Are such activities regularly included and appropriately emphasized in educational programming for older adults? Are older adults properly prepared for health maintenance through lifespan educational exercise programs in childhood, adolescence or middle adulthood? In general, what is the role of education in developing dynamic health maintenance programs throughout the lifespan?

AN ECOLOGICAL FRAMEWORK

The major theoretical frame of reference which will be used in the paper can be called an "ecological" or "systems" view of human development and aging (Bronfenbrenner, 1979; Schiamberg and Smith, 1982). The reason for using this perspective is that it emphasizes the linkages between self control of behavior, or lifestyle, and outcomes of lifespan development including health, social development, and

education. The general principles of this ecological or systems model for viewing older adult development are as follows (Schiamberg and Smith, 1982):

1. The aging person, like all other individuals, is a self controlled system. The main fact of aging, however, is that its processes gradually reduce the level and scope of this self control of behavior and physiological functioning.
2. The manifestations of aging are ecological and cultural as well as behavioral and physiological. Not only the people around the older adult, but the structure of society may impose restrictions, such as retirement, limited access to employment and education, and so on. These restrictions may induce many of the apparent symptoms of social and physical helplessness, lack of motivation, and inability to cope, which are sometimes attributed to older adults.
3. The idea that old age is simply a deteriorating state of human existence is both a misconceived and denigrating concept. For the healthy person, old age is a phase of life span development. Older persons not only can learn and develop, but such learning and development are an inevitable result of positive adjustment.
4. The processes of aging are multifaceted. These processes depend on the interaction of behavior and physiological functioning in the individual. An exclusively biological view of aging (e.g., that aging is primarily the result of cellular

exhaustion or DNA deterioration) is probably incomplete. As we shall see in our discussion of the physiology of human energy regulation, the most probable primary origins of the symptoms of aging are in the behavioral domain--in the way that the individual has ordered his or her life throughout the lifespan (e.g. exercise, work, and social interactions).

5. Later adulthood, like other periods of life, involves opportunities for self determination. For example, individual adaptation often requires the ability to learn and develop new ways and organized patterns of living, the application of social skills in reestablishing relations with others, and astuteness in adjusting to limited economic resources.

The adenylate control hypothesis. What is the physiological basis for viewing individual behavior as such a self-controlled, feedback-governed system? One of the most unexplored and mysterious aspects of modern science concerns the mechanisms of interaction between social/behavioral activities, on the one hand, and biological/physiological processes, on the other. The nature of this interaction has frequently been obscured by concepts of physiological "drive" and mental or "cognitive" motivation. These notions have frequently been used to suggest that human behavior is the one-way, end-product of internal body states or environmental circumstances. While such explanations may be satisfactory for explaining some behaviors in constrained or limited contexts, they do not adequately describe the overall relationship between biological processes and

human behavior (and, in particular, the behavior of older adults). A systems explanation emphasizes the mutual, dynamic relationship of social behavior and physiological functioning.

An ecological or systems basis for the health of older adults rests on experimental discoveries in molecular biology and systems research over the past 20 years. These discoveries have revised classical concepts of the linkage between behavior and organic functioning. Past medical ideas of health often rest on the assumption that inner organic functions including both the brain and internal organs govern external muscular behavior as an end product. However, experimental discoveries by Huxley (1968, 1969) and others have established that the primary levels of energy exchange needed for muscular activity occurs in the muscles themselves as an aspect of muscle contraction. According to this view, the human body has an incomparable set of resources for governing the efficiency of muscular feedback control of energy exchanges and for the development of the universal energy molecule ATP (adenosine triphosphate). These mechanisms involve the use of different muscles in multijoint muscle systems so as to govern the length and tension-fatigue functions of contracting muscles. For example, during work or exercise, muscle fibers that are stretched and under tension, are not used in the main work of a motion while those that are in shortened state, or in the process of being shortened, are made to contract. The effect of this differential control of contraction in relation to the degree of stretch of different muscles in a multijoint coordination is to utilize

the biochemical power of shortened muscles to efficiently replace energy molecules from the internal biochemical resources of these muscle cells and to avoid using stretched muscles which have a far lower biochemical efficiency (Huxley, 1968, 1969). Thus, these mechanisms regulate the efficiency of energy exchanges in muscles.

This muscle control process is not confined to simple muscle-energy production. It also has been established that this muscular energy-producing process regulates by secondary biochemical feedback circuits all of the levels of organic metabolism (fat, oxygen, carbohydrate, lactic acid, etc.) that provide the metabolic ingredients for producing the universal energy molecule ATP (adenosine triphosphate) in muscle contraction. Furthermore,, this process is also related to other types of physiological and health-related feedback mechanisms including control of oxygen metabolism, neurohormonal secretions, circulation, and respiration. The implication of these physiological facts are that the biological processes which are the basis of health are subject to individual self control in a broad and far reaching manner. Therefore, a primary component of lifespan health and well-being for older adults is muscular activity and exercise. Such activity, rather than being a simple end product of organic or mental functioning, may actually dominate, (both biochemically and physiologically) all aspects of energy exchange and muscular functions, and is essential for integration of these functions on a developmental and systems basis.

The Social Context, Older Adults, and Exercise. How does the muscle energy processes which we have just discussed influence the everyday experiences of older adults? Individual human beings including older adults do not exist in an interpersonal-social vacuum. Likewise, regulation of muscle-energy production and health related mechanisms does not occur in interpersonal isolation. In particular, infants, children, adolescents, and adults of all ages spend considerable time interacting with one another in several social contexts including the family, the school, the world of work, and the community/neighborhood. Such experiences include mutual behaviors such as play, team activities, work activities, marital relationships/communication, friendship, and sexual behavior. Many such adult-child, child-child, and adult-adult relationships involve mutual interaction behavior which is critical to adaptation and adjustment. It is important to recognize that such behavior simultaneously involves mutual regulation of energy-production as well as organic metabolism.

When two individuals (e.g. parent-infant) are engaged in mutual interaction or the mutual following of each other's movements, they not only can control the effects of the environment on each other but also mutually regulate the efficiency of energy production through their mutual movements in muscles. In so doing, they can also influence health functions (e.g. circulation, respiration, neurohormonal secretions, and so on) which are related to energy production. Smith (1972) indicated that every one of the common modes of mutual social

behavior, for both adults and children, in conversaton, games, and team activity involves a refined parallelism, matching, and coordinate sequencing of common and interrelated movements which have correlated physiological effects, especially on respiration and circulation. It appears that it is these matched and correlated behavioral and vital processes which persons sense and act upon in trying to relate their behavior to one another in intimate and closely-coordinated relationships.

The most significant health and educational implication of this social-physiololgical coordination is in appreciating the role that social behavior and social relationships have on energy production and organic function and hence upon the physiological, health, and conditioning of individuals. According to this point of view, work and sexual behavior, as well as many other forms of social interaction, should be looked upon as lifespan forms of exercise that are essential to maintaining the health and well-being of the interacting persons. Consequently, the oft heard advice that older adults should remain socially and interpersonally active, has a biological basis rather than simply being a well meant suggestion. Unfortunately, current theories of aging (biological theories - DNA deterioration - and social theories, e.g. activity, disengagement, etc.) have not provided a meaningful integration of biological and social processes to be very useful to educators.

Exercise, Heart Disease, and Obesity. What does research say about exercise and health? Obviously, there are some health problems

which have a rather large genetic component (e.g., Tay-Sachs disease, cystic fibrosis or sicle cell disease) and others which appear to be a complex mixture of genetic and environmental factors (e.g. heart disease and some forms of cancer). Research is demonstrating that prevention of some diseases and disabling conditions at all ages may be subject to self control of such "lifestyle" variables as nutrition, smoking, alcohol consumption, and exercise (Schiamberg and Smith, 1982). Relatively recent findings of both the United States and Canadian governments indicate that the future of the health-care system (really an illness-care sytem) and the future of health are not the same thing. That is, the most important factors that influence overall health at all ages are lifestyle and environment (Hancock, 1982). According to the U.S. Surgeon General "Perhaps as much as half of the U.S. mortality in 1976 was due to unhealthy behavior or 'lifestyle'; 20 percent to environmental factors; 10 percent to human biological factors; and only 20 percent to inadequacies in health care" (U.S. Surgeon General's Report, Healthy People, 1980).

During the last 15 to 20 years there has been an effort on the part of the allied health professions to identify individuals, at early ages, who may be susceptible to coronary heart disease (Gilliam, Katch, Throland and Weltman, 1977). Gilliam (1977) has shown that many young children display high levels of one or more risk factors typically associated with heart disease in adults (e.g. high blood pressure, obesity, and high cholesterol levels). Furthermore, Gilliam found that for children (7-12 years of age) with high levels of blood lipids or

fats (a risk factor), a vigorous 12-week exercise program (in place of the regular school physical education classes) significantly reduced blood lipids. The control group which participated in the typical physical education classes demonstrated no such reduction. The implication of this finding suggests that exercise programs may be a vital component of lifespan health. Furthermore, such programs could be designed to motivate young children to engage in exercise throughout their lives.

The activities which are typically related to the benefits of exercise are associated with aerobic exercise (exercise which can be maintained over a relatively long time period without building an oxygen debt in the muscles). Aerobic exercises result in physical stress on the cardiovascular system by causing the heart and lungs to work harder than when at rest. Common aerobic exercises such as walking, jogging, bicycling, rope-skipping, and swimming, when carried out at a certain rate over a long enough period of time, raise body temperature, induce sweating, and increase heart and breathing rates. One result of vigorous exercise which is generally agreed upon is the fitness dimension (improving strength, stamina, coordination, and an overall sense of well-being). A physically fit individual is able to consume oxygen more efficiently during strenuous exercise than an unfit individual. At a given level of exertion, the skeletal muscles of the fit individual produce less lactic acid (a by-product of exercising muscles which is a major contributor to muscle fatigue) than the skeletal muscles of the unfit individual (Vander, 1978).

Aerobic exercise is often associated with reduced blood pressure levels (particularly in individuals with diagnosed hypertension) as well as with basic changes in blood chemistry (fats, in particular). Human blood contains two primary types of fats--cholesterol and triglycerides. Both types of fats are necessary for life. The level of both fats is primarily the result of genetic and dietary factors. High levels of both fats are commonly associated with the likelihood of a heart attack. There is some evidence that exercise lowers the level of cholesterol and more convincing evidence that it lowers the level of triglycerides (Wood, 1977).

Other research has demonstrated that the ratio of high-density to low-density lipoproteins (protein compounds which transport cholesterol in the blood) may be even more important than levels of blood fats (Wood, 1977). Low-density lipoproteins (LDL) carry cholesterol into body tissues where it can form artheriosclerotic plaques which clog arteries and limit blood flow (Wood, 1977). On the other hand, high-density lipoproteins (HDL) serve a different function. "High density lipoproteins are the body's sewer system. The only way the body has to get rid of cholesterol from the arteries and other tissues is this transport protein which carries it to the liver, which can degrade it and throw it out" (Leon, 1977). Epidemiological studies have indicated that for groups of people with low rates of coronary heart disease, the level of high-density lipoproteins is much higher than in the general population (Wood, 1977). Wood (1977) has demonstrated that vigorous exercise raises the level of high-density lipoproteins. Using a group

of 41 middle-aged men who ran at least 15 miles a week and a similar group of nonrunners, Wood and his colleagues at the Stanford Heart Disease Prevention Program found that the runners had plasma triglyceride levels that were half that of the nonrunners (Wood, 1977). In addition, the total cholesterol level for runners was slightly less than for nonrunners. Of considerable interest was the fact that the level of high-density lipoproteins for runners was more than that of the nonrunners (64 milligrams for the runners, 42 milligrams for the nonrunners). This relatively high level placed the runners in the same category as other individuals in the Stanford Heart Disease Prevention Program with similar high-density lipoprotein levels who displayed low rates of coronary heart disease (Wood, 1977).

In addition, there is some evidence that regular and vigorous exercise is related to another risk factor associated with heart disease--obesity. Regular and vigorous exercise results in significant and permanent weight loss providing, of course, that the exercise is a continued activity. This is important to note in light of the fact that virtually all of the weight-loss programs in the United States are based primarily on diet. Diet can and does make a difference. However, to ignore the role of exercise as a valid life-style variable is simply to minimize an important aspect of the life process which, to some degree, is under the control of the individual. The public has been left with the general impression that exercise is of little value in weight control and reduction because of the relatively large amounts of exercise required to burn a rather small number of calories. The

problem with this reasoning is that it does not take into account the cumulative contribution of exercise over the lifespan. For example, a 155 pound person who adds an additional 15 pounds about five years after leaving school may have been able, through exercise, to have significantly reduced the weight gain. In this particular example, exercise might be a brisk walk of approximately five minutes a day over the five year period. In such a walk, calories are burned at about the rate of six or seven per minute. If 15 pounds is the equivalent of 52,500 stored calories (1 pound = 3,500 calories), then a brisk walk each day, for five years, would have resulted in the expenditure of 63,875 calories--more than enough to reduce the weight gain. This logic is, of course, based on the assumption that there has been a consistent intake of food over the five year period. In reality, as opportunities for interaction in social settings typically increase throughout adulthood, intake of food is also likely to increase. Consequently, exercise must be balanced with reasonable eating patterns to prevent obesity. Furthermore, there is some evivdence that metabolic requirements for food may decline requiring close attention to the unique individual balance of food and exercise.

It should be pointed out here that the complex relationships between ATP synthesis or utilization and obesity is currently the subject of pioneering research at Michigan State University (Romsos, 1981). Initial findings lend strong support to the conclusion that obese and lean individuals, with diet and exercise controlled, have differential patterns of energy regulation which is directly related to

ATP processes. As indicated in our discussion above, one primary mode of influencing ATP synthesis or utilization--and, therefore, influencing obesity--is exercise.

In summary, exercise as a life-style variable contributes to greater cardiovascular efficiency, some reduction in cholesterol levels, substantial reduction in serum triglycerides, an increase of high-density lipoproteins compared to low-indensity lipoproteins, and may promote weight control. All of the above characteristics are risk factors in coronary heart disease. All are, to some extent, under the control of the individual--whether child, adolescent, middle-aged adult, or older adult.

Exercise and Older Adults. Current research is helping to reverse the longstanding myth that the deteriorating manifestations of aging are totally predetermined and manifest themselves independent of any intent or action of the older adult. Muscle deterioration, stiff joints and other aches and pains typically associated with aging do not just "happen." According to DeVries and his colleagues (1982): "There is no longer any doubt that the health benefits to be derived by the elderly, by exercise, are entirely similar to the benefits derived by the young and middle-aged." In other words, there is good reason to think that exercise can tone muscles and improve ease of movement by maintaining tendon, ligament, and joint flexibility as well as promoting cardiovascular fitness.

In DeVries' (1981, 1972a, 1972b, 1974, 1982) landmark research, men and women (ages 56 through 87) were given an exercise regimen which

included walking, jogging, swimming, calisthenics, and stretching exercises. Results indicated some dramatic changes:

- A marked increase in oxygen capacity (the best single indicator of individual vigor). Walking and jogging, in particular, resulted in deeper and easier breathing. Hearts gained in endurance and efficiency.
- Drop in blood pressure.
- Loss of fat.
- Drop in nervous tension. Subjects reported more restful sleep, less anxiety, and reduced aches and pains.
- Increase in muscle strength.

While this research has demonstrated the positive results of exercise on the health and well-being of older adults, other research has begun to demonstrate the possibility of stabilizing--or partially reversing--some deleterious outcomes previously associated with aging. Smith and his colleagues (1981) have shown that osteoporosis (i.e. the decrease in bone mass with age, which causes bones to become brittle and, in some cases, crack under stress) can be slowed or partially reversed. The rate of osteoporosis appears to be the greatest between 45 and 70 years of age and particularly prominent for females (Smith, Khairi, Norton, and Johnston, 1976). The subjects for the Smith study were 80 females between the ages of 69-95 years of age. Smith found that the group of 80 year olds (controls) who did not participate in exercise had continued osteoporosis (a loss of bone marrow content of over .3%) while the exercise group actually reversed their osteoporosis

(a bone marrow content gain of 1.5%).

IMPLICATIONS FOR OLDER ADULT HEALTH AND EDUCATIONAL PROGRAMS

Several fundamental and positive health principles of behavior and development may be derived from this brief review of theory and research:

1. Exercise, and its related states of physiological efficiency and positive states of health, are interrelated.
2. Exercise has its significance at every age of the life span as a preeminent means of monitoring and promoting efficiency of physiological functioning and health. Well-designed work, sexual activity, and social activities represent diversified skills that function, as exercise does, to promote development of physiological health. This is true throughout the lifespan.
3. Educational and health programs for adults and older persons can be planned and designed in new ways to meet the skill demands for maintaining physiological efficiency and organic integration in terms of these systems ideas of health and development.
4. Aging does not occur in cells, organs, and physiological mechanisms independently of behavioral adjustment. Throughout development, muscular behavior in the form of skilled activity controls critical physiological and health-related processes such as chemical energy exchanges in cells. Primary causes and manifestations of aging (e.g. increased simple reaction time, susceptibility to fatigue, limited sensory functioning, lowered

accuracy and coordination in infrequently-used motorsensory functions, and so on) may well be symptoms of failure to maintain muscular regulation of these physiological and health-related processes over the life span (through exercise, diversified skilled work, and social activity).

5. The preventive behavioral measures for maintaining positive levels of health in childhood, adolescence, and adulthood are the same behavioral measures for maintaining positive levels of health and preventing the early onset and deteriorative effects of aging and retirement. These measures include: (a) development and maintenance of diversified skilled activity in work and other forms of adjustment, (b) daily torso or whole-body exercises, (c) achieving control over stress in family, community and work contexts, (d) continued adult development of skill, practical knowledge and social-institutional interactions by maintaining diversified social associations and participation, (e) regular sleep, and (h) avoidance of excessive smoking, and use of alcohol and drugs.

The Human Ecology of Health. How do these systems principles of exercise and health relate to our current health care system? In our society we have come to think of our health care system as playing a vital role in the health and quality of life of individuals. However, this is not a completely accurate picture.

Although such dramatic advances as the CAT-scanner (a diagnositc aid), treatment aids such as insulin infusion pumps (for diabetic

patients), or replacement parts (e.g. nuclear-powered hearts) are indeed remarkable achievements, it is not likely that they--and others like them--will have a serious impact on the overall health of the population including older adults. Rather, there are other--perhaps less expensive and more effective alternatives. As Hancock (1982) has indicated:

> "Much of the blame for our current ill health lies in our individual and collective behavior and in our physical and social environments. Thus, it seems logical and probable that future improvements in health will result from changes in these areas rather than improvements in the health care system.

The way in which health or illness are defined influences the way in which we as educators approach health problems. For several decades, the primary mode of thinking about health and illness has been the so-called medical model (i.e. Disease is typically understood as the result of a specific cause or agent; common interventions include antibiotic drugs, surgery, or immunizations). However, current major health problems (e.g. heart disease, stroke, cancer, accidents, and mental health concerns) are neither caused by single agents nor are they subject to simple remedies or "quick fixes."

If human health can no longer be viewed in the simplistic terms of the medical model, then an alternative must be sought. One such alternative is an ecological model of health. From an ecological or systems perspective, the most immediate and early lifespan context which influences health is the family. To a very large extent, the habits of a lifetime are nurtured in the family context (e.g. risk-

taking behavior, eating habits, self care, and responses to stress). Other vital contexts include the school and the world of work.

From an ecological perspective, lifestyle is not simply personal behavior. Rather, it is the learned pattern of self-regulating personal behavior which is, in turn, the result of life-span socialization. For example, an individual decides to exercise because of a complex set of factors, including prior lifespan experiences within and outside the family (in the school and work settings), the current influence of peers (in school or at work), and the possibility of exercise in the physical environment. This ecological viewpoint helps to put simplistic solutions in perspective:

> "Consequently, simplistic solutions that would change people's habits by dealing with them out of the context of their psycho-social environments are not likely to work. Indeed, by putting the emphasis on the individual while neglecting the factors that lead to a particular set of behaviors, we may be blaming the victim and at the same time excusing society." (Hancock, p. 6)

Specific Recommendations. Given the above discussion of lifestyle as a socially learned phenomenon in the developmental contexts of the lifespan, it is important to distinguish two educational levels of dealing with the implications of this paper for the use of exercise in improving health for older adults:

1) A lifespan perspective which emphasizes the fact the benefits of exercise are the same for children, adolesents, middle aged individuals, and older adults. Such a long term perspective requires the adaptation of at least three primary contexts of life-span development: the family, the school, and the world

of work (Schiamberg and Smith, 1982).

Of these three contexts of life-span development, the family has probably received the least attention in terms of public policy. This is most ironic in light of the dramatic contributions of the family to lifestyle formation throughout the lifespan. Dynamic efforts need to be made at the policy level to restore the family to its historical role as a vital support system for life-span health development.

With reference to the educational system, some limited educational information programs have been instituted related to use of alcohol, smoking, and drugs. However, an equally necessary and more direct factor would be the redesign and revitalization of typical school physical education programs to promote vigorous and continuous (over time) exercise programs.

The availability of well-designed and planned exercise programs for employees in work settings is becoming a more common and recognized part of the work experience. Recently, a major paper manufacturing corporation in northern Wisconsin had an on-site gymnasium facility, jogging track, and swimming pool constructed for its white collar employees. Many factors may account for such corporate awareness and responsibility, including the increasing costs of employee health benefits as well as some recognition of improved productivity as a function of exercise.

2) Specific exercise programs targeted at older adults. Many older adults enjoy exercises such as walking, swimming, or bicycle riding. Other possibilities include aerobic dancing, yoga, or calisthenics. The following guidelines are appropriate for beginning exercise activity:

a) Anyone planning to start a fitness program should first have a physical examination (certain medical problems may require avoidance of some exercises);

b) Tailor or design the exercise to fit individual needs (e.g. jogging is not for everyone) doing something at whatever level may be better than doing nothing.

c) Decide whether you wish to exercise alone or join a group (most communities have available programs).

d) Strong emphasis in older adult educational programs should be placed on the possibility of exercise in the broad range of social-interpersonal experience.

To conclude this paper I will cite Robert N. Butler, former Director of the National Institute on Aging, who aptly stated: "If exercise could be packed into a pill, it would be the single most widely prescribed, and beneficial, medicine in the Nation."

REFERENCES

Bronfenbrenner, U. The Ecology of Human Development. Cambridge: Harvard University Press, 1979.

DeVries, H.A. Vigor Regained, New York: Prentice Hall, 1974.

DeVries, H.A. and G.M. Adams. Comparison of exercise responses on old and young men. I. The cardiac effort/total body effort relationship. Journal of Gerontology, 27(2), 244-248, 1972a.

DeVries, H.A. and G.M. Adams. Comparison of exercise responses on old and young men, Vol. II, Ventilatory mechanics. Journal of Gerontology, 27:3, 349-352, 1972b.

DeVries, H.A. and Hales, D. Fitness After Fifty. New York: Charles Scribner's and Sons, 1982.

Friedman, M. and Roseman, R. Type A Behavior and Your Heart. New York: Knopf, 1974.

Gilliam, T.B., Katch, V.L. and Weltman, A. "Prevalence of coronary heart disease risk factors in active children, 7 to 12 years of age," Medicine and Science in Sports., 1977, 9, pp. 21-25.

Hancock, T. J "Beyond health care: creating a healthy future," The Futurist, August, 1982, pp. 4-13.

Huxley, H.E. "The mechanism of muscular contraction," Science, 1969, 164, p. 1356.

Huxley, H.E. "The contraction of muscle," Scientific American, November, 1968.

Romsos, D.R. "Efficiency of energy retention in genetically obese animals and in dietary--induced thermogenesis,"," Fed. Proc., 1981, 40, pp. 2524-2529.

Schiamberg, L. and Smith, K.U. Human Development. New York: Macmillan, 1982.

Schiamberg, L. and Smith, K.U. Student Guide and Resource Manual (to accompany Human Development). New York: Macmillan, 1982.

Smith, D.M., M.R.A. Khairi, J. Norton, and C.C. Johnston, Jr. "Age and activity effects on rate of bone mineral loss," Journal of Clinical Invest., 58:716-721, 1976.

Smith, E.L., Jr. "The effects of physical activity on bone in the aged," International Conference on Bone Mineral Measurements, 1973, pp. 397-405.

Smith, E.L., Jr. and W.J.L. Felts. "The effects of physical activity on bone," Bone Mineral and Body Composition Progress Report, University of Wisconsin COO:1422-1433, 1968.

Smith, E.L., Jr. and K. Stoedefalke. Aging and Exercise, Hillside, New Jersey: Enslow Publishers, 1980.

Smith, E., Reddan, W., and Smith, P. "Physical activity and calcium modalities for bone mineral increase in aged women," Medicine and Science in Sports and Exercise, 1981, 13, pp. 60-64.

U.S. Surgeon General, Healthy People, 1980.

Vander, A.J., Sherman, J.H., and Luciano, D.S. Human Physiology: The Mechanisms of Body Function, New York: McGraw-Hill, 1975.

Wood (1977). The Stanford Heart Disease Prevention Project.