

Editorial**Health promotion through research and training in exercise and sports medicine**

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The physical and psychological benefits of exercise as a form of physical activity or sports is well documented. The modern day living has become sedentary as a result of mechanization and automation. As a result, many infirmities and disabilities of old age appear early in life as a result of sedentary living. Therefore, research and training into sports and exercise medicine has now been undertaken at numerous centers around the world including the World Health Organization (WHO) in order promote health to achieve the goal of 'sports for all and health for all by year 2000'.

Research and training into sports and exercise medicine is a team effort comprising of several trained professionals such as sports physicians, physiotherapists, orthopaedic surgeons, exercise physiologists with the common goal of enhancing the benefits of exercise and reducing the risks associated with physical activity. It has so far resulted in major discoveries, which not only benefit the competitive athlete but also the nonathlete and the patient.

However, it is important to clinically evaluate the subject for physical fitness prior to taking part in a carefully planned program of exercise in order to reduce the risks associated with exercise such as aggravation of potentially serious masked diseases such as ischaemic heart disease or injuries. Physical exercise appear to play an important role in the prevention of disease such as coronary artery disease, hypertension, and for the promotion of health during old age. It also plays an important role in the rehabilitation of patients with numerous diseases and following sports or other injuries. An

understanding of the basic science and research endeavors will help in the design and prescription of safe and effective programs of physical activity in the future.

Introduction

Benefits of physical exercise towards maintaining good health is well documented and recognized¹. Towards promoting health through research and training in exercise and sports medicine, research into exercise and sports medicine has now been undertaken at several centers around the world. The World Health Organization (WHO) itself has several collaborating centers in Asia for such research activity in order to achieve its goal of sports for all by the year 2000².

Today there is an enormous waste of human potential that can be attributed to physical inactivity. In addition, sedentary people have about twice the risk of coronary heart disease as their more active counterparts. It is also known that many of the infirmities and disabilities of old age appear to be the result of habitual inactivity rather than of aging itself². Sedentary living is therefore now recognized to be a major contributor to ill health and unnecessary death.

In the present century, mechanization and automation have radically reduced human physical activity. This is highly evident in developed countries, where heavy manual labour has virtually disappeared, and labour saving appliances in homes have drastically reduced physical effort. This tendency is not restricted to adults, since there are signs that children and adolescents are also becoming less active. Lowering of physical activity is thus becoming a world wide phenomenon².

During the second world war and prior to that, preventive medicine and public health was

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considered an important issue in the face of many communicable diseases such as tuberculosis, leprosy, respiratory and diarrhoeal diseases in both industrialized countries and the third world¹. However, that has changed since then, and the emerging disease pattern has again focused attention to preventive medicine, but for different reasons. To some extent this is true for most of the developing countries. With the quality of life and life expectancy increasing steadily in most countries world wide, such considerations will be paramount in the future projections for health promotion in the developing world as well¹.

The roles of different therapists in sports and exercise medicine

It is important to appreciate the important roles played by different professionals as a team in ensuring efficacy and safety in sports medicine science in noncompetitive recreational as well as in competitive sports. Exercise physiologists, sports physicians, orthopaedic surgeons, cardiologists, rheumatologists, physiotherapists, sports nutritionists, sports psychiatrists as well as scientists are some of those who form a team to produce the optimum results^{1,3}.

History of sports medicine

The man had since prehistoric times lead a very active life, and the benefits of such a life style is all too evident from the marvels of ancient civilizations found all over the world. The history of sports and medicine goes back several thousand years^{4,5}. However, the development of the discipline of sports and exercise medicine in the modern era is quite recent⁵. Sports and medicine in ancient Greece were the result of a widespread tradition of liberty, which was at the heart of one of the most brilliant civilizations in history⁴. Whereas war encouraged the development of surgical knowledge coming out of medical experience in the battlefield, peace promoted the burgeoning of sport as an integral part of greek upbringing, allowing the channeling of young peoples aggressiveness into physical competition⁴. Thus it can be seen that the medical knowledge associated with the practice of sport progressed during antiquity because of its obligation

to follow the warrior and then the athlete⁴. In modern day science, the discipline of sports medicine took a new turn in 1986 with the appointment of board certified sports clinical specialists in USA⁵.

Influence of exercise on social and mental health

Physical health of an individual is known to improve by sports or other forms of physical exercise. It has also been shown that sustained physical activity will result in positive changes in mood, anxiety, depression and self esteem^{6,7,8,9,10,11}. Recent studies, which have been carried out among school leavers in Sri Lanka have found that although over 90% of Sri Lankans are aware of the beneficial effects of physical exercise on social and mental health, only about one fourth of them participate in physical exercise regularly (more than four times a week), or take part in competitive sports^{7,8}. A similar study carried out among medical entrants to a medical school in Sri Lanka has found that although the majority of them are aware of the significance of regular exercise or sports, only a minority took part in regular physical exercise^{9,10}. The main reasons given by the medical entrants for not exercising or taking part in sports were due to studies, not interested in exercise or spending time on other activities such as reading^{9,10}. These studies have shown that physical exercise improved appetite, mood and self esteem significantly and reduced anxiety levels,^{7,8,9} although only about a third believe that the concentrating power and memory are improved by regular physical exercise^{7,8}. Even a majority of patients with psychiatric neurotic disorders with minimal disturbances agreed that physical exercise is beneficial for health, and preferred to promote it as a suitable form of psychotherapy, although only a minority took part in exercise regularly¹¹.

Therefore, it is clear that in Sri Lanka, different populations of different social backgrounds and age groups are aware of the beneficial effects of exercise on promoting cardiovascular fitness, reducing anxiety levels, depression and osteoporosis, while promoting prosocial behaviour and to enhance self esteem^{7,8,9}. However, the majority do not take part in physical exercise regularly due to other activities or lack of interest^{7,8,9,10}.

Evaluation of physical fitness for sports and physical activity

The clinical evaluation of the competitive athlete or the nonathlete wishing to exercise must begin with a carefully performed history and physical examination^{12,13}. The evaluation of the cardiovascular system is the most important, and should include electrocardiography and chest X rays. However, the mainstay of the evaluation of exercise performance is the graded exercise test on either a bicycle ergometer or a treadmill¹². These procedures are designed to provide increments in workload until the subject reaches maximal oxygen consumption or is symptom limited¹². The heart rate and blood pressure monitoring are often adequate to determine individual response to exercise and to provide appropriate exercise advice. Following the guidelines of thorough medical evaluation plus stress testing, it is unlikely that an athlete or the exercising nonathlete will develop serious cardiovascular problems with exercise^{12,13}.

The cardiologist involved in the evaluation of the competitive athlete requires knowledge of the normal variations seen in clinical examination and laboratory studies¹³. It has been observed that there is a presence of an abnormal ST segment in about 10% of a young athlete population in USA in response to treadmill stress electrocardiography¹⁴. Therefore, 'false positive' exercise electrocardiograms suggest that this test has major limitations in screening for underlying cardiovascular disease in athletes, and other tests should also be employed¹⁴. Electrocardiographic and other abnormalities of highly trained athletes are well documented, but not enough is known and the more extreme changes still cause diagnostic confusion¹⁵. Therefore, while exercise electrocardiograph and echocardiography help to exclude organic disease, left heart catheterization is justified when doubt still exists¹⁵.

Training and research in sports and exercise medicine

All over the world, at numerous scientific centers involved in exercise and sports medicine, training of athletes and research directed towards various aspects of the discipline are being carried out in order to enhance the standard of training, and also to offer

guidance and advice to both competitive and noncompetitive athletes on the benefits and potential risks of different forms of physical exercise to health^{16,17,18,19,20,21,22}.

Strength training has become quite popular, and is now recommended as part of a well balanced fitness program in healthy individuals as well as in a wide range of other clinical circumstances¹⁶. An understanding of the basic science and research endeavours will help in the design and prescription of safe and effective programs¹⁶. The contribution of frequency, intensity and duration of chronic exercise has been found to be effective in producing a training effect²³. The important factor is to design a program for the individual to provide the proper amount of physical activity to attain maximal benefit at the lowest risk²³. Emphasis should therefore be placed on factors that result in permanent life style changes and encourage a life time of physical activity.

Research into exercising muscles leading to fatigue has observed that by using an ergometer cycle, standard submaximal dynamic exercise in humans indicate that the fatigue induced by submaximal dynamic exercise results in a velocity dependent effect on muscle power. It is suggested that the reduced maximal power at the higher velocities was due to a selective effect of fatigue on the faster fatigue sensitive fibres of the active muscle mass¹⁷. However, it has also been observed that near maximal power output in humans can be attained during acidotic conditions¹⁸. However, acidosis may interfere with the energy supply possibly by reducing the glycolytic rate leading to muscle fatigue¹⁸. Muscle fatigue and recovery following alternating isometric contractions at different levels of force in young adult males (ages between 25-35) performing an isometric contraction of the right quadriceps muscle have found a relationship between intensity of exercise and recovery time from exercise²⁴. A study of pre and early post pubertal children in resistance training and its efficacy and persistence have found that training induced strength gains appear to decay during detraining compared to adults and adolescents¹⁹.

Vision and sports training is another aspect of sports training²⁰. Because vision influences the capacity of an athlete to perform successfully in a

sport, scientific research has been carried out to investigate the link between skills and vision²⁰. It has been observed that enhanced visual skills will result in improved athletic performance.

The effect of exercise on the myocardial mechanics has also been studied extensively^{21,22}. Using echocardiography, the effect of exercise on left ventricular filling in athletes and nonathletes have observed that with ergometer or treadmill exercise, athletes have a greater left ventricular diastolic filling²¹. The trained athletes (long distance runners, powerlifters) also found to have hypertrophy of the left ventricular muscle mass²².

The regulation of blood flow to the heart and skeletal muscle during exercise is yet another area of exercise research, which has shed light on many biological and biophysical aspects of exercise^{25,26,27,28}. The blood flow to skeletal muscle at rest appears to be mainly regulated by myogenic and neural factors²⁵. However, during exercise, metabolic factors including adenosine appear to play a more important role in the regulation of blood flow,^{26,27,28} and adenosine plays a more important role in the mediation of coronary active hyperaemia than the active hyperaemia in the skeletal muscle²⁹.

Among the many areas of sports and exercise physiology research conducted in order to promote 'health for all and sports for all by the year 2000' is the understanding of oxygen utilization of muscle during exercise^{30,31}. The metabolic basis of muscle oxygen consumption and muscle fatigue could be examined using noninvasive measures of muscle metabolism such as magnetic resonance spectroscopy and near infrared spectroscopy (NIRS). Clinical signs of hypoxia of tissues including muscles and the heart are non specific and unreliable, yet both are potentially injurious. With NIRS, the change in optical density is measured as an index of oxygen saturation of haemoglobin, and can be applied to any tissue in the body³¹. Therefore, NIRS measures the final common factor for hypoxia, and hypoxia of muscles during exercise can be detected accurately in human muscles^{31,32}.

Exercise training and prevention of disease during old age

Normal aging is characterized by detrimental

changes in body composition, muscle strength and somatotrophic function^{33,34,35}. Reduction of muscle strength contributes to frailty and risk of fracture in the elderly³³. Although older adults increase muscle strength as a result of resistance exercise training, the strength gains quickly level off with only modest increases thereafter despite continuous training³³. It has been found that aging skeletal muscles exhibit decreases in muscle mass and force, and changes in contractile properties³⁴. The age related muscle fibre atrophy contributes to the decline in muscle mass, and the resistance training appear to attenuate the age related alterations in skeletal muscle properties if the stimulus is of a sufficient intensity and duration³⁴.

Since musculoskeletal impairment increases with age, it is important to determine if exercise can change the age related muscle weakness³⁵. A study conducted to observe the effects of voluntary contraction or electrical stimulation of quadriceps muscles in an aged male population (72± 4 years) have found that both methods improved strength and future research should examine electrical stimulation in older persons with compromised ability to exercise using traditional methods³⁵. In order to minimize the effects of aging, maintenance exercise procedures must be advocated to avoid rapid, detraining effects seen in elderly people, who become sedentary.

Exercise and disease development

While it is well recognized that physical exercise benefits health, it also appears to be associated with the development of some disease process in the body^{36,36}. It has been observed that there is a transitory suppression of secretory and natural immunity one hour after intense endurance exercise, which reached pre-exercise levels within 24 hours³⁶. This could explain the anecdotal statements by athletes of an increased susceptibility to upper respiratory infection after exercise. Eating disorders such as bulimia is another health hazard associated with athletes³⁷.

Exercise and prevention of disease

Physical exercise has been increasingly identified as one of the important factors, which play an important role in the prevention of major noncommunicable diseases such as ischaemic heart disease, hypertension, cerebrovascular

disease,³⁸ and for promotion of psychological health^{7,8,9}. Exercise has beneficial effects for the athlete as well as the nonathlete. Therefore, promotion of exercise through public awareness programs, research into exercise and sports medicine should be further advocated^{1,3}. Exercise however, is only one of the factors important in fitness and cardiovascular risk reduction³⁸.

Patient rehabilitation by exercise

Rehabilitation of patients by means of exercise is important in many diseases such as coronary artery disease³⁹, arthritis⁴⁰ and in sports injuries⁴¹. Exercise training for patients with heart disease is no longer limited to a monotonous single activity routine⁴². Training regimes can and should employ a wide variety of activities that involve the arms and legs in both dynamic and static exercise. Significant cardiovascular benefit can be derived from a training program that employs a diversity of activities in a safe and effective manner⁴².

Research has found that when compared to interval training, continuous training in the post coronary patient seems to offer more benefit in the longer term than in most patients except in the severely disabled anginal patients³⁹. In patients suffering from rheumatoid arthritis, it has been observed that muscle strength, endurance and aerobic capacity improves significantly with muscle training rehabilitation programs⁴⁰.

Sports injuries, their prevention and rehabilitation after injury

A wide range of sports injuries are associated with athletes as well as in nonathletes⁴³. The injuries, which occur in recreational activities have the effect of eliminating participation for a period, and also in many cases lead to a cessation of physical activity. The loss of wellbeing as a result of idleness is a price that today's physically inactive world cannot afford to pay⁴³. Motivation also seems to be an important factor in sports medicine rehabilitation adherence, since it has been found that patients low in self esteem and high in ego involvement tended to miss the most treatment appointments⁴⁴. Therefore, proper advice on prevention of sport injuries and treatment and rehabilitation following injuries is vital.

Conclusions

Research and training into different aspects of the discipline of sports and exercise medicine has resulted in physical and psychological benefits to both athletes and nonathletes. Careful clinical assessment of the individuals for physical fitness prior to taking part in exercise has significantly reduced the risks associated with physical activity. It has been observed that physical exercise promotes health even during old age and reduces the risk of development of diseases such as ischaemic heart disease and hypertension.

Physical exercise also plays an important role in the rehabilitation of the patient with joint disease, heart disease etc. Research into sports and exercise medicine has significantly reduced the incidence of sports injuries and also enhanced rehabilitation following injury. Emphasis should therefore be placed on research, which meets the challenges posed by permanent life style changes and encourage a life time of physical activity.

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