BENEFITS AND PROBLEMS OF EXERCISE

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Abstract

Development of technology has made muscles and bones redundant. Association between lack of exercise and non-communicable diseases led to studies on exercise. Benefits of exercise include: increased strength and vascularity of skeletal muscles, increased strength of bones, tendons and ligaments, thicker articular cartilage, increased growth at epiphyseal plate, reduced risk of heart diseases, reduced coagulability of blood, improved blood glucose control, improved lipid profile (less LDL and more HDL), improved Immunity and wound healing and reduced adipose tissue. Benefits to higher functions include improved problem solving ability, feeling of wellbeing, good sleep, reduced anxiety and depression and reduced sexual activity among adolescents. Exercise plays an important role in rehabilitation after many disorders. The negative aspects of exercise include injuries – overuse, accidental or foul play. Whether the stresses of competitive sports outweigh the benefits of exercise is worth considering. Effects of exercise in illnesses like viral infections, liver diseases and kidney diseases seem not to have been studied adequately. Majority of the world population is undernourished and still depends on manual work to earn their living. The effect of excessive energy expenditure of exercise on their body composition and health is likely to have adverse consequences. Whether females get all the benefits as males remains as a question and the problems of exercise during menstruation and pregnancy need consideration. Exercise induced asthma is known. The problem of increased dust due to hyper ventilation of exercise in dusty environment could be another risk of respiratory infection.

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1. Introduction

Human is said to have evolved as hunter-gatherer. Until about 200 years ago, human beings depended on the muscles and bones to get food or to protect from enemies. The body evolved to suit the needs at that time with roughly 40 % of the body mass as muscles and 10 % bones. Large portion of the brain and spinal cord are dedicated to control of muscles. The cerebral cortex (intellectual brain) has evolved in human which makes human unique and capable of controlling the behavior considering the long term benefits and consequences. But the limbic system, that is the emotional brain, continues to dominate the control of behavior as in other animals based on the immediate needs and comfort. The commands of the intellectual brain are mostly ignored. The development of technology facilitating automation and communication has made physical activity redundant and the people are using the muscles, bones and the brain minimally. But the nature of the body and the brain remains the same as before, obeying the principle, "use it or lose it". This necessitates compulsory indulgence in physical exercise to remain healthy if the life style is sedentary. The aim of this lecture is to explain the role of exercise in healthy life and to illustrate the problems associated with it on the basis of the scientific publications.

2. Exercise:

Exercise is muscular activity. It may be related to fulfilling the needs of the day-to-day life or planned physical exertion either in play ground or in gymnasiums. Mild exertion is the exercise done without much strain to the body and without considerable change in heart rate. On the other hand, heavy exercise is done using maximal muscular power, stressing the body. Moderate exercise is done with medium intensity between the two extremes.

3. Nutrition

Food is used for growth and to provide the energy for body activities. The following equation is important with respect to energy intake:

$$\text{Energy Intake} = \text{Energy for Exercise} + \text{Other Energy Needs of the Body} \pm \text{Body Energy Storage}$$

Energy intake is the energy liberated by combustion of the carbohydrate, fat and protein in our diet. Energy for the exercise is the amount of energy needed for the working muscles and the additional need for the extra activity of the heart and others during the exercise. When we relax without any external work, there are internal works going on such as the heart, respiratory system, the digestive system and other systems. Body energy store is the energy equivalent to the energy that will be liberated when the combustible substances such as body fat and the proteins are combusted. Therefore, if does excessive exercise and does not match it with increased food intake, weight loss is inevitable. Similarly, over eating without exertion will result in increased body weight.

Inadequate energy intake can result in reduced muscle mass, reduced bone density, increased risk of fatigue, injuries and illness and disturbance in reproductive function. Whether exercise should be performed on empty stomach or after meals is a controversy but for glucose control, exercise after meal is said to be beneficial. Vitamins B, C, D, E and beta carotene and minerals like calcium, iron, zinc, magnesium and selenium should be provided adequately to meet the increased body needs of exercise. These deficiencies can become a problem in people doing exercise for weight reduction with dietary restriction. Dehydration and hyponatremia leading to muscle cramps and renal and

circulatory problems can occur if adequate fluids and electrolytes are not consumed to match sweating (American Dietetic Association (ADA), Dietitians of Canada (DC), and American College of Sports Medicine (ACSM) 2004).

4. Metabolism

It has been observed that metabolic functions of those who engage in regular physical exercise adapt towards better health. Exercise training increases the enzymes to utilize more fat for energy than glucose. Exercise training increases oxidative capacity and minimizes glycogen depletion (Cartee 1994).

The fact that the hormone insulin is a major controlling factor of metabolism and its deficiency causes diabetes mellitus is well known. In regular exercisers insulin sensitivity is increased and the level of leptin, which causes adverse effects in the body, falls (Ramazan Sari 2007). When energy intake exceeded energy expenditure, serum cholesterol and phospholipids levels were increased. Therefore energy deficiency nullifies the benefits of exercise (Vaisberg M 2012).

Short and intense exercise like sprinting is said to increase post exercise metabolism to facilitate weight reduction (Hazell TJ 2012). Change in intramyocellular lipid content was not clear and said to be dependent on metabolic status (Bajpeyi S, 2012).

5. Exercise and Diabetes.

Now let us look at the exercise as a therapy for diabetes. Regular exercise reduces the risk of diabetes in overweight and obese individuals (Chae JS 2012). Regular walking exercise was associated with increased energy consumption, decreased fasting blood glucose, haemoglobin A1c and reduced trigleceride level. The study claims that walking can reduce the complications of type II diabetes. (Sung K, Effects of a regular walking exercise program on behavioral and biochemical aspects in elderly people with type II diabetes. 2012). The response was better when the walking was after dinner. Moderate exercise increases glucose up take by muscles more than that of hepatic glucose release reducing the blood glucose level. At the same time insulin level also falls making the risk of exercise induced hypoglycaemia low. This can be a problem for people on insulin injection or drugs that stimulate insulin secretion.

6. Skeletal Muscles

One effect of exercise training on skeletal muscle is hypertrophy (Ogasawara R 2012). The number of arteries in the muscle was increased in young rats and cross sectional area of the vessels increased in old rats (Behnke BJ 2012). The expression of the gene for heat shock proteins is activated by exercise (Morton JP 2009). This protein is said to be involved in homeostasis of the muscle, facilitation of repair after injury and preserving muscle function through aging. Exercise also is said to promote anabolic effect on protein in preventing muscle wasting of old age.

7. Bones, Tendons and Ligaments

An experiment in young mice has indicated that physical activity is proportional to the volume of the articular cartilage (Plochocki JH 2006). An exercise program in older women did not show any change in articular cartilage. But postmortem examination of horses revealed increase in hyaline cartilage, calcified cartilage and subchondral bone thickness in relation to exercise (Tranquille CA 2009). Exercise may influence the articular cartilage in young children (Brama PA 2009). The joint

form is modified during post natal ontogeny through differential rates of articular cartilage proliferation which is probably regulated by the magnitude and orientation of stress in the articular surface. Bone mass and architecture are influenced by load bearing (Lanyon 1996). The functional strain on the bone leads to adaptive response of the bone which results in remodeling along the line of stress (P. 2009). A fibroblast growth factor is secreted in response to exercise and investigators are looking at its effect on reducing blood glucose. Whether it contributes to strengthening the tendons and ligaments is worth considering. One survey investigating knee abnormalities reported more abnormalities among more physically active persons (Stehling C 2010). Running as a course of osteoarthritis is inconclusive and may depend on pre-existing health of the joint (Hansen P 2012).

8. Injuries to musculo-skeletal system

Epiphysis is stimulated by weight bearing of exercise in addition to endocrine factors. Excessive weight bearing can cause damage to epiphysis and stunting. Muscles and bones are subject to injuries due to excessive training for competitive sports or games (Hoang QB 2012). Accidental injuries and willfully inflicted injuries are also risks of competitive sporting. The stress of competitive sporting can overweigh the benefits of exercise by the catabolic actions of stress hormones. The harm of exercising with viral infections, liver diseases and kidney disease needs consideration.

9. Immunity

Exercise immunity is a growing field. Antibody production is supposed to be optimal in moderate exercise but intense exercise is reported to suppress it (Walsh NP 2011). This is transient suppression and passes off within 24 hours but repeated or continuous intense exercise may result in chronic suppression of acquired immunity. The suppression may be due to elevated stress hormones and alterations in the balance between pro and anti- inflammatory cytokines. Exercise alters the number and function of neutrophils, monocytes and natural killer cells. This may be due to the anti-inflammatory effect of exercise. This anti-inflammatory effect is also reported to be profilactic in insulin resistance, atherosclerosis, tumour growth and neuro-degeneration. Enhanced anti-tumour immunity is reported to protect against post menopausal breast cancer and cancers of colon, endometrium, lungs and pancreas. Progression of HIV infection to AIDS is reported to be slowed down by moderate physical activity (Mustafa T 1999).

10. Respiratory System

Exercise training improves pulmonary function at rest and during exercise by enabling greater operating lung volumes (Mendelson M 2012). There is a concern about increased incidence of respiratory tract infection among athletes and investigators relate this to immuno-suppression of exercise. The effect of inadequate air conditioning in the upper respiratory tract resulting cooler air and increased dust load due to hyperventilation of exercise and breathing through mouth is worth considering. The cool air is attributed to exercise induced asthma. Significant benefits from exercise training are reported in chronic obstructive pulmonary diseases, acute exacerbation of chronic obstructive pulmonary diseases and co-morbidities (Reid WD 2012).

11. Blood

Thrombotic risk increases with aging through increase in fibrinogen, factor VII and plasma viscosity. Regular exercise reduces this risk (Veríssimo MT 2001). Acute exercise which is unaccustomed strenuous exertion is reported to cause transient activation of the coagulation system accompanied by increase in fibrinolytic capacity. This may be a reason for ischeamic heart problems being precipitated by sudden exertion (Lin X 1999). Other contributory factors may be haemoconcentration due to reduced plasma volume and rupture of small, inflamed coronary plaque and resultant activation of thrombogenic factors. Long term moderate or strenuous physical activity is associated with considerable reduction of cardiovascular morbidity and mortality.

12. Cardiovascular system

Beneficial effects of exercise training on resting heart rate, heart rate recovery, exercise heart rate and exercise blood pressure showed strong association in runners and swimmers, less in walkers and least in sedentary persons (Sieverdes JC 2011). Exercise is reported to result in larger end diastolic volume and wall thickness, more in males but others doubt it saying that the increase does not exceeded the limit of resolution of the methods employed even though statistically significant (Perrault H 1994). Training also showed increased transport capacity by increase in blood flow and capillary exchange. The Structural change included increase in cross-sectional area and angiogenesis (Kojda G 2005). Functional change was improved control of vascular resistance. Other adaptations observed were improvements in endothelial function, vascular smooth muscle function, antioxident systems and heat shock proteins and reduced inflammation (Di Francescomarino S 2009). While strenuous exercise increases oxidative metabolism and produces a pro-oxidant environment, regular moderate physical activity promotes an antioxidant state and preserves endothelial function.

13. Cardiovascular Rehabilitation.

A bout of afternoon exercise interrupted with short rest periods is recommended for lowering blood pressure. Patients who underwent Coronary Bypass syrgery improved exercise capacity associated with restorations of peripheral oxygen utilization in both with and without Diabetes after exercise training (Wu YT 2012). Aquatic exercise improved exercise capacity and muscle function in patients with the combination of Congestive Cardiac Failure and Diabetes (Asa C 2012). Exercise failed to show any beneficial effect on Intermittent Claudication in one study. Exercise training is also reported as effective antioxidant and antiatherogenic therapy. However, numbers of adverse events were observed in one study: 12.2% for Systolic Blood Pressure, 10.4% for Tri Glecerides, and 13.3% for High Density Lipoprotein-C (Bouchard C 2012). About 7% of participants experienced adverse responses in two or more risk factors.

14. Higher functions of the Brain.

In an experiment with rats, exercise reversed the effects of early maternal separation partially which suggests the effects of exercise in coping with early life stress (Dimatelis JJ 2012). Exercise reduced depression and fear of falling in older persons (Gogulla S 2012). In another study, exercise training resulted in significant improvements in depressive symptoms, fatigue and vigor, and aspects of quality of life (Marquez DX 2012). Exercise with integrated cognitive and motor coordination may help with preservation of global ability in elders at risk of cognitive decline as observed in Chinese

old subjects (Lam LC 2012). Other suggested benefits include improved problem solving ability and feeling of wellbeing.

15. Sleep

Exercise, 5-6 hours before sleep time, has been recommended for enhancing sleep (Liaison May 21, 2007). In animals exercise increases NREM sleep. Six months of training improved sleep in elderly. Exercise training program has moderately positive effects on sleep quality in middle-aged and older adults (Yang PY 2012). Moderate treatment efficacy is reported for the reduction of apnea-hypopnea index in sedentary overweight and obese adults (Kline CE 2011). Exercise may be beneficial for the management of obstructive sleep apnoea. In Stage IV lung and colorectal cancer patients, exercise seemed to improve the mobility, fatigue, and sleep quality (Cheville AL 2012). Physical exercise could be an alternative or complementary approach to existing therapies for sleep problems.

16. Reproductive System

Physical Working Capacity at heart rate of 170 was found to be decreased in luteal and menstrual phases (Girija B 2011). Strenuous exercise is associated with delayed puberty, luteal phase deficiency, oligo-amenorrhea or anovulation (Chen EC 1999). This could be due to disturbance of GnRH pulsatility (G. L. Warren MP 2003). It is postulated that energy expenditure exceeding energy intake as the main cause (P. N. Warren MP 2001). Leptin also may have a role in it. Hypoestrogenemia found in athletic females can cause premature osteoporosis but most cases are reversible with dietary and exercise modifications. Exercise is suggested for patients with pre-eclampsia because it is observed to result in improved blood flow, reduced blood pressure, enhanced placental growth and vascularity, increased activity of antioxidant enzymes, reduced oxidative stress and restored vascular endothelial dysfunction (Leung FP 2008). Menopausal symptoms such as night sweats, mood swings, and irritability were reduced by aerobic training (Moilanen JM 2012). High impact sports activities may produce urinary incontinence (S. S. Warren MP 2000). Effect of exercise on male reproductive system is not considered.

17. Sexuality

Examination of diary entries revealed greater sexuality enhancements such as frequency of various intimate activities, reliability of adequate functioning during sex, percentage of satisfying orgasms, etc. among exercisers. Reduced or abstinence of sexual activity was reported following cardiac events (White JR 1990). The suggested reasons were fear of coital death, re-infarction, dyspnea, anxiety, angina, exhaustion, depression, loss of libido, impotence, partners anxiety or concern, and feeling of guilt. It is reported that patients that can climb one or two flights of stairs can keep his/her marital sexual life without running further risk or even experiencing cardiac symptoms. Among normal individuals, risk of Myocardial Infarction during sexual activity is three times higher. The sexual activity could be viewed as acute exercise and the risk can be reduced and sexual function can be improved by regular exercise. Erectile dysfunction in middle-aged men is often improved by physical activity (La Vignera S 2012). Adolescents indulge in sexual activities due to lack of recreation- exercise.

18. Rehabilitation- Cancer

In patients with prostate cancer exercise is reported to provide positive benefits for improving surgical outcomes, reducing symptom experience, managing side effects of radiation and chemotherapy, improving psychological health, maintaining physical function, and reducing fat gain and loss of muscle and bone (Newton RU 2008). In breast and colorectal cancers survivorship was increase by 50%-60%. In the wide range of cancer populations, both young and old, with curative and palliative intent, exercise is well tolerated and benefits the patient psychologically and physically.

19. Rehabilitation- Old Age

The proportion of the aged population is increasing and minor illness will render them dependent. Exercise training was feasible and effective in reducing fear of falling and improving dynamic balance and isometric strength in institutionalized older people with fear of falling (Gusi N 2012). Older women can effectively change the decline in physical ability associated with aging by exercising. The 60-65 year age group was the most capable of converting physical activity into health benefits in both the short and long term (Alburquerque-Sendín F, et al. 2012).

20. Conclusion

There is much evidence that a moderate amount of exercise is needed for the maintenance of functional integrity of all body systems. Not only can exercise reverse the effects of immobilization, it can readily produce a further 10 to 20% improvement in strength and aerobic power, effectively postponing functionally important thresholds for some 10 to 20 years. Regular exercise is rapidly gaining widespread advocacy as a preventative measure in schools, medical circles and in the popular media. In a Medical Faculty in India, of those who were currently exercising, the proportion of boys was more compared to girls (62% v/s 38%). Lack of time, laziness, and exhaustion from academic activities were identified as important hindering factors for not doing exercise. Lifelong moderate exercise is good but heavy exercise can be harmful

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