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Exercise prescriptions in Obesity, Diabetes and Hypothyroidism: A Review.

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ABSTRACT

Exercise is being recommended to patients by Physician and Exercise Physiologist over the years. Many research studies conducted in last decade pointed out the benefits of exercise on health. Various researchers conducted different exercise protocol to evaluate its effect on health. By and large most patients or individuals with coronary vascular risk factors, or those suffering with type 2 diabetes, Obesity induced hypertension, metabolic syndrome, or hypothyroid obese practice their self-design exercise regime or one recommended by any health gymnasium instructor. But as Obesity, Diabetes and Metabolic Syndrome have reached the iceberg and are main contributors towards mortality and death; it's necessary that apart from dietary control a well-designed scientific exercise protocol should be followed by the diseases. These facts gave us an impetus to earmark suitable exercise and prescription regime in Obese, Diabetics and Hypothyroid Obese.

Keywords: Obesity, Hypertension, Diabetes, Hypothyroid, Physician, Exercise Physiologist.

INTRODUCTION

Exercise and its benefits are widely acclaimed by doctors, researchers and scientist community. The benefits of exercise are immense and it promoteslongevity of life; helps in weight control, aids in socialization, and help in prevention of diseases.1Exercise promotes optimum health. As a matter of fact most healthy individuals and patients especially of obesity, diabetes and hypertension practice some kind of physical activity or exercise protocol which is either self-determined or as instructed by health gym trainer. But practicing a scientifically based health prescription is the need of the day today. All individual's healthy and diseased needs to consult Physician and Exercise Physiologist for exercise prescription. Patients with cardiorespiratory diseases, metabolicsyndromes, arrhythmia, acute pulmonary embolism, acute myocarditis, sickle cell anemia, thalassemia etc. needs special attention.[1,2] These facts gave us an impetus to explore the literature for finding out the various exercise prescription regime in Obesity, Diabetes and Hypothyroidism.

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DISCUSSION

Overweight and obesity varied considerably across the globe. Overweight is found to be in 9% of population in India while it is 37% in Russia. The percentage of obese is around 3% in India to about 35% in South Africa.[2] The prevalence of hypertension, angina, stroke and diabetes is considerably at rise in obese and overweight individuals. It is very much needed that the exercise which has proven to benefit the obese individuals in controlling weight and occurrence of hypertension, diabetes and hypothyroidism needs to be inculcated as way of life in overweight and obese individuals to prevent morbidity and mortality in them.
The benefits of exercise on physiological functions and biochemical homeostasis; as revealed by various scientific study needs to be emphasized and discussed.

Exercise and Calcium Homeostasis

Physical exercise improves bone mass predominantly at the load-bearing bone sites. Insulin-like growth factor-1 and sexual hormones which are altered by physical training exercises modulates the bone response. Maimoon L et all found that exercise influences calcium homeostasis and alter calciotropic hormone levels depending on duration and intensity of exercise training.[3] Henderson SA et all found out that serum calciumlevel is significantly increased by exercise at

50% of maximum aerobic capacity (VO2 max), and this persists until the late recovery phase and thereafter it falls below resting levels. The plasma parathormone levels are initially decreased by moderate exercise (50% VO2 max.) but get significantly increased during and immediately after severe exercise.Exercise stimulates the hormonal, osteolytic influence on the skeleton, increases plasma parathormone release and mobilises calcium stores producing a positive skeletal balance.[4,8]

Exercise and Diabetes Prevention

Exercise is the best insulin sensitizer and its benefits are immense. The physiological understanding of exercise explains that during the first few minutes of exercise the muscle glycogen breaks over anaerobically. It's after 5-10 minutes of exercise the muscle glycogenolysis activity slower down and then the glucose from the liver is released into circulation and is taken up by the muscles as fuel by process hepatic glycogenolysis. After twenty minutes of completing the exercise the muscles' glycogen stores are now depleted and the blood glucose is now maintained by hepatic glycogenolysis and triglyceridesthat are broken down from adipose tissue by lipolysis. The further continuation of exercise leads to breaking down of fat to free fatty acids (FFA) and is used as a source of fuel for the muscles. The benefits of exercise in diabetes is that it revitalize blood glucose control, improves insulin sensitivity, lowers insulin requirements often leading to a reduced dosage of insulin and or oral hypoglycemic agents especially in patients of Type 2 diabetes. In the earlier phase of exercise there is translocation of glucose transporters to the plasma membrane and glucose uptake. As the exercise duration progresses there is up regulation of glucose transporter numbers and changes in capillary density and this causes an improvement in insulin sensitivity. Exercise is beneficial for both glucose uptake mechanisms and the anti-lipolytic effects of insulin.9 Physical activity and exercise training also benefit patients with type 1 diabetes mellitus (T1DM) reducing the risk of cardiovascular diseases and metabolic syndrome. T1DM patients avoid performing exercise due to the apprehension of developing hypoglycemia and this can be prevented by modulating the dose of both basal long-acting insulin and short-acting insulin, as well as the choice of exercise intensity and duration.[10]

Exercise and Brain Region Specific Adaptation

Julie A Morgan et al and Greenwood BN et all pointed out in there review as they investigated regional brain adaptations to exercise, that there is evidence of multiple regional adaptations to both forced and voluntary exercise.[11] Exercise can induce molecular adaptations in neuronal functions in several instances.[12-15] Similarly Mischel et all found out that physical (in) activity-dependent structural plasticity in bulbospinal catecholaminergic neurons of rat rostral ventrolateral medulla.[16] The physiological adaptations in exercises may elucidate molecular and cellular mechanisms of recovery in psychiatric and neurological health conditions.

Zinc Metabolism in Exercise

Exercise influences zinc metabolism and there redistribution within the body. There is increased zinc requirement with strenuous activity due to additional zinc losses via sweat and urine as evaluated by Overgaard K et all, DeRuisseau KC et all in their studies.[17-19]

Effects of training on potassium homeostasis during exercise

Potassium which is released by contracting skeletal muscle cells facilitates muscle contraction but it also leads to muscular fatigue. Endurance and sprint training prolonged and high intensity exercisesdecreases the exercise-induced rise in plasma [K+] and enhances the concentration of Na+,K+ pumps in trained human muscle by ~15%.[20-23] Thus McKenna MJ in his study pointed out that the physical training enhances, whilst inactivity hampers K+ regulation while exercising.[20,22] Others workers have also opined that Na+-K+-2Cl-transporter, K+-Cl- cotransporter, ATP-sensitive K+ channel, and calcium-activated K+ channel which are present in the skeletal muscle, and might contribute to extracellular potassium homeostasis in exercise.[21-23]

Exercise and Anti-Oxidant and Free Radical Levels

Sen CK and Packer L while exploring thiol homeostasis opined that the physical exercise may induce oxidative stress and lead to blood glutathione oxidation.[25-27] The physical training programs and exercise protocols have specific effects on glutathione metabolism and it depends on the exercise protocol, duration and intensity of exercises. Glutathione metabolism in tissues sensitively responds to strenuous exercise. Similarly Gene expression of muscle mitochondrial (Mn) superoxide dismutase is enhanced after an acute bout of exercise and this is accompanied by increased level of NF-kappaB and AP-1 binding. The repeated bouts of exerciseincreases de novo protein synthesis of an antioxidant enzyme.[27-30]

Contraction-induced production of reactive oxygen species (ROS) produces oxidative stress to skeletal muscle. As an adaptive combat response the muscle antioxidant defence systems gets up regulated after heavy exercise. The nuclear factor (NF) kappaB and mitogen-activated protein kinases (MAPKs) are oxidative stress-sensitive signal transduction pathways in mammals. ROS may serve as messenger molecules and the adaptive responses act via redox-sensitive signalling pathways to maintain

cellular oxidant-antioxidant homeostasis in exercise.[31-35]

Writing an Exercise Prescription

This needs complete understanding of basic principles of energy expenditure and exercise pattern: Sequential understanding of principle are briefed point wise below.

1. Type of Exercises in practice in health and disease[30-32]
   A. Aerobic exercise: These are endurance type exercise, rhythmic and sustained for sometimes. Example: Walking, jogging, running, cycling, swimming, etc.
   B. Strength (Resistance) exercise: It includes weight training with free weight, machine, elastic rope, calisthenics, etc.
   C. Flexibility exercise:These are stretching exercise.
2. Physical Activity Intensity in Metabolic Equivalent (MET)[30,34-37]
   - Metabolic Equivalent (MET) is the amount of energy expended during exercise relative to the energy expenditure during rest.(Note: Energy expenditure Energy expenditure during rest = 1 MET; in Light Physical Activity: Less than 3 MET, Moderate Physical Activity: 3 – 6 MET and Vigorous Physical Activity: Above 6 MET)
3. Activities of Light, Moderate and Vigorous Physical Activities [35-38] are
   A. Light Physical Activity: Leisure walking, cooking, daily household activities etc.
   B. ModeratePhysical Activities are: Brisk walking, Recreational swimming, Volleyball, Slow aerobics, Moderate cycling Gardening, Tennis-double, Badminton etc. Note that moderate Physical Activity Performed Regularly for 120 – 200 min. per week reduces the incidence of Diabetes.
   C. VigorousPhysical Activities are: Jogging, Running, Tennis-single, Basketball, Rope skipping, Squash, Fast aerobics, Fast cycling, Stepping, Soccer, etc.
4. Energy Cost of Physical Activity

Examples: Slow Walking -2.5 MET, Fast walking 4MET, Swimming 6 MET, Tennis 8, Rope Skipping 8 MET, Basket Ball 8 MET etc.

Calculating Energy Expenditure

- Energy Expenditure during Brisk Walking= 0.07 k. calorie per kg of body weight / min. An Example: a person weighing 80 kg would expend: 0.07 X 80 = 5.6 k. calorie per min.
- If he has to expend 1200 k. calories per week.
  - How much time he should walk per week?
  - 1200 / 5.6 = 214.4 min.
  - Duration of walking / day = 43 min / 5 days per week, or
  - Duration of walking / day = 54 min / 4 days per week.

Exercise Prescription

Exercise Regime in Overweight Individuals and Obesity without and clinical signs and symptoms includes.[37,39,40]

The moderate Intensity Physical Activity in which the energy expenditure = 3 - 6 MET and is practice for ≥ 30 min/day, ≥ 5 days/week to expend (Approximately 150 min. per week)and energy expended is ≥ 1000 k. calories/week with muscle strengthening activity for 2 or more days/week (notably 8-10 exercises/ 8-12 reps).

Patients of Diabetes[2,36,39]

A. Aerobic activity for 30 min. increased up to 60 min. every day or most days/week.
B. The heart rate during activity should be gradually increased to reach 60 – 70% of HR max.
C. Moderate intensity weight training program should be done regularly to maintain muscle strength (8-12 repetitions 2 times /week).
D. In patient is on insulin, he / she should avoid exercise if glucose levels below 100 mg/dl or above 250 mg/dl.
E. Note that patients with patients above 35 years of age with long duration of history of diabetes coronary heart disease risk factors, micro vascular disease (retinopathy, nephropathy) and peripheral vascular disease should consult Physician before starting exercise protocol sessions.

Exercise prescription in patients of hypothyroidism[40-43]

The reduced levels of thyroid hormone affect body's ability to burn calories at a normal rate. Hence shedding excess weight becomes difficult in hypothyroid patients. Patients who are overtly hypothyroid and on treatment with drugs the edema subsides over period of time but duration is unknown while severely hypothyroid and underweight patients may tend to gravitate towards the mean. Hypothyroidism causes fat build-up, which leads to insulin resistance in the body, leading up to weight gain and susceptibility to diabetes. Treatment for thyroid disorder is what benefits the patient in controlling weight while exercises act as placebos. Exercise and diet go hand in hand to manage weight for a hypothyroid patient. Exercise helps by sweating thus loosing excess water and preventing fluid retention in the body. Exercise promotes better sleep patterns and relieves anxiety too.

CONCLUSION

Exercise is the best "medicine" for physical fitness and in achieving perfect sense of physical, social and mental wellbeing. All patients' physical activity should be assessed. . Patients with cardiorespiratory diseases, metabolic syndromes, arrhythmia, acute pulmonary embolism, acute myocarditis, sickle cell

anemia, thalassemia etc. should consult Physician prior to following any exercise protocol. The moderate Intensity Physical Activity in which the energy expenditure = 3 - 6 MET and is practice for ≥ 30 min/day, ≥ 5 days/week to expend (Approximately 150 min. per week)and energy expended is ≥ 1000 k. calories/week with muscle strengthening and flexibility exercise should be followed for optimum health.

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