Benefits of Exercise and Sports

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The benefits of exercise and sport are much more than just a nice physique. In our modern "connected" life we to ride out our days stuck in one position. This inactivity leads to increase incidence of diabetes, heart disease, and death. A new branch of exercise physiology, inactivity physiology, inevitably emerged studying the increasingly chair ridden society. A study of 10,224 healthy men and 3120 healthy women from JAMA demonstrated a marked decrease in mortality with higher fitness levels [1]. In addition to mortality, exercise helps us live out our lives with a higher quality of life. Insurance companies are recognizing exercise as a way to cut costs for seniors. Several major health insurance companies are offering free gym memberships to seniors. The program has cut reportedly cut sedentary behavior down by 70% (www.silversneakers.com). This senior population, masters athletes, have an improved quality of life and healthier life due to their dedication to exercising. Exercising is a major factor in delaying the aging process for the heart, lungs, and musculoskeletal system.

The NEAT Way to Increase Metabolism

A study of sedentariness at work demonstrated that people sit an average of 8-12 hours a day [2]. The concerning part is that these same people sit 7-9 hours on their leisure days, meaning they are more active when outside of work, but still are planted for the majority of the week. The sedentary life style of work and play has been shown to decrease metabolism. The energy used in normal daily life is known as non-exercise activity thermogenesis or NEAT. NEAT has recently been targeted as a key to decreasing weight and promoting healthy life style. NEAT is a factor that can be directly decreased by inactivity. Levine has shown that obesity is associated with a lower NEAT and obese individuals walk and stand 2 ½ less than lean sedentary people [3] . To target this Levine has used the approach of STRIPE: Select a NEAT activity, Targeted-define goals, Rewards identified, Identify barriers and remove them, Plan NEAT activity, Evaluate adherence and efficacy [4]. Ways to increase the a person's NEAT in the office vary from walking to a coworkers desk instead of calling, climbing the stairs, using a balance ball as an office chair, and taking breaks to stand. A more extreme solution in the office place is to use "active" computer workstations, computers with stationary bikes and treadmills attached. At home similar techniques can be applied: playing active video games, watching TV on a treadmill or bike, talk with friends on walks instead of the phone, using push lawn mowers, and many other small changes can lead to increased NEAT and weight loss.

Lean people walk 3.5 miles more than obese in a study on nonexercise normal day walking. This makes sense that the obese walk less, but more importantly with increased weight gain walking decreases further [5]. Clearly this is a double edged sword because with inactivity comes health concerns that make exercise more difficult to safely perform. However, as Levine states in his book "Move a Little Lose a Lot" small increases in the daily activity, the NEAT, weight loss will ensue stopping the downward spiral of weight gain and inactivity. The question can then be asked, do lean people eat less or is their energy expenditure more? To study this a group of rats were breed selectively due to their resistant to obesity[6]. These rats and controls were fed high

fat diets. The lean rats did not gain weight which supported the theory that lean rats had a higher usage of energy. It was found that lean rats and people had a higher daily level of activity which was measured as endurance capacity. To measure the endurance capacity a sedentary group of people used a treadmill test to obtain their oxygen consumption, VO2max, which is correlated to endurance capacity[6]. Not surprising, lean people had a higher VO2max demonstrating that they are more active throughout a normal day, they have a higher NEAT. This article is not suggesting that the only cause of obesity is daily activity or endurance capacity, but it is simply testing theories on why lean people despite similar caloric intake, remain lean.

Inactivity and Health Problems

A new aspect of physiology has emerged to study this harmful trend of increasingly sedentary live, inactivity physiology. The basic principles of inactivity physiology are that sitting more and performing less nonexercise activity can cause a decrease in fitness and increase in mortality. Also that the body's response to inactivity varies greatly versus the body's cellular/molecular response to exercise. Furthermore the response to exercise in an inactive person would differ from a person that had a more active baseline. A few epidemiologic studies have been done demonstrating this fact that inactivity leads to increased risk for coronary vascular disease and death. A British professor in the 1950s made the observation that deaths from heart disease were more common in people with sedentary jobs [7]. He then studied a few groups of people to find this hypothesis true. First, he studied the conductors and drivers of London's double-decker buses. He found that the active conductors versus the sedentary drivers of the double-decker buses had lower incidence against coronary heart disease. Then he was able to reproduce this study in active postmen versus sedentary telephonists and other desk government workers. The physique of a conductor was overall more lean and the waist band size smaller than the drivers. This abdominal obesity became known as central obesity. After accounting for weight, age, and height the rate of sudden death from coronary heart disease (CAD) was 2 times higher in the drivers, even if they had "slim" physique [8]. As expected, the conductors had lower low density lipoprotein (LDL) cholesterol and triglyceride levels. Further studies of fitness level and heart disease demonstrated that regardless of body mass index (BMI) low fitness levels lead to increased risk of coronary heart disease (CHD) and mortality; the authors even stated that a low fitness level was comparable to diabetes as a health morbidity contributor [9].

In addition to increased cardiovascular morbidity, inactivity has been shown to be a detriment to other areas of health as well. A high level of exercise in postmenopausal women has shown to decrease breast cancer risks [10]. Maintaining a waist circumference below 102 cm and moderate intensity physical activity is associated with sustaining proper erectile function [11]. Asthma has been shown to decrease physical activity in adults, in this population there is a higher number of emergency room visits, use of medication/inhalers, sleep issues, and inability to go to work [12].Interestingly, a prospective study showed that asymptomatic children with low physical fitness had increased development of asthma in adolescence[13].

It was speculated that inactivity lead to an increase in systemic inflammation. Another study demonstrated tumor necrosis factor alpha and C-reactive protein, inflammatory reactants, increased with inactivity, further supporting the fact that a low level of systemic inflammation increases a sedentary lifestyle [14]. This systemic inflammatory state is what is hypothesized to increase the risk for tumor growth, insulin resistance, and CHD. Exercise then acts as an anti-inflammatory; skeletal muscles release various myokines that have endocrine and paracrine effects on visceral fat and fat oxidation signaling[15]. A molecular study by Hamilton demonstrated decreasing the daily low level activity lead to a change in the cellular regulation of skeletal muscle lipoprotein lipase, a protein that is important in triglyceride catabolism and high density lipoprotein (HDL) cholesterol [16]. Inactivity in essence decreases muscle lipoprotein lipase, decreases the HDL concentration, and decreases triglyceride uptake. In this study when sedentary people added vigorous exercise to their daily routine they did not have as much affect on the skeletal muscle lipoprotein lipase as did increasing baseline activity. In another study by Hamilton treadmill walking was shown to raise lipoprotein lipase by 8-fold within 4 hours after inactivity. [17] This perhaps is why even low level exercise such as walking, is beneficial in preventing heart disease.

Exercise in Seniors

Athletes over 40, known as masters athletes, have been shown to have improved life expectance, life satisfaction, and improved overall health. A survey conducted by the Arthritis Foundation, 64 % of masters athletes reported feeling an average of 11 years younger than their actual age, while 40 % reported living a more healthy and physically fit lifestyle than in their 20's (chapter). It is interesting to note the later fact, that these incredibly active people are more fit as seniors. Moreover, 33 % of them boasted that they can beat their children in at least one sport. These people are not the exception, but the standard. All individuals have the chance to maintain this high quality of life and functional capacity throughout their lifespan if they chose to avoid a sedentary lifestyle. The sedentary lifestyle is quiet a detriment to aging, it has been shown that in sedentary people their health declines twice as fast as their age matched active counterparts.

Contrary to popular belief that older individuals can not exercise or remain active due to age, this has not been shown to be true until the seventh decade of life. In a study of track athletes aged 50 to 85 who participated in the 2001 National Summer Senior Games, running times across all distances declined with age. While this trend was expected, the surprising find was the small degree of performance decline that occurred with age. Until the age of 75, the observed decline was slow and linear, with decreases of less than 2 % per year. This decline was not found to be statistically significant. At age 75, however, the rate of decline jumped to approximately 8 %. This trend of performance decline with age is shown in Senior Olympians running the 100 meter dash. These results suggest that if disuse and disease are eliminated, individuals should be able to maintain high levels of functional independence until the age of 75[18]. Therefore, the loss of

independence before the age of 75 must be attributed to disuse, destructive lifestyle habits, disease or genetic predisposition. Although it has been shown in multiple studies that at age 75 the aging process becomes a factor in exercise, this still does not stop Senior Olympians. It is not uncommon for competitors to run into their 90s and more impressively, gain a position on the metal stand.

Health Benefits from Exercise

These masters athletes are quite serious about fitness; although some aspects of aging they cannot ward off with exercise. The good news is that even if aging in inevitable, intense exercise has shown to slow its process.

Lungs

With age the efficiency of oxygen delivery decreases which changes peak performance. Oxygen is a much more efficient energy producer than any other catabolic pathway. This change in performance with aging is attributed to lower lactate threshold, lower exercise efficiency, and lower VO2max. The VO2max is the most important factor, and a reduction in VO2max is the primary reason for a decline in functional endurance with aging. The VO2max decreases 5-15 % per decade after age 50; this decline is mainly because of changes in cardiac output. An intense endurance workout program can cut this decline of VO2max in half.

The lung tissue also changes with age and body abuse. The lungs become more stiff and cannot expand to hold the amount of air that a more elastic lung can hold. This capacity decreases by 250 milliliters per decade. Also, from age 20-70 the maximum breathing capacity declines by 40%. Smoking and asthma can also lead to decreasing the elasticity of the lungs. There is also a decline in the number of lung capillaries which further decreases oxygen exchange. With the combination of less elasticity and decreased capillaries, the lungs do not exchange oxygen for carbon dioxide in the blood as efficiently. The only way to decrease the damage to the lungs is to stop smoking.

Heart

The heart cannot take a moments rest in the 80+ years of life, it beats on average 80 times per minute and over 50 years this is 2.1 billion heartbeats. With all that daily work, it is not surprising that the heart ages. The maximum heart rate, heart muscle contractility, stroke volume all decline with age. Without an aerobic workout program that stresses the heart, the muscle, just like a bicep or quadriceps can weaken. Other control measures to keep the heart pumping strong are controlling blood pressure, emotional stress reduction, and as always a well balanced diet. The numbers can be frightening with 40% of deaths in people ages 65-74 from heart disease, and increases to a staggering 60% in people over 80 [19]. The cardiac output is only twice the resting capacity in an 80-year-old, while a 20-year-old has a 3.4 to 4 time the resting capacity. To increase cardiac output the heart pumps harder, in an older person this is a challenge as well

because with age the arteries become less elastic, and therefore the blood pressure increases. To counter act the higher blood pressure the left ventricle become hypertrophied. This leads to a heart that can be up to 40% larger than a young person. The heart rate maximum decreases 1 beat per year after age 10 and the heart is not capable of beating as quickly, due to the aforementioned reasons. The good news is that the aging process on the heart can be delayed with an intense endurance workout program. This strengthens the heart and causing the resting heart rate to be lower because the heart muscle is more efficient. The muscle can make more forceful contractions to squeeze out the blood and therefore does not need to squeeze it as often.

In addition to arteries becoming less elastic they may harden due to build up cholesterol and calcium deposits. Diets high in fat and smoking can exacerbate this. The repeated theme of exercise and a well balanced diet can prevent narrowing of the arteries and help control blood pressure.

Skeletal Muscle

Age related changes affect a muscle's overall power and strength. The changes seen are due to sarcopenia, a loss of lean muscle mass. This decreases the size of muscle fibers, leads to a loss of muscle cells, and decreases muscle flexibility [18]. Lean muscle mass starts to decrease at age 25 with a loss of muscle fibers and loss of fiber size, mostly fast twitch muscle [20]. By age 80 50% of lean muscle mass is lost. This dramatically increases with a sedentary lifestyle. More importantly with inactivity the muscle becomes replaced with fat [21]. However, an intense endurance workout program can again prevent age related changes. In a Swedish and Finnish study, the vastus lateralis of 18 to 84 year old male sprinters were studied and they found the typical age related reduction in the size of fast twitch fibers, but these fibers were preserved at a high level in the older runners [22] .

Old muscle has the ability to hypertrophy, just like young muscle, if the muscle is exercised. Multiple studies have shown that high-intensity strength training results in substantial, continual increases in strength [23]. This has been shown true for deconditioned elderly as well. The strength training has been shown to be essential in keeping healthy muscles. A study of masters athletes that mainly partake in aerobic exercise for fitness had muscle composition similar to age matched sedentary controls. However masters athletes that had workout routines that included weight training had muscle composition similar to controls that were forty years younger. Other research has shown that regardless of age if people are using comparable training regimens this results in similar muscle composition. In essence, the aging process can go seemingly unnoticed with an intense and consistent strength training program.

Bone

The loss of bone with aging is a big concern leading to many complications. Bone mineral density decreases with age, but risk factors such as inactivity, smoking, low calcium intake, and low sunlight exposure or vitamin D intake can accelerate bone loss. A decrease in bone mineral

density leads to osteoporosis. These soft bones are much more prone to fracture than normal density bone. A seemingly harmless fall in an osteoporotic person can lead to a complex fracture and quite possibly permanent disability. A once independent elderly person may then end up in a nursing home. Bone loss is inevitable, but osteoporosis is not. After the age of 40 bone is lost at 1.5-2% per year and women lose bone twice as fast as men. The key to bone health is of course a well balanced diet rich in calcium and vitamin D, but also weight baring exercises. For example, although swimming is an excellent cardiovascular activity, it does not stress the bones. Bones need a stress or load in order to maintain density. A study performed at the University of Pittsburgh on the bone density in senior athletes found that the women had normal bone, even the Senior Olympians in their 80s. The prevalence of osteoporosis was lower than the general population at any age.

New Trends in Exercise

Circuit Training

Circuit training has become increasingly popular. At many health clubs they have circuit training workout classes or preprinted circuit workouts for members to use. There is even a club that is devoted entirely to circuit training. The name of that chain is Curves and is a women's only circuit training health facility. These workouts are only 30 minutes and combine strength training with aerobic activity. This has become the number 1 fitness franchise recently (www.curves.com).

Dance Exercise

At every health club there are multiple workout classes that include dance workouts. The theme ranges from African dance, flashdance, and an increasingly popular Zumba. Zumba was created in Columbia and has a Latin flare. The songs are salsa, meringue, samba, reggaeton, and other Latin rhythms. The class consists of slow and fast tempo songs for a strength training and cardiovascular workout (http://www.zumba.com/us/). To follow along to the fast beat of the music the aerobic expenditure can be intense.

Exercise Video Games?

Exercise has even become a trendy subject in the video game world with the advent of interactive video games. One of these gaming systems is the Wii by Nintendo. The Wii holding 48.8% of the world market and Wii Fit is in the top 3 of video games in the last few years. This gaming system requires standing and movement for game play, in contrast to typical video games where people are seated and stationary. The Wii Fit in particular has an exercise program that incorporates aerobic, balance, and strength training. In both adults and children the Nintendo Wii has been scientifically shown to increase energy expenditure [24] . Although good old fashioned exercise such as walking is always a benefit and free, the Nintendo Wii may be a nice alternative to motivate previously sedentary people.

While our society has become increasingly sedentary, our bodies have not gone along with the trend. We still need to exercise and remain active every day. The entire body depends on exercise to keep working efficiently. The lungs, heart, muscles, and bones all benefit from exercise. An exercise that can be anything from jogging to the stairs at work, push mowing the lawn, or boxing a friend on a video game. Although any extra movement a day can mean pounds lost or lower resting heart rate, only intense exercise can elevate a person to the level of the masters athlete. These older people have taken the aging process head on and are winning, with better health, longer life, and more satisfaction.

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