The Proven Benefits of Exercise

By

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In this article we will examine the positive effects of exercise that have been scientifically proven. This article will review a sampling of some of the major benefits of exercise and will not be a complete discussion of all of the benefits.

How is the Intensity of Exercise Determined?

One measure of the intensity of physical activity is the metabolic equivalent of task or MET. One MET is equal to the rate of energy expended by a person sitting at rest. Light-intensity activities expend less than three METs, moderate-intensity activities expend three to six METs, and vigorous activities expend six or more METs.[1]

Examples of light-intensity activities are slow walking and standing light work. Moderate-intensity activities include brisk walking, mowing the lawn with a power mower, playing doubles tennis and bicycle riding at 10-12 mph. Vigorous-intensity

activities include jogging, hiking, shoveling snow, bicycle riding over 14 mph, and playing basketball, soccer, or singles tennis.[2]

The Physical Activity Guidelines Advisory Committee Findings

In 2018, the Physical Activity Guidelines Advisory Committee, a U.S. government advisory committee, after reviewing the science available found that there are health benefits from doing any amount of moderate-to-vigorous physical exercise. However, to obtain substantial health benefits, it was recommended that adults should do at least 150 to 300 minutes per week of **moderate**-intensity, or 75 to 150 minutes per week of **vigorous**-intensity aerobic physical activity, or a combination of the two. They also recommended that adults should do muscle-strengthening activities of moderate or greater intensity involving all major muscle groups on two or more days a week, as these activities may provide additional health benefits.

The committee reported that health benefits of exercise in adults included: Lowered risk of death, heart disease, stroke, high blood pressure, type 2 diabetes, and elevated cholesterol. They also noted that the risk of cancers of the bladder, breast, colon, uterus, esophagus, kidney, lung, and stomach were lessened. Dementia and falls in the elderly were also reduced in exercisers. Exercise improved cognition, quality of life, sleep, bone health, the ability to lose weight and also reduced anxiety.[3]

Cardiovascular and Mortality Benefits

A 30-year study of 116,221 adults reported that the group who did moderate-intensity physical activity for 150 to 299 minutes per week had a 19% to 25% decrease in mortality. Moderate-intensity physical activity of 300–599 minutes per week resulted in a further 3% to 13% decrease in mortality.

The group that had a history of vigorous-intensity physical activity of 75 to 149 minutes per week had a 31% decrease in cardiovascular mortality and a 15% decrease in other causes of mortality. Those who reported vigorous-intensity physical activity of 150 to 299 min per week had a further decrease in mortality of 2% to 4%.

Vigorous-intensity physical activity of more than 300 minutes a week and moderate-intensity physical activity of more than 600 minutes per week did not lower mortality any further in this study.

The authors concluded that the decreased mortality effect of exercise was maximally achieved by performing approximately 150 to 300 minutes per week of long-term

leisure-time vigorous physical activity or 300 to 600 minutes per week of long-term leisure-time moderate physical activity, or an equivalent combination of both.[4]

A meta-analysis of 196 articles and over 30 million participants comparing leisure-time moderate-to-vigorous exercisers to controls found the following:

Reduction in All-Cause, Cardiovascular Mortality and Cancer Incidence in Leisure-Time Moderate-to-Vigorous Exercisers Compared to Controls

	75 minutes of moderate-to-vigorous exercise/ week	**150 minutes of moderate-to-vigorous exercise /week**	**300 minutes of moderate-to-vigorous exercise /week**
All-cause mortality	23% reduction	31% reduction	34% reduction
Cardiovascular mortality	19% reduction	29% reduction	35% reduction
Cancer incidence	7% reduction	12% reduction	15% reduction

It was reported that even as little as 11 minutes of moderate-to-vigorous a day could produce some health benefits, although higher amounts of exercise of up to 300 minutes per week were more beneficial.

The authors also calculated that about 10% of premature deaths could be prevented if everyone in the population did 75 minutes of moderate-to-vigorous exercise per week, with increasing premature death prevention at increasing levels of exercise.

Predicted Reduction in Premature Deaths if Everyone in the Population Exercised

	75 minutes of moderate-to-vigorous exercise/ week	**150 minutes of moderate-to-vigorous exercise /week**	**300 minutes of moderate-to-vigorous exercise /week**
Predicted reduction in premature deaths if everyone exercised	10%	16%	19%

[5]

Gender Differences in Exercise Effect on Mortality Reduction

In a study of over 400,000 adults, it was reported that regular leisure-time aerobic exercise reduced all-cause mortality 24% in women and 15% in men compared to non-exercisers. For cardiovascular mortality, regular aerobic exercise was associated with a risk reduction of 14% for men and 36% for women.

Men reached their maximal survival benefit of a 19% reduction in mortality from approximately 300 minutes of exercise per week while women, to get the same benefit, only needed to perform 140 minutes of exercise per week. However, women's maximal mortality benefit of a 24% reduction occurred at approximately 300 minutes of exercise per week.[6]

Cancer Risk and Exercise

Exercise in many meta-analyses has been shown to decrease cancer risk.

- The risk of bladder cancer was 15% lower for individuals with the highest level of recreational or occupational physical activity than in those with the lowest levels. A study which included over 1 million individuals found that leisure-time physical activity was associated with a 13% reduced risk of bladder cancer.
- For breast cancer it was reported that the most physically active women had a 12–21% lower risk of breast cancer than those who were the least physically active.
- Individuals who engaged in the highest level of physical activity had a 19% lower risk of colon cancer than those who were the least physically active.
- Highly physically active women had a 20% lower risk of endometrial cancer than women with low levels of physical activity.
- Individuals who were most physically active had a 21% lower risk of esophageal adenocarcinoma than those who were least physically active.
- The most physically active people have been found to have a 12% lower risk of renal cancer than those who were the least active. Another analysis of over 1 million individuals found that leisure-time physical activity was linked to a 23% reduced risk of renal cancer.
- Individuals who were the most physically active in another meta-analysis had a 19% lower risk of stomach cancer than those who were least active.[1]

Dementia and Alzheimer's disease

A systematic review reported that high physical activity individuals compared to very low physical activity individuals had a 28% decreased risk of dementia, and a 45%

decreased risk of Alzheimer's disease. It is postulated that exercise is neuroprotective due to reducing inflammation, improving cerebral blood flow, lowering blood pressure, reducing lipids and increasing the body's production of neuroprotective substances, such as brain-derived neurotropic factor.[7]

Type 2 Diabetes and Exercise

After eating, insulin is secreted and increases glucose storage as glycogen and fatty acid storage as triglycerides. During exercise, fuel stores need to be mobilized. The pancreas decreases insulin secretion, and the body increases other processes that help mobilize glucose and fatty acids needed for energy. After exercise is completed, there is a need to refill the fuel depots mobilized during the exercise, mainly glycogen stores in the muscles. This is facilitated by an increased sensitivity of muscles to insulin post-exercise. The increased insulin sensitivity allows lower levels of insulin to be secreted from the pancreas. Insulin sensitivity is higher in people who exercise regularly which decreases the amount of insulin the pancreas needs to produce.[8]

Many studies have demonstrated that exercise can increase insulin responsiveness and decrease the risk of people developing type 2 diabetes.[9] In one study, people who exercised and had an impaired glucose tolerance (prediabetes) had a 46% percent decreased incidence of progressing onto clinical diabetes compared to a control group.[10] In other studies, there was a 30% risk reduction in subjects who exercised, with a history of impaired glucose tolerance, progressing onto type 2 diabetes.[9]

Lipids and Exercise

There have been mixed results in some meta-analyses as to the effect of aerobic exercise on lipid values. One reported that only triglycerides were reduced,[11] while another found statistically significant decreases in total cholesterol (TC), triglycerides (TG), low-density lipoprotein(LDL), with an increase in high-density lipoprotein (HDL) when compared to a control group.[12]

In a meta-analysis with female subjects, exercise led to statistically significant reductions of approximately 2%, 3%, and 5%, for TC, LDL, and TG respectively, whereas HDL increased by 3%.[13]

In a meta-analysis with male subjects, exercise led to significant decreases of 2% for TC, 9% for TG and an increase of 2% for HDL. There was a 3% decrease in LDL which was not found to be statistically significant.[14]

Although the effects of exercise on lipids seems to be small, there are some data that even a 1% decrease in TC reduces the incidence of coronary heart disease (CAD) by 2%.[15] Each LDL decrease of 1% reduces the risk of major coronary events by approximately 1.7%.[16]

It appears that most of the medical literature points to exercise producing a small decrease in lipid levels, which while helpful, may also require alterations in diet as well as lipid-reducing medications for adequate treatment.[14]

Decreased Inflammation with Exercise

It has been reported that leisure-time physical activity reduces levels of high-sensitivity C-reactive protein (CRP), a systemic marker of inflammation. Inflammation can have a multitude of deleterious effects on the body.[17] Some studies have reported a lowering of CRP with exercise, as well as lowering of other inflammatory markers including tumor necrosis factor alpha and interleukin-6.[18]

Theoretically, the anti-inflammatory effects of exercise may be related to a reduction of visceral fat (fat deep in the abdominal cavity) which in turn decreases the release of adipokines which activate inflammatory pathways.[19]

Interleukin-6 (IL-6) has been found to have both inflammatory and anti-inflammatory properties. IL-6 is released both by adipose tissue when at rest and by muscular activity during exercise. It is felt that there may be different forms of IL-6 [20] with the one produced in muscles having anti-inflammatory properties.[21]

Depression and Exercise

Data from a number of meta-analyses have found that exercise can reduce depressive symptoms. Theories about why this occurs include: increased endorphin release, increased brain neurotransmitters, distraction from worries, and positive self-efficacy (the positive feeling one gets from completing a task with the desired outcome).[22]

Bone Health and Exercise

Bone mass peaks at approximately 20 to 30 years of age, then plateaus and later starts to decrease with age in both men and women. There is more bone loss in women due to estrogen reduction at menopause which may lead to osteoporosis.

Bone adaptation occurs when bone tissue deforms from muscle contraction and other stresses such as tortional force that occur during exercise. Those forces affect biological sensors that lead to osteogenesis (new bone formation) at the site. This process is seen

in tennis players, fencers and baseball players who have all been found to have higher bone densities in their active arm than their less active arm.[23,24]

In men there is evidence that exercise late in life will increase bone density, however the results of exercise in post-menopausal women in some studies showed no effect on bone density.[23,24] It is possible that women who start exercising at younger ages and increase their bone mass might be able to mitigate some of the bone loss of aging.[24]

Hip Fractures and Exercise in the Elderly

In a study of 77, 206 postmenopausal women, with a mean follow-up of 14 years, researchers reported that both walking activity and moderate to vigorous recreational physical activity reduced the risk of hip fractures. There was a 1%, 8% and 12% decrease in hip fractures in subjects that did little walking, moderate walking or a lot of walking respectively, compared to a control group of non-regular walkers. It was also reported that the risk of hip fracture was reduced 8% in moderate exercisers and 18% in vigorous exercisers.[25] This occurred despite the lack of proof that exercise increases bone density in post-menopausal women.[23,26]

Another study of 13,987 elderly individuals compared the hip fracture incidence in subjects who engaged in more than one-half hour of daily exercise versus a control group who daily exercised less than one-half hour or did no exercise. It was reported that compared to the control group, exercising an hour or more a day resulted in a 38% decrease in females and a 49% decrease in males in the risk of sustaining a hip fracture. Exercising one-half hour to one-hour a day reduced the risk of hip fracture 28% in both males and females compared to the control group.[27]

DNA Changes from Exercise

In an interesting experiment, 23 young subjects engaged in vigorous one-leg exercise for three months. Muscle biopsies were taken before and after the training in both legs. The researchers found 4,919 changes in DNA methylation in sites on the trained leg. DNA methylation can facilitate or inhibit gene expression with respect to RNA transcription and the proteins synthesized. Areas where DNA methylation was increased were mainly associated with muscle remodeling and glucose metabolism. Areas with decreased DNA methylation were associated with inflammatory or immunological processes and transcriptional regulation. This suggested to the authors that the changes in methylation seen with exercise training is not random, but rather a controlled process that may help skeletal muscle adapt to endurance training.[28]

Is There a Difference Between Leisure-Time and Occupational Physical Activity?

In a study of 104,046 subjects, it was reported that there was a significant reduction in major adverse cardiovascular events and all-cause mortality risk in subjects who exercised moderately or more when compared to low leisure-time physical activity subjects. However not all exercise is necessarily equal, and in what was called the "physical activity paradox", occupational physical activity at all levels was found to increase both major adverse cardiovascular events and all-cause mortality risk. [29]

In another study it was reported that moderate-to-vigorous levels of occupational physical activity were found to have significantly higher CRP levels than leisure-time moderate-to-vigorous exercisers.[17]

The explanation for this confusing result is that occupational physical activity is possibly of a too low intensity or too long a duration for improving cardiovascular health. Improvement of cardiorespiratory fitness requires a high intensity of physical activity for a short period of time. Leisure-time exercise is for a short period with a recovery period where occupational physical activity is often performed throughout the entire day. It has been found that occupational physical activity elevates 24-hour heart rate, and if there is frequent heavy lifting or standing without moving much, muscle contractions can occur which can elevate 24-hour blood pressure. In addition, work stresses may contribute to the detrimental effects of occupational physical activity.[29,30] Although the authors controlled for socio-economic class and felt it was not an issue in their conclusions, there was a much higher percentage of workers in the upper income group who did low amounts of manual labor.[28] Thus, it is possible there still might be other lifestyle or socioeconomic class issues that might partially explain the "physical activity paradox".

Conclusions

There is abundant scientific evidence that regular leisure-time exercise can reduce systemic inflammation as well as the reduce the incidence of premature mortality, arteriosclerotic heart disease, some cancers, diabetes, dementia, Alzheimer's disease, hip fractures, and improve bone health and depression.

There is some evidence that occupational related exercise may not have the same protective effects as leisure-time exercise.

As little as 11 minutes of moderate-to vigorous exercise per day may result in health benefits.

People with health problems or middle aged and above should consult a doctor before embarking on an exercise program to ensure safety.

Author's Note : The photo at the beginning of the article was used because of the unbridled joy of exercise it depicted. However, it is recommended that a helmet be worn whenever you ride a bicycle to prevent serious head injury.

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