

221 SCIENCE BASED REASONS WHY I EXERCISE

(A Meta Analysis)

by

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CANCER

- The Clinical Oncology Society of Australia (COSA) cites more than 30 journal references to show that regular exercise before, during and following cancer treatment decreases the severity of other adverse side effects and is associated with reduced risk of developing new cancers and comorbid conditions such as cardiovascular disease, diabetes and osteoporosis (*Med J Aust*, May 7, 2018). They recommend that:
 - Doctors should prescribe exercise within physical limitations as part of cancer care.
 - Cancer care should include referral to an accredited exercise physiologist or physiotherapist with experience in cancer care.
 - All health professionals should discuss with their cancer patients the role of exercise in cancer recovery, to avoid inactivity and progress towards at least 150 minutes of moderate intensity aerobic exercise and two to three moderate intensity resistance exercise sessions each week.
- A study of 15,450 adult survivors of childhood cancer showed that regular exercisers gained a 40 percent reduction in death rate eight years after treatment (compared to non-exercisers), and the highest survival rate was in those who exercised 15 to 18 metabolic equivalent task (MET) hours per week, equal to brisk walking for about 60 minutes a day, five days a week (*JAMA Oncology*, June 3, 2018). National physical activity guidelines for cancer survivors recommend five days a week for 30 minutes per session.
- The American Association for Cancer Research reports that being overweight is linked to 25 percent of newly diagnosed cancer cases in the U.S. (*Am Cancer Soc. Cancer Prevention & Early Detection: Facts & Figures 2017-2018*). Adding lack of exercise and a pro-inflammatory diet increases the number to 33 percent. The International Agency for Research on Cancer (IARC) reported that being overweight increases risk for 17 different types of cancers: colon, rectum, esophagus, kidney, breast (women), endometrium, stomach, liver, gall bladder, pancreas, ovary and thyroid, as well as fatal prostate cancer and breast cancer in men, meningioma, multiple myeloma and B-cell lymphoma (*N Engl J Med*, Aug 25, 2016;375:794-798). Overweight is associated with almost five million cancer deaths each year. Gaining as little as ten pounds between ages 18 and 55 is associated with increased risk for heart attacks, diabetes and the obesity-related cancers later in life (*JAMA*, 2017;318:255-69).
- An extensive review of research (*Translational Journal of the American College of Sports Medicine*, December 1, 2016;1(17):152-158) shows that exercise:
 - * Reduces the side effects of chemotherapy treatments including nausea, fatigue, anxiety and depression, and increases bone strength and muscle mass (*Curr Treat Options Oncol*, 2008;9:135-46).
 - * Increases the percentage of people who are able to complete full-dose chemotherapy regimens (*J Clin Oncol*, 2007;25:4396-404).
 - * Can increase tumor sensitivity to chemotherapy (*Cancer Prev Res (Phila)*, 2013;6:925-37).
 - * Reduces heart damage from chemotherapy (*Circulation*, 2011;124:642-50)
 - * Markedly reduces arm swelling from extensive breast cancer surgery (*N Engl J Med*, 2009;361:664-73).

* Is associated with a 50 percent increased survival rate in patients treated for breast cancer (*JAMA*, 2005;393:2479–86) and colon cancer (*J Clin Oncol*, 2006;24:3535–41)

* Is associated with a 70 percent risk reduction of high-grade, advanced or fatal prostate cancers (*Arch Intern Med*, 2005;165:1005–10).

- A regular exercise program reduced carcinogenic inflammation, strengthened the immune system and improved mental processing by increasing apoptosis and by lowering cancer-inducing insulin-like growth factor 1, DNA damage and gene mutations (*Br J Cancer*, 2011;105:S52–73).
- A new study shows that women who do not engage in any regular moderate or vigorous physical activity are twice as likely to develop cervical cancer as women who exercise at least four times a month (*Journal of Lower Genital Tract Disease*, May 13, 2016).
- 1.44 million people, ages 19 to 98, in the U.S. and Europe, were followed for a median of 11 years during which 187,000 new cases of cancer occurred. Leisure-time physical activity was associated with a lower risk of cancers of the colon, breast, endometrium, esophagus, adenocarcinoma, liver, stomach, kidney, head, neck, rectum, bladder and lung, and myeloid leukemia and myeloma (*JAMA Internal Medicine*, May 16, 2016).
- Lack of exercise and being overweight are associated with increased risk for the type of prostate cancer that kills (*Cancer*, June 2015 and *Cancer Prevention Research*, May 19, 2015).
- An extensive review shows that exercise is associated with a lowered risk for prostate cancer and its recurrence (*Cancer Epidemiology, Biomarkers & Prevention*, January 28, 2015).
- An exceptionally well-done study on mice shows how exercise can be an important part of the treatment for cancer (*The Journal of the National Cancer Institute*, March 2015). Mice implanted with breast cancer cells who were given chemotherapy and exercise had much smaller and fewer tumors than those given the same chemotherapy but no exercise. Mice who ran but did not receive chemotherapy also had smaller tumors and signs of increased cancer cell death.
- Many studies show that regular exercisers are less likely to suffer many different types of cancer. A new study following 293,511 men and women for 12 years shows that people who exercised before they were diagnosed with cancer are less likely to die from their cancers than those who did not exercise (*International Journal of Cancer*, 12/06/2013). Compared to people who rarely exercised, those who exercised for more than seven hours per week had lower death rates from cancers of the colon by 30 percent, of the liver by 29 percent, of the lung by 16 percent, and by 20 percent in cases of non-Hodgkins lymphoma. However, exercisers had an 18 percent higher death rate with cancer of the kidney.
- A review of 48 studies covering 40,674 colon/colorectal cancer cases showed reduced recurrence among patients who continued to exercise, and the more a person exercised, the less likely the cancer was to recur (*Med Sci Sports Exerc*, 2001 Jun;33(6 Suppl):S530-50; discussion S609-10). In the same journal issue, a review of 41 studies covering 108,031 breast cancer cases showed that people who exercised moderately had reduced breast cancer recurrence.
- Among a group of 164 white men having prostate biopsies to look for cancer, those who exercised regularly were less likely to have prostate cancer and less likely to have the high-grade type of prostate cancer that can kill (*Cancer*, published online Feb 11, 2013).
- Spectacular news for the 14 million Americans living today with a diagnosis of cancer: two impressive medical studies show that exercise helps to prevent recurrence of cancer. The first study of 45 peer-reviewed articles published from January 1950 to August 2011 shows that exercisers are less likely to die of their cancers than non-exercisers. Also, 27 observational studies strongly showed that exercise is associated with reduced death from breast and colon cancers specifically (*J Natl Cancer Inst*, published online May 8, 2012). Those who exercised were also less likely to die from other diseases such as heart attacks.

- Cancer survivors who exercised had far more energy, were far more active, and were less tired than survivors who did not exercise. Exercising gave them more energy (*PLoS One*, published online May 2, 2012).
- There is overwhelming evidence that exercise helps to protect against colon cancer. A study from Australia shows that vigorous, not moderate, exercise reduces colon and rectal cancer risk (*Cancer Causes Control*, December 2011; 22(12):1647-58).
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- Intense, vigorous exercise prevents colon cancer in the last part of the colon, (*Cancer Causes and Control*, 10/08/2011).
- Many research papers show that exercise markedly reduces a person's chances of developing colon cancer. Now research from Finland shows that intense exercise offers even more protection (*British Journal of Sports Medicine*, August 2009).
- A review of 170 animal and human studies shows that regular exercise is associated with reduced cancer risk, particularly for the types of cancers that are associated with unhealthy lifestyles, such as those of the breast, colon, prostate, lung and endometrium (*J Nutr*, 2002 Nov;132(11 Suppl):3456S-3464S).
- The most likely reason why exercise reduces cancer risk is that it reduces an overactive immunity (*Exerc Sport Sci Rev*, 2015;43(3):134-142).
- Exercise was shown to reduce inflammation that caused mice to develop colon cancer (*Int. J. Oncol*, 2014; 45(2):861-8) and breast cancer (*Cytokine*, 2011; 55(2):274-9).
- Exercise helped to prevent breast cancer in rats (*Cancer Prev. Res (Phila)*, 2012; 5(3):414-22) and mice (*Cytokine*, 2011; 55(2):274-9).
- Exercise reduced inflammation in humans to increase survival from colon cancer (*Gut*, 2006; 55(1):62-7).
- Exercise is associated with reduced pre-cancerous polyps in humans (*BMC Res Notes*, 2012; 5: 312).
- Adults who exercise regularly and are active are less likely to develop a range of cancers (*American Journal of Epidemiology*, August 2008). Those who were more active had reduced risk for developing any type of cancer, particularly cancers of the colon, liver, pancreas or stomach.
- Men who spend a lot of time walking are at reduced susceptibility to developing colon cancer (*European Journal of Cancer Prevention*, October 2007).

AGING

- One study of 111 women, ages 65 to 70, showed that replacing 30 minutes of sitting time with the same amount of time in light or moderate exercise very significantly

reduced markers of inflammation (C-reactive protein and fibrinogen) and diabetes (*Medicine & Science in Sports & Exercise*, July 2018).

- Studies in the new field of Epigenetics are showing that lifestyle factors can change the way your body responds to your genes. In one of these studies, researchers were delighted to find a set of identical twins with vastly different lifestyles. They found that a lifetime of exercise is likely to give you the body characteristics of a healthy athlete, while an inactive lifestyle can give you body characteristics associated with increased risk for many diseases (*Eur J Appl Physiol*, July 14, 2018).
- Researchers at Surrey University in England reviewed 68 studies on the effects of diet on osteoarthritis and found that osteoarthritis is associated with everything that increases inflammation, and that the joint pain can be reduced by everything associated with the control of inflammation (*Rheumatology*, May 1, 2018;57(suppl_4):iv61-iv74). Steps recommended to reduce inflammation include: Strengthening and flexibility exercises (*Arthritis Care & Research*, Dec 5, 2017;69(12)) and aerobic exercise (*The Knee*, January 18, 2018)
- Two exciting new studies show that older men and women who have cycled for many years do not have the markers of aging found in non-exercising people (*Aging Cell*, March 8, 2018). Their muscle size and strength, amount of body fat, levels of hormones such as testosterone, and blood cholesterol levels were close to those of much younger people. Their maximal ability to take in and use oxygen was more like that of people in their twenties than that of non-exercisers of their own age. Incredibly, the cyclists' immunity did not show the deterioration that is expected with aging. These studies focused on cyclists, but similar results would probably be found with other types of sustained exercise.
- A new research report shows that you can improve athletic performance with proper training, even if you are over 100 years old. Traditional feeling among scientists is that aging is progressive and inevitable, and that your genetic programming causes you to age no matter what you do. This paper shows that physical training can reverse established markers of aging (*J Appl Physiol*, February 15, 2017). Example: Robert Marchant, a 105-year-old cyclist who had improved his world record for how far he could ride a bicycle in one-hour from 15.07 miles (24.25 kilometers) at age 101 to 16.73 miles (26.92 kilometers) at age 103. That is an 11 percent improvement in a world record after just two years of serious training, an impressive accomplishment at any age.
- If you do not exercise regularly and vigorously, expect to lose a significant amount of muscle strength as you age, and expect that loss of strength to reduce the quality of your life. A 15-year follow-up study showed that older people who lift weights at least twice a week, had a 46 percent lower death rate within the study period, a 41 percent lower death rate from heart attacks, and a 19 percent lower death rate from cancer, compared to the control group that did not lift weights (*Preventive Medicine*, June 2016;87:121-127).
- A new randomized controlled study of 126 people with knee osteoarthritis and at least one of the following: heart disease, heart failure, type 2 diabetes, chronic obstructive pulmonary disease (COPD) or obesity (body mass index greater than 24), showed that aerobic and strength training for 20 weeks markedly decreased knee pain and increased mobility (*Arthritis Care & Research*, August 30, 2016).
- A review of fourteen articles on the life spans and death rates of elite endurance athletes shows that they live longer than the general population, and suffer far less from heart disease (*J of Sci and Med in Sport*, July 2010;13(4):410-416).
- A review of 174 studies shows that even activities such as gardening and household chores are associated with a lower risk of stroke, breast cancer, colon cancer, diabetes and heart disease. Larger risk reductions came with increasing intensity and duration of exercise (*British Med J*, August 9, 2016).

- A study from the University of Copenhagen shows that wearing an immobilizing knee brace for just two weeks caused men in their 20s to lose 22 to 34 percent of their leg muscle strength, while men in their 60s lost 20 to 26 percent (*Journal of Rehabilitation Medicine*, June 26, 2015).
It took them six weeks of exercising on a bicycle 3-4 times a week to restore the leg muscle size and ability to exercise, but even that did not fully restore the leg muscle strength. This study shows that:
 - * When muscles of young men are immobilized for two weeks, they lose strength equivalent to aging 40 or 50 years.
 - * As soon as you stop moving, your muscles start to weaken.
 - * The larger your muscles, the more muscle you have to lose.
 - * Younger and stronger people lose strength even faster than older people.
 Other studies show that it takes three times the amount of time you were inactive to regain the muscle size that you have lost, probably because you were immobilized 24 hours a day and you exercise for only a short time each day.
- Exercising as you age slows down the loss of maximum heart rate (*Med Sci Sports Exerc*, Jan, 2016;48(1):73-81). Keeping your maximum heart rate up means that your heart is stronger which allows an individual to exercise faster and longer. Exercising as you age can also prolong your life and help prevent heart attacks, cancers, strokes, diabetes, overweight and more.
- Exercise in older people is associated with a slower rate of decline in thinking skills that occurs with aging. People who reported light to no exercise experienced a decline equal to 10 more years of aging as compared to people who reported moderate to intense exercise, according to a population-based observational study. (March 23, 2016, online issue of *Neurology*.)
- A study shows the mechanism through which high-intensity interval training strengthens muscles and helps slow down the expected loss of muscles with aging (*PNAS*, November 6, 2015). It shows that high-intensity interval exercise increases maximal oxygen use by changing how muscle cells manage calcium.
- A study compared continuous exercise with intermittent exercise in rats (*Experimental Gerontology*, published online November 3, 2015). The interval exercise reduced inflammation in blood and skeletal muscles and helped to strengthen young rats and preserve strength in aging rats.
- In a small study researchers found that, after age 40, those who had been active had visibly younger looking skin, similar to that of someone in their 20s or 30s, even if the participant was over the age of 65. (Presented at The American Medical Society for Sports Medicine, April 2014)
- Older people who move around live longer than those who are consistently sedentary, and sedentary older people who become more active live longer than those who remain sedentary (*Med & Sci in Spts & Ex*, Aug 2013;45(8):1501-1507).
- Paul T. Williams, a statistician at Lawrence Berkeley National Laboratory, has followed almost 40,000 men and women who walk for exercise for more than 10 years. His latest report shows that the faster you walk, the longer you live (*PLoS One*, December, 2013). Picking up the pace is more healthful than just walking slowly, even if you go longer than the recommended 30 minutes per day. In his study group, those who walked at a very slow pace (24 minutes per mile) were 44 percent more likely to die in 10 years than those who walked at a faster pace.
- 14,811 women and 45,078 men were followed for 17 years. Those with the best performance on the maximal treadmill exercise test were far less likely to die in that period or suffer dementia (*Med Sci Sports Exerc*, 2012 Feb; 44 (2):253-9).
- A study led by Dr. Dean Ornish followed 35 men with low-risk prostate cancer for five years. Ten of the men were given a special lifestyle plan with weekly instructions for several months, while 25 were informed of the lifestyle changes but not put in special discussion groups or lectures. The lifestyle-change group increased their

telomere length by an average of 10 percent, while the control group had telomere shrinkage of three percent (*The Lancet Oncology*, published online September 17, 2013). Telomere Length Predicts How Long a Cell Will Live.

The program followed by the lifestyle-change group included:

- * A low-fat, low-refined carbohydrate diet, with unprocessed, plant-based whole foods;
- * Walking for thirty minutes six days a week;
- * Managing stress with yoga, meditation, stretching, breathing and relaxation;
- * Attending a support group for one hour each week.
- As you age, expect your muscles to become smaller and weaker. Because of this, you lose strength and mobility. You walk slower, tire earlier, lose coordination and are at increased risk for falling, breaking bones, and injuring yourself. Lack of exercise is the main reason for the progressive weakness of aging (*Exerc Sport Sci Rev*, July, 2013;41(3):169-173). The most effective way to maintain muscle strength as you age is to exercise against resistance.
- A review article from The Netherlands shows that:
 - * All men and women lose muscle as they age;
 - * All men and women make new protein in their muscles in response to exercising and eating protein;
 - * Older people cannot grow muscle as much or as rapidly as younger people do in response to exercising and eating protein;
 - * The only known way to prevent loss of muscle with aging is to exercise against progressive resistance; and
 - * Muscle growth in aging is enhanced markedly by taking protein and carbohydrates immediately after heavy exercise (*Ex and Spts Sciences Reviews*, July 2013;41(1):169-173).
- Virtually all studies on the subject show that reducing calories can prolong the lives of yeast, insects and animals. However a recent study shows that restricting calories in fruit flies and preventing them from exercising does not prolong their lives (*Cell Metabolism*, July 3, 2012).
- Those who exercised at least one hour per week had a 33 percent lower risk of death during that period. Those who exercised intensely had even greater protection. (*American Journal of Public Health*, April, 2012; 102(4):698-704).
- People who exercise regularly are far less likely to suffer dementia and had less than half the risk of death during the 17-year study period, compared to those who do not exercise (*Medicine & Science in Sports & Exercise*, February, 2012).
- Men who were physically fit in their 40s and continued to exercise regularly ten years later are 30 percent less likely to die and 44 percent less likely to die from heart attacks than men who do not exercise (*Circulation*, December 2, 2011;124:2483-2490).
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- Competitive masters athletes, 40 to 81 years of age, who trained four to five times per week did not lose any muscle size or significant strength with aging. This shows that loss of muscle size and strength in older people is caused by lack of exercise, not just with aging. (*The Physician and Sportsmedicine*, October, 2011; 39(3):172-8).
- Rats that had greater endurance, as shown by their genetic ability to run longer on a treadmill, lived 24 to 48 percent longer than those who have less endurance on a treadmill, (*Circulation Research*, Epub September 2011).

- Middle-aged people are 63 percent less likely to die within 18 years if they avoid smoking, eat a low-fat and low-sugar diet, **exercise regularly**, and drink alcohol moderately (*American Journal of Public Health*, published online August 18, 2011).
- People who suffer from arthritis need to exercise regularly because lack of exercise damages joints (Arthritis Care & Research, January 2011). Even people with severe joint disease, such as rheumatoid arthritis, need to exercise (*Journal of Aging Research: Aging, Physical Activity and Disease Prevention*, 2011).
- Tour de France Cyclists live 17 percent longer than people who do not participate in strenuous exercise (*International Journal of Sports Medicine*, August 2011). This supports other studies that show that endurance exercisers live more than 12 years longer than those who do not exercise (*British Journal of Sports Medicine*, March 2008).
- Exercising helps to prevent loss of mitochondria and even makes them larger (*Exercise and Sport Sciences Reviews*, April, 2007).
- Hundreds of articles show that exercise promotes every marker for longevity. It enlarges telomeres, increases size and number of mitochondria and helps to prevent disease. It prevents a high rise in blood sugar, lowers triglycerides and empties fat from both fat and muscle cells (*e-zone*, May 29, 2011).
- Exercise prevents aging in mice programmed to grow old rapidly (*The Proceedings of the National Academy of Sciences*, September 22, 2010). The exercising mice did not have the expected shrinkage with aging of their brains, hearts, muscles, skin, hair, ovaries, testicles, spleen, kidneys, and liver.
- Being even a little bit overweight shortens your life and the heavier you are the more likely you are to die of cancer and heart attacks (*New England Journal of Medicine*, December 2, 2010).
- Exercise prolongs life and prevents heart attacks and cancers by causing the body to dispose of free radicals with increased production of antioxidants (*e-zone*, September 19, 2010).
- Longevity is determined a maximum of one-third by genetics and more than two-thirds by environmental factors (Swedish *Twin Study*, December 1998).
- Exercise prevents loss of the connections between nerves and the muscles that they innervate caused by aging (*Proceedings of the National Academy of Sciences*, published online August 29, 2010).
- After running a marathon, a person's lymphocytes live longer (*BMC Physiology*, May 2010).
- Exercisers live more than 12 years longer than those who do not exercise (*British Journal of Sports Medicine*, March 2008).
- Almost all people should do some form of strength training as they age. Aging causes loss of muscles which increases your risk for metabolic syndrome, diabetes, obesity, heart attacks and premature death (*Sports Medicine*, May 2010).
- A study following more than 100,000 runners for 20 years and has shown that training for a marathon dramatically reduces the high incidence of heart attacks, strokes, certain cancers, glaucoma, diabetes, cataracts, macular degeneration, gout, gall stones, diverticulitis, and many other ailments (*Medicine & Science in Sports & Exercise*, March 2009).
- 50-year-old men who ran more than 50 miles per week at a fast pace had telomeres (chromosome caps) that were almost the same length as those of 20-year-old runners on the German National Team, and more than 40 percent longer than those of inactive men of the same age (*Circulation*, December 2009). This is astounding because shortened telomeres represent aging.
- Running 40 miles per week can lower risk of stroke by 69 percent, heart attacks by 37 percent and diabetes by 68 percent. To prevent progressive weight gain with aging, the runners needed to add 1.4 miles a week each year (*Medicine & Science in Sports & Exercise*, March 2009).

- Sedentary people who start to exercise at age 85 are twice as likely to be living three years later than people of the same age who remained sedentary (*Archives of Internal Medicine*, December 2009).
- A major cause of loss of muscle is that aging prevents muscles from responding to insulin and that exercising helps to slow this loss of muscle size and strength (*The American Journal of Clinical Nutrition*, September 2009).
- Lack of exercise is associated with obesity, diabetes, heart attacks, strokes, osteoporosis, and cancer. Exercising regularly more than halves your chance of dying prematurely (*Archives of Internal Medicine*, December 2007). Yet more than 50 percent of North Americans do not exercise.
- Men who start or increase their exercise programs after age fifty live longer than those who remain at their present activity levels, according to a study in the *British Medical Journal* (March 2009).
- Loss of coordination with aging is caused primarily by loss of strength (*Medicine and Science in Sports and Exercise*, February 2009).
- A review of the entire world's literature shows that endurance improves as you age, *Exercise and Sports Sciences Reviews* (January, 2009). Wow!
- Athletes who compete into their eighties suffer few medical problems, but those who lapse into inactivity regress toward the general population norms for fitness, weight control and health problems, (*Clinical Journal of Sport Medicine*, November 2008).
- Overwhelming data show that exercisers have lower rates of disability and death (*Arch Intern Med*, 2008;168(15):1638-1646), and are healthier and live more than seven years longer than non-exercisers (*Med Sci Sports Exerc.*, 1993;25(2):237-244).
- With aging, a man's testosterone blood levels drop, causing muscle to shrink and fat cells to fill (*Journal of the American Geriatrics Society*, September 2008).
- Exercise prevents cancers and helps to improve mental function with aging. Researchers from the University of Melbourne in Australia show that adults with memory impairment improve mental function after a six-month exercise program (*JAMA*, September 3, 2008).
- Exercise may help to prevent kidney damage that occurs with aging (*Clinical Journal of Sport Medicine*, May 2008).
- People who exercise regularly have telomeres in the DNA of their white blood cells that are longer than those of sedentary people. White blood cell telomeres shorten over time and serve as a marker of a person's biological age, *Archives of Internal Medicine* (January 28, 2008).

SPORT/PERFORMANCE

- A few minutes of high-intensity interval training makes you a better athlete by increasing your maximal ability to take in and use oxygen (max VO₂). (*PLoS One*, May 29, 2013;8(5):e65382; *J Cardiopulm Rehabil Prev*, Feb 13, 2014).
- Humans riding on bicycles are more energy-efficient than any other animal and any other form of transportation. Vance Tucker of Duke University compared bicyclists to humans and animals running, birds flying and fish swimming, as well as to people in motor-powered cars, boats, trains and planes (*J. Exp. Bio*, 1973;68(9):689-709). Here is a partial list, ranked from most to least energy-efficient: human on a bicycle, condor, salmon, horse, human in a jet plane, human walking, human running, human in an automobile, cow, sheep, dog.
- You do not have to lift very heavy weights to grow large muscles (PLoS ONE. August 10, 2010).

DIABETES

- In a study, researchers at the University of Liverpool in England asked 45 healthy active adult men and women who averaged walking more than 10,000 steps a day, to reduce their steps to fewer than 2,000 steps per day and to sit three and a half additional hours each day for two weeks (*Diabetologia*, Jun 2018;61(6):1282-1294). All of the participants had significant rises in blood sugar, lowered response to insulin, raised blood cholesterol, decreased leg muscle size and increased fat in their bellies.
- In a study, 22 diabetic, overweight adults (average age 69), who took 7000 or more steps a day, were asked to take fewer than 1000 steps a day for two weeks (*J Gerontol A Biol Sci Med Sci*, Jul 9, 2018;73(8):1070-1077). They all had changes predicting loss of muscle size and were less able to respond to insulin, and some had very high rises in blood sugar after meals. Most of the subjects did not have their markers of diabetes return to their more normal levels two weeks after they resumed their normal activity levels.
- Everyone should try to exercise every day because exercise helps to prevent diabetes and heart attacks by lowering high blood sugar and stabilizing plaques. A review of 12 studies shows that exercising within three hours after eating lowers blood sugar levels significantly because contracting muscles remove sugar from the bloodstream at a very high rate and don't even need insulin to do so (*Sports Medicine*, Feb 2, 2018;1-13).
- Recent studies show that the high blood sugar of diabetes is caused by excess fat in:
 - * the liver (*JAMA*, February 14, 2017),
 - * the muscles (*J Cardiovascular Pharmacology and Therapeutics*, April 2017) and
 - * the pancreas (*Diabetes Care*, December 2015).Diabetes can be treated and often cured with:
 - * exercise that removes fat from muscles (*Scandinavian Journal of Medicine & Science in Sports*, March 13, 2017;27(5)) and
 - * diets that remove fat from the liver and other organs (*Diabetologia*, 2011 Oct; 54(10): 2506–2514).
- A study from Finland shows that high-intensity interval training rapidly lowers blood sugar levels and increases a Type II diabetic's cell response to insulin (*Scan J Med & Science in Sports*, March 13, 2017;27(5)).
- Researchers at the Mayo Clinic showed that both weightlifting and cycling reversed some of the effects of aging on muscles (*Cell Metabolism*, March 2017;25(3):581–592). Both types of exercise increased:
 - * endurance,
 - * fitness level, and
 - * insulin-stimulated glucose uptake in both leg and arm muscles to lower high blood sugar levels.
- Nearly half of California adults, including one in every 3 young adults, are estimated to have undiagnosed diabetes or pre-diabetes which is a precursor to life threatening Type 2 diabetes. (UCLA Center for Health Policy Research, March, 2016)
- A study shows that having extra belly fat and low levels of fat everywhere else markedly increases risk for arteriosclerosis and premature death in diabetics (*Cardiovascular Diabetology*, 10/13/2015). This study shows that storing fat primarily in the belly is associated with a high degree of arteriosclerosis and death in diabetics, even if they did not have much fat underneath their skins in the rest of their bodies.
- In one recent study, intense short-interval exercise before meals lowered blood sugar more than a single 30-minute session of moderate exercise (*Diabetologia*, May 2014).

- A ground-breaking article from The Netherlands shows that lack of exercise is probably the most common cause of cell damage in diabetics today (*Medicine and Science in Sports and Exercise*, April, 2013).
- Men who exercised regularly stopped exercising for just one week. Both those who were lean and those who were overweight had rises in blood factors that are abnormal in diabetics (*Metabolism-Clinical and Experimental*, September 20, 2012).
- A study from the Mayo Clinic shows that slow walking after eating markedly reduces the rise in blood sugar levels after meals (*Diabetes Care*, published online Aug 8, 2012). A study from Japan shows that mild exercise after meals prevents the usual high rise in blood triglycerides after meals (*Medicine and Science in Sports and Exercise*, August 2012). Thus exercising after eating helps to protect your body from damage from high blood sugar levels.
- Reducing your physical activity by just 50 percent for just three days, without changing your diet, doubles the rise in blood sugar levels after meals (*Medicine & Science in Sports & Exercise*, June 2011).
- Researchers at the University of Massachusetts show that, after just one day of not exercising, your body loses some of its ability to respond to insulin (*Metabolism: Clinical and Experimental*, July 2011).
- Unlike resting muscles, contracting muscles do not require insulin to move sugar inside their cells (*Journal of Applied Physiology*, July 2005).
- Contracting muscles remove sugar maximally from the bloodstream, without needing insulin, during & up to one hour after exercise. The effect tapers off to zero at about 17 hours (*Journal of Applied Physiology*, February 2010).
- "Fasted training is more potent than fed training to facilitate adaptations in muscles and to improve whole-body glucose tolerance and insulin sensitivity" (*Journal of Physiology*, November 2010).
- Diabetes is controlled better by a combined program of lifting weights and walking on a treadmill than if people just lift weights or just walk (*Journal of the American Medical Association*, November 24, 2010).
- Taking sugar when you exercise is good for you (*e-zone*, October 3, 2010).
- The more intensely an individual exercises, the better his/her body responds to insulin. Even those who do not improve their exercise capacity are able to markedly improve their body's ability to respond to insulin (*European Journal of Internal Medicine*, October 2010).
- Exercise helps to control blood sugar while you do it and for a few hours afterwards (*Journal of Applied Physiology*, February 2010).
- A study of active National Football League players shows that even though they are very heavy, they have lower fasting blood sugar levels than the average American (*JAMA*, June 1, 2009). This agrees with other studies that show that exercise helps to prevent diabetes.
- Almost all obese men will eventually become diabetic (*Circulation*, December 2009).
- Intense exercise is far more effective than casual exercise in preventing and treating diabetes (*Circulation*, July 2008).
- Vigorous exercise can help to prevent and to treat diabetes, (*American Journal of Physiology - Regulatory, Integrative and Comparative Physiology*, April 2008).

WEIGHT

- Researchers at Boston University and Harvard reviewed three studies following more than 225,000 adults over age 50, for eight to twenty years, and showed that being even slightly overweight can increase your risk of dying by 6 percent, and in those who are obese, by a whopping 73 percent (*Annals of Internal Medicine*, April 3, 2017). The main causes of death are heart and lung disease and cancers and the

more overweight you are, the greater your chance of dying prematurely. Two thirds of adult North Americans are at increased risk of dying prematurely because they are overweight.

- One third of U.S. adults are overweight and another third are obese (*Centers for Disease Control and Prevention, 2017*).
- A study from Ireland shows that exercise may help to control weight by increasing the number and types of bacteria in your intestines (*Gut*, published online June 9, 2014). Other studies show that people with many different types of bacteria and large numbers of bacteria in their intestines are thinner and healthier, and have less diabetes or heart attacks.
- The 2008 National Health and Nutrition Examination Survey (NHANES) showed that 68 percent of U.S. adults age 20 years and older, were overweight (excess body fat). The number in 1994 was 56 percent. Now the estimates run as high as 80 percent. Excess weight has been associated with increased risk for the following types of cancers: Colon and rectum, Breast (after menopause), Endometrium (lining of the uterus), Kidney, Esophagus, Pancreas, Thyroid, Gall Bladder, Prostate, Ovary, Liver,
- You need lots of exercise each week to prevent the weight gain that usually comes with aging. A study measuring the exercise programs of more than 19,000 adults for 20 years or more shows that the people most likely to avoid significant weight gain with aging are those who exercise more than the current recommended amounts (*British Journal of Sports Medicine*, published online April 29, 2014).
- The *American Institute for Cancer Research* has released a report showing that being overweight is a "probable" cause of ovarian cancer (February 11, 2014). Obesity is also associated with cancers of the colon, pancreas, kidney, uterus, esophagus, gallbladder and thyroid and postmenopausal breast cancer.
- A review of 35 studies shows that continuous aerobic exercise is far more effective than lifting weights in reducing belly fat (*Obesity Reviews*. January, 2012; 13 (1):68-91).
- You will lose the most belly fat by exercising intensely in any sport (*Medicine and Science in Sports and Exercise*, November 2008).
- Dieting without exercise does not work, (*NEJM*, July 17, 2008).

CARDIOVASCULAR

- Exercise Helps You to Live Longer, Even If You Already Have Heart Disease. Another new study reviewed 30 years of records of 3,307 adults who had had heart attacks or angina (pain from blocked arteries leading to the heart). Those who exercised at least a little bit were 36 percent less likely to die during the study period (*J of the Am Coll of Card*, March 2018;71(1)). Weight loss without exercising did not reduce their death rate. This study agrees with another study of more than 15,000 heart disease patients that also showed that exercise helps to prevent death in people who have already had heart attacks (*J of the Am Coll of Card*, October 2017;70(14)).
- A recent study of almost 30,000 older women followed for 12 years shows that those who did strength training had fewer deaths from heart attacks and all causes than those who did not lift weights (*J Am Heart Assoc*, Oct 31, 2017;6(11)).
- A study that followed 80,306 adults for two years shows that people:
 1. Doing strength training at least twice a week by lifting weights or using weight machines are at 20 percent reduced risk for dying from cancers and from all causes.
 2. Doing aerobic exercise for 2.5 hours per week had a 20 percent reduced chance of dying from heart attacks and all causes, and
 3. Doing both strength training and

aerobic exercises had a 30 percent reduced rate of death from cancers and all causes (*Am J Epidemiol*, Dec 12, 2017).

- Men over 60 performed 12 weeks of resistance training involving bending and straightening the knees against resistance, three sets of 10 repetitions a day, two days a week. They increased their ability to move heavy weights by 16 percent and they had higher blood levels of nitric oxide, which relaxes and opens arteries to increase blood flow to the heart and helps to prevent heart attacks (*Br J Sports Med*, 2006 Oct; 40(10):867-9).
- A study of 10,500 men who weight trained for 20 minutes a day showed that they gained far less belly fat over 12 years than their aerobic-exercising but non-weight lifting countrymen (*Obesity*, Feb 2015;23(2):461-467).
- A study reviewing 13 placebo-controlled studies of the effect of lifting weights in later life on health showed reduced HBA1C (a blood test that measures cell damage caused by sugar stuck on cells), body fat and systolic blood pressure. Strength training did not affect total cholesterol, high-density cholesterol, low-density cholesterol, triglyceride or diastolic blood pressure (*Sports Medicine*, May 2010;40(5):397-415).
- In ten subjects tested after both intense resistance training and aerobic activity, there was increased blood flow to the heart and reduced blood pressure immediately after lifting heavy weights (*J Strength & Conditioning Research*, October 2010;24(10):2846-2852).
- Strength training reduced heart attack risk factors in men who had already had a heart attack (*Proc Bayl Univ Med Cent*, Jul 2006;19(3):246-248).
- Two recent breakthrough studies give the best explanation yet of how exercise helps to prevent heart attacks. Competitive older endurance athletes may have more plaques in their arteries than non-exercisers, but they have the type of plaques that are far less likely to break off and cause heart attacks (*Circulation*, April 27, 2017;136:138-148; May 2, 2017;136:126-137).
- Not exercising is a risk factor for atrial fibrillation (*Am J Cardiol*, 2012 Aug 1;110(3):425-32).
- A slow resting heart rate in an athlete generally indicates a strong heart, but apparently healthy men who do not exercise and have slow resting heart rates are at increased risk for atrial fibrillation (*Circ Arrhythm Electrophysiol*, Aug, 2013;6(4):726-31).
- Obesity is also a major risk factor for atrial fibrillation (*J Am Coll Cardiol*, Jul 7, 2015 and *JAMA*, 2004 Nov 24;292(20):2471-7). Elite endurance athletes are virtually never obese and they are unlikely to have high blood pressure, which is a major risk factor for atrial fibrillation (*J Am Soc Hypertens*, Mar 2015;9(3):191-6).
- A resting heart rate greater than 80 beats per minute is a strong predictor for future heart attacks, diabetes and even cancer. From 1974 to 2002, 53,322 healthy people were followed at the Cooper Clinic in Dallas, Texas. Those with a resting heart rate lower than 60 beats per minute were far less likely to suffer heart attacks or to die than those with a resting heart rate greater than 80 beats per minute (*Mayo Clinic Proceedings*, 12/12/2013). In one study, 58 obese men and women exercised five times a week at 70 percent of maximum heart rate for 45 minutes. In just 12 weeks they lowered their resting heart rates by five to nine beats per minute (*Br J Sports Med* 2009; 43: 924-927).
- Researchers at the London School of Economics, Harvard and Stanford analyzed data from 305 trials involving 339,274 people. They found that exercise is at least as effective as drugs in preventing diabetes, and second heart attacks, and is more effective in preventing death from strokes (British Medical Journal, published online October 2013). Drug treatments in these studies included statins and beta blockers to prevent heart attacks, and anticlotting and antiplatelet drugs to prevent strokes.

- A new study shows that forty minutes of intense exercise, three times a week for 10 weeks: increased VO₂max, lowered blood pressure, lowered blood sugar levels, reduced body fat, and lowered total cholesterol, the bad low-density lipoprotein (LDL) cholesterol, and the oxidized LDL cholesterol that forms plaques in arteries. (*PLOS One*, June 4, 2013). VO₂max measures the maximal ability to take in and use oxygen. It is a measure of fitness level that also predicts how long a person is likely to live (*Med Sci Sports Exerc* 1999;31: S646–662).
- Exercise is at least as beneficial as statins in preventing heart attacks. Statins reduce heart attack risk by 10 to 20 percent for every drop of 40 mg/dL in LDL levels. Regular exercise can reduce your chances of dying from a heart attack by as much as 50 percent. (*The Journal of the American College of Cardiology*, published online May 22, 2013).
- The Copenhagen Male Study followed the health of 3000 men for 16 years and found that the higher the resting heart rate, the more likely that person is to die (*Heart*, Apr 17, 2013). Compared to a resting heart rate of 50 beats per minute, a resting heart rate of 71 to 80 beats/min was associated with a 50 percent increased risk of death, 81 to 90 beats/min was associated with a 100 percent increased risk, and over 90 beats/min was associated with a 150 percent increased risk. Exercise lowers heart rate and helps to prevent death from a heart attack (Aerobics Center Longitudinal Study, *Circulation*, Dec. 5, 2011;124: 2483-2490).
- Sudden cardiac death among marathoners is very rare, with one event per 100,000 participants. This is due to these benefits of exercise:
 - * Increases the good HDL cholesterol
 - * lowers triglycerides
 - * treats obesity
 - * lowers high blood pressure
 - * Improves insulin sensitivity
 - * lowers blood sugar
 - * strengthens arteries
 - * helps with smoking cessation
 - * reduces psychological stress
 - * lowers hematocrit and blood viscosity
 - * expands blood volume
 - * prevents clotting
 - * increases blood flow to the heart
 - * increases collateral circulation to the heart
 - * increases tolerance of decreased blood flow to the heart
 - * reduces atherosclerosis
 - * enlarges arteries leading to the heart
 - * reduces major sickness and death
 (Med Sci Sports Exerc. 2012;44(6):990-994; N Engl J Med. 2012;366(2):130-140).
- Intense exercise lowers high blood pressure (*Journal of Sports Sciences*, June 2012).
- Those who exercised at least one hour per week had a 33 percent lower risk of death during that period. Those who exercised intensely had even greater protection. (*American Journal of Public Health*, April, 2012; 102(4):698-704).
- Men who were physically fit in their 40s and continued to exercise regularly ten years later are 30 percent less likely to die and 44 percent less likely to die from heart attacks than men who do not exercise (*Circulation*, December 2, 2011;124:2483-2490).
- People whose heart rates increased from under 70 beats per minute to more than 85 beats per minute over 10 years had a 90 percent increased chance of dying from heart disease, compared to people whose heart rates stayed under 70 beats per minute (*Journal of the American Medical Association*, December 21, 2011). Exercise lowers and maintains resting heart rate.

- Exercise can prevent a rise in blood pressure from salt, (presented at the American Heart Association Scientific Sessions, March 2011).
- "JUST ONE DAY OF EXERCISE CAN PROTECT THE HEART AGAINST...(A HEART ATTACK).... and this protection is upheld with months of exercise, making exercise one of the few sustainable preconditioning stimuli" (*Journal of Applied Physiology*, September 2011). WOW!
- People who do not exercise, or exercise only occasionally, have a higher risk of suffering a heart attack during exercise or making love (JAMA, March 23/30, 2011).
- Men who spent more than 23 hours a week watching TV and sitting in their cars had a 64 percent greater chance of dying from heart attacks than those who sat for fewer than 12 hours a week (*Medicine and Science in Sports and Exercise*, May 2010).
- There is no evidence that intense exercise can damage a healthy heart. (*Journal of the American College of Cardiology*, April 2010).
- Short term, high-intensity interval training on a bike can provide you with all the health and fitness benefits of exercising than exercising less intensely for a much longer period of time (*The Journal of Physiology*, March 2010).
- Endurance training (swimming, cycling, running, walking, etc) lowers systolic blood pressure significantly, and there is no additional lowering from exercising at increased intensity. However, the more intensely a person exercises, the greater the lowering of resting heart rate (*Journal of Human Hypertension*, July 2009).
- High intensity interval training maximally improves every conceivable measure of heart function and heart strength. It also helps to prevent both the pre-diabetic metabolic syndrome and the heart damage it causes (*Exercise and Sports Sciences Reviews*, July 2009).
- High-intensity interval training raises the good HDL cholesterol far more than less intense exercise (*Journal of Strength and Conditioning Research*, March 2009).
- Resistance exercise may help prevent heart attacks (*Medicine & Science in Sports & Exercise*, February 2009).
- Athletes have lower maximum heart rates than sedentary people (*International Journal of Sports Medicine*, January 2008).
- Cycling to work has a positive influence on heart attack risk factors and is likely to improve the health-related quality of life in previously untrained healthy adults, (*Scandinavian Journal of Medicine & Science in Sports*, December 2007).

BACK

- People who run or walk regularly have healthier and stronger spinal discs than non-exercisers do (*Scientific Reports* 7, April 19, 2017).
- Scientists have known for hundreds of years that lack of exercise weakens muscles and bones, while exercise strengthens them (*Sports Med*, 2016;46:1165–1182).
- Several animal studies show that a regular exercise program strengthens discs (*Eur. Spine J*, 2011;20:1796–1812), makes discs larger and stronger (*Spine*, 2012;37:1440–1447) and strengthens discs in rat spines (*Spine*, 2010;35:1429–1436).
- There is data that a regular exercise program strengthens human discs and is probably the most effective means of treating many cases of back pain caused by weak or damaged discs (*Sports Med*, 2016;46:473–485).
- We also have strong MRI data that people who run or walk regularly have larger and stronger discs that contain more fluid to pad and protect them from injury (*Scientific Reports* 7, April 19, 2017).

GENERAL

- The SUN Study on 18,737 middle-aged people showed that those who exercise intensely have half the rate of heart attacks as those who did the same amount of exercise less intensely (*Am J of Cardiology*, Sept 11, 2018).
- Increased time spent exercising intensely gives adolescents a healthier metabolic profile than more time spent just exercising (*PLOS Medicine*, Sept 2018; 15 (9): e1002649).
- Exercise is healthful: Not exercising is worse for your health than smoking, diabetes or heart disease. The vigorous exercisers had nearly a 500 percent reduced risk of death during the study period, compared to the non-exercisers (*JAMA Network Open*, Oct 19, 2018;1(6):e183605).
- Just 20 minutes a day of regular exercise can reduce all of the markers of inflammation (*Brain, Behavior, and Immunity*, Mar 2017;61:60-68; *PLOS One*, Jan 17, 2018).
- Exercise increases the number of mitochondria in your cells that convert food to energy (*Ageing Res. Rev*, 2008;7:34B42), which increases the available energy for your body. The extra sources of energy increase the number of good colon bacteria that do not need to invade your cells. The increase in good bacteria suppresses the number of bad bacteria, and the good bacteria have enzymes that convert soluble fiber in plants to short chain fatty acids that dampen inflammation (*Front. Physiol*, May 19, 2017).
- Exercise is an anti-inflammatory lifestyle habit, while inactivity is pro-inflammatory. Exercise speeds up the breakdown of estrogen in a woman's body, while inactivity slows it down (*Medicine & Science in Sports & Exercise*, March 2016;48(3):439-448). Women with high estrogen levels are at increased risk for breast cancer.
- If you want to protect yourself from infections, exercise regularly and lose weight if you are overweight. A new study on mice shows how exercise helps to strengthen your immunity (*Sci Rep*, November 6, 2015;5:16364). Exercise that is vigorous enough to damage muscles stimulates the same immune cells that heal muscles to help your immunity respond to and kill invading germs.
- Casual exercise does not help prevent the increased risk for heart attacks and diabetes caused by spending more than 10 hours a day sitting (*Med & Sci in Spts & Ex*, Aug 2013;45(8):1493-1500). To protect yourself from the health consequences of sitting more than 10 hours a day, you need to stop sitting so much or exercise longer and more intensely to compensate for the hours spent sitting.
- 18,670 men and women, average age of 49 years were tested for fitness by their ability to continue exercising on a treadmill. Increasing levels of fitness were associated with far less likelihood to develop heart failure, heart attacks, strokes, diabetes, chronic lung or kidney disease, Alzheimer's disease, and colon or lung cancer (*Clin J Sport Med*, 2013 Nov;23(6):499-500).
- High intensity training (strength or aerobic) in the morning appears to not only increase metabolism, fat loss and overall health, but decreases interest in food (*Science Daily*, Sept. 12, 2012).
- Exercise helps to prolong life and prevent disease: Exercising, before, during or immediately after eating helps to prevent high rises in blood sugar and fat levels. High-intensity exercise is far more effective than less-intense exercise in preventing high rises in blood fat levels after a high-fat meal (*Clinical Science*, March 2012).
- Being over-fat damages every tissue in your body, including your brain (*e-zine*, February 26, 2012).
- According to *Lancet*, due to "the prevalence, global reach, and health effect of physical inactivity, the issue should be appropriately described as pandemic, with far reaching health, economic, environmental, and social consequences." Both the

United Nations and the World Health organization include physical inactivity as among the top four global health risks. (*Lancet*, 2012).

- Virtually all studies on the subject show that reducing calories can prolong the lives of yeast, insects and animals. However a recent study shows that restricting calories in fruit flies and preventing them from exercising does not prolong their lives (*Cell Metabolism*, July 3, 2012).
- Being over-fat damages every tissue in your body, including your brain (*e-zine*, February 26, 2012).
- A longitudinal study of 207 85-year old Japanese men and women showed that being strong and active in later life helps you live longer. For each increase of one kilogram in hand grip strength, a person had a 6 percent lower chance of dying and for each increase of one kilogram of leg extension force, a person had a 2 percent lower chance of dying. (*Archives of Gerontology and Geriatrics*, January, 2012; 54(1):28-33).
- Lifting weights before puberty makes children stronger and has not been shown to stunt growth or damage the growth plates in their bones (*Pediatrics*, November 2010).
- Exercising vigorously before going to bed does cause your body to produce large amounts of its own stimulants, adrenalin and noradrenalin that make your heart beat rapidly and raise body temperature, but this does not usually prevent you from falling asleep (*Clinics in Sports Medicine*, April 2005).
- Exercise does not increase the rate of knee damage in people with osteoarthritis, and usually reduces knee pain and disability (*Canadian Family Physician*, September 2009).
- Running in later life improves running capacity and speed, survival, and body fat content (*AJP-Regulatory, Integrative and Comparative Physiology*, July 2009).
- Intense exercise protects you from inflammation by raising blood levels of the antioxidants superoxide dismutase, glutathion peroxidase and glutathione S-transferase (*The Journal of Sports Medicine and Physical Fitness*, September 2008).
- Saturated fat risks are cancelled by exercise, (*British Journal of Sports Medicine*, July 2008).
- Interrupting an exercise program can cause you to gain weight that won't come off easily even after you resume training, (*Medicine & Science in Sports & Exercise*, February 2008).
- A better diet and exercise program is all that's needed to live better, even if you've had an unhealthy lifestyle in the past." (*American Journal of Clinical Nutrition*, December 2007).

METABOLIC SYNDROME

- Researchers followed 6,500 "apparently healthy" obese men and women, ages 25 to 64, for six to 10 years, and found that they were at high risk for diabetes and heart attacks (*Journal of Clinical Endocrinology & Metabolism*, published online November 20, 2013. The researchers defined "apparently healthy" as having normal blood pressure, fasting insulin levels, triglycerides, HDL (good) cholesterol, and blood sugar levels; no insulin resistance and low levels of LDL (bad) cholesterol. However, they found that all of these measures eventually tended to become abnormal, moving from "apparently healthy" to a diagnosis of metabolic syndrome. Study

author Dr. Carlos Lorenzo says: "All people who are obese face an increased risk of developing cardiovascular disease and diabetes in the future."

- After age 35, the more you exercise, the lower your fasting blood sugar levels, and the more protected you are from the side effects of high blood sugar levels, including dementia, heart attacks and certain cancers (*Ann Epidemiology*, July 13, 2012).
- Brisk walking halved a person's chances of suffering metabolic syndrome over a 10-year period, while leisurely walking up to an hour a day did not prevent metabolic syndrome (*British Medical Journal*, October 8, 2012).
- Exercise helps to prolong life and prevent disease: Exercising, before, during or immediately after eating helps to prevent high rises in blood sugar and fat levels. High-intensity exercise is far more effective than less-intense exercise in preventing high rises in blood fat levels after a high-fat meal (*Clinical Science*, March 2012).
- A study followed 1800 Swedish overweight men, from age 50 for 30 years and showed that almost all are at high risk for heart attacks and premature death (*Circulation*, December 2009). The authors showed that overweight men who originally did not have metabolic syndrome eventually suffered from metabolic syndrome, diabetes and heart attacks.

BRAIN

- Many studies show that having excess fat in your belly is associated with increased risk for dementia, but a new study shows that as a person ages, lack of muscle size and strength appears to be an even stronger predictor of dementia than having excess belly fat (*Clinical Interventions in Aging*, July 5, 2018;13).
- In this study the authors followed 353 men and women, average age 69, and found that those who had both excess body fat and small, weak muscles had the worst memory, speed in answering questions and executive function such as making intelligent decisions. Those who had the weakest and smallest muscles had even worse mental function than those who were just obese and did not have excessive muscle weakness. Another well-performed study of more than 5000 people, with an average age over 70, also found that low muscle size is associated with increased risk for dementia (*Age and Ageing*, March 2017;469(2):250–257).
- More than 80 percent of North Americans over the age of 85 suffer from some form of dementia. A new study in rats helps to explain why exercise could help to prevent or delay this dreaded condition (*Sci Rep*, 2017 Sep 7;7(1):10903).
- Rats that ran long distances on exercise wheels at their own choice of speeds had the greatest increase in nerves associated with memory, and the more miles they ran, the more their brains produced brain-derived neurotrophic factor (BDNF) that causes new brain nerves to grow (*J Physiol*, 2016 Apr 1; 594(7): 1855–1873).
- A study of 60 men and women, ages 65 to 85, had them ride an exercise bike for 20 minutes three times a week for 12 weeks. Those who exercised had no rise in brain levels of choline, while those who did not exercise had elevated levels (*Translational Psychiatry*, 2017; 7 (7): e1172). Choline levels rise with nerve cell damage such as is found in Alzheimer's disease.
- A review of hundreds of articles in the world's scientific literature showed that exercising older people have: far less loss of brain function with aging, less brain blood vessel damage, larger hippocampal brain size for better memory, less loss of brain tissue with aging, better spatial memory, better communication between brain nerves and improved ability to learn new facts (*Mayo Clin Proc*, 2011 Sep; 86(9): /876–884).

- Exercise appears to be one of the most effective treatments for brain- debilitating Parkinson's disease (*Neurology*, 2011 Jul 19;77(3):288-94.)
- UCLA researchers followed the physical activity and did brain MRIs of 3700 aging men and women, over 60 years of age, for more than 10 years and found that the most active people had a larger hippocampus, the part of the brain that controls short-term memory formation. The greatest benefit from exercise was seen in the people who were 75 or older (*J of Geron Ser A: Biol Sci and Med Sci*, August 2016).
- Canadian researchers analyzed brain scans of 330 healthy adults, ages 19 to 79, and showed that those who walked up and down stairs regularly had younger and larger brains compared to those who did not use stairs (*Neurobiology of Aging*, April 2016;40:138–144). They estimated that for every flight of stairs per day a person reduces brain age by half a year. Walking up stairs burns two to three times as many calories as walking on level surfaces.
- Overwhelming data show that regular exercise improves memory. Exercising muscles produce, and release into the bloodstream, a substance called cathepsin B (CTSB) that has been shown to increase memory and grow nerves in mice, monkeys and humans (*Cell Metabolism*, June 12, 2016). Many previous studies show that the higher the blood levels of CTSB, the greater the improvement in fitness level and memory. Researchers showed that after just one week of exercise, a normal mouse's memory improved dramatically. However mice who were genetically engineered to be unable to produce CTSB gained no memory improvement from exercise. Other exciting new studies are proceeding right now to find out if CTSB given to people will help to prevent or treat Alzheimer's amyloid plaques.
- Brain studies show that as you age, exercise helps to preserve:
 - * Memory (*Proc. Natl. Acad. Sci. U. S. A.*, 2011; 108(7): 3017–22)
 - * Brain size (*Psychol. Sci*, 2003; 14(2): 125–30; *J. Gerontol. A Biol. Sci. Med. Sci*, 2006; 61(11): 1166–70; *Hum. Brain Mapp*, 2013; 34(11): 2972–85)
 - * Blood flow to the brain (*Stroke*, 2013; 44(11): 3235–8; *J. Hypertens*, 2013; 31(12): 2400–9)
 - * Brain function in general (*J. Magn. Reson. Imaging*, 2013; 38(5): 1169–76)
 - * Brain function by preventing strokes (*Stroke*, 2003; 34(10): 2475–81)
 - * Brain function by preventing Alzheimer's disease (*Lancet Neurol*, 2014; 13(8): 788–94)
- A study showed that men and women who compete in sports in later life are smarter than people who do not compete (*Exercise & Sport Sciences Reviews*, October 2015;43 (4):181–189). The authors found that regular exercise improves brain health and function with aging by improving blood flow to the brain, brain structure, and brain function. The greater the intensity of the exercise, the greater the protection of brain health.
- More than 30 percent of dementia cases may be related to modifiable risk factors such as physical inactivity and all heart attack risk factors (*Lancet Neurol*, 2014; 13(8): 788–94).
- People who exercise into later life are smarter than those who do not exercise. A new study from King's College in London showed that of 162 healthy pairs of twins, ages 43 to 73, the ones with the strongest legs were the smartest (*Gerontology*, Nov 10, 2015).
- John J. Ratey, an associate clinical professor of psychiatry at Harvard Medical School, has called exercise "Miracle-Gro for the brain." (The Chronicle of Higher Education, Jan. 13, 2015).
- The authors of a recent study speculate that perhaps a major cause of dementia in North America is lack of exercise (*The Lancet Neurology*, 11/09/2014).
- Higher midlife fitness levels were associated with lower risk for suffering dementia later in life (*Arch Intern Med*, Sept 24, 2012;172(17):1333-40 and *Ann Intern Med*, 2013 Feb 5;158(3):162-8).

- Many of the benefits that exercise provides to muscles are also provided to your brain (*The Journal of Physiology*, February, 2012;590 (Pt3):607-16).
- People who exercise regularly are far less likely to suffer dementia and had less than half the risk of death during the 17-year study period, compared to those who do not exercise (*Medicine & Science in Sports & Exercise*, February, 2012).
- Many of the benefits that exercise provides to muscles are also provided to your brain (*The Journal of Physiology*, February, 2012;590 (Pt3):607-16).
- Exercise increases the size and number of mitochondria in the brains of mice (*American Journal of Physiology*, September 2011).
- Physical inactivity increases an American's chances of developing Alzheimer's disease by 21 percent, (San Francisco VA Medical Center study, 2011). Currently, an estimated 5.3 million are affected with the disease and by 2050 it is expected to triple, (*Lancet Neurology*, 2010).
- Exercise may produce new, positive addiction pathways in the brain that could counter negative addictive behaviors. (*Current Neuropharmacology*), March 2011.
- Exercise may be beneficial for stress and depression due to its effect on neurotransmitter synthesis. (*Neuro Endocrinology Letters*), 2010.
- Exercise helps to preserve brain function as you age (*The Journal of Applied Physiology*, November 2008).
- Exercise helps to prevent loss of mental function (*Applied Physiology, Nutrition and Metabolism*, October 2007).

BONE

- 85 percent of North American women over 50 years of age suffer from either low bone mineral density or osteoporosis (U.S. Department of Health and Human Services, Bone Health and Osteoporosis: A Report of the Surgeon General, 2004). The most effective way to prevent loss of bone with aging is to lift heavy weights. (*Journal of Strength & Conditioning Research*, March 2012; 26(3):867-872).
- 85 percent of North American women over 50 years of age suffer from either low bone mineral density or osteoporosis (U.S. Department of Health and Human Services, Bone Health and Osteoporosis: A Report of the Surgeon General, 2004). The most effective way to prevent loss of bone with aging is to lift heavy weights. (*Journal of Strength & Conditioning Research*, March 2012; 26(3):867-872).
- A review of 10 studies shows that the higher the level of competitive sports, the greater the bone density of female collegiate athletes (*J Am Board Fam Med*, November, 2011;24:728-34).
- Adolescent male athletes have much denser bones than non-athletes (*J Strength Cond Res*, November 11, 2011).
- Men and women who participate in high-impact sports at the ages when bones grow the most (10 to 30 years) gain the most bone, according to a review of the scientific literature reported in *Physical Medicine and Rehabilitation* (September, 2011;3(9):861-7).
- During a six-day bicycle race, the bones of world class bicycle racers become stronger (*Physiologie Appliquée, Nutrition et Métabolisme*, June 2010).
- Weight lifting and weight bearing sports strengthen bones, but a study from Thailand suggests that non-impact exercise such as swimming or cycling help to increase calcium absorption from the intestines (*American Journal of Physiology. Endocrinology and Metabolism*, April 2009).