PubMed Results: Benefits of Walking

J Gerontol A Biol Sci Med Sci. 2006 Nov;61(11):1166-70

Aerobic exercise training increases brain volume in aging humans.

Colcombe SJ, Erickson KI, Scalf PE, Kim JS, Prakash R, McAuley E, Elavsky S, Marquez DX, Hu L, Kramer AF. Beckman Institute, Department of Psychology, University of Illinois, 405 N. Mathews Ave., Urbana, IL 61801, USA.

BACKGROUND: The present study examined whether aerobic fitness training of older humans can increase brain volume in regions associated with age-related decline in both brain structure and cognition. METHODS: Fifty-nine healthy but sedentary community-dwelling volunteers, aged 60-79 years, participated in the 6-month randomized clinical trial. Half of the older adults served in the aerobic training group, the other half of the older adults participated in the toning and stretching control group. Twenty young adults served as controls for the magnetic resonance imaging (MRI), and did not participate in the exercise intervention. High spatial resolution estimates of gray and white matter volume, derived from 3D spoiled gradient recalled acquisition MRI images, were collected before and after the 6-month fitness intervention. Estimates of maximal oxygen uptake (VO2) were also obtained. RESULTS: Significant increases in brain volume, in both gray and white matter regions, were found as a function of fitness training for the older adults who participated in the aerobic fitness training but not for the older adults who participated in the stretching and toning (nonaerobic) control group. As predicted, no significant changes in either gray or white matter volume were detected for our younger participants. **CONCLUSIONS: These results suggest that cardiovascular fitness is associated with the sparing of brain tissue in aging humans. Furthermore, these results suggest a strong biological basis for the role of aerobic fitness in maintaining and enhancing central nervous system health and cognitive functioning in older adults.**

http://www.wtopnews.com/?nid=106&sid=977689 (news version)

Br J Sports Med. 2009 Jan;43(1):22-4. Epub 2008 Oct 16

Aerobic exercise effects on cognitive and neural plasticity in older adults.

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Older adults frequently experience cognitive deficits accompanied by deterioration of brain tissue and function in a number of cortical and subcortical regions. Because of this common finding and the increasing aging population in many countries throughout the world, there is an increasing interest in assessing the possibility that partaking in or changing certain lifestyles could prevent or reverse cognitive and neural decay in older adults. In this review we critically evaluate and summarize the cross-sectional and longitudinal studies that assess the impact of aerobic exercise and fitness on cognitive performance, brain volume, and brain function in older adults with and without dementia. We argue that six-months of moderate levels of aerobic activity are sufficient to produce significant improvements in cognitive function with the most dramatic effects occurring on measures of executive control. **These improvements are accompanied by altered brain activity measures and increases in prefrontal and temporal grey matter volume that translate into a more efficient and effective neural system.**

AJNR Am J Neuroradiol. 2009 Nov;30(10):1857-63. Epub 2009 Jul 9

The effect of exercise on the cerebral vasculature of healthy aged subjects as visualized by MR angiography.

Bullitt E, Rahman FN, Smith JK, Kim E, Zeng D, Katz LM, Marks BL.

Department of Surgery, University of North Carolina, Chapel Hill, NC, USA.

BACKGROUND AND PURPOSE: Prior studies suggest that aerobic exercise may reduce both the brain atrophy and the decline in fractional anisotropy observed with advancing age. It is reasonable to hypothesize that exercise-induced changes to the vasculature may underlie these anatomic differences. The purpose of this blinded study was to compare high-activity and low-activity healthy elderly volunteers for differences in the cerebrovasculature as calculated from vessels extracted from noninvasive MR angiograms (MRAs). MATERIALS AND METHODS: Fourteen healthy elderly subjects underwent MRA. Seven subjects reported a high level of aerobic activity (64 +/- 5 years of age; 5 men, 2 women) and 7, a low activity level (68 +/- 6 years of age; 5 women, 2 men). Following vessel segmentation from MRA by an individual blinded to subject activity level, quantitative measures of vessel number, radius, and tortuosity were calculated and histogram analysis of vessel number and radius was performed. RESULTS: Aerobically active subjects exhibited statistically significant reductions in vessel tortuosity and an increased number of small vessels compared with less active subjects. **CONCLUSIONS: Aerobic activity in elderly subjects is associated with lower vessel tortuosity values and an increase in the number of small-caliber vessels. It is possible that an aerobic exercise program may contribute to healthy brain aging. MRA offers a noninvasive approach to visualizing the cerebral vasculature and may prove useful in future longitudinal investigations.**

http://www.sciencedaily.com/releases/2009/06/090629132254.htm (news version)

Br J Sports Med. 2009 Jan;43(1):25-7. Epub 2008 Nov 19

Exercise and cognition in older adults: is there a role for resistance training programmes?

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In recent years, there has been a strong interest in physical activity as a primary behavioural prevention strategy against cognitive decline. A number of large prospective cohort studies have highlighted the protective role of regular physical activity in lowering the risk of cognitive impairment and dementia. Most prospective intervention studies of exercise and cognition to date have focused on aerobic-based exercise training. These studies highlight that aerobic-based exercise training enhances both brain structure and function. However, it has been suggested that other types of exercise training, such as resistance training, may also benefit cognition. The purpose of this brief review is to examine the evidence regarding resistance training and cognitive benefits. Three recent randomised exercise trials involving resistance training among seniors provide evidence that resistance training may have cognitive benefits. Resistance training may prevent cognitive decline among seniors via mechanisms involving insulin-like growth factor I and homocysteine. A side benefit of resistance training, albeit a very important one, is its established role in reducing morbidity among seniors. Resistance training specifically moderates the development of sarcopenia. **The multifactorial deleterious sequelae of sarcopenia include increased falls and fracture risk as well as physical disability. Thus, clinicians should consider encouraging their clients to undertake both aerobic-based exercise training and resistance training not only for "physical health" but also because of the almost certain benefits for "brain health".**

Neurology. 2008 Jul 15;71(3):210-6

Cardiorespiratory fitness and brain atrophy in early Alzheimer disease.

Burns JM, Cronk BB, Anderson HS, Donnelly JE, Thomas GP, Harsha A, Brooks WM, Swerdlow RH. Department of Neurology, Hoglund Brain Imaging Center, University of Kansas School of Medicine, 3599 Rainbow Blvd, MSN 2012, Kansas City, KS 66160, USA.

OBJECTIVE: To examine the correlation of cardiorespiratory fitness with brain atrophy and cognition in early-stage Alzheimer disease (AD). BACKGROUND: In normal aging physical fitness appears to mitigate functional and structural age-related brain changes. Whether this is observed in AD is not known. METHODS: Subjects without dementia (n = 64) and subjects with early-stage AD (n = 57) had MRI and standard clinical and psychometric evaluations. Peak oxygen consumption (VO(2)(peak)), the standard measure of cardiorespiratory fitness, was assessed during a graded treadmill test. Normalized whole brain volume, a brain atrophy estimate, was determined by MRI. Pearson correlation and linear regression were used to assess fitness in relation to brain volume and cognitive performance. RESULTS: Cardiorespiratory fitness (VO(2)(peak)) was modestly reduced in subjects with AD (34.7 [5.0] mL/kg/min) vs subjects without dementia (38.1 [6.3] mL/kg/min, p = 0.002). In early AD, VO(2)(peak) was associated with whole brain volume (beta = 0.35, p = 0.02) and white matter volume (beta = 0.35, p = 0.04) after controlling for age. Controlling for additional covariates of sex, dementia severity, physical activity, and physical frailty did not attenuate the relationships. VO(2)(peak) was associated with performance on delayed memory and digit symbol in early AD but not after controlling for age. In participants with no dementia, there was no relationship between fitness and brain atrophy. Fitness in participants with no dementia was associated with better global cognitive performance (r = 0.30, p = 0.02) and performance on Trailmaking A and B, Stroop, and delayed logical memory but not after controlling for age. **CONCLUSIONS: Increased cardiorespiratory fitness is associated with reduced brain atrophy in Alzheimer disease (AD). Cardiorespiratory fitness may moderate AD-related brain atrophy or a common underlying AD-related process may impact both brain atrophy and cardiorespiratory fitness.**

Proc Natl Acad Sci U S A. 2009 Dec 15;106(50):21401-6. Epub 2009 Dec 4

The transcriptional coactivator PGC-1{alpha} mediates exercise-induced angiogenesis in skeletal muscle.

Chinsomboon J, Ruas J, Gupta RK, Thom R, Shoag J, Rowe GC, Sawada N, Raghuram S, Arany Z. Cardiovascular Institute, Beth Israel Deaconess Medical Center, Harvard Medical School, 330 Brookline Avenue, Boston, MA 02215.

Peripheral arterial disease (PAD) affects 5 million people in the US and is the primary cause of limb amputations. Exercise remains the single best intervention for PAD, in part thought to be mediated by increases in capillary density. How exercise triggers angiogenesis is not known. PPARgamma coactivator (PGC)-1alpha is a potent transcriptional co-activator that regulates oxidative metabolism in a variety of tissues. We show here that PGC-1alpha mediates exercise-induced angiogenesis. Voluntary exercise induced robust angiogenesis in mouse skeletal muscle. Mice lacking PGC-1alpha in skeletal muscle failed to increase capillary density in response to exercise. Exercise strongly induced expression of PGC-1alpha from an alternate promoter. The induction of PGC-1alpha depended on beta-adrenergic signaling. beta-adrenergic stimulation also induced a broad program of angiogenic factors, including vascular endothelial growth factor (VEGF). This induction required PGC-1alpha. The orphan nuclear receptor ERRalpha mediated the induction of VEGF by PGC-1alpha, and mice lacking ERRalpha also failed to increase vascular density after exercise. **These data demonstrate that beta-adrenergic stimulation of a PGC-1alpha/ERRalpha/VEGF axis mediates exercise-induced angiogenesis in skeletal muscle.**

http://www.sciencedaily.com/releases/2009/12/091202101757.htm (news version)

Neurology. 2008 May 6;70(19 Pt 2):1786-94. Epub 2007 Dec 19

Physical activity (walking, stair climbing, etc.) and dementia risk in the elderly: findings from a prospective Italian study.

Ravaglia G, Forti P, Lucicesare A, Pisacane N, Rietti E, Bianchin M, Dalmonte E. Department of Internal Medicine, University Hospital S. Orsola-Malpighi, Via Massarenti, 9-40138 Bologna, Italy.

OBJECTIVE: To examine the effect of physical activity on risk of developing Alzheimer disease (AD) and vascular dementia (VaD) in the elderly. METHODS: Data are from a prospective population-based cohort of 749 Italian subjects aged 65 and older who, in 1999/2000, were cognitively normal at an extensive assessment for clinically overt and preclinical dementia and, in 2003/2004, underwent follow-up for incident dementia. Baseline physical activity was measured as energy expenditure on activities of different intensity (walking, stair climbing, moderate activities, vigorous activities, and total physical activity). RESULTS: Over 3.9 +/- 0.7 years of follow-up there were 86 incident dementia cases (54 AD, 27 VaD). After adjustment for sociodemographic and genetic confounders, VaD risk was significantly lower for the upper tertiles of walking (hazard ratio [HR] 0.27, 95% CI 0.12 to 0.63), moderate (HR 0.29, 95% CI 0.12 to 0.66), and total physical activity (HR 0.24, 95% 0.11 to 0.56) compared to the corresponding lowest tertile. The association persisted after accounting for vascular risk factors and overall health status. After adjustment for sociodemographic and genetic confounders, AD risk was not associated with measures of physical activity and results did not change after further adjustment for vascular risk factors and overall health and functional status. **CONCLUSIONS: In this cohort, physical activity (walking, stair climbing, etc.) is associated with a lower risk of vascular dementia but not of Alzheimer disease. Further research is needed about the biologic mechanisms operating between physical activity and cognition.**

http://www.aan.com/press/index.cfm?fuseaction=release.view&release=568 (news version)

Stroke. 2008 Dec;39(12):3341-50. Epub 2008 Aug 28

Treadmill exercise (walking) activates subcortical neural networks and improves walking after stroke: a randomized controlled trial.

Luft AR, Macko RF, Forrester LW, Villagra F, Ivey F, Sorkin JD, Whitall J, McCombe-Waller S, Katzel L, Goldberg AP, Hanley DF. Department of General Neurology, University of Maryland, School of Medicine, Baltimore, MD, USA.

BACKGROUND AND PURPOSE: Stroke often impairs gait thereby reducing mobility and fitness and promoting chronic disability. Gait is a complex sensorimotor function controlled by integrated cortical, subcortical, and spinal networks. The mechanisms of gait recovery after stroke are not well understood. This study examines the hypothesis that progressive task-repetitive treadmill exercise (T-EX) improves fitness and gait function in subjects with chronic hemiparetic stroke by inducing adaptations in the brain (plasticity). METHODS: A randomized controlled trial determined the effects of 6-month T-EX (n=37) versus comparable duration stretching (CON, n=34) on walking, aerobic fitness and in a subset (n=15/17) on brain activation measured by functional MRI. RESULTS: T-EX significantly improved treadmill-walking velocity by 51% and cardiovascular fitness by 18% (11% and -3% for CON, respectively; P<0.05). T-EX but not CON affected brain activation during paretic, but not during nonparetic limb movement, showing 72% increased activation in posterior cerebellar lobe and 18% in midbrain (P<0.005). Exercise-mediated improvements in walking velocity correlated with increased activation in cerebellum and midbrain. CONCLUSIONS: T-EX improves walking, fitness and recruits cerebellum-midbrain circuits, likely reflecting neural network plasticity. This neural recruitment is associated with better walking. **These findings demonstrate the effectiveness of T-EX rehabilitation in promoting gait recovery of stroke survivors with long-term mobility impairment and provide evidence of neuroplastic mechanisms that could lead to further refinements in these paradigms to improve functional outcomes.**

http://www.medicalnewstoday.com/articles/119732.php (news version)

Am J Physiol Regul Integr Comp Physiol. 2009 Nov;297(5):R1452-9. Epub 2009 Aug 19

Aerobic exercise training improves whole muscle and single myofiber size and function in older women.

Harber MP, Konopka AR, Douglass MD, Minchev K, Kaminsky LA, Trappe TA, Trappe S. Human Performance Laboratory, Ball State University, Muncie Indiana 47306, USA.

To comprehensively assess the influence of aerobic training on muscle size and function, we examined seven older women (71 +/- 2 yr) before and after 12 wk of cycle ergometer training. The training program increased ($P < 0.05$) aerobic capacity by 30 +/- 6%. Quadriceps muscle volume, determined by magnetic resonance imaging (MRI), was 12 +/- 2% greater ($P < 0.05$) after training and knee extensor power increased 55 +/- 7% ($P < 0.05$). Muscle biopsies were obtained from the vastus lateralis to determine size and contractile properties of individual slow (MHC I) and fast (MHC IIa) myofibers, myosin light chain (MLC) composition, and muscle protein concentration. Aerobic training increased ($P < 0.05$) MHC I fiber size 16 +/- 5%, while MHC IIa fiber size was unchanged. MHC I peak power was elevated 21 +/- 8% ($P < 0.05$) after training, while MHC IIa peak power was unaltered. Peak force (Po) was unchanged in both fiber types, while normalized force (Po/cross-sectional area) was 10% lower ($P < 0.05$) for both MHC I and MHC IIa fibers after training. The decrease in normalized force was likely related to a reduction ($P < 0.05$) in myofibrillar protein concentration after training. In the absence of an increase in Po, the increase in MHC I peak power was mediated through an increased ($P < 0.05$) maximum contraction velocity (Vo) of MHC I fibers only. The relative proportion of MLC(1s) (Pre: 0.62 +/- 0.01; Post: 0.58 +/- 0.01) was lower ($P < 0.05$) in MHC I myofibers after training, while no differences were present for MLC(2s) and MLC(3f) isoforms. **These data indicate that aerobic exercise training improves muscle function through remodeling the contractile properties at the myofiber level, in addition to pronounced muscle hypertrophy. Progressive aerobic exercise training should be considered a viable exercise modality to combat sarcopenia in the elderly population.**

Hippocampus. 2009 Oct;19(10):1030-9

Aerobic fitness is associated with hippocampal volume in elderly humans.

Erickson KI, Prakash RS, Voss MW, Chaddock L, Hu L, Morris KS, White SM, Wójcicki TR, McAuley E, Kramer AF.

Department of Psychology, University of Pittsburgh, Pittsburgh, PA 15206, USA.

Deterioration of the hippocampus occurs in elderly individuals with and without dementia, yet individual variation exists in the degree and rate of hippocampal decay. Determining the factors that influence individual variation in the magnitude and rate of hippocampal decay may help promote lifestyle changes that prevent such deterioration from taking place. Aerobic fitness and exercise are effective at preventing cortical decay and cognitive impairment in older adults and epidemiological studies suggest that physical activity can reduce the risk for developing dementia. However, the relationship between aerobic fitness and hippocampal volume in elderly humans is unknown. In this study, we investigated whether individuals with higher levels of aerobic fitness displayed greater volume of the hippocampus and better spatial memory performance than individuals with lower fitness levels. Furthermore, in exploratory analyses, we assessed whether hippocampal volume mediated the relationship between fitness and spatial memory. Using a region-of-interest analysis on magnetic resonance images in 165 nondemented older adults, we found a triple association such that higher fitness levels were associated with larger left and right hippocampi after controlling for age, sex, and years of education, and larger hippocampi and higher fitness levels were correlated with better spatial memory performance. Furthermore, we demonstrated that hippocampal volume partially mediated the relationship between higher fitness levels and enhanced spatial memory. **Our results clearly indicate that higher levels of aerobic fitness are associated with increased hippocampal volume in older humans, which translates to better memory function.**

http://www.fitbrains.com/blog/2009/03/02/aerobic-exercise-hippocampal-volume-and-spatial-memory/

(news version)

Eur J Public Health. 2002 Sep;12(3):171-6

Physical activity and coronary heart disease in older adults. A systematic review of epidemiological studies.

Batty GD.

Epidemiology Unit, London School of Hygiene and Tropical Medicine, Keppel Street, London WC1E 7HT, UK.

BACKGROUND: While there is good evidence to suggest an inverse relation of physical activity and cardiorespiratory fitness with coronary heart disease (CHD) in middle-aged men and women, much less is known about this association in older adults. The purpose of this paper was to explore the relation of physical activity and cardiorespiratory fitness with CHD in older adults by reviewing relevant studies. METHODS: Publications were identified in two ways: i) conducting a PUBMED search from its inception in 1966 until January 2001; and ii) scrutinizing the reference sections of identified papers. RESULTS: Ten studies relating physical activity and two relating cardiorespiratory fitness in older people to CHD met the inclusion criteria. With one exception, the studies were observational in nature and the majority of these were of prospective cohort design. Most studies featured men only. Of the eleven studies that presented data on older men, eight reported an inverse relation between physical activity or cardiorespiratory fitness and CHD, and statistical significance was seen in five of these. There were too few data on older women to draw clear conclusions regarding the association in this group. **CONCLUSIONS: This review suggests that, in older adult men, physical activity and cardiorespiratory fitness are inversely related to CHD risk. This association is unlikely to be attributable to reverse causality or confounding. Except where such advice is contraindicated, older adult men may benefit from physical activity in terms of reduced CHD risk.**

Journal of the American Heart Association, June 2009

Exercise Training for Type 2 Diabetes Mellitus Impact on Cardiovascular Risk
A Scientific Statement From the American Heart Association

Thomas H. Marwick, MD, PhD, Chair; Matthew D. Hordern, PhD; Todd Miller, MD, FAHA; Deborah A. Chyun, RN, PhD, FAHA; Alain G. Bertoni, MD, MPH, FAHA; Roger S. Blumenthal, MD, FAHA; George Philippides, MD; Albert Rocchini, MD, FAHA; on behalf of the American Heart Association Exercise, Cardiac Rehabilitation, and Prevention
Committee of the Council on Clinical Cardiology; Council on Cardiovascular Disease in the Young; Council on Cardiovascular Nursing; Council on Nutrition, Physical Activity, and Metabolism; and the Interdisciplinary Council on Quality of Care and Outcomes Research

Conclusions

Exercise training in patients with T2DM is feasible, well tolerated, and beneficial. Individualized exercise prescription offers an ideal opportunity to account for both cardiac and noncardiac considerations in T2DM. To improve cardiovascular risk, it is recommended that patients with T2DM accumulate a minimum of 150 minutes per week of at least moderate-intensity and/or 90 minutes per week of at least vigorous-intensity cardiorespiratory exercise. In addition, resistance training should be encouraged. These guidelines can be achieved with varying contributions of moderate- to vigorous-intensity cardiorespiratory exercise. Patients should train on at least 3 nonconsecutive days each week to maximize benefits. Individual sessions should last for no less than 10 minutes. Sedentary behaviors should be minimized. Exercise training should be implemented longterm, with telephone exercise counseling identified as a strategy that is economical, practical, and effective. This counseling provides the opportunity to assess exercise levels, adjust exercise prescriptions, and provide motivation and support. Contact frequency can decrease over time, because maintenance of initial high-frequency contact may not be necessary.

http://circ.ahajournals.org/cgi/reprint/CIRCULATIONAHA.109.192521 (entire document)
http://www.sciencedaily.com/releases/2009/06/090608162541.htm (news version)

Med Sci Sports Exerc. 2007 Aug;39(8):1435-45

Physical activity and public health in older adults: recommendation from the American College of Sports Medicine and the American Heart Association.

Nelson ME, Rejeski WJ, Blair SN, Duncan PW, Judge JO, King AC, Macera CA, Castaneda-Sceppa C. John Hancock Center for Physical Activity and Nutrition, Tufts University, Boston, MA, USA.

OBJECTIVE: To issue a recommendation on the types and amounts of physical activity needed to improve and maintain health in older adults. PARTICIPANTS: A panel of scientists with expertise in public health, behavioral science, epidemiology, exercise science, medicine, and gerontology. EVIDENCE: The expert panel reviewed existing consensus statements and relevant evidence from primary research articles and reviews of the literature. PROCESS: After drafting a recommendation for the older adult population and reviewing drafts of the Updated Recommendation from the American College of Sports Medicine (ACSM) and the American Heart Association (AHA) for Adults, the panel issued a final recommendation on physical activity for older adults. **SUMMARY: The recommendation for older adults is similar to the updated ACSM/AHA recommendation for adults, but has several important differences including: the recommended intensity of aerobic activity takes into account the older adult's aerobic fitness; activities that maintain or increase flexibility are recommended; and balance exercises are recommended for older adults at risk of falls. In addition, older adults should have an activity plan for achieving recommended physical activity that integrates preventive and therapeutic recommendations. The promotion of physical activity in older adults should emphasize moderate-intensity aerobic activity, muscle-strengthening activity, reducing sedentary behavior, and risk management.**

http://www.acsm.org/AM/Template.cfm?Section=Home_Page&Template=/CM/ContentDisplay.cfm&ContentID=7789
(entire document)

Stroke. 2008 Dec;39(12):3341-50. Epub 2008 Aug 28

Treadmill exercise activates subcortical neural networks and improves walking after stroke: a randomized controlled trial.

Luft AR, Macko RF, Forrester LW, Villagra F, Ivey F, Sorkin JD, Whitall J, McCombe-Waller S, Katzel L, Goldberg AP, Hanley DF.

Department of General Neurology, University of Maryland, School of Medicine, Baltimore, MD, USA.

BACKGROUND AND PURPOSE: Stroke often impairs gait thereby reducing mobility and fitness and promoting chronic disability. Gait is a complex sensorimotor function controlled by integrated cortical, subcortical, and spinal networks. The mechanisms of gait recovery after stroke are not well understood. This study examines the hypothesis that progressive task-repetitive treadmill exercise (T-EX) improves fitness and gait function in subjects with chronic hemiparetic stroke by inducing adaptations in the brain (plasticity). METHODS: A randomized controlled trial determined the effects of 6-month T-EX (n=37) versus comparable duration stretching (CON, n=34) on walking, aerobic fitness and in a subset (n=15/17) on brain activation measured by functional MRI. RESULTS: T-EX significantly improved treadmill-walking velocity by 51% and cardiovascular fitness by 18% (11% and -3% for CON, respectively; $P<0.05$). T-EX but not CON affected brain activation during paretic, but not during nonparetic limb movement, showing 72% increased activation in posterior cerebellar lobe and 18% in midbrain ($P<0.005$). Exercise-mediated improvements in walking velocity correlated with increased activation in cerebellum and midbrain. **CONCLUSIONS: T-EX improves walking, fitness and recruits cerebellum-midbrain circuits, likely reflecting neural network plasticity. This neural recruitment is associated with better walking. These findings demonstrate the effectiveness of T-EX rehabilitation in promoting gait recovery of stroke survivors with long-term mobility impairment and provide evidence of neuroplastic mechanisms that could lead to further refinements in these paradigms to improve functional outcomes.**

AJNR Am J Neuroradiol. 2009 Nov;30(10):1857-63. Epub 2009 Jul 9

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Bullitt E, Rahman FN, Smith JK, Kim E, Zeng D, Katz LM, Marks BL.

Department of Surgery, University of North Carolina, Chapel Hill, NC, USA.

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Stroke. 2008 Nov;39(11):2950-7. Epub 2008 Aug 7

Cardiorespiratory fitness as a predictor of fatal and nonfatal stroke in asymptomatic women and men.

Hooker SP, Sui X, Colabianchi N, Vena J, Laditka J, LaMonte MJ, Blair SN. Department of Exercise Science, University of South Carolina, Columbia, SC 29208, USA

BACKGROUND AND PURPOSE: Prospective data on the association between cardiorespiratory fitness (CRF) and stroke are largely limited to studies in men or do not separately examine risks for fatal and nonfatal stroke. This study examined the association between CRF and fatal and nonfatal stroke in a large cohort of asymptomatic women and men. METHODS: A total of 46,405 men and 15,282 women without known myocardial infarction or stroke at baseline completed a maximal treadmill exercise test between 1970 and 2001. CRF was grouped as quartiles of the sex-specific distribution of maximal metabolic equivalents achieved. Mortality follow-up was through December 31, 2003, using the National Death Index. Nonfatal stroke, defined as physician-diagnosed stroke, was ascertained from surveys during 1982 to 2004. Cox regression models quantified the pattern and magnitude of association between CRF and stroke. RESULTS: There were 692 strokes during 813,944 man-years of exposure and 171 strokes during 248,902 woman-years of exposure. Significant inverse associations between CRF and age-adjusted fatal, nonfatal, and total stroke rates were observed for women and men (P trend<or=0.05 each). After adjusting for several cardiovascular disease risk factors, the inverse association between CRF and each stroke outcome remained significant (P trend<0.05 each) in men. In women, the multivariable-adjusted relationship between CRF and nonfatal and total stroke remained significant (P trend<or=0.01 each), but not between CRF and fatal stroke (P(trend)=0.18). A CRF threshold of 7 to 8 maximal metabolic equivalents was associated with a substantially reduced rate of total stroke in both men and women. **CONCLUSIONS: These findings suggest that CRF is an independent determinant of stroke incidence in initially asymptomatic and cardiovascular disease-free adults, and the strength and pattern of the association is similar for men and women.**

Am J Physiol Regul Integr Comp Physiol. 2009 Nov 18. [Epub ahead of print]

Endurance training enhances BDNF release from the human brain.

Seifert T, Brassard P, Wissenberg M, Rasmussen P, Nordby P, Stallknecht B, Adser H, Jakobsen AH, Pilegaard H, Nielsen HB, Secher NH.

Rigshospitalet, University of Copenhagen.

The circulating level of brain-derived neurotrophic factor (BDNF) is reduced in patients with major depression and type-2 diabetes. Since acute exercise increases BDNF production in the hippocampus and cerebral cortex, we hypothesized that endurance training would enhance the release of BDNF from the human brain as detected from arterial and internal jugular venous blood samples. In a randomized controlled study, twelve healthy sedentary males carried out three months of endurance training (n = 7) or served as controls (n = 5). Before and after the intervention, blood samples were obtained at rest and during exercise. At baseline, the training group (58 +/- 106 ng 100 g(-1) min(-1), mean +/- SD) and the control group (12 +/- 17 ng 100 g(-1) min(-1)) had a similar release of BDNF from the brain at rest. Three months of endurance training enhanced the resting release of BDNF to 206 +/- 108 ng 100g(-1) min(-1) ($P < 0.05$), with no significant change in the control subjects, but there was no training-induced increase in the release of BDNF during exercise. Additionally, eight mice completed a 5-week treadmill running training protocol that increased the BDNF mRNA expression in the hippocampus (4.5 +/- 1.6 vs. 1.4 +/- 1.1 mRNA/ssDNA; $P < 0.05$), but not in the cerebral cortex (4.0 +/- 1.4 vs. 4.6 +/- 1.4 mRNA/ssDNA) as compared to untrained mice. **The increased BDNF expression in the hippocampus and the enhanced release of BDNF from the human brain following training suggests that endurance training promotes brain health.**

Mayo Clin Proc. 2009 Sep;84(9):780-6

The association between cardiorespiratory fitness and risk of all-cause mortality among women with impaired fasting glucose or undiagnosed diabetes mellitus.

Lyerly GW, Sui X,. Department of Exercise Science, Arnold School of Public Health, University of South Carolina, Columbia, USA.

OBJECTIVE: To evaluate the independent and joint associations among cardiorespiratory fitness (CRF), body mass index, and risk of mortality from any cause among women with impaired fasting glucose (IFG) or undiagnosed diabetes mellitus (DM). PATIENTS AND METHODS: Female patients (N=3044; mean age, 47.4 years) with IFG or undiagnosed DM completed a maximal exercise treadmill test (between January 26, 1971, and March 21, 2001). The women had no history of a cardiovascular disease event or diagnosed DM at baseline. Cardiorespiratory fitness was defined categorically as low (bottom 20%), moderate (middle 40%), or high (upper 40%) according to previously published Aerobics Center Longitudinal Study guidelines. Body mass index was calculated as the weight in kilograms divided by the height in meters squared (kg/m(2)). RESULTS: During a 16-year follow-up period, 171 deaths occurred. There was an inverse association between CRF and all-cause mortality risk. Women with moderate or high CRF were at lower risk of mortality (moderate CRF, 35% lower; high CRF, 36% lower; P(trend)=.03) than those with low CRF. An exercise capacity lower than 7 metabolic equivalents was associated with a 1.5-fold higher risk of death than an exercise capacity of 9 metabolic equivalents or higher (P(trend)=.05). The multivariate adjusted hazard ratios (HRs), including adjustments for CRF, were higher for heavier patients than for patients of normal weight (overweight patients: HR, 0.86; 95% confidence interval, 0.57-1.30; obese patients: HR, 1.19; 95% confidence interval, 0.70-2.03; P(trend)=.84). Combined analyses showed that women who were overweight or obese and unfit (low CRF) were at more than twice the risk of death than women who were of normal weight and fit (moderate or high CRF). CONCLUSION: **Cardiorespiratory fitness, not body mass index, is a significant predictor of all-cause mortality among women with IFG or undiagnosed DM. Assessing CRF levels provides important prognostic information independent of traditional risk factors.**

JAMA. 2009 Jan 14;301(2):165-74

Treadmill exercise and resistance training in patients with peripheral arterial disease with and without intermittent claudication: a randomized controlled trial.

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CONTEXT: Neither supervised treadmill exercise nor strength training for patients with peripheral arterial disease (PAD) without intermittent claudication have been established as beneficial. OBJECTIVE: To determine whether supervised treadmill exercise or lower extremity resistance training improve functional performance of patients with PAD with or without claudication. DESIGN, SETTING, AND PARTICIPANTS: Randomized controlled clinical trial performed at an urban academic medical center between April 1, 2004, and August 8, 2008, involving 156 patients with PAD who were randomly assigned to supervised treadmill exercise, to lower extremity resistance training, or to a control group. MAIN OUTCOME MEASURES: Six-minute walk performance and the short physical performance battery. Secondary outcomes were brachial artery flow-mediated dilation, treadmill walking performance, the Walking Impairment Questionnaire, and the 36-Item Short Form Health Survey physical functioning (SF-36 PF) score. RESULTS: For the 6-minute walk, those in the supervised treadmill exercise group increased their distance walked by 35.9 m (95% confidence interval [CI], 15.3-56.5 m; P < .001) compared with the control group, whereas those in the resistance training group increased their distance walked by 12.4 m (95% CI, -8.42 to 33.3 m; P = .24) compared with the control group. Neither exercise group improved its short physical performance battery scores. For brachial artery flow-mediated dilation, those in the treadmill group had a mean improvement of 1.53% (95% CI, 0.35%-2.70%; P = .02) compared with the control group. The treadmill group had greater increases in maximal treadmill walking time (3.44 minutes; 95% CI, 2.05-4.84 minutes; P < .001); walking impairment distance score (10.7; 95% CI, 1.56-19.9; P = .02); and SF-36 PF score (7.5; 95% CI, 0.00-15.0; P = .02) than the control group. The resistance training group had greater increases in maximal treadmill walking time (1.90 minutes; 95% CI, 0.49-3.31 minutes; P = .009); walking impairment scores for distance (6.92; 95% CI, 1.07-12.8; P = .02) and stair climbing (10.4; 95% CI, 0.00-20.8; P = .03); and SF-36 PF score (7.5; 95% CI, 0.0-15.0; P = .04) than the control group. **CONCLUSIONS: Supervised treadmill training improved 6-minute walk performance, treadmill walking performance, brachial artery flow-mediated dilation, and quality of life but did not improve the short physical performance battery scores of PAD participants with and without intermittent claudication. Lower extremity resistance training improved functional performance measured by treadmill walking, quality of life, and stair climbing ability.**

http://www.sciencedaily.com/releases/2009/01/090113174426.htm (news version)

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Role of walking-exercise therapy after stroke.

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Stroke commonly leads to reduced mobility, which leads to deconditioning and a worsening of vascular risk factors, such as diabetes. The worsened risk profile leads to further strokes and disability--a vicious cycle for the stroke survivor. Exercise (walking) therapy may break this cycle by providing adequate stimuli for improving gait through plastic adaptation in the brain and through increasing fitness. Randomized, controlled data demonstrate the efficacy for gains in fitness and walking speed, the latter being related to lasting changes in activation patterns of the brainstem and cerebellum. Diabetes and muscle inflammation can also be improved by aerobic exercise training. The scope of this review summarizes these data and identifies unresolved issues related to optimization, intensity and maintenance of therapy effects**. Exercise should be an integral part of every rehabilitation program.**

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Treadmill exercise rehabilitation improves ambulatory function and cardiovascular fitness in patients with chronic stroke: a randomized, controlled trial.

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BACKGROUND AND PURPOSE: Physical inactivity propagates disability after stroke through physical deconditioning and learned nonuse. We investigated whether treadmill aerobic training (T-AEX) is more effective than conventional rehabilitation to improve ambulatory function and cardiovascular fitness in patients with chronic stroke. METHODS: Sixty-one adults with chronic hemiparetic gait after ischemic stroke (>6 months) were randomized to 6 months (3x/week) progressive T-AEX or a reference rehabilitation program of stretching plus low-intensity walking (R-CONTROL). Peak exercise capacity (Vo2 peak), o2 consumption during submaximal effort walking (economy of gait), timed walks, Walking Impairment Questionnaire (WIQ), and Rivermead Mobility Index (RMI) were measured before and after 3 and 6 months of training. RESULTS: Twenty-five patients completed T-AEX and 20 completed R-CONTROL. Only T-AEX increased cardiovascular fitness (17% versus 3%, delta% T-AEX versus R-CONTROL, P<0.005). Group-by-time analyses revealed T-AEX improved ambulatory performance on 6-minute walks (30% versus 11%, P<0.02) and mobility function indexed by WIQ distance scores (56% versus 12%, P<0.05). In the T-AEX group, increasing training velocity predicted improved Vo2 peak (r=0.43, P<0.05), but not walking function. In contrast, increasing training session duration predicted improved 6-minute walk (r=0.41, P<0.05), but not fitness gains. CONCLUSIONS: T-AEX improves both functional mobility and cardiovascular fitness in patients with chronic stroke and is more effective than reference rehabilitation common to conventional care. Specific characteristics of training may determine the nature of exercise-mediated adaptations.

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Walking decreased risk of cardiovascular disease mortality in older adults with diabetes.

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OBJECTIVE: This study examines the association of walking with mortality in persons with type 2 diabetes compared to those with normal glucose tolerance. STUDY DESIGN AND SETTING: This prospective study included community-dwelling adults from the Rancho Bernardo Study aged 50-90 years in 1984-86 who had type 2 diabetes (n=347) or normal glucose tolerance (n=1,317). During the 10-year follow up, Cox proportional hazards modeling was used to model time until death from all causes (n=538), coronary heart disease (CHD, n=143), other cardiovascular disease (non-CHD CVD, n=138), and other causes (n=257) while adjusting for multiple potential confounders. RESULTS: After adjusting for sex, age, smoking, body mass index, alcohol, exercise, history of CHD, and other covariates, adults with diabetes who walked > or =1 mile per day were half as likely to die from all causes combined (hazard ratio [HR]=0.54; 95% confidence interval [CI]: 0.33, 0.88), and less than one-fifth as likely to die from non-CHD CVD (HR=0.19; 95% CI: 0.04, 0.86) compared to adults with diabetes who did not walk. Walking was also protective among adults with normal glucose tolerance (HR=0.55; 95% CI: 0.32, 0.96). **CONCLUSION: Results suggest walking > or =1 mile per day may provide strong protection from all-cause and non-CHD CVD mortality in older adults with diabetes.**

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Maximal oxygen intake and independence in old age.

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This brief review examines the likelihood that a deterioration of aerobic fitness will lead to a loss of independence in old age. The rate of deterioration of maximal aerobic power observed in middle-aged adults continues unabated during the retirement years. Loss of independence seems likely if maximal oxygen intake falls below a threshold of 18 ml/[kg x min] in men and 15 ml/[kg x min] in women, reached at 80-85 years. **A regular programme of aerobic exercise can slow or reverse the functional deterioration, reducing the individual's biological age by 10 or more years, and potentially prolonging independence by a similar amount. There remains a need to clarify the importance of decreasing aerobic fitness relative to other potential causes of dependency but, from the practical viewpoint, regular aerobic activity should be commended to elderly people since it can address many of the issues of both functional loss and chronic disease.**

http://www.sciencedaily.com/releases/2008/04/080409205827.htm (news version)

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Independence: a new reason for recommending regular exercise to your patients.

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There are many good reasons to advise regular and adequate physical activity: longevity seems extended by up to 2 years, and the risk of a wide range of chronic disorders is substantially reduced. However, from the viewpoint of the overall, quality-adjusted lifespan, perhaps the most important reason is the ability of physical activity to counter the relentless, age-related decrease in physical capacity (maximal aerobic power, muscle strength, flexibility, and balance). The case is detailed for maximal aerobic power, which deteriorates by about 5 mL/ [kg.min] for each decade of adult life. **Independence is generally at risk when the maximal oxygen intake has dropped to 18 mL/ [kg.min] in men and 15 mL/ [kg.min] in women. A sedentary person typically reaches this threshold between 80 and 85 years old. However, regular physical activity can augment maximal oxygen transport by 5 to 10 mL/ [kg.min], setting back the need for institutional support by 10 to 20 years.**