

PROMUOVERE L'ATTIVITÀ FISICA: OBIETTIVO di SALUTE per TUTTI

Villa Doria D'Angri
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Attività fisica ed alimentazione:
quale ruolo nella prevenzione
del declino cognitivo

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Research over the past 5-10 years has provided evidence for the influence of physical activity and diet in preventing neurological diseases.

Physical Activity and Alzheimer's Disease: From Prevention to Therapeutic Perspectives

Yves Rolland, MD, PhD, Gabor Abellan van Kan, MD, and Bruno Vellas, MD, PhD

J Am Med Dir Assoc 2008; 9: 390–405)



ELSEVIER

Brain Research 886 (2000) 47–53

**BRAIN
RESEARCH
INTERACTIVE**

www.elsevier.com/locate/brain

Interactive report

Neuroprotective signaling and the aging brain: take away my food and let me run¹

Mark P. Mattson*

Review

Trends in Neurosciences Vol.32 No.5 **Cell**
PRESS

Exercise and the brain: something to chew on

Henriette van Praag

CLINICAL EVIDENCES

Physical activity and risk of neurodegenerative disease: a systematic review of prospective evidence

M. Hamer* and Y. Chida

Psychobiology Group, Department of Epidemiology and Public Health, University College London, UK

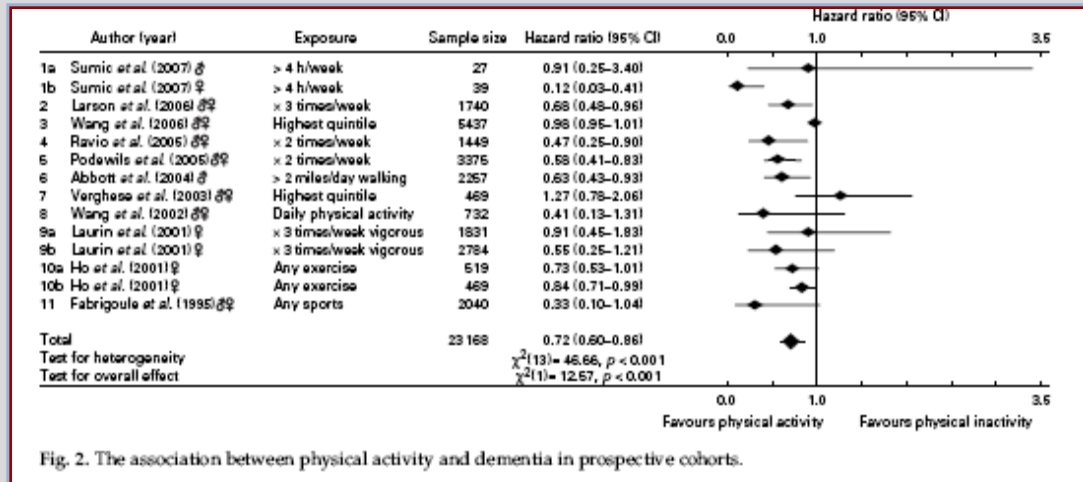


Fig. 2. The association between physical activity and dementia in prospective cohorts.

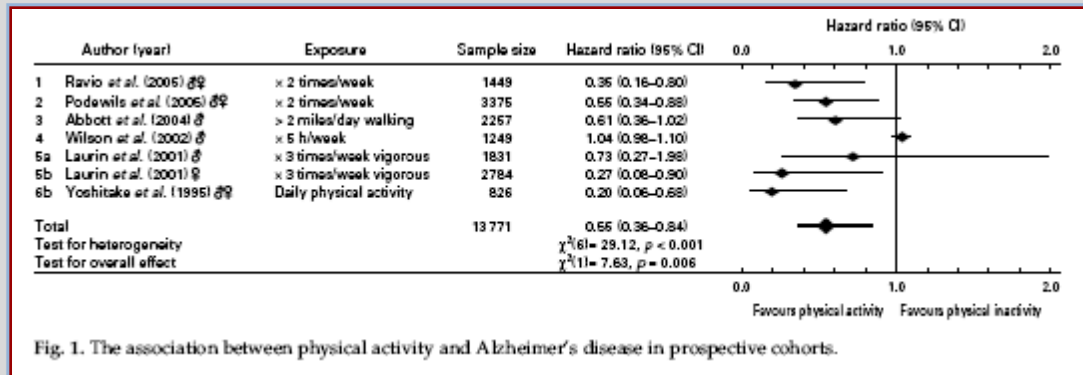


Fig. 1. The association between physical activity and Alzheimer's disease in prospective cohorts.

Physical activity and risk of neurodegenerative disease: a systematic review of prospective evidence

M. Hamer* and Y. Chida

Psychobiology Group, Department of Epidemiology and Public Health, University College London, UK

Results. We included 16 prospective studies in the overall analysis, which incorporated 163797 non-demented participants at baseline with 3219 cases at follow-up. We calculated pooled relative risk (RR) using a random effects model. The RR of dementia in the highest physical activity category compared with the lowest was 0.72 [95% confidence interval (CI) 0.60–0.86, $p < 0.001$], for Alzheimer's, 0.55 (95% CI 0.36–0.84, $p = 0.006$), and for Parkinson's 0.82 (95% CI 0.57–1.18, $p = 0.28$).

Conclusions. Our results suggest that physical activity is inversely associated with risk of dementia. Future studies should examine the optimal dose of physical activity to induce protection, which presently remains unclear.

From energy metabolism
to cognition



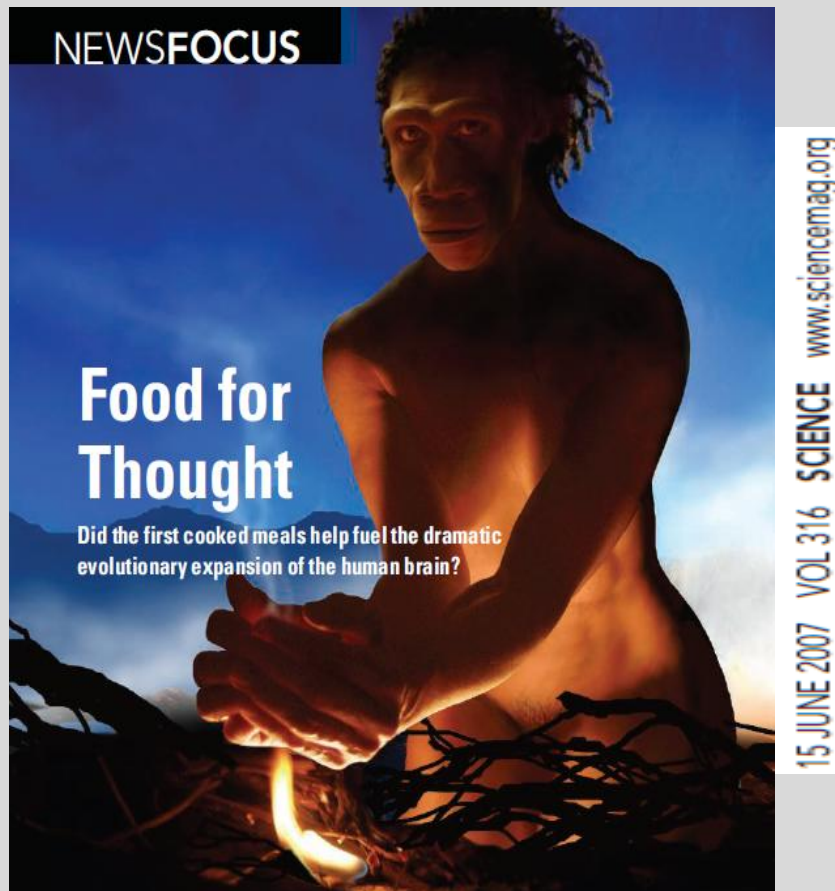
Sea squirt

"That which we call thinking is the evolutionary internalization of movement" (Llinas, 2001)

*“Diet, in conjunction with other aspects of daily living, such as **exercise**, has had a crucial role in shaping brain evolution and cognitive capacity”*

[F. Gomez-Pinilla, 2008]

Feeding habits have been intrinsically associated with the development of human civilization, as people's choice of what to eat is influenced by culture, religion and society.



The brain consumes an immense amount of energy relative to the rest of the body. Thus, adaptations that facilitated food acquisition and energy efficiency exerted strong evolutionary pressures on the energy-demanding development of cognitive skills.

Feeding as an adaptive mechanism for the development of cognitive skills



Paleontological evidence suggests that there is a direct relationship between brain size and access to food in terms of both quantity and quality.

It has been proposed that access to docosahexaenoic acid (DHA) during hominid evolution had a key role in increasing the brain/body-mass ratio.

[Crawford MA, et al. 1999]

NEUROBIOLOGICAL BASIS

MOLECULAR CROSSTALK BETWEEN MUSCLE AND CNS

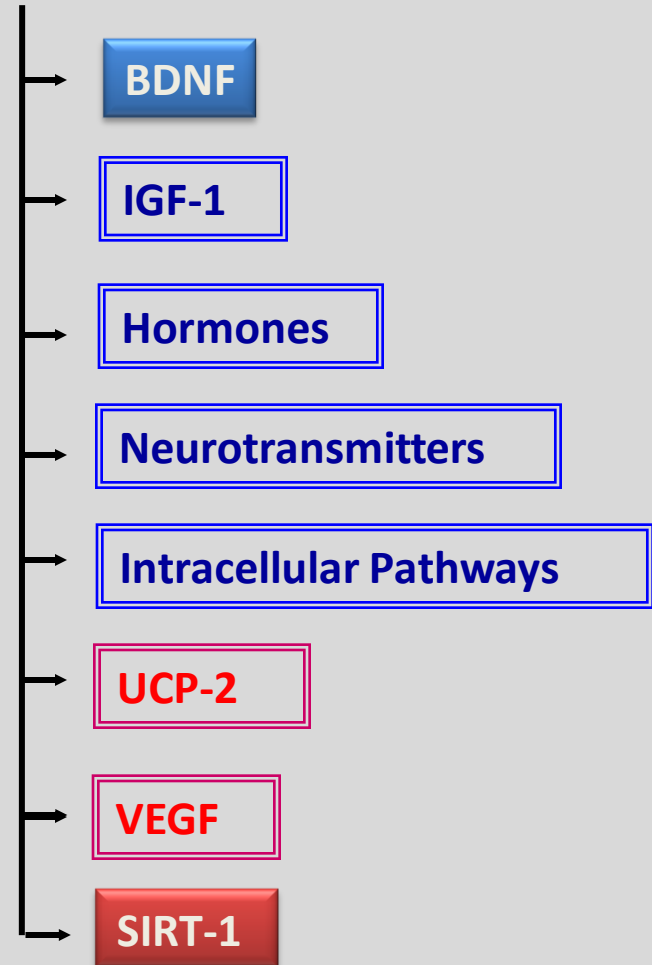
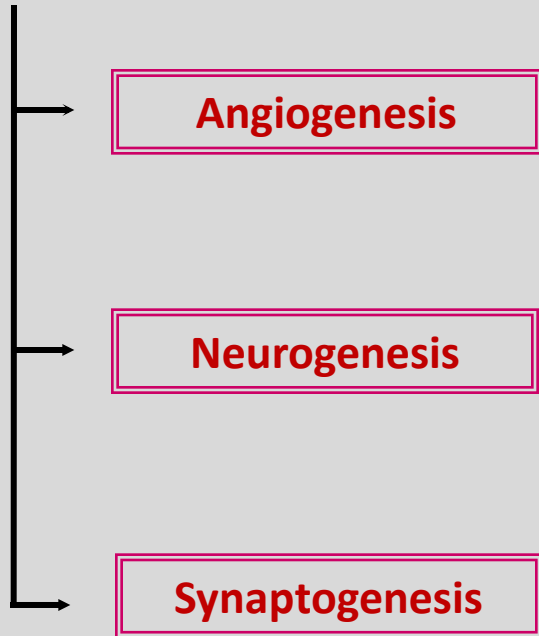
The functional relationship between CNS and its periphery has been traditionally regarded as a unidirectional downstream flow of information controlling muscle contraction.

Considering the crucial role of movement in the adaptability to the environment, it is plausible to assume the presence of a retrograde flow of information to the CNS.

NEUROBIOLOGICAL BASES

Supramolecular mechanisms

Molecular mechanisms



[Lista I & Sorrentino G, 2010]

Whereas the role of PA on neurogenesis is well established, synaptogenesis seems to be prevalently induced by cognitive stimuli such as those present in the experimental paradigm of EE. Nevertheless, a direct effect of PA on synaptogenesis has been reported.

Voluntary Exercise Alters the Cytoarchitecture of the Adult Dentate Gyrus by Increasing Cellular Proliferation, Dendritic Complexity, and Spine Density

BRENNAN D. EADIE,¹ VAN A. REDILA,² AND BRIAN R. CHRISTIE^{1-3*}

Effects of Exercise on Gene-Expression Profile in the Rat Hippocampus

Liqi Tong,¹ Hong Shen, Victoria M. Perreau, Robert Balazs, and Carl W. Cotman

In rats, spine density on dendrites in DG increased following exercise.

Using high-density oligonucleotide microarrays a large number of gene transcripts associated with synapses has been showed in the hippocampus of rats voluntary running.



ELSEVIER

Brain Research 726 (1996) 49–56

BRAIN
RESEARCH

Research report

Physical activity increases mRNA for brain-derived neurotrophic factor and nerve growth factor in rat brain

Shawne A. Neeper^{a,c}, Fernando Gómez-Pinilla^{b,c,*}, James Choi^c, Carl W. Cotman^{a,b,c}

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BDNF that is involved in neuroplasticity, neuroprotection, growth and differentiation.

Neeper et al. (1995) first observed that PA affects BDNF production in the brain. Surprisingly, the greatest effects of exercise on BDNF mRNA occurred in regions not directly related to the motor system but associated with cognitive function.

Brief Communication

Brain-Derived Neurotrophic Factor val⁶⁶met Polymorphism Affects Human Memory-Related Hippocampal Activity and Predicts Memory Performance

Ahmad R. Hariri, Terry E. Goldberg,* Venkata S. Mattay,* Bhaskar S. Kolachana, Joseph H. Callicott, Michael F. Egan, and Daniel R. Weinberger

Clinical studies also support the importance of BDNF in learning and memory in humans. A study conducted by Hariri et al. (2003) reported that individuals expressing a specific polymorphism in the BDNF gene exhibit learning impairments.

Brief Communication

Voluntary Exercise Decreases Amyloid Load in a Transgenic Model of Alzheimer's Disease

Paul A. Adlard, Victoria M. Perreau,* Viorela Pop,* and Carl W. Cotman

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Interestingly, BDNF shows large deficit in AD brain. In AD transgenic mice model it was reported that transcripts encoding BDNF are significantly upregulated in brain of mice exposed to EE and PA.

Diet and epigenetics

Diet and epigenetics

- Innovative studies indicate the exciting possibility that diet can influence epigenetic events (DNA methylation, transcriptional activation, translational control, post-translational modifications).
- These events can cause a potentially heritable phenotypic change.
- BDNF is particularly susceptible to epigenetic modification.

Diet and epigenetics

These studies represent a starting point for understanding how intracellular signaling that is triggered by lifestyle factors can promote lasting changes in DNA function in the brain and in cognitive capacity.

Diet and epigenetics

- Silent information regulator 2 (SIRT2), a member of the sirtuin protein family, has emerged as an important modulator of genomic stability that seems to act by silencing the function of specific genes.
- A diet high in saturated fat reduces the expression of SIRT2 in the rat hippocampus, whereas a diet high in omega-3 fatty acids has the opposite effect.

[Wu A, 2007]



TRENDS in Cognitive Sciences

Physical activity and cognition



Invariant object cognition

Moral judgments

Emotion-cognition interactions

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