3rd European Initiative for Exercise in Medicine

Physical activity and Brain function

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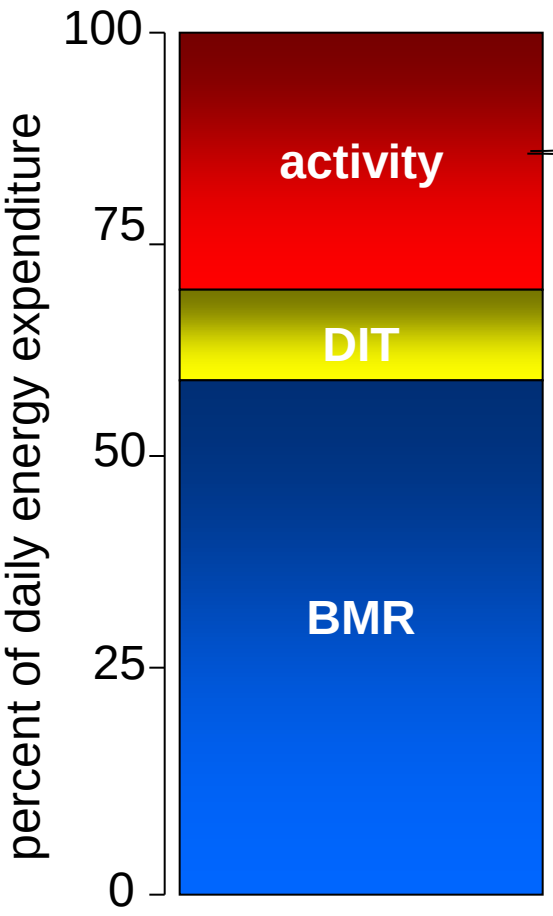
University of Groningen, the Netherlands

Daily energy expenditure

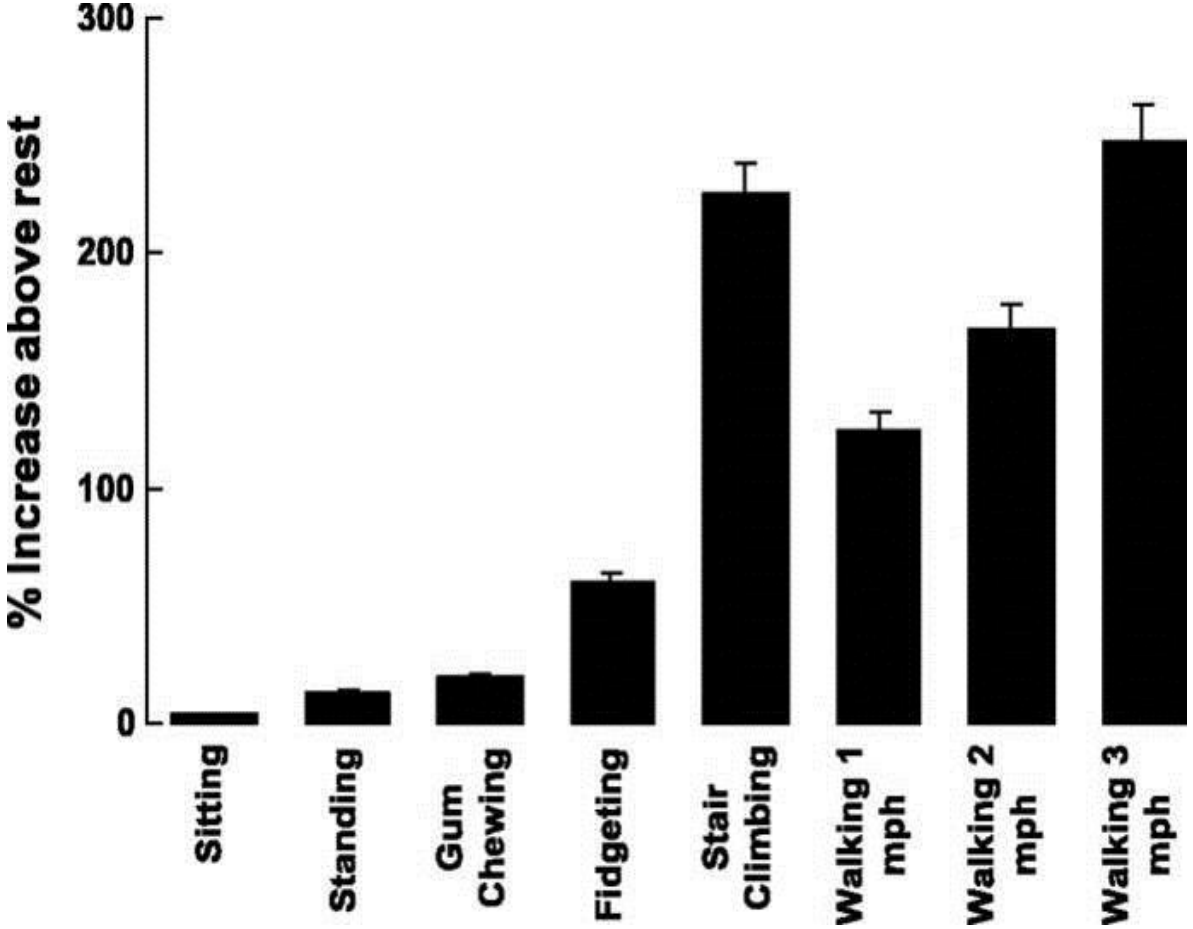


Planned exercise

Non-exercise activity thermogenis (NEAT).

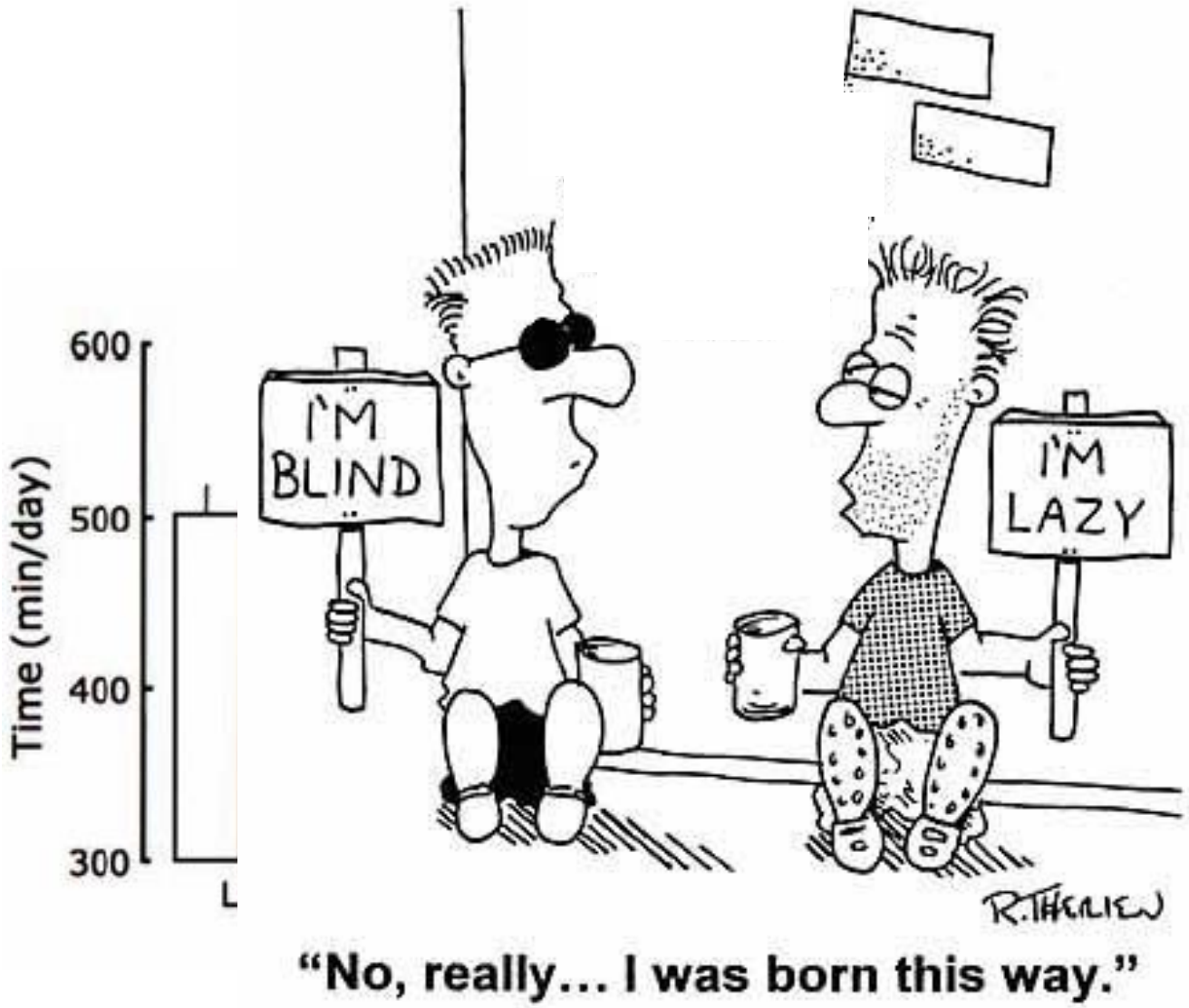
NEAT can vary up to 1500 kCal/day!

Energy expenditure of varied low-level activities (James Levine)



Levine, J. A. Am J Physiol Endocrinol Metab 286: E675-E685 2004; doi:10.1152/ajpendo.00562.2003

Changes in NEAT and weight gain



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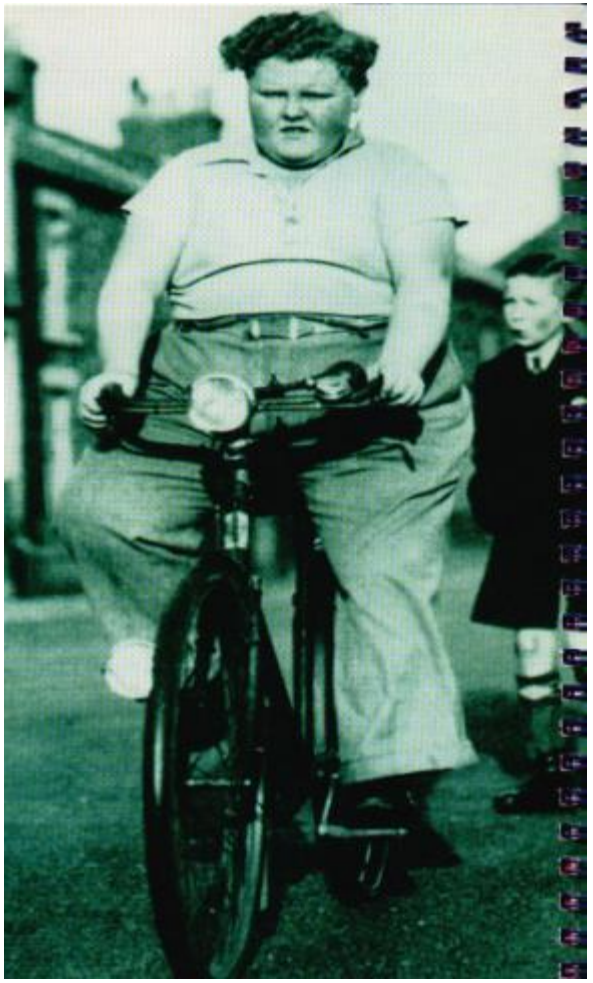
- JA Levine et al, Science 2005

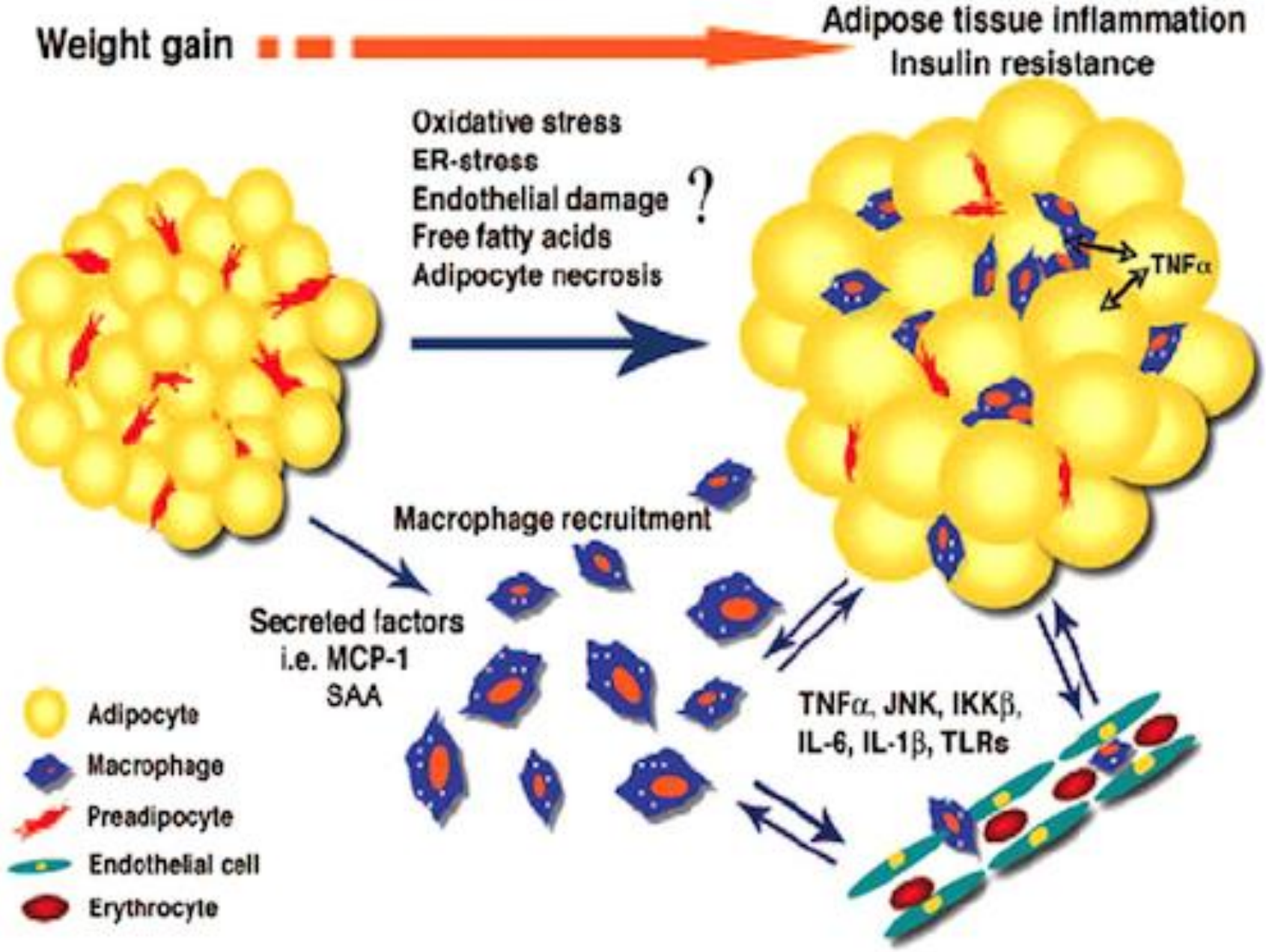
Weight gain = energy intake (EI)-expenditure (EE)

1920’ vs 2000:
Gradual decline of EE, but almost no difference in EI

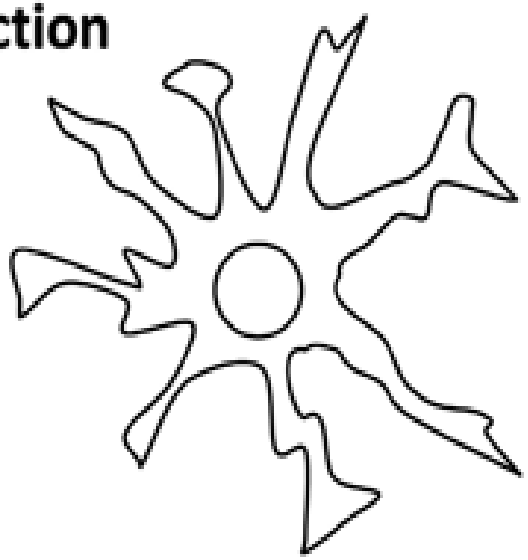


the Netherlands in 2011:

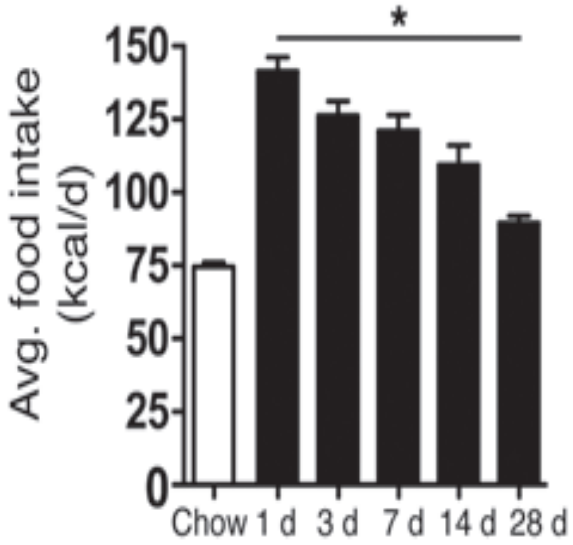
less than 40% meets the minimal requirement:
5x per week 30 min/day moderate exercise

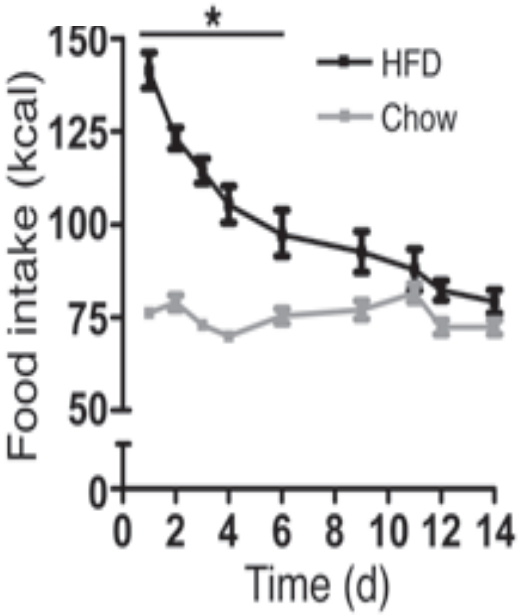

Weight gain
Adipose tissue inflammation
Insulin resistance
Oxidative stress
ER-stress
Endothelial damage
Free fatty acids
Adipocyte necrosis
?
TNFα
Macrophage recruitment
Secreted factors
i.e. MCP-1
SAA
TNFα, JNK, IKKβ,
IL-6, IL-1β, TLRs
Adipocyte
Macrophage
Preadipocyte
Endothelial cell
Erythrocyte

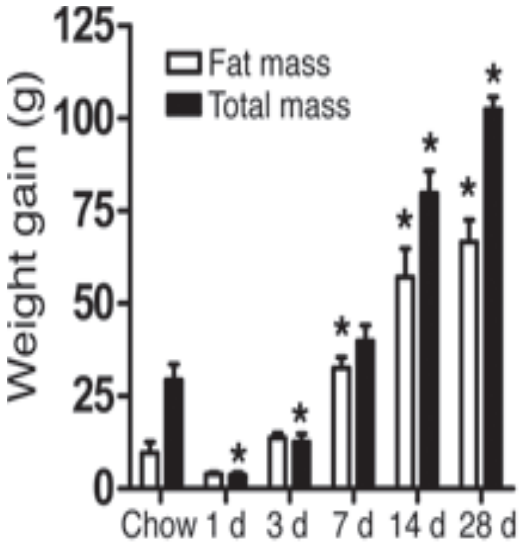
Astrocytes preserve and promote CNS function



Gupta J Neurochem 2012

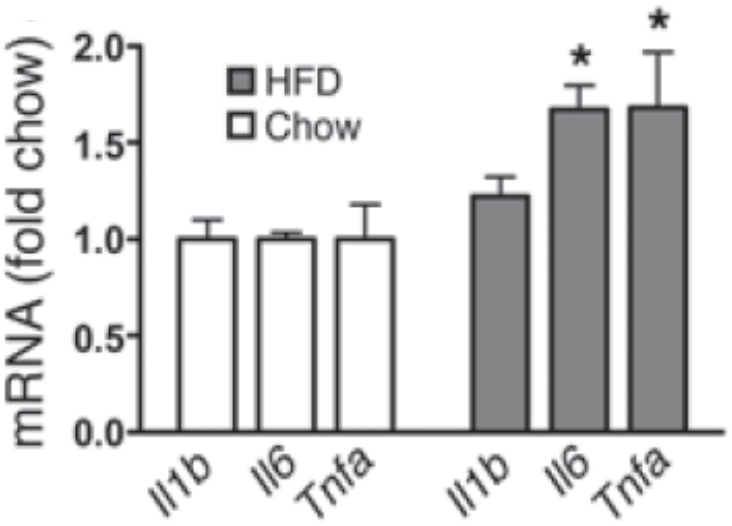


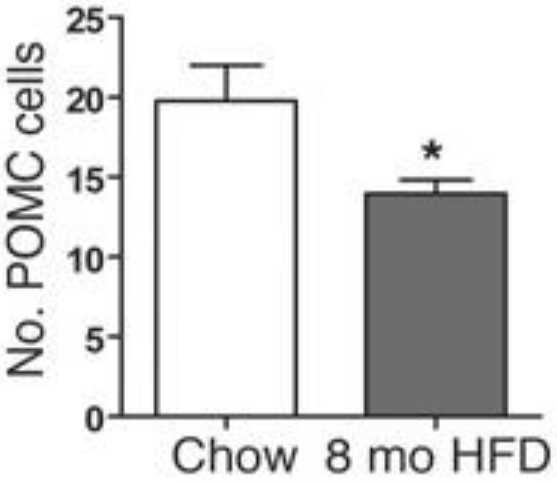


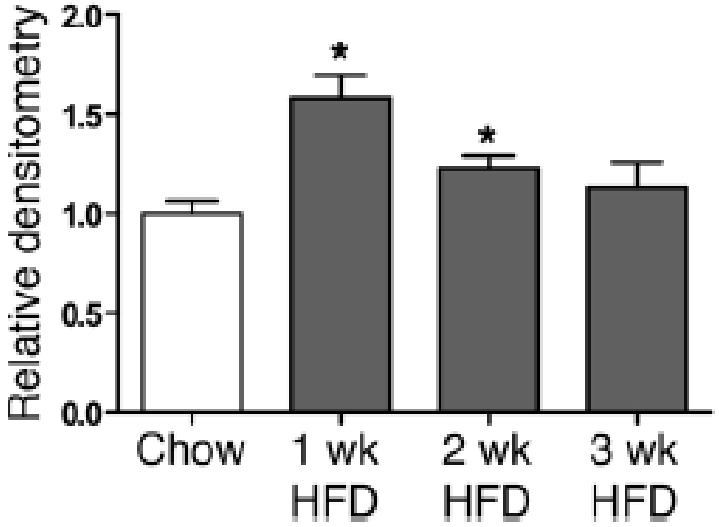


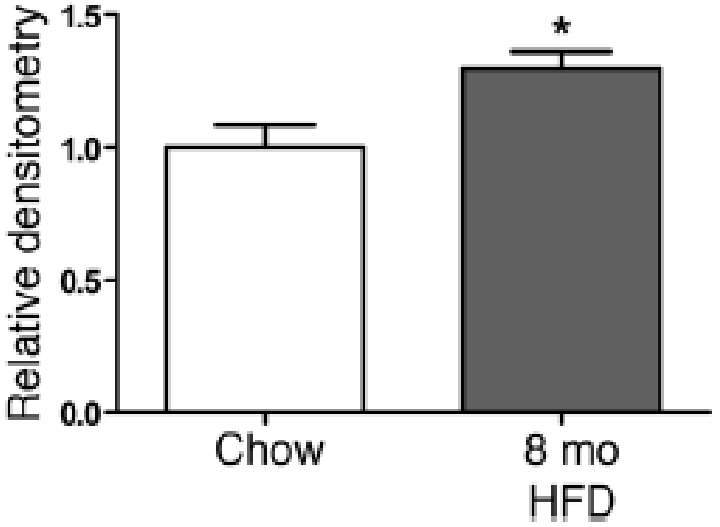
Thalens JCI 2011

Brain inflammation by HF diet



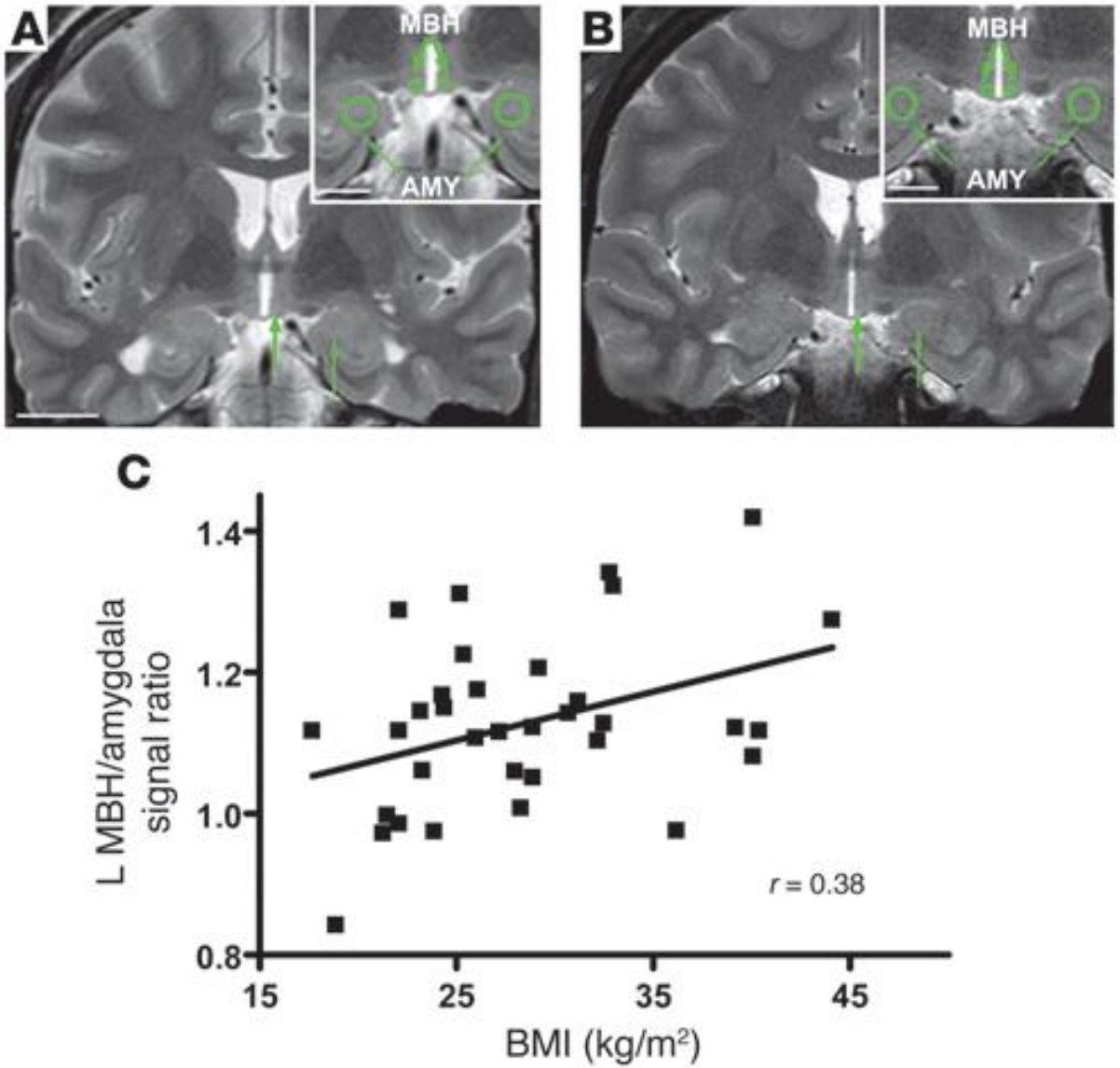






Thalens JCI 2011

Gliosis in obese subjects



Thalens JCI 2011

Association of diabetes mellitus and dementia: The Rotterdam Study

Diabetologia (1996) 39: 1392–1397

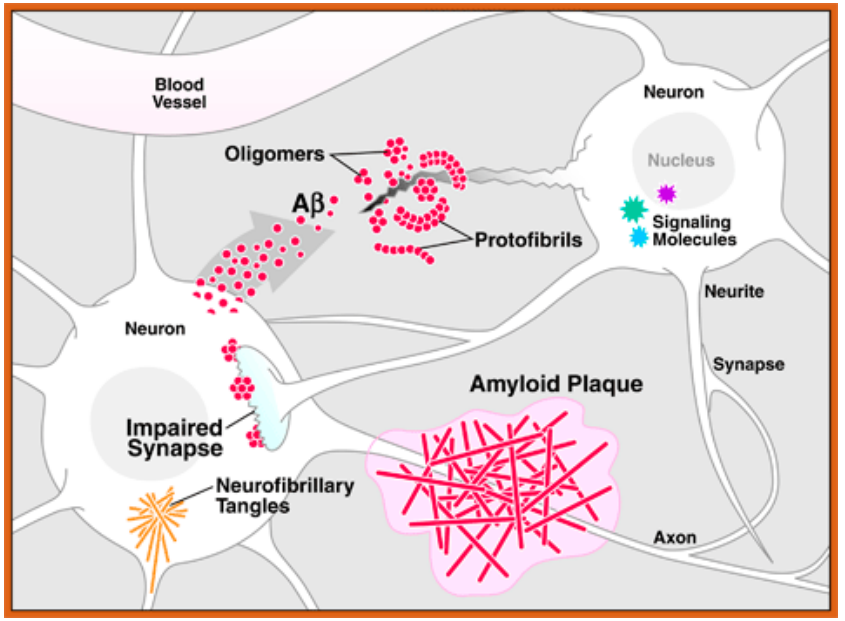
A. Ott[1], R.P. Stolk[1], A. Hofman[1], F. van Harskamp[2], D.E. Grobbee[1], M.M.B. Breteler[1]

[1] Department of Epidemiology & Biostatistics, Erasmus University Medical School, Rotterdam, The Netherlands
[2] Department of Neurology, Erasmus University Medical School, Rotterdam, The Netherlands

Type Diabetes 1

Type Diabetes 2

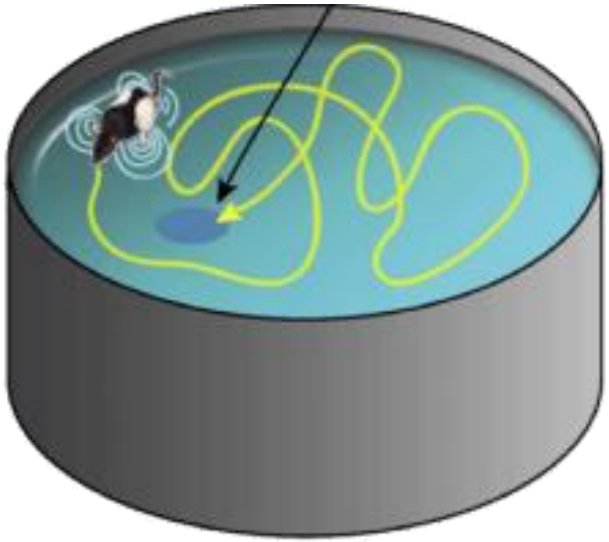
2-fold higher risk!!



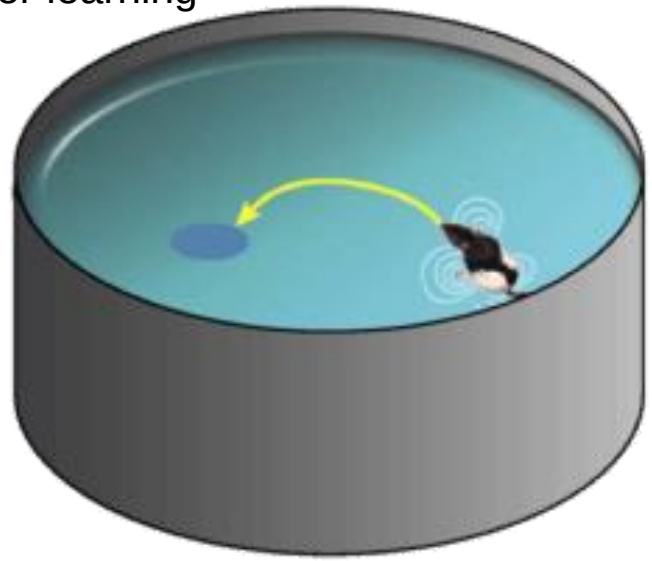
Spatial memory

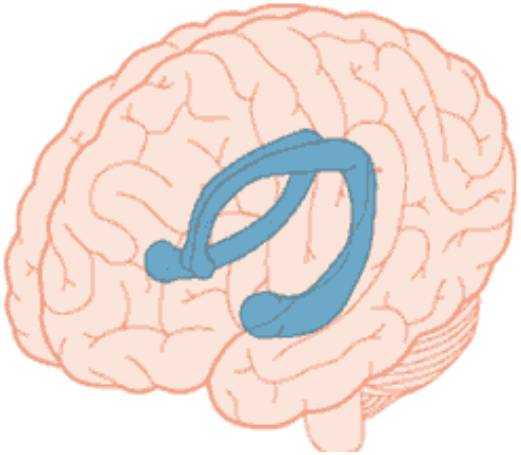
During learning

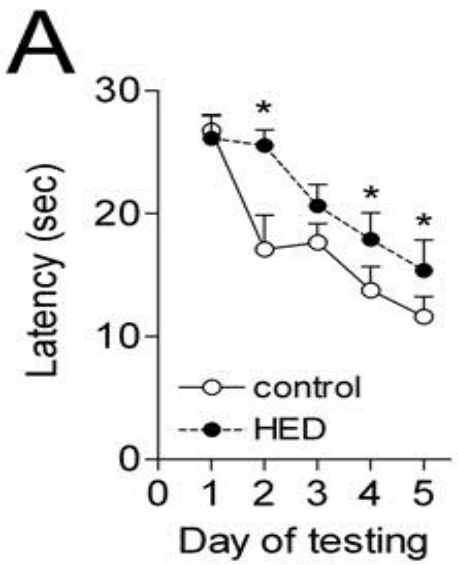
Hidden platform

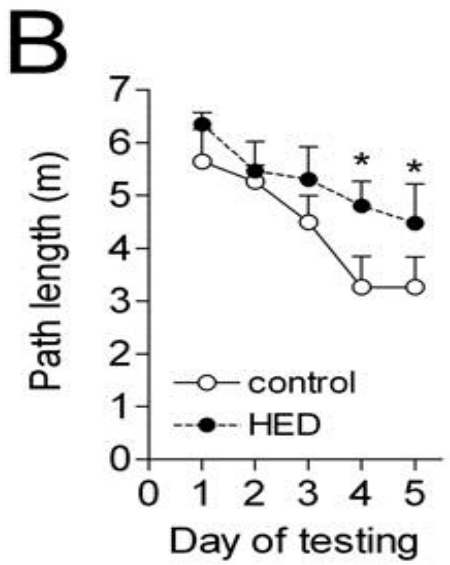


After learning

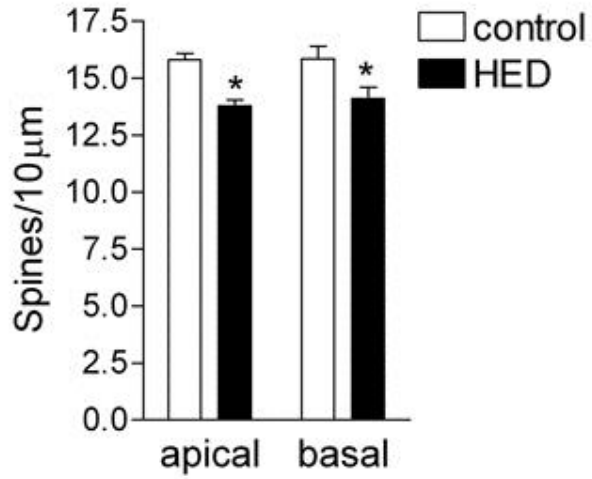


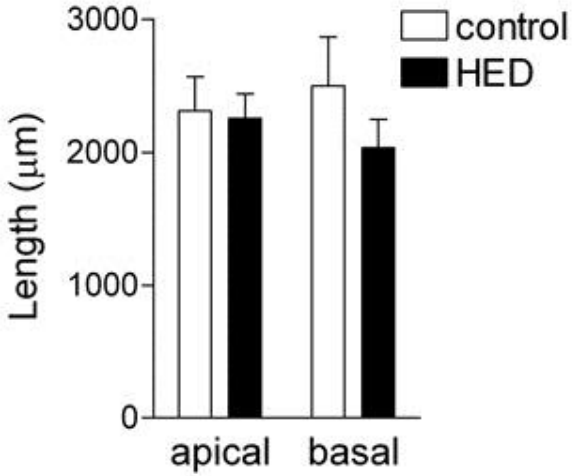


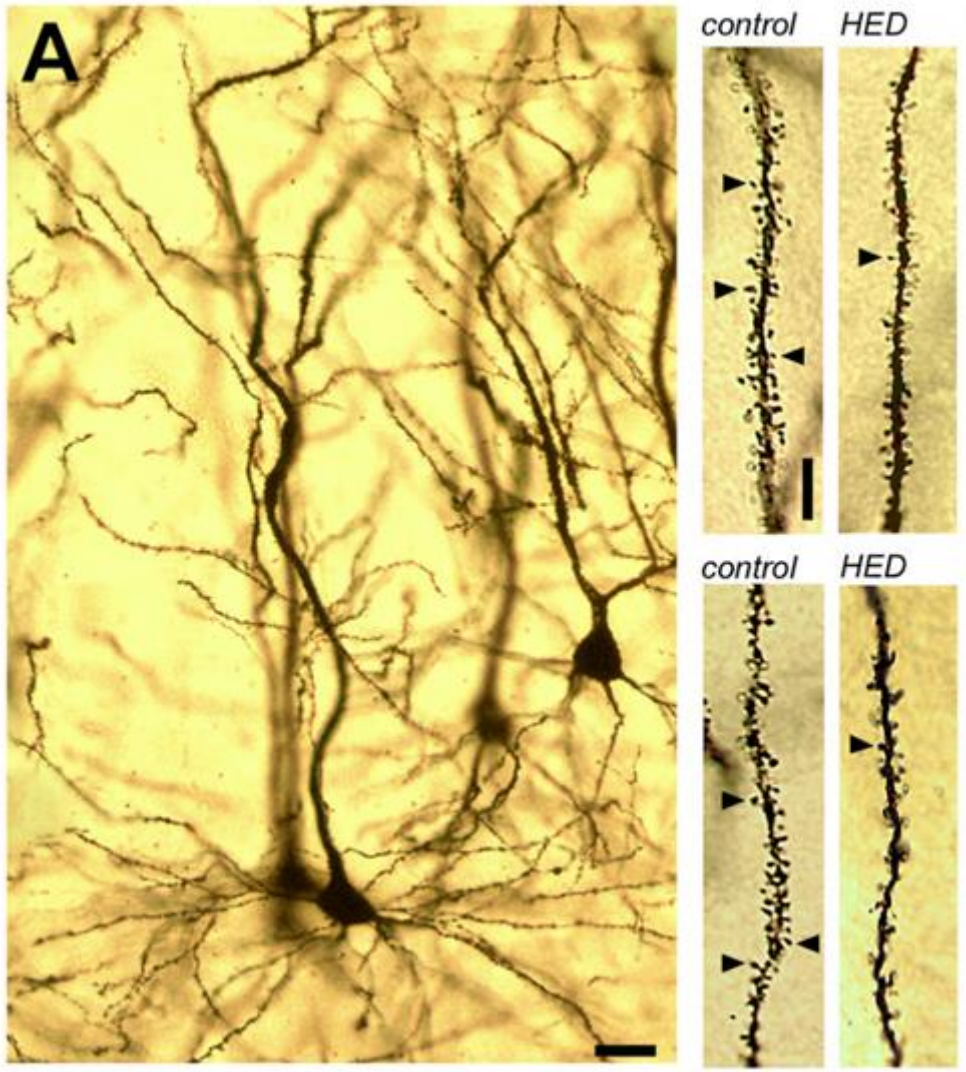




Stranahan et al Hippocampus 2008

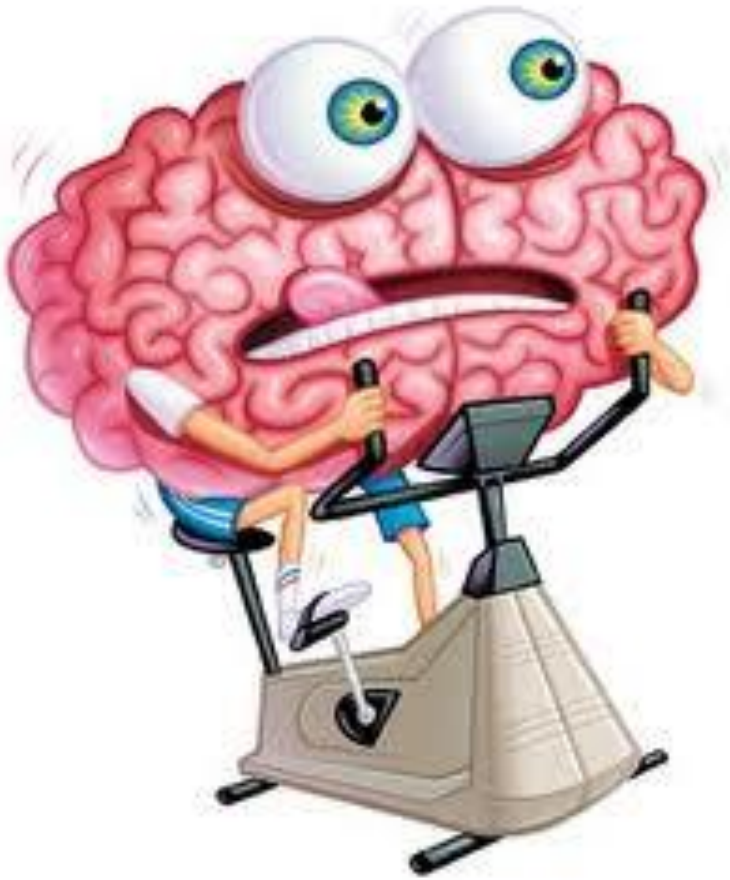






Stranahan et al Hippocampus 2008

Is there hope???




db/db mouse
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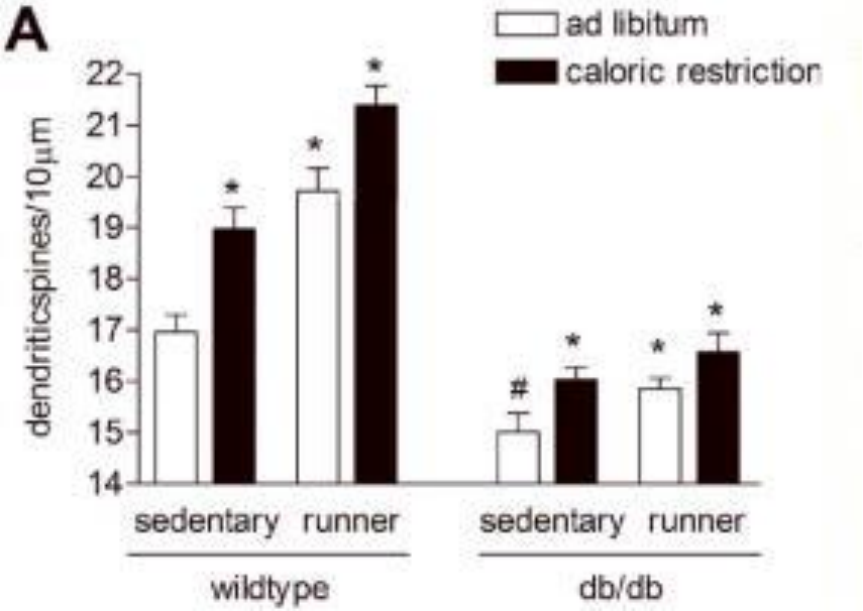
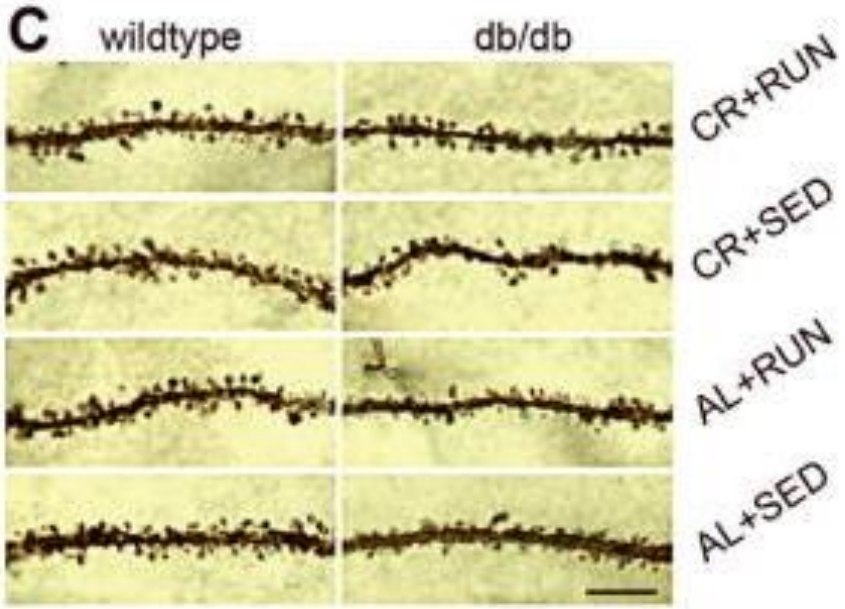
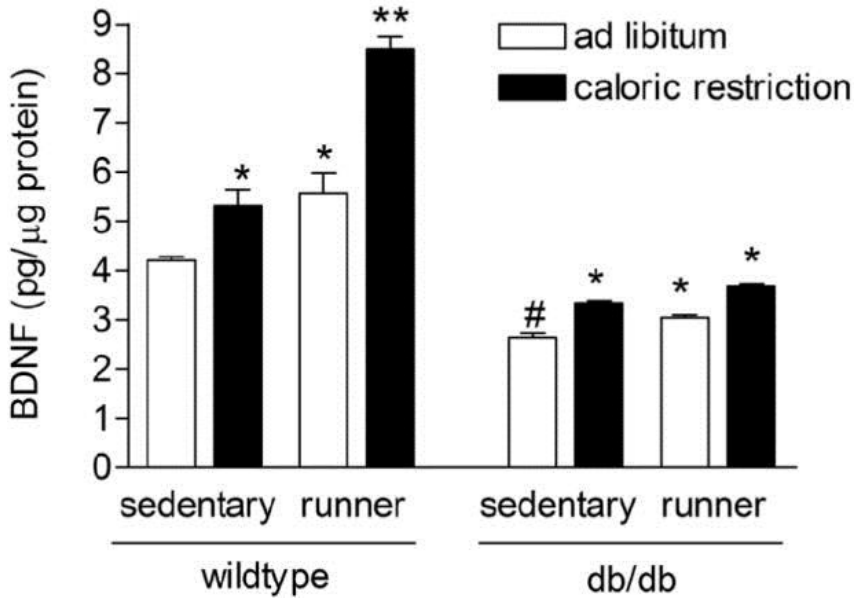
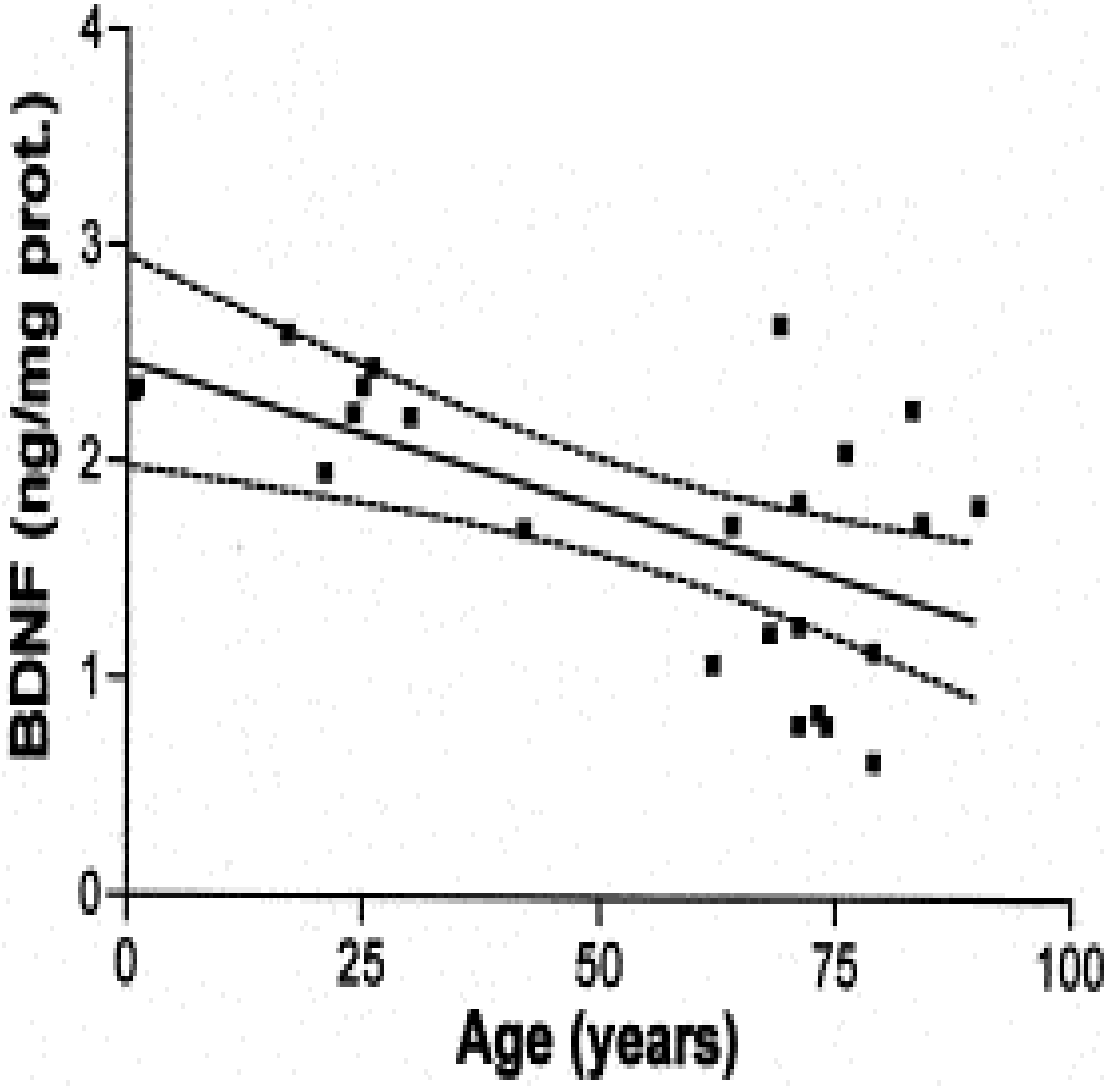




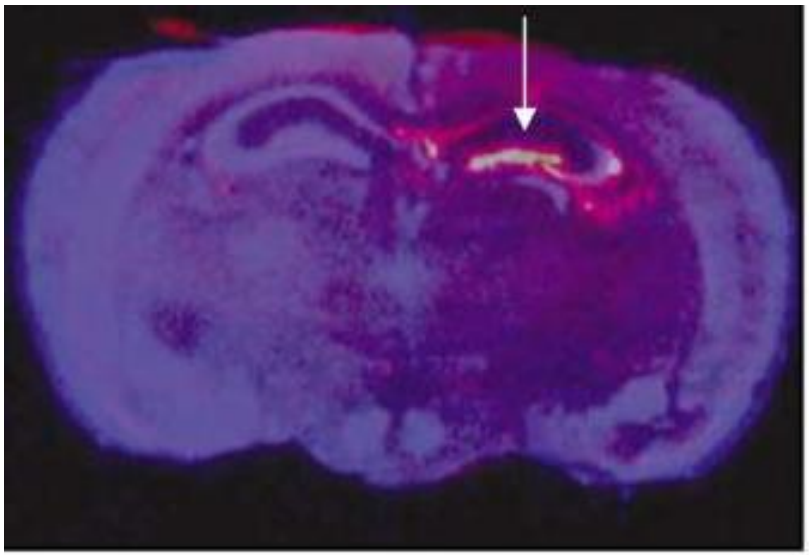


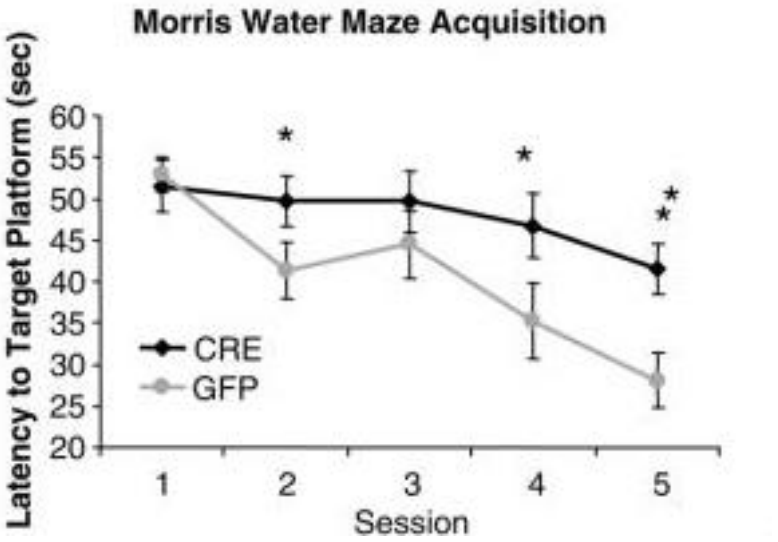
Stranahan et al Hippocampus 2009

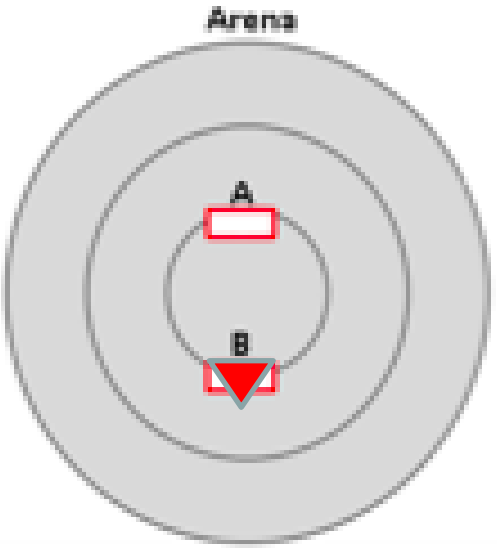
Ageing decrease BDNF



Site-specific deletion of BDNF-gene in hippocampus by Cre-Lox







Heldt et al Mol Psychiatry 2007

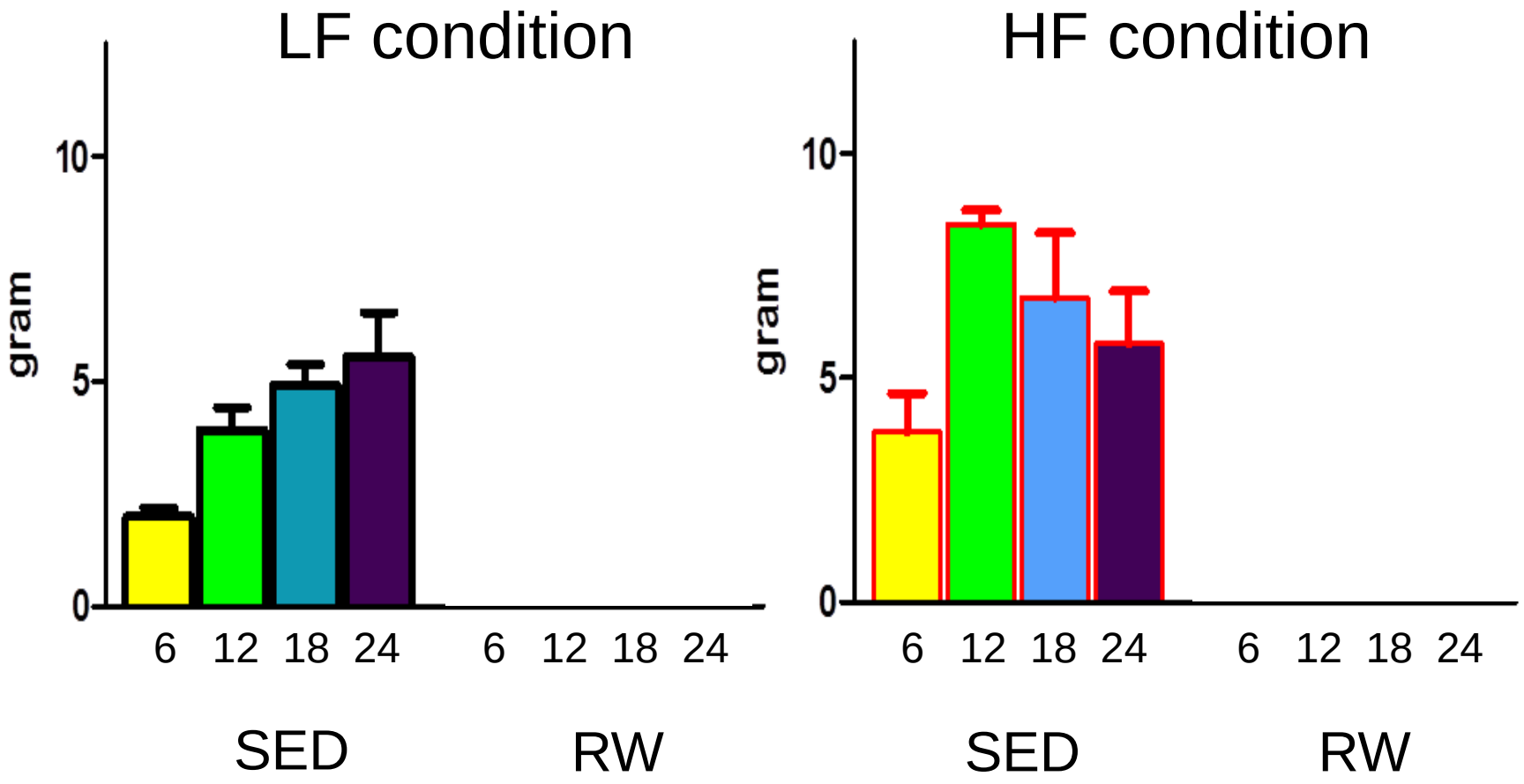
What if one is not banning junk food, but tries to compensate with physical activity?

“Effect of diet and physical activity on the systems biology of ageing”

Male C57 Bl6 mice housed under:
LF - HF SED
LF - HF RW
LF - HF CR

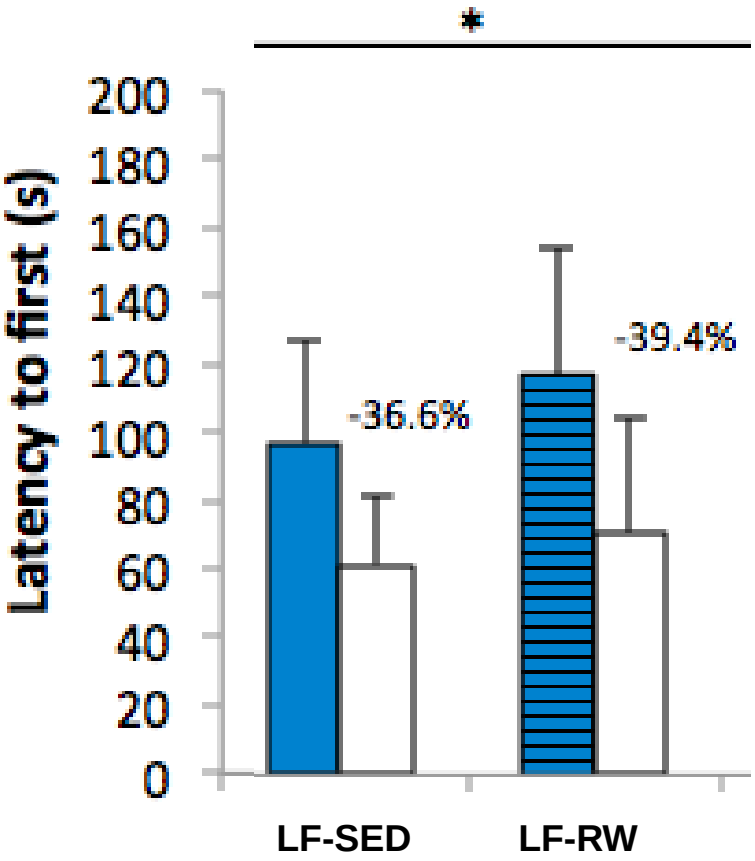
-sacrifice at 6, 12, 18 and 24 mnth
-lifespan groups

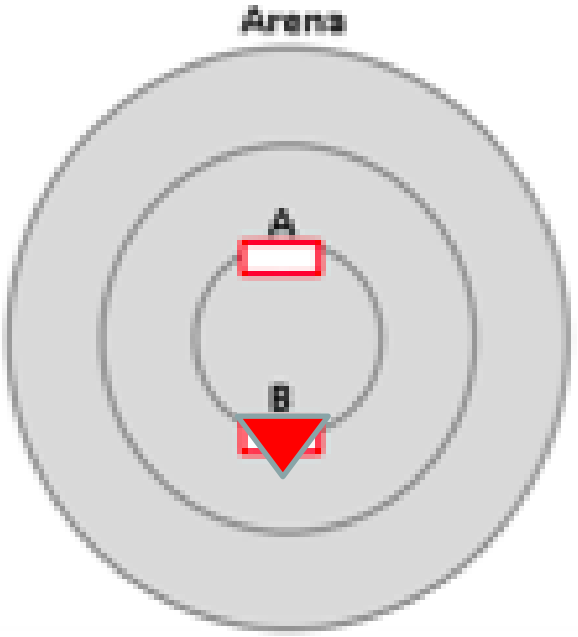
Visceral fat



Behavioral tests: NOR

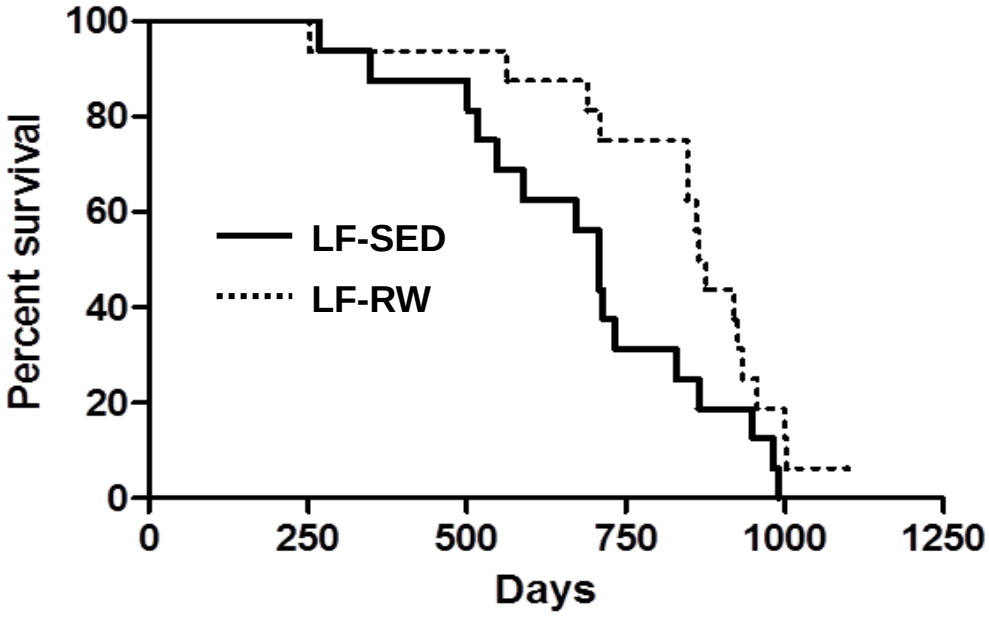
(age 21 months)



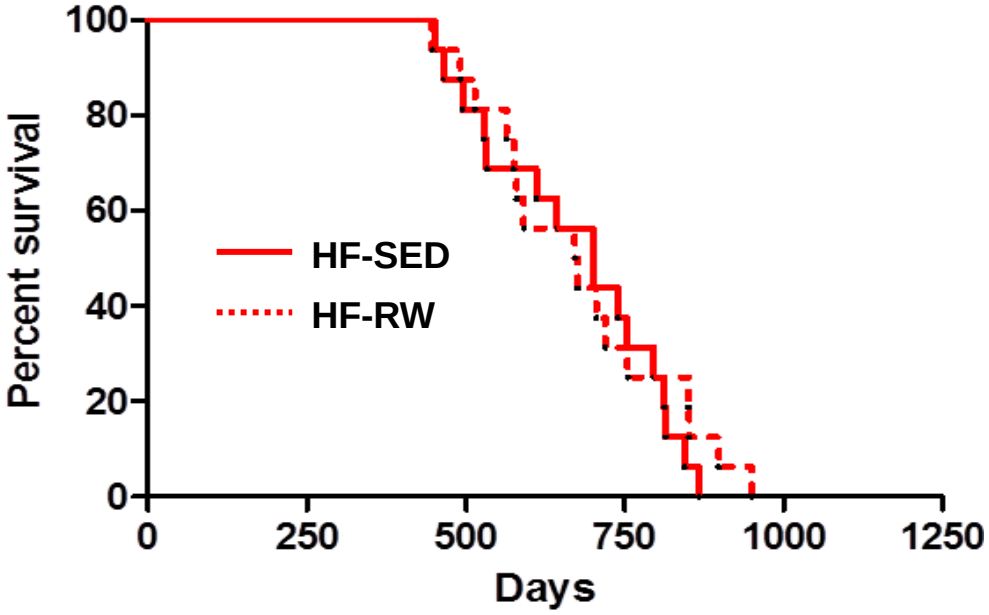


FO NO

LF diet



HF diet



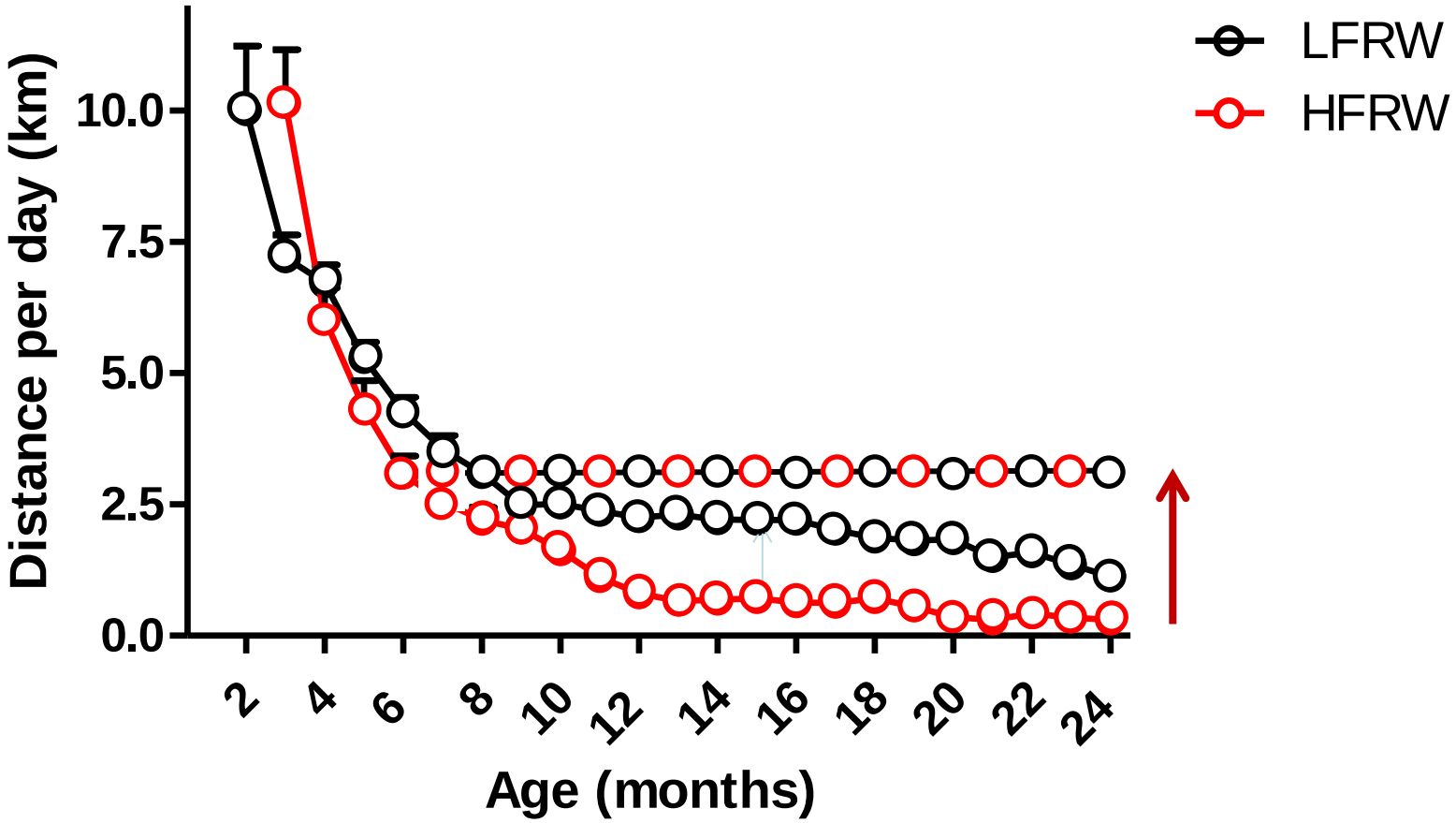
Median life span
LF-SED 707 days
LF-RW 870 days

Maximum lifespan
LF-SED 990 days
LF-RW > 1120 days

Median life span
HF-SED 700 days
HF-RW 674 days

Maximum life span
HF-SED 887
HF-RW 950

Running wheel activity



Semmelweis University-Budapest, Hungary

Faculty of Physical Education and Sport Sciences

Research Institute of Sport Sciences

- Muscular mechanisms and adaptation in physical exercise
- Physical activity and health, health promotion, sport performance
- Neurodegenerative illnesses
- Ageing and well being through exercise

Laboratory of Endurance Physiology

Biochemistry Laboratory

Laboratory animal house

Effects of life-long exercise on brain ageing

Life-long exercise protocol:

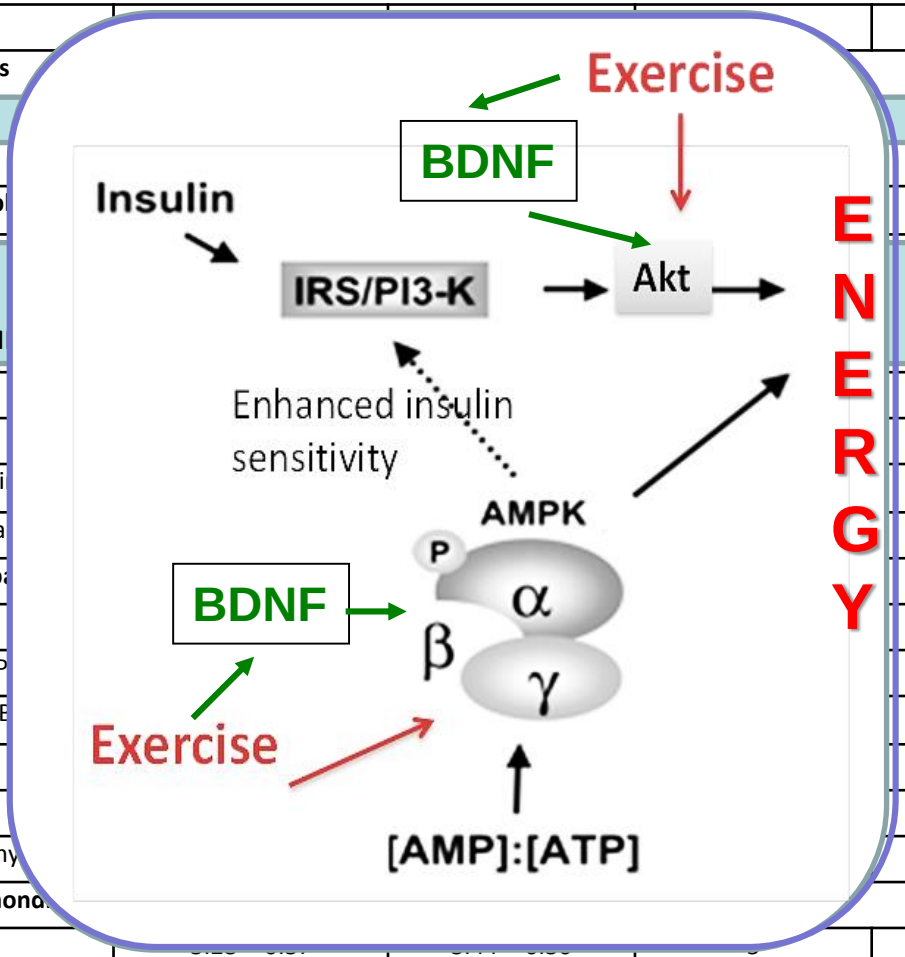
Male Wistar rats

Moderate intensity treadmill running (15 m/min)

3 training sessions per week (3*60 min)

From the age of 3 month to 24 months

Short Summary Molecular aspects



proteins	sedentary	exercise	% change to sedentary controls	p=
Cholinergic brain				
CHAT				0.024
hic factors				
BDNF				0.019
DCX				0.012
gy suppl				
Glut-1				0.049
p-Akt/Akt				0.047
p-AMPK/AM				0.012
Synaptic support				
myloidPP				0.055
synaptophysi				0.079
p-synapsin/syna				0.045
MAPK-CREB signal pa				
ERalpha				ns
p-MAPK/MAP				ns
p-CREB/CREE				ns
Oxidative stress				
ROS				0.045
Protein Carbony				0.019
Immune and mitochond				
NFkappaB				ns
PGC-1	3.17 ± 0.38	3.79 ± 0.24	20	ns
NRF-1	1.14 ± 0.14	1.59 ± 0.13	39	ns
mTTFA	2.68 ± 0.30	2.98 ± 0.22	11	ns

Conlusion

- Feeding a HF diet causes brain inflammation, and increases the risk for neurodegenerative disorders.
- Physical activity improves physical and and mental fitness, and extends life span when feeding a healthy fiberred LF diet, but not when feeding a HF diet.
- HF feeding reduces voluntary phsyical activity.

Thanks to

University of Groningen

- Drs F Reijne
- Dr B Talarovicova
- Prof B. Groen
- Prof B. Bakker
- Prof A Scheurink
- Prof H Meijer
- Prof E van der Zee
- Prof U Eisel

- students

Semmelweis University

- Prof C. Nyakas

Me? In 50 years from now??


YAHOOO!