# Ausdauertraining und psychische Gesundheit

1. Münsteraner Marathon-Medizin-Symposium
Samstag, 16. August 2008

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Münster

## Homo sapiens sapiens

- Speziesdesign ca. 150.000 – 200.000 Jahre alt
-Extreme physische Aktivität: Bedingung des Überlebens nomadisierender Jäger und Sammler
- „mismatch“ von Spezieskonstitution und modernen Lebensbedingungen (Adipositas, Diabetes, …)

## Definitionen

- **„physische Aktivität“**: 5 x 30‘ / Wo und mehr; selbstbestimmt, Vergnügen
➔74% aller erwachsenen US-Bürger sind i.d.S. physisch inaktiv
- **Sport** / z.B. Marathon: regelbestimmt, Ehrgeiz; u.U. extremes Trainingspensum

„Physische Aktivität dient der psychischen Gesundheit!“
- Eine so alte wie aktuelle Idee -

- Juvenal (1. Jh.): *„mens sana in corpore sano“*
- Jeremy Morris (1994), Pionier der Ausdauertraining/Gesundheits-Forschung: *„… today‘s best buy for public health“*
- A.E. Hardman (2001): *„Physical inactivity is a waste of human potential.“*

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# *„- mens sana in corpore sano -“*

## „Stimmt das?“

**Empirische Forschungsergebnisse**

AUSDAUERTRAINING

- physische Aktivität verbessert die „aerobic fitness“ (max. Sauerstoffnutzungskapazität des kardio-respiratorischen Systems)
- nachgewiesene günstige psycho-biologische Effekte auf Funktionen des zentralen Nervensystems, z. B.
  - kognitive Leistungsfähigkeit
  - positive Emotionen / Wohlbefinden
  - Stress-Resistenz
  - Angst-/Depressionsprophylaxe
  - Angst-/Depressionstherapie

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| Vorteile physischer Aktivität | Ausgewählte Referenzen |
| --- | --- |
| Angstreduktion | Landers & Petruzzello 1994; O‘Connor et al 2000; Taylor 2000 |
| Depressionsreduktion | Brosse et al 2002; Craft & Landers 1998; Mutrie 2000; O‘Neal et al 2000 |
| Verbesserte Lebensqualität Älterer, div. Patientengruppen | Berger 2004; Berger & Motl 2001; Rejeski & Mihalko 2001 |
| Verbessertes phys. & generelles Selbstbewusstsein | Fox 2000a,b; Sonstroem 1997 |
| Verbesserter Schlaf | Kubitz et al 1996; Youngstedt 2000 |
| Geringere Stressreaktivität | Dishman & Jackson 2000; Sothman et al 1996 |
| Verbesserte kognitive Leistungsfähigkeit aller Altersgruppen | Colcombe & Kramer 2003; Etnier et al 1997 |
| Stimmungsverbesserung | Arent et al 2000; Biddle 2000 |

# Positive psychologische Effekte physischer Aktivität

BETREFFEN

- beide Geschlechter
- alle Altergruppen
- diverse Patientengruppen
- Dosis-Wirkungsbeziehung: „Je länger und je intensiver, desto effektiver!“

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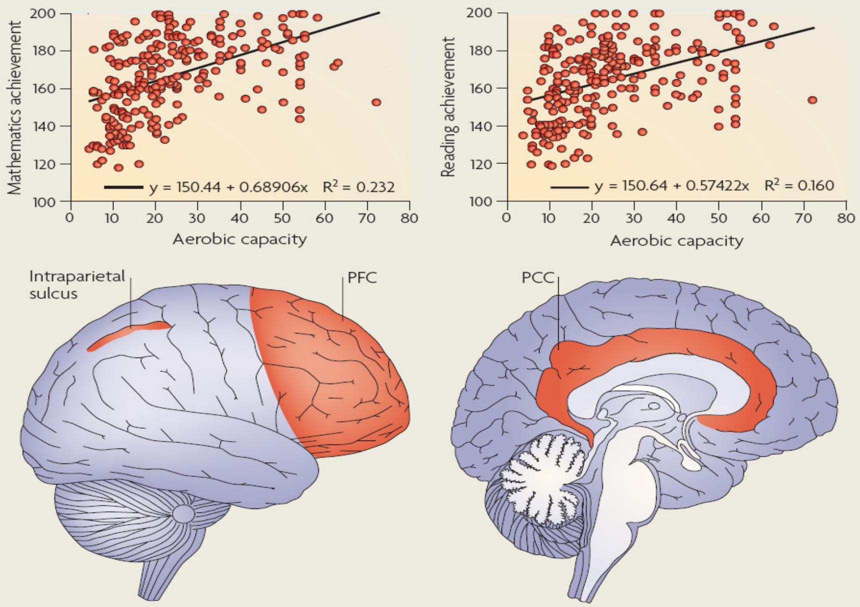
# Kognitive Leistungs-fähigkeit von Kindern

Box 1 | **Physical activity and academic performance in school-age children**

Recently, owing to the increasing importance placed on standardized testing, many schools in the United States have reduced or eliminated physical education (PE) requirements, in an effort to increase students' academic performance. However, no empirical evidence exists to suggest that the elimination of non-academic programmes (such as PE) is related to higher academic achievement. In fact, empirical evidence suggests otherwise. Aerobic fitness has a small but positive relation to academic achievement, whereas body mass index (BMI) has a negative relation[23]. Recent studies have indicated that achievement in standardized tests of mathematics (the left-hand graph in the figure) and reading (the right-hand graph in the figure) was positively related to physical fitness scores, measured using the progressive aerobic cardiovascular endurance run (PACER) test (a 20 metre shuttle run that increases in difficulty and is considered a field test of aerobic capacity), in school-age children[88]. This relationship was selective to aerobic fitness, as muscle strength and flexibility fitness were unrelated to academic achievement[23]. Similarly, beneficial relationships have been observed between physical activity and other measures of academic performance, such as academic grades in the classroom[24,89–90].

Relevant neural networks have been identified for component processes that might be involved in mathematics and reading performance (see the lower two panels of the figure). Research that examined the functional neuroanatomy of reading comprehension revealed an activation of the prefrontal cortex (PFC) and parietal/posterior cingulate cortex (PCC)[91]. Likewise, mathematical calculations and numerical magnitude processing have been linked to bilateral regions of the intraparietal sulcus in children and adults[92–94]. However, children also recruit the right dorsolateral prefrontal cortex[92,94]. Given that both mathematics and reading elicit activation in the frontoparietal network, there is a sound basis for examining these structures in relation to academic performance. As fitness has also been related to the frontoparietal network[48,53,55], it would follow that children might derive benefits in school performance from increased participation in physical activity.

Finally, a few studies have indicated that physical activity is unrelated to academic performance. For example, a study that relied on the self-reported teacher perception of students' physical activity did not find a relation with academic performance[22]. However, another study[95] reported that pupils who engaged in vigorous physical activity performed better in school than those that performed moderate or no physical activity. Sallis *et al.*[96] observed a trend for improved achievement test scores following physical activity, but the relationship might have been blunted because the school district examined was one with historically high test scores. Collectively these data indicate that, at the very least, time spent in physical activity programmes does not hinder academic performance, and it might indeed improve performance. Given the positive health benefits that are derived from physical activity, these studies support PE as an important component of children's health and wellbeing. Bottom panels adapted from REF. 97 © (1996) Appleton & Lange.



# Kognitive Leistungsfähigkeit von Älteren

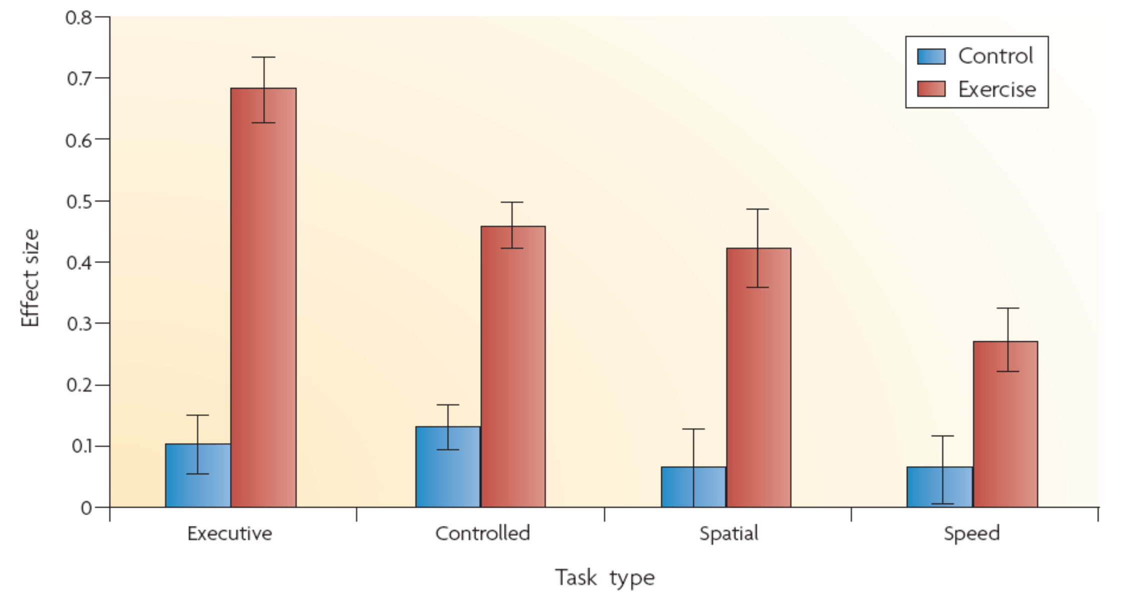



Figure 1 | **Meta-analytic findings of exercise-training effects on cognition in older adults.** The results of a meta-analysis of the effects of fitness training on cognition showed that the benefits of fitness training on four different cognitive tasks were significant. As illustrated in the figure, fitness training has both broad and specific effects. The effects are broad in the sense that individuals in aerobic fitness training groups (represented by the red bars) showed larger fitness training effects across the different categories of cognitive processes illustrated on the x-axis. They are specific in the sense that fitness training effects were larger for some cognitive processes, in particular executive control processes, than for other cognitive processes. Figure reproduced, with permission, from REF. 32 © (2003) Blackwell Publishers.

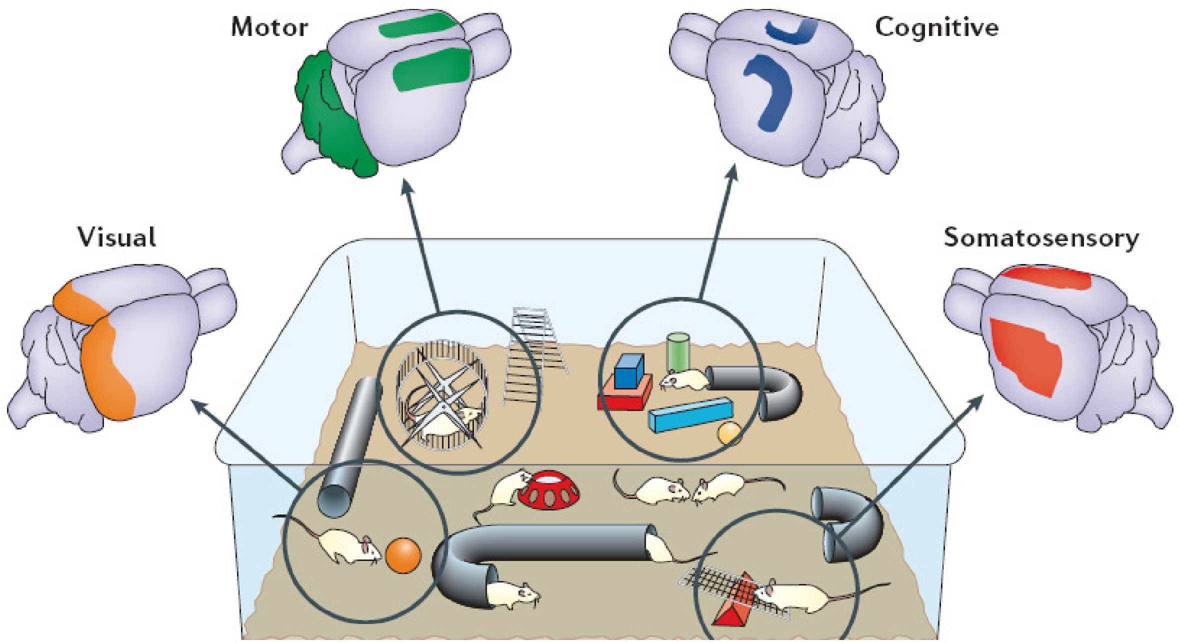
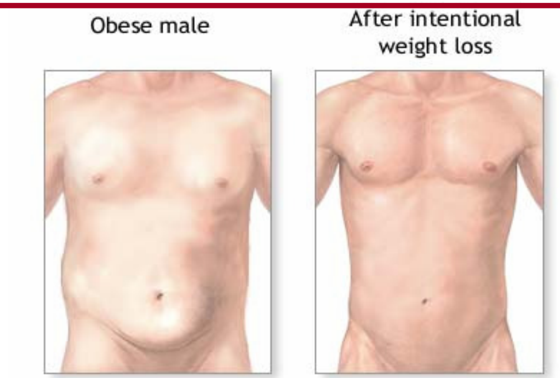



Figure 1 | **Environmental enrichment and the effects of enhanced sensory, cognitive and motor stimulation on different brain areas.** Enrichment can promote neuronal activation, signalling and plasticity throughout various brain regions. Enhanced sensory stimulation, including increased somatosensory and visual input, activates the somatosensory (red) and visual (orange) cortices. Increased cognitive stimulation — for example, the encoding of information relating to spatial maps, object recognition, novelty and modulation of attention — is likely to activate the hippocampus (blue) and other cortical areas. In addition, enhanced motor activity, such as naturalistic exploratory movements (including fine motor skills that differ radically from wheel running alone), stimulates areas such as the motor cortex and cerebellum (green).

# Positive Emotionen & Wohlbefinden

- Direkte psycho-*biologische* Effekte
- Indirekte *psycho*-biologische Effekte
  - Selbstverwirklichung, Selbstwirksamkeit, …
  - Ablenkung, „time out“ vom Alltag („hazzles“)
  - Gute Figur: soziale Anerkennung, Status
  - Gruppenaktivität: Affiliationsbedürfnis




# Direkte psycho-biologische Effekte

- (Neuro-)Hormone
  - unzählige
- Neurotransmitter
  - Serotoninausschüttung 🡅 (Meeusen et al 2001)
  - Opiatausschüttung 🡅 („runner‘s high“)
- Belohnungssystem
  - Meso-limbische dopaminerge Aktivität 🡅
- Stressreagibilität
  - LC-NA-System („Sympathikus“) ↓
  - HPA-Achse ↓
- Expression neurotropher Faktoren 🡅

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# An *in vivo* correlate of exercise-induced neurogenesis in the adult dentate gyrus

Ana C. Pereira[*†], Dan E. Huddleston[*†], Adam M. Brickman[*†], Alexander A. Sosunov[‡], Rene Hen[§], Guy M. McKhann[‡], Richard Sloan[§], Fred H. Gage[¶], Truman R. Brown[‖], and Scott A. Small[*†**]

[*]The Taub Institute for Research on Alzheimer's Disease and the Aging Brain, Departments of [†]Neurology, [‡]Neurosurgery, [§]Psychiatry, and [‖]Radiology, Columbia University College of Physicians and Surgeons, New York, NY 10032; and [¶]The Salk Institute, La Jolla, CA 92037

- Proceedings of the National Academy of Sciences (März 2007)

- Experimentelle Untersuchung der trainingsabhängigen Neuroneogenese im Gyrus dentatus (Teil des Hippocampus) des Menschen
  - große Bedeutung für Gedächnisfunktionen
  - Im Alter durch Neurodegeneration bedroht
  - Neuroneogenese beim Menschen post mortem bereits nachgewiesen

- Vorgehen
  - Tiermodell: Blutflussvolumen im MRT korreliert mit Neuroneogenese abhängiger Angioneogenese
  - 11 Probanden (9 Frauen, 2 Männer; Durchsnittsalter 33) wurden vor und nach 3 Monaten Aerobic-Training untersucht
  - Ergebnis: signifikante rCBV-Zunahme im Gyrus dentatus (DG) spricht für eine Neuroneogenese beim Menschen

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*The Taub Institute for Research on Alzheimer's Disease and the Aging Brain, Departments of †Neurology, ‡Neurosurgery, §Psychiatry, and ||Radiology, Columbia University College of Physicians and Surgeons, New York, NY 10032; and ¶The Salk Institute, La Jolla, CA 92037

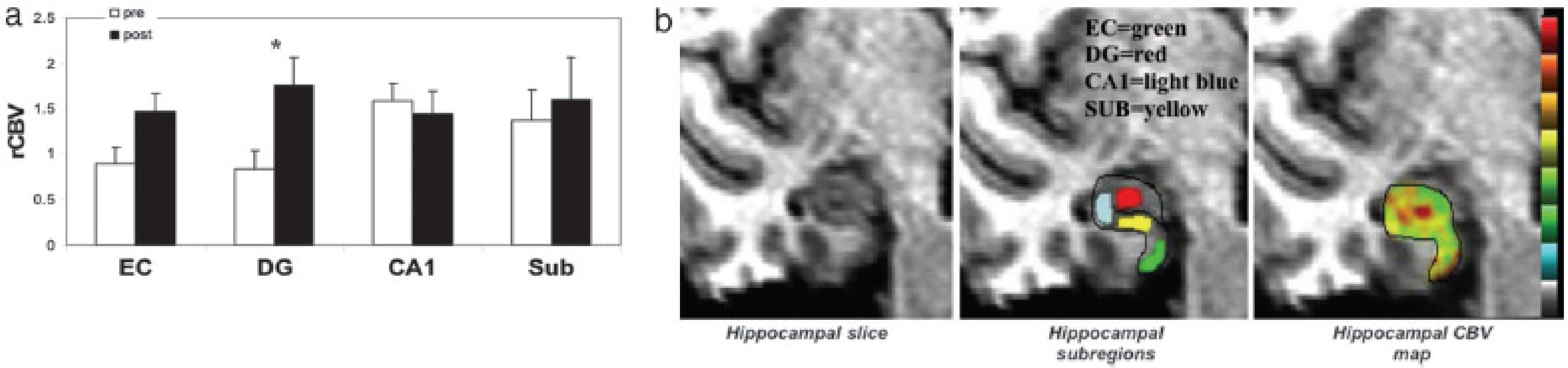


**Fig. 3.** Exercise selectively increases dentate gyrus CBV in humans. (*a*) Exercise had a selective effect on dentate gyrus CBV. Bar graph shows the mean relative CBV (rCBV) values for each hippocampal subregion before exercise (open bars) and after exercise (filled bars). As in mice, the dentate gyrus was the only hippocampal subregion that showed a significant exercise effect, whereas the entorhinal cortex showed a nonsignificant increase in CBV. (*b*) An individual example. (*Left*) High-resolution MRI slice that visualizes the external morphology and internal architecture of the hippocampal formation. (*Center*) Parcellation of the hippocampal subregions (green, entorhinal cortex; red, dentate gyrus; blue, CA1 subfield; yellow, subiculum). (*Right*) Hippocampal CBV map (warmer colors reflect higher CBV).

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# T.C. Camacho et al, 1991, *„Physical Activity and Depression: Evidence from the Alameda County Study“,* Am J. Epidemiology, 134, 220-31

- „catchment area“-Erhebung
  - Baseline 1965
  - Nachuntersuchungen 1974 und 1983
  - Einteilung in Grade der körperlichen Aktivität: „low“, „moderate“, „high“
  - Depressionsdiagnostik
- Ergebnis:
  - ➢ **„low“ : „high“ ~ 1,8 : 1,0 Depressionsrisiko**
  - ➢ beide Geschlechter gleich

# W.J. Strawbridge et al, 2002, *„Physical activity reduces the risk of subsequent depression for older adults“,* Am. J. Epidemiology, 156, 328-34

- Alameda County Kohorte
  - 1947 selbständig lebende Bürger zwischen 50 und 94 Jahren
  - Nachuntersuchungen 1994 und 1999
  - Depressive Verstimmung in Abhängigkeit vom Grad physischer Aktivität
- Trotz Adjustierung für *Alter, Geschlecht, ethnische Zugehörigkeit, finanzielle Schwierigkeiten, chronische Krankheiten, Behinderungen, BMI, Alkoholkonsum, Rauchen und soziale Beziehungen* erwies sich **physische Aktivität als protektiver Faktor bezüglich prävalenter und inzidenter Depressionen**.

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# Effects of Exercise Training on Older Patients With Major Depression

*James A. Blumenthal, PhD; Michael A. Babyak, PhD; Kathleen A. Moore, PhD; W. Edward Craighead, PhD; Steve Herman, PhD; Parinda Khatri, PhD; Robert Waugh, MD; Melissa A. Napolitano, MA; Leslie M. Forman, MD; Mark Appelbaum, PhD; P. Murali Doraiswamy, MD; K. Ranga Krishnan, MD*

*Arch Intern Med. 1999;159:2349-2356*

- umfangreiche, gut gemachte Studie
- > 50-Jährige, MDD
- Training: 3x/Wo, 45‘, 70-85% Auslastung
- Medikation: Sertralin (Standarddosis)

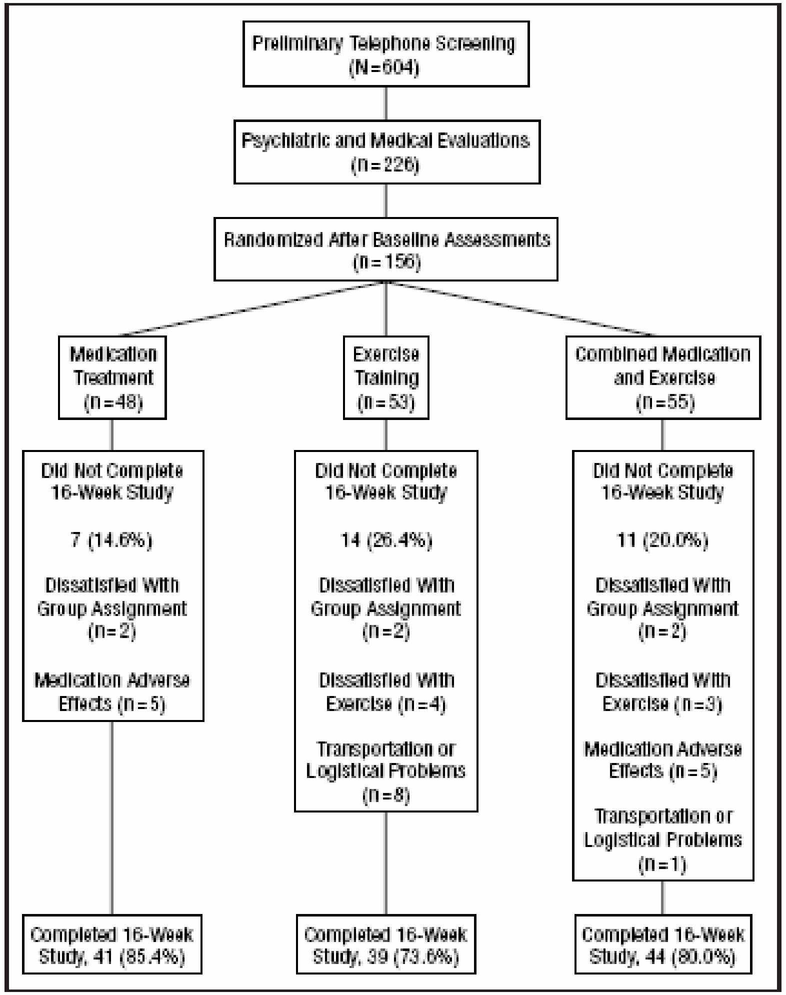


**Figure 1.** *Flowchart of trial.*

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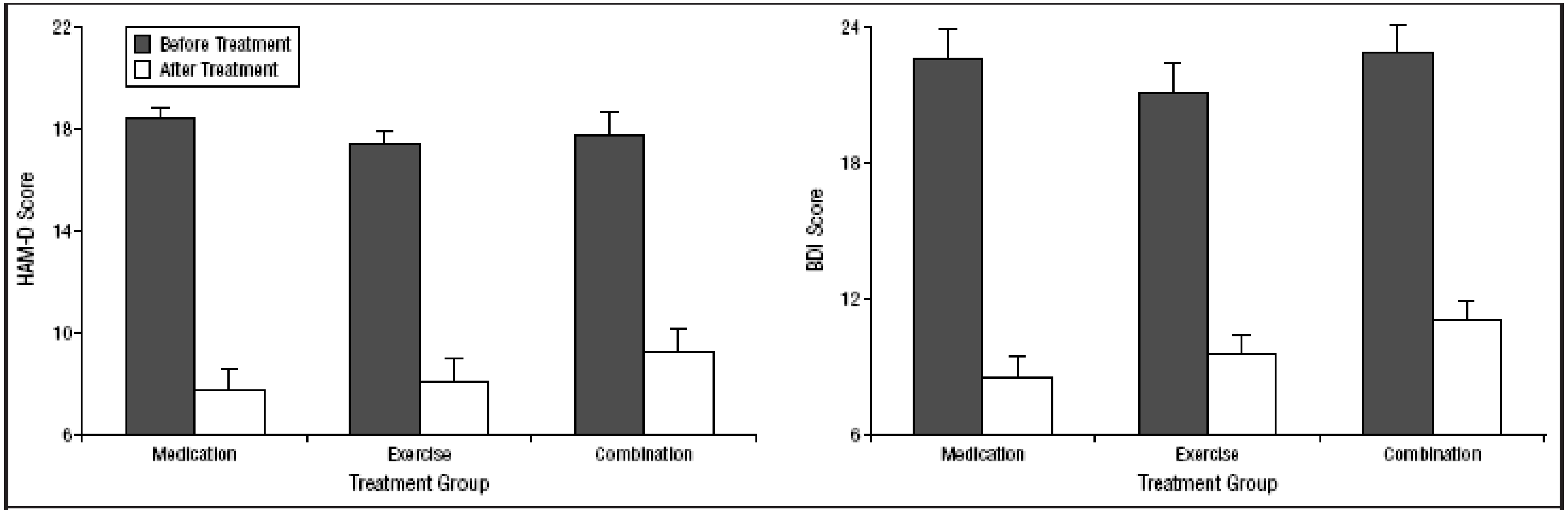


**Figure 3.** *Observed mean depression scores before and after treatment. All changes from pretreatment to posttreatment were statistically significant (P<.001 for all). The treatment groups did not differ on baseline or posttreatment levels of depression. Error bars represent SEs. HAM-D indicates Hamilton Rating Scale for Depression; BDI, Beck Depression Inventory.*

# Exercise Treatment for Major Depression: Maintenance of Therapeutic Benefit at 10 Months

Michael Babyak, PhD, James A. Blumenthal, PhD, Steve Herman, PhD, Parinda Khatri, PhD, Murali Doraiswamy, MD, Kathleen Moore, PhD, W. Edward Craighead, PhD, Teri T. Baldewicz, PhD, and K. Ranga Krishnan, MD

Psychosomatic Medicine 62:633–638 (2000)

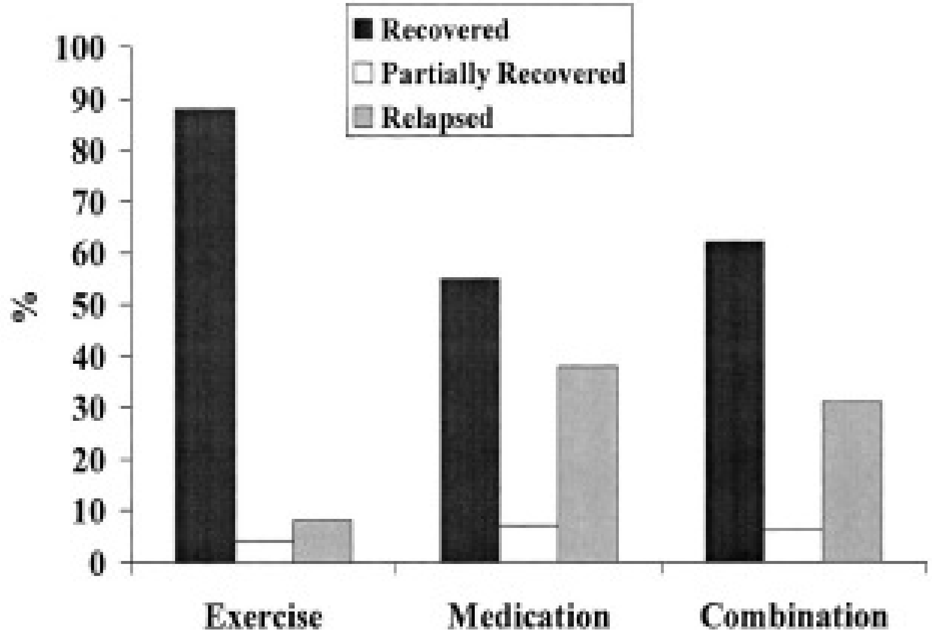


Fig. 1 Clinical status at 10 months (6 months after treatment) among patients who were remitted ($N$ = 83) after 4 months of treatment in Exercise ($N$ = 25), Medication ($N$ = 29), and Combination ($N$ = 29) groups. Compared with participants in the other conditions, those in the Exercise condition were more likely to be partially or fully recovered and were less likely to have relapsed.

## Table 1 Level and strength of evidence for a relationship between physical activity and contemporary chronic conditions

| | Preventive effects | | | Therapeutic effects | |
|---|---|---|---|---|---|
| Condition | Level of evidence† | Strength of effect | Evidence of a dose response relationship | Level of evidence† | Strength of effect |
| **Cardiovascular disease** | | | | | |
| Coronary heart disease | High | Strong | Yes | Medium | Moderate |
| Stroke – occlusive | High | Moderate | – | Low | Weak |
| – haemorrhagic | Medium | Weak | – | Low | Weak |
| Peripheral vascular disease | No data/ insufficient data | – | – | Medium | Moderate |
| Obesity and overweight | Medium | Moderate§ | – | Medium | Moderate§ |
| Type 2 diabetes | High | Strong | Yes | Medium | Weak |
| **Musculoskeletal disorders** | | | | | |
| Osteoporosis‡ | High | Strong | – | Medium | Weak |
| Osteoarthritis | No data/ insufficient data | – | – | Medium | Moderate |
| Low back pain | Medium | Weak | – | High | Moderate |
| **Psychological well-being and mental illness** | | | | | |
| Clinical depression | Low | Weak | – | Medium | Moderate |
| Other mental illness | No data/ insufficient data | – | – | Low | Weak |
| Mental well-being | – | – | – | Medium | Moderate |
| Mental function | Low | Moderate | – | Low | Weak |
| Social well-being | No data/ insufficient data | – | – | Low | Weak |
| **Cancer** | | | | | |
| Overall | Medium | Moderate | Yes | No data/ insufficient data$ | – |
| Colon | High | Strong | Yes | | |
| Rectal | Medium | No effect | – | | |
| Breast | High | Moderate | Yes | | |
| Lung | Low | Moderate | – | | |
| Prostate | Medium | Equivocal | – | | |
| Endometrial | Low | Weak | Yes | | |
| Others | Low | Equivocal | – | | |

† = Volume and quality of data

‡ = From bone mineral density data. Osteoporosis is defined in terms of bone mineral density.

§ = Includes the effect of activity on disease as well as weight status.

$ = However, a low level of evidence indicates weak effects on physical function and fatigue during and following cancer treatment.

This table provides a simplified summary of the nature and volume of evidence and an estimate of the strength of effect of activity currently indicated by that evidence. The 'level of evidence' is intended to be a general indication of the volume and quality of the available evidence. The 'strength of effect' is intended to indicate how positive, or otherwise, the findings are. Three broad categories (descriptors), agreed between the Review Panel and the Expert Reviewers, have been selected within both 'level of evidence' and 'strength of effect'.

There is considerable variability in both the volume and quality of studies found in different areas of research regarding activity and health. Cardiovascular disease is relatively well investigated compared with areas such as obesity and mental health that have only recently attracted interest. The full picture is further confounded by the fact that physical inactivity affects a wide range of diseases and risk factors, many of which may occur in the same individual. The multiple effects of increased activity across these many chronic conditions are rarely considered in study design, so the true value of physical activity in terms of public health may well be under-estimated.

Department of Health, 2004, At least five a week

# Problematische Folgen des Marathonlaufens für die Psychische Gesundheit?

Br J Sports Med 1996;30:324–326

**Incidence of injuries and other health problems in the Auckland Citibank marathon, 1993**

Peter Satterthwaite, Peter Larmer, James Gardiner, Robyn Norton

Brit.J.Sports Med. — Vol. 22, No. 1, March 1988, 19-21

**THE ELITE MARATHON RUNNER: PROBLEMS DURING AND AFTER COMPETITION**

P. HÖLMICH, E. DARRE, F. JAHNSEN and T. HARTVIG-JENSEN
*The Wonderful Copenhagen Marathon 1986 Study Group*

➔ **keine!**

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