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Effectiveness of Schoolbased physical activity interventions What do we know?

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A little background

1) Some children do have metabolic problems
2) This is related to PA and fitness
3) It is possible to increase PA levels in interventions
4) However, this has not resulted in increased PE in school
5) So – what is needed?

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Effect of school-based interventions on physical activity and fitness in children and adolescents: a review of reviews and systematic update

S Kriemler,[1,2] U Meyer,[1] E Martin,[2] E M F van Sluijs,[3] L B Andersen,[4,5] B W Martin[2]

Br J Sports Med 2011;**45**:923–930

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All 20 trials in the review update showed a positive effect on in-school, out-of-school or overall PA

6 of 11 studies showed an increase in fitness

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Association between PA, fitness and metabolic health

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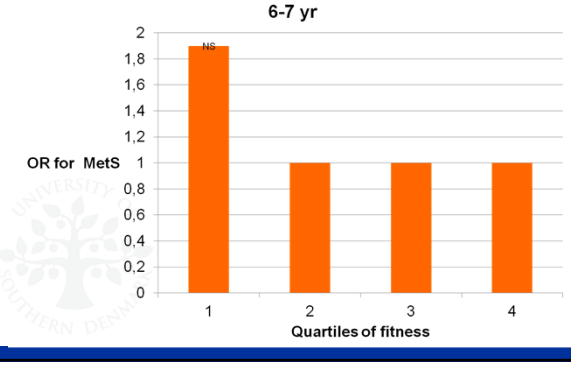
OR for MetS in quartiles of fitness in 6 yr olds

(Andersen et al *IJPO, 2011; 6(S1): 29–34*



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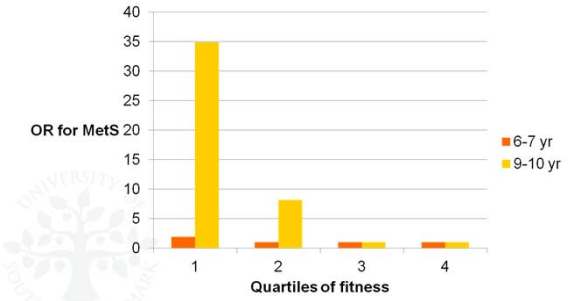
OR for MetS in quartiles of fitness in 6-7 and in 9-10 yr olds

IJPO, 2011; 6(S1): 29–34



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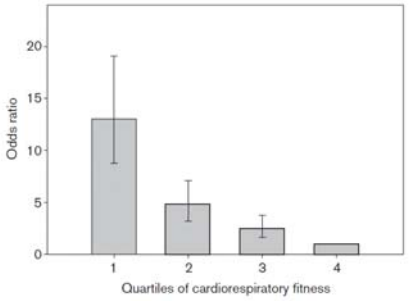
The association between MetS and fitness is supported by EYHS data

(Anderssen et al 2007, Eur J Cardiovasc Prev Rehabil 14:526–531)



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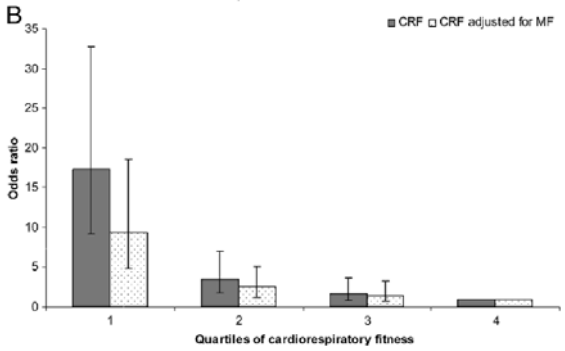
Steene-Johannessen et al 2009; MSSE 41:1351-7



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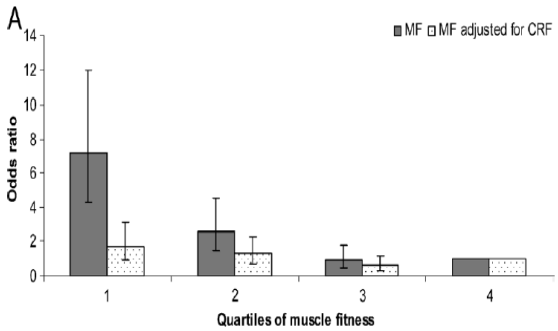
Steene-Johannessen et al 2009; MSSE 41:1351-7



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Physical activity and clustered cardiovascular risk in children: a cross-sectional study (The European Youth Heart Study)

Lars Bo Andersen, Moanke Harro*, Luis B Sardinha, Karsten Froberg, Ulf Ekelund, Søren Brage, Sigmund Alfred Anderssen

Background Atherosclerosis develops from early childhood; physical activity could positively affect this process. This study's aim was to assess the associations of objectively measured physical activity with clustering of cardiovascular disease risk factors in children and derive guidelines on the basis of this analysis.

Methods We did a cross-sectional study of 1732 randomly selected 9-year-old and 15-year-old school children from Denmark, Estonia, and Portugal. Risk factors included in the composite risk factor score (mean of Z scores) were systolic blood pressure, triglyceride, total cholesterol/HDL ratio, insulin resistance, sum of four skinfolds, and aerobic fitness. Individuals with a risk score above 1 SD of the composite variable were defined as being at risk. Physical activity was assessed by accelerometry.

Findings Odds ratios for having clustered risk for ascending quintiles of physical activity (counts per min; cpm) were 3·29 (95% CI 1·96–5·52), 3·13 (1·87–5·25), 2·51 (1·47–4·26), and 2·03 (1·18–3·50), respectively, compared with the most active quintile. The first to the third quintile of physical activity had a raised risk in all analyses. The mean time spent above 2000 cpm in the fourth quintile was 116 min per day in 9-year-old and 88 min per day in 15-year-old children.

Interpretation Physical activity levels should be higher than the current international guidelines of at least 1 h per day of physical activity of at least moderate intensity to prevent clustering of cardiovascular disease risk factors.

Lancet 2006; 368: 299–304
See Comment page 261

Department of Sports Medicine, Norwegian School of Sport Sciences, Oslo, Norway (Prof L B Andersen PhD, S A Anderssen PhD); National Institute for Health Development, Estonian Centre of Behavioural and Health Sciences, Tartu, Estonia (M Harro PhD); Faculty of Human Movement, Technical University of Lisbon, Lisbon, Portugal (Prof L B Sardinha PhD); Institute of Sport Sciences and Clinical Biomechanics, University of Southern Denmark, Odense, Denmark (K Froberg); and Medical Research Council Epidemiology Unit, Cambridge, UK (U Ekelund PhD, S Brage MPhil)

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Physical activity and sum of z-scores as continouos variable

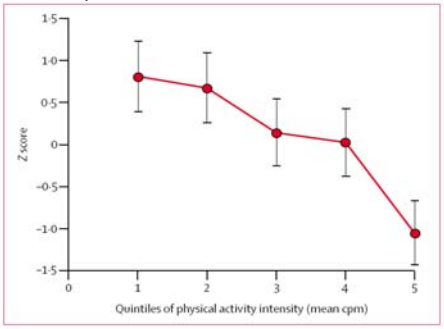

Figure 1: **Mean Z score in every quintile of average physical activity intensity**
Vertical bars=95% CI.

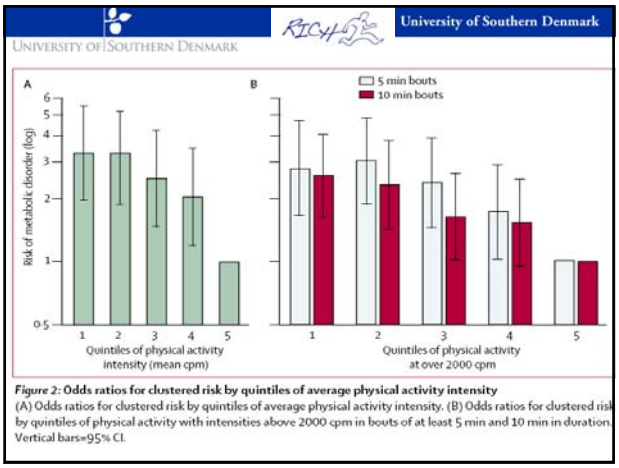

Figure 2: **Odds ratios for clustered risk by quintiles of average physical activity intensity**
(A) Odds ratios for clustered risk by quintiles of average physical activity intensity. (B) Odds ratios for clustered risk by quintiles of physical activity with intensities above 2000 cpm in bouts of at least 5 min and 10 min in duration. Vertical bars=95% CI.

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	Time >2000 cpm (min per day, SD)	Mean intensity of the minutes spent >2000 cpm (cpm, SD)
9-year-old children		
Least active quintile	38 (20)	2869 (1286)
Second quintile	69 (20)	3487 (786)
Third quintile	92 (26)	3649 (746)
Fourth quintile	116 (32)	3728 (651)
Most active quintile	167 (49)	4125 (1117)
15-year old children		
Least active quintile	34 (15)	3253 (1080)
Second quintile	53 (24)	3684 (850)
Third quintile	70 (24)	3744 (754)
Fourth quintile	88 (32)	3941 (956)
Most active quintile	131 (47)	4119 (820)

Table 3: Time per day spent at physical activity intensities above 2000 cpm in the five quintiles of physical activity, and the mean intensity

What is the problem quantifying PA?

1) There is a gradual increase in risk with lower PA, so where should we cut?
2) A statistical significant increase does not mean that it is biologically important
3) Calculation of MVPA highly depends on definition in terms of cutpoint

	Percentage fulfilling PA guidelines of 60 min/day			
	9 yr olds		15 yr olds	
MVPA cutpoint	Boys	Girls	Boys	Girls
>2000 cpm	90.5%	75.2%	54.1%	49.9%
>2500 cpm	66%	44%	32%	30%
>3000 cpm	37%	15%	21%	15%

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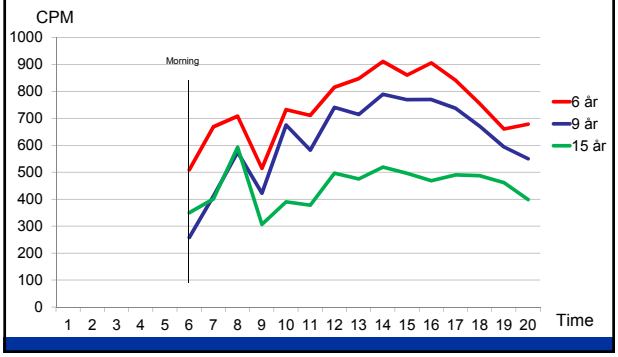
Data from Copenhagen School Child Intervention Study



What does this decrease in PA reflect?

Do we believe health deteriorate?

There are no more children with MetS at age 15 than at age 9 yr

It could just reflect a more intermittend PA behaviour with longer bouts of continuous PA and longer sedentary time

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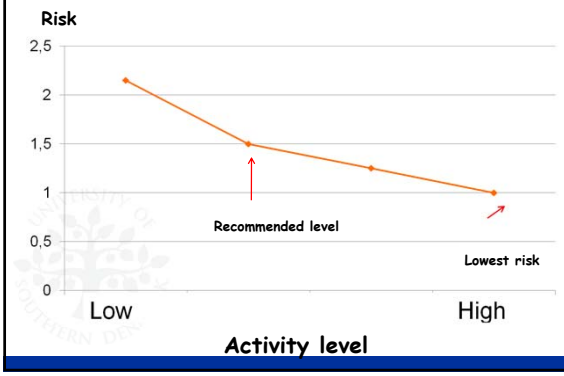
Basic idea of PA recommendations

Contrary to recommendations of smoking, Pa recommendations do not target to illiminate risk – just to reduce risk to an 'acceptable' level

Recommendations reflect a balance between risk reduction and motivating the least active

Hypothetical dose-response curve



Examples of interventions

We started a program of interventions in 2000

There is a balance between the strength (amount and intensity) of the intervention and the risk that it is impossible to implement it on large scale

Progression in school based physical education interventions

1) We doubled PE-lessons in the Copenhagen Schoolchild intervention Study (from 1 to 2 double lessons)
2) We tried 1 hour of PA during school hours in Sogndal
3) In Svendborg we are trying 3 double lessons

Results from Copenhagen Schoolchild Intervention Study

- Improvements were found in waist, VO2 and fasting glucose
- Improvements were significant - but small

Improved facilities for play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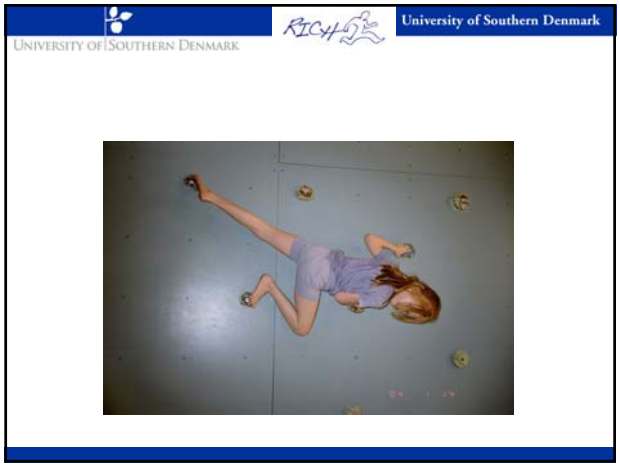
Indoor equipment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However

- **We still only found modest improvements compared to the control group**
- **We therefore tested the effect of a much stronger intervention**

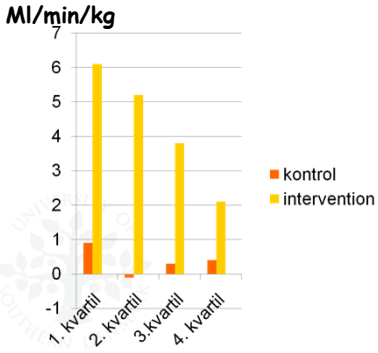
INTERVENTION 125 children; 60 min physical activity in school every day over 2 y

CONTROL 131 children; 2x45 min ordinary physical education each week over 2 y

The PA lessons were planned, organized and led by expert physical education (PE) teachers

The intervention resulted in a greater beneficial development in systolic (P=0.003) and diastolic (P=0.002) BP, C/HDL ratio (P=0.011), triglyceride (P=0.030) and peak oxygen uptake (P<0.001)

Sogndal: Resaland et al Scand J Med Sci Sports, 2009



Change in fitness

The least fit children at baseline improved 15% and the most fit 3% compared to the control group

Other types of interventions

Open Access

BMJ open

Bicycling to school improves the cardiometabolic risk factor profile: a randomised controlled trial

Lars Østergaard,[1] Line A B Børrestad,[1,2] Jakob Tarp,[1] Lars Bo Andersen[1,3]

BMJ Open 2012

Table 3 Absolute and relative bicycling intensity, speed and distance to school by gender in the entire intervention group (ie, both compliant and non-compliant participants included)

	Average intensity (bp/min)	Peak intensity (bp/min)	Average intensity (% of max HR)	Relative peak intensity (% of max HR)	Average speed (km/h)	School bicycling (km)	Total bicycling (km)
Boys	138.5 (15.8)	164.4 (17.9)	72.0 (7.4)	85.5 (8.7)	13.1(3.4)	124.4 (119.5)	211.6 (100.1)
Girls	146.6 (17.3)	171.9 (17.0)	75.2 (7.7)	88.2 (7.1)	13.9 (4.2)	109.7 (63.4)	177.8 (64.0)

Data presented as mean and SD values.
bp/min, beats per minute.

N=58

Based upon intention-to-treat

Clustering of cardiometabolic risk factors was lowered by 0.58 SD (95% CI −1.03 to −0.14) in the bicycling group compared to the control group.

Cardiorespiratory fitness (l O2/min) per se did not increase significantly more in the intervention than in the control group

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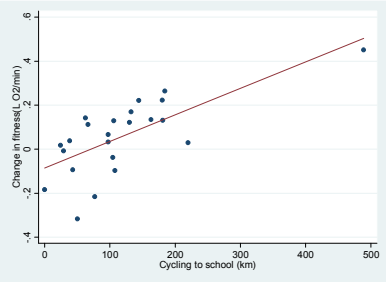
RCT with cycling to school (Ostergaard et al BMJopen 2011)



Intention-to-treat analysis showed an improvement in composite risk factor score of 0.58 SD

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Effective interventions are possible to implement

However, why is it so difficult to make the changes in the school?

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I think we must convince teachers in school and politicians about the beneficial effect of PA on cognitive function and potential improvement in the theoretical subjects

Studies have clearly shown association between fitness and intelligence/executive function and have come up with biological plausible explanations

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Cardiovascular fitness is associated with cognition in young adulthood

Maria A. I. Åberg[a,b], Nancy L. Pedersen[c,d], Kjell Torén[e], Magnus Svartengren[f], Björn Bäckstrand[g], Tommy Johnsson[h], Christiana M. Cooper-Kuhn[a], N. David Åberg[a,i], Michael Nilsson[a,1], and H. Georg Kuhn[a,1]

20906–20911 | PNAS | December 8, 2009 | vol. 106 | no. 49

Fitness and cognition

An epidemiological study

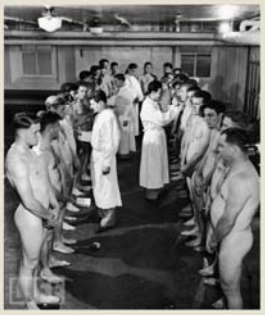
- Is there a correlation between fitness and cognition?

Slides borrowed from George Kuhn

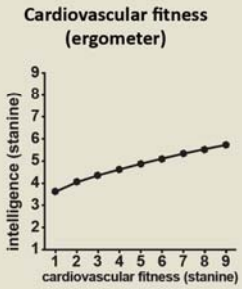
Fitness and cognition

An epidemiological study

- Military conscription test
  - standardized IQ test
  - Medical examination
  - Psychological examination
  - Physical fitness tests
    - Ergometer (bicycle test – Wmax)
    - Muscle strength (Isometric 4 muscle groups)

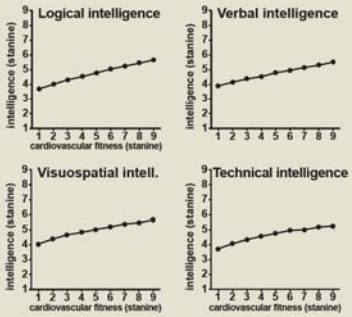


IQ and fitness



IQ and cardiovascular fitness

IQ subcategories



Twins

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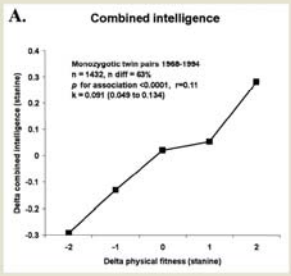

Fitness and brain diseases later in life

- **Depression**
- **Dementia**
- Anxiety
- Bipolar disorder
- Schizophrenia
- Epilepsy
- Stroke
- Parkinson's disease

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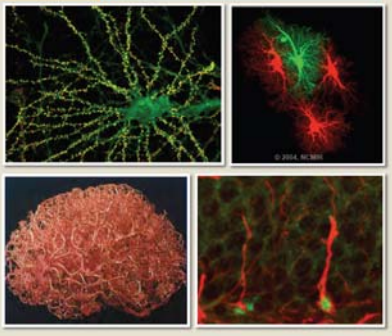
Neuroplasticity

- Neurons
  - Synapses
  - Dendrites
- Glial cells
- Vasculature
- Stem cells



Hippocampus & memory

- Relay station for memory consolidation
- Association of memories with context/sensory information
- Timing and sequence

H.M.
Henry Gustav Molaison
1926 – 2008

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Why this association?

Hippocampus is stimulated by a protein: Brain derived neurotrophic factor (BDNF)

BDNF is strongly associated with insulin sensitivity and therefore all the risk factors we have studied for years

It is excreted during acute PA and increased in the trained subject

(see Huang et al, Scand J Med Sci Sports 2013)

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So, PE may not yet be increased in school, but we have reasons to be optimistic!

Thank you!