Fit or fat?
Adiposity, physical activity, insulin resistance and blood pressure in children

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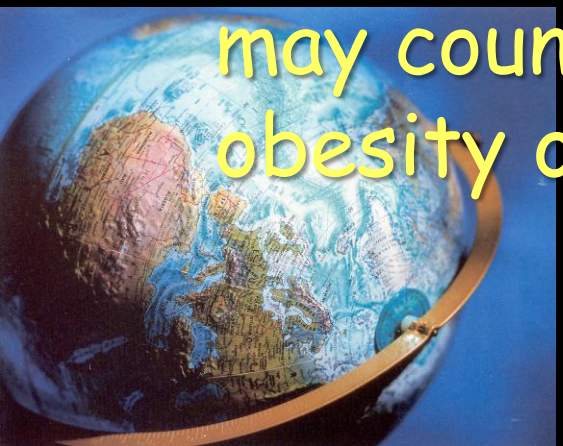
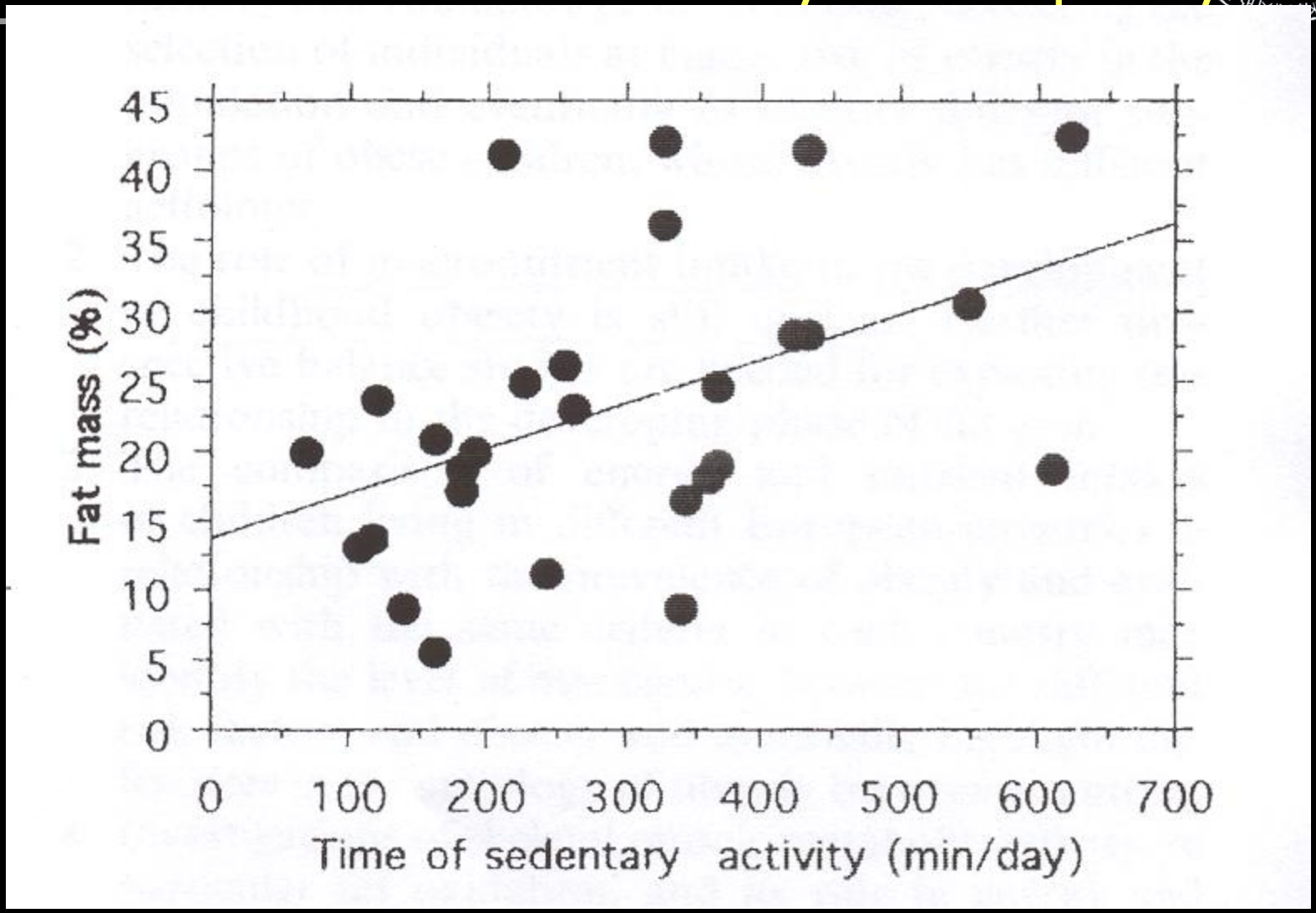
Fitness versus fatness

- Prevalence of childhood obesity is increasing over the last years
- Excess adiposity is associated, among others, with insulin resistance, vascular and CNS dysfunction, elevated blood pressure etc
- Fitness and in particular of aerobic type may counteract some of these effects of obesity on health



Association between inactivity and adiposity



Maffeis et al. J Pediatr 1997;131:288-92

Association between physical activity, fitness and adiposity

Activity Measure/Group	Correlations With Endurance Time (Bruce test)			Correlations With Log Σ7 Skinfolds		
	r	*P*	*n*	*r*	*P*	*n*
	All days combined					
ΣTritrac						
All	0.66*	0.000	32	−0.42†	0.015	33
Boys	0.64*	0.007	16	−0.28	0.279	17
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Rowland et al. J Appl Physiol 1999;86:1428-35

The role of aerobic fitness

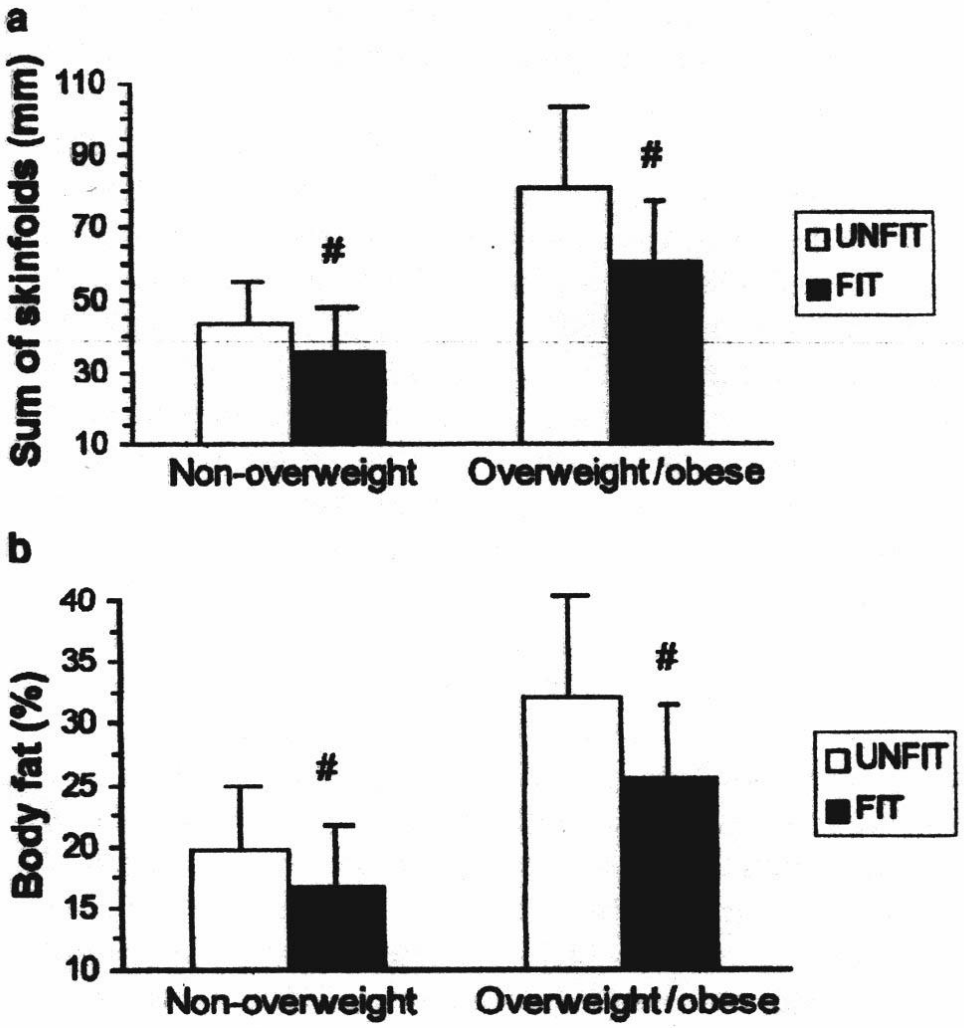
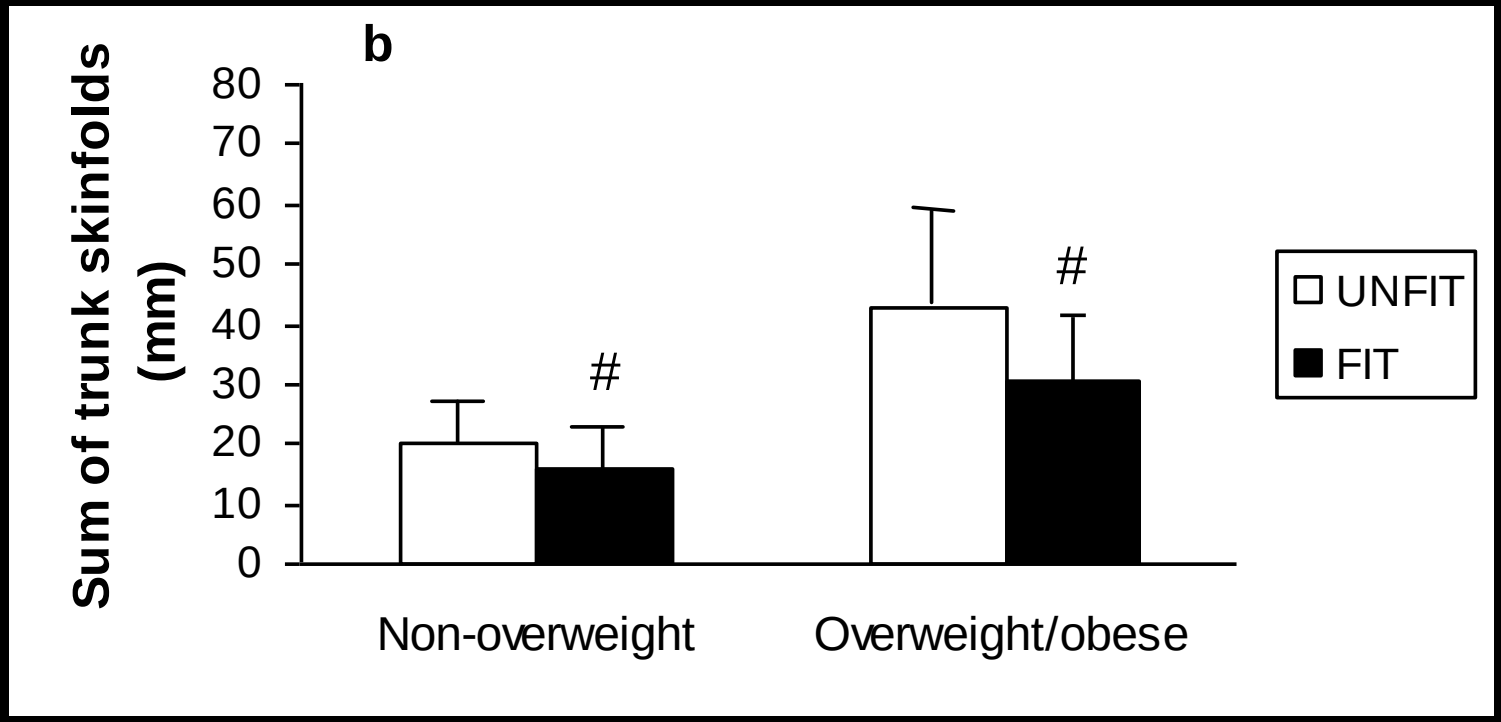


Figure 2 Sum of skinfolds (a) and per cent body fat (b) for the nonoverweight and overweight/obese children with high (fit) and low (unfit) CRF (means ± s.d.). # $P<0.01$ between fit and unfit within the same BMI category.

Nassis et al (2005) Eur J Clin Nutr 59:137-141

The role of aerobic fitness



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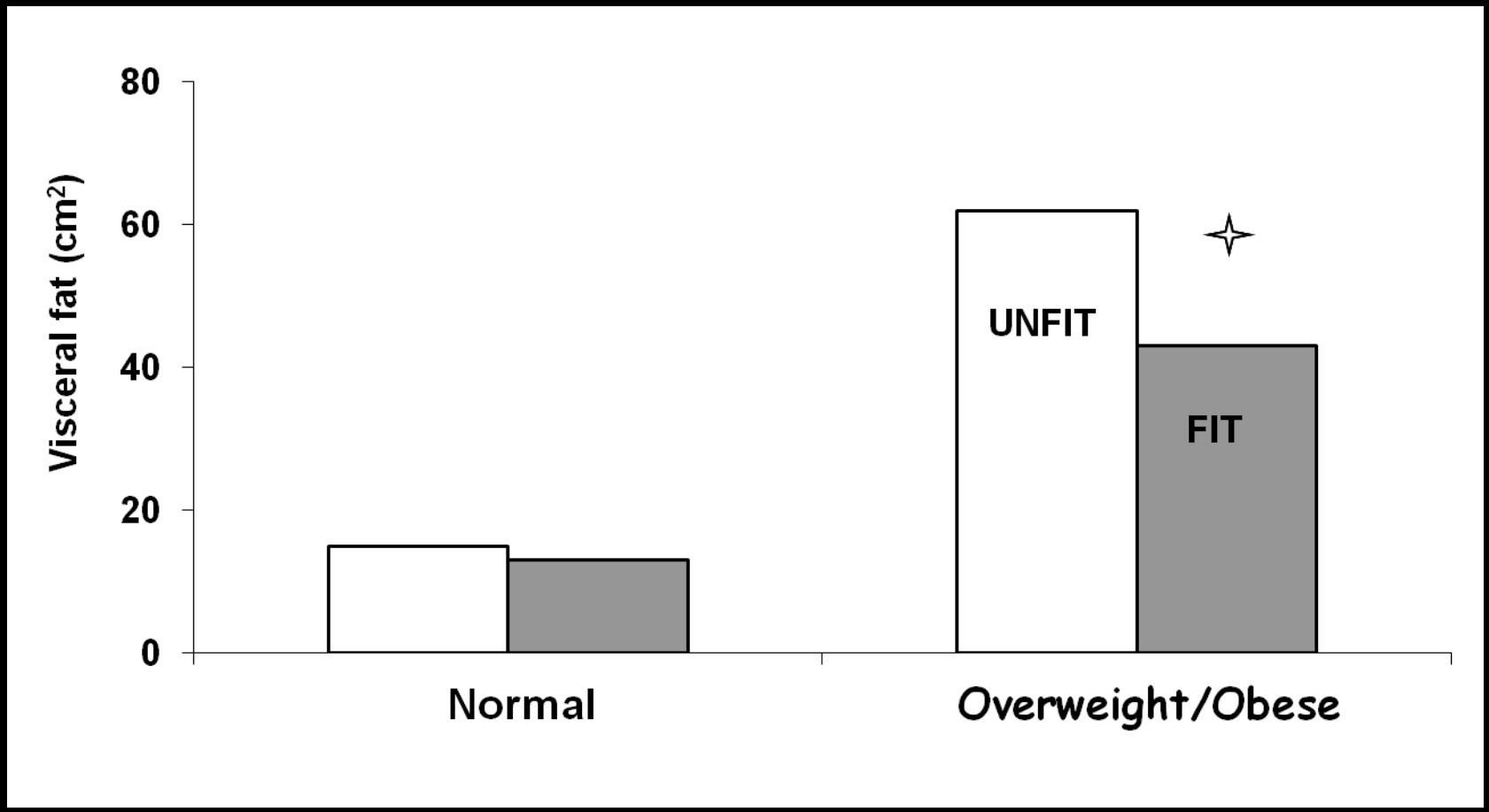
The role of aerobic fitness

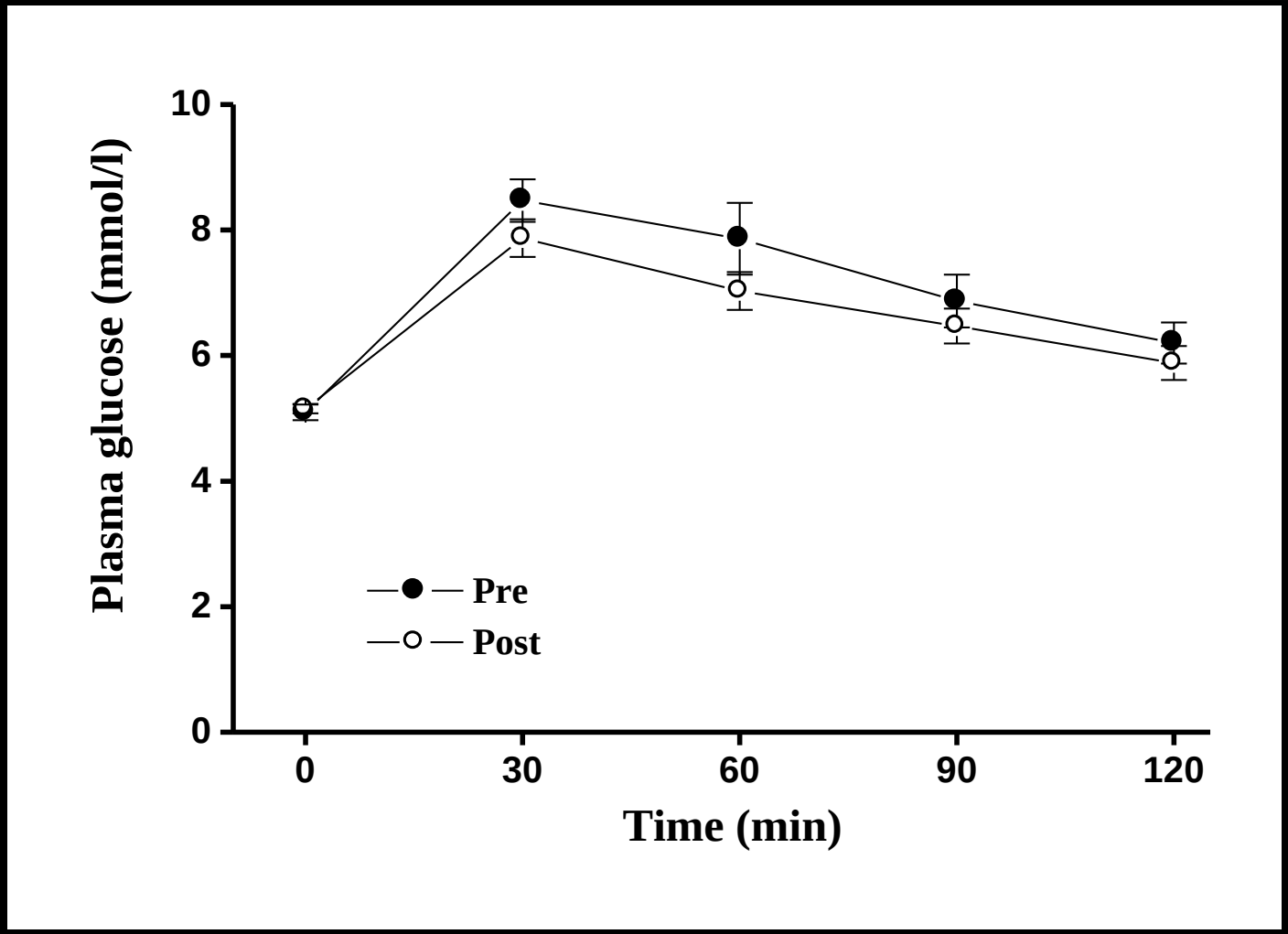


Lee & Arslanian (2007) Eur J Clin Nutr 61:561-565

Conclusion

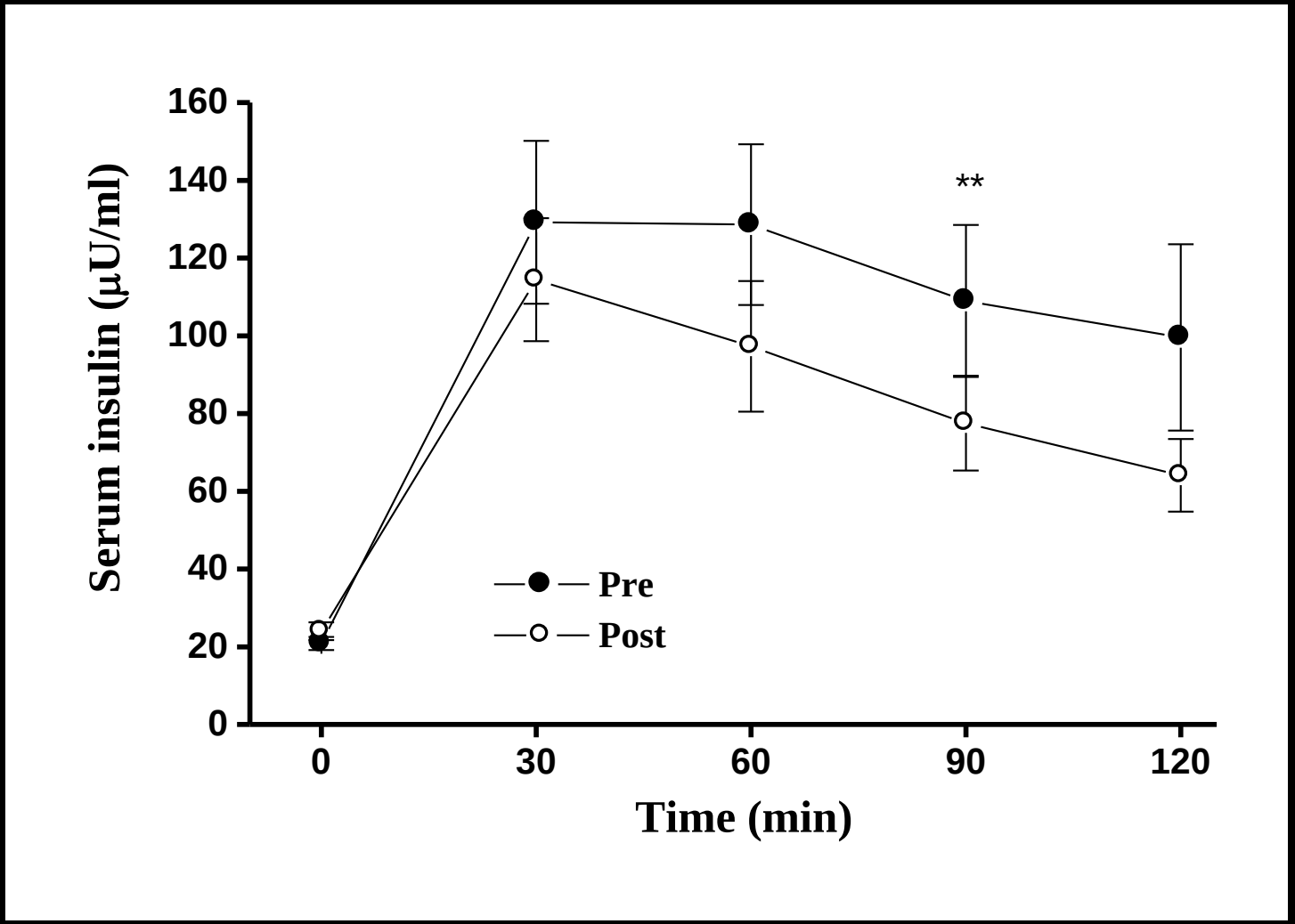
It seems, therefore, that aerobic (cardiorespiratory) fitness has an independent role on risk factors in overweight and obese children and adolescents

Plasma glucose responses during the 2-hour OGTT before and after 12 weeks of aerobic training in overweight and obese girls. Mean±SE



Nassis et al. (2005) Metabolism 54:1472-9

Serum insulin responses during the 2-hour OGTT before and after 12 weeks of aerobic training in overweight and obese girls . Mean±SE, **P< 0.01 vs post-intervention



Nassis et al. (2005) Metabolism 54:1472-9

Conclusion

It appears that an increase in cardiorespiratory fitness may improve insulin sensitivity without changes in body weight and adiposity in overweight and obese children

Caloric Restriction with or without Exercise: The Fitness versus Fatness Debate

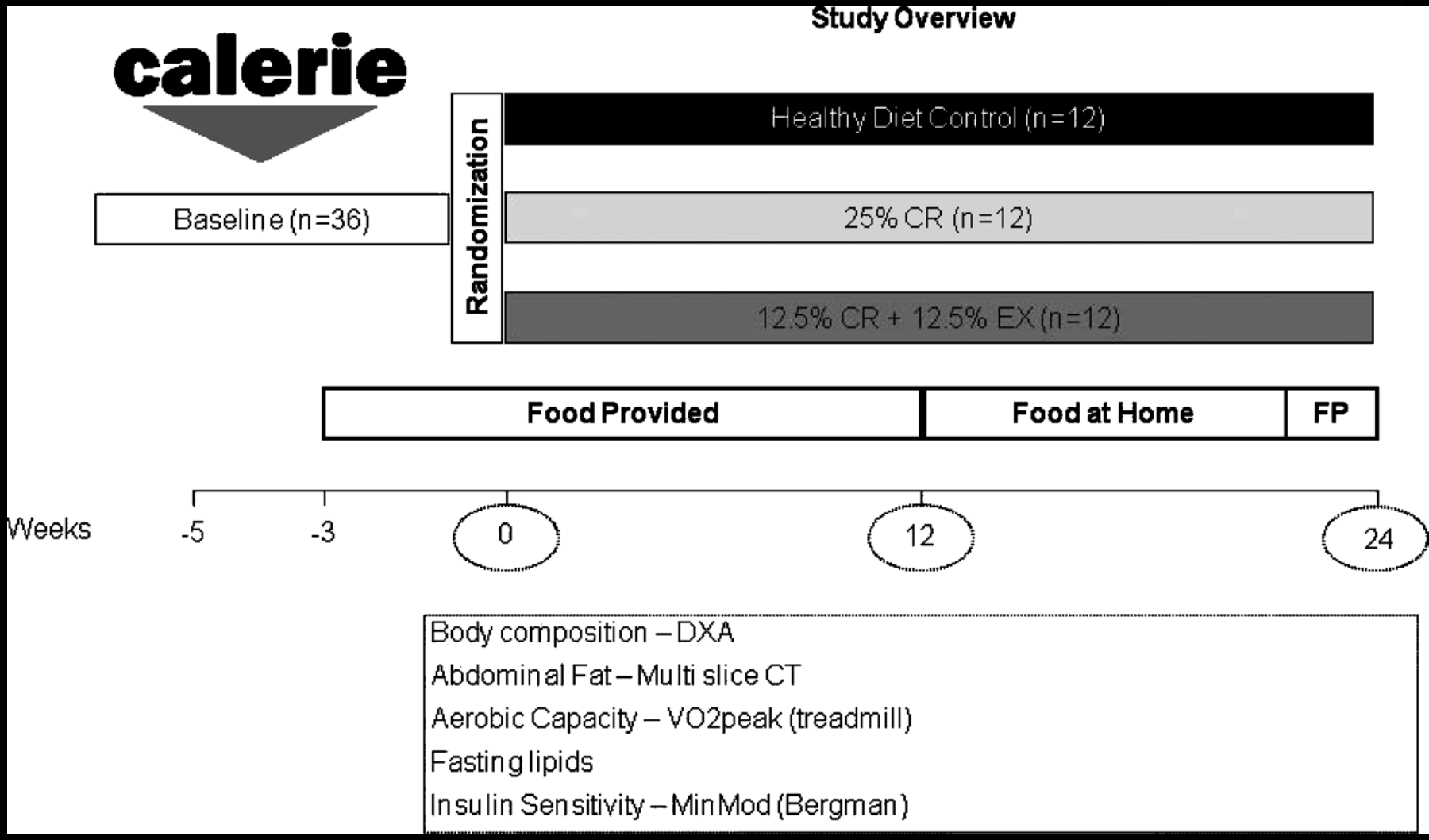
D. ENETTE LARSON-MEYER[1,2], LEANNE REDMAN[1], LEONIE K. HEILBRONN[3], CORBY K. MARTIN[1], and ERIC RAVUSSIN[1]

[1]*Pennington Biomedical Research Center, Louisiana State University, Baton Rouge, LA;* [2]*University of Wyoming, Laramie WY; and* [3]*Garvan Institute, Sydney, AUSTRALIA*

ABSTRACT

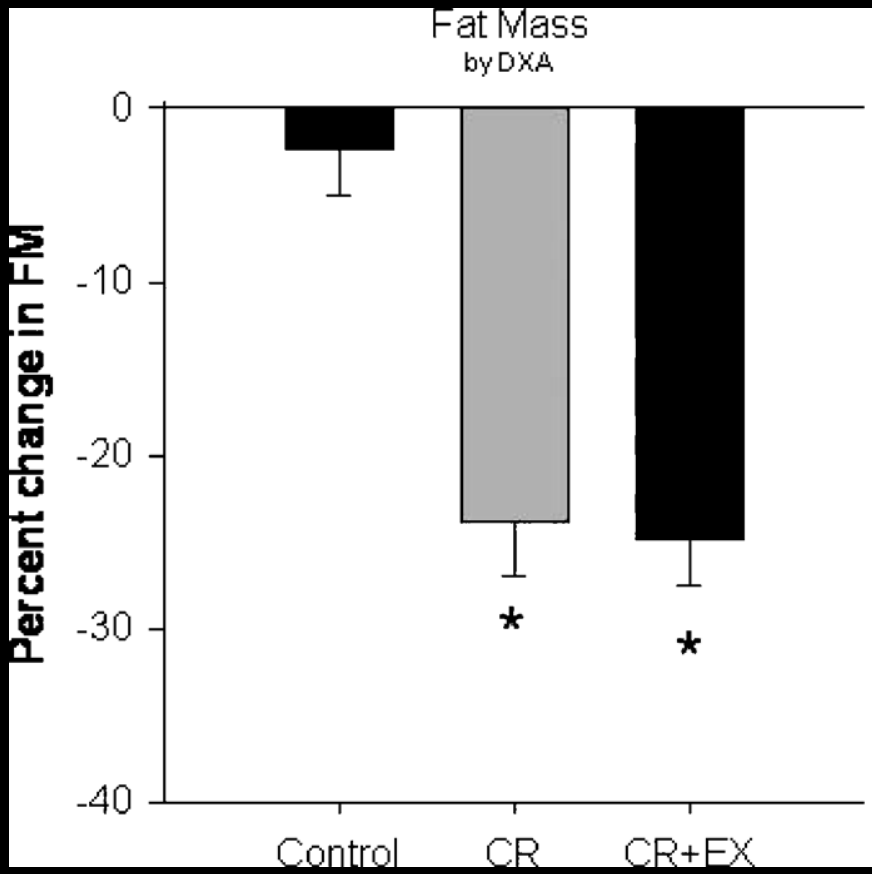
LARSON-MEYER, D. E., L. REDMAN, L. K. HEILBRONN, C. K. MARTIN, and E. RAVUSSIN. Caloric Restriction with or without Exercise: The Fitness versus Fatness Debate. *Med. Sci. Sports Exerc.*, Vol. 42, No. 1, pp. 152–159, 2010. There is a debate over the independent effects of aerobic fitness and body fatness on mortality and disease risks. **Purpose**: To determine whether a 25% energy deficit that produces equal change in body fatness leads to greater cardiometabolic benefits when aerobic exercise is included. **Methods**: Thirty-six overweight participants (16 males/20 females) (39 ± 1 yr; 82 ± 2 kg; body mass index = 27.8 ± 0.3 kg·m^2, mean ± SEM) were randomized to one of three groups (n = 12 for each) for a 6-month intervention: control (CO, weight-maintenance diet), caloric restriction (CR, 25% reduction in energy intake), or caloric restriction plus aerobic exercise (CR + EX, 12.5% reduction in energy intake plus 12.5% increase in exercise energy expenditure). Food was provided during weeks 1–12 and 22–24. Changes in fat mass, visceral fat, $\dot{V}O_{2peak}$ (graded treadmill test), muscular strength (isokinetic knee extension/flexion), blood lipids, blood pressure, and insulin sensitivity/secretion were compared. **Results**: As expected, $\dot{V}O_{2peak}$ was significantly improved after 6 months of intervention in CR + EX only (22 ± 5% vs 7 ± 5% in CR and −5 ± 3% in CO), whereas isokinetic

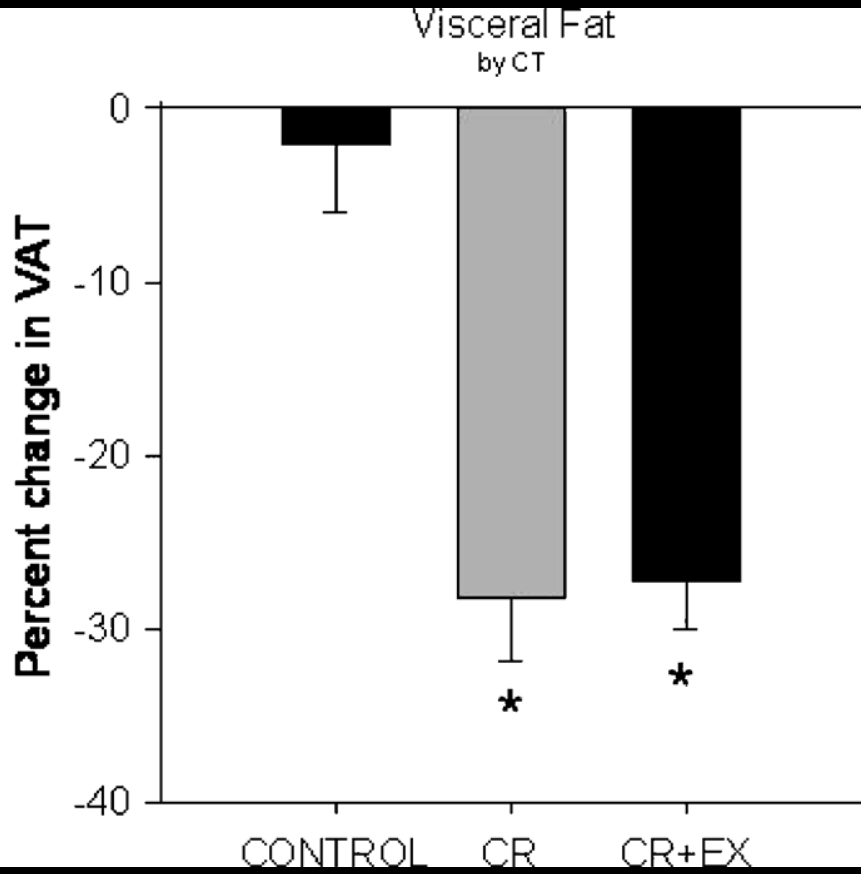
The Fitness vs Fatness debate



Larson-Meyer et al. (2010) Med Sci Sports Exerc 42:152-159

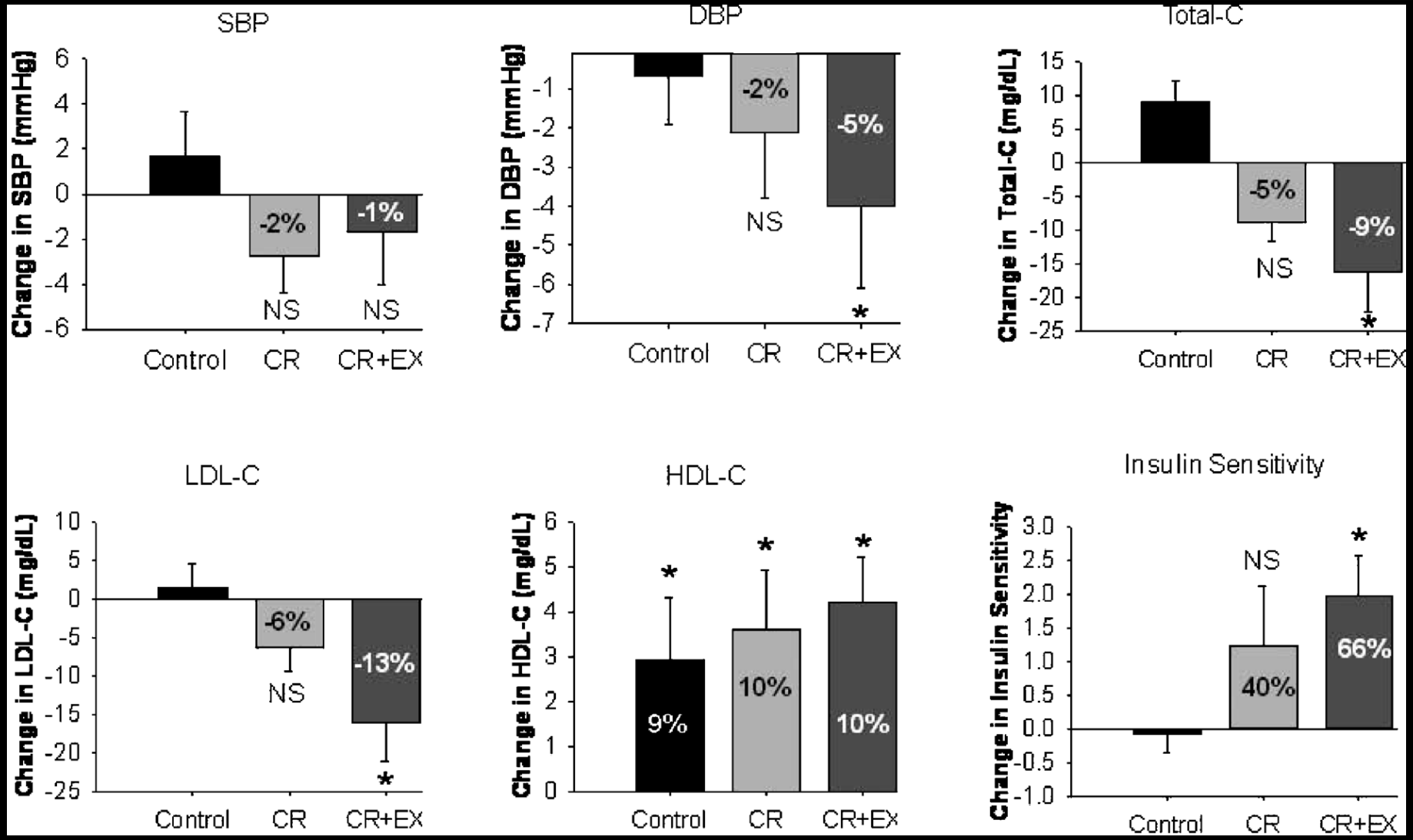
Effect of diet and physical training on body composition





Larson-Meyer et al (2010) Med Sci Sports Exerc 42:152-159

Effect of physical training on risk factors



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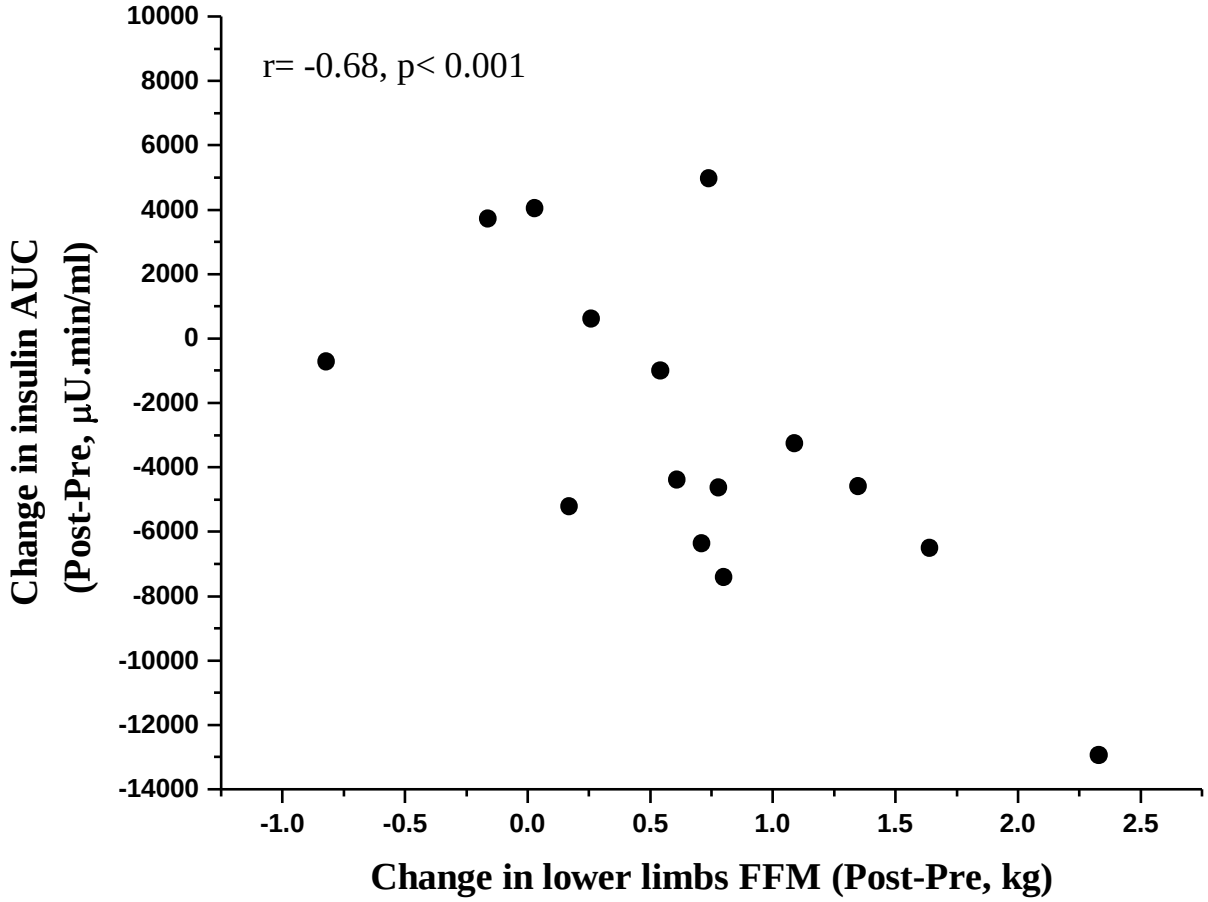
FFM and insulin resistance



Nassis et al. (2005) Metabolism 54:1472-9

BMJ

RESEARCH

Thigh circumference and risk of heart disease and premature death: prospective cohort study

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doi:10.1136/bmj.b3292

ABSTRACT

Objective To examine associations between thigh circumference and incident cardiovascular disease and coronary heart disease and total mortality.

Design Prospective observational cohort study with Cox proportional hazards model and restricted cubic splines.

Setting Random subset of adults in Denmark.

Participants 1436 men and 1380 women participating in the Danish MONICA project, examined in 1987-8 for height, weight, and thigh, hip, and waist circumference, and body composition by impedance.

Main outcome measures 10 year incidence of cardiovascular and coronary heart disease and 12.5 years of follow-up for total death.

Results A small thigh circumference was associated with an increased risk of cardiovascular and coronary heart diseases and total mortality in both men and women. A threshold effect for thigh circumference was evident, with greatly increased risk of premature death below around 60 cm. Above the threshold there seemed to be no additional benefit of having larger thighs in either sex. These findings were independent of abdominal and general obesity, lifestyle, and cardiovascular risk factors such as blood pressure and lipid concentration.

Conclusion A low thigh circumference seems to be associated with an increased risk of developing heart disease or premature death. The adverse effects of small thighs might be related to too little muscle mass in the region. The measure of thigh circumference might be a relevant anthropometric measure to help general practitioners in early identification of individuals at an increased risk of premature morbidity and mortality.

INTRODUCTION

Several studies have shown a U-shaped association between body mass index (BMI) and mortality, suggesting both a high and a low BMI are associated with premature death.[1] More recent data suggest that while the increased risk seen with a high BMI is mirrored by the risk associated with a high body fat mass, the risk observed at low BMI seems more closely linked to the risk associated with low fat free mass than low fat mass.[2,3] A larger hip circumference relative to BMI and waist circumference seems a strong inverse predictor of both morbidity and mortality.[4-7] In this context, a recent study suggested that lower body muscle mass is particularly related to the development of type 2 diabetes. Indeed, studies have reported that insulin resistance could be provoked in lower body muscle, such as leg muscle, but not in arm muscle,[8,9] suggesting that the size of the lower body muscle might have great relevance for developing type 2 diabetes. These findings are in line with results from a study among patients with chronic obstructive pulmonary disease, a condition characterised by wasting of muscle, particularly of the lower extremities, which found that the cross sectional area of mid-thigh muscle was a far better predictor of mortality than BMI.[10] Lower body fat, however, might also offer cardioprotection through endocrine secretion of various adipokines, such as adiponectine, a peptide with apparent anti-inflammatory properties.[11-13] In particular, low subcutaneous fat in the thighs leads to adverse glucose and lipid metabolism.[14]

We do not know whether thigh size is independently related to cardiovascular and coronary heart disease or premature death among the general population. We therefore examined associations between thigh circumference and early total mortality and morbidity from heart disease. We hypothesised that a threshold effect would be evident, above which no further protection from large thighs would be evident because of a sufficient thigh tissue mass.

METHODS

Sample

Of those invited to participate, 2987 (83%) people born in 1922, 1932, 1942, or 1952, and with a mean age of 50.1 (SD 10.8) in men and 49.7 (SD 10.9) in women at examination in 1987-8, had their height, weight, and thigh, hip, and waist circumference measured as part of the Danish MONICA (monitoring trends in and determinants of cardiovascular disease) project,[15] an international study conducted under the auspices of the World Health Organization.[16] Body fat mass and lean body mass was estimated from impedance measures, by using an equation developed previously for estimating body composition specifically for this population sample.[17] We included in this study only the 1436 men and 1380 women who were free from

Heitmann et al (2009) BMJ 339:b3292

Muscle mass and risk factors

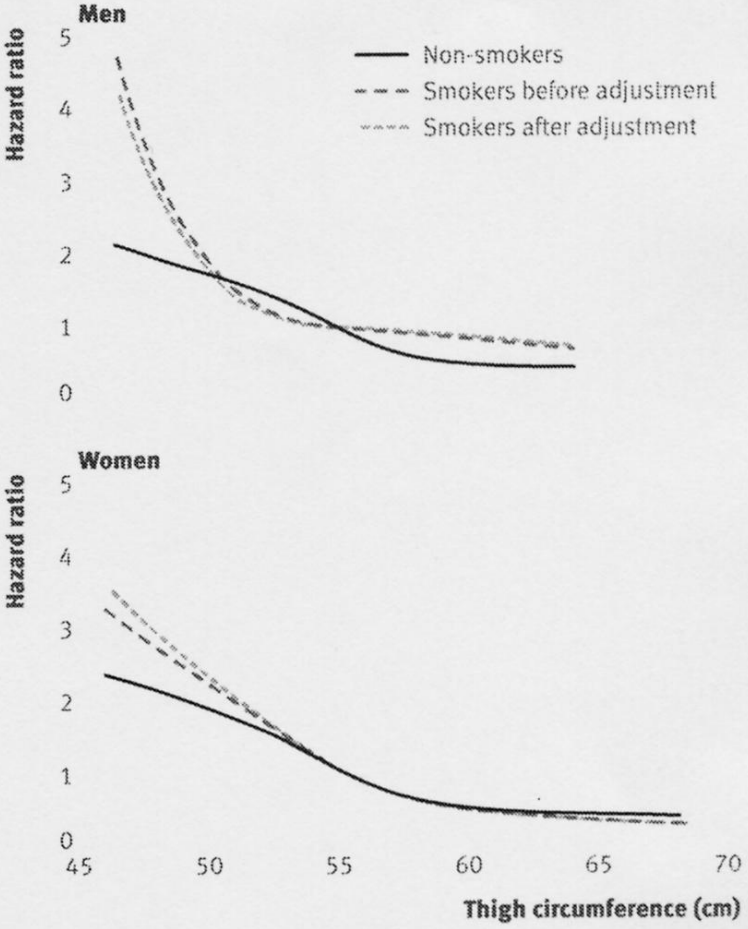

Fig 3| Hazard ratio for total death according to thigh circumference among 1436 men and 1380 women. Model 3 for non-smokers, adjusted for education, physical activity, menopause in women, BMI, and waist circumference; and for smokers, before and after additional adjustment for pack years

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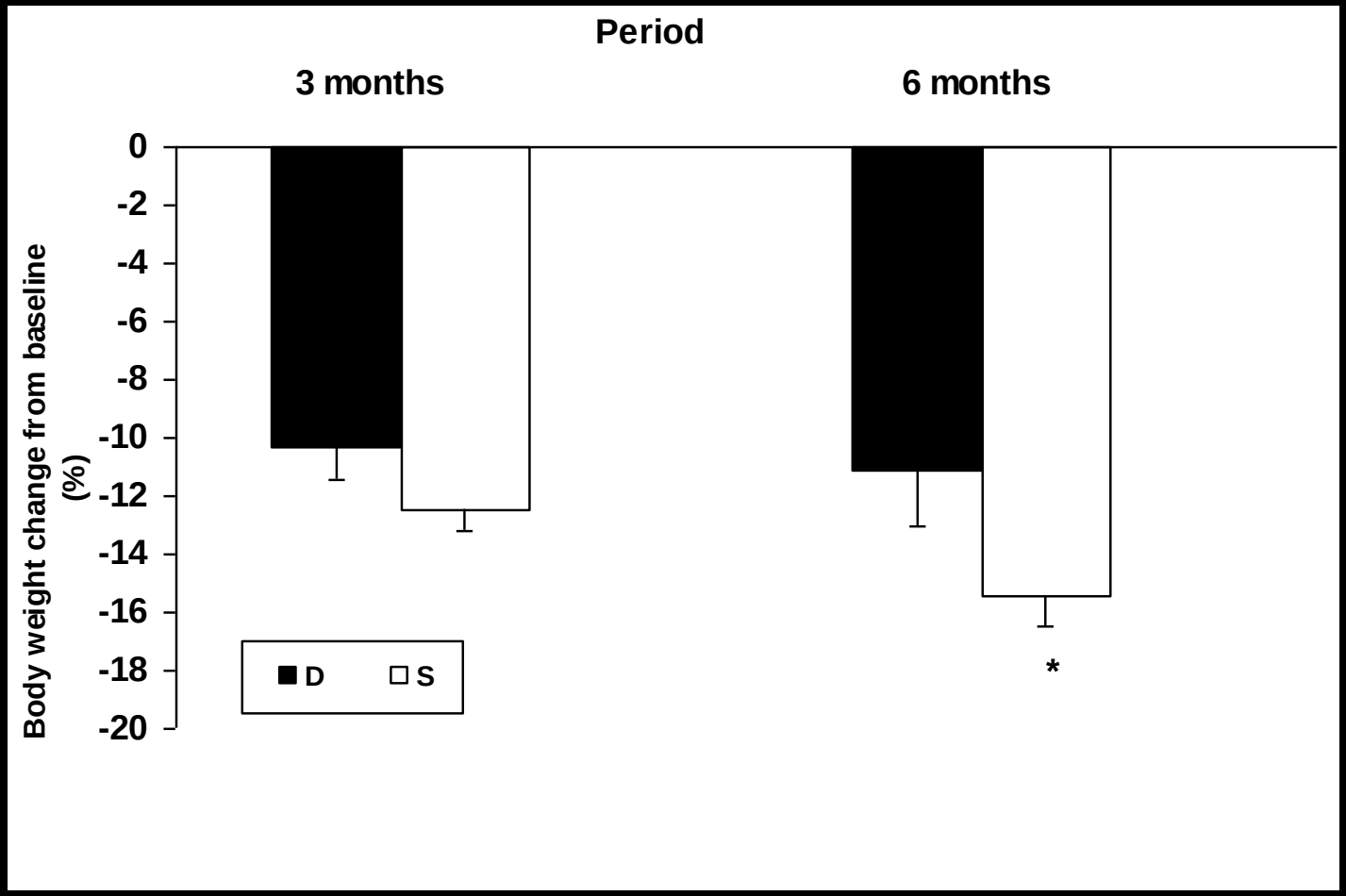
Muscle mass and risk factors

Is there a threshold for muscle mass to observe beneficial effects on health?

Is there a threshold for cardiorespiratory fitness to observe beneficial effects on health?

It seems that there is a critical weight loss to observe significant improvements in insulin resistance in obesity



Florakis et al (2009) Int J Obes 32:692-9

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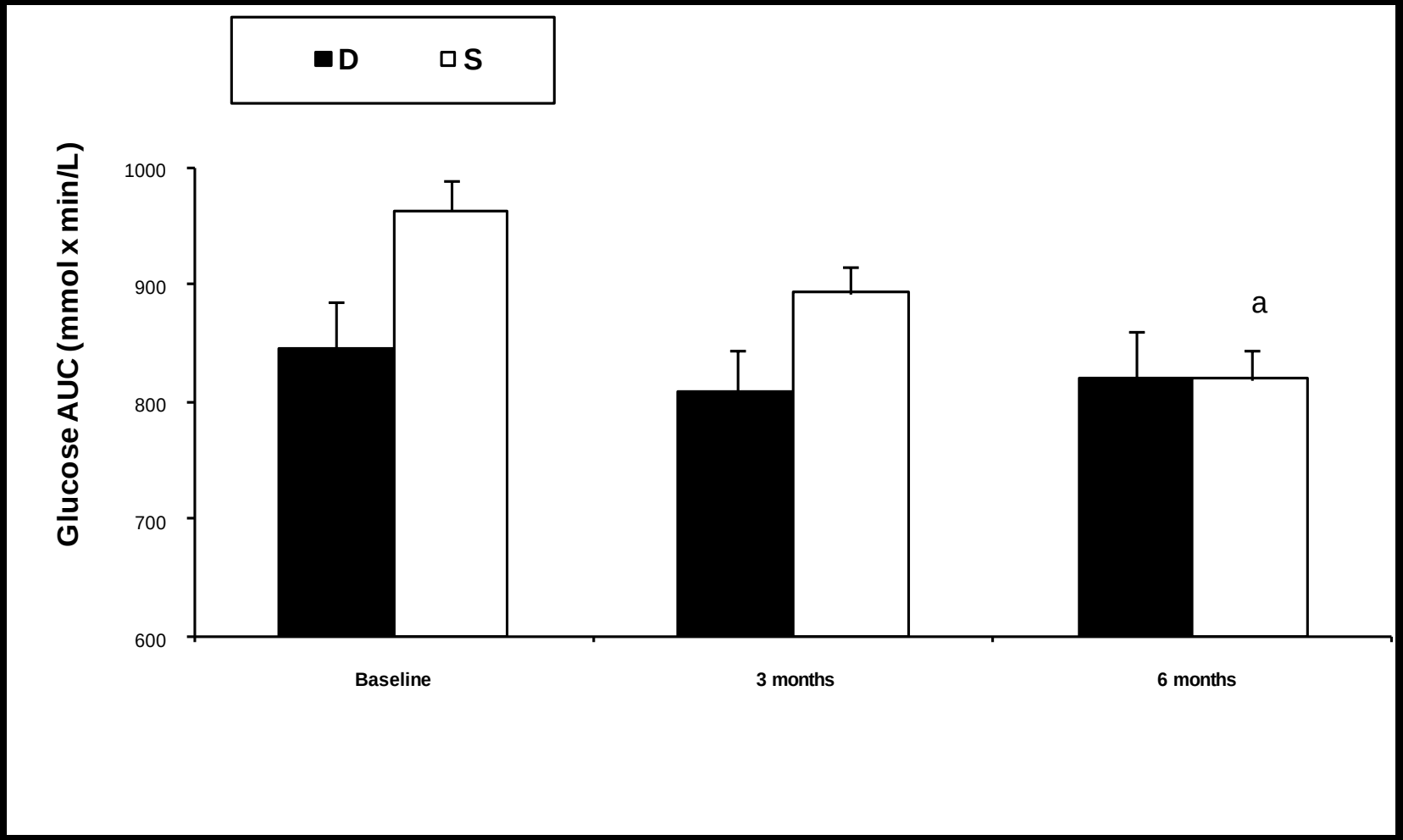

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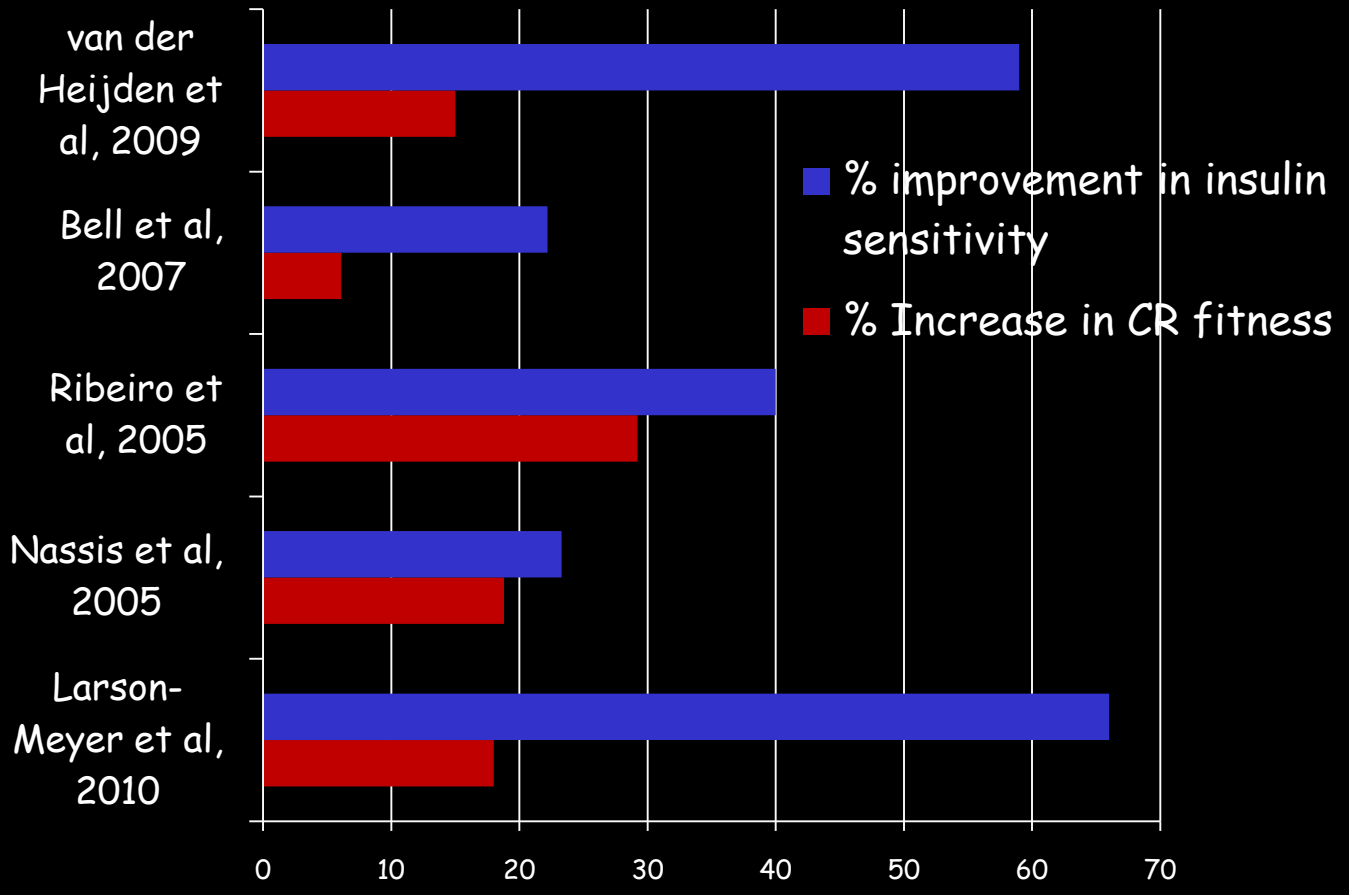
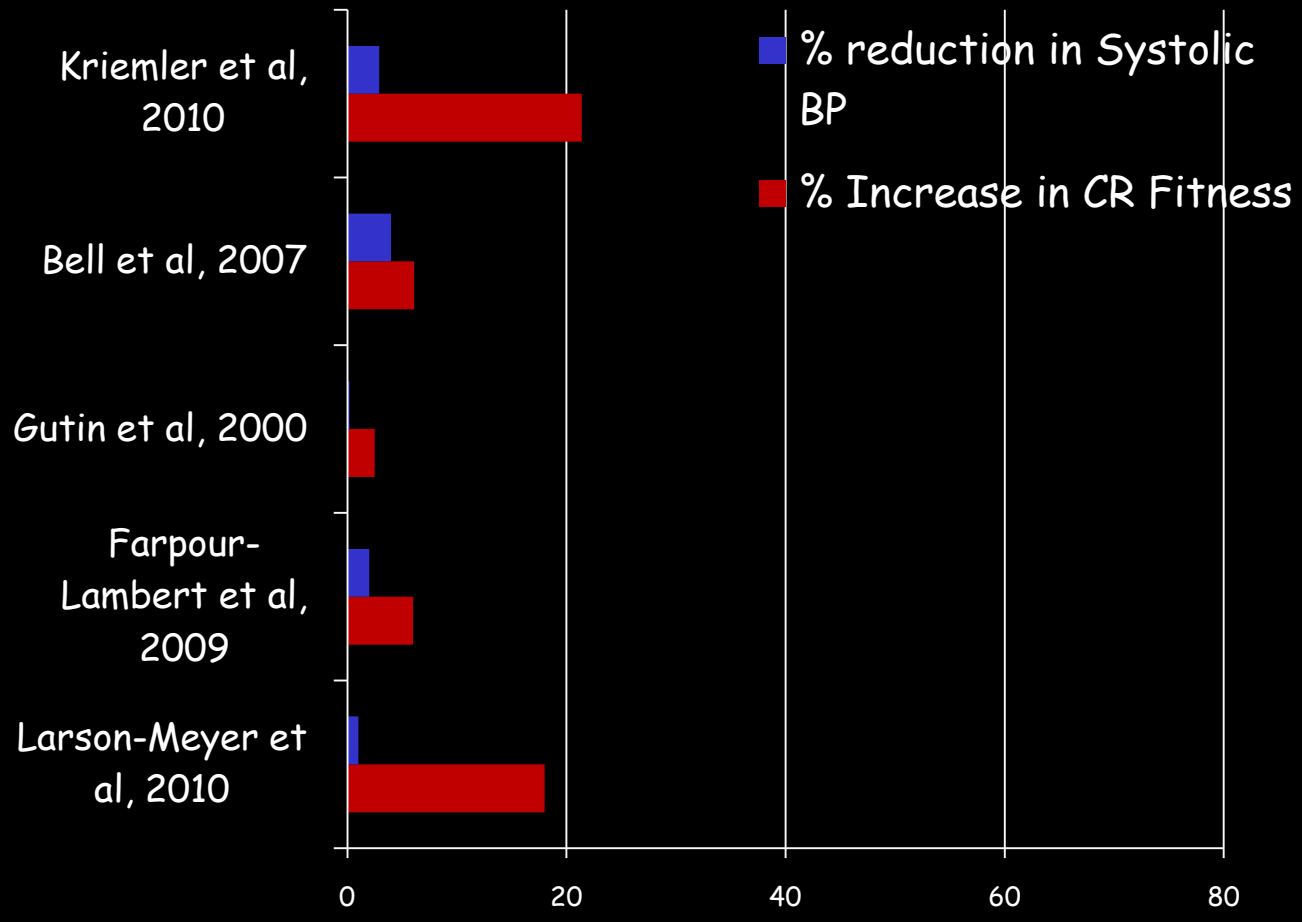
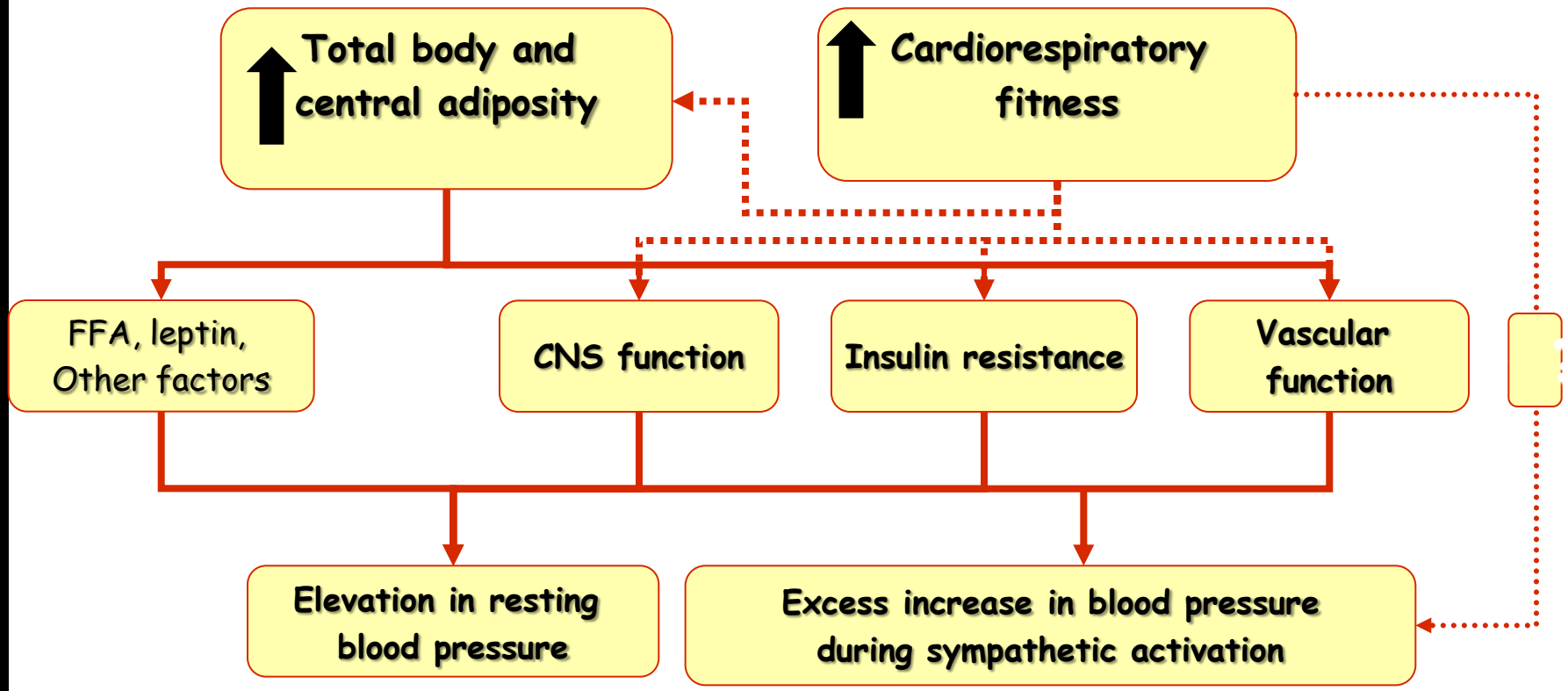
How much improvement in cardiorespiratory (CR) fitness is enough for insulin sensitivity increase?



How much improvement in cardiorespiratory (CR) fitness is enough for resting blood pressure reduction?



Effect of cardiorespiratoyr fitness and obesity on risk factors (insulin resistance, blood pressure)



Physical activity or fitness?

Which is the most important?

Conclusions

- Exercise at moderate to vigorous intensity, that increases aerobic fitness, should be the target in pediatric population

Conclusions

- In addition, the promotion of a physically active lifestyle in overweight youth is important in reducing the risk of subsequent disease in the absence of weight loss

Study group

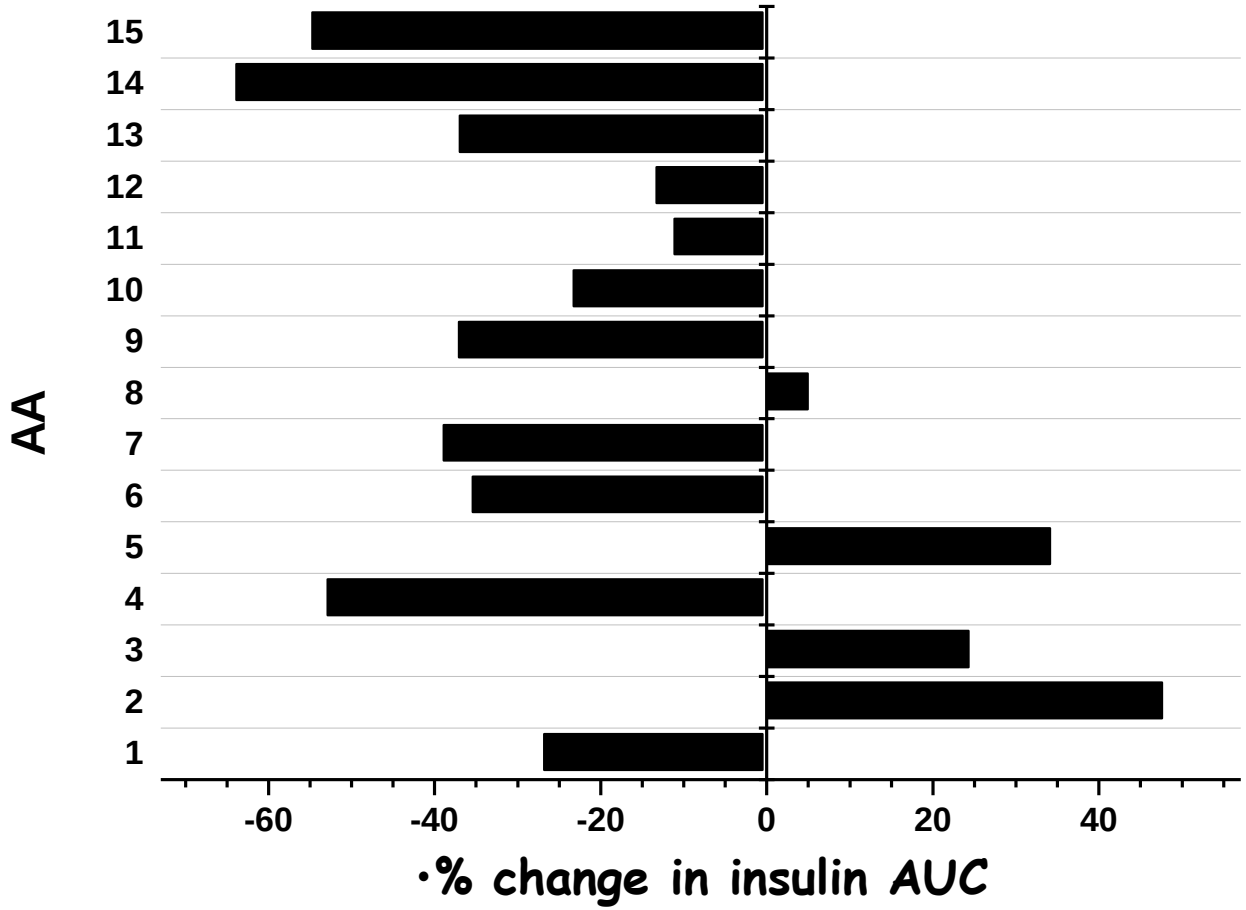
- Professor LS Sidossis, Harokopio University
- Professor N Geladas, Athens University
- Professor G Chroussos, Athens University
- Ass Prof S Kavouras, Harokopio University
- Ass Prof M Yannakoulia, Harokopio University
- K Papadakou, MSc, Harokopio University
- K Skenderi, PhD, Harokopio University
- M Krekoukia, MSc, Harokopio University
- G Psarra, PhD, Harokopio University
- C Legantis, MSc, Athens University

Conclusions

- Elevated physical activity and cardiovascular fitness are associated with reduced adiposity in youth

- An increase in aerobic fitness is associated with improved insulin sensitivity in obese children. This effect might be without changes in total and central adiposity

Individual responses



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Evidence

- Cross-sectional studies
- Intervention studies

Physical activity or fitness?

Which is the most important?

Variables	Intervention (n=297)		Control (n=205)	
	Before	After	Before	After
Skinfolds (mm)	32.11 (13.23)	32.50 (14.67)	31.32 (12.82)	33.70 (17.24)
Shuttle run (stages)	5.6 (2.3)	6.8 (2.2)	5.8 (2.1)	6.7 (1.9)
Total physical activity (counts/min)	770 (197)	726 (181)	792 (204)	728 (225)
In school	807 (276)	870 (217)	828 (292)	738 (235)
Out of school	755 (217)	653 (197)	777 (209)	722 (248)
Total MVPA (min/day)	106 (36)	106 (34)	106 (33)	97 (34)
In school	38 (16)	45 (14)	37 (14)	32 (12)
Out of school	67 (27)	61 (25)	69 (25)	66 (28)
Physical quality of life	53.4 (8.9)	53.7 (8.7)	53.2 (7.7)	53.9 (6.5)
Psychological quality of life	52.5 (6.9)	52.3 (7.7)	53.0 (6.5)	52.0 (7.3)

ICC=intraclass correlation coefficient; MVPA=moderate and vigorous physical activity.
*Adjusted difference in average z score of respective outcome at follow-up between intervention and control group with 95
for grade, sex, and z score at baseline in mixed linear model with random effect for school class.

Kriemler et al. BMJ 2010 340:c785

Questions

- Is reduction in fatness necessary in light of adequate fitness (aerobic)?
- Does improvement in fitness or fatness independently change risk factors for CVD and metabolic syndrome?
- Is the intensity of physical activity important?
- Is physical activity more important than fitness?