Exercise Interventions for Improvement of Body Composition in Youths

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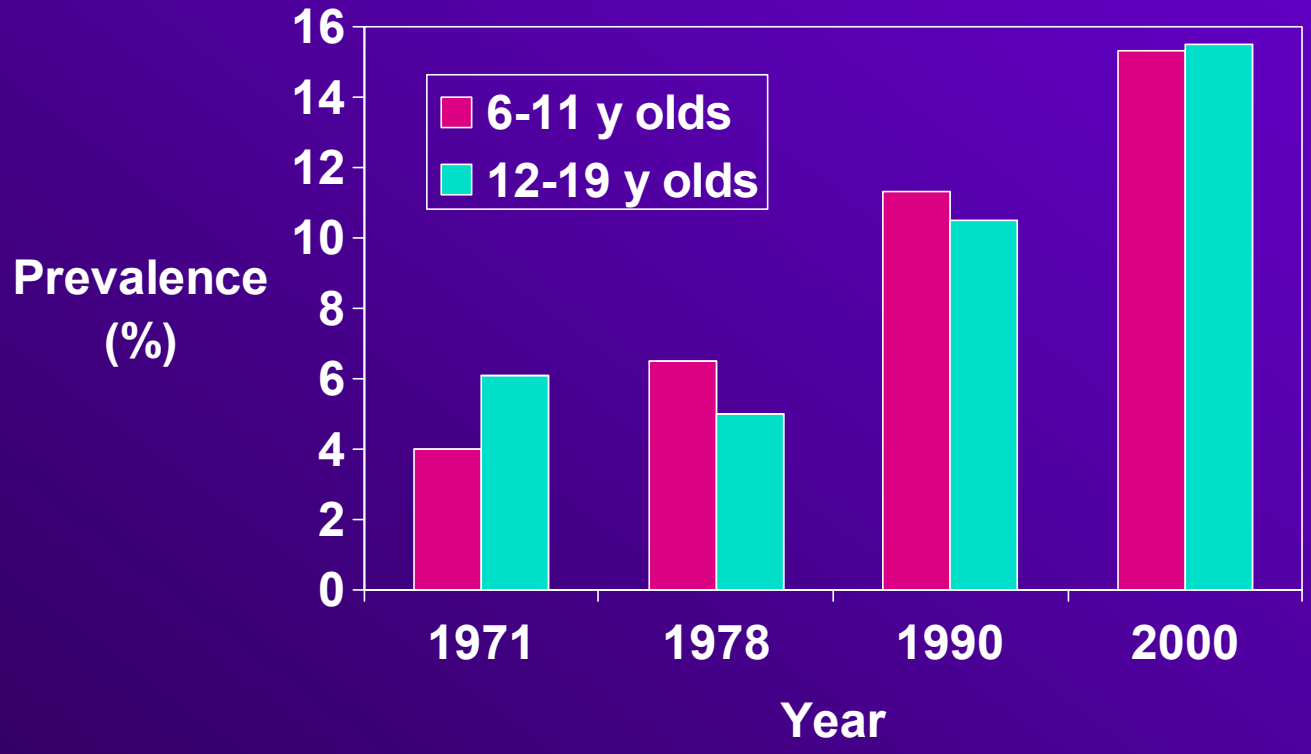
Key Questions

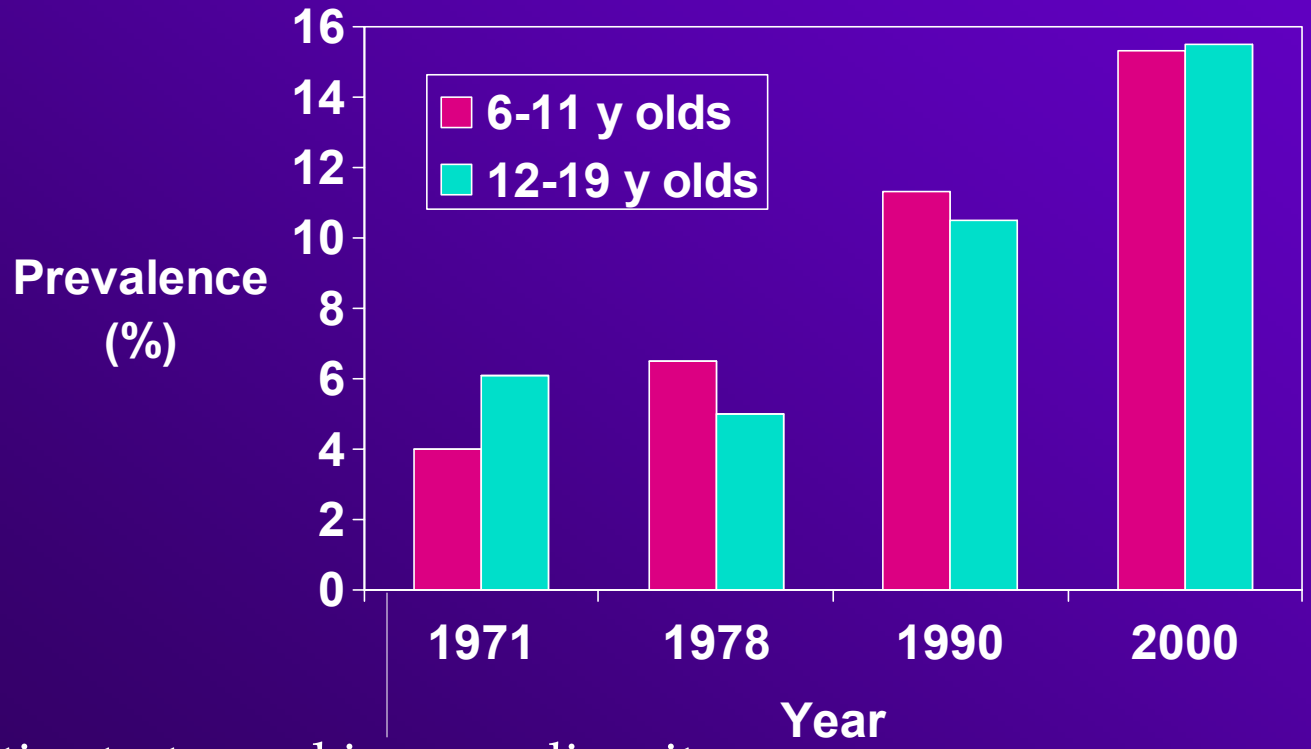
- Can physical activity (PA) play a role in prevention & treatment of juvenile obesity & related disorders?
- What dose of PA should be built into site-based interventions?

Changing Prevalence of Overweight in U.S. Youths: 1971-2000



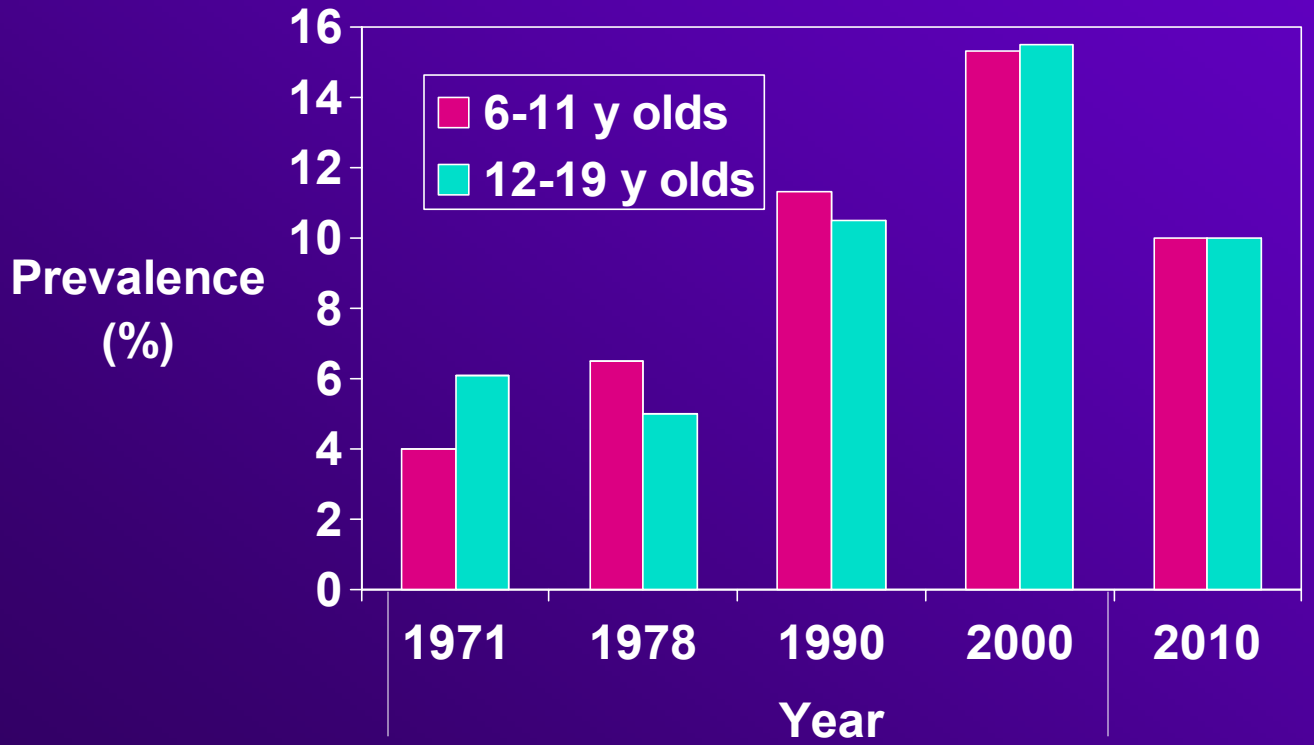
Mystery: What powerful factor(s) can account for this trend?

Changing Prevalence of Overweight in U.S. Youths: 1971-2000



Gutin starts working on adiposity

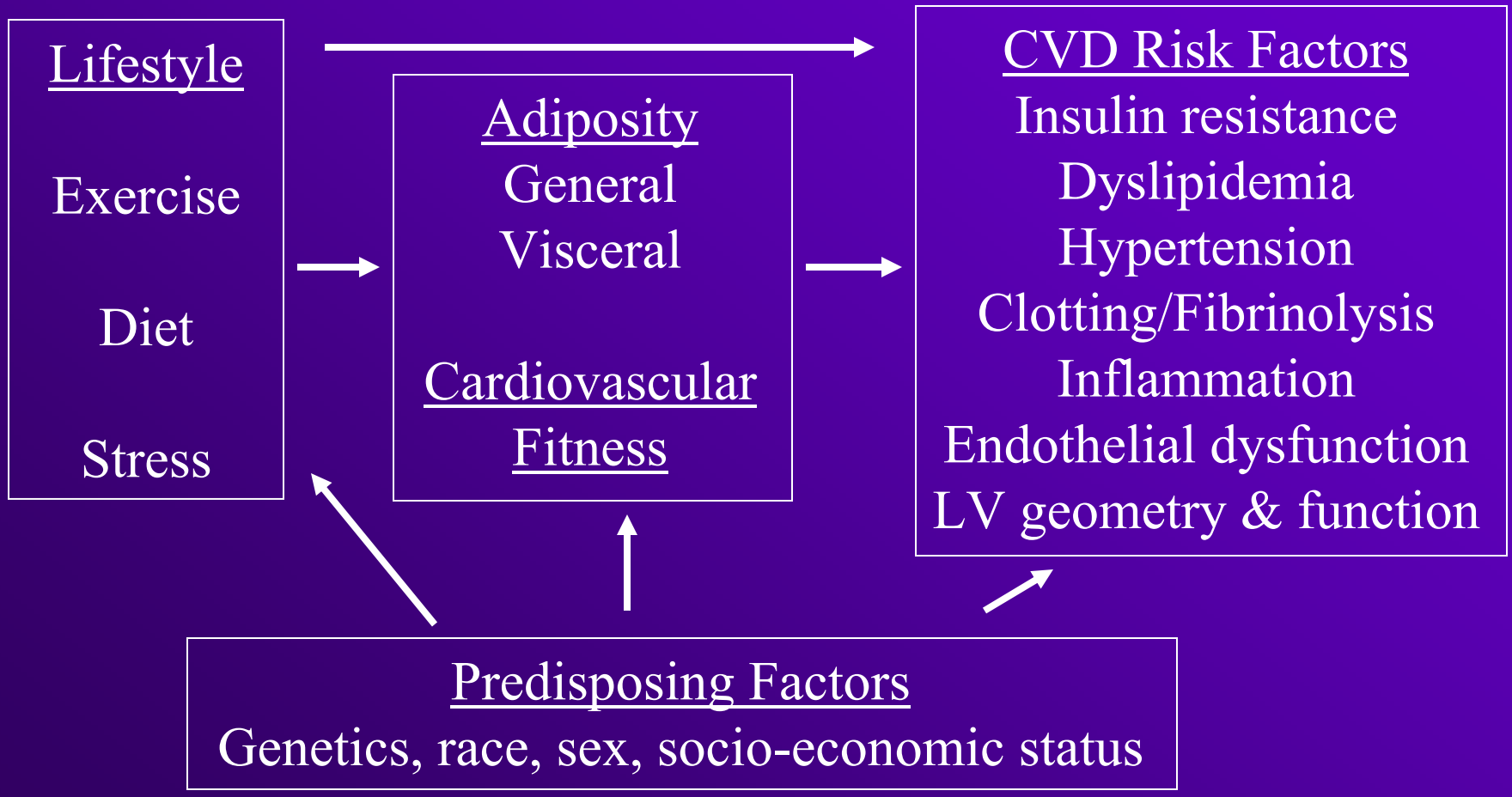
Hypothesized Effect of Gutin's Career on the Prevalence of Overweight in U.S. Youths



Gutin starts working on adiposity

Gutin retires, the profession celebrates

Lifestyle, Adiposity & CV Health in Youths (LACHY)



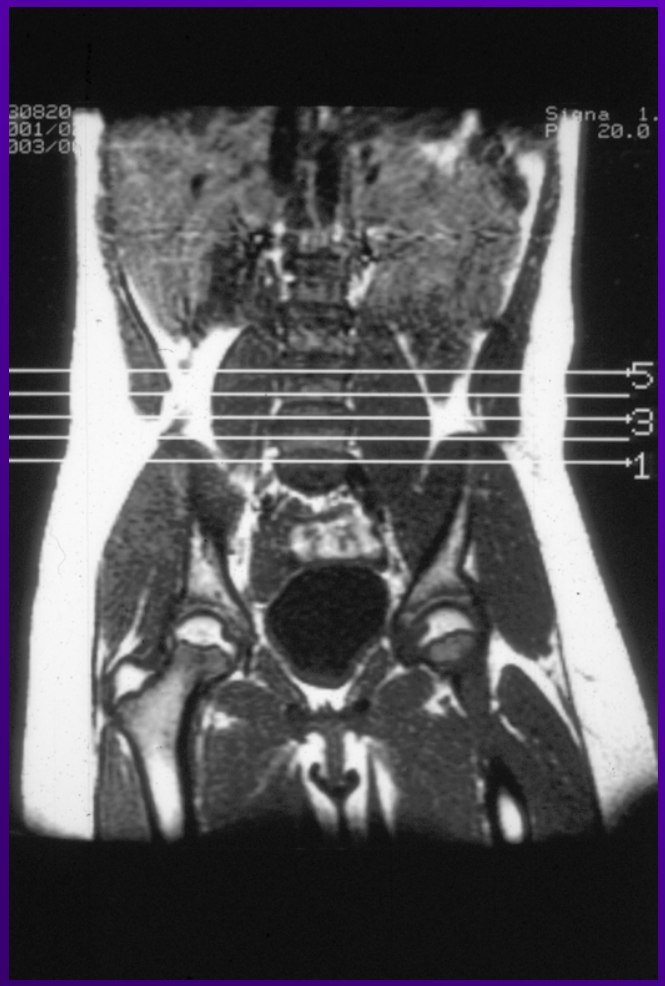
Body Composition: Dual-Energy X-ray Absorptiometry (DXA)

Dual-energy x-ray absorptiometry (DXA)

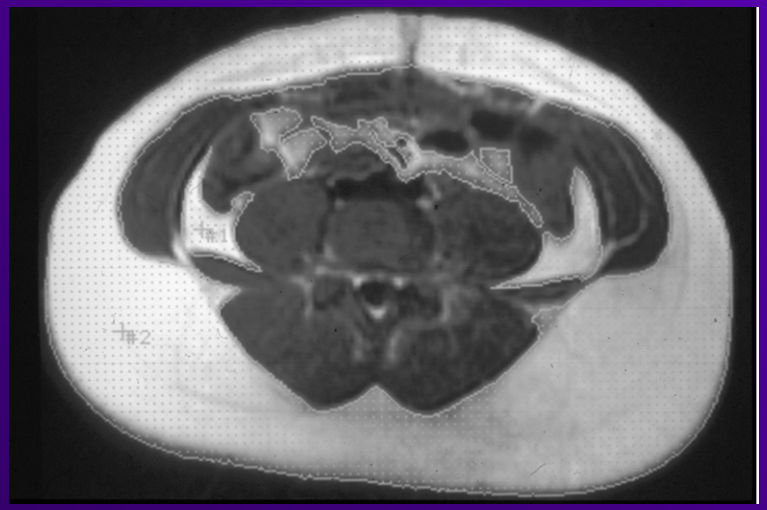
- Objective & easily-obtained data on 3 compartments
  - Bone mineral content (BMC)
  - Fat mass (FM)
  - Fat-free soft tissue (FFST)
- Derived variables
  - Bone mineral density (BMD) = BMC/area
  - Fat-free mass (FFM) = FFST + BMC
  - Percent body fat (%BF) = FM/total mass

Magnetic Resonance Imaging (MRI)

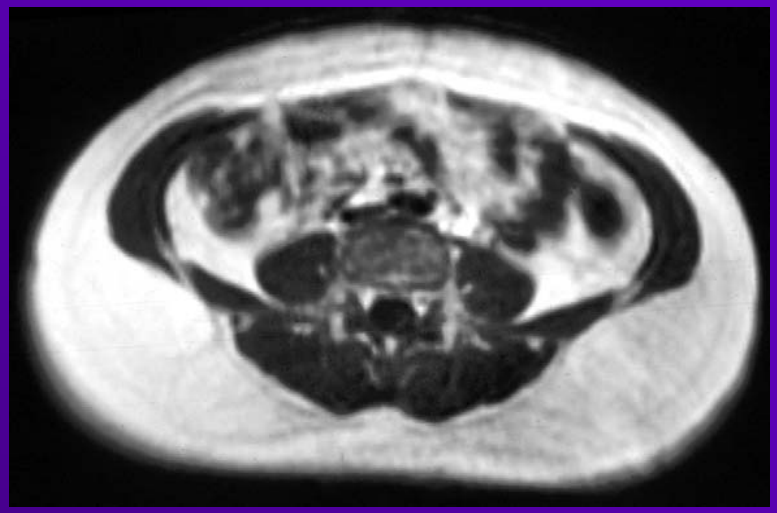
MRI Scan



Visceral Adipose Tissue (VAT)

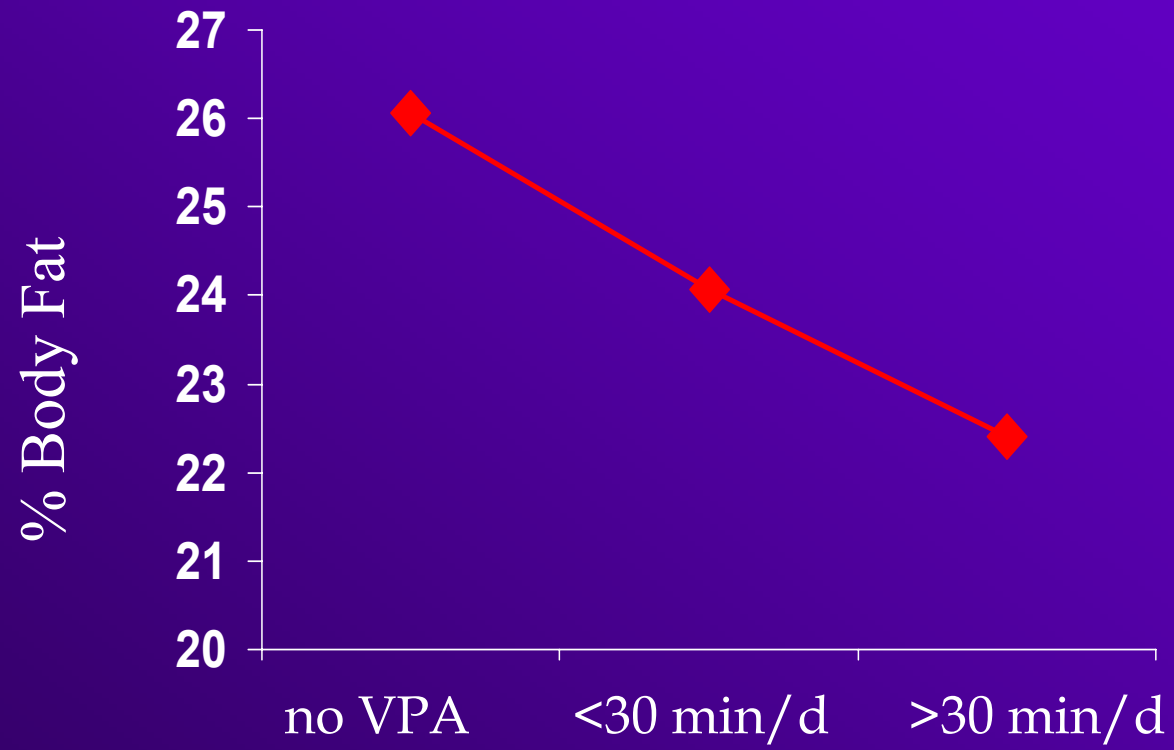


Less VAT



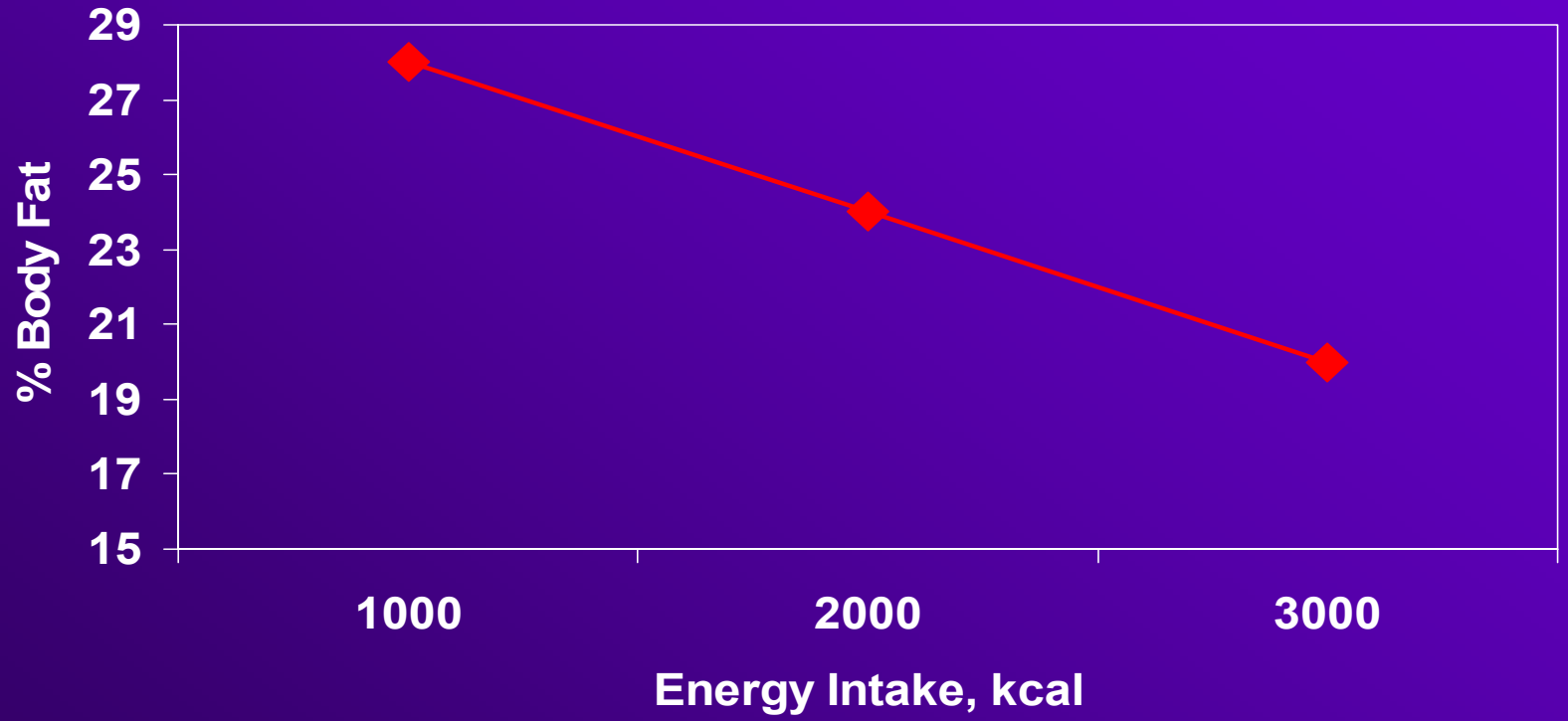
More VAT

Percent Body Fat and Vigorous PA* in ~500 Adolescents



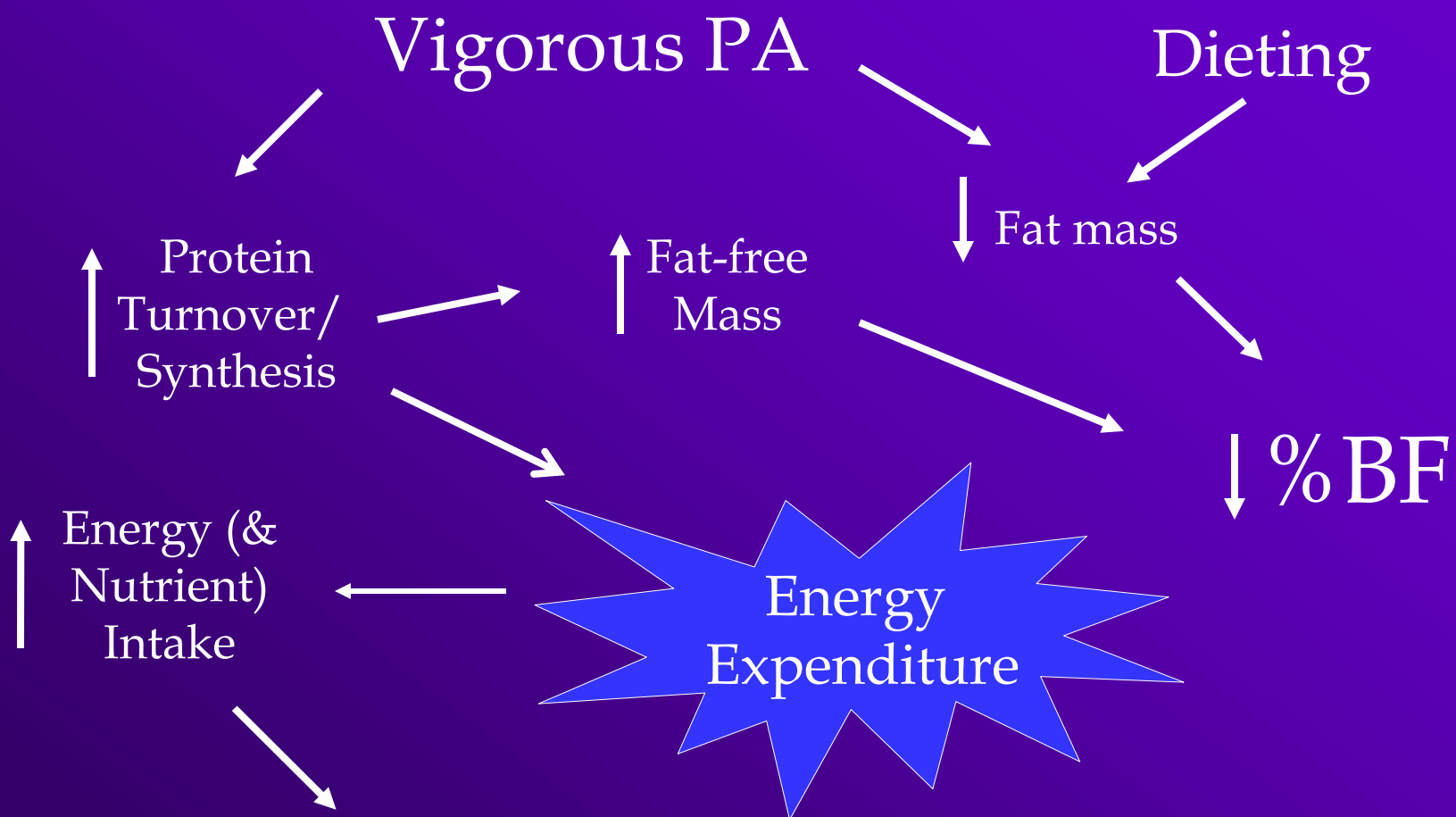
*PA measured with 5 d of accelerometry or 7, 24-h recalls. Moderate PA did not explain variation in %BF.

Percent Body Fat & Energy Intake* in ~500 Adolescents



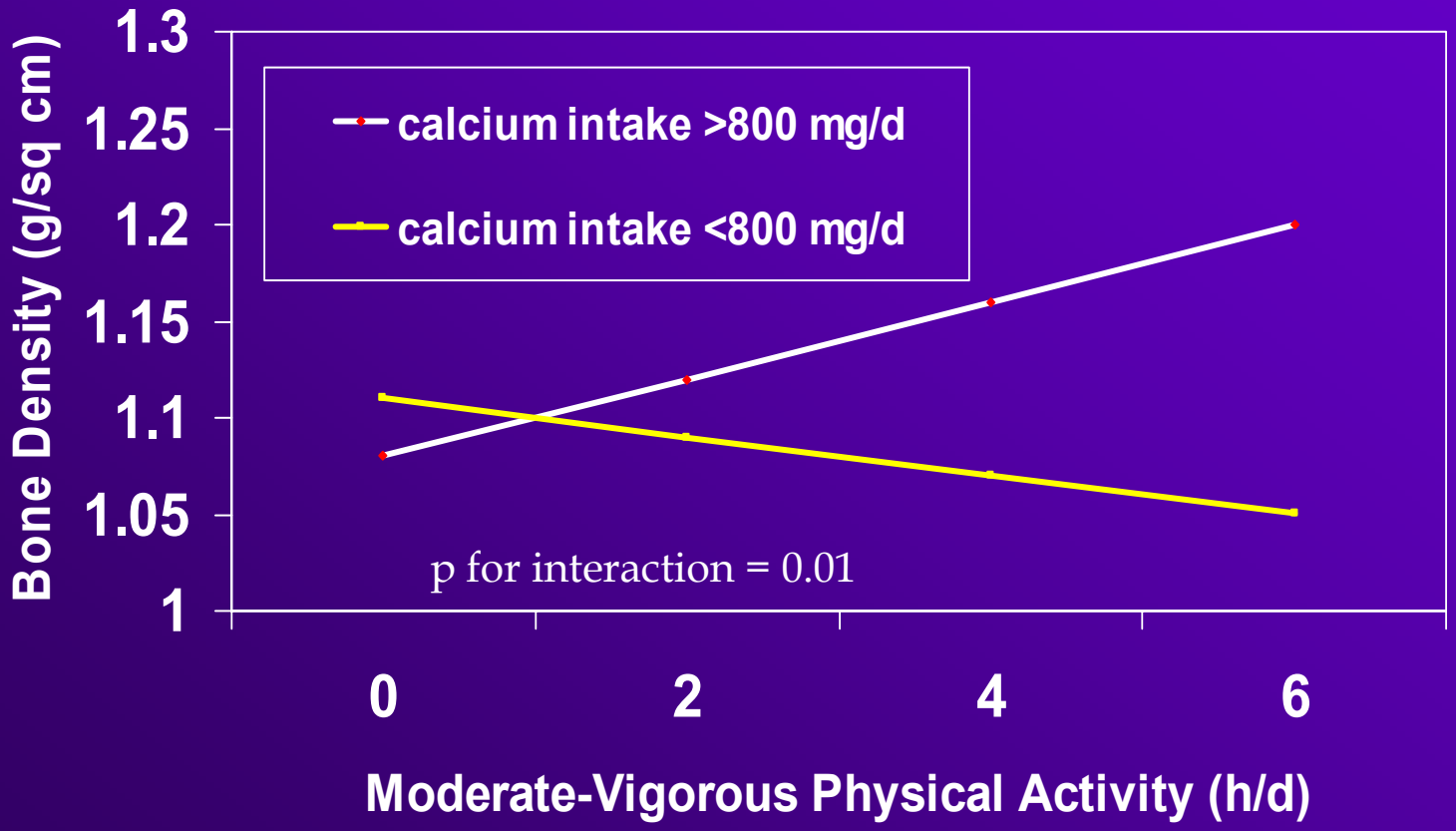
*Diet measured with 7, 24-h recalls. It is likely that the fatter youths tended to under-report energy intake more than the leaner youths did.

Hypothetical Model



Adequate nutrition for optimal growth:
eg, calcium for bone

Interaction of PA & Calcium Intake on Bone Density in Teens



Gutin et al, *SEACSM meeting*, Atlanta, 2003

Implications of Non-Experimental Studies

- Already in childhood, higher levels of general & visceral adiposity & lower levels of fitness are associated with unfavorable risk factors for several diseases that manifest themselves later in life
- Youths with better fitness & body composition tend to have a higher energy throughput – i.e., higher levels of vigorous physical activity & energy/nutrient intake

Vigorous PA, Fatness & Fitness are Correlated

The direction of causality cannot be unequivocally established from non-experimental designs, because the time sequence of events is unclear.

Experimental designs, in which PA is controlled, allow clearer causal attributions.

Experimental Designs

- Primary question: When youths do or do not engage in physical activity, what happens to body composition & risk factor?
- Some potential answers:
  - Body composition & risk profile improve
  - Youths compensate for the PA by reducing their PA at other times of the week or by increasing energy intake, with result that body composition does not improve
  - Body composition improves, but risk factors do not
  - Body composition does not improve, but risk profile does

Physical Training & CV Health of Obese 7-11 y Olds

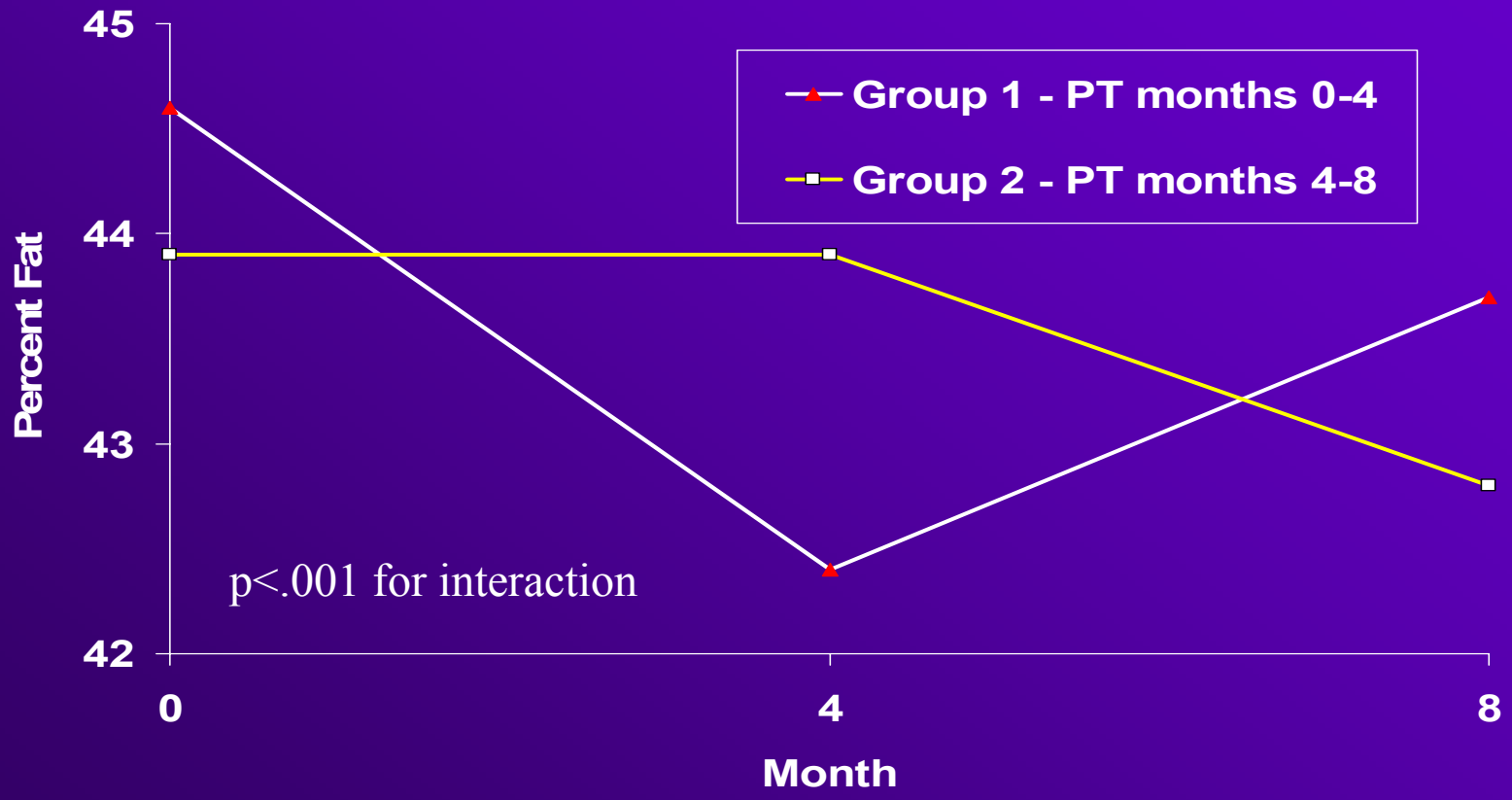
- 79 youths randomly assigned to 2 groups
  - Group 1 - PT for 1st 4 mo
  - Group 2 - PT for 2nd 4 mo
- 40-min PT period
  - 20 min on machines
  - 20 min games
- PT- HR averaged 157 bpm
- PT attendance averaged 4 d/w

HR Monitoring

Machines

Games

Physical Training, Detraining & Percent Fat in Obese 7-11 Y Olds



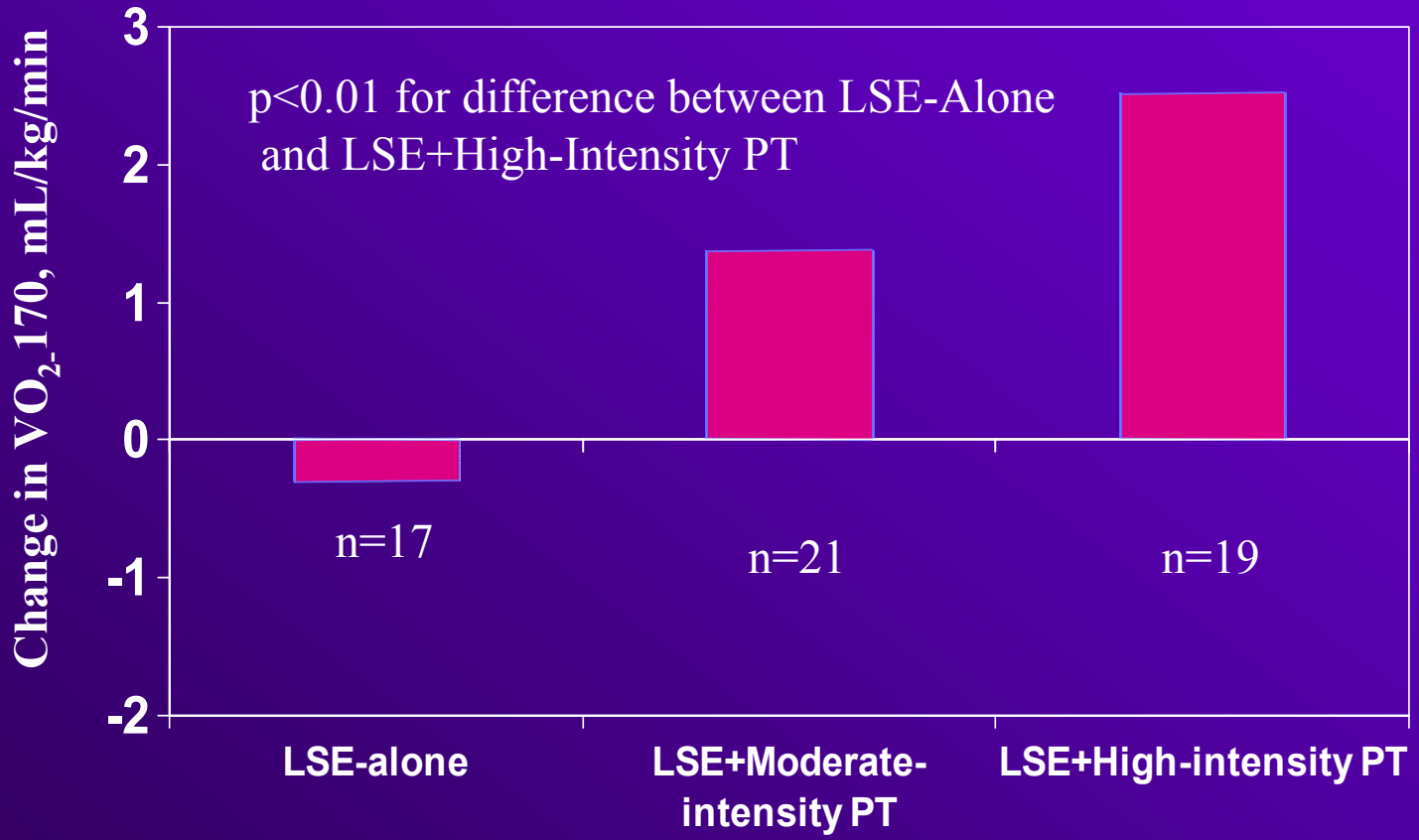
Similar results were found for fitness & some CVD risk factors

Gutin et al, ***Obesity Research*** 1999;7:208-14

PT- DOSE & CV Health of Obese Adolescents

- 13-16 y olds (n=81) randomized to
  - Lifestyle education (LSE) alone
  - LSE + moderate intensity PT – mean HR=138 bpm
  - LSE + high intensity PT – mean HR=154 bpm
- Energy expenditure= 250 kcal/session
- Duration of sessions = 30-60 min, longer for moderate group

Effect of Different PT Intensities on Change in CV Fitness in Obese Teens



Similar pattern for TAG, TC/HDLC, LDL size, & DBP, but not for %BF or VAT

Gutin et al, *Am J Clin Nutr* 2002;75:818-26; Kang et al, *Med Sci Sports Exerc* 2002;34:1920-7

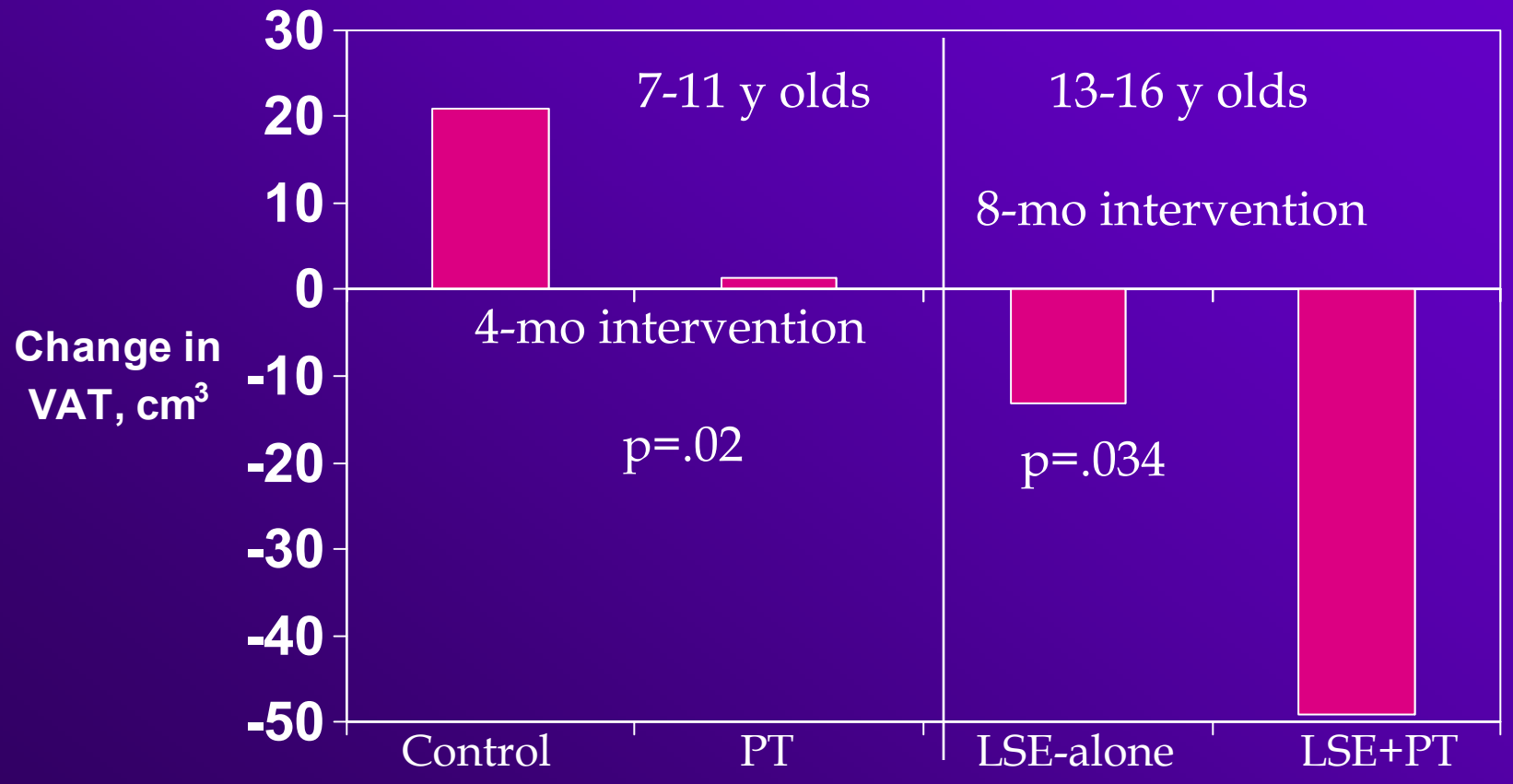
Changes in Fitness, Body Composition & Risk Factors after 8 mo of PT in Obese Teens

Variable	LSE (n=18)	PT (n=22)*	p
CVF, ml/kg/min	0.33	3.56	.001
%BF	0.19	-3.57	.001
Bone Density	0.041	0.047	.040
TAG,mmol/L	0.12	-0.22	.002
TC/HDLC	0.53	-0.02	.005
LDL Size, (A)	-1.92	4.18	.009
Insulin, pmol/L	23.3	-17.8	.085
SBP, mmHg	1.50	-3.73	.203

*PT subjects met criteria for exposure to adequate PT of >40% attendance, regardless of assigned PT intensity

Gutin et al, *Am J Clin Nutr* 2002;75:818-26
Kang et al, *Med Sci Sports Exerc* 2002;34:1920-7

Changes in Visceral Adipose Tissue with Interventions of 4 & 8 Months



Adiposity Prevention by Exercise in Black Girls (APEX)

- Dr. Paule Barbeau is now PI
- 8-10 y olds, varying in adiposity
- 10-mo intervention
  - Neighborhood schools
  - 5 d/wk
- Sessions include
  - 30 min - snack, homework, apply HR monitors
  - 25 min - skills instruction (HR=149 bpm)
  - 35 min - vigorous aerobic activity (HR=162 bpm)
  - 20 min - strengthening & stretching (HR=121)

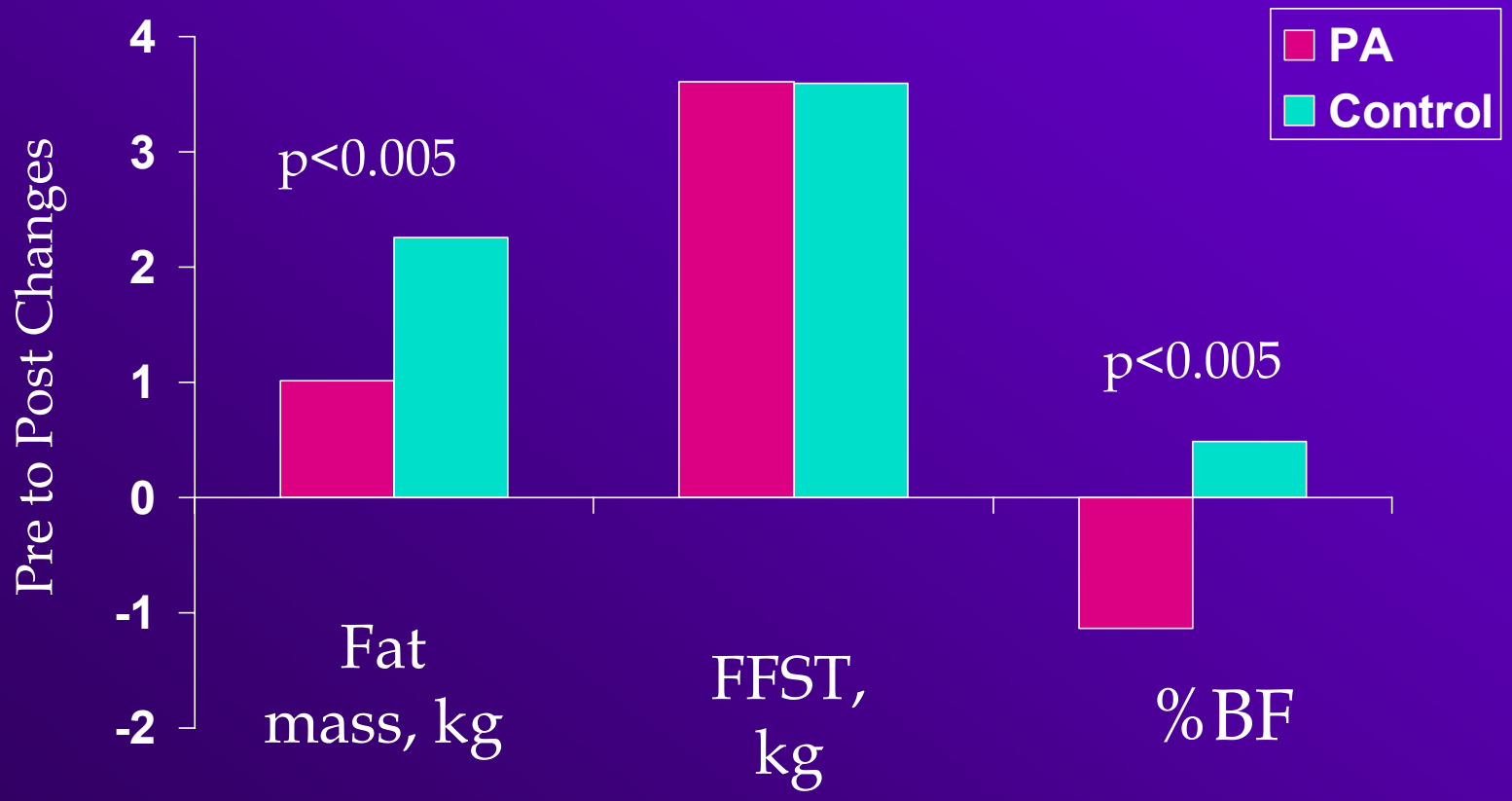
Games

Strengthening

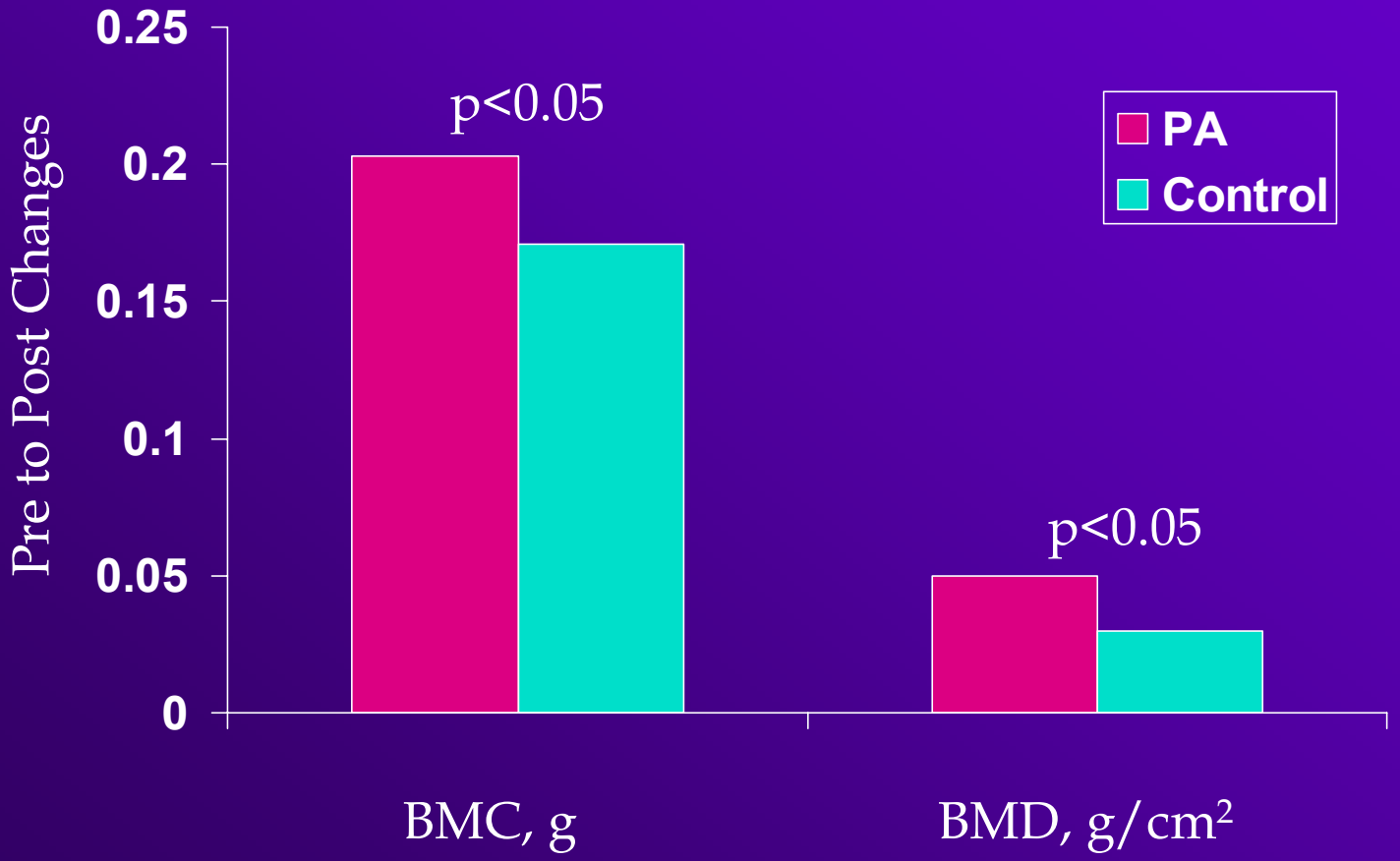
Stretching


Prince
9/9

Changes in Body Composition in 159 Black Girls: The MCG APEX Study



Bone Mass Changes in 159 Black Girls: The MCG APEX Study



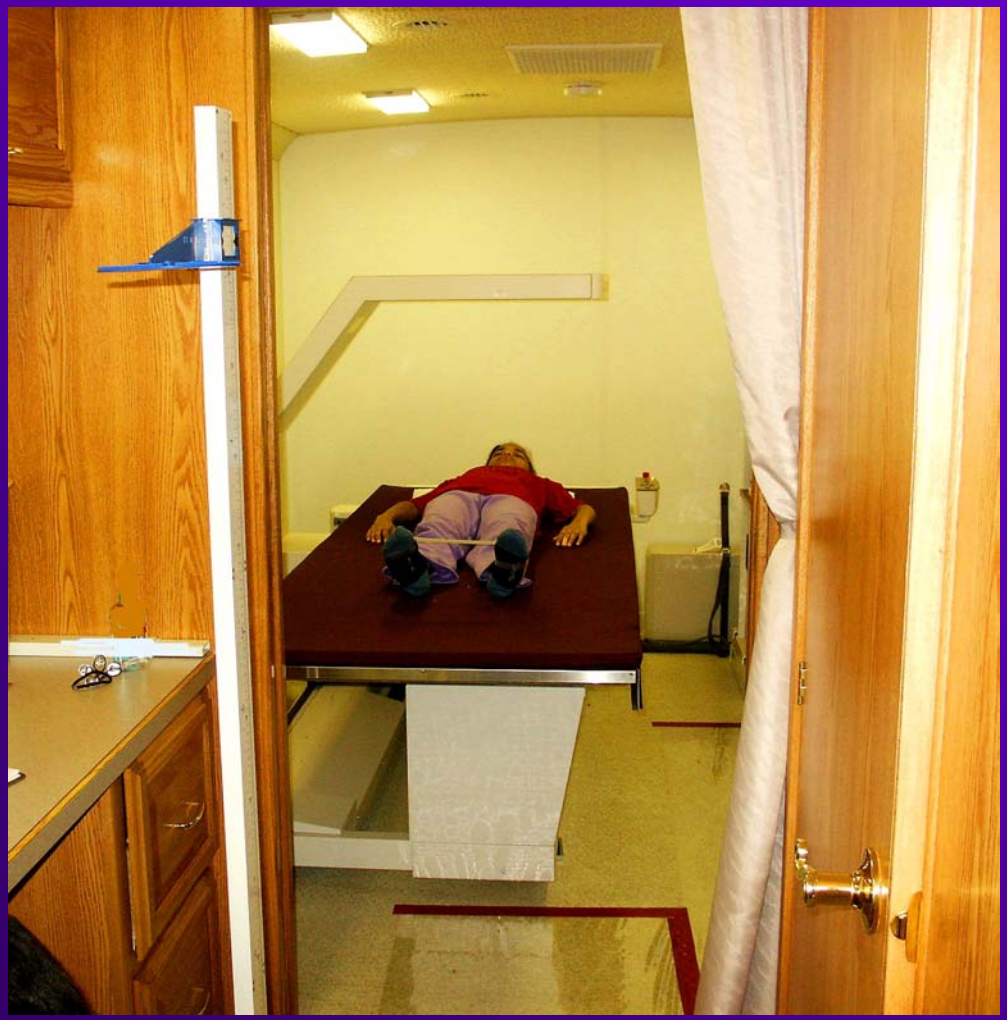
Similar results were found in 4-mo & 8-mo PT studies

The MCG FitKid Project

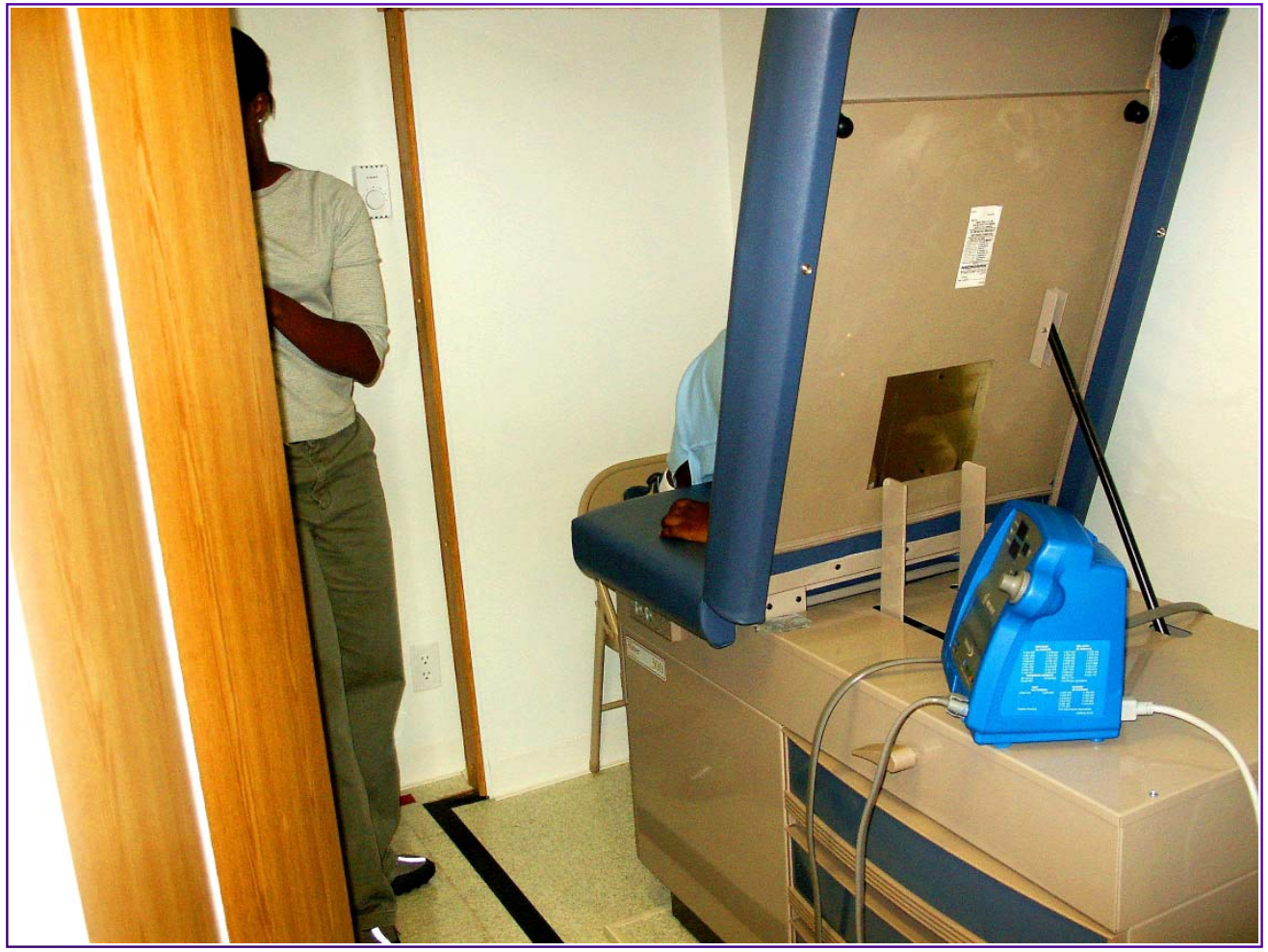
- Dr. Zenong Yin is now PI
- Based on premise that we live in an "obesogenic" environment – i.e. vigorous PA is discouraged & unhealthy eating is facilitated
- Primary hypothesis: a "fitogenic" after-school environment will lead to less accretion of fat
- 18 schools randomized to receive health screenings alone or screenings + intervention (~600 children)
- Youths followed from 3rd-5th grades, with measurements at beginning, mid & end of each grade
- Intervention started in 2003-4 school year

GPI Mobile Research Laboratory

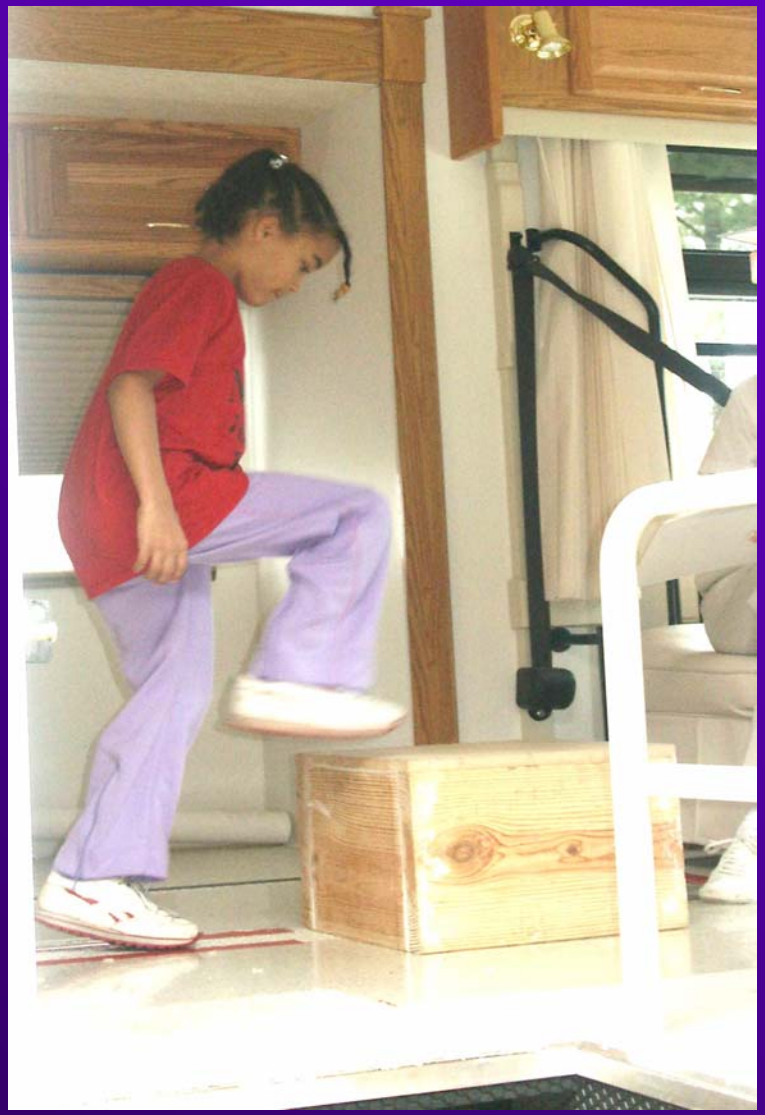
Body Composition by DXA



Blood Pressure Station



Measurement of CV Fitness by Step Test



Finger Stick for Cholesterol Measurement

Measurement of Psychosocial Factors Related to Physical Activity

Parents queried about demographic factors (e.g., SES)
Schools provide grades & standardized test scores

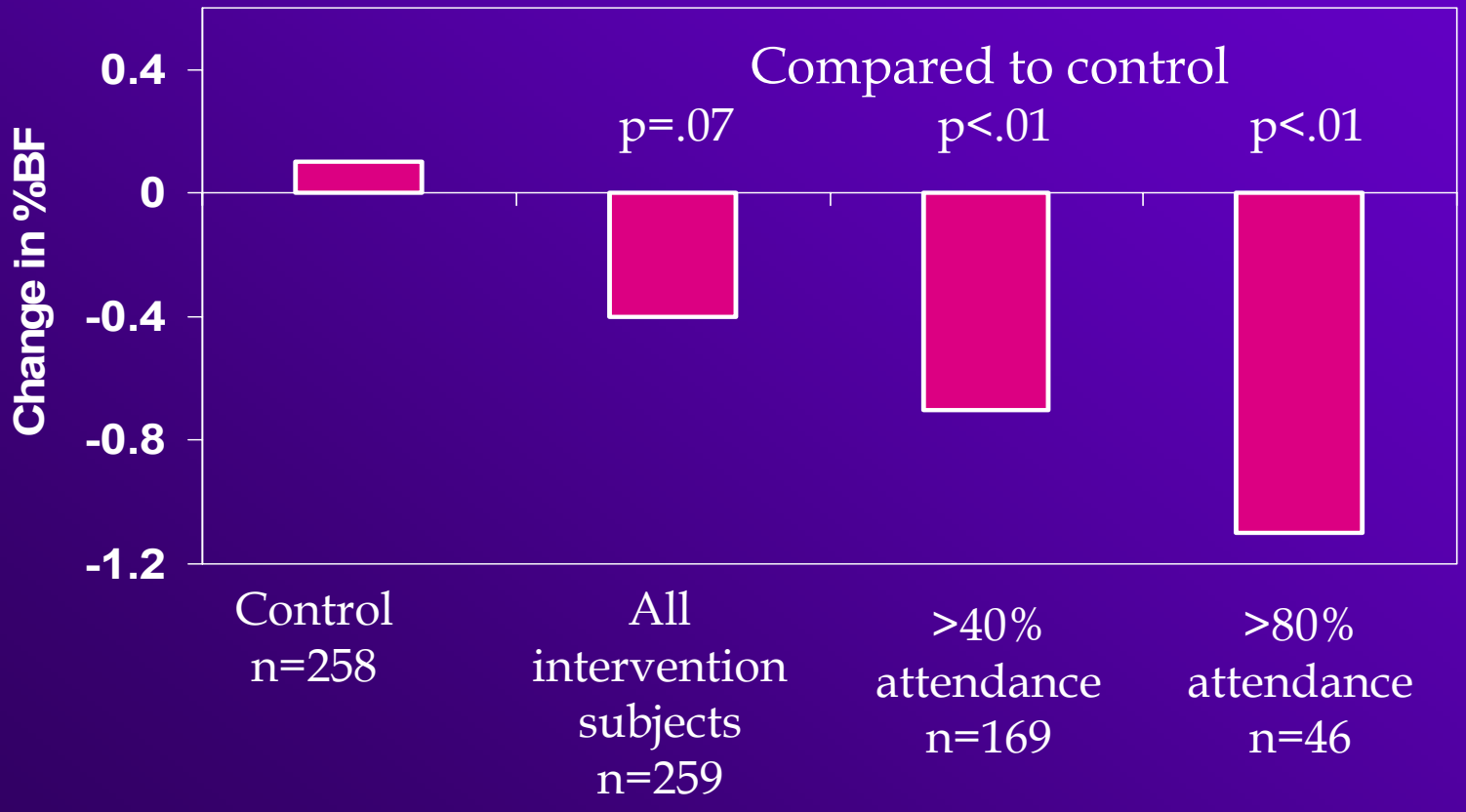
Academic Enrichment/Snacks (~40 min)

Academic enrichment coordinated with school personnel
Snacks provided through USDA program

Skills & Fitness (~80 min)

Fitness activities aim for HR >150 bpm

MCG FitKid Program: Preliminary Body Fatness Results for 3rd Grade



FitKid - Anecdotal Information

- Importance of long-term relation with schools
  - SCI - >1000 medical students have taught HP/DP to >70,000 6th graders for ~30 y
  - Communication with both intervention & controls
- Importance of advisory board
  - Parents
  - Principals
  - Teachers
  - School officials (coordinators of nutrition, PE)
- Carryover from FitKid program
  - To regular PE
  - Home

Promotion of Vigorous PA in Integrated Trans-Community Interventions

- Positive message – fitness rather than obesity
- Convenience/cost/safety
  - Use regular schools
  - Provide transportation
  - Free program
- Supervision
  - PE & classroom teachers - know youths & schools
  - Trained to emphasize vigorous PA

Speculations

- Schools focus on test scores - hard to provide sufficient PA within the school day
  - More & better PE
  - Recess periods
- Large blocks of discretionary time
  - After-school hours
  - Weekends & vacations
- Integrating academic enrichment with PA is attractive to schools & parents

Implications of Experimental Studies

- Obese & non-obese youths can derive benefits from vigorous exercise
- Favorable effects on body composition may be obtained without focusing on diet
- Higher doses of PT elicit greater improvements in some health outcomes

Needed Research

- Dose-Response
  - Time – e.g. 20-min vs 40-min sessions for body composition & insulin sensitivity (Dr. C. Davis is PI)
  - Frequency – days/wk
  - Intensity
  - Type – e.g. strength training
- Strategies for improving compliance
- Parental involvement

The Bottom Line: What PA Recommendations for Youths?

- For attainment & maintenance of a healthy body composition, youths should do at least 1-2 h of moderate-vigorous PA almost every day, including aerobic & strengthening exercises
- Youths who are inactive & relatively fat can derive benefit from lower doses of PA; as their fitness improves they should progress to more vigorous intensities & amounts of PA

Last Words

- I have reprints of a recent review paper that summarizes many of the MCG studies
- I hope our efforts will contribute to greater numbers of fit, lean & healthy kids in the future
- Thanks for your attention