Physical Inactivity: The Biggest Public Health Problem of the 21st Century

University of Alberta
January 5, 2005

Prelude

- This presentation was sponsored by the Faculties of Medicine and Physical Education and Recreation at the University of Alberta and the Alberta Centre for Active Living.
- Dr. Blair is also a Research Affiliate of the Alberta Centre for Active Living.

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Steven N. Blair
President and CEO
Cooper Institute

Aerobics Center Longitudinal Study

Design of the ACLS

1970 More than 75,000 patients 2003

Cooper Clinic examinations--including history and physical exam, clinical tests, body composition, EBT, and CRF

Mortality surveillance to 1998
More than 4100 deaths

1982 '86 '90 '95 '99

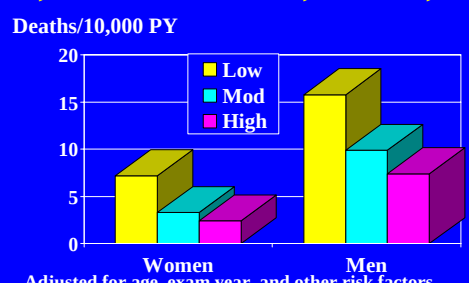
Mail-back surveys for case finding and monitoring habits and other characteristics

Aerobics Center Longitudinal Study

- Prospective investigation of 7,080 women and 25,341 men examined at the Cooper Clinic at least once during 1970-1989
- Average age: women=42.7 yrs; men=42.9 yrs
- Approximately 97% white, mid- to upper-socioeconomic strata
- Followed for mortality to 12/31/89
  - 89 deaths during 52,982 woman-years
  - 601 deaths during 211,996 man-years

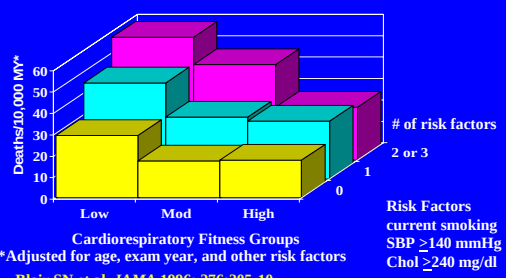
Blair SN et al. *JAMA* 1996; 276:205-10

CVD Death Rates* by Fitness Groups, 7,080 Women and 25,340 Men, ACLS



Adjusted for age, exam year, and other risk factors
Blair SN et al. *JAMA* 1996; 276:205-10

Cardiorespiratory Fitness, Risk Factors and All-Cause Mortality, Men, ACLS

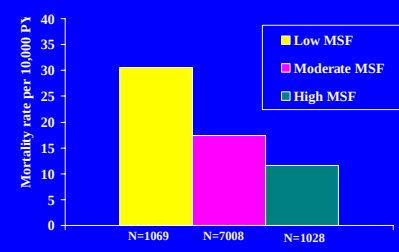


Cardiorespiratory Fitness Groups

*Adjusted for age, exam year, and other risk factors

Blair SN et al. *JAMA* 1996; 276:205-10

Mortality Rates per 10,000 Person-Years by Musculoskeletal Fitness Category, ACLS

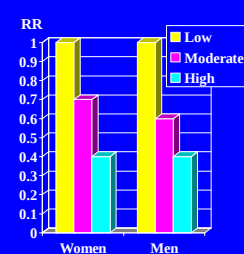


FitzGerald S et al. *J Phys Act Health 2004*

Older Women and Men

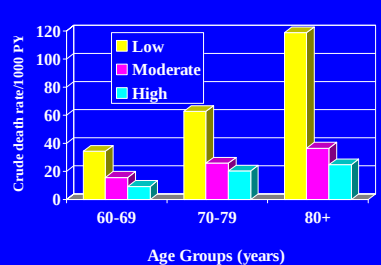
Risk of Death by Fitness Groups, 749 Women and 1758 Men 60 and Older, ACLS

- Age, exam-year, BMI, cholesterol, high blood pressure, diabetes, smoking, CVD, parental CVD adjusted RR for all-cause mortality
- Patients with cancer and failure to achieve at least 85% of predicted max HR were excluded



Blair & Wei. Am J Health Prom. 2000

Death Rates/1000 by Fitness Groups, 2135 Men Aged 60 and Older, ACLS



Blair & Wei. *Am J Health Prom* 2000; 15:1-8

Fitness and Functional Limitations

- Prospective study of 1,175 women and 3,495 men age 40 years and older
- Medical exam during 1980-88
- Average follow-up of 5.5 years
- Self-report of functional limitations in 1990 by mail-back survey
  - Are you physically able to do?
    - personal care activities
    - household activities
    - recreational activities

Huang et al. MSSE 1998, 30:1430-5

Fitness and Functional Limitations

- The 10 questions were scored as--
  - Yes=0
  - Yes, with assistance or no=1
- All with a score of 1 or more were classified as having some functional limitation

Huang et al. MSSE 1998, 30:1430-5

Prevalence of Self-reported Functional Limitations by Fitness and Age Groups

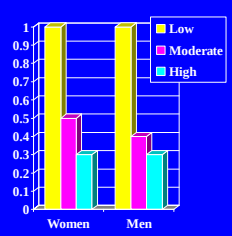
	Age Groups (years)		
Fitness Group	*40-49*	*50-59*	*60+*
Women			
Low	18*	23	46
Moderate	8	13	26
High	7	3	18
Men			
Low	7	14	24
Moderate	3	5	9
High	3	1	7

*Prevalence (%)

Huang et al. MSSE 1998, 30:1430-5

Fitness and Functional Limitations, Women and Men, ACLS

- Risk of self-reported functional limitation adjusted for age, follow-up, BMI, smoking, alcohol intake, baseline disease, & disease at follow-up



Huang et al. MSSE 1998, 30:1430-5

Physical Fitness and Functional Health Status in the ACLS

- Prospective study of 589 women and 3069 men 30-89 years of age
- Medical exam during 1980-1989
  - Health and clinical assessments
  - Cardiorespiratory fitness
  - Musculoskeletal fitness
- Responded to mail-back survey in 1990
  - 10 questions on ability to function in recreational, household, daily living, and personal care tasks

Brill PA et al. *MSSE* 2000; 32:412-6

Physical Fitness and Functional Health Status in the ACLS

- Three tests of musculoskeletal fitness
  - 1RM bench press
  - 1RM leg press
  - # of bent leg sit-ups in 60 seconds
- Musculoskeletal fitness index
  - Tertiles for each test scored as 0, 1, or 2
  - Summed tertile scores (range 0-6)
  - Summary score of 5 or 6=high strength
- CRF by maximal exercise test

Brill PA et al. *MSSE* 2000; 32:412-6

Adjusted OR for Functional Limitations

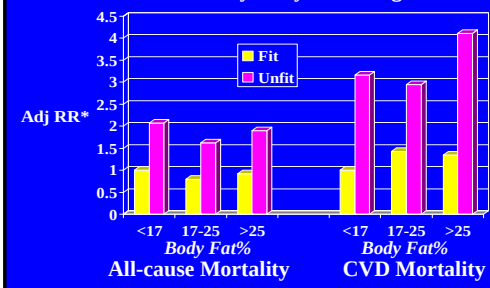
	Men		*Women*	
	OR	95% CI	OR	95% CI
High strength	0.56	0.34-0.93	0.54	0.21-1.39
TM time (min)	0.90	0.86-0.93	0.90	0.83-0.98
Age (year)	1.05	1.04-1.07	1.04	1.00-1.10
BMI	1.03	0.99-1.07	1.04	0.94-1.14
Health prob	2.14	1.57-2.92	2.72	1.50-4.96

OR adjusted for exam year and all variables in table

Brill PA et al. *MSSE* 2000; 32:412-6

Benefits of Physical Activity for Individuals of Any Size

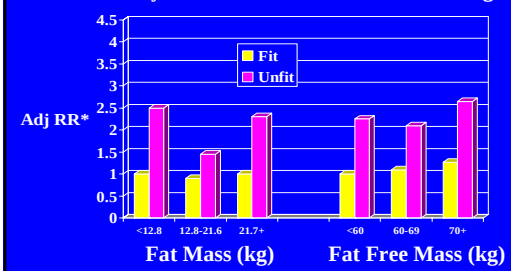
RR for All-cause and CVD Mortality in Fit and Unfit ACLS Men by Body Fat Categories



*adjusted for age, exam year, smoking, alcohol, & parental history

Lee CD, Blair SN, & Jackson AS. *Am J Clin Nutr* 1999; 69:373-80

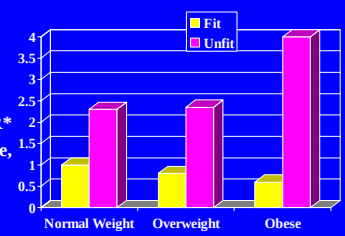
RR for All-cause Mortality in Fit and Unfit ACLS Men by Fat Mass and Fat Free Mass Categories



*adjusted for age, exam year, smoking, alcohol, & parental history

Lee CD, Blair SN, & Jackson AS. *Am J Clin Nutr* 1999; 69:373-80

Adjusted RR for All-Cause Mortality by Fitness and BMI, ACLS Women

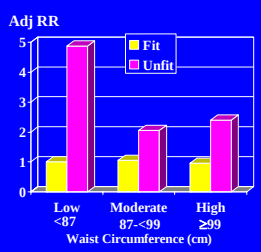


*adj for age, exam year, smoking, & health status

Farrell et al. *Obes Res*. 2002; 10:417-423

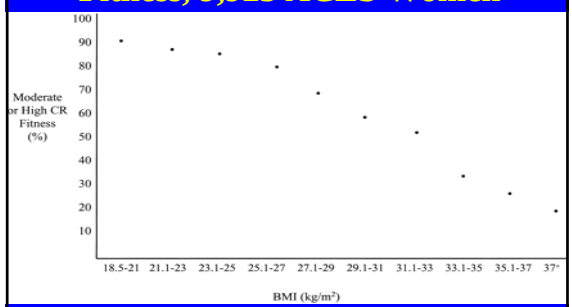
Adjusted RR for All-Cause Mortality by Fitness and Waist Circumference

- Waist circumference measurements in a subgroup 14,043 men
- 162 deaths in 78,008 man-years
- RR adjusted for age, examination year, smoking habit, alcohol intake, and parental history of CHD



Lee CD, Blair SN, & Jackson AS. *Am J Clin Nurt* 1999; 69:373-80

Prevalence of Moderate or High Fitness, 9,925 ACLS Women



Farrell SW et al. *Obes Res* 2002; 10:417

Should We Tell Overweight or Obese Persons about the Results of Fitness-Fatness Studies?

- What is the affect of stating that moderate levels of fitness substantially ameliorate the hazards of fatness?
  - Provides a "convenient excuse not to lose weight because of their self-perceived high levels of physical activity"
  - Provides hope and encouragement to overweight and obese individuals that they can take an action that has important health benefits whether or not they lose weight
- I know of no data to support either of these statements

Does a Fit and Active Way of Life Protect Against Diabetes and Metabolic Syndrome?

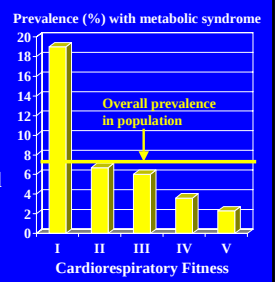
The Metabolic Syndrome

- Metabolic syndrome is now listed as a disease in the International Classification of Diseases
- Metabolic syndrome is defined* as any 3 of:
  - High blood sugar (≥5.6 mmol/L)
  - High triglycerides (≥1.69 mmol/L)
  - Low HDL-cholesterol (<1.30 mmol/L in women, 1.04 mmol/L in men)
  - High blood pressure (≥130 mmHg systolic or ≥ 85 mmHg diastolic, or hypertensive)
  - High waist circumference (>88 cm in women, >102 cm in men)

*ATP III criteria-U.S.A.

Prevalence of Metabolic Syndrome by Cardiorespiratory Fitness, ACLS Women

- Cross-sectional analyses
- 7,104 women
- Mean age=44.7 years
- Cardiorespiratory fitness assessed by a maximal exercise test on a treadmill



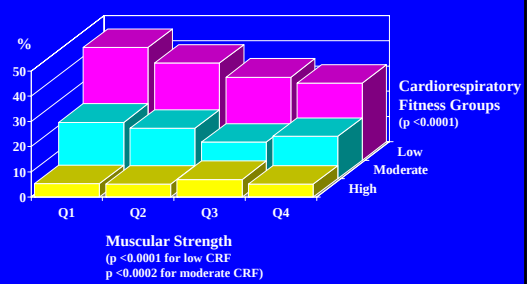
Farrell et al. *Obes Res* 2004; 12:824

Muscular Strength and Prevalence of Metabolic Syndrome, ACLS Men

- 8570 men
  - 20-75 years at baseline
- Muscular strength
  - 1-RM bench press and 1-RM leg press
  - Scores for the two tests were summed and expressed as kg lifted per kg body weight
    - Men assigned to fourths of strength index within age groups (20-29, 30-39, 40-49, 50-59, and 60+ years)

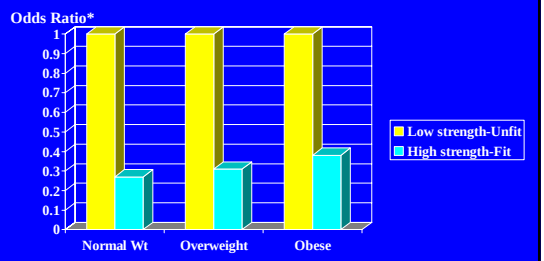
Jurca R et al. *MSSE* 2004; 36:1301-7.

Age and Smoking Adjusted Prevalence of Metabolic Syndrome by Fitness Groups in 8570 ACLS Men



Jurca R et al. *MSSE* 2004; 36:1301-7.

Odds of Metabolic Syndrome By Weight and Fitness, 8570 ACLS Men



*Adjusted for age & smoking
p <0.0001 for all groups

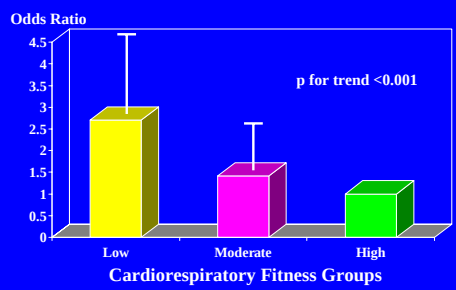
Jurca R et al. *MSSE* 2004; 36:1301-7.

Fitness, Metabolic Syndrome, and Mortality in ACLS Men

- 19,223 men, 20-83 years of age
  - 3,757 men (~20%) with metabolic syndrome
  - 15,466 healthy men
- Followed for approximately 10 years
- 480 men died

Katzmarzyk et al. *Arch Int Med* 2004; 164:1092

All-Cause Mortality by Fitness Groups in 3,757 Men with Metabolic Syndrome



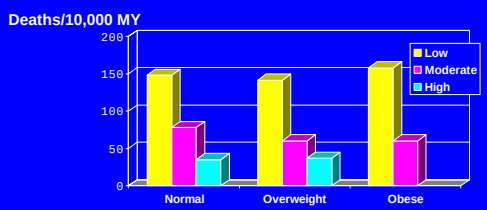
Katzmarzyk et al. *Arch Int Med* 2004; 164:1092

Fitness, Fatness, and Mortality in Men with Type 2 Diabetes

- Observational cohort study
- 2196 men with confirmed type 2 diabetes
  - fasting glucose >125 mg/dL or on pharmacological therapy for diabetes
- Mortality follow-up for up to 26 years (32,162 man-years of observation)
  - 275 deaths from all causes
  - 134 deaths from CVD
  - 71 deaths from cancer

Church et al. *Diab Care* 2004; 27:83-8

All-Cause Mortality by Fitness and BMI Categories, Men with Type 2 Diabetes



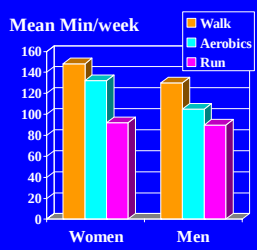
Deaths	24	37	23	64	44	13	55	15	
Men	101	263	335	294	466	220	328	189	

Linear trends p<0.0001 across fitness categories in all BMI groups
*Adjusted for age and year of examination

Church et al. *Diab Care* 2004; 27:83-8

Amount of Specific Physical Activities for Moderately Fit Women and Men

- Detailed physical activity assessments in women and men who also completed a maximal exercise test
- Average min/week for the moderately fit who only reported each specific activity

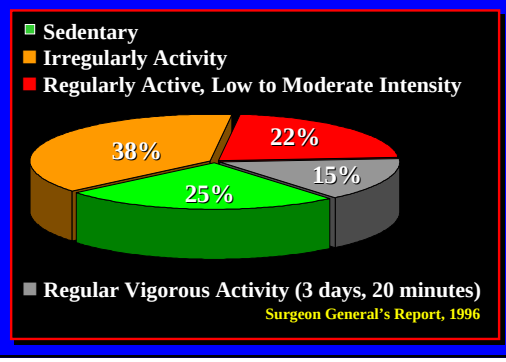


Stofan JR et al. *AJPH* 1998; 88:1807

N=3,972 13,444

Public Health Burden of Sedentary Lifestyles

Physical Activity Levels for U.S. Adults



Surgeon General's Report, 1996

Direct Costs of Inactivity (billion $), U.S., 1995

Condition	*RR*	*PAR*	*Costs*
Diabetes	1.5	12%	6.4
CHD	2	22%	8.9
Hypertension	1.5	12%	2.3
Gall bladder disease	2	22%	1.9
Breast cancer	1.2	5%	0.38
Colon cancer	2	22%	2.0
Osteoporosis fractures	2	18%	2.4
Total			24.3

Colditz GA. *MSSE* 1999; 31 (#11 Suppl):S663-7

Consensus Public Health Recommendation for Physical Activity

- Statements from the American College of Sports Medicine/Centers for Disease Control and Prevention, American Heart Association, NIH, and the office of the US Surgeon General conclude:
  - All adults should accumulate at least 30 minutes of at least moderate intensity physical activity each day
  - This is equivalent to walking about 1.5 miles at a pace of 3 to 4 mph
  - Doing more exercise and perhaps more strenuous exercise may produce additional health benefits

Conclusions

- Low cardiorespiratory fitness, caused primarily by sedentary habits, is a strong and independent predictor of mortality
  - For persons in normal weight, overweight, and Class I obesity categories
  - In men with visceral obesity
  - In men with metabolic syndrome or type 2 diabetes
- Low cardiorespiratory fitness is stronger than overweight or Class I obesity as a predictor of mortality
- More emphasis should be given to physical activity