This Or That:
Continuous Exercise Training

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Exercise is Good For You!
Causes of Death

**Major Causes of Death in the United States (2006)**

- **Cardiovascular Disease**
  - Men: 399 (46%)  
  - Women: 433 (50%)

- **Cancer**
  - Men: 290 (34%)  
  - Women: 270 (31%)

- **Accidents**
  - Men: 79
  - Women: 43

- **Respiratory Disease**
  - Men: 59
  - Women: 65

- **Diabetes**
  - Men: 36
  - Women: 51

- **Alzheimers**
  - Men: 0
  - Women: 0
Heart Disease Time Line (Mortality)

1958: Coronary arteriography developed (Sones)
1962: First beta-blocker developed (Black)
1969: First description of CABG (Favaloro)
1970: Risk factors defined
1972: NHBPEP
1977: Coronary angioplasty developed (Grüntzig)
1980: First implantable cardioverter-defibrillator developed (Mirowski)
1985: TIMI 1
1986: GISSI and ISIS-2
1985: NCEP
1992: SAVE
1993: Superiority of primary PCI vs. fibrinolysis in acute MI noted
1992: ALLHAT
2002: Efficacy of drug-eluting vs. bare-metal stents determined
2003: Benefit of cardiac resynchronization therapy in heart failure demonstrated
2009: Left-ventricular assist device as destination therapy in advanced heart failure shown to be effective
2009: Genomewide association in early-onset MI described
2009: Deep gene sequencing for responsiveness to cardiovascular drugs performed

Deaths per 100,000 Population

Year

All This Technology Helps

But, What Changed the Basic Direction of Heart Disease Mortality?
Tobacco and Cancer Trends

The putative causative agent, must preceed the outcome
We’ve Know Exercise is Important for a Long Time

Harry Truman
POTUS 1944-1952
Mens sana in corpore sano

Satire X of the Roman poet Juvenal

You should pray for a healthy mind in a healthy body. Ask for a stout heart that has no fear of death, and deems length of days the least of Nature's gifts that can endure any kind of toil, that knows neither wrath nor desire and thinks the woes and hard labors of Hercules better than the loves and banquets and downy cushions of Sardanapalus.

What I commend to you, you can give to yourself; For assuredly, the only road to a life of peace is virtue.
We’ve Know Exercise is Important for a Long Time

Coronary Heart Disease and Physical Activity of Work
JN Morris *Lancet* ii:1111, 1953

Vs 1969

![Graph showing active vs inactive transport and communications](image-url)
Incidence and Prediction of Ischemic Heart Disease in London Busmen
JN Morris  *Lancet* ii:7463, 1966

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![Graph showing incidence of ischemic heart disease in London busmen.](image)

Vs 1969
We’ve Known Exercise is Important for a Long Time

**Work Activity of Longshoremen as Related to Death from Coronary Heart Disease and Stroke**

RS Paffenbarger  *NEJM* 282: 1109, 1970

**CHD Death rates/10,000 person years**

![Graph showing CHD death rates for active and less active longshoremen]

**Vs 1969**

**Graph details:**
- **Active**
- **Less Active**

Year: 1955 - 2009
- 1955: First reports of angina pectoris
- 1960: First reports of sudden death
- 1961: First reports of heart attacks
- 1962: First reports of heart disease
- 1963: First reports of heart disease
- 1964: First reports of heart disease
- 1965: First reports of heart disease
- 1966: First reports of heart disease
- 1967: First reports of heart disease
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- 2005: First reports of heart disease
- 2006: First reports of heart disease
- 2007: First reports of heart disease
- 2008: First reports of heart disease
- 2009: First reports of heart disease

**Notes:**
- 1955: Left ventricular hypertrophy
- 1960: First reports of heart disease
- 1961: First reports of heart disease
- 1962: First reports of heart disease
- 1963: First reports of heart disease
- 1964: First reports of heart disease
- 1965: First reports of heart disease
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- 2007: First reports of heart disease
- 2008: First reports of heart disease
- 2009: First reports of heart disease

**Graph highlights:**
- Comparison of CHD death rates between active and less active longshoremen.
- Data from 1969 to 2009, showing trends and improvements in heart disease prevention.
Vigorous Exercise in Leisure Time and the Incidence of Coronary Heart Disease


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Vs 1969
Physical Activity as an Index of Heart Attack Risk in College Alumni

Risk of First Heart Attack

<table>
<thead>
<tr>
<th>Physical Acitivity Index</th>
<th>Relative Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>100</td>
</tr>
<tr>
<td>1000</td>
<td>90</td>
</tr>
<tr>
<td>2000</td>
<td>80</td>
</tr>
<tr>
<td>3000</td>
<td>70</td>
</tr>
<tr>
<td>4000</td>
<td>60</td>
</tr>
<tr>
<td>5000</td>
<td>50</td>
</tr>
</tbody>
</table>

Other Activities
- Pink line

Strenuous Sports
- Blue line

R.S. Paffenbarger et al

Vs 1969
Activity vs Training

We’ve Known Exercise is Important for a Long Time
Every US adult should accumulate ≥30 minutes of moderate-intensity physical activity on most, preferably all, days of the week.

To promote and maintain health, all healthy adults need moderate-intensity aerobic activity for ≥30 min on 5 days/week or vigorous-intensity aerobic activity ≥20 min on 3 days/week.

In addition, every adult should perform activity that maintain or increase muscular strength and endurance ≥2 days/week.

The birth of ACSM’s Exercise is Medicine
We’ve Known Exercise is Important for a Long Time

JH O’Keefe et al. Potential dangers of extreme endurance exercise: How much is too much?

Prog Cardiovasc Dis 57: 396-405, 2015

Vs 1969
Quantitative Index

~ 1 hour per day
We’ve Known Exercise is Important for a Long Time

Leisure Time Physical Activity and Mortality: A Detailed Pooled Analysis of the Dose-Response Relationship

H Arem et al. *JAMA Internal Medicine* April 2015

Vs 1969

Quantitative Index

ACSM Guidelines

3 mph = 4.8 km/hr = 3.3 METs = 7-12 hr/wk = 20-36 miles/wk = 32-58 km/wk

7 mph = 11.3 km/hr = 11.7 METs = 2-3.5 hr/wk = 13-24 miles/week = 21-39 km/wk

8 mph = 12.9 km/hr = 13.3 METs = >5.5 hr/wk = 45 miles/wk = 72 km/wk

**Multiples of minimum recommended LTPA level**

1-2x  
2-3x  
3-5x  
5-10x  
≥10
We’ve Known Exercise is Important for a Long Time

TMH Eisvogels et al. Exercise at the extremes: The amount of exercise to reduce cardiovascular events
JACC 67:316-329, 2016

Figure 2: The Dose-Response Curve of Physical Activity and Cardiovascular Mortality

Main Effect @ 22 MET-h/week

@ 3.3 METs=6.7 hr/week
walking @ 3.0 mph=20 min/mile
@10 METs=2.2 hr/wk
jogging @ 6.0 mph=10 min/mile
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_JACC 67: 316-329, 2016_
We’ve Known Exercise is Important for a Long Time

TMH Eijsvogels et al. Exercise at the extremes: The amount of exercise to reduce cardiovascular events

JACC 67: 316-329, 2016
We’ve Known Exercise is Important for a Long Time


Daily Step Counts

- quarter 1: 2006
- quarter 2: 4659
- quarter 3: 7093
- quarter 4: 10569

Meier survival curves for the death, myocardial infarction, and study coronary events by randomization.
**We’ve Known Exercise is Important for a Long Time**

**WE Kraus et al. Physical activity, all cause and cardiovascular mortality and cardiovascular disease**

*MSSE 51: 1270-1281, 2019*

<table>
<thead>
<tr>
<th>Authors (year)</th>
<th>Exposure</th>
<th>Sample size</th>
<th>Hazard ratio (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 Wannamethee et al (1998)</td>
<td>Walking &gt; 1 hour/day</td>
<td>4311</td>
<td>0.62 (0.37 to 1.05)</td>
</tr>
<tr>
<td>2 Hakim et al (1996)</td>
<td>Walking &gt; 3.2 km/day</td>
<td>707</td>
<td>0.55 (0.37 to 0.83)</td>
</tr>
<tr>
<td>3 Bijnen et al (1998)</td>
<td>Walking &gt; 1 hour/week</td>
<td>802</td>
<td>0.71 (0.58 to 0.88)</td>
</tr>
<tr>
<td>4 Davey Smith et al (2000)</td>
<td>Brisk walking</td>
<td>6702</td>
<td>0.55 (0.48 to 0.63)</td>
</tr>
<tr>
<td>5 Fujita et al (2004)</td>
<td>Walking &gt; 1 hour/day</td>
<td>20 004</td>
<td>0.92 (0.80 to 1.06)</td>
</tr>
<tr>
<td>6b Schnohr et al (2007)</td>
<td>Walking &gt; 2 hours/day</td>
<td>3204</td>
<td>0.89 (0.69 to 1.14)</td>
</tr>
<tr>
<td>6b Schnohr et al (2007)</td>
<td>Brisk walking</td>
<td>3204</td>
<td>0.43 (0.32 to 0.59)</td>
</tr>
<tr>
<td>Subtotal</td>
<td></td>
<td>38 934</td>
<td>0.66 (0.53 to 0.83)</td>
</tr>
<tr>
<td>Female</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 Gregg et al (2003)</td>
<td>Walking &gt; 898 kcal/week</td>
<td>9518</td>
<td>0.71 (0.62 to 0.82)</td>
</tr>
<tr>
<td>2 Fujita et al (2004)</td>
<td>Walking &gt; 1 hour/day</td>
<td>21 159</td>
<td>0.72 (0.59 to 0.89)</td>
</tr>
<tr>
<td>3a Schnohr et al (2007)</td>
<td>Walking &gt; 2 hours/day</td>
<td>4104</td>
<td>0.81 (0.59 to 1.10)</td>
</tr>
<tr>
<td>3b Schnohr et al (2007)</td>
<td>Brisk walking</td>
<td>4104</td>
<td>0.48 (0.35 to 0.66)</td>
</tr>
<tr>
<td>4 Matthew et al (2007)</td>
<td>Walking &gt; 10 MET-hours/day</td>
<td>67 143</td>
<td>0.86 (0.71 to 1.05)</td>
</tr>
<tr>
<td>Subtotal</td>
<td></td>
<td>106 028</td>
<td>0.72 (0.62 to 0.84)</td>
</tr>
<tr>
<td>Male and female</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 LaCroix et al (1996)</td>
<td>Walking &gt; 4 hours/week</td>
<td>1645</td>
<td>0.73 (0.48 to 1.10)</td>
</tr>
<tr>
<td>2 Stessman et al (2000)</td>
<td>Walking &gt; 4 hours/week</td>
<td>456</td>
<td>0.14 (0.04 to 0.50)</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>147 063</td>
<td>0.68 (0.59 to 0.78)</td>
</tr>
</tbody>
</table>

Test for heterogeneity:

\[ \chi^2(13) = 31.35, p < 0.001 \]

Test for overall effect:

\[ \chi^2(1) = 57.86, p < 0.001 \]
We’ve Known Exercise in Important for a Long Time

WE Kraus et al. Physical activity, all cause and cardiovascular mortality and cardiovascular disease
MSSE 51: 1270-1281, 2019
Summary

Exercise is good for you!

Whether simple physical activity or structured aerobic exercise (walking), exercise reduces the risk of most chronic diseases

The magnitude of risk reduction from adding exercise to the lifestyle is at least as great as the control of other risk factors by lifestyle or medications

The magnitude of benefit from exercise is somewhat proportional to the dose of exercise

In terms of disease prevention and treatment effectiveness for chronic diseases exercise compares favorably with other medical Rx
Future Directions

C Foster et al. Work capacity and left ventricular function during rehabilitation after myocardial revascularization surgery *Circulation* 69: 748-755, 1984

Issues related to Training

Rate of improvement
Extent of improvement
Locus of improvement (cardio-respiratory or metabolic)
Fitness
Primary prevention
Secondary prevention

Is there something about the structure of exercise training programs that is more time efficient than steady state aerobic exercise?
Thank You

A Cat Named Chicken Production