Exercise is Medicine: A Call To Action !!

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Program Director, Cardiac Rehabilitation
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Stamford Hospital
We are heading in the wrong direction!
FREE DIABETES WITH PURCHASE OF LARGE COKE
SITTING

There’s no running away from it: The more you sit, the poorer your health and the earlier you may die, no matter how fit you are.

SMOKING

by SELENE YEAGER

PHOTOGRAPHED BY Nick Ferrari
Physical inactivity: the biggest public health problem of the 21st century

Steven N Blair

Figure 1  Attributable fractions (%) for all-cause deaths in 40,842 (3,333 deaths) men and 12,943 (491 deaths) women in the Aerobics Center Longitudinal Study. The attributable fractions are adjusted for age and each other item in the figure. *Cardiorespiratory fitness determined by a maximal exercise test on a treadmill.

Attributable Fractions(%) for All-Cause Deaths
CRF: Cardiorespiratory Fitness
Original Contribution

Physical Activity and Mortality: Is the Association Explained by Genetic Selection?

Sofia Carlsson\textsuperscript{1,2}, Tomas Andersson\textsuperscript{1,2}, Paul Lichtenstein\textsuperscript{3}, Karl Michaélsson\textsuperscript{4}, and Anders Ahlbom\textsuperscript{1,2}

*Am J Epidemiol* 2007;166:255–259

<table>
<thead>
<tr>
<th>Sex</th>
<th>Physical activity level</th>
<th>All-cause mortality</th>
<th>Cardiovascular mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Hazard ratio</td>
<td>95% confidence intervals</td>
</tr>
<tr>
<td>Men</td>
<td>Low</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Moderate</td>
<td>0.84</td>
<td>0.72, 0.98</td>
</tr>
<tr>
<td></td>
<td>High</td>
<td>0.64</td>
<td>-36%, 0.50, 0.83</td>
</tr>
<tr>
<td>Women</td>
<td>Low</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Moderate</td>
<td>0.82</td>
<td>0.70, 0.96</td>
</tr>
<tr>
<td></td>
<td>High</td>
<td>0.75</td>
<td>0.50, 1.14</td>
</tr>
</tbody>
</table>
Are We Sitting Too Much?
Sedentary behaviour and life expectancy in the USA: a cause-deleted life table analysis

Sitting Hurts

2X Greater Risk Of Diabetes

90% Greater Risk Of Cardiovascular Disease

49% Greater Risk Of All-Cause Mortality

Sources:
Katzmarzyk BMJ Open, 2012
Wilmot, Diabetologia, 2012

Katzmarzyk PT, Lee I-M. British Medical Journal, 2012
“Sitting Disease” by the numbers

Our modern sedentary lifestyles, both at home and in the workplace, are costly for us and for our employers.

Average hours of seated commute + average hours of seated homelife = too much sitting!

7.7 hours

A 2008 Vanderbilt University study of 6,300 people published in the *American Journal of Epidemiology* estimated that the average American spends 55% of waking time (7.7 hours per day) in sedentary behaviors such as sitting.
81.6 Million Or 27.7% Of Americans Are Totally Inactive
Not Active In Any Of 104 Activities In The Past Year

- 2007: 70.4 M (25.4%)
- 2015: 81.6 M (27.7%)
Physical inactivity costs the global economy over $67.5 billion per year.

#PhysAct2016  https://t.co/nbx3xsETRw  pic.twitter.com/MF6C218SKt

Physical inactivity cost the world $67.5 billion in 2013
Public costs accounted for almost half of that

Source: Study in The Lancet
Who foots the bill because of physical inactivity in the U.S.? Americans' inactivity cost $27,792,555 in 2013

- Household costs/out of pocket
- Indirect costs/productivity losses
- Private costs/health insurance
- Public costs/tax revenue

Source: Study in The Lancet
Physical fitness and activity as separate heart disease risk factors: a meta-analysis

Estimated dose-response curve for the relative risk of CHD
The risks of coronary heart disease and cardiovascular disease decrease linearly in association with increasing percentiles of physical activity.
Daily hours in sedentary behavior across the lifespan

- Screen time
- Workplace sitting

Hypothetical sedentary reduction goal

Age (years)

6-11, 12-15, 16-19, 20-29, 30-39, 40-49, 50-59, 60-69, 70-85

- Men
- Women

Retirement
AHA SCIENCE ADVISORY

Sedentary Behavior and Cardiovascular Morbidity and Mortality
A Science Advisory From the American Heart Association

Endorsed by The Obesity Society

Circulation Published Ahead of Print
August 15, 2016

“For people who sit most of the day, their risk of heart attack is about the same as smoking.”

- Martha Grogan, Cardiologist, Mayo Clinic
U.S. adults spend an average of 6 to 8 hours per day sitting.

Epidemiologic evidence is accumulating that indicates greater time spent in sedentary behaviors is associated with all-cause and cardiovascular morbidity and mortality in adults.

While the evidence base for guidelines on sedentary behavior continues to grow, it is appropriate to recommend that adults “sit less, move more.”
MVPA indicates moderate to vigorous physical activity

Estimated daily time spent in different contexts of energy expenditure among adults, based on the National Health and Nutrition Examination Survey

New evidence emerging on its contribution to cardiovascular risk
<table>
<thead>
<tr>
<th>Home</th>
<th>Work/School</th>
<th>Transportation</th>
<th>Leisure</th>
</tr>
</thead>
<tbody>
<tr>
<td>TV viewing: sitting, reclining</td>
<td>Computer work</td>
<td>Driving or riding in a vehicle</td>
<td>Playing an instrument</td>
</tr>
<tr>
<td>Talking on the phone</td>
<td>Sitting</td>
<td></td>
<td>Arts and crafts</td>
</tr>
<tr>
<td>Listening to music</td>
<td>Writing</td>
<td></td>
<td>Knitting/sewing</td>
</tr>
<tr>
<td>Eating</td>
<td>Talking on the phone</td>
<td></td>
<td>Meditating</td>
</tr>
<tr>
<td>Bathing</td>
<td>Sitting in class</td>
<td></td>
<td>Playing cards or board games</td>
</tr>
<tr>
<td>Reading</td>
<td>Typing</td>
<td></td>
<td>Viewing a sports event</td>
</tr>
<tr>
<td></td>
<td>Reading</td>
<td></td>
<td>Attending a religious service</td>
</tr>
</tbody>
</table>
“For Moderate to Vigorous Physical Activity, there is a large body of experimental evidence identifying how different durations, intensities, and types of physical activity can influence CVD risk biomarkers.”

However, it is likely that sedentary behavior influences risk in part through some distinct mechanisms that act independent of Moderate to Vigorous Physical Activity”
Summary of Key Findings: Potential Mechanisms

- **Sedentary behavior** might increase CVD and Diabetes Mellitus risk through distinct mechanisms that are independent of Moderate to Vigorous Physical Activity.

- **Reduced insulin sensitivity** is found during prolonged sedentary behavior that can be mitigated with short bouts of physical activity.
Key Finding:

“Interventions focusing solely on reducing sedentary behavior appear to be more effective at reducing sedentary behavior than those that include strategies for both increasing physical activity and reducing sedentary behaviors”
Let’s Look at Some Recent “Sedentary Time” Studies....
Meta-analysis were performed on outcomes for cardiovascular disease and diabetes (14 studies), cancer (14 studies), and all cause mortality (13 studies).

Prospective cohort designs were used in all but 3 studies; sedentary times were quantified using self-report in all but 1 study.
Significant hazard ratio (HR) associations were found with Sedentary time and:

1. All-cause Mortality (HR, 1.24)
2. Cardiovascular disease mortality (HR, 1.18)
3. Cardiovascular disease incidence (HR, 1.14)
4. Cancer Mortality (HR, 1.17)
5. Cancer Incidence (HR, 1.13)
6. Type 2 Diabetes Incidence (HR, 1.91)
Conclusions:

• Prolonged sedentary time was independently associated with deleterious health outcomes regardless of physical activity.

• The results reaffirm the need for greater public awareness about the hazards associated with sedentary behaviors.
Original Investigation

Continuous Dose-Response Association Between Sedentary Time and Risk for Cardiovascular Disease: A Meta-analysis

Ambarish Pandey, MD; Usman Salahuddin, MD; Sushil Garg, MD; Colby Ayers, MS; Jacquelyn Kulinski, MD; Vidhu Anand, MD; Helen Mayo, MLS; Dharam J. Kumbhani, MD, SM; James de Lemos, MD; Jarett D. Berry, MD, MS
• **Nine** prospective cohort studies with **720,425 participants** (57.1% women; 42.9% men;)

• Mean age, 54.5 years)

• Median **follow-up of 11 years**
Association Between Total Sedentary Duration and Risk for Cardiovascular Disease (CVD)
Excluding physical activity

- No apparent risk associated with intermediate levels of sedentary time (HR for 7.5 h/d, 1.02) was found.
CONCLUSIONS:
The association between sedentary time and the risk for CVD was nonlinear with an increased risk at very high levels. After adjustment for physical activity and other CVD risk factors, significant risk for CVD was observed with very high levels of sedentary time (>10 h/d), with no apparent risk associated with intermediate levels of sedentary time.
“The biological mechanism underlying this nonlinear association is not completely understood, but it appears to reflect an apparent threshold effect of sedentary time on cardiometabolic risk factors.”
Confirmation for the risks associated with sedentary lifestyle, and the benefits of exercise

"Does physical activity decrease, or even eliminate, the detrimental association of sitting time with mortality? A meta-analysis of data from more than 1 million men and women" ... Ekelund U, et al

The Lancet 2016; (16)3072-1 (Published Online July 27, 2016)
16 studies were analyzed

A total of 1,005,791 men and women

84,609 died during the follow-up period
Previous reports have demonstrated a direct link between time spent sitting, and an increased risk for death.

Other studies have suggested an inverse relationship between physical activity and the risk for death.

This unique new study analyzed the joint implications of both sedentary lifestyles and physical activity.

The study hoped to answer the question of whether or not this association could be counteracted by physical activity.
Those who sat for more than 8 hours a day and completed less than 2.5 METs of a task had a 59% increased risk for mortality when compared with those who sat for less than 4 hours a day but completed more than 35.5 METs (HR=1.59)
Participants who sat for over **8 hours a day** and averaged **35.5 METs a day** had lower chances (HR 1.04) of dying during the study's follow-up period compared with participants who **sat for less than 4 hours a day** but averaged **less than 2.5 METs a day** (HR 1.27) (+27% Risk).
Conclusions:

High levels of moderate-intensity physical activity *attenuate* (decrease) the increased risk associated with high TV-viewing time, and eliminate the increased risk of death associated with high sitting time.
Frequency, Type, and Volume of Leisure-Time Physical Activity and Risk of Coronary Heart Disease in Young Women


METHODS:

- Prospective analysis among 97,230 women aged 27 to 44 years at baseline in 1991.
- Leisure-time physical activity was assessed by questionnaire.
- Examined the associations between physical activity frequency, type, and volume, and CHD risk.
- 20 years of follow-up
Supplemental Table 1: Hazard ratios (95% CI) of coronary heart disease according to categories of cumulative average physical activity, 1997 – 2011, Nurses’ Health Study II

<table>
<thead>
<tr>
<th>Categories of Cumulative Average Physical Activity, MET-hrs/wk</th>
<th>Hazard Ratios:</th>
<th>p-value for linear trend</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Physical Activity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cases</td>
<td>99</td>
<td>159</td>
</tr>
<tr>
<td>Person-years</td>
<td>250,780</td>
<td>434,577</td>
</tr>
<tr>
<td>Age-adjusted</td>
<td>1.00</td>
<td>0.84</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Categories of Average Physical Activity</th>
<th>Walking</th>
<th>Jogging</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Activity MET-hrs/wk</td>
<td>(&lt;1)</td>
<td>(1-5.9)</td>
</tr>
<tr>
<td>Hazard Ratios:</td>
<td>1.00</td>
<td>0.84</td>
</tr>
</tbody>
</table>
Results:

- Physical activity was associated with lower risk of coronary heart disease (CHD) in young women.
- Exercise **did not have to be strenuous** to have such associations; moderate-intensity physical activity, including brisk walking, was associated with lower risk of CHD.
- Frequency of physical activity not as important as **total volume**.
- The associations between physical activity and lower CHD risk were evident **regardless of body mass index**.
Being Unfit May Be Almost as Bad for You as Smoking
By GRETCHEN REYNOLDS
Low aerobic capacity in middle-aged men associated with increased mortality rates during 45 years of follow-up

Per Ladenvall¹, Carina U Persson², Zacharias Mandalenakis¹, Lars Wilhelmsen¹, Gunnar Grimby², Kurt Svärdsudd³ and Per-Olof Hansson¹
METHODS:

A representative sample of men born in 1913 was followed from 50–99 years of age, with periodic medical examinations and data from the National Hospital Discharge and Cause of Death registers.

At 54 years of age, 792 men performed an ergometer exercise test, with 656 (83%) performing the maximum exercise test.
Results:

The variable impact of predicted $\text{VO}_2$ Max (aerobic capacity) on mortality was secondary only to smoking.

The risk associated with low predicted Max $\text{VO}_2$ was evident throughout four decades of follow-up.
Conclusion:

Low aerobic capacity was associated with increased mortality rates, independent of traditional risk factors, including smoking, blood pressure and serum cholesterol, during more than 40 years of follow-up.
Physical activity and risk of breast cancer, colon cancer, diabetes, ischemic heart disease, and ischemic stroke events: systematic review and dose-response meta-analysis for the Global Burden of Disease Study 2013

Hmwe H Kyu,1 Victoria F Bachman,2 Lily T Alexander,1 John Everett Mumford,1 Ashkan Afshin,1 Kara Estep,1 J Lennert Veerman,3 Kristen Delwiche,4 Marissa L Iannarone,1 Madeline L Moyer,1 Kelly Cercy,1 Theo Vos,1 Christopher J L Murray,1 Mohammad H Forouzanfar1
Methods:

Used data from **174 cohort studies**
First **meta-analysis** to quantify the dose-response association between total physical activity and the risk of chronic diseases.

Examined the association between physical activity and the risks of one of five outcomes:

- Breast cancer
- Colon cancer
- Diabetes
- Ischemic heart disease
- Ischemic stroke

Estimated relative risks of diseases for each dose of **total physical activity** in MET minutes/week.
Get Moving: High Physical-Activity Level Reduces Risk of 5 Diseases

Disease Risk Reduction for Highly Active Participants
(≥ 8000 MET minutes/week)

- Breast Cancer: 14%
- Colon Cancer: 21%
- Ischemic Heart Disease: 25%
- Ischemic Stroke: 26%
- Diabetes: 28%

Source: BMJ. Published online August 9, 2016.
Fig 7 | Continuous risk curves for association between physical activity and breast cancer, colon cancer, diabetes, ischemic heart disease, and ischemic stroke
Conclusions:

Higher levels of total physical activity were significantly associated with lower risk for all outcomes.

Major gains occurred at lower levels of activity and there were diminishing returns at levels higher than 3000-4000 MET minutes/week.

Greater attention and investments in interventions to promote physical activity in the general public is required.
How little can you exercise and still get benefits
“Do what you can, with what you have, where you are.”

Theodore Roosevelt
Prolonged sitting-induced leg endothelial dysfunction is prevented by fidgeting

Takuma Morishima,1,2,3 Robert M. Restaino,4 Lauren K. Walsh,1 Jill A. Kanaley,1 Paul J. Fadel,5 and Jaume Padilla1,6,7
Prolonged sitting impairs endothelial function in the leg vasculature, and this impairment is thought to be largely mediated by a sustained reduction in blood flow-induced shear stress.

Can endothelial dysfunction be prevented by periodic leg movement, or “fidgeting”? 

Fidgeting movement:

1 min on/4 min off
~250 taps/minute
Methods: In 11 young, healthy subjects, bilateral measurements of popliteal artery flow-mediated dilation (FMD) were performed before and after a 3-hour sitting period during which one leg was subjected to intermittent fidgeting (1 min on/4 min off) while the contralateral leg remained still throughout and served as an internal control.
RESULTS:

• Popliteal Artery flow-mediated dilation was impaired after 3 hours of sitting in the control leg (presit, 4.5 to postsit: 1.6; $P > 0.03$)

• Popliteal artery flow-mediated dilation improved in the fidgeting leg (presit to postsit, 6.6; ($P >0.01$)
Flow-Mediated Dilation
Conclusions:

- Simple behavior of fidgeting is sufficient to counteract the detrimental effects of prolonged sitting on leg endothelial function, likely through the intermittent increases in blood flow-induced shear stress.

- This study provided the first evidence that the detrimental vascular effects of sitting are preventable with small amounts of leg movement while seated for an extended period.

- People should be encouraged to consciously engage in leg movement when sitting for prolonged periods of time either at work or at home.
Impact of moderate physical activity on the longitudinal trajectory of a cardiac specific biomarker of injury: Results from a randomized pilot study of exercise intervention

Christopher R. deFilippi, MD, a James A. de Lemos, MD, b Anne B. Newman, MD, MPH, c Jack M. Guralnik, MD, PhD, d Robert H. Christenson, PhD, e Marco Pahor, MD, f Timothy Church, MD, PhD, MPH, g Mark Espeland, PhD, h Stephen B. Kritchevsky, PhD, i Randall Stafford, MD, PhD, j and Stephen L. Seliger, MD, MS k.

Am Heart J 2016;179:151-6.
Background:

“In animal models, physical activity (PA) prevents cardiac myocyte cell death. Data for PA mitigating myocyte injury in humans are limited to observational studies.

A randomized controlled trial design sought to determine if introducing moderate Physical Activity (PA) to previously sedentary older adults could reduce the trajectory of myocardial injury as measured by the high-sensitive cardiac troponin T (hs-cTnT) assay.”
Methods:

Participants (age ≥70 years) were assigned to a 1-year intervention of moderate Physical Activity or health education control.

High-sensitive cTnT measured at baseline & 1-year.

Changes in hs-cTnT within 1 year were compared between Physical Activity and control groups.

Moderate to vigorous Physical Activity in kcal/week was estimated with a questionnaire.
RESULTS:

- Activity kcal/week increased in the Physical Activity, but not in the control group at 1 year.
- The median increase in hs-cTnT level from baseline was >3 times larger in the control (0.73 ng/L vs the PA group 0.19ng/L)

Conclusions:
Initiation of moderate Physical Activity in sedentary older adults may favorably modify subclinical myocardial injury
GREAT OPPORTUNITY AHEAD
Measuring Vital Signs
The following **Seven** items are considered **“Vital signs”**:  
- Sitting or standing blood pressure  
- Supine blood pressure  
- Pulse rate and regularity  
- Respiration  
- Temperature  
- Height  
- Weight
“a fundamental change in approach or underlying assumptions”
A Physical Activity Vital Sign (PAVS) could provide valuable insight into a patient's health status and lead to opportunities to advance a culture of Wellness.
Call to Action!

The New Stamford Hospital
Problem Solving Requires New Approaches

“We can’t solve problems by using the same kind of thinking we used when we created them.” – Albert Einstein
Never doubt that a small group of thoughtful, committed citizens can change the world; indeed, it's the only thing that ever has.

Margaret Mead
Call to Action on Making Physical Activity Assessment and Prescription a Medical Standard of Care

Robert E. Sallis, MD, FACSM; Jason M. Matuszak, MD, FAAFP; Aaron L. Baggish, MD, FACC, FACSM; Barry A. Franklin, PhD, FACSM; Wojtek Chodzko-Zajko, PhD, FACSM; Barbara J. Fletcher, RN, MSN, FAAN, FPCNA; Andrew Gregory, MD, FAAP, FACSM; Elizabeth Joy, MD, MPH, FACSM; Gordon Matheson, MD, PhD, FACSM; Patrick McBride, MD, MPH, FACC; James C. Puffer, MD, FACSM; Jennifer Trilk, PhD; and Janet Williams, MA.

Current Sports Medicine Reports: Special Communication
American College of Sports Medicine
WARNING: Prolonged sitting and physical inactivity cause chronic disease and premature death.
Using an Electronic Medical Record to Assess Physical Activity?
1. On average, how many days per week do you engage in moderate to strenuous exercise (like a brisk walk)?
   _____ days

2. On average, how many minutes do you engage in exercise at this level?
   _____ minutes
### Exercise Vitals

**Instant Taker:**
- **Date:** 4/30/2009
- **Time:** 1149

### Exercise Level of Effort

<table>
<thead>
<tr>
<th>Days per week of moderate to strenuous exercise (like Brisk walk)</th>
<th>Minutes per day of exercise at this level?</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 1 2 3 4 5 6 7</td>
<td>10 20 30 40 50 60 90 120 150 or greater</td>
</tr>
</tbody>
</table>

On average, minutes per day of exercise at this level?
THE TIME IT TAKES TO COLLECT EXERCISE AS A VITAL SIGN.
Kaiser Permanente in Southern California (KPSC) pioneered the use of an **Exercise Vital Sign (EVS)** to record minutes per week of **Physical Activity (PA)** at every visit.

**PURPOSE:**

Evaluated the correlation between self-reported **Physical Activity** level (using EVS) and the likelihood of suffering an ACE (acute MI or revascularization procedure).
METHODS:

Data were abstracted from electronic medical records of KPSC (N=1,423,525). 3 Exercise Vital sign (EVS) measurements spanning over a yr. from 2009 to 2011.

Patients were classified into 1 of 3 distinct categories for EVS:

- **Consistently Inactive (CI)** EVS = 0 min/wk for every measure,
- **Insufficiently Active (IA)** EVS 10-149 min/week) and
- **Consistently Active (CA)** EVS ≥ 150 min/week for every measure)
RESULTS:

- **Consistently Active men** were found to be less likely to experience an ACE compared to Consistently Inactive men \((HR (CI) = 0.74 (-26\%))\).

- **Consistently Active women** were found to have a nearly 3 fold decrease in the hazard of an ACE \((HR = 0.33)\) compared to Consistently Inactive women.

- **Women who were Insufficiently Active** were also found to be less likely to experience an ACE \((HR = 0.79)\) compared to Consistently Inactive
CONCLUSIONS:

Based on Exercise Vital Sign Data (EVS), self-reported PA was strongly correlated with the likelihood of suffering an ACE.

Study suggested that a low EVS predicts increased risk for CVD

“For this reason, any patient presenting with chest pain or other symptoms of an acute coronary event, should be asked about their exercise habits and a Low EVS should add to the clinical suspicion for heart disease in such a patient”.
Start Here!

**Asking** about Physical Activity sets the stage for Advising!
THE SECRET OF CHANGE IS TO FOCUS ALL OF YOUR ENERGY NOT ON FIGHTING THE OLD, BUT ON BUILDING THE NEW.
Facilitating effective health behavior change counseling during a medical visit

- **Ask—Physical Activity Vital Sign**
- **Advise**—encourage increased physical activity
- **Assess** readiness to increase physical activity
- **Assist with** treatment plan
- **Arrange** follow-up

Last 3 have the greatest impact on healthful behavior change

Change Starts Here!
Conclusion:

- **Clinicians have a responsibility** to inform their patients of the risks of physical inactivity.
- Patients should understand that the **benefits of exercise far outweigh the risks**.
- **Regular** physical activity should be advocated for the prevention and **first-line treatment of chronic disease**.
- The default exercise prescription is to **walk at least 30 minutes** a day, most days of the week.
- Any type of physical activity done **at a moderate pace** can count toward the latter weekly goal.
We Can Do It!

The Revolution is coming

JOIN THE REVOLUTION
We need to promote implementation of a Physical Activity Vital Sign in our medical record, to be assessed at every medical office visit.

Please invite your colleagues to join us in this important population health initiative.
SUCCESS Starts Here
IF YOU'RE WAITING FOR A SIGN (S)

THIS IS IT.
DANGER

KEEP OFF!  WARNING!

Sitting for extended periods of time WILL cause IRREPARABLE harm to your health.
ARE YOU SITTING TOO MUCH?
No Elevators Day

Take the Stairs
Burn Calories, Not Electricity
WALK TO WORK DAY
THURSDAY APRIL 7, 2016
Miracle Cure!

If any single drug had the same range of health benefits as Physical Activity it would be sold as a miracle cure!
There is no magic pill.
No shake.
No special diet.

Just get off your butt.
Final Thought ....
“If I had first concentrated on heart disease prevention, rather than saving the lives of 150 people, I could have saved the lives of 150 million.”

Christian Barnard, MD, 2001
(Performed The First Successful Heart Transplant, 1967)
Thank you
Time for Questions