



# ***ExerCise Science update***

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# AGENDA

## Applied Exercise Science Update – Cardiometabolic Risk

Exercise & covid

Sitting time

Blood fats and exercise

Cell phones and fit apps vs pedometers

High intensity ex and T2D

Value of light intensity ex

Least measures

Just Move!

**The Gym Inside Your Door update**



**Just move**

*and move often*

*Least measures*

Get 2-5 minutes PA before work/breakfast

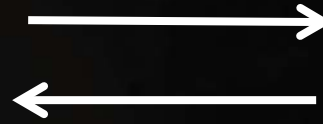
Move 5 min on the hour\*

At least twice a week at least 30 minutes of sustained PA\*

At least one weekend day at least 60 minutes of sustained PA

\* *Domestic/household/work chores count too*

**Cardiorespiratory  
Fitness**



**Physical  
Activity**

**Aerobic capacity**  
(e.g., maxV<sub>O2</sub>, performance)

- Genetics

- Gender, age

**More intensive ex**

**Activity/step counts**

**Muscle contractions**

**Energy expenditure  
(total kcal)**

**Just Move!**

**Functional and metabolic benefits**  
(*glucose transport, AMPK, PPAR $\delta$ , insulin sensitization, epigenetic changes*)

**Measurable body fat alterations, weight loss,  $\downarrow$  LDL-C, ...**

**Weight loss maintenance**



500

1000

1500

2000

2500+ kcal/week

walking ~5 miles

~10 miles

~15 miles

~20 miles

25+miles

## Weekly Physical Activity and Cardiometabolic Benefit

# The impact of moving more, physical activity, and cardiorespiratory fitness: Why we should strive to measure and improve fitness

Myers J et.al. Prog in CV Dis 54:77, 2021

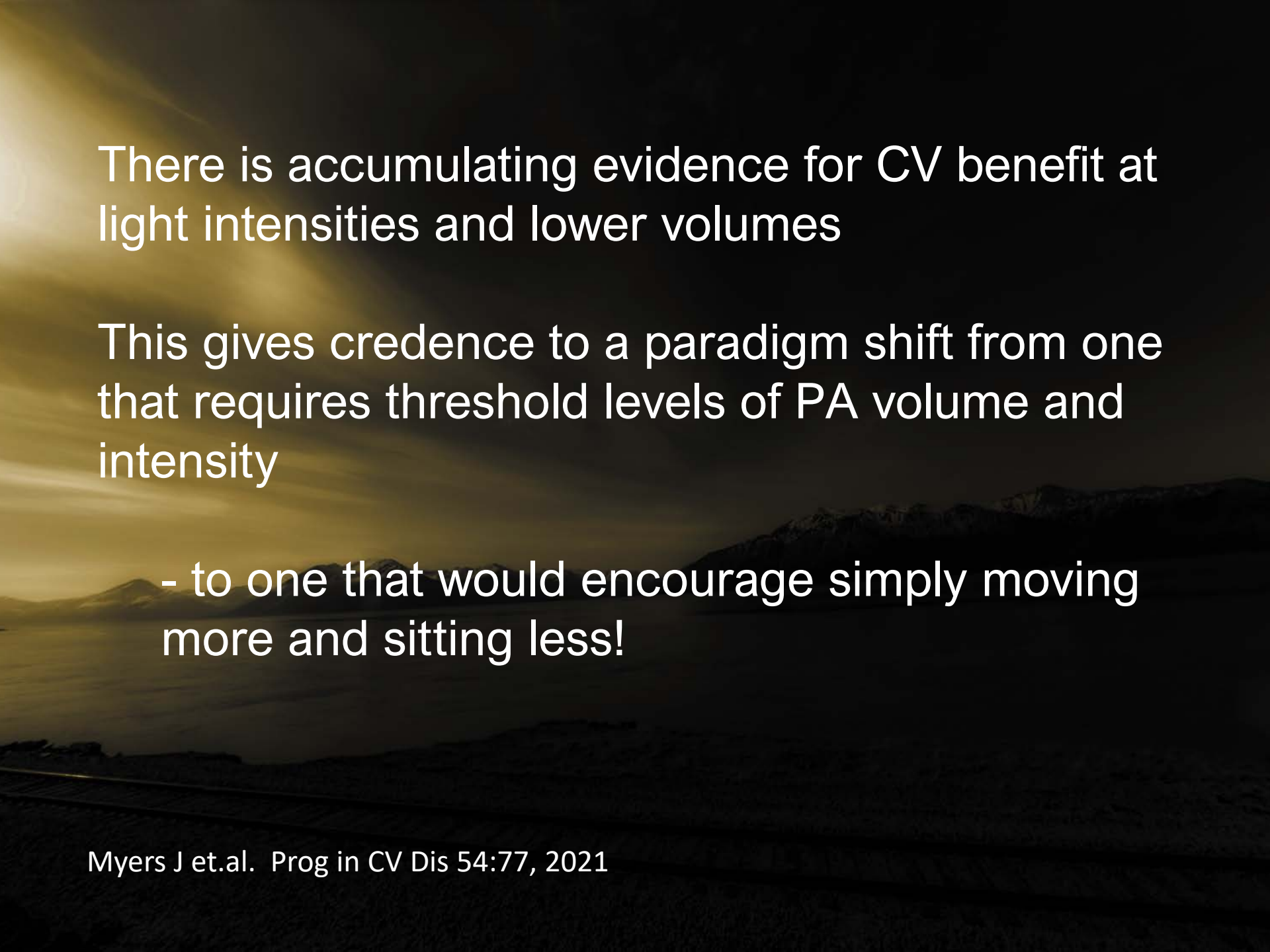
7 decades of epidemiologic research

Being physically active is associated with better health outcomes *independent of cardiorespiratory fitness*, a concept that would have been considered heretical a few decades ago

Both increased CRF and statin treatment were independently associated with lower mortality among dyslipidemic individuals.

Consistent with other studies, treatment with statins resulted in a 35% lower mortality risk. CRF alone also exhibited a graded reduction in mortality risk; compared to the least-fit group, low-fit, moderate-fit and high-fit subjects had 26%, 43% and 63% reductions in mortality, respectively



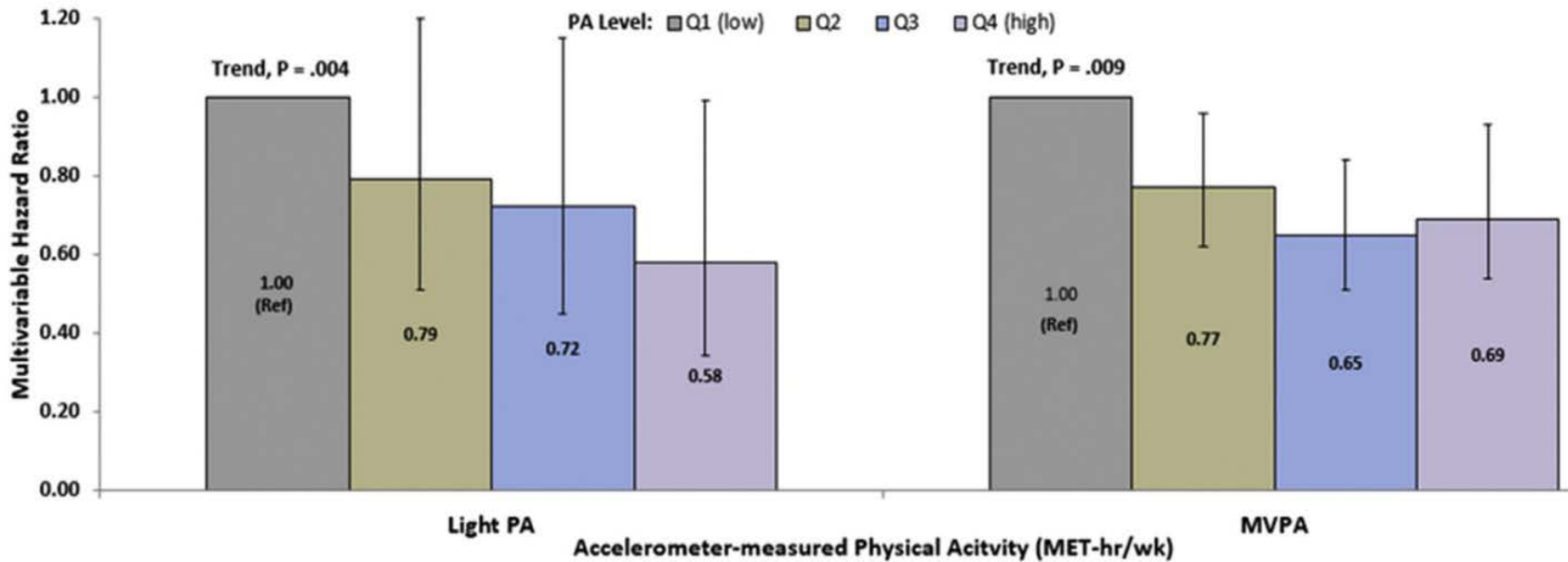


There is accumulating evidence for CV benefit at light intensities and lower volumes

This gives credence to a paradigm shift from one that requires threshold levels of PA volume and intensity

- to one that would encourage simply moving more and sitting less!

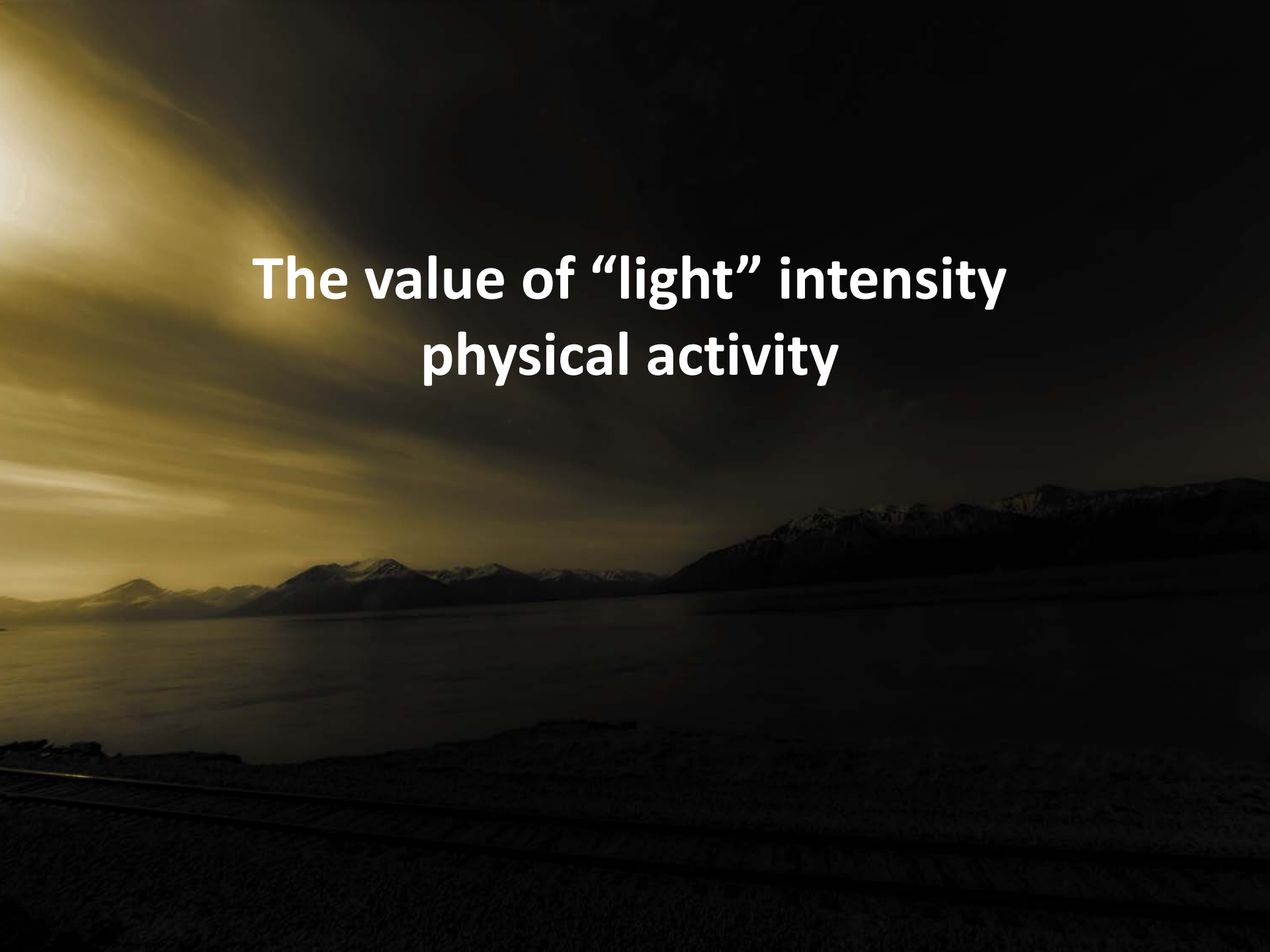
# The Value of even light level PA and CHD



CVD

Myers J et.al. Prog in CV Dis 54:77, 2021

LaCroix et. al. JAMA 1019 WHI

A scenic landscape at sunset or sunrise. The sky is filled with soft, golden light, with rays of light emanating from the top left corner. The sun is partially visible, creating a bright glow. In the foreground, there is a dark, silhouetted landscape, possibly a field or a path. In the middle ground, a calm body of water reflects the light from the sky. In the background, a range of mountains is visible, with some peaks covered in snow. The overall mood is peaceful and serene.

# The value of “light” intensity physical activity

Moderate - vigorous physical activity:

6+ METs for 50 minutes per day, 6+ kcal/min,  
or approximately **400-500+ kcal**

WORKOUT

Light PA

2-3 METs for 6 hours per day @ 3.5 kcal/min or  
~**700-900 kcal**

HOUSEHOLD/  
DOMESTIC

# What Counts as Light-Intensity Aerobic Activity?

During *light-intensity activities* there is not noticeable change in your breathing; you can talk and sing normally. You also don't break out in a sweat. Doing the activity feels easy.

Examples of activities that require only a small amount of energy above baseline—inactivity—for most people include:

**general housework,  
light gardening,  
playing an instrument  
shopping  
walking less than 3 mph,**

# Metabolic Value of Single Acute Bouts of Physical Activity

2-5 minute intentional bouts of physical activity at moderate intensity activate AMPK, glu-transport mechanisms, PPAR<sub>delta/gamma</sub>, insulin signaling, and improvements in insulin sensitivity

e.g., yard or housework, short walks

Braun B J Appl Physio 1995;78:300 & 2006

Church T JAMA 2007;297 2081

Blair SN MedSc Rev. 12/2006

Ross R Ob Res. 2004;12:789

Telford R Med Sci Spts Ex 2007;39:1233

Hamilton M 2011-12

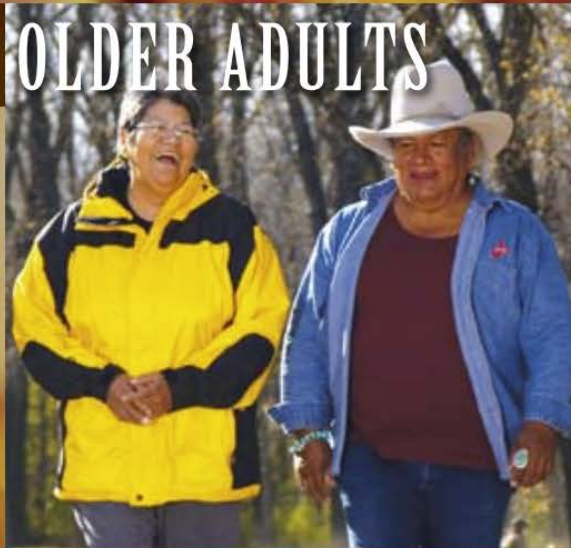
Neiderberger Sports Med 2015, 45

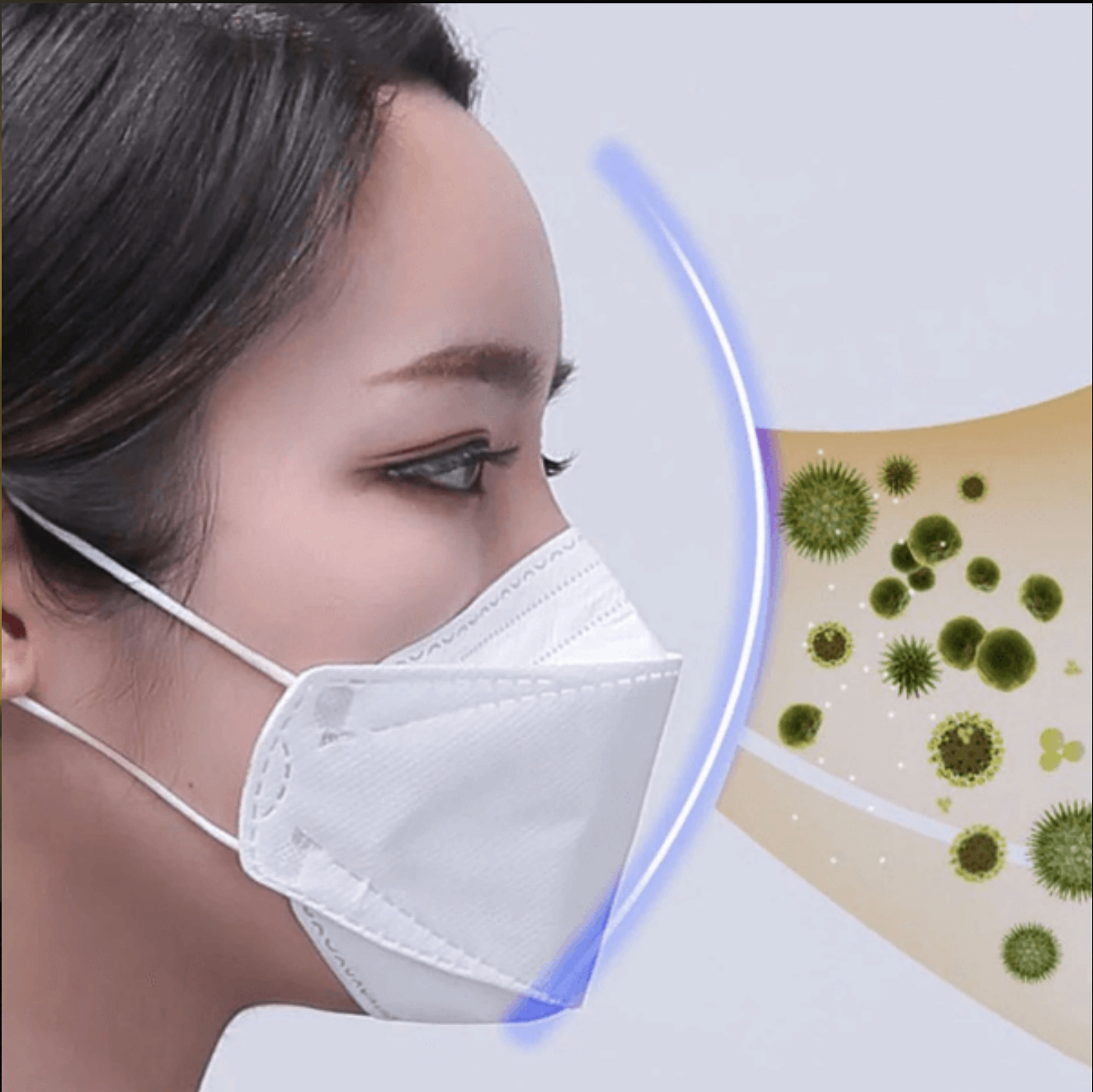
Jacicic J 2020

# PHYSICAL ACTIVITY KIT (PAK)

*staying on the active path in native communities ... a Lifespan approach!*

**BOOK #7** OLDER ADULTS







## Pulmonary Ventilation Considerations

Normal resting ventilation volume output ( $V_e$ ) is 4-7 liters/minute.

Individuals performing stationary dynamic aerobic exercise (walking, running, rowing, etc.) easily generate high minute ventilation rates of >80-120 liters/min. Two or more people 6-10 feet of each other dramatically increases potential virion exposure - even with moderate cross-ventilation provided by the gym.

The key culprit for covid spread in gyms is the **high pulmonary ventilation** nature of dynamic exercise and being in close proximity in indoor spaces.



# The effect of aerobic exercise on immune biomarkers and symptoms severity and progression in patients with COVID-19: A randomized control trial

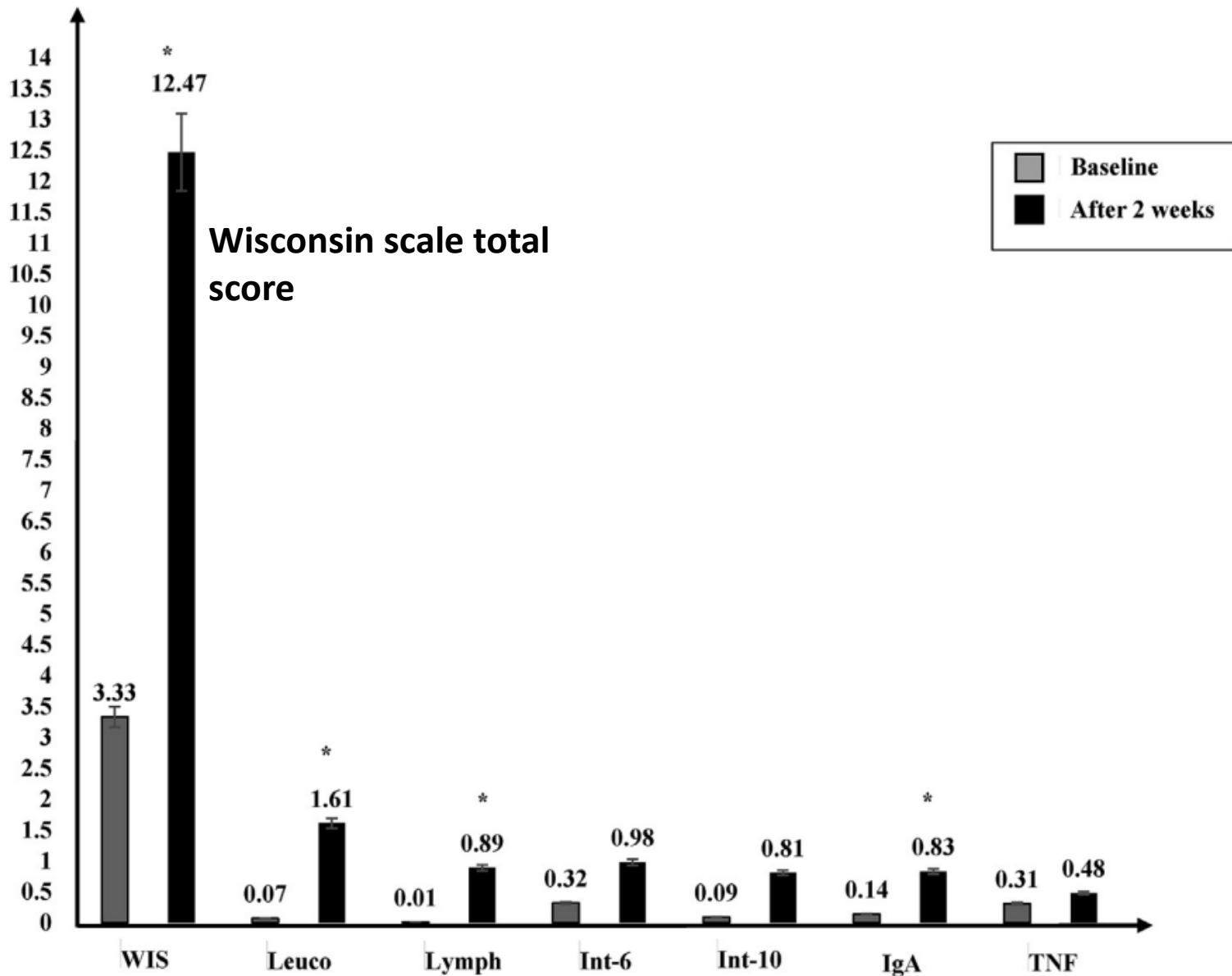
Mohammad A et.al. *JBodyw Mov Ther.* 2021 Oct;28:425-432.

N= 30 Covid pts (25-45yrs)

2 weeks of *moderate-intensity* aerobic exercise for 40 min/session, 3 sessions/week

The current study indicated that two weeks of moderate intensity aerobic exercise decreased the severity and progression of COVID-19 associated disorders and quality of life.

Also, two weeks of aerobic exercise produced a positive effect on the immune system by increasing the amounts of Leucocytes, Lymphocytes, Immunoglobulin A..



# Yoga, immunity and COVID-19: A scoping review

**Komal Shah<sup>1</sup>, Chiranjivi Adhikari<sup>1,2</sup>, Somen Saha<sup>1</sup>, Deepak Saxena<sup>1</sup>**

*<sup>1</sup>Department of Public Health, Indian Institute of Public Health-Gandhinagar (IIPHG), Gandhinagar, Gujarat, India,*

*<sup>2</sup>Department of Public Health, School of Health and Allied Sciences, Pokhara University, Pokhara-30, Nepal*

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## ABSTRACT

Yoga is recognized and practiced for different levels of prevention since antiquity. The current scoping review aimed to identify and document the evidence reporting the effect of yoga interventions on immunity against COVID-19 infection. Three databases--PubMed, Cochrane, and Google Scholar, were searched to identify eligible studies. Articles published in English after 2010 and assessing the impact of any form of yoga (such as yogasanas, meditations, or pranayamas) on immunological markers were included in the review. The studies without information of the intervention on immunity markers, and experience sharing reviews were excluded. The search yielded 45 eligible articles with majority of the studies being published from the USA and India. Most of the studies were randomized controlled trials, enrolling the adult population with a specific focus on diseases like HIV, cancer, and heart failure. It was observed that a variety of yoga interventions along with meditation and pranayama, in different combinations were used by the authors. However, all these studies unanimously reported improvement in immunological profile (indicated by improved biochemical markers) of an individual (irrespective of disease state and type) with yoga. Moreover, the beneficial effects of these traditional Indian interventions were also found to have a positive impact on overall physical and physiological wellbeing and quality of life. Findings from the existing literature indicate that the practice of yoga has the potential to strengthen cell-mediated immunity and hence could be used as an effective preventive measure against COVID-19 where immunity plays a critical role.

N=45 studies

Journal of Family Medicine and Primary Care Volume 11: 5, 2022

The results suggested that the practice of hatha yoga and allied activities enhance the inflammatory profile of diseased as well as healthy individuals

The reduction was documented in *CRP, IL-1  $\beta$*  and the similar pro-inflammatory biomarkers whereas increase in *IL-6, IL-10, TNF- $\alpha$ , IFN-gamma* and other anti-inflammatory ones

# Hatha Yoga

Viniyoga  
Iyengar  
Restorative  
Ashtanga  
Kripalu  
Integral  
Somatic  
Sivananda  
Ananda  
Bikram  
Kundalini  
Tibetan  
etc.







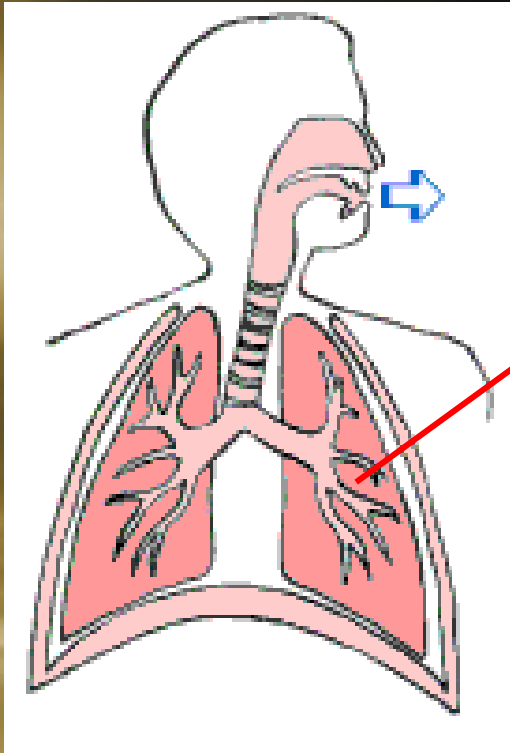
# Yogic Breathing

*Breathwork - Pranayama*



To sustain relaxed attention of the flow and sound of the breath

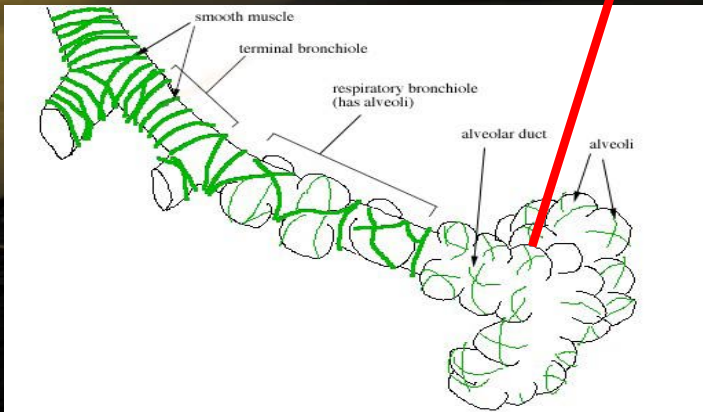
# Yogic Breathing



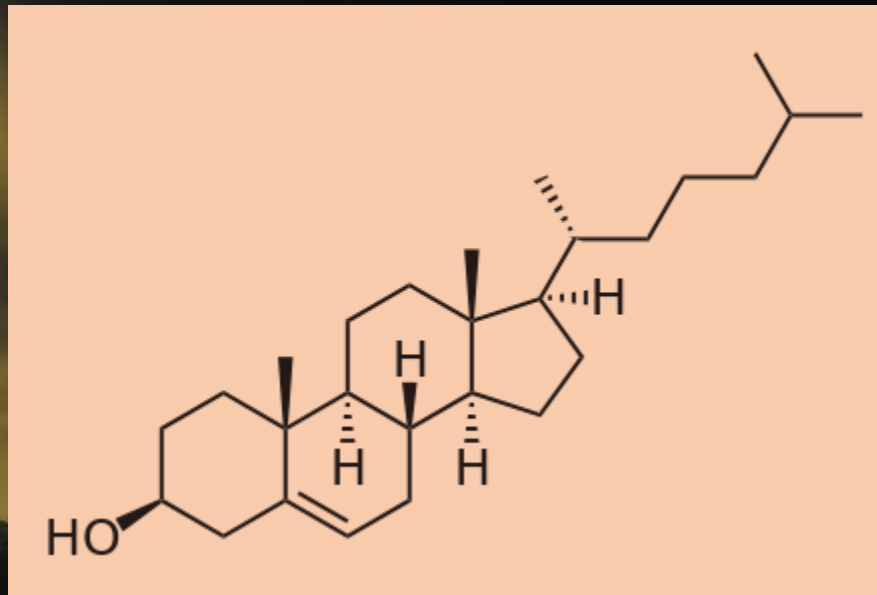
Inhalation & expiration:  
stretch receptors in  
pulmonary tissue stimulate  
vagus nerve (parasympathetic)

Prolonged expiratory phase:  
further enhancement of  
inhibitory tone

eg. chanting, singing,  
pranayama, diaphragmatic  
breathing.



Cholesterol is a **sterol** - not a fat



- ✓ Unlike fatty acids and triglycerides cholesterol cannot be hydrolyzed to generate ATP-energy to fuel exercise

# Lifestyle Lab Panel

## Primary

**Triglycerides**  
**Non HDL-C \***  
**Sys BP**



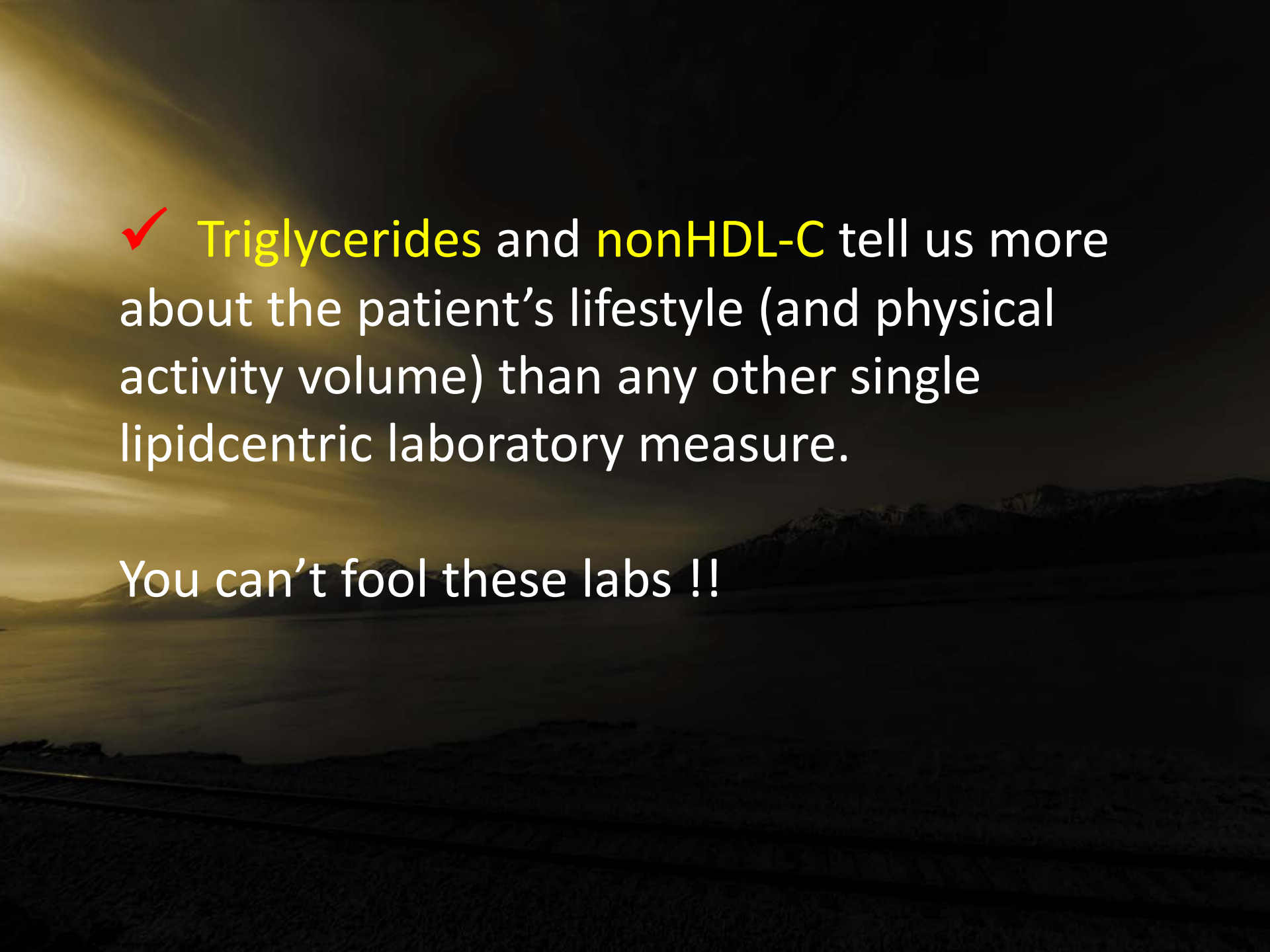
## Secondary

FPG

Subscap SF

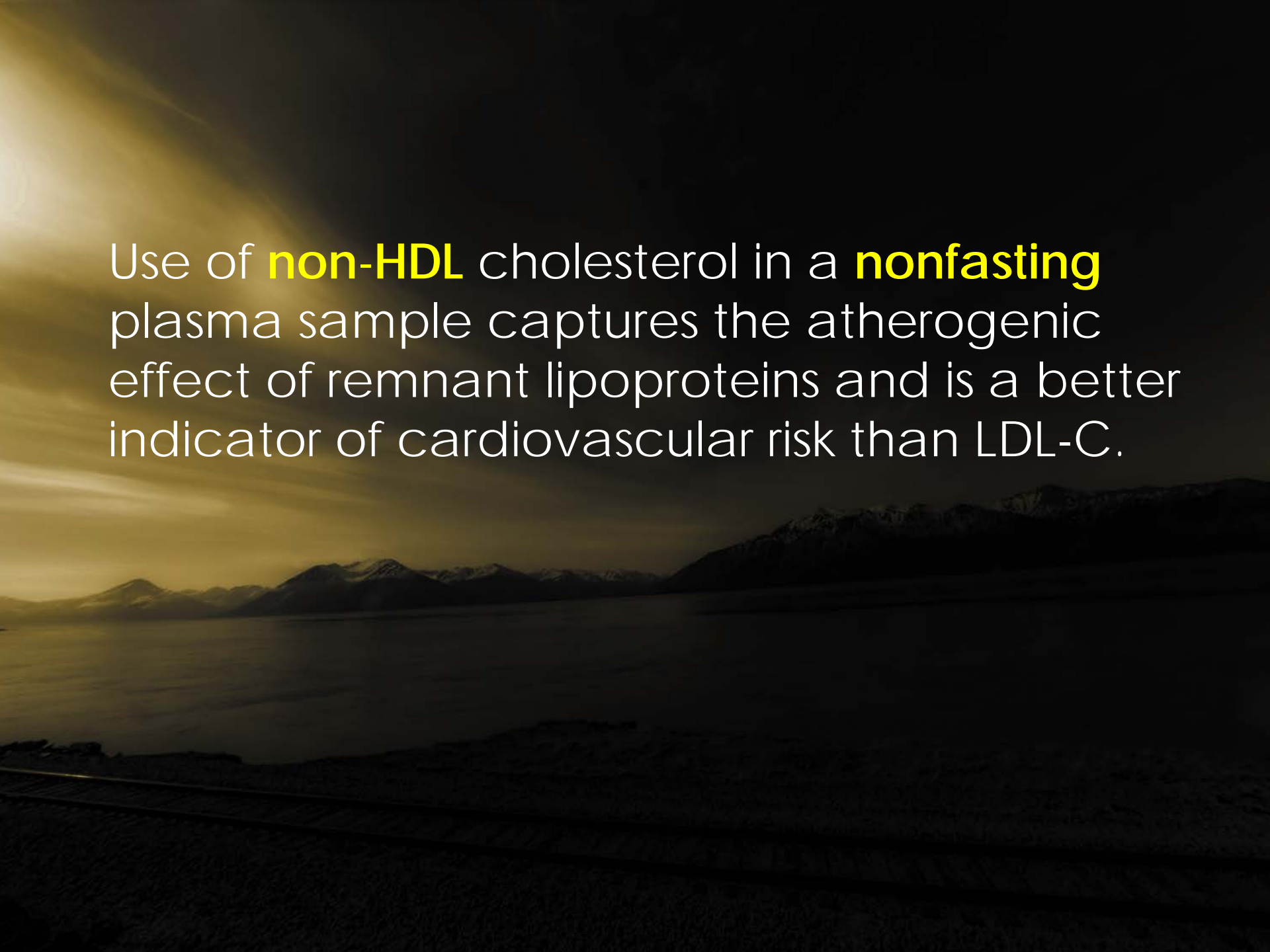
Waist circumf

\* **Non HDLC** = TC-HDL and most important in CVD risk prediction in T2D



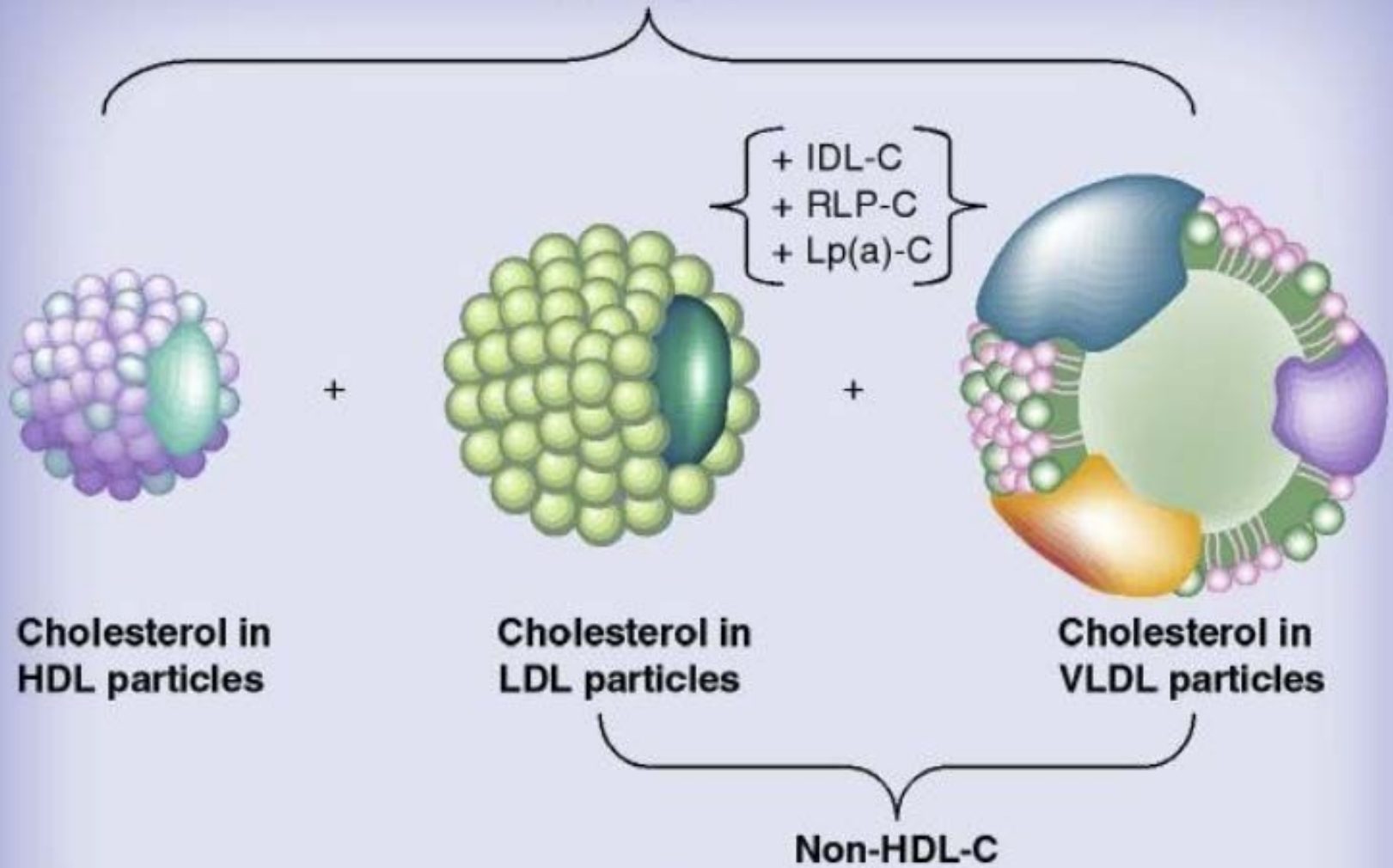
✓ Triglycerides and nonHDL-C tell us more about the patient's lifestyle (and physical activity volume) than any other single lipidcentric laboratory measure.

You can't fool these labs !!



Use of **non-HDL** cholesterol in a **nonfasting** plasma sample captures the atherogenic effect of remnant lipoproteins and is a better indicator of cardiovascular risk than LDL-C.

**Total cholesterol**



# Assessing Serial Changes in Adiposity



**B** Subscapular

**Figure 28.11B.** Anatomic location of five common skinfold sites: Subscapular. Measurements are taken on the right side of the body in the vertical plane, except diagonally at subscapular and suprailiac sites.

Copyright © 2001 Lippincott Williams & Wilkins



**A** Triceps

**Figure 28.11A.** Anatomic location of five common skinfold sites: Triceps. Measurements are taken on the right side of the body in the vertical plane, except diagonally at subscapular and suprailiac sites.

Copyright © 2001 Lippincott Williams & Wilkins

Lange calipers (~ \$220)



How hard should a prediabetic or diabetic patient exercise for overall metabolic health benefits?





*Is exercise intensity or volume the most important determinant for the improved insulin action observed after exercise training?*

Low-to-moderate intensity exercise may be just as effective as moderate-to-high intensity exercise training in terms of lowering the HbA1c levels of obese patients with type 2 diabetes

**Reality check:** A large proportion of patients with type 2 diabetes suffer from comorbidities, such as *osteoarthritis, cardiac problems and other disease states*, that confer a low tolerance for exercise of any sort.

*Hansen et.al. Diabetologia 52, 2009*

*Hawley 2009 “*

# % of Max Exercise Intensity Definitions (by effort)

light

**20 – 40%** low

**40 – 60%** moderate

**60 – 80%+** high

max

# High-intensity interval training versus continuous training on physiological and metabolic variables in prediabetes and type 2 diabetes: A meta-analysis

Da Nardi et.al. Diabetes Res. Mar. 137: 2018 Brazil

**Methods:** included randomized clinical trials that compared the use of HIIT and MICT in prediabetes and T2D adults.

**Results:** From 818 relevant records, seven studies were included in systematic review (64 prediabetes and 120 T2D patients) and five with T2D were meta-analyzed.

HIIT promoted significantly increased of 3.02 mL/kg/min of  $VO_2$ max, measured for functional capacity, compared to MICT. No differences were found between two modalities of exercises considering the outcomes HbA1c, systolic and diastolic blood pressure, total cholesterol, HDL and LDL cholesterol, triglycerides, BMI, and waist-to-hip ratio. Most of the studies presented unclear risk of bias, and low and very low quality of evidence.

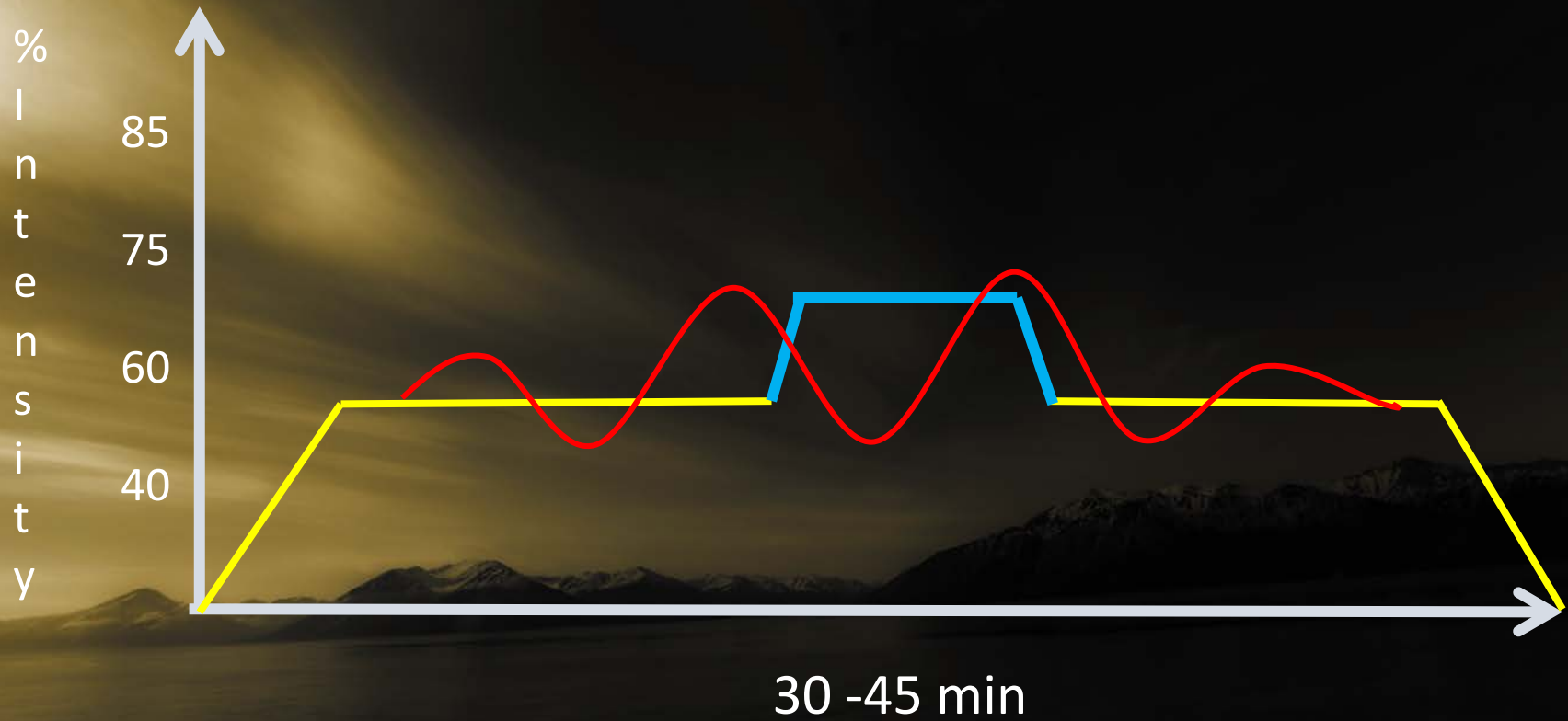
**Conclusion:** HIIT induces cardiometabolic adaptations similar to those of MICT in prediabetes and T2D, and provides greater benefits to functional capacity in patients with T2D.

## Examples of HIIT for T2D

*Diabetes365.org*

One of the simplest HIIT workouts you can do is a simple *sprint/walk workout*. For an effective *running HIIT workout*, sprint as fast as possible for 10 – 15 seconds (it's harder than it sounds) then jog slowly for 45 seconds, repeat the process 5 times before resting.

Stationary bikes are another option for a sweat inducing HIIT workout. These workouts will look similar to the running HIIT. *Bike very hard for 30 seconds, and then slow down to a comfortable pace for 1 minute to a minute and a half.*



Multi-intensity continuous aerobic exercise session





**H**

**~300+ kcal**

**1  
mile**

**1  
mile**



**Neighborhood Circuit**

# Caution with high intensity exercise in prediabetes and T2D

- High risk prediabetes (HbA1c 6.1–6.4)
- Other chronic conditions especially hypertension and obesity
- Palpitations or chest discomfort
- Post prandial caution
- Heat index

## Rule of thumb

RT at least 10 reps, avoid exerting to failure

AE always graduate intensity

20-40-60-85-60-40-20% effort

# Steps as outcomes measures



# 10000 Steps - Not necessarily

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Although  $> 5000$  steps/day is generally a laudable minimalist goal and  $>10.000$  steps has generally been accepted as the optimal goal

- recent evidence from multiple trials has clearly demonstrated that **the change** in daily stepcount (ie. walking distance) is a principal key for improving various parameters of health and reducing all-cause mortality

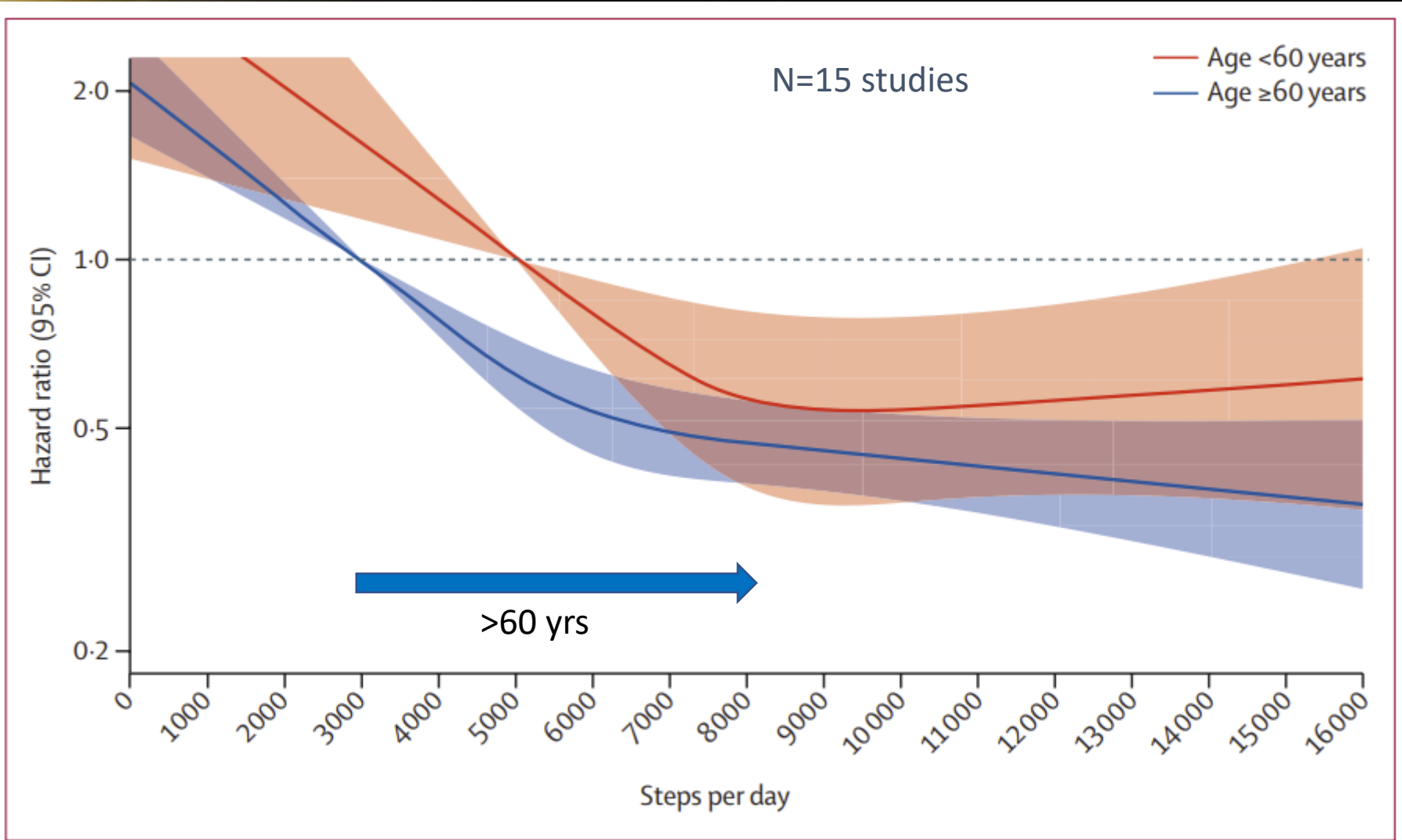
# Steps per Day and All-Cause Mortality in Middle-aged Adults in the Coronary Artery Risk Development in Young Adults Study

Paluch AE et.al. *JAMA Netw Open*. 2021;4(9):e2124516 U Mass

In this cohort study of 2110 adults (CARDIA Study) with a mean follow-up of 10.8 years, **participants taking at least 7000 steps/d, compared with those taking fewer than 7000 steps/d, had a 50% to 70% lower risk of mortality**. There was no association of step intensity with mortality regardless of adjustment for step volume.

**Meaning** This cohort study found that higher daily step volume was associated with a lower risk of premature all-cause mortality among Black and White middle-aged women and men.

# Daily steps and all-cause mortality



In this meta-analysis of 15 studies, seven published and eight unpublished, we found that taking more steps per day was associated with progressively lower mortality risk, with the **risk plateauing for older adults (aged  $\geq 60$  years) at approximately 6000–8000 steps per day**

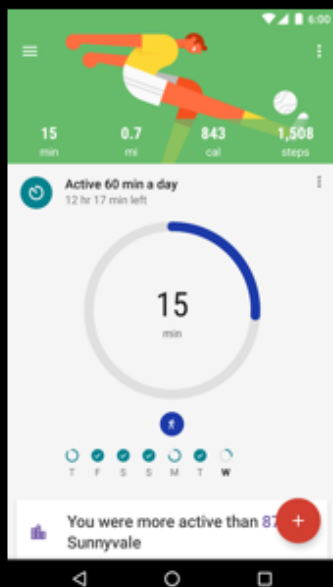
and for **younger adults (aged  $< 60$  yrs) at approximately 8000–10000 steps per day**. We found inconsistent evidence that step intensity had an association with mortality beyond total volume of steps.







## Google Fit vs Accusplit 2720



308,987 steps\*



314,066 steps\*

\*Cornwall UK – Southwest Coastal Path (155 miles, 4-8/2017))

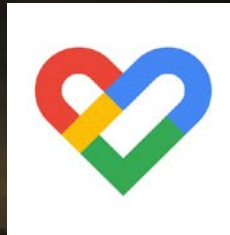
Camino de Santiago – Portuguese and French Way (130 & 255 miles): 286,665 vs 292,330 steps respectively for the 130 mile Portuguese way and 597,800 vs 606,010 French Way.

# More reliable step tracking apps

Accupedo

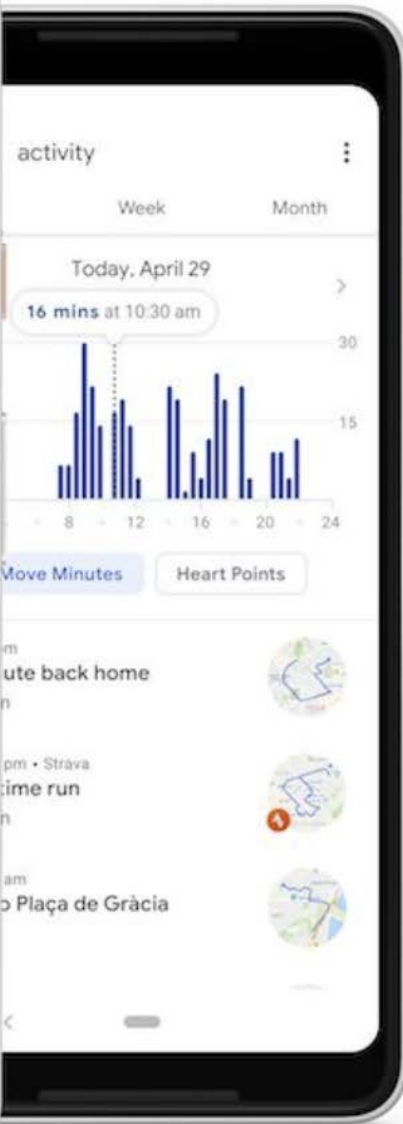
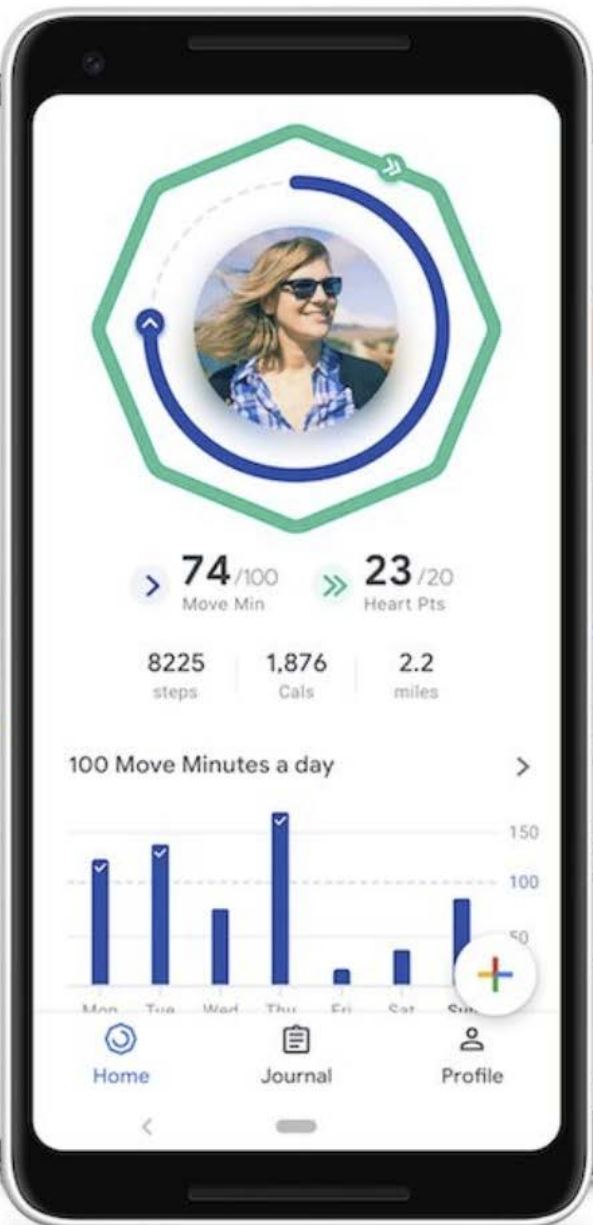


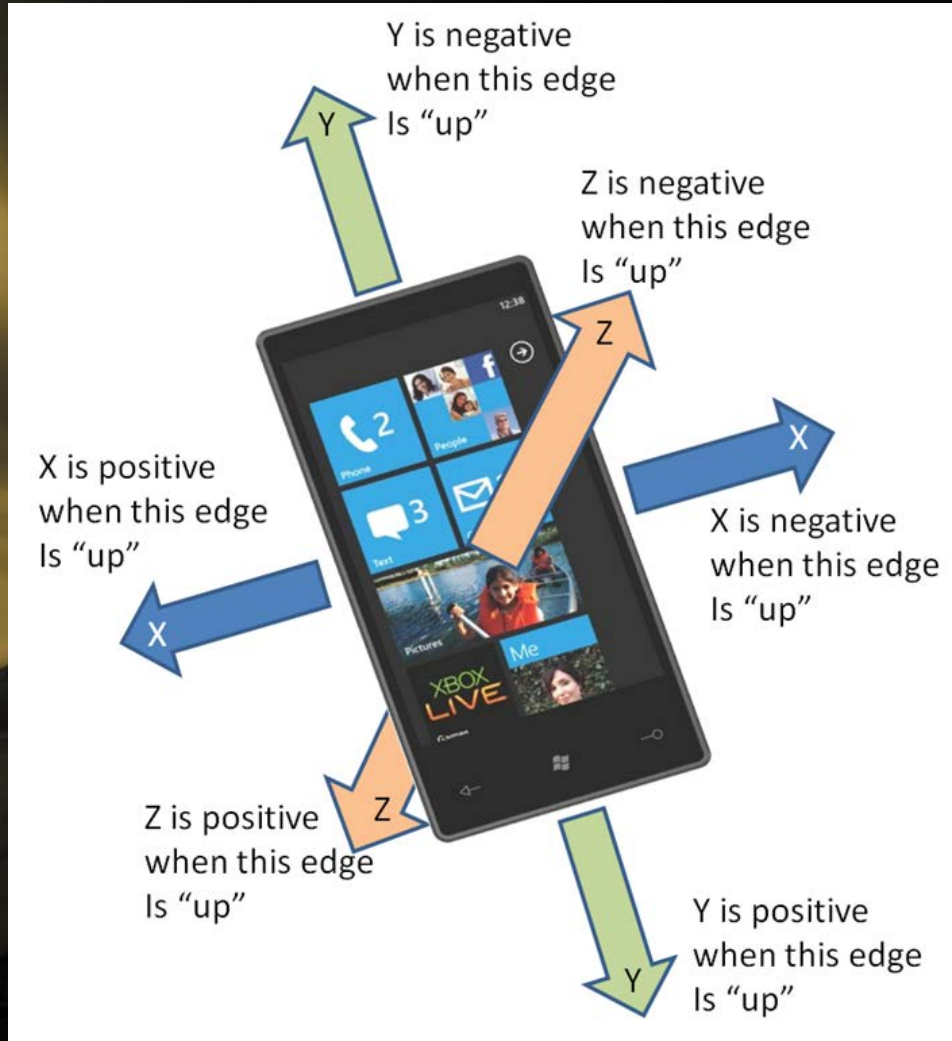
Google Fit



Pedometer++









500  
microns



How a Smartphone Knows Up from Down (accelerom...

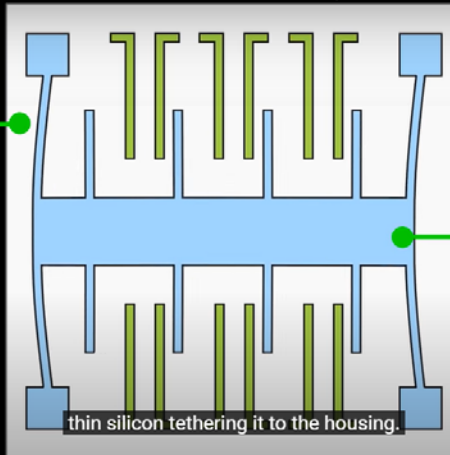


Watch later



Share

Housing



Seismic  
Mass



thin silicon tethering it to the housing.

## Smart phones & watches

3 axis sensing  
*multiplane sensor*

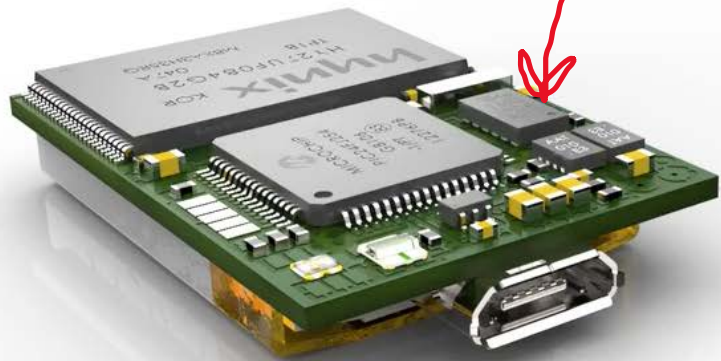
Can record movement  
in all 3 axes

## Waist-worn pedometers

*single axis – foot strike*

Records foot-strike only  
with less superfluous  
recording

accelerometer





# Cell phone and wearable device accuracy

**STEPS**

*(most reliable)*



*Heart rate*

**DISTANCE**

*(less reliable)*



**ENERGY EXPENDITURE**

*(least reliable)*

# STORE OUTSIDE YOUR DOOR

HUNT

FISH

GATHER

GROW



## Store Outside Your Door

2,429 likes · 800 talking about this

✓ Liked

Message

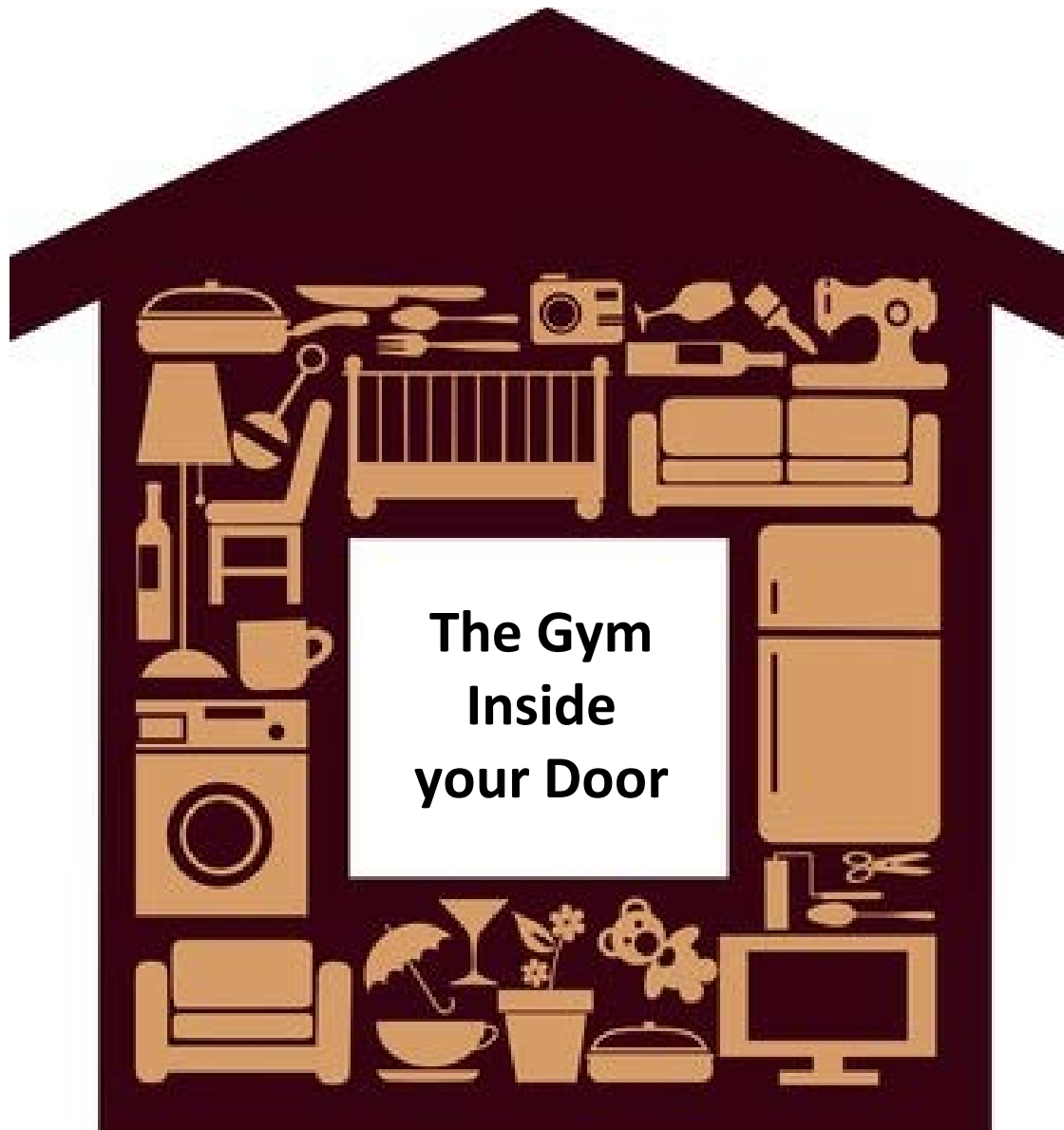


<http://www.anthctoday.org/storeoutside/>

<https://www.facebook.com/StoreOutside>

Alaska Native Tribal Health Consortium





**The Gym  
Inside  
your Door**



# The Gym Inside Your Door

*Utilitarian household and yard chore circuit "workouts" that can be systematically and creatively organized into one productive workout expending 150-500 kcal. Prediabetes and diabetes-centric focus.*

## Admin Panel

Edit Page

Build Audience

Help

Show



## The Gym inside Your Door

3 likes

Update Page Info

✓ Liked



# Household & Domestic Physical Activity Program

## Why is this important?

- Diverse forms of physical activity have been shown to improve health outcomes and reduce risk for chronic disease.
- Systematically combining a number of household and yard chores in a defined period of time or "circuit" can improve daily energy expenditure without having to travel to a gym or exercise class.
- Doing domestic chores as a circuit activity may result in significant caloric expenditure and weight loss but more importantly such exercise is an insulin sensitizer.

***Diverse*** types of moderate exercise is also associated with lower incidence of diabetes and CVD mortality.

This includes such utilitarian activities as *walking, gardening, climbing, and household/yard chores*. Those who expend 1000 - 1200 kcal per week in such utilitarian activities may require very little additional exercise to lower diabetes and CVD risk.

Lakka TA. Et.al. NEJM 1994;330:1549

Thompson P et.al. Circ. 2003;107:3101

Fransson E. et.al. Scan J Pub Health 2003;31:324

Meisinger C et.al. Diabetologia 2005;48:27

Marcus B et.al. Circ. 2006;114: 2739

Holme I et.al. *BMC Public Health* 2007, 7:154

# Relationship of leisure-time and household physical activity level and type with cardiovascular disease: secondary analysis of the Takashima Study data

3,741 participants without any history of CVD participated in the Takashima Study.

The highest activity group had an adjusted hazard ratio of 0.40 compared to the lowest activity group **i.e. 60% relative reduction in CVD**

Increasing the amount of leisure-time and household physical activity and promoting engagement in two or more types of such activities may reduce the rate of CVD incidence in the Japanese general population.



Diverse types of  
daily physical  
activity





# A compilation of energy costs of physical activities

Mario Vaz<sup>1,\*</sup>, Nadine Karaolis<sup>2</sup>, Alizon Draper<sup>2</sup> and Prakash Shetty<sup>2</sup>

<sup>1</sup>Division of Nutrition, Department of Physiology, St. John's Medical College, Bangalore 560034, India:

<sup>2</sup>Public Health Nutrition Unit, London School of Hygiene and Tropical Medicine, 49/51 Bedford Square, London WC1B 3DP, UK

Sweeping, walking, and carrying groceries and boxes on the ground and stairs ranged from 3.0 to 5.5 METs. (3–5kcal/min)

200++ kcal

Sweeping  
floor/driveway

Shower/bath  
cleaning

**30+ min daily walk**

Vacuuming raking

Painting/scrubbing/re  
pair work

# Household-Community Circuit Rx

Name  
Date  
Rx:

20 - 90 minutes

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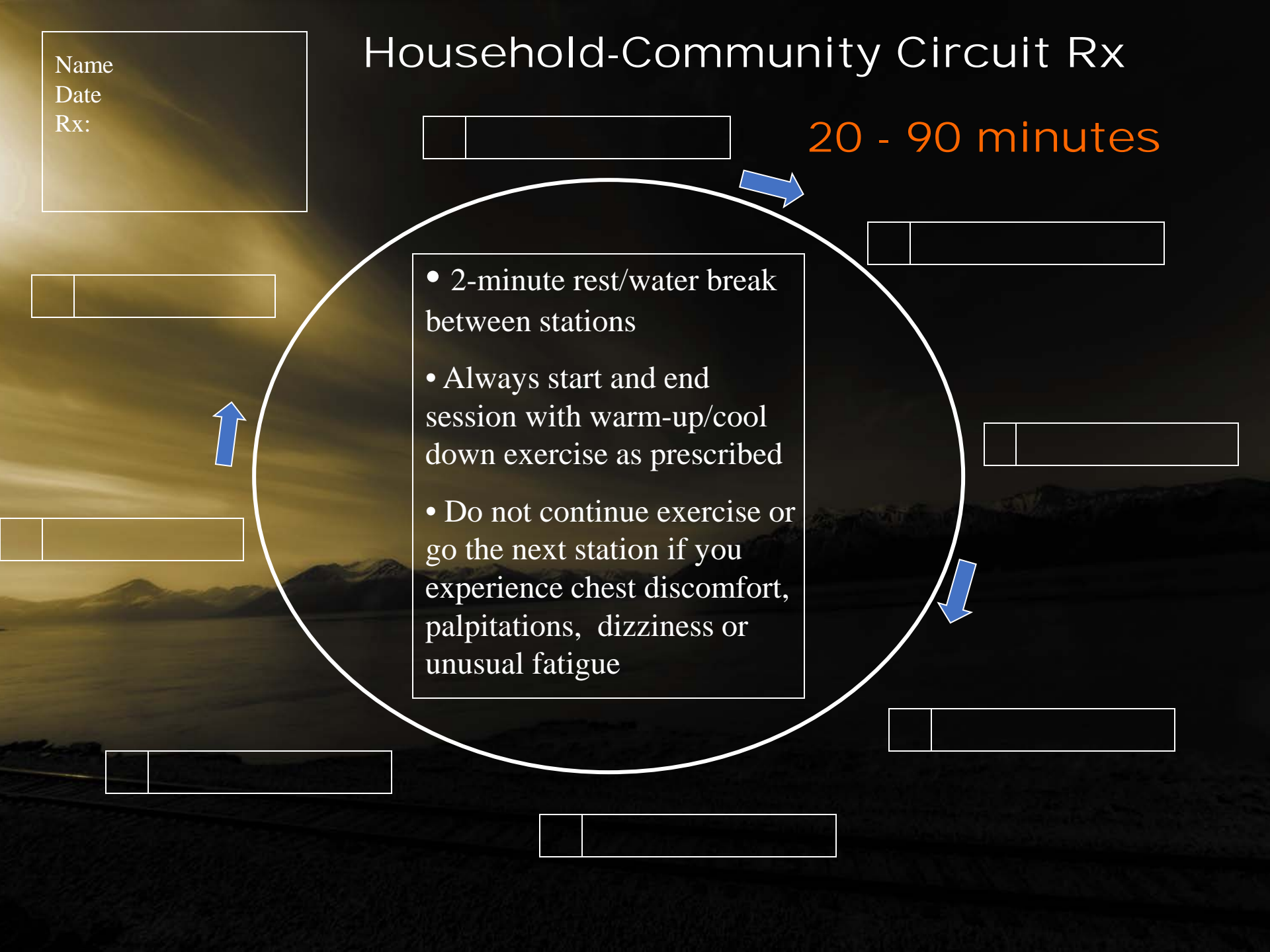
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- 2-minute rest/water break between stations
- Always start and end session with warm-up/cool down exercise as prescribed
- Do not continue exercise or go the next station if you experience chest discomfort, palpitations, dizziness or unusual fatigue

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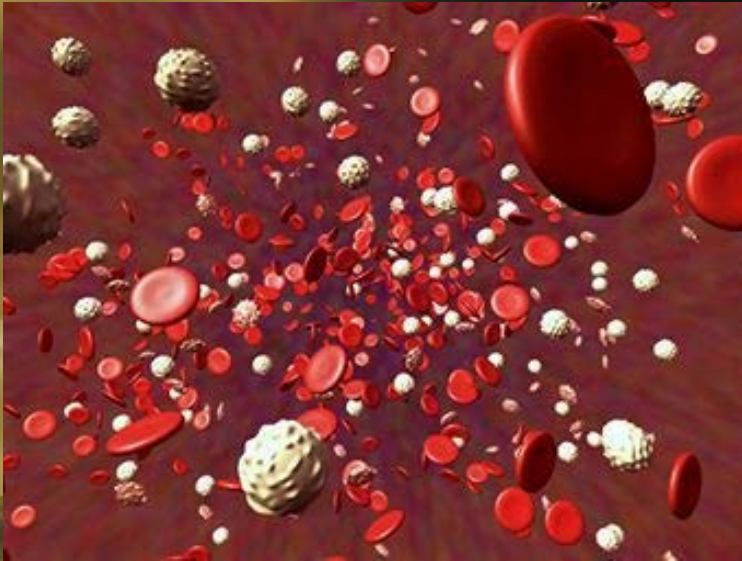


# REDUCE SITTING TIME

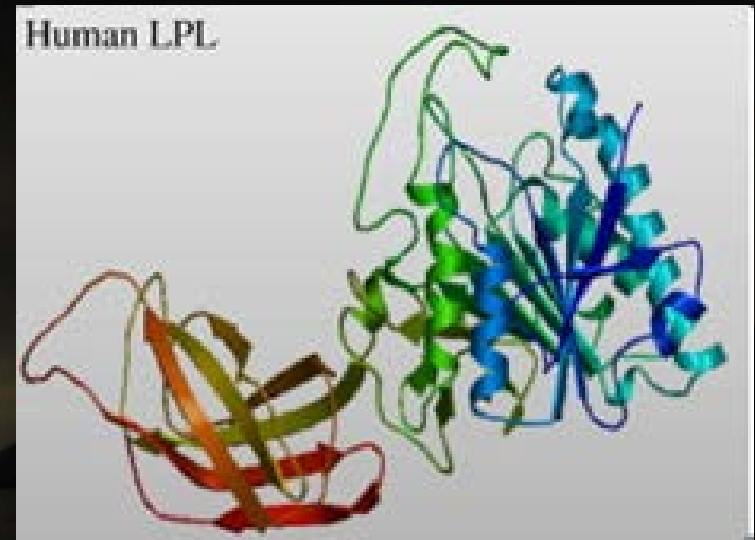


# The Physiology of Inactivity

i.e., Prolonged Sitting



Increased platelet  
“stickiness”



Decreased lipoprotein  
lipase activity

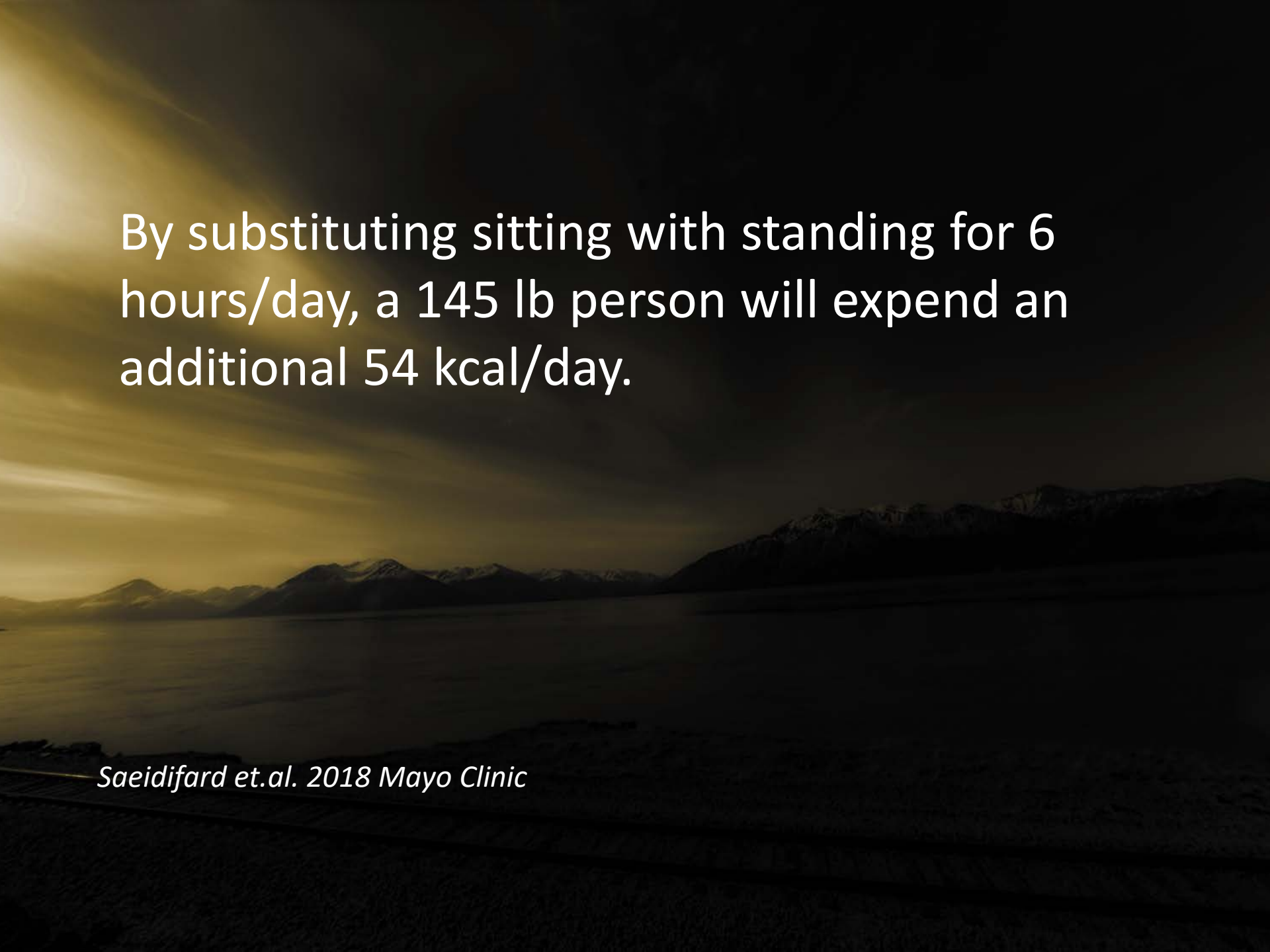
# Sitting Time, Type, and Context Among Long-Term Weight-Loss Maintainers

Roake J et.al. Obesity . 2021 Jun;29(6):1067-1073. Cal Poly

N= 4035 wgt loss maintainers

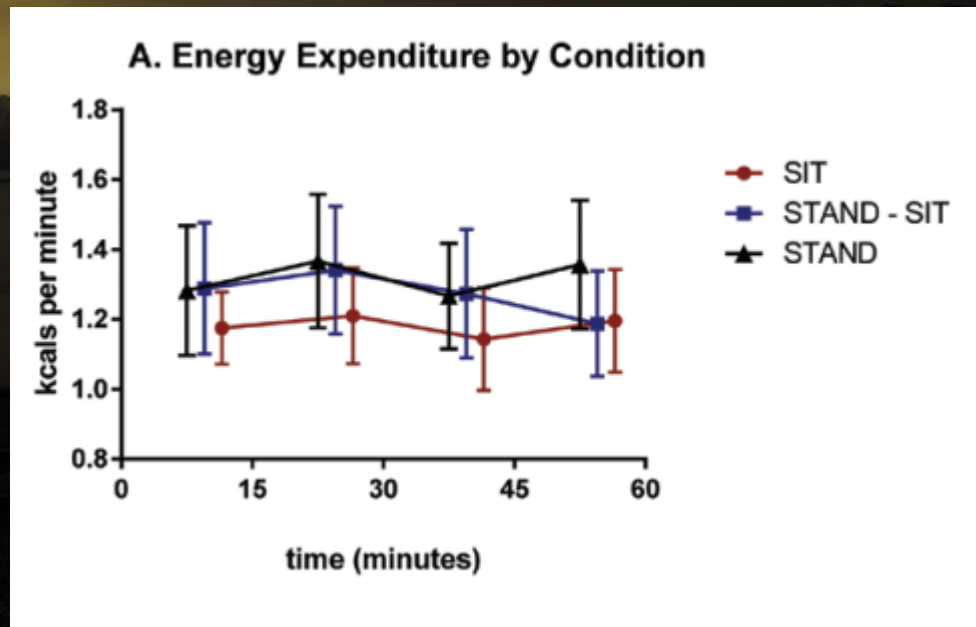
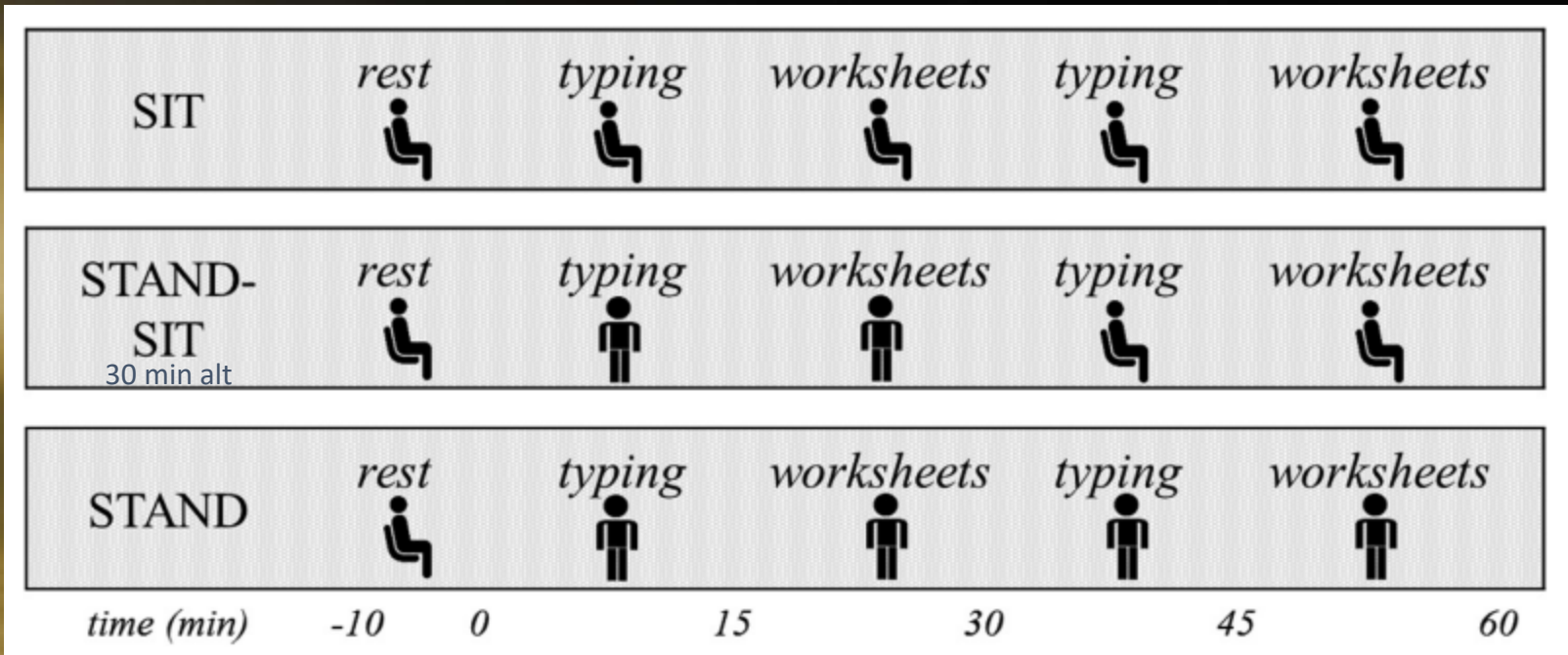
Weight-loss maintainers spent **three hours less per day sitting during the week** (10.9 hours versus 13.9 hours) and on weekends (9.7 hours versus 12.6 hours).

The maintainers also spent one hour less per day in non-work-related sitting while using a computer or playing a video game on both weekdays and weekends.

A scenic landscape featuring a large body of water in the foreground, likely a lake or bay, with a range of mountains in the background. The sky is filled with soft, golden light, suggesting a sunset or sunrise. The overall tone is calm and natural.

By substituting sitting with standing for 6 hours/day, a 145 lb person will expend an additional 54 kcal/day.

*Saeidifard et.al. 2018 Mayo Clinic*



40-70 kcal/  
7hr shift



# Rx for prolonged sitting: Body weight squat “activity snacks”

Prolonged sitting can impair postprandial glycemia, lipidemia, and insulin sensitivity regardless of previous health status.

- Uninterrupted sitting
- sitting with 15 “body-weight squats” (chair stand to calf raise) every 30 min
- sitting with 2-min walks at 3.1 mph (average adult walking speed) every 30 min

We demonstrated that interrupting prolonged sitting with brief periods of activity, such as body weight squats or short bouts of walking, improves insulin sensitivity and muscle contractile protein synthesis



# Workplace EE

5 min/hr X 7 hrs

35 min @ 3-4 kcal/min

2000-2500 steps

**100 – 140 kcal**  
(insulin sensitization –  
e.g., 10-15 mg metformin)





Big Rig



Big Rig

*Least measures*

Get 2-5 minutes PA before work/breakfast

Move 5 min on the hour\*

At least twice a week at least 30 minutes of sustained PA\*

At least one weekend day at least 60 minutes of sustained PA

\* *Domestic/household/work chores count too*

# Just Move Programming in AIAN Communities

**Understand - Just Move**

**Survey home and community environment**


**Creatively insert activities that do not allow more than 30 minutes of sitting**

**Circuit household chores**

**Weekly LSD (>60 min)**

**Employ cultural motivators**

**Track and record steps/movements**



**Just move**

*and move often*

