The Female Cardiovascular System

....

Facts vs. Clic-tion

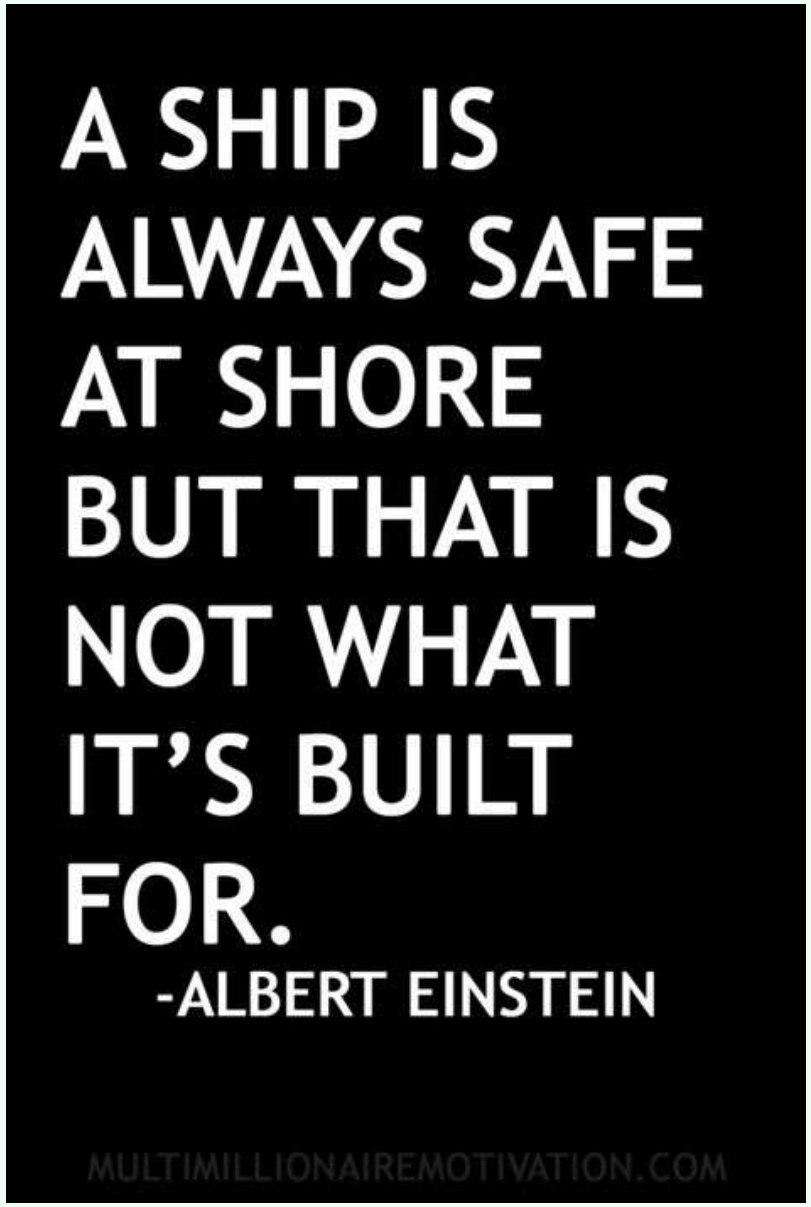
Patricia A. VanGalen, M.S.
MedFit Virtual Webinars
October, 2025

Clic-tion

- Bait
- Headlines vs. study Titles
- Null Findings … where are they?
- Contradictory findings … where are they?
- CONTEXT n=1

“We don’t live to be safe and healthy; we live safely and healthfully to live life.”

PVG



"A culture that allows the *concept of 'safety'*
to creep so far

that it equates any '*emotional discomfort'* with physical danger

is a culture
that encourages people to systematically protect one another

from the very experiences embedded in daily life,

that they <u>need</u> to become strong and healthy."

The Coddling of the American Mind: How Good Intentions and Bad Ideas Are Setting Up a Generation for Failure

Outline

I. We've Come A Long Way …. In my lifetime
II. Overview: Robust Aging System
III. Sex Differences: CV system and Training Adaptations
IV. Female Stages + CV-Met abolic Risk
V. Training Nuggets
VI. How Much Stamina to I need? Want?
VII. Summary

NOTE: an abundance of resources and references

I. We've Come A Long Way ….


BULLET PROOF?


FRAGILE
FRAGILE
FRAGILE
FRAGILE

Sex and **Age Matter**

Where now?

Where been? - Hx

Orthopedic Cost

Mike Boyle

CV-Met Incident Risk

What matters most?

tor

Women who exercise regularly throughout life are *physiologically* 20-30 years *younger* than their sedentary counterparts.

Miszko TA, ME Cress. A lifetime of fitness. Exercise in the perimenopausal woman and postmenopausal woman. Clin Sprts Med. 2000 Apr;19(2):215-32.

Upon separation of the *male* LLE [life-long exercisers] cohort, LLE-P[Performance] and LLE-F [Fitness] were ~35 yrs and 15 yrs younger than their respective chronological ages.

Gries KJ, Raue U, et al. Cardiovascular and skeletal muscle health with lifelong exercise. J Appl Physiol (1985). 2018 Nov 1;125(5):1636-1645.

II. Overview: Robust Aging System

ROBUST Aging

=

Adaptability + Resilience + Durability

Hardiness

not frailty, fragility & fractures

The 'Active & Agile' System of Robust Aging

4 I's *Stop the Insults, Assaults and Neglect*

Buffer *– Deflect - Nurture – Nourish – Strengthen - Fortify*

5 *Pillars* *Rebuild and fortify:* ***Rocks*** *– Pebbles – Granules*

7s *Buckets* *Repair and Refill ALL Functional 'Freedom' Buckets*

3 *B's* *Beat Baselines, Reclaim Basics, Strive for Benchmarks*

R.E.H.A.B. ***R****estore* ***E****nergy,* ***H****ardiness,* ***A****spirations &* ***B****asics to* ***B****enchmarks*

Super-Agers

"There's no silver bullet. It's more like silver buckshot."

Dan Buettner, Author, The Blue Zones

American Heart Association.

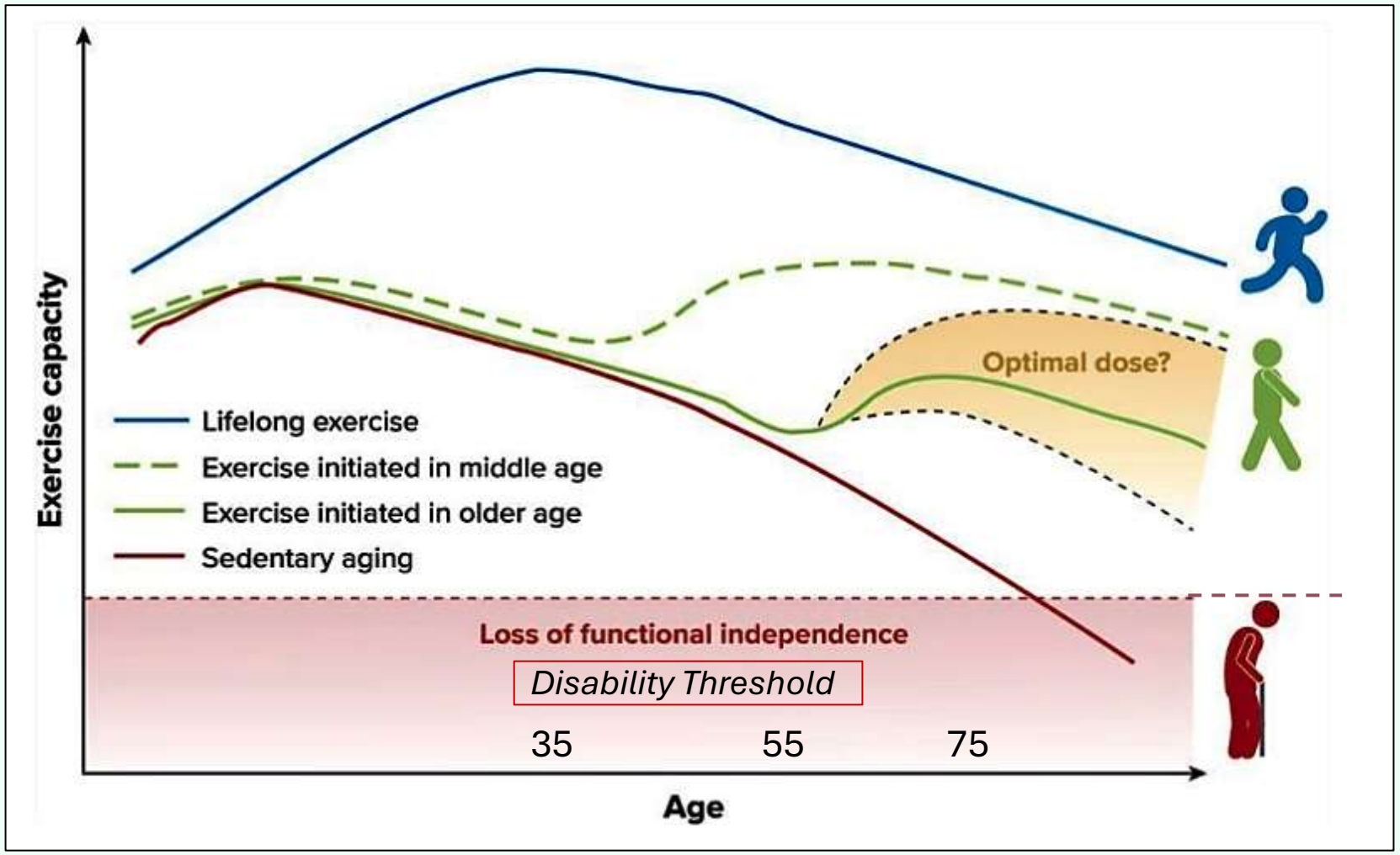
"My argument to people is …. today we have ***one intervention that is very profoundly anti-aging***, and it is ***physical activity, exercise, in <u>all</u> of its forms***. Once you have optimized this, I think let's talk about doing something else on top of that."

Eric Verdin, President, CEO, Buck Institute for Research on Aging

Guest: Peter Attia Podcast, August 4, 2025

Reserve Capacity

Overall Robustness



The earlier one develops the exercise habit, the greater the odds of living independently into old age, as evidenced in this evidence-based schematic.

CREDIT: G. Carrick-Ranson et al / AR Medicine 2022.

Table 1. *Physiological adaptations to exercise training in women based on the period that endurance exercise training is initiated*

Parameter	Initiated at Midlife	Initiated at Older Age
Cardiorespiratory fitness		
Exercise capacity ($\dot{V}O_{2max}$; $\dot{V}O_{2peak}$; peak METs, total exercise time)	↑ (91–96)	↑ (41, 46, 97–100)
LV function during exercise		
Maximal exercise cardiac output	↑ (92, 93)	↔ (41, 46, 97, 99)
Maximal exercise stroke volume	↑ (92, 93)	↔ (41, 46, 97, 99)
Maximal exercise v-a coupling	ND	ND
Submaximal exercise stroke volume	↑ (absolute workload) (91, 92) ↑ (low intensity), ↔ (moderate intensity) (relative workload) (101)	↔ (absolute workload) (46) ↑ (relative workload) (41)
Submaximal exercise heart rate	↓ (absolute workload) (91–93) ↔ (relative workload) (93, 101)	↓ (absolute workload) (46) ↓ (relative workload) (41)
Submaximal exercise v-a coupling	ND	ND
Cardiac structure and function		
LV mass	↑ (94)	↔ (98)
LV cavity dimensions	↑ (94)	↔ (98, 100)
LV chamber stiffness	↓ (95)	ND
Resting LV relaxation	↔ (94)	ND

↑, increased; ↓, decreased; ↔, no change; LV, left ventricular; ND, no data in women only cohorts; $\dot{V}O_{2max}$, maximal oxygen uptake; $\dot{V}O_{2peak}$, peak oxygen uptake; v-a coupling, ventricular-arterial coupling.

Effects of aging and endurance exercise training on cardiorespiratory fitness and cardiac structure and function in healthy midlife and older women. Graeme Carrick-Ranson et al. J Appl Physiol 135: 1215–1235, 2023.

Super Agers & Cognitive Function

Garo-Pascual, Marta et al. Brain structure and phenotypic profile of superagers compared with age-matched older adults: a longitudinal analysis from the Vallecas Project [near Madrid, Spain] www.thelancet.com/healthy-longevity, Vol.4, August 2023.

For Alessandro Cellerino, PhD, of the Leibniz Institute on Aging–Fritz Lipmann Institute in Jena, Germany, this is the most crucial aspect of the study. "Even before this study, we knew that superagers demonstrated *less atrophy in certain areas of the brain*, but this was always only ever based on a single measurement."

According to Cellerino, this finding confirms that …
physical activity is paramount for cognitive function.

"These people were over 80 years old — the fact that there was not much difference between their levels of activity is not surprising.

Much more relevant is the question of how you get there — i.e.,
how active you are at the ages of 40, 50 or even 60 years old,"
he stressed.

The ultimate brain workout

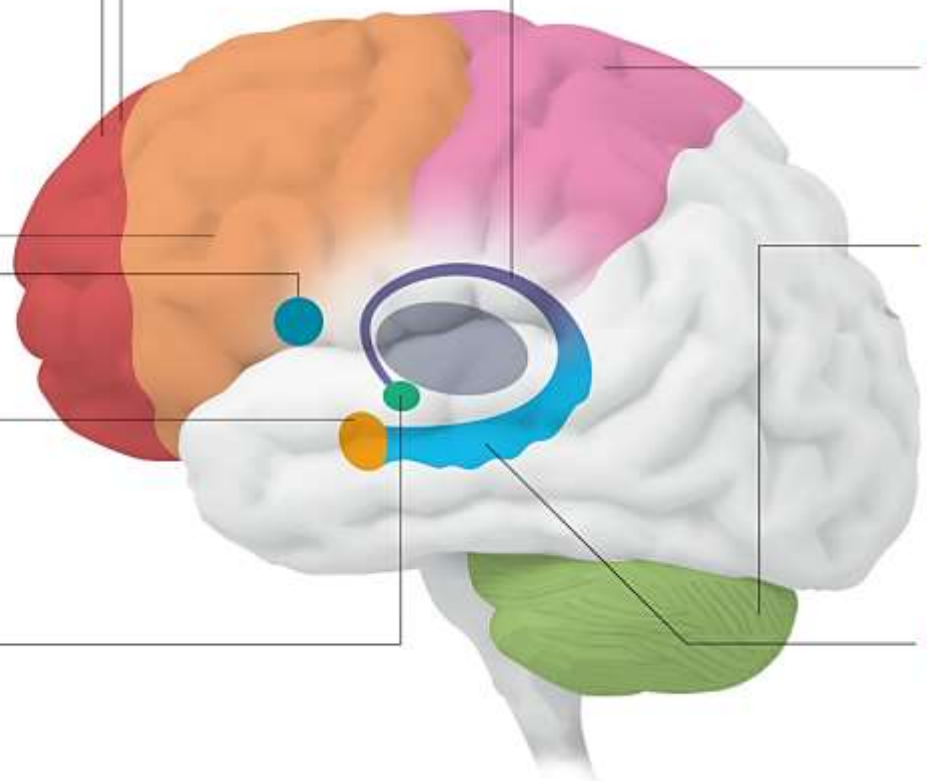
Different physical exercises can bring specific mental gains, from improving memory to dealing with cravings or reducing stress

LIFTING WEIGHTS
Prefrontal cortex
complex thinking, reasoning, multitasking, problem-solving

YOGA
Frontal lobe
Insula
integrates thoughts and emotions

Amygdala
fear and anxiety

HIGH-INTENSITY INTERVALS
Hypothalamus
appetite regulation, cravings and addiction



SPORTS DRILLS
Prefrontal cortex
Basal ganglia
attention, switching between tasks, inhibition

Parietal lobe
visual-spacial processing

Cerebellum
attention

AEROBIC EXERCISE
Hippocampus
memory

Where Performance Training meets Robust Aging

Once we
HAVE it,
it takes less
to
KEEP it,
and
the slower
we'll lose it!

"I get what I train for,

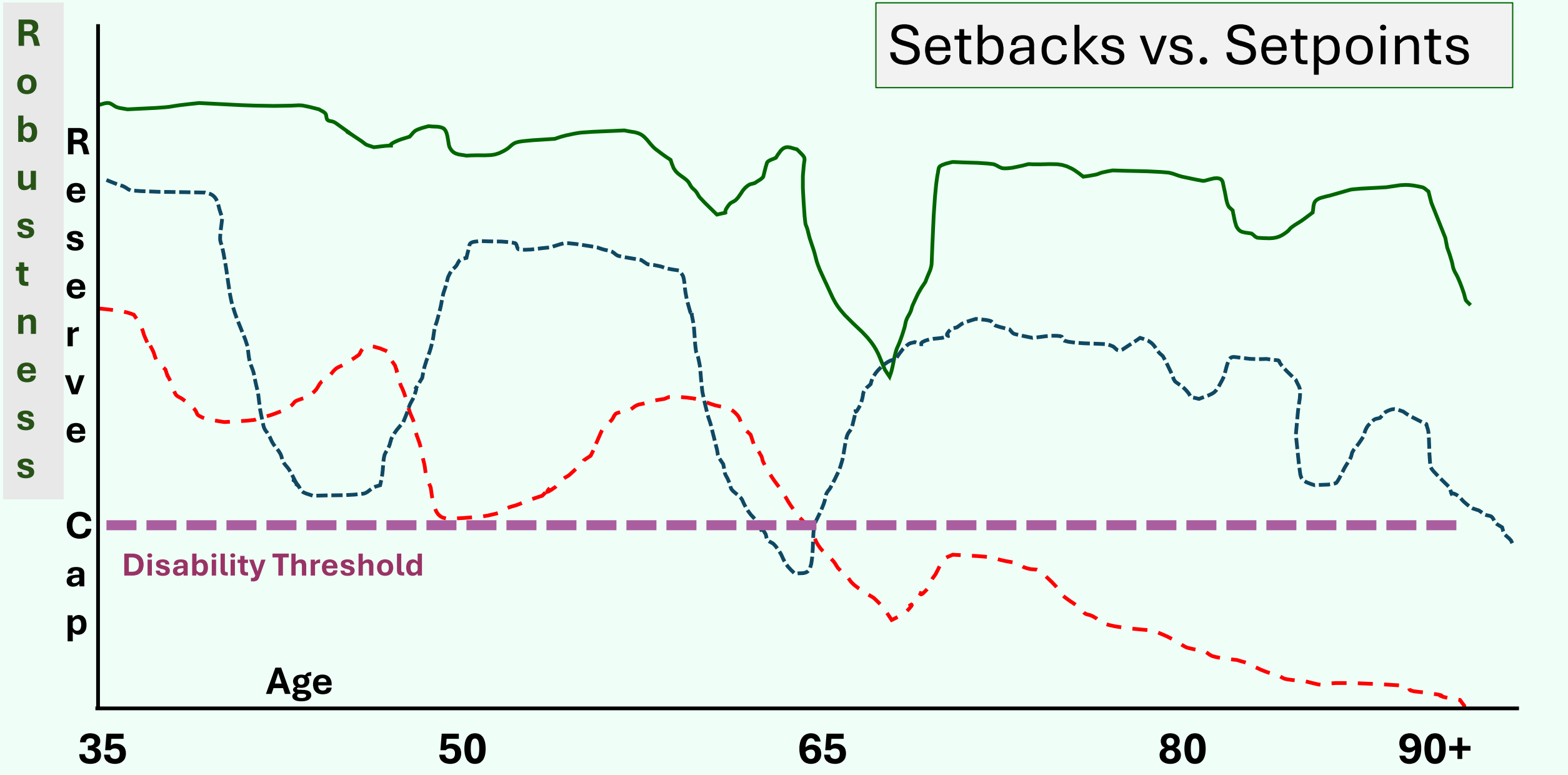
I keep what I train and do!

Neglect is NOT an option."

PAVG

The more robust
our
reserve capacity,
earned from
consistent
small deposits
over time,
the …….

Setbacks vs. Setpoints



IV. Across the Lifespan: Transitions

What am I
bringing
to my
30s, 40s, 50s, 60s +++?

When did I
start
investing?

Functional Training is …

Investing in our *reserve capacity*, our *robustness…*

So that the 'seasoned' client or athlete CAN ….

- Live, Labor, Play, Care-give & Compete …
- At their desired level (competence) and intensity (capacity) …
  - With confidence and automaticity …
    - Within their *chosen environments* and in *emergency* situations,
- While adding *purpose* to 'living life' and enhancing all aspects of health and well-being, that is QOL, despite the curveballs that will strike,
- for ALAP.

The 7S Training Buckets …
in *Functional* Training for Robustness

The Freedom Buckets

1. Spirit
2. Suppleness & Stability
3. Gait Speed w/ Sprint-like Mechanics
4. Strength & Power
5. Skills
6. *Stamina – Spurts (HIIT | SIT) + Steady*
7. Specificity & Specifics

S's = Simple

not EASY!

Bucket #6

Stamina: MIT, HIIT, SIT [Steady + in Spurts]

The Energy Bucket – to GO-ALL-DAY Bucket

- The Cardio-Vascular-Lymph-Pulmonary health Bucket serving all tissue-organ systems
- The CR – Metabolic Health Bucket
- The O2 delivery / waste disposal Bucket
- The Mitochondrial Density Bucket
- The Immune System Booster
- The Brain Fertilizer Bucket
- Cellular waste recycle-removal [Autophagy]
- A pillar in prevention, **pre-emption**, R.E.H.A.B. and treatment of chronic CV-metabolic-Neuro-degenerative diseases

Bucket #6 (cont.)

Stamina: MIT, HIIT, SIT

- central to robustness of the aging body and BRAIN.
- a key player in managing + dissipating the ill-effects of chronic distress, providing a buffer, so that when faced with a fear or threat, we are physiologically prepped + ready to handle it, and to quickly bounce back.
- endurance-type activities are mother nature's anti-depressant, especially the mountain, forest or beach variety.
- a champion of better moods and a sense of optimism; fewer MEDS.

- A healthy CV-CR circulation pumping system is the 'cycle of life' for every cell in the body

Bucket #6

Freedom to …

- GO-ALL-DAY, WEEK, SEASON, YEAR

- With Vitality, Vim & Vigor ….. from training to work,
  to chores to care-giving to play to …..

Bucket #6

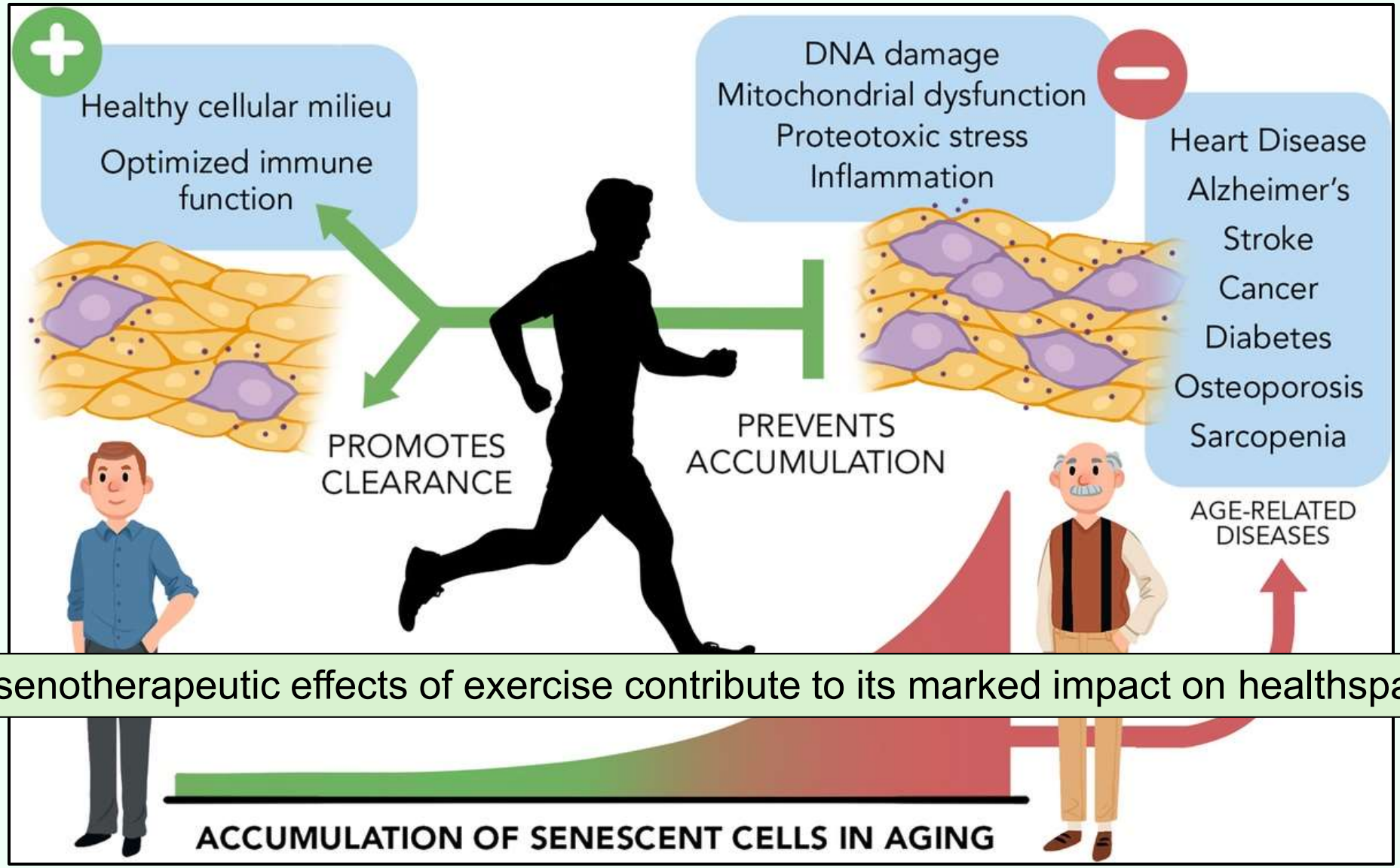
The Antithesis to …

- Fatigue and lethargy
- CVD, TIIDM, Cancers, NDDs [AD, PD, dementia], poor circulation, PVD, most chronic diseases, depression, poly-morbidities w/ poly-pharmaceuticals
- Premature Mortality + morbidity
- Accelerated aging

Exercise Counters the Age-Related Accumulation of Senescent Cells

Fig 2

Exercise and Sport Sciences Reviews 50(4):213-221, October 2022.



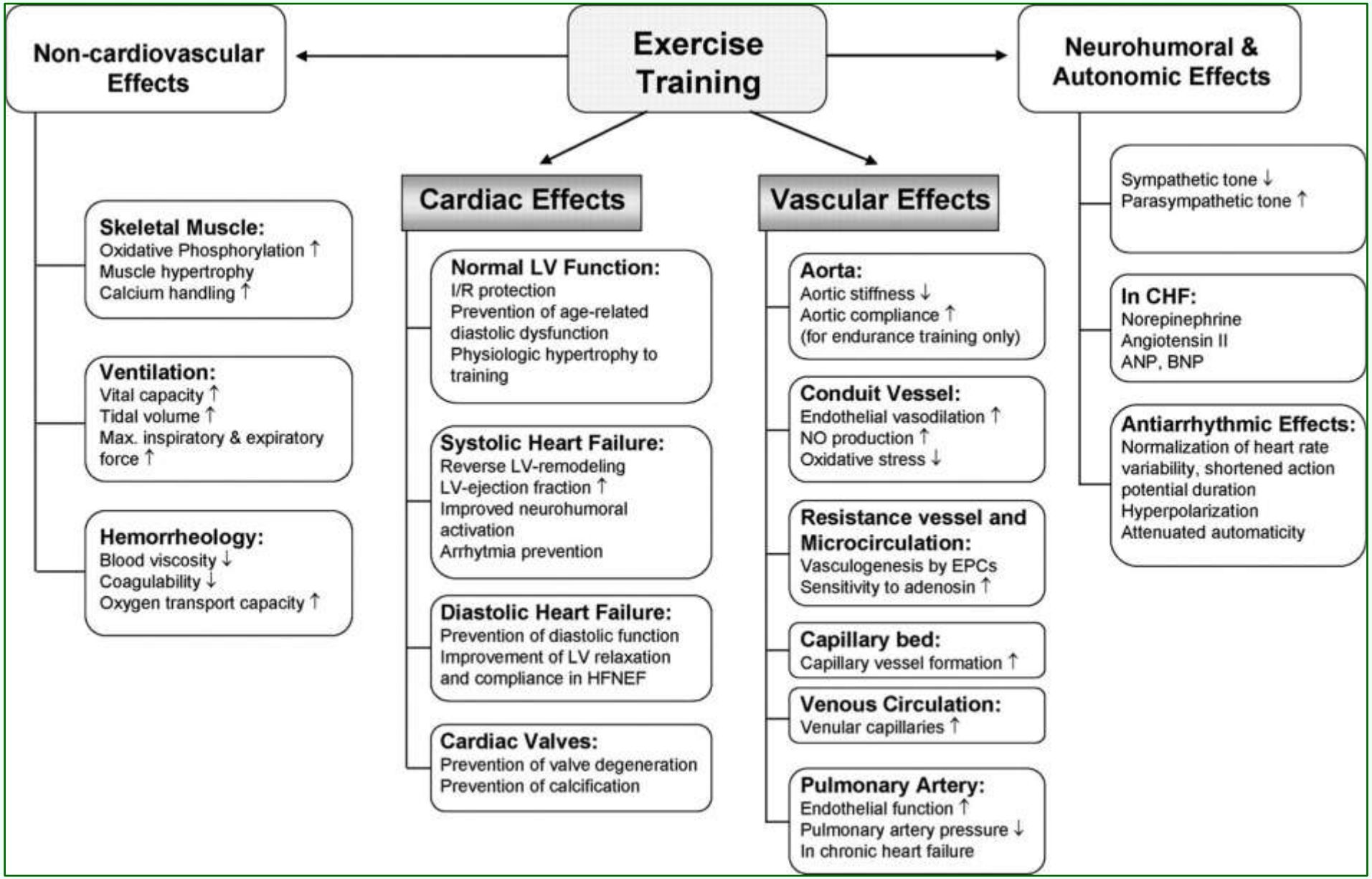
The senotherapeutic effects of exercise contribute to its marked impact on healthspan.

III. Sex Differences: CV system and Training Adaptations

Figure 1.

Summary of exercise-mediated effects on different parts of the CV system.

Max. indicates maximum; HFNEF, heart failure with normal ejection fraction; ANP, atrial natriuretic peptide; BNP, brain natriuretic peptide.



Cardiovascular Effects of Exercise Training: Molecular Mechanisms. Stephan Gielen, Gerhard Schuler and Volker Adams
Originally published 21 Sep 2010 https://doi.org/10.1161/CIRCULATIONAHA.110.939959 Circulation. 2010;122:1221–1238

Main sex differences in cardiac adaptation to exercise.

AF: atrial fibrillation
BSA: body surface area
CAC: coronary artery calcification
CAD: coronary artery disease
CH: concentric hypertrophy
CR: concentric remodeling
EH: eccentric hypertrophy
LAD: left atrial dilation
LVEDD: left ventricular end diastolic diameter
LVH: left ventricular hypertrophy
LVM: left ventricular mass
LVWT: left ventricular wall thickness
RVH: right ventricular hypertrophy
VC: voltage criteria.

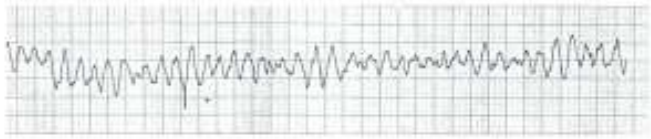
VC for LVH and RVH
LAD

↑ Anterior TWI
[T-wave Inversion]

↑ LVWT
↑ LVM
↑ LVEDD
↑ CH/CR (endurance athletes)

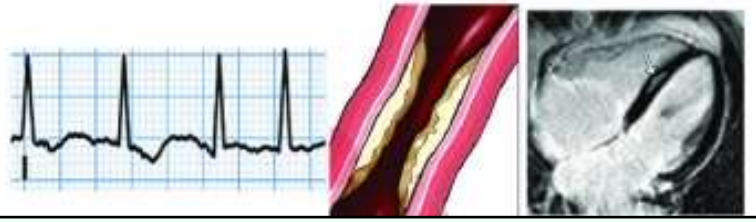
↓ LVWT
↓ LVM
↑ LVEDD/BSA
↑ EH (endurance athletes)

↑ risk of SCD



↓ risk of SCD

↑ CAC
↑ CAD
↑ AF
↑ Myocardial fibrosis



↓ CAC
↓ CAD
↓ AF
↓ Myocardial fibrosis

Colombo, C., & Finocchiaro, G. (2018). The Female Athlete's Heart: Facts and Fallacies. *Current treatment options in cardiovascular medicine,* 20(12), 101. https://doi.org/10.1007/s11936-018-0699-7

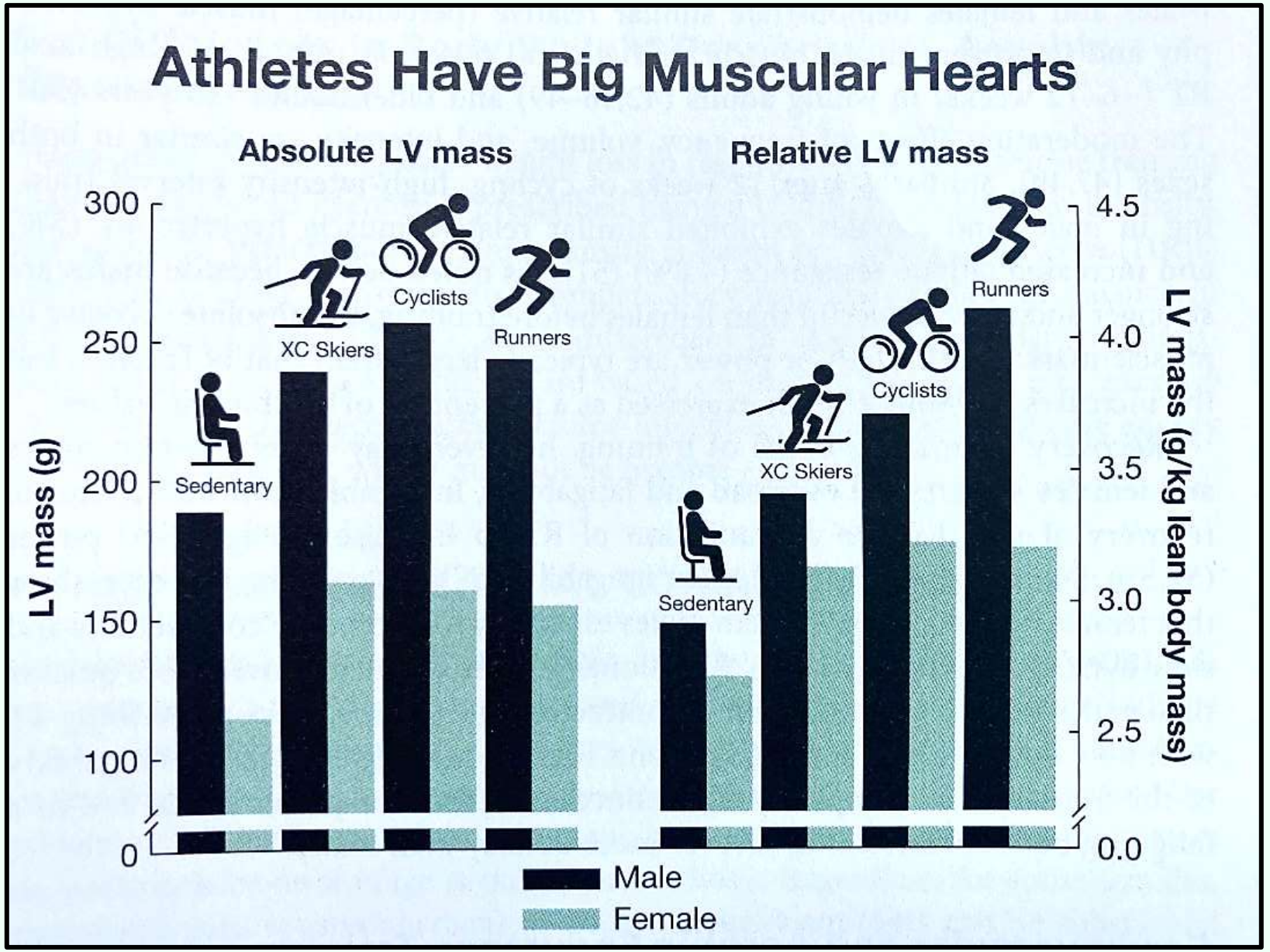
Figure 5.1

Cardiac mass (absolute and relative to lean body mass) of male and female athletes and sedentary controls.

LV – Left Ventricular

Data adapted from (34,35) and published in Hunteret al. (25) with permission.

ACSM's GETP, 12th Edition (2025)



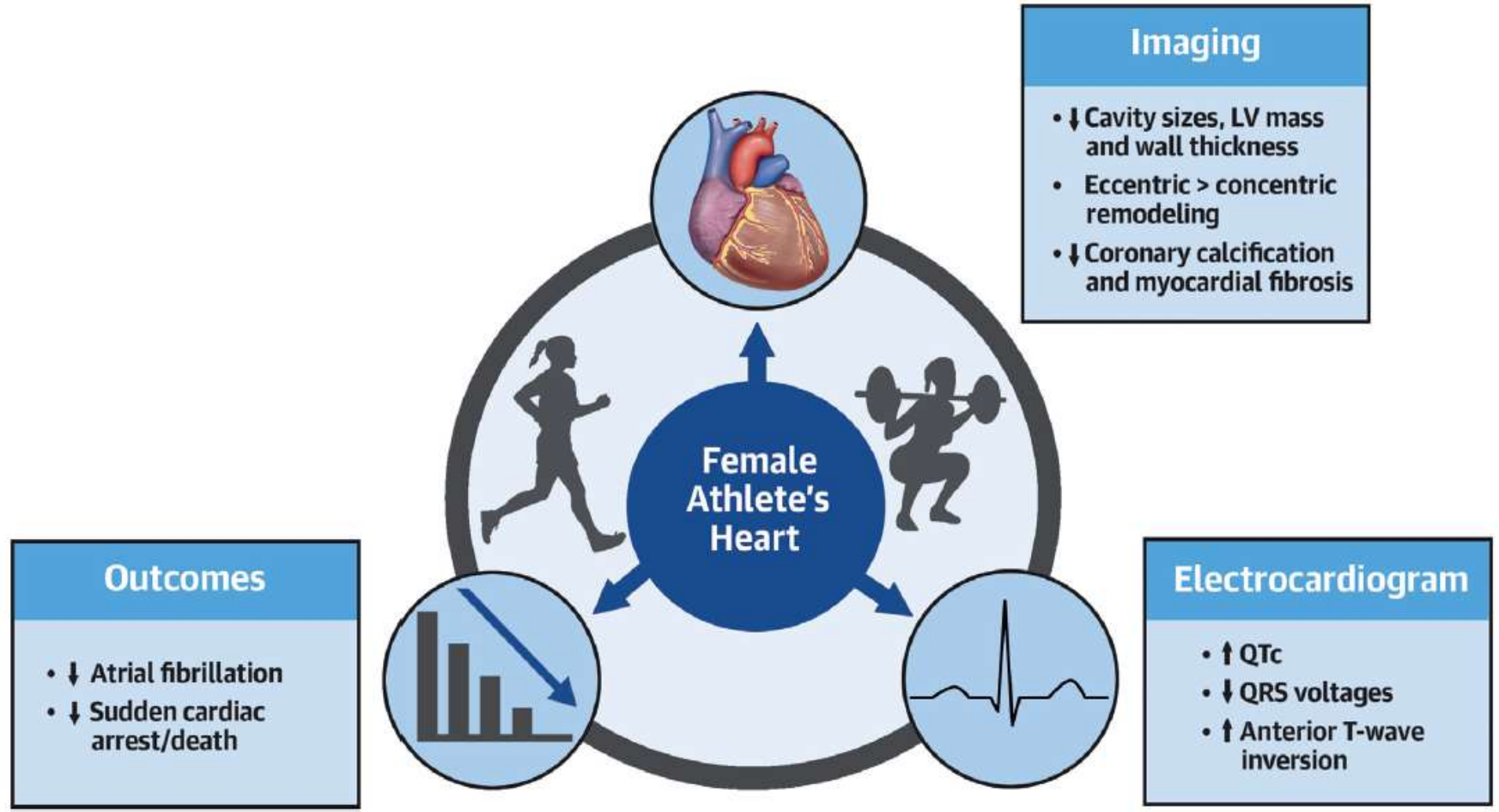
Data adapted from Milikan, et al. Am J Cardiol. 1988;62:301-05.Riley-Hagan, et al. Am J Cardiol.1992;69:1067-74.

Impact of Sex on Cardiovascular Adaptations to Exercise

Bradley J. Petek, MD, et al.

JACC Review Topic of the Week: JACC, Vol. 82 (10), 2023.

CENTRAL ILLUSTRATION Sex-Based Differences in Exercise-Induced Cardiac Remodeling and Outcomes



Petek BJ, et al. J Am Coll Cardiol. 2023;82(10):1030-1038.

This review focuses on sex-based differences between female compared to male athletes in 3 domains: the electrocardiogram, cardiovascular imaging, and outcomes.
LV = left ventricular.

IV. Female Stages + CV Risk

- Cardiovascular disease (CVD) is the leading cause of death for women.
- Cardiovascular conditions in the United States make up at least *a third of the women's health gap* because of inequities between women and men in care delivery, efficacy, and data availability.
- Addressing heart health at *every life stage* can improve a woman's quality of life and overall health.
- It could lead to at least 1.6 million years of higher-quality life and boost the US economy by $28 billion annually by 2040.

Women and CVD

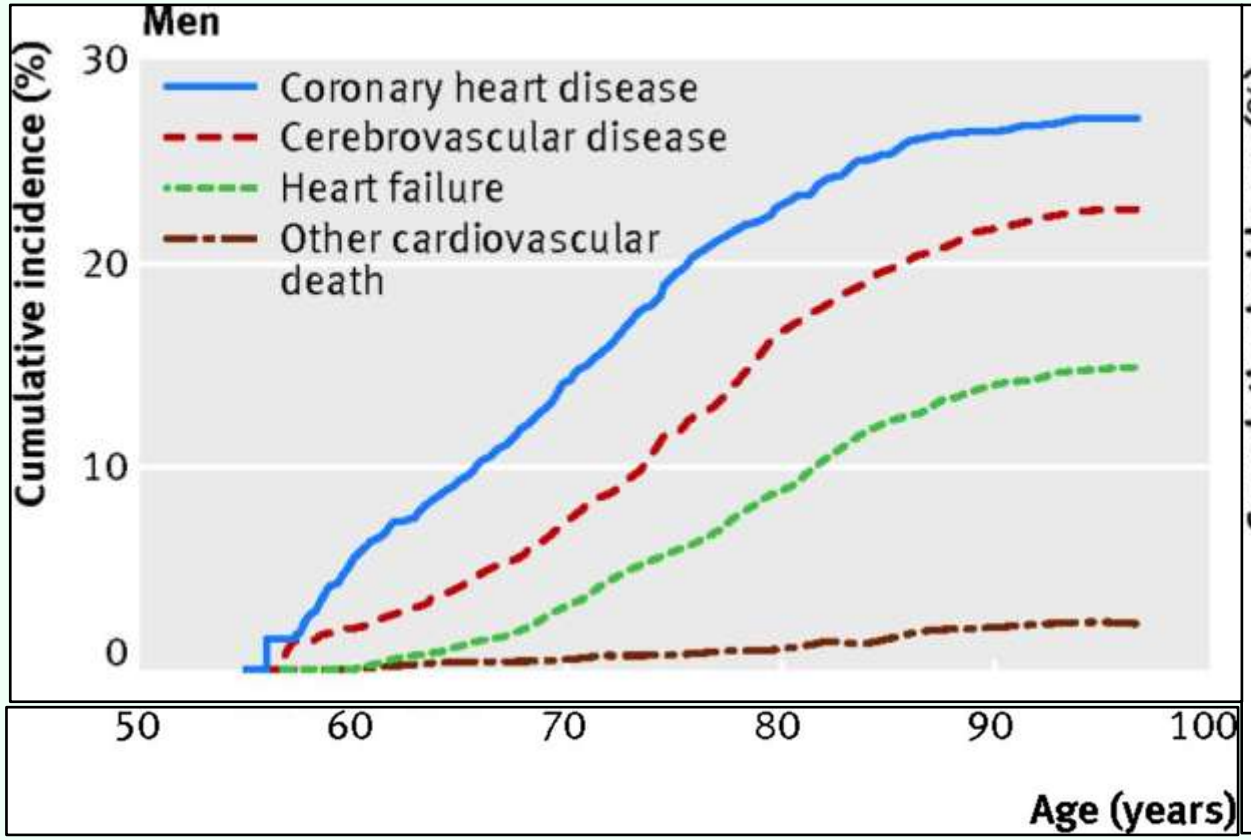
Symptoms

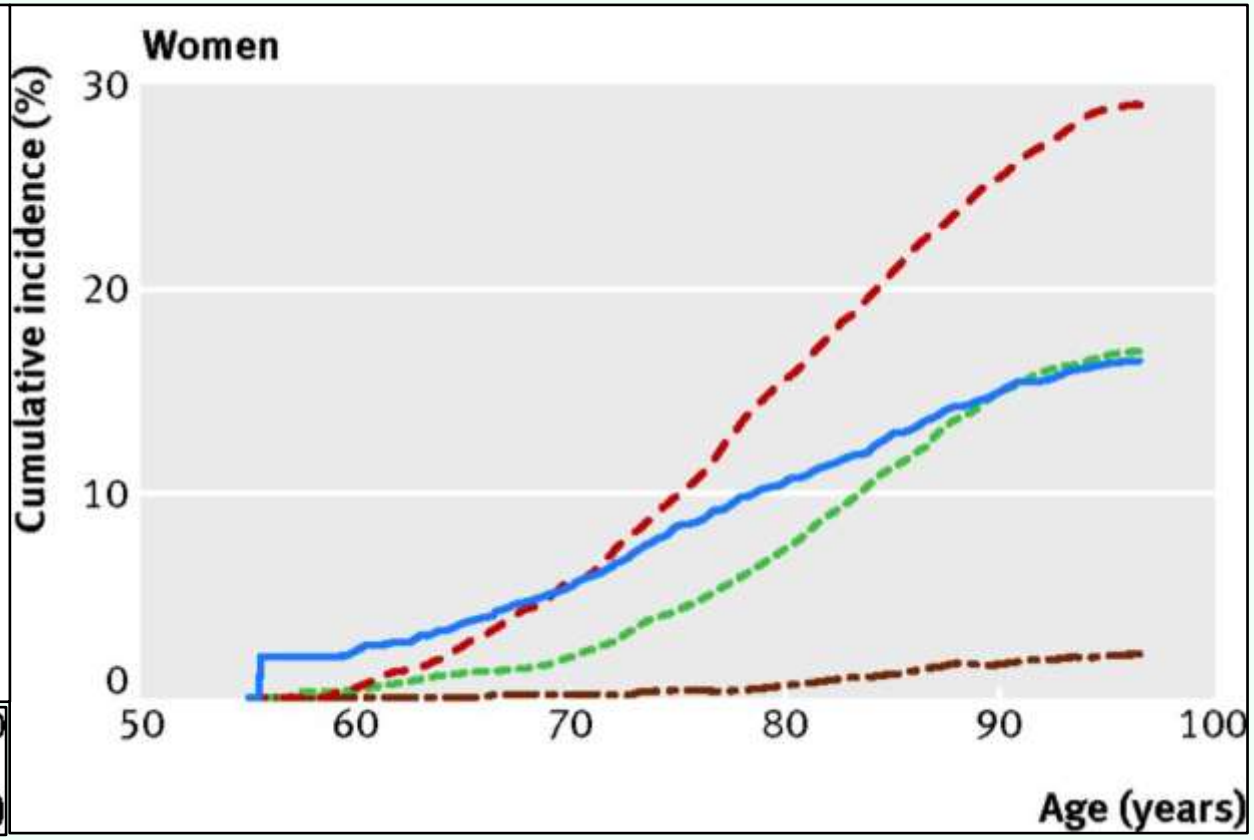
- Older
- *More co-morbidities*
- *Less physically active*
- #1 killer of women in the U.S.
- 46% of total deaths in women over 50

- Stress response: women – HR ↑; men vasoconstriction ↑ - ↑ BP
- Men –stiffer arteries post-puberty; Women – higher distensibility [?? Inflammation]
- Men – more CAD
- Women – more microvascular disease [often missed by heart scans]

  - more tears in Coronary artery, 'Broken Heart Syndrome'

Sex differences in lifetime risk and first manifestation of cardiovascular disease: prospective population based cohort study. [Netherlands] BMJ 2014;349:g5992





Conclusions At age 55, though men and women have similar lifetime risks of cardiovascular disease, there are considerable differences in the *first manifestation*. **Men** are more likely to develop *coronary heart disease as a first event*, while **women** are more likely to have *cerebrovascular disease or heart failure as their first event*, although these manifestations appear most often at older ages.

TABLE 1 The Stages of Reproductive Aging Workshop [STRAW] +10 staging system for reproductive aging in women

Body composition and cardiometabolic health across the menopause transition.

Marlatt KL, Pitynski-Miller DR, Gavin KM, et al. *Obesity (Silver Spring).* *2022;30:14–27.* https://doi.org/10.1002/oby.23289

	Menarche					FMP (0)				
Stage	-5	-4	-3b	-3a	-2	-1	+1a	+1b	+1c	+2
Terminology	REPRODUCTIVE				MENOPAUSAL TRANSITION		POSTMENOPAUSE			
	Early	Peak	Late		Early	Late	Early			Late
					Perimenopause					
Duration	*variable*				*variable*	1-3 years	2 years (1+1)		3-6 years	*Remaining lifespan*
PRINCIPAL CRITERIA										
Menstrual Cycle	Variable to regular	Regular	Regular	Subtle changes in Flow/ Length	*Variable Length:* Persistent ≥7-day difference in length of consecutive cycles	Interval of amenorrhea of ≥60 days				
SUPPORTIVE CRITERIA										
Endocrine FSH AMH Inhibin B			Low Low	Variable * Low Low	↑ Variable * Low Low	↑ >25 IU/L ** Low Low	↑ Variable * Low Low	Stabilizes Very Low Very Low		
Antral Follicle Count			Low	Low	Low	Low	Very Low	Very Low		
DESCRIPTIVE CHARACTERISTICS										
Symptoms						Vasomotor symptoms *Likely*	Vasomotor symptoms *Most Likely*			*Increasing* symptoms of urogenital atrophy

This table was adapted with permission from the previously published STRAW+10 staging guidelines (11).

Abbreviations: AMH, anti-Müllerian hormone; FMP, final menstrual period; FSH, follicle-stimulating hormone.

↑ = elevated.

*Blood draws during early follicular phase (cycle days 2-5).

**Approximate expected concentration based on assays using current international pituitary standard.

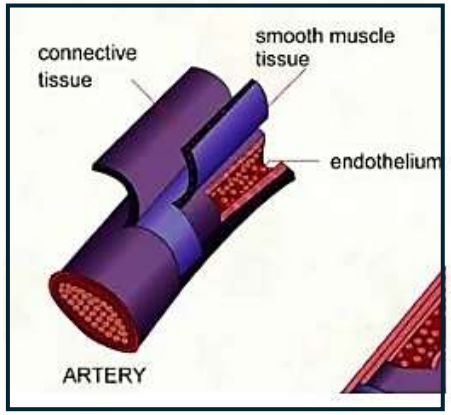
The Transitions

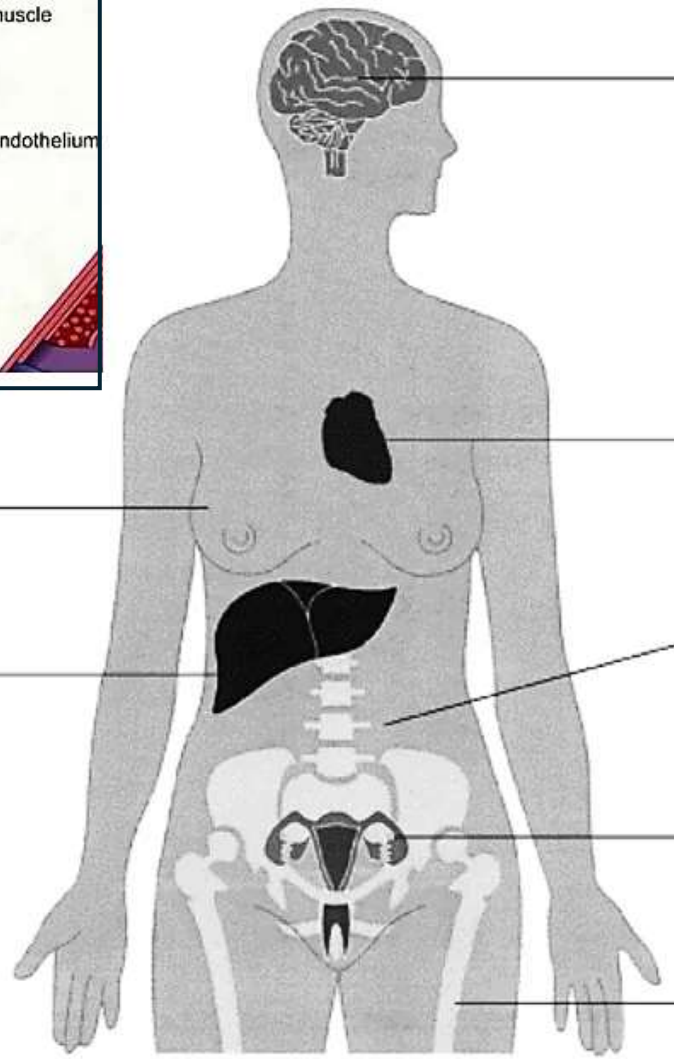
- Puberty
- Pre-Peri-Post-**Natal**
- ***Pre***-Peri-Menopause
- Peri-Menopause
- Menopause
- Post-Menopause
- 60 +++++

Dodge
&
Delay
Sarco penia
Osteo penia
Dyna penia!

Fight
Frailty,
Fragility
&
Fractures
with a
Vengeance!

Estrogen Receptor Distribution Within the Body





brain
ERα, ERβ

cardiovascular system
ERα, ERβ

breast
ERα, ERβ

gastrointestinal tract
ERβ

liver
ERα

urogenital tract
ERα, ERβ
uterus: ERα dominant
prostate: ERβ dominant

bone
ERα, ERβ

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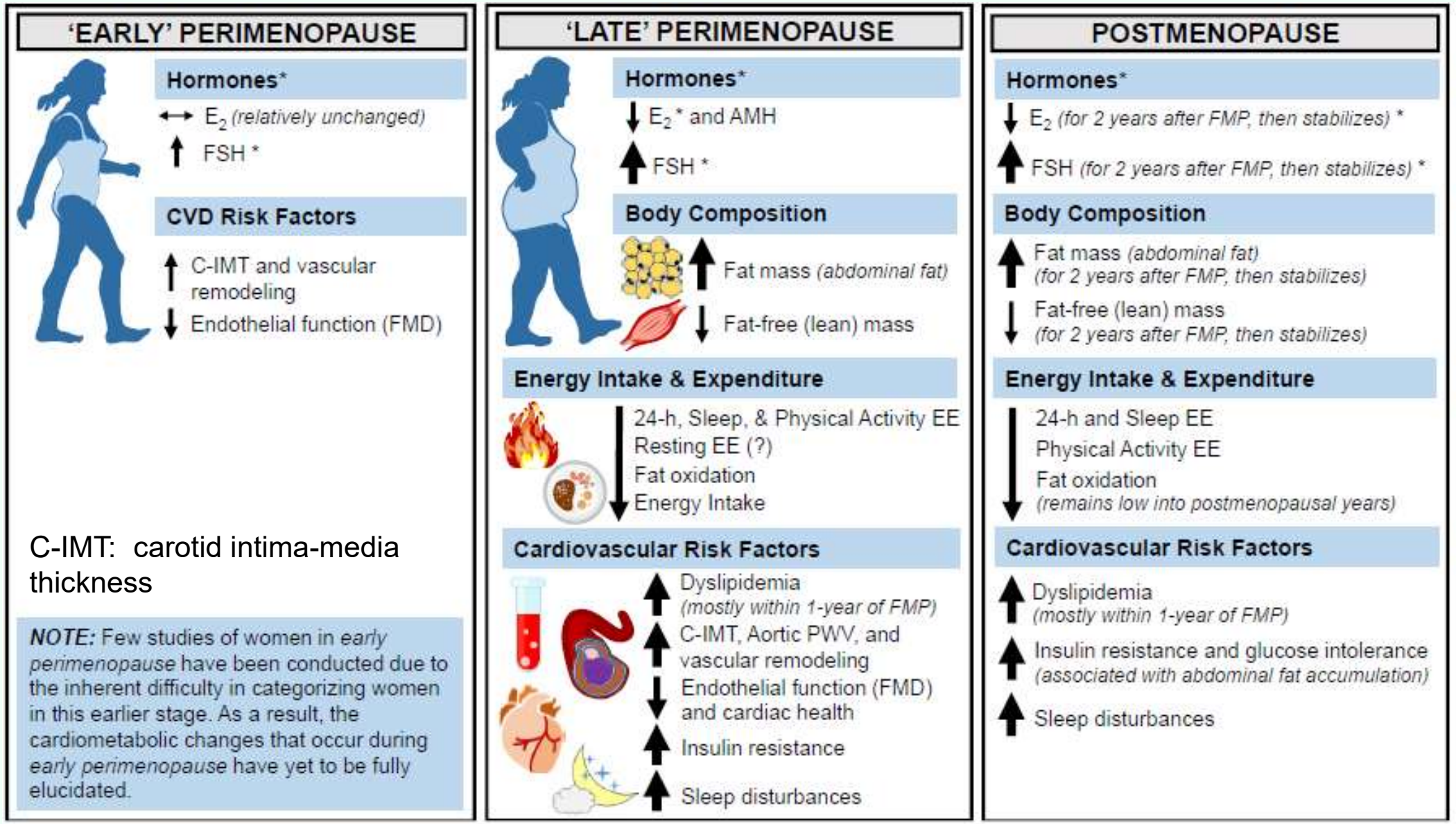
U of Pittsburgh
Div of Endocrinology & Metabolism
Center for Neuroscience
.ppt Jan09, 2025

FIGURE 1 '*Associated*' changes in cardiometabolic risk during the menopause transition.



C-IMT: carotid intima-media thickness

NOTE: Few studies of women in *early perimenopause* have been conducted due to the inherent difficulty in categorizing women in this earlier stage. As a result, the cardiometabolic changes that occur during *early perimenopause* have yet to be fully elucidated.

Body composition and cardiometabolic health across the menopause transition. Marlatt KL, Pitynski-Miller DR, Gavin KM, et al. *Obesity (Silver Spring).2022;30:14–27.* https://doi.org/10.1002/oby.23289

Sex Differences in Myocardial and Vascular Aging. Ji et al. *Circulation Research*. 2022;130:566–577. DOI: 10.1161/CIRCRESAHA.121.319902 February 18, 2022

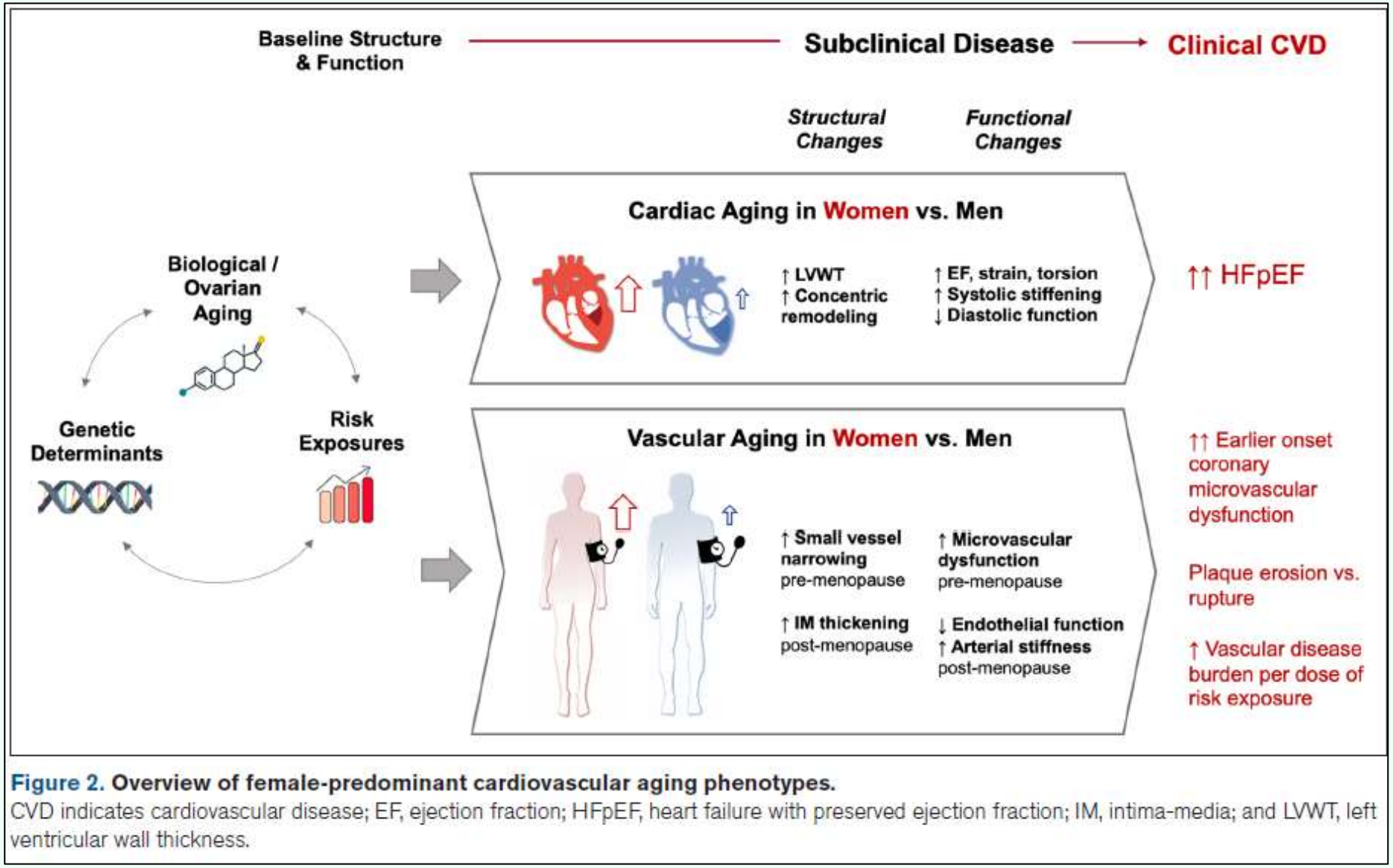


Figure 2. Overview of female-predominant cardiovascular aging phenotypes.
CVD indicates cardiovascular disease; EF, ejection fraction; HFpEF, heart failure with preserved ejection fraction; IM, intima-media; and LVWT, left ventricular wall thickness.

Figure 1. Illustrated summary: brief overview of vascular aging in women.

Contemporary Issues in Cardiology Practice
Vascular Aging in Women
Maria Agustina Lopez Laporte, Thais Coutinho, *Canadian Journal of Cardiology* 40 (2024) 1493-1495.

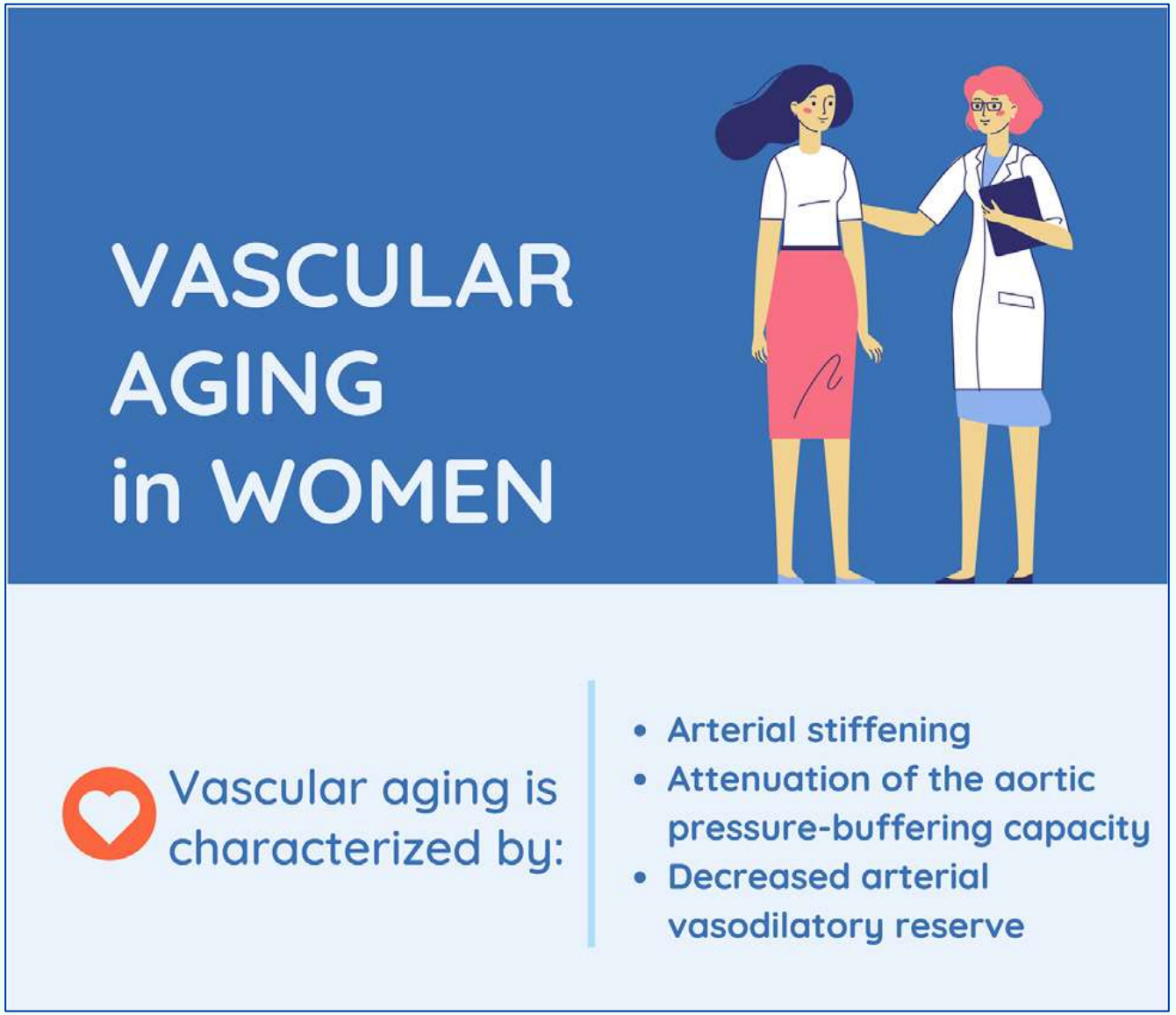


Figure 1 (cont.)

Can J Cardiol 40 (2024) 1493-1495.

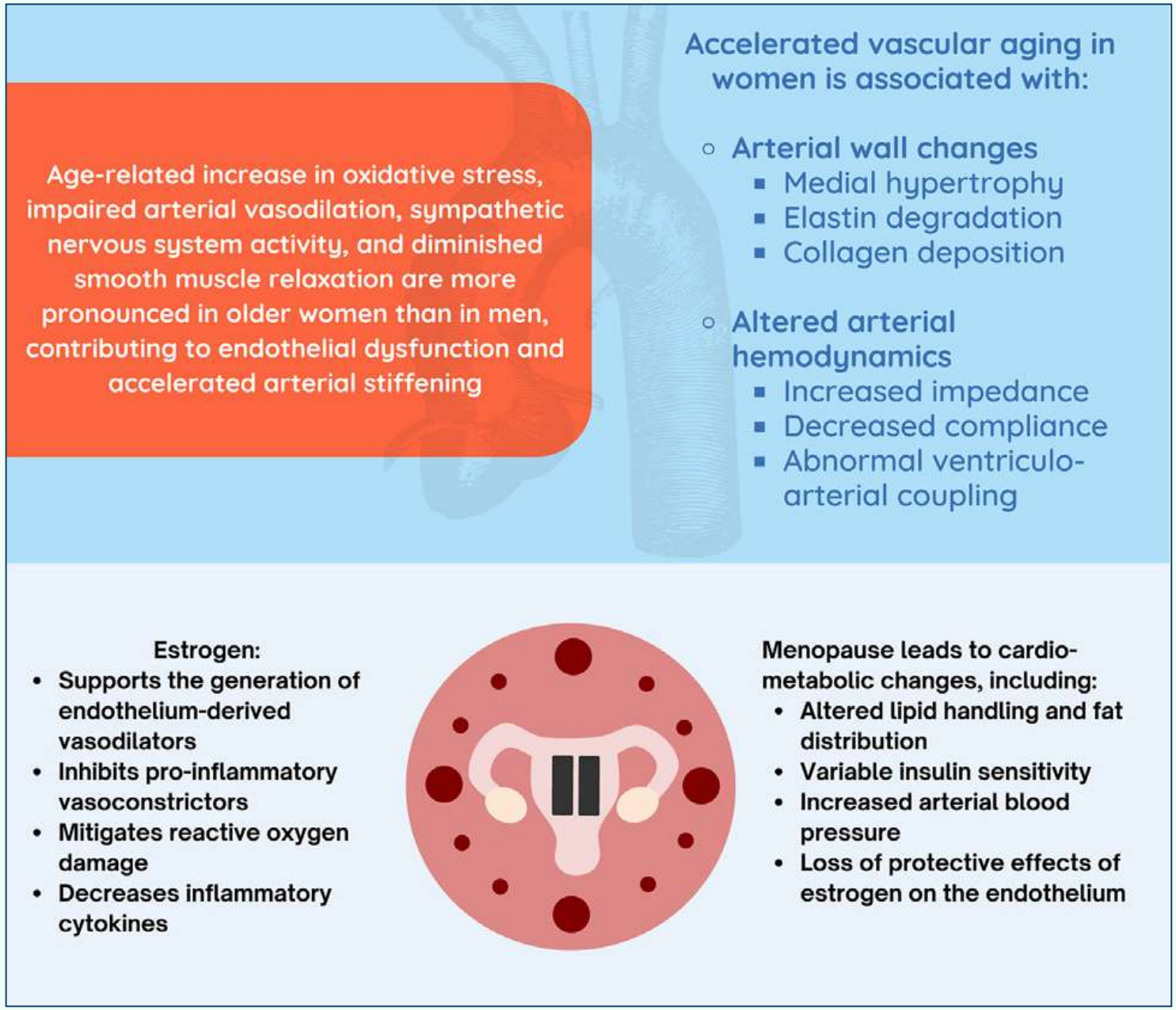


Figure 1 (cont.)

Can J Cardiol 40 (2024) 1493-1495.

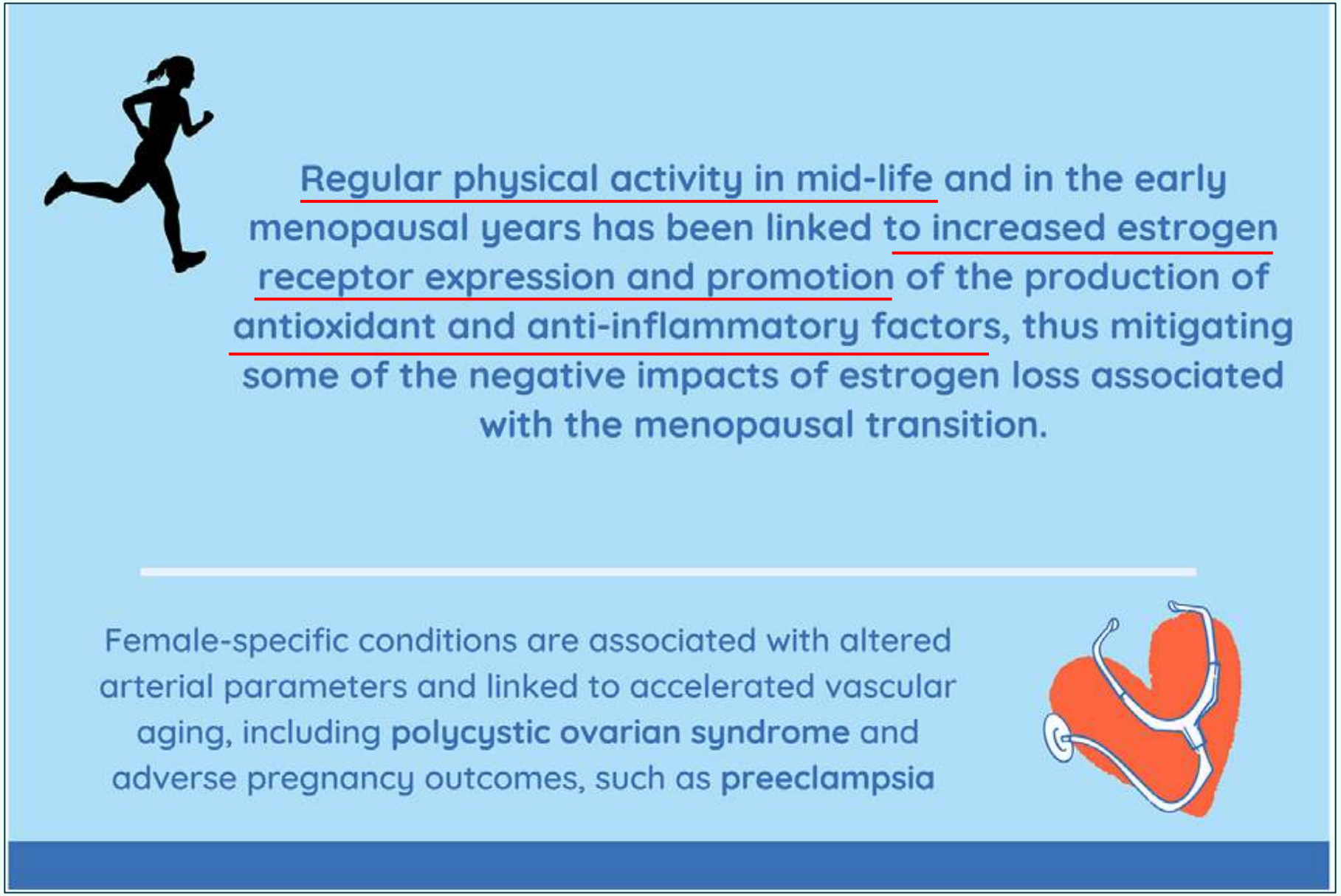
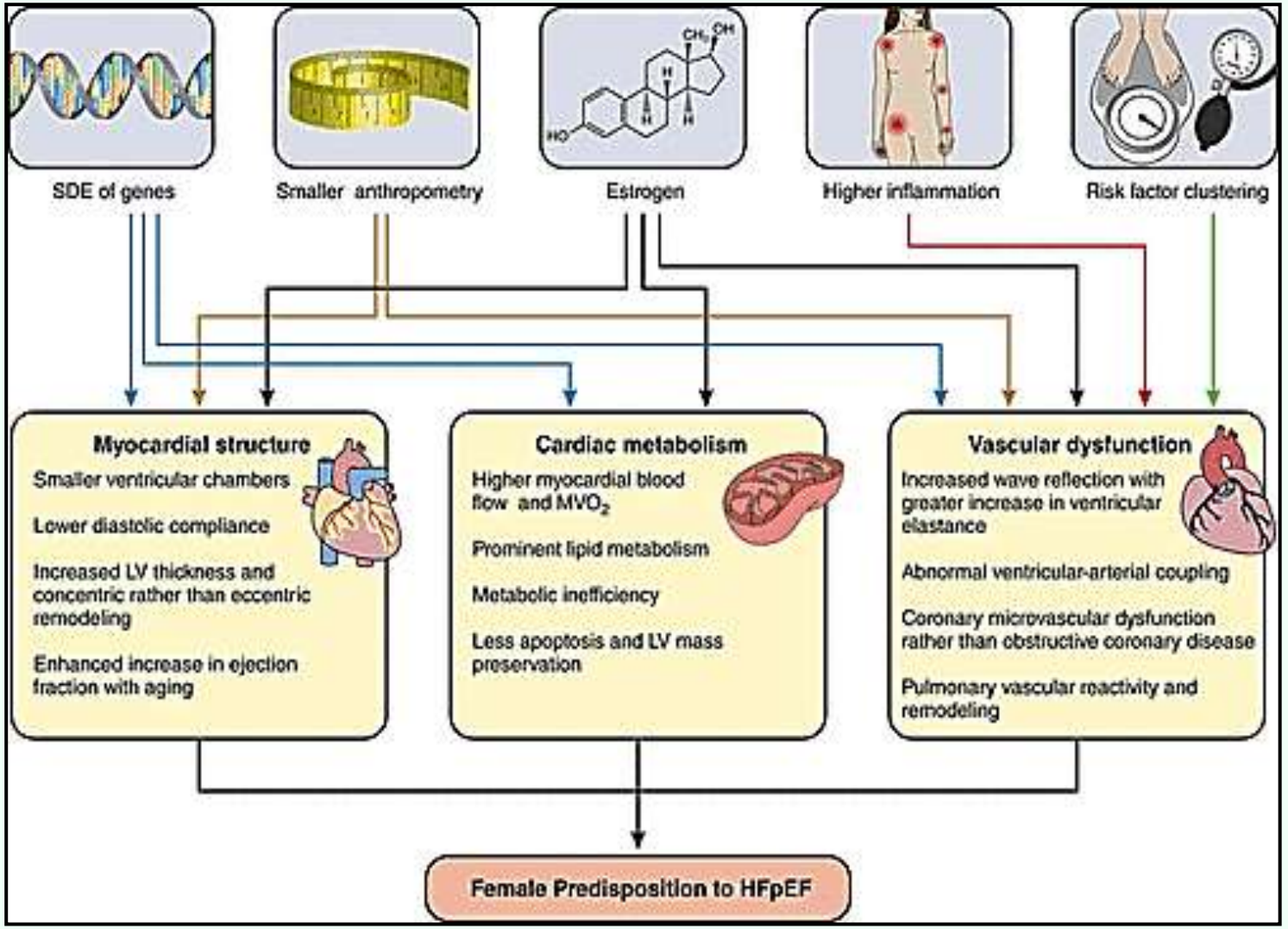


Figure 1.
Fundamental sex differences that predispose women to the development of HFpEF.

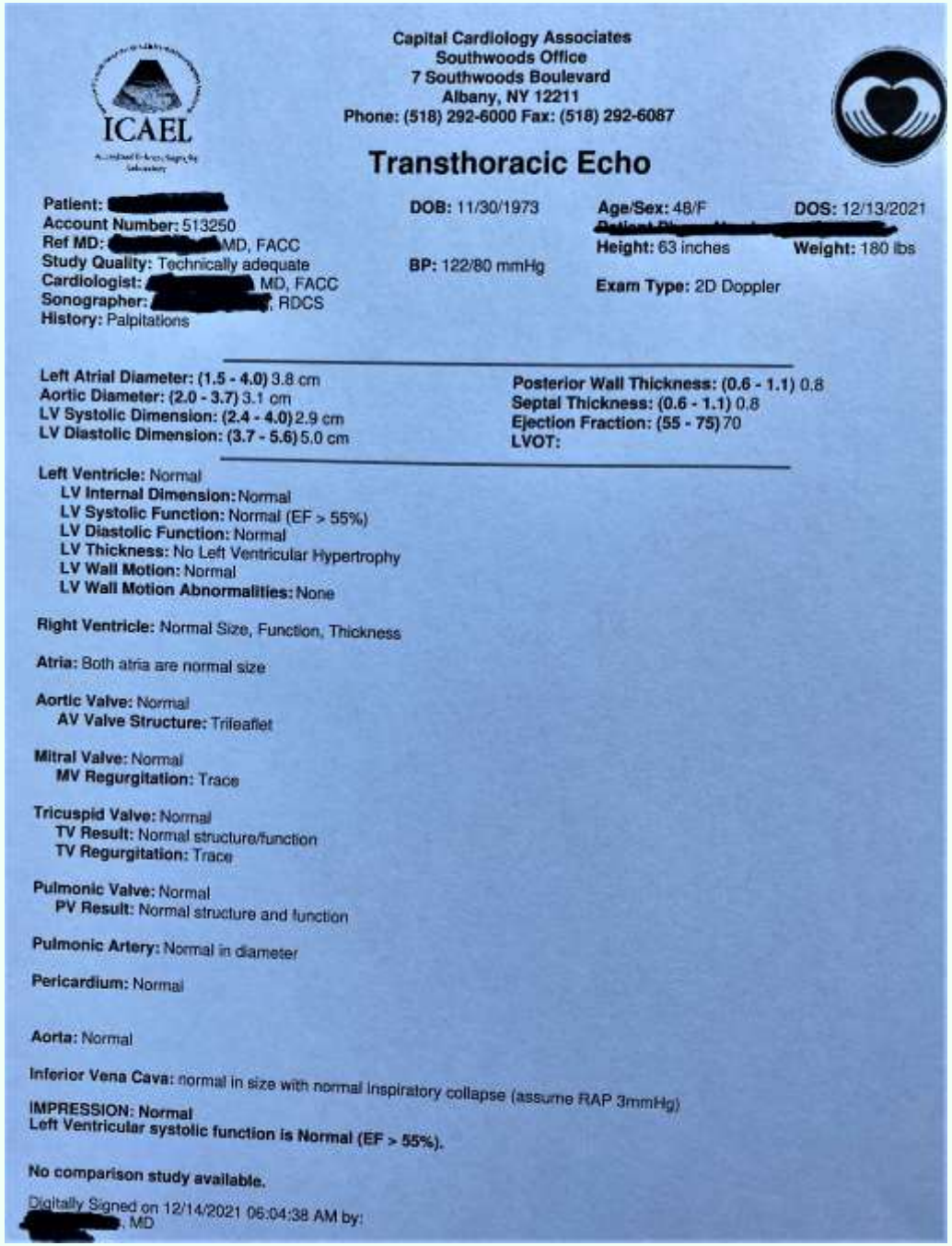
Interactions between estrogen, gene expression, inflammation, anthropometry, and comorbidities drive the higher relative prevalence of HFpEF in women.

HFpEF, heart failure with preserved ejection fraction;
LV, left ventricle;
MVO_2, myocardial oxygen consumption;
SDE, sex differential expression.



Anna L. Beale. Circulation. Sex Differences in Cardiovascular Pathophysiology, Volume: 138, Issue: 2, Pages: 198-205, DOI: (10.1161/CIRCULATIONAHA.118.034271)

Palpitations?
Peri-menopause?



ICAEL

Capital Cardiology Associates
Southwoods Office
7 Southwoods Boulevard
Albany, NY 12211
Phone: (518) 292-6000 Fax: (518) 292-6087

Transthoracic Echo

Patient: [redacted]
Account Number: 513250
Ref MD: [redacted] MD, FACC
Study Quality: Technically adequate
Cardiologist: [redacted] MD, FACC
Sonographer: [redacted], RDCS
History: Palpitations

DOB: 11/30/1973
BP: 122/80 mmHg

Age/Sex: 48/F
Height: 63 inches
Exam Type: 2D Doppler

DOS: 12/13/2021
Weight: 180 lbs

Left Atrial Diameter: (1.5 - 4.0) 3.8 cm
Aortic Diameter: (2.0 - 3.7) 3.1 cm
LV Systolic Dimension: (2.4 - 4.0) 2.9 cm
LV Diastolic Dimension: (3.7 - 5.6) 5.0 cm

Posterior Wall Thickness: (0.6 - 1.1) 0.8
Septal Thickness: (0.6 - 1.1) 0.8
Ejection Fraction: (55 - 75) 70
LVOT:

Left Ventricle: Normal
- **LV Internal Dimension:** Normal
- **LV Systolic Function:** Normal (EF > 55%)
- **LV Diastolic Function:** Normal
- **LV Thickness:** No Left Ventricular Hypertrophy
- **LV Wall Motion:** Normal
- **LV Wall Motion Abnormalities:** None

Right Ventricle: Normal Size, Function, Thickness

Atria: Both atria are normal size

Aortic Valve: Normal
- **AV Valve Structure:** Trileaflet

Mitral Valve: Normal
- **MV Regurgitation:** Trace

Tricuspid Valve: Normal
- **TV Result:** Normal structure/function
- **TV Regurgitation:** Trace

Pulmonic Valve: Normal
- **PV Result:** Normal structure and function

Pulmonic Artery: Normal in diameter

Pericardium: Normal

Aorta: Normal

Inferior Vena Cava: normal in size with normal inspiratory collapse (assume RAP 3mmHg)

IMPRESSION: Normal
Left Ventricular systolic function is Normal (EF > 55%).

No comparison study available.

Digitally Signed on 12/14/2021 06:04:38 AM by:
[redacted], MD

Active Agile

Cardiac Adaptations to High-Intensity Aerobic Training in Premenopausal and 'Recent' Postmenopausal Women: The Copenhagen Women Study.

Jon Egelund et al. J Am Heart Assoc. 2017;6:e005469. DOI: 10.1161/JAHA.117.005469.

Conclusions

- The present study demonstrates that cardiac dimensions and subclinical measures of cardiac function are *similar* in premenopausal and postmenopausal women with a small age difference.
- The finding indicates that, *despite the known beneficial effects of estrogen on cardiac tissue*, loss of estrogen and other hormonal changes at menopause, *do not seem to alter cardiac dimensions or functionality in the near term*.
- Moreover, a period of *high-intensity aerobic* exercise* training led to significant and similar adaptations in cardiac dimensions and systolic and diastolic function in pre and post-menopausal women.

*cycle ergometer (Body Bike) | 2 training sessions / week | 50:00 intermittent high intensity intervals | HRs > 85% maximum HR | HR monitored all training sessions (TEAM2 Wearlink+, Polar).

- These findings contrast with the notion that postmenopausal women adapt 'less well' to exercise training and clearly suggest that high intensity aerobic training is an effective means of attaining beneficial cardiac adaptations in *both* premenopausal and recent postmenopausal women.

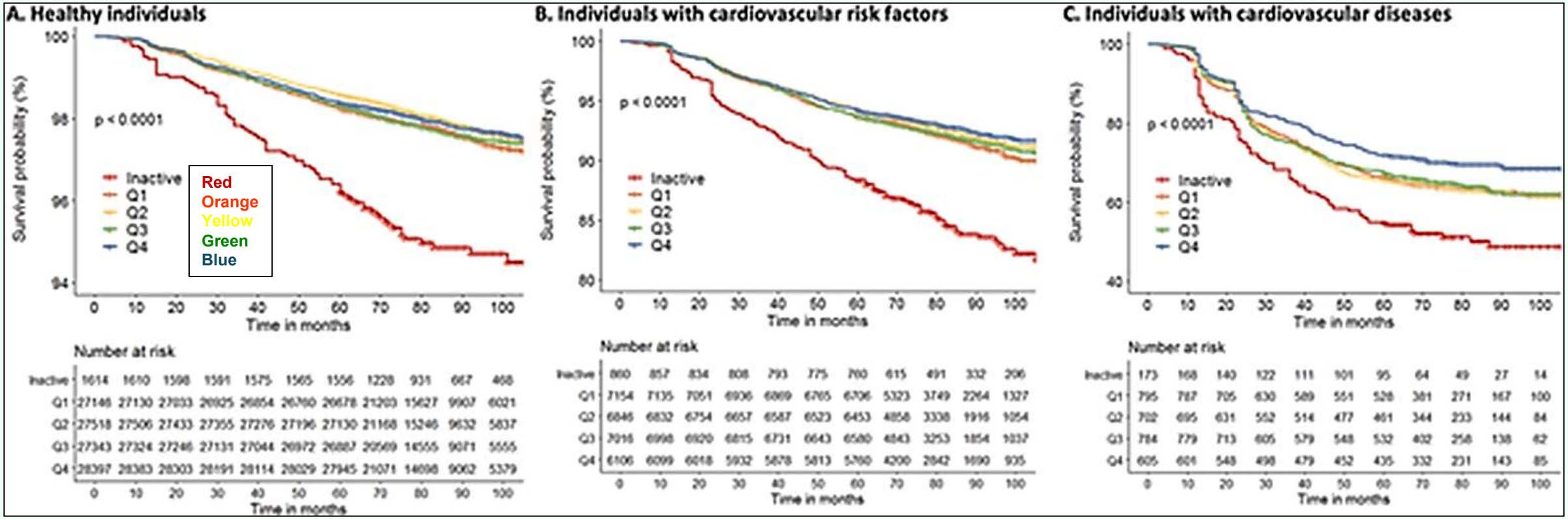
Effects of aging and endurance exercise training on cardiorespiratory fitness and cardiac structure and function in healthy midlife and older women.

Graeme Carrick-Ranson et al.
J Appl Physiol 135: 1215–1235, 2023.

Table 2. *Research gaps and future directions*

	Research Gap	Future Direction
Exercise intolerance	Physiological mechanisms that contribute to exercise intolerance	Define cardiovascular, skeletal muscle, and autonomic function during acute submaximal and peak/maximal exercise in midlife and older women
Physiological adaptions to training	Physiological adaptations to relatively short-term (1–6 mo), long-term (6 mo–1 yr) habitual (>5 yr), and lifelong (>20 yr) endurance training	Define cardiovascular, skeletal muscle, and autonomic nervous system adaptations to short-term, long-term, habitual, and lifelong exercise training in midlife and older women
Cardiac adaptations	Cardiac adaptations to endurance training in different stages of adulthood	Identify the cardiac adaptations to relatively short- and long-term habitual endurance training in young, midlife, and older women.
Ventricular-arterial coupling (v-a coupling)	v-a coupling adaptations with aging, menopausal status, and exercise training	Identify the v-a coupling changes with aging, menopausal status, and exercise training.
Exercise training prescription	Optimal prescription of physical activity and exercise training programs to elicit targeted physiological and health benefits	Identify the training modalities that optimally elicit targeted adaptations in the cardiovascular, skeletal muscle and autonomic nervous systems in midlife and older women
Dose-response effect	The exercise dose-response effect for targeted physiological adaptations for different modalities of physical training	Determine the dose-response effects of different exercise modalities on adaptations in $\dot{V}O_{2max}$, cardiovascular, skeletal muscle, and autonomic nervous systems in midlife and older women
Menopausal effects	The effect of menopausal status on cardiac adaptations to exercise training including testing the exercise timing hypothesis.	Determine whether menopausal status influences targeted training adaptations
Perceived barriers	The perceived barriers to initiating or continuation of physical activity or exercise training programs.	Define the perceived barriers to both initiating or continuing physical activity or exercise training programs in midlife and older women
Adherence, tolerance, and safety of physical activity and exercise programs	Adherence, tolerance, and safety of endurance-focused and multi-modality exercise training programs	Examinations of adherence, safety, and tolerance to physical activity and exercise training programs in midlife and older women
Exercise programs for special populations	Physiological adaptations to short and longer-term multi-modality exercise training programs in the oldest-old, frail, or those with chronic diseases	Determine the cardiovascular, skeletal muscle, and autonomic nervous system adaptations to different multimodal exercise training programs in special populations of midlife and older women

Fig 1. Dose–response association between moderate to vigorous physical activity and incident morbidity and mortality for individuals with a different cardiovascular health status: A cohort study among 142,493 adults from the Netherlands.



Bakker EA, Lee Dc, Hopman MTE, Oymans EJ, Watson PM, et al. (2021) Dose–response association between moderate to vigorous physical activity and incident morbidity and mortality for individuals with a different cardiovascular health status: A cohort study among 142,493 adults from the Netherlands. PLOS Medicine 18(12): e1003845. https://doi.org/10.1371/journal.pmed.1003845 https://journals.plos.org/plosmedicine/article?id=10.1371/journal.pmed.1003845

V. Training Nuggets


.....
spent decades
trying to lose
those
last 5 pounds

VO_{2max} + Lactate

04/12/2021

Pat VanGalen
66
114.2lbs
64.5”

Results		
Maximal Values	**Measured:**	**Info**
Relative VO2max (mL/kg/min)	42.65	Maximal rate of VO2 relative to body weight
Absolute VO2max (L/min)	2.22	Maximal rate of VO2
HRmax (bpm)	149	Maximal heart rate
Vemax (L/min)	122.8	Maximal ventilation rate per minute.
Aerobic Threshold (AeT)	**Measured:**	**Info**
Heart Rate (bpm)	119	Heart rate separating zone 2 and zone 3.
VO2 at AeT (mL/min)	30.4	Rate of oxygen consumption at Aerobic Threshold % of VO2max = 0.71
Speed / incline	4.2 @ 3%	Power output at Aerobic Threshold
Energy Expenditure (total)	8.9 534	kcal/min kcal/hour
Carbohydrate metabolism	1.7 102	kcal/min kcal/hour
Fat metabolism	7.2 432	kcal/min kcal/hour
Lactate Threshold (LT)	**Measured:**	**Info**
Heart Rate (bpm)	137	Heart rate separating zone 4 and zone 5
VO2 at LT (mL/min)	36.95	Rate of oxygen consumption at Lactate Threshold. % of VO2max= 0.87
Speed / incline	4.2 @ 6%	Power output at Lactate Threshold

Summary

Based on results from the test, the major take-aways are:

- Your ***zone 2*** heart rate is between 110 – 122 bpm. When training with HR, I would recommend spending 70% of your total training time at this intensity. Training in zone 2 will help build mitochondria density and be an intensity that is much easier to recover from.
- Endurance training should be repeatable day after day and month after month; training with intensity isn't always the easiest to repeat. Zone 2 will lead to consistency and steady improvement over time.
- With adding intensity into your training plan, I recommend completing a weekly intensity session. Referring to your training zones I would create interval sessions with repeated bouts of 6-12 minutes in ***zone 4***.
    - For example, (3-4 x 6 min (2 min rest). (3-4 x 8 min w/ 3 min rest) (3 x 10 min w/ 3 min rest).
    - You can be creative with these sessions; however, training in zone 4 which it seems like an intensity you are quite familiar with will continue to keep you striving forward!
- ***Zone 5*** examples: HR above 137- 149 bpm (interval sessions 90 seconds – 4 minutes)
- I recommend reading Stephen Seiler's hierarchy of endurance needs to apply this information to.
- Ideally with polarized training the endurance training will become very absorbable and allow you to ***increase your zone 2*** relative heart rate and be able to run the hilly and mountain terrain we have here in Big Sky!

CRF

WOMEN

Treadmill

WOMEN		Age Group (yr)				
Percentile		20–29	30–39	40–49	50–59	60–69
95	Superior	56.0	45.8	41.7	35.9	29.4
90		51.3	41.4	38.4	32.0	27.0
85	Excellent	48.3	39.3	36.0	30.2	25.6
80		46.5	37.5	34.0	28.6	24.6
75		44.7	36.1	32.4	27.6	23.8
70	Good	43.2	34.6	31.1	26.8	23.1
65		41.6	33.5	30.0	26.0	22.0
60		40.6	32.2	28.7	25.2	21.2
55		38.9	31.2	27.7	24.4	20.5
50	Fair	37.6	30.2	26.7	23.4	20.0
45		35.9	29.3	25.9	22.7	19.6
40		34.6	28.2	24.9	21.8	18.9
35		33.6	27.4	24.1	21.2	18.4
30	Poor	32.0	26.4	23.3	20.6	17.9
25		30.5	25.3	22.1	19.9	17.2
20		28.6	24.1	21.3	19.1	16.5
15		26.2	22.5	20.0	18.3	15.6
10	Very poor	23.9	20.9	18.8	17.3	14.6
5		21.7	19.0	17.0	16.0	13.4
		(*n* = 410)	(*n* = 608)	(*n* = 843)	(*n* = 805)	(*n* = 408)

Percentiles from cardiopulmonary exercise testing on a tre
maximal volume of oxygen consumed per unit time (VO_2
Data obtained from the Fitness Registry and the Importan
Database (FRIEND) Registry for men and women who w
known cardiovascular disease.

Adapted with permission from (124).

Performance Group by VO2 max

Age	Low	Below Average	Above Average	High	Elite
Women					
18-19	< 35	35-39	40-45	46-52	≥ 53
20-29	< 28	28-35	36-40	41-50	≥ 51
30-39	< 27	27-33	34-38	39-48	≥ 49
40-49	< 26	26-31	32-36	37-46	≥ 47
50-59	< 25	25-28	29-35	36-45	≥ 46
60-69	< 21	21-24	25-29	30-39	≥ 40
70-79	< 18	18-21	22-24	25-35	≥ 36
≥ 80	< 15	15-19	20-22	23-29	≥ 30

Performance Group by VO2 max

Age	Low	Below Average	Above Average	High	Elite
Men					
18-19	< 38	38-45	46-49	50-57	≥ 58
20-29	< 36	36-42	43-48	49-55	≥ 56
30-39	< 35	35-39	40-45	46-52	≥ 53
40-49	< 34	34-38	39-43	44-51	≥ 52
50-59	< 29	29-35	36-40	41-49	≥ 50
60-69	< 25	25-29	30-35	36-45	≥ 46
70-79	< 21	21-24	25-29	30-40	≥ 41
≥ 80	< 18	18-22	23-25	26-35	≥ 36

Table 1. Classification of Cardiorespiratory Fitness by Age and Sex reproduced from Mandsager et al.7
VO2 max (estimated VO2 peak) in ml/kg/min of oxygen consumption;
METS: metabolic equivalents, with 1 MET equaling 3.5 ml/kg/min of oxygen consumption.
Classification (percentile range) is as follows: low (<25th percentile), below average (24th-49th percentile), above average (50th-74th percentile), high (75th-97.6th percentile), and elite (≥97.7th percentile).

CRF

MEN

Treadmill

TABLE 3.8 • Treadmill-Based Cardiorespiratory Fitness Classifications ($\dot{V}O_{2max}$) by Age and Sex

$\dot{V}O_{2max}$ (mL $O_2 \cdot kg^{-1} \cdot min^{-1}$)

		MEN Age Group (yr)				
Percentile		20–29	30–39	40–49	50–59	60–69
95	Superior	66.3	59.8	55.6	50.7	43.0
90		61.8	56.5	52.1	45.6	40.3
85	Excellent	59.3	54.2	49.3	43.2	38.2
80		57.1	51.6	46.7	41.2	36.1
75		55.2	49.2	45.0	39.7	34.5
70	Good	53.7	48.0	43.9	38.2	32.9
65		52.1	46.6	42.1	36.3	31.6
60		50.2	45.2	40.3	35.1	30.5
55		49.0	43.8	38.9	33.8	29.1
50	Fair	48.0	42.4	37.8	32.6	28.2
45		46.5	41.3	36.7	31.6	27.2
40		44.9	39.6	35.7	30.7	26.6
35		43.5	38.5	34.6	29.5	25.7
30	Poor	41.9	37.4	33.3	28.4	24.6
25		40.1	35.9	31.9	27.1	23.7
20		38.1	34.1	30.5	26.1	22.4
15		35.4	32.7	29.0	24.4	21.2
10	Very poor	32.1	30.2	26.8	22.8	19.8
5		29.0	27.2	24.2	20.9	17.4

TABLE 5.3 • Commonly Used Equations for Estimating Maximal Heart Rate (HR_{max})

Author	Equation	Population
Astrand (51)	$HR_{max} = 216.6 - (0.84 \times age)$	Men and women age 4–34 yr
Tanaka et al. (48)	$HR_{max} = 208 - (0.7 \times age)$	Healthy men and women
Gellish et al. (50)	$HR_{max} = 207 - (0.7 \times age)$	Men and women in an adult fitness program with broad range of age and fitness levels
Gulati et al. (52)	$HR_{max} = 206 - (0.88 \times age)$	Asymptomatic middle-aged women referred for stress testing

Phil Maffetone: The MAF 180 Formula for determining your MAF HR

Find the ***ideal maximum aerobic heart rate*** *in which to base all aerobic training*.

When exceeded, this number indicates a rapid transition towards anaerobic work.

Subtract your age from 180, then modify from one of the categories below:

a) If you have or are recovering from a major illness (heart disease, any operation or hospital stay, etc.), are in rehabilitation, are on any regular medication, or are in Stage 3 (chronic) overtraining (burnout), subtract an additional 10.

b) If you are injured, have regressed or not improved in training (such as poor MAF Tests), or competition, get more than two colds, flu or other infections per year, have seasonal allergies or asthma, are overfat, are in Stage 1 or 2 of overtraining, or if you have been inconsistent, just starting, or just getting back into training, subtract an additional 5.

Phil Maffetone: The MAF 180 Formula for determining your MAF HR

c) If you have been training consistently (at least four times weekly) for up to two years without any of the problems mentioned in a) or b), no modification is necessary (use 180 minus age as your MAF HR).

d) If you have been training for more than two years without any of the problems listed above, have made progress in your MAF Tests, improved competitively and are without injury, add 5.

Exemptions:

The MAF 180 Formula may need to be further individualized for athletes over the age of 65.

- For some, up to 10 beats may have to be added for those only in category (d) of the Formula.
- This does not mean 10 should automatically be added, but that an honest self-assessment be made.

For athletes 16 years of age and under, the formula is not applicable; rather, an MAF HR of 165 has been used.

Phil Maffetone: https://philmaffetone.com/180-formula/

Example:

d) @ 67 yo ADD 5 + Exemption + 10

180 – 67 = 113 + 5 = 118 + 10 = 128

*My ideal maximum aerobic heart rate in which to base all **aerobic** training*.

When exceeded, this number indicates a rapid transition towards anaerobic work.

Heart Rate Variability [HRV]

- the variability of the time [space] between each heartbeat [ms]
- the ability to switch gears from fight-flight to rest-digest, from SNS to PNS; to turn the stress response ‘on or off’
- Low HRV – poor self-regulation, chronic alarm state, higher risk for CVD and death
- High HRV – HR can adapt and respond to stressors; can bounce back to homeostasis; less inflammation and healthier aging.
  - High HRV = high Vagal tone; common in athletes and those with high CRF

< 50	**Unhealthy**
50-100	**Compromised?**
100+	**Healthy**

TABLE 5.2 • Methods of Estimating Intensity of Cardiorespiratory Exercise

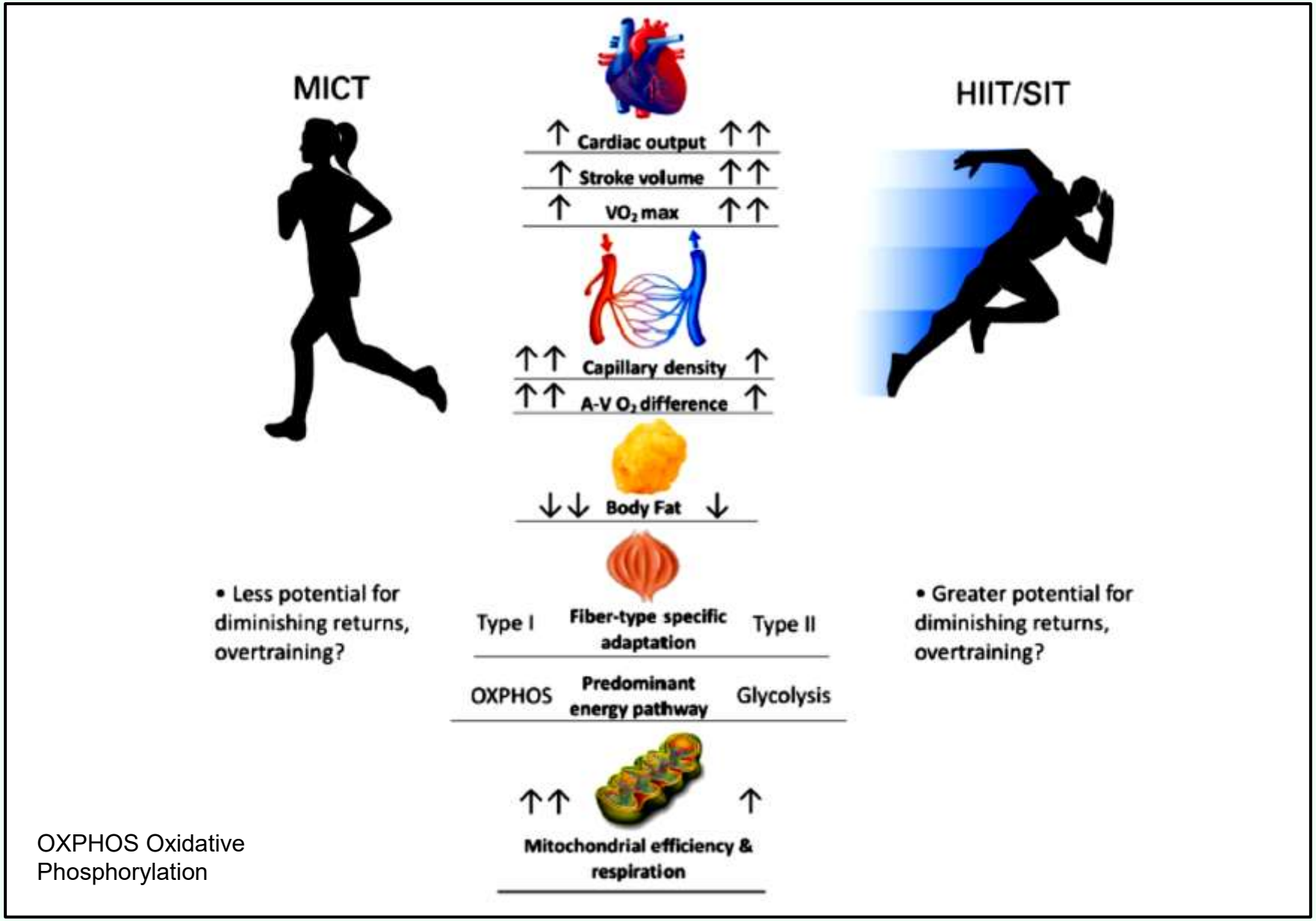
Cardiorespiratory Endurance Exercise											
	Relative Intensity				Intensity ($\%\dot{V}O_{2max}$) Relative to Maximal Exercise Capacity in MET			Absolute Intensity	Absolute Intensity (MET) by Age		
Intensity	%HRR or $\%\dot{V}O_2R$	$\%HR_{max}$	$\%\dot{V}O_{2max}$	Perceived Exertion (Rating on 6–20 RPE Scale)	20 METs $\%\dot{V}O_{2max}$	10 METs $\%\dot{V}O_{2max}$	5 METs $\%\dot{V}O_{2max}$	METs	Young (20–39 yr)	Middle Age (40–64 yr)	Older (≥65 yr)
Very light	<30	<57	<37	Very light (RPE <9)	<34	<37	<44	<2.0	<2.4	<2.0	<1.6
Light	30–39	57–63	37–45	Very light to fairly light (RPE 9–11)	34–42	37–45	44–51	2.0–2.9	2.4–4.7	2.0–3.9	1.6–3.1
Moderate	40–59	64–76	46–63	Fairly light to somewhat hard (RPE 12–13)	43–61	46–63	52–67	3.0–5.9	4.8–7.1	4.0–5.9	3.2–4.7
Vigorous	60–89	77–95	64–90	Somewhat hard to very hard (RPE 14–17)	62–90	64–90	68–91	6.0–8.7	7.2–10.1	6.0–8.4	4.8–6.7
Near-maximal to maximal	≥90	≥96	≥91	≥ Very hard (RPE ≥18)	≥91	≥91	≥92	≥8.8	≥10.2	≥8.5	≥6.8

HR_{max}, maximal heart rate; HRR, heart rate reserve; MET, metabolic equivalent; RPE, rating of perceived exertion; $\dot{V}O_{2max}$, maximal volume of oxygen consumed per unit time; $\dot{V}O_2R$, oxygen uptake reserve.
Adapted from (3).

AGE

FIGURE 1 | Comparing physiological adaptations between MICT and HIIT/SIT.

Two arrows denotes greater magnitude of adaptation.



OXPHOS Oxidative Phosphorylation

Langan SP and Grosicki GJ (2021) Exercise Is Medicine…and the Dose Matters. *Front. Physiol. 12:660818.* doi:10.3389/fphys.2021.660818

MICT [Moderate Intensity Continuous Training (Zone 2)]

HIIT/SIT [High Intensity Interval Training / Sprint Interval Training]

Interval Training …. Examples … Pros + Cons

High Intensity Interval Training [HIIT]*

- 4 X 4:00 at 90-95% peak HR / 3:00 recovery between

*walk, run, row bike, assault bike, swim, XC-skate ski, skate, etc.

Sprint Interval Training [SIT]*

- 3 X 20 secs at max effort / 2:00 recovery between

Tabata

Resistance-Based Interval Training

- SA KB complex: 6 for 6 X 3-4 rounds each: Clean – Press - OH rear lunge - lateral racked squat to SL stance – SLDL - Bentover row; 30 sec recovery between sides; 1:00 between rounds

High Intensity Functional Training [HIFT]

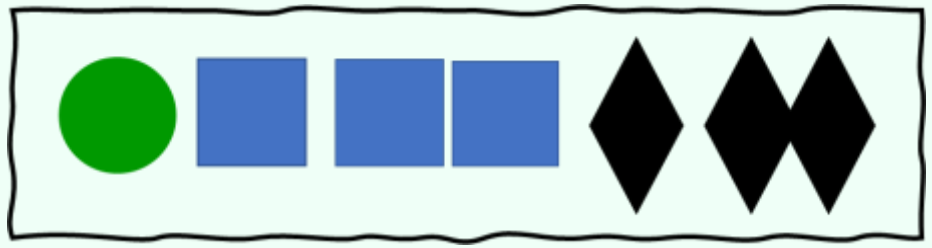
- 4 rounds for time: 400 m run / 10 swings to snatch / 100 JR skips or 50 DUs

VI. Layering on levels of Robustness

Environment

How much STAMINA do I *need* and *want* to have?

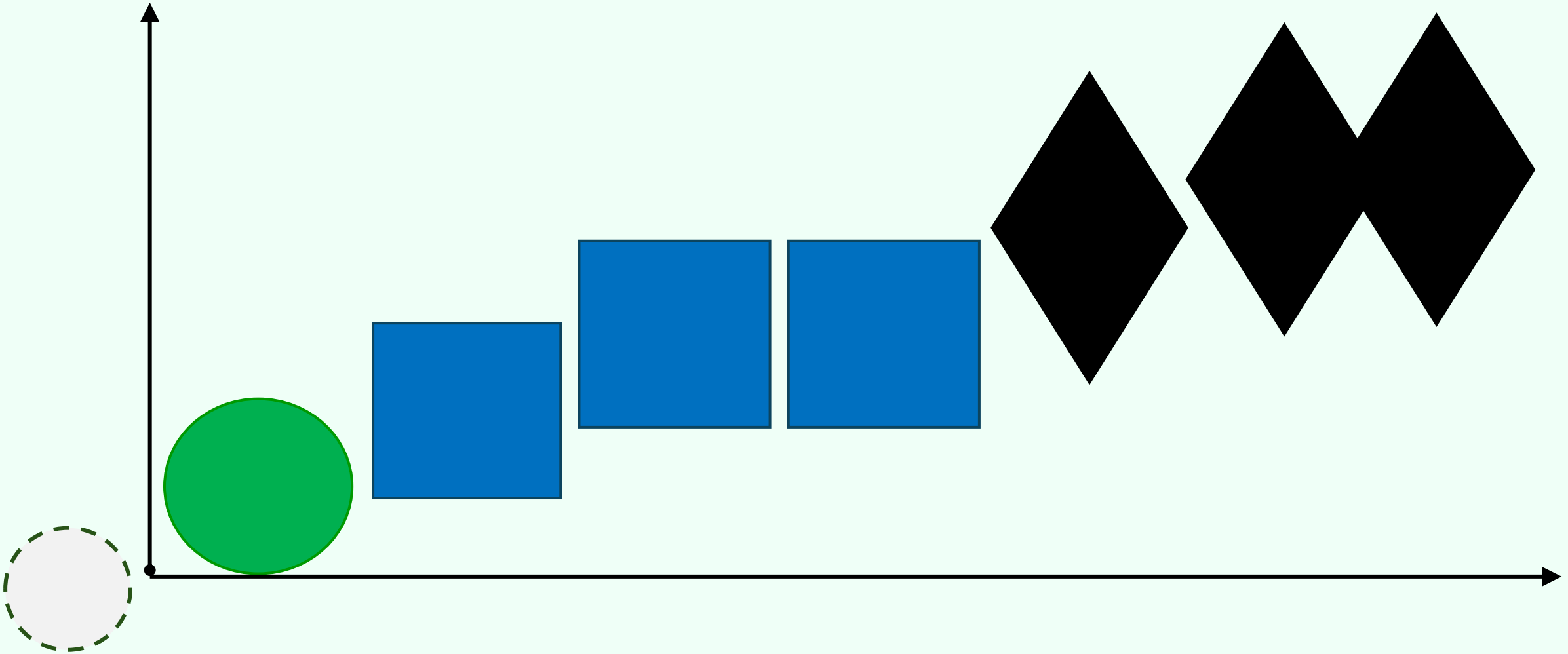
Stamina: Bucket #6

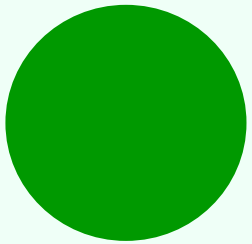


GO GO^2 GO^3 GO^4

…. and NOT BLOW

How much STAMINA do I *need* and *want* to have?



Tier 1: *GO for* …  Health-Brain-Strength spans

Battling the 4I's, the Aging Accelerants that precede Chronic Disease and Mobility Disability
AND ..
in the presence of Chronic disease and disability …. Giving people energy, functional independence and QOL.

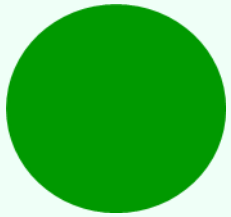
The Fitness Space

- competent and confident movement in *low-risk* activities and environments.

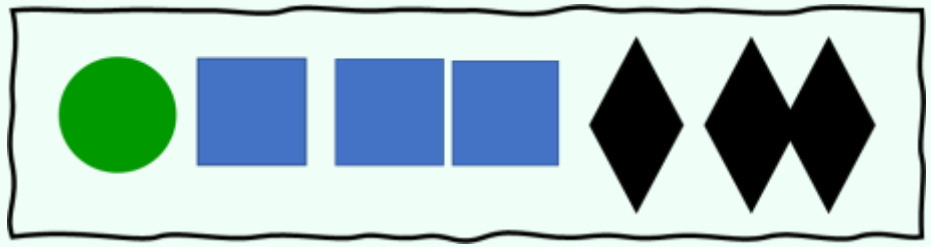
"Do it or lose it! Load it or lose it!" *[sarco-dyna-osteo-penias]*

Train to ***build a reserve***, and to *fight frailty* with a vengeance, especially ***women***.

KEEP *strength and power* in the BASICS, the squat, lunge, hinge, carry, pull and press patterns.



“Health and well-being
are not to be sacrificed at the altar of
‘performance or aesthetics’
in the ***seasoned*** adult.”



GO GO^2 GO^3 GO^4

.... and NOT BLOW

"Do it or lose it! Load it or lose it!" *Reserve*

"Load it to KEEP it!" *Bigger Reserve*

"Load to explode, not implode!" ***Reservoir***

"Play hard + fast, train smart + fast!" ***BEAST***

DAZ

… the most common cause of *adult* MSK injuries?
Thinking that I'm still a kid!

… the most common cause of adult CV-Met incidents?
A sedentary lifestyle … then 'overexert'!

VI. Summary

"Meet Jane where she's at,
know where she's been,
and
get her on the journey to where she
'needs and wants' to go."

“A lifelong commitment to DAILY movement ….
walking, frequent PA, recreation, sport, dance and hobbies,
anchored in regular TRAINING designed to sustain ROBUSTness
in life, labor, care-giving, play and competition
IS a ‘non-negotiable’
in a screen-stuck, movement-sucking lifestyle.”

“Adults, instead of reacting, repairing and rehabbing at 65,
we can be prepping and prehabbing at **35**,
investing early in a very possible 100-year haul.
Kind of like a leaky roof … patch it and hold your breath …
Or find the source, repair-replace it, protect, correct,
and maintain it to better weather the storms of life.”

Pat VanGalen, M.S.
Changing the *way*, and the *pace,* at which we age.

Sex and **Age Matter**

Where now?

Where been? - Hx

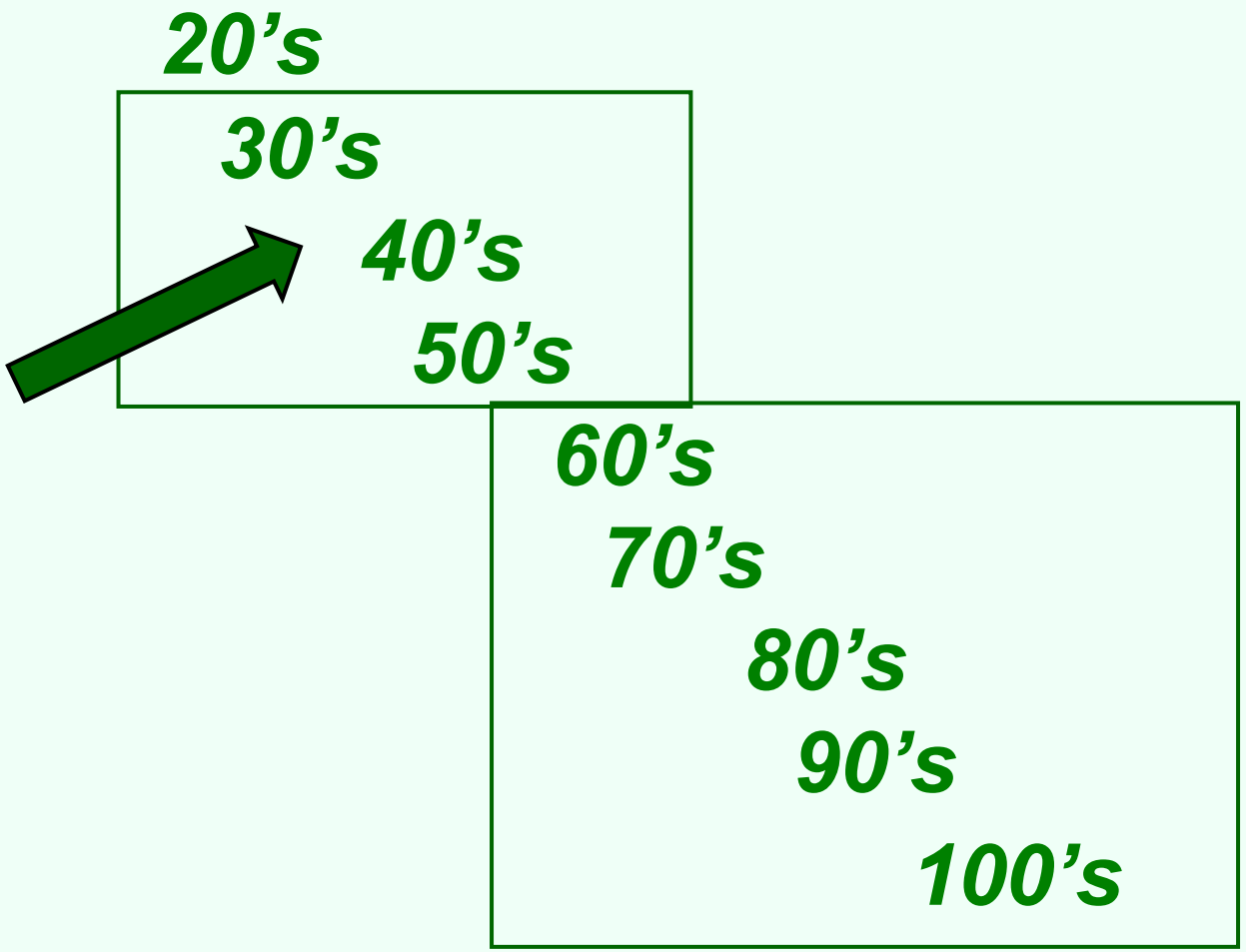
Orthopedic Cost

Mike Boyle

CV-Met Incident Risk

What matters most? *ctor*

On Training



"Programs with a 'start and stop' will fail. Systems built on a ***lifespan*** philosophy will prevail."

Want to be a ….

Jane

-of-all-Buckets

with

a *Robust Reserve*?

For ALAP?

The Active & Agile Approach to Robust Aging ….

Movement
- Locomotion+PA
- Enjoyment
- *TRAINING*

At HOME

- DAILY, get down and up from the ground at least once.
- KEEP the ability to reach and care for your toenails. Cross-legged is NOT mandatory, and neither is putting your leg around your neck.
- KEEP our feet 'smart'. Walk barefoot at home, and wear minimalist shoes when appropriate.
- Walk the dog DAILY and often; no dog? walk yourself DAILY and often.
- KEEP the ability to climb UP stairs every other one, and to *descend* without holding on.
- Continue doing all housework and in/outdoor maintenance involving multiple position changes, tasks, surfaces and tools for ALAP.
- KEEP the ability to tie your shoes in a ½ kneeling position.

At WORK, seated and stuck, counter it …

- Every 30 minutes, stand up, walk around, take stairs, stretch, reach, arch, bend, squat and rotate away from the chair.
- Take ‘strength & power’ snacks.
- Read something screen-less, while sitting on the floor.
- Time to rewire? Seek a vocation that is RICH in movement.

At PLAY

- Its’ all seasons, GO! Backpack, hike, camp, paddle, sail or golf. Ride any board, ski or skate. Hunt, fish or birdwatch. Try something new.
- DANCE, of any type is brain candy!
- Racquet sports [pickleball is booming], team sports, and anything physical, you deem fun, exciting and stimulating, do it!
- TRAIN so you CAN ….!

TRAIN to fill gaps and holes.

- ‘0’ physical labor and ‘0” physical hobbies, interests, sports or activities combined with the ill-effects of screens, sitting, tech-postures and a soft, cushy lifestyle is a recipe for *disability and dependence*.

- The purpose of *training* is to move, feel and perform better now, and for decades to come.
- It must *transfer* first to my overall health and well-being, and secondly to the ‘robustness’ of my Buckets for MY ‘game of life’, care-giving, emergencies and leisure-time pursuits.
- I TRAIN for *my* game, of life, that is.
- I COACH *my* clients for their ‘game of life.’

In TRAINING, fix what needs fixing, restore and refill the empty buckets.

- DAILY, practice breath work, bending, and rotating into and out of positions that are ignored; yoga, tai chi, martial arts, Pilates, other mind-body blends work.
- Past 40? DAILY, do soft tissue work [foam rolling] and stretching.

- DAILY, walk BRISKLY a minimum of 30 minutes per day. Twice a day is better. Outdoors is even better. In the winter, wear spikes. Prefer to bike, row, hike, run, XC ski, swim, Zumba +++? Do it.

- Accumulate a minimum of 7500 steps/day, unless you trained all of the Buckets that day.

- XC skiing and pole-walking reinforce the arm-leg patterns and stoke the brain networks.

In TRAINING, fix what needs fixing, restore and refill the empty buckets.

Compete

- TWICE a week, include HIIT sessions OR
  1X SIT and 1X HIIT / week.
- TWICE a week, include *total body* strength, power and speed-agility training.
  - OWN strength and power in the hinge, squat, lunge, carry, pull and press-push.
  - TWEAK with load, speed or complexity, including diagonal + single limb versions.
  - ALWAYS include skips, jumps, leaps and bounds in all directions during locomotive power segment.
  - Skipping rope, shadow boxing, footwork and reactive eye-hand drills are big-bang moves.

Read
React
Right

Compete

Adjust based on season, competitions, events, etc.

THE BOLD START with GROWINGBOLDER

People who wonder if the glass is half empty or half full miss the point. The glass is refillable.

GROWINGBOLDER.COM

It's on you to get up and get yourself a refill of whatever you need.

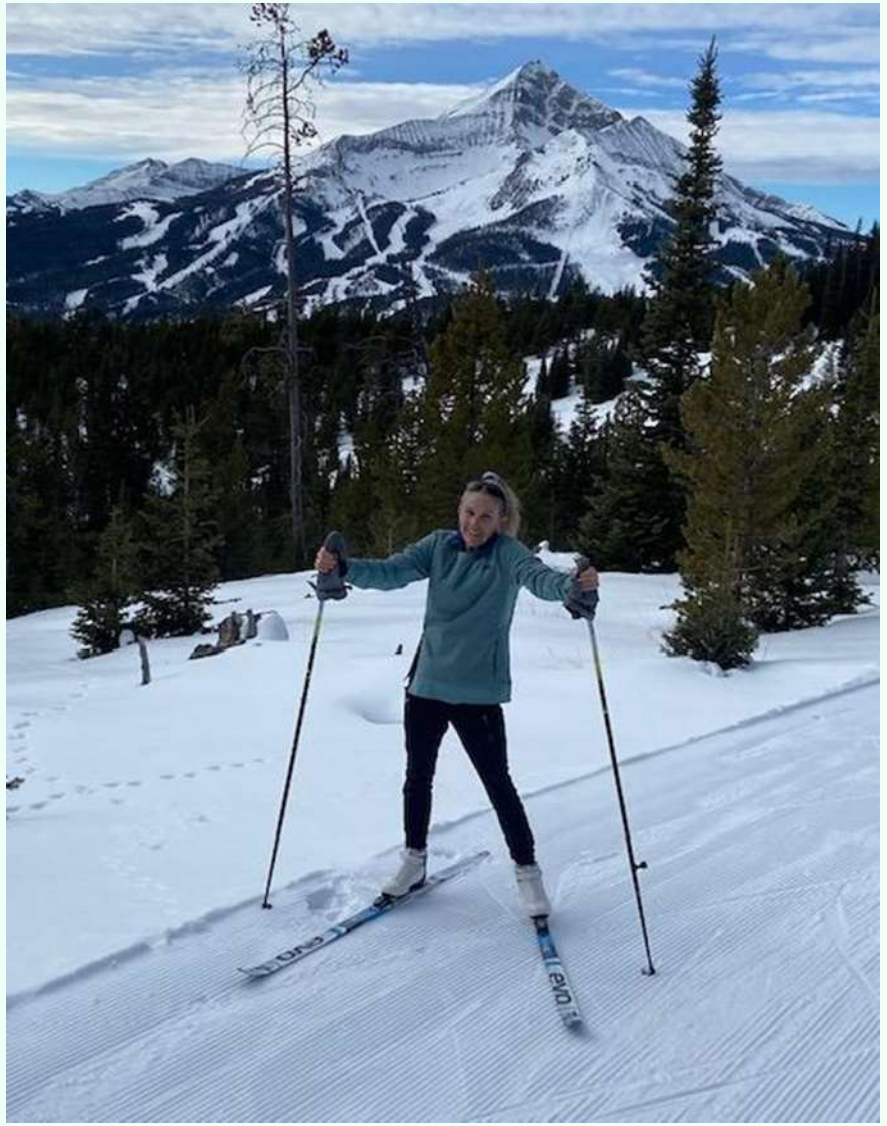
Start by doing what is necessary,

Then do what is possible,

Suddenly, you are doing the impossible!

St. Francis of Asissi

Train so you CAN ....



“If we want to change the way and the *pace* at which we age, We need to change the way we *live*, and how we *think* about aging.

And ….
That takes place in our
Purpose Pillar
and our
Spirit Bucket.”

“I inspire to Aspire!”

Thank You

Lisa Dougherty

and

The MedFit Team

and

ALL of YOU!!

LinkedIn: Pat VanGalen

MedFit Cardiac R.E.H.A.B Fitness Specialist Course [20 hours Online]

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