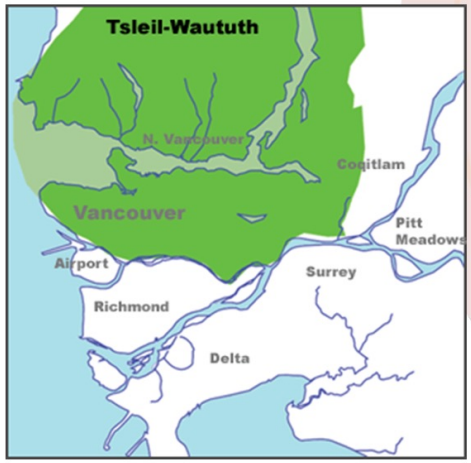
We would like to acknowledge that we are gathered today on the traditional territories of the Musqueam, Squamish and Tsleil-Waututh peoples.

Source: www.johomaps.net/na/canada/bc/vancouver/firstnations/firstnations.html



Exercise and Cardiovascular Disease: From Cardiac Rehabilitation to Marathons

NATE MOULSON, MD, MHA, FRCPC
UBC DIVISION OF CARDIOLOGY
MEDICAL DIRECTOR, VGH CARDIAC REHABILITATION AND CARDIORISK CLINIC
DIRECTOR, DCI CENTRE FOR CARDIOVASCULAR HEALTH AND PREVENTION
RESEARCH DIRECTOR, SPORTS CARDIOLOGY BC

UBC

Vancouver CoastalHealth Research Institute

DILAWRI Cardiovascular Institute

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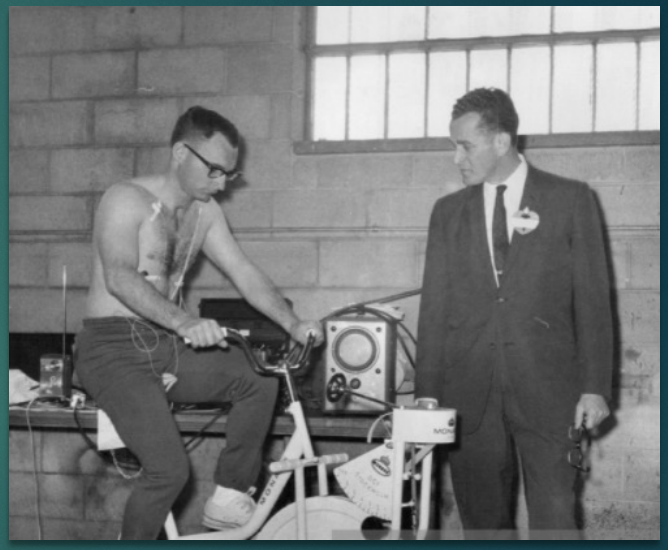
Membership on advisory boards or speakers' bureaus	HLS Therapeutic, NovoNordisk, Merck	Ad Board Participation
Funded grants, research, or clinical trials	Amgen	Local PI for multi-centre RCT
Patents for a drug or device		
All other investments or relationships that could be seen by a reasonable, well-informed participant as having the potential to influence the content of the educational activity		

Outline

- Exercise and Cardiovascular Disease
- What is Contemporary Cardiac Rehab?
- Indications
- Evidence of Benefit
- Cardiac Rehab in BC
- Sports Cardiology and Exercise Considerations in Athletes and Highly Active Persons with CV Disease

Is exercise beneficial or harmful in patients with Cardiovascular Disease?

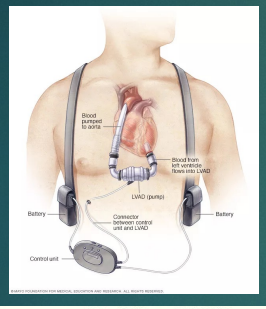
1. Beneficial
2. Harmful
3. Both
4. *Depends on the patient and the type of exercise

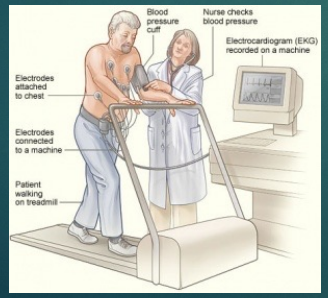


Spectrum of exercise and CVD

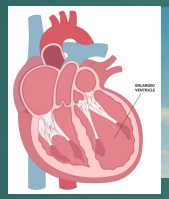
End-stage/Severe CVD

Supervised Cardiac Rehab

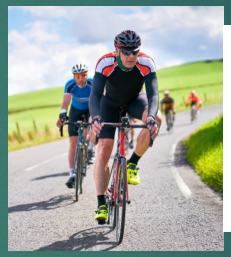


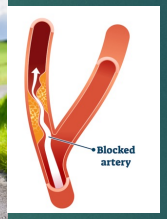


Exerciser with mild HF



Masters Athlete with CAD

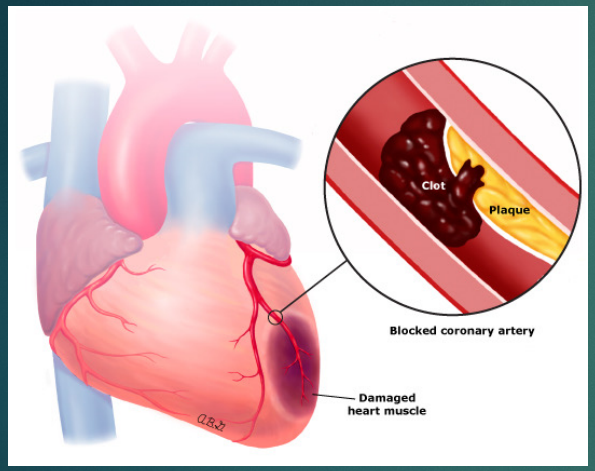




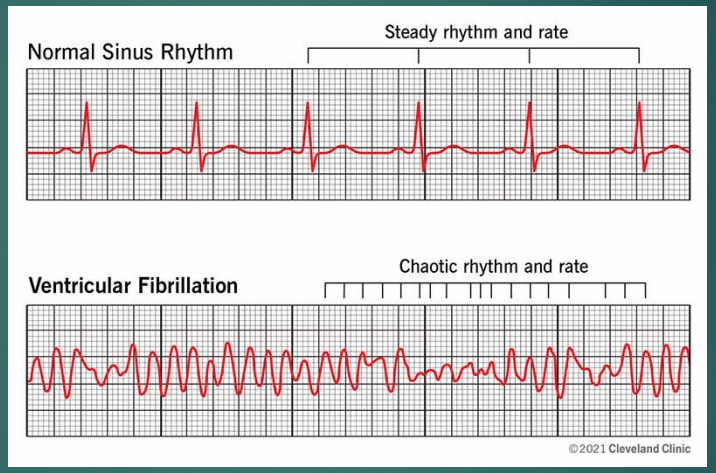
High Level Athletes with Cardiac Disease

Exercise and CVD

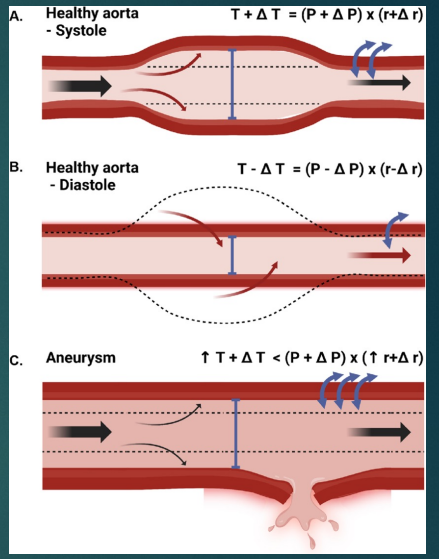
Exercise can be stressful…



Plaque Rupture



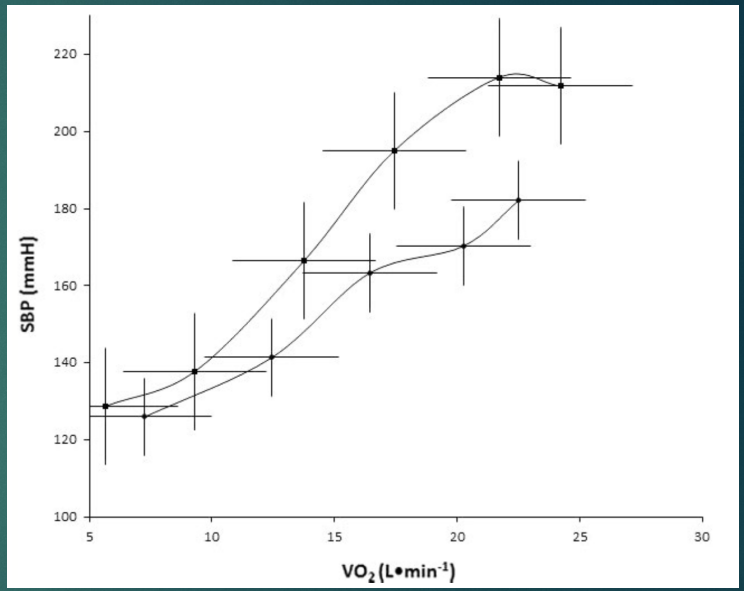
Ventricular Fibrillation/Cardiac Arrest



Aortic Dissection/Rupture

Hemodynamic response to exercise

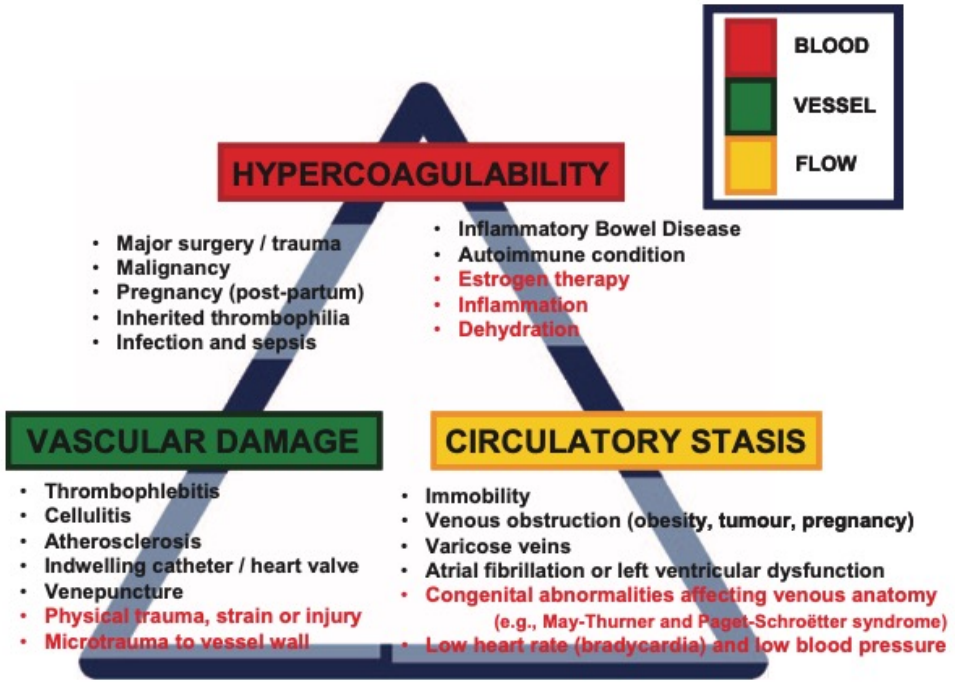
- Healthy Individuals
  - BP = CO x SVR
  - Exercise → ↑Cardiac Output
  - Exercise → ↓SVR
  - Net Effect:
    - SBP Increases proportionally to workload (~10mmHg/MET)
    - DBP stays the same or decreases

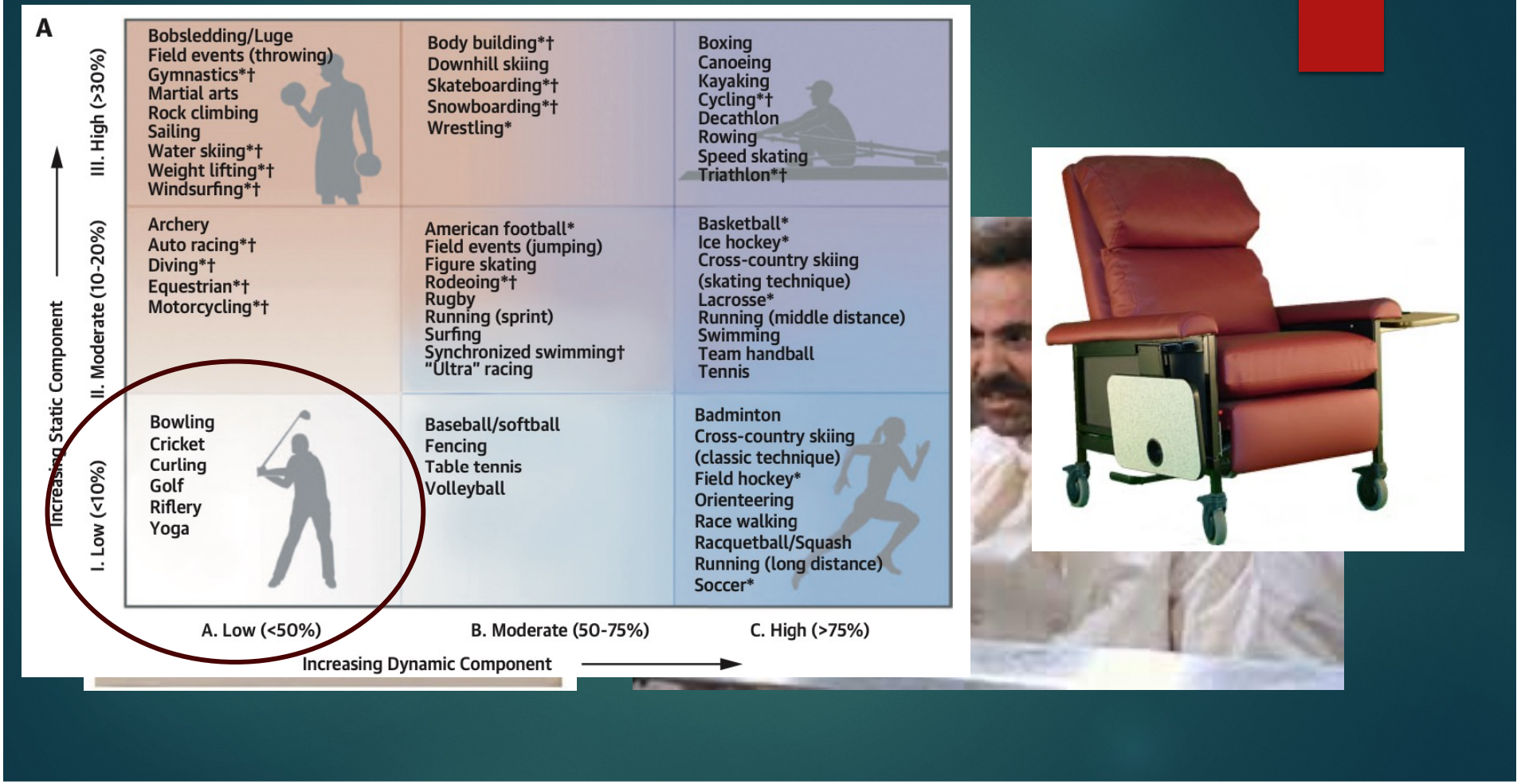


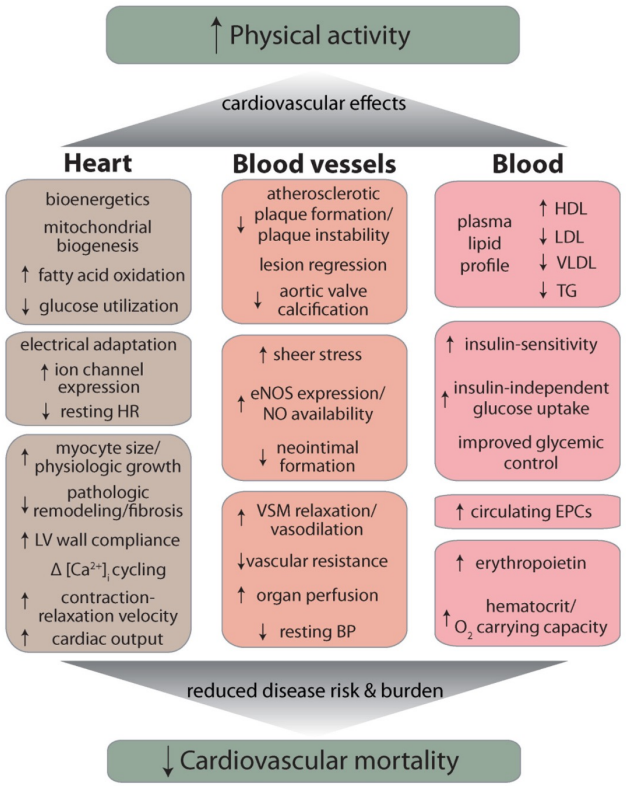
Richard et al, Scand J Med Sci Sports 2021 May;31(5):956-966

bonse to

- Increased afterload
- Increased cardiac demand
- Increased shear stress

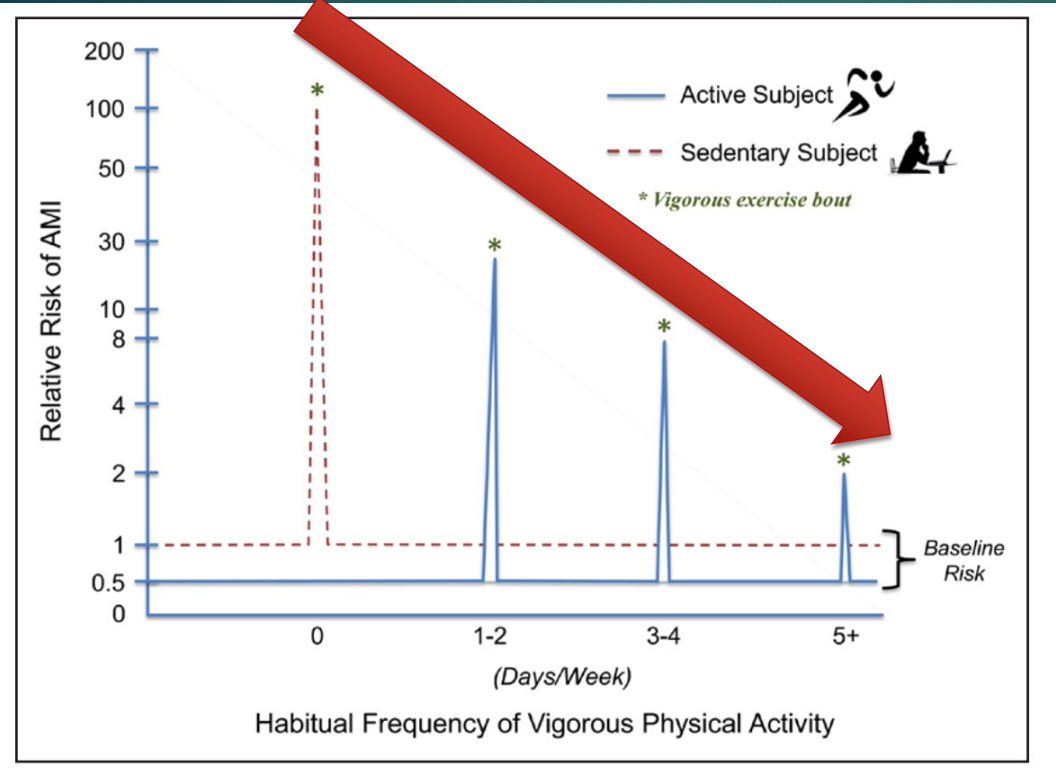



A
III. High (>30%)
II. Moderate (10-20%)
I. Low (<10%)
Increasing Static Component
Bobsledding/Luge
Field events (throwing)
Gymnastics*†
Martial arts
Rock climbing
Sailing
Water skiing*†
Weight lifting*†
Windsurfing*†
Body building*†
Downhill skiing
Skateboarding*†
Snowboarding*†
Wrestling*
Boxing
Canoeing
Kayaking
Cycling*†
Decathlon
Rowing
Speed skating
Triathlon*†
Archery
Auto racing*†
Diving*†
Equestrian*†
Motorcycling*†
American football*
Field events (jumping)
Figure skating
Rodeoing*†
Rugby
Running (sprint)
Surfing
Synchronized swimming†
"Ultra" racing
Basketball*
Ice hockey*
Cross-country skiing
(skating technique)
Lacrosse*
Running (middle distance)
Swimming
Team handball
Tennis
Bowling
Cricket
Curling
Golf
Riflery
Yoga
Baseball/softball
Fencing
Table tennis
Volleyball
Badminton
Cross-country skiing
(classic technique)
Field hockey*
Orienteering
Race walking
Racquetball/Squash
Running (long distance)
Soccer*
A. Low (<50%)
B. Moderate (50-75%)
C. High (>75%)
Increasing Dynamic Component



Nystoriak, Front. Cardiovasc. Med, 2018

Exercise Paradox



1. Exercise (vigorous intensity) INCREASES the instantaneous risk of CV events
2. Habitual exercise DECREASES the absolute risk of overall CV events

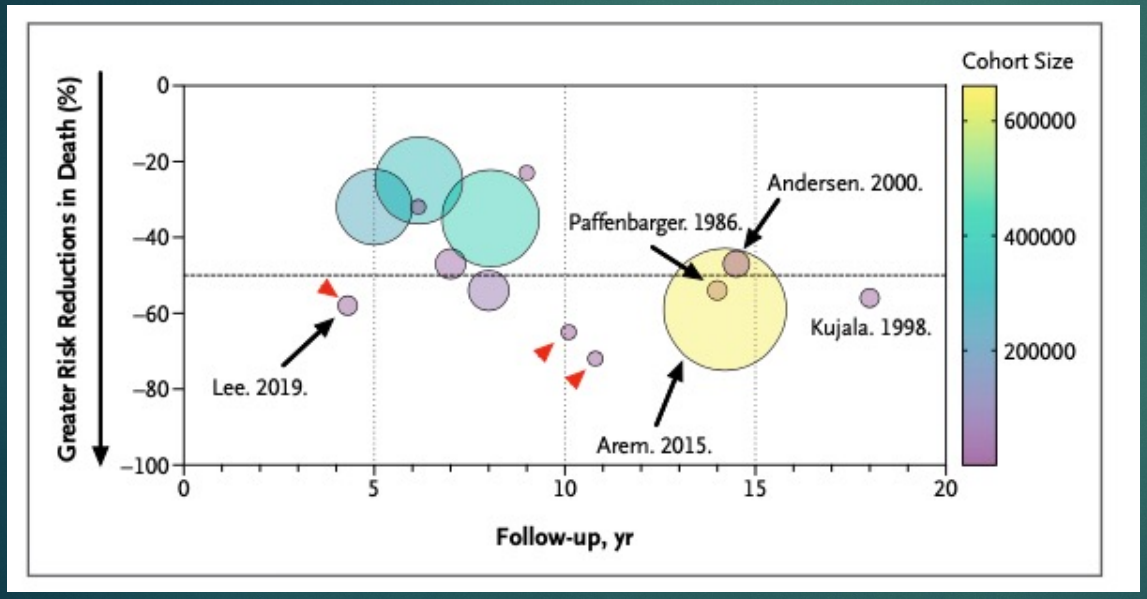
Franklin et al, Circulation, 2020;141:e705–e736

NEJM Evidence

REVIEW ARTICLE

The Evidence for Exercise in Medicine — A New Review Series

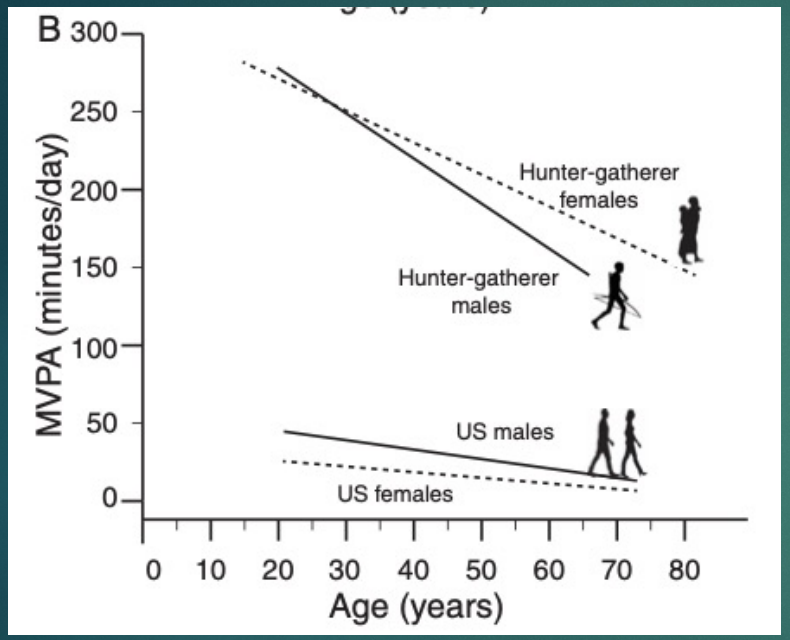
J. Sawalla Guseh, M.D.,[1] Daniel Lieberman, Ph.D.,[2] and Aaron Baggish, M.D.[1]

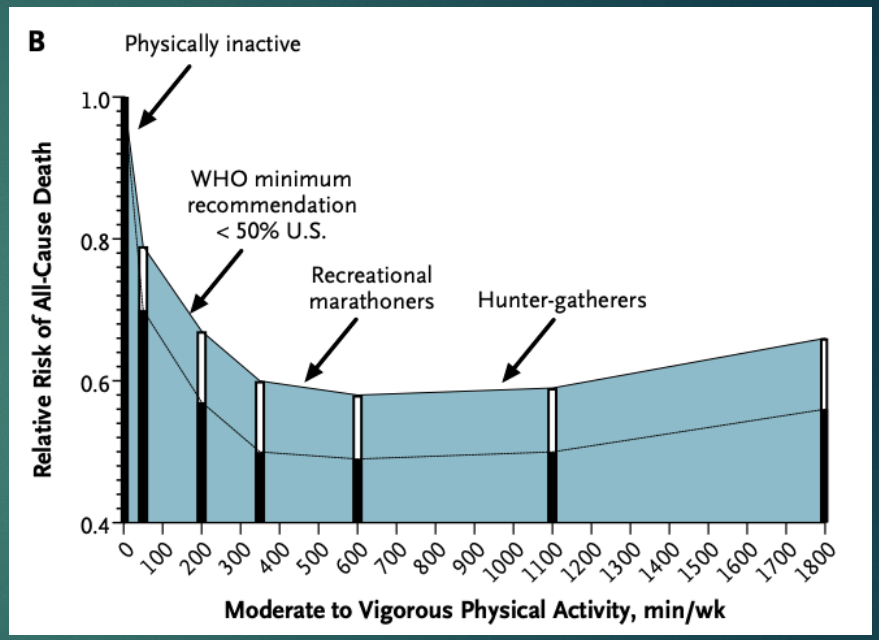


Exercise more, over a longer period of time, and make sure it counts (i.e., objective from wearable data/accelerometers = bigger benefit)

Guseh and Baggish, NEJM Evidence, 2022

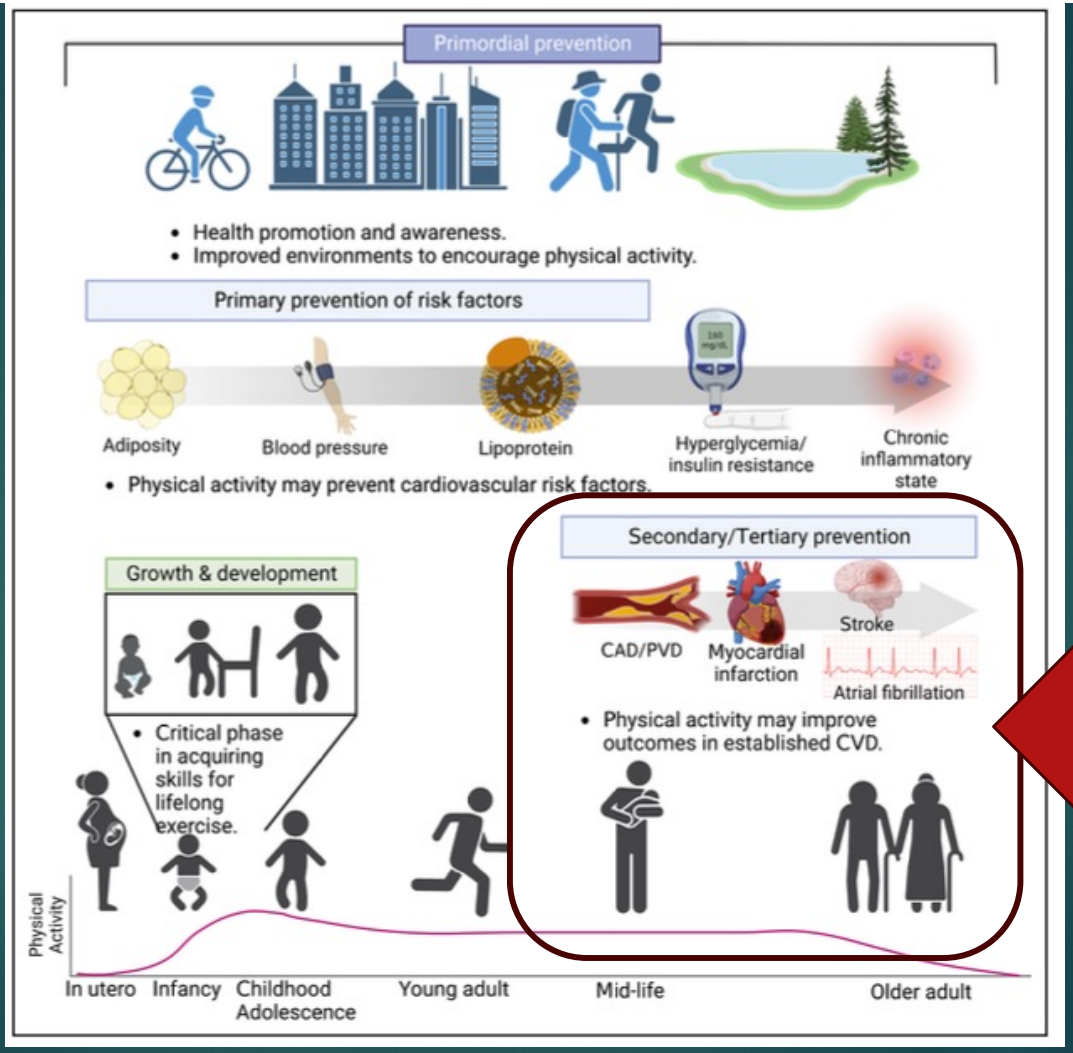
Evolution





"Physical Inactivity is a potent risk factor for disease"

Guseh and Baggish, NEJM Evidence, 2022



Perry et al , Circulation Research, 2023

Cardiac rehabilitation

"… is ***less a therapy than it is a process***; a therapeutic process to be sure, but none the less *a process rather than a simple, single intervention or procedure*"

Canadian Guidelines for Cardiac Rehabilitation and Cardiovascular Disease Prevention 3rd Edition

Cardiac rehabilitation

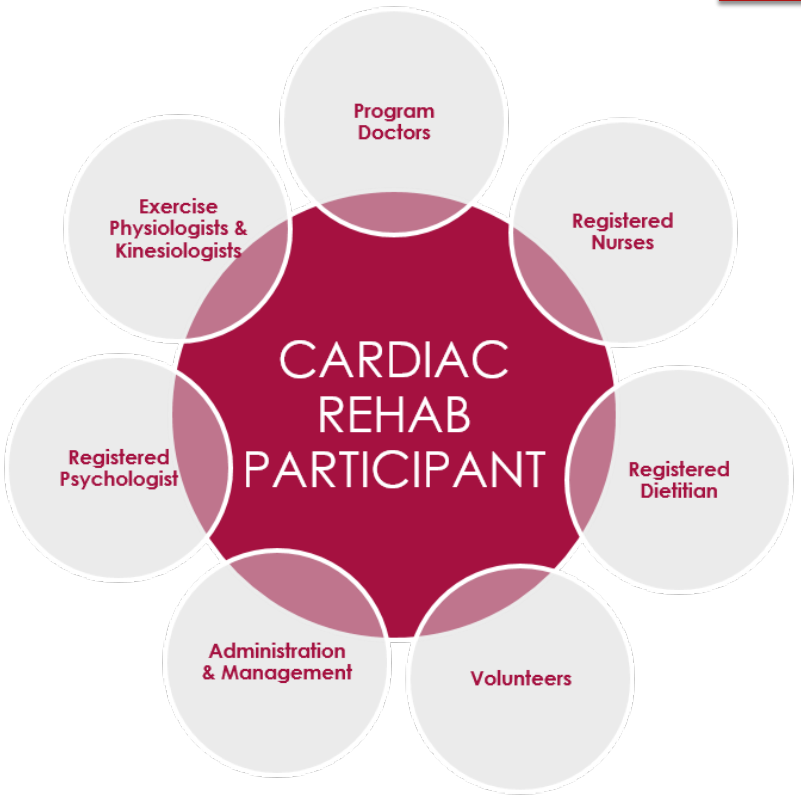
"The ***enhancement and maintenance of cardiovascular health*** through ***individualized programs*** designed to optimize physical, psychological, social, vocational, and emotional status. This process includes the facilitation and delivery of secondary prevention through risk factor identification and modification in an effort to ***prevent disease progression, and the recurrence of cardiac events***"

Canadian Guidelines for Cardiac Rehabilitation and Cardiovascular Disease Prevention 3rd Edition

Core Components/Elements

- Patient assessment
  - *Risk Stratification (i.e., GXT, risk factor assessment etc.)*
- Exercise Training
- Dietary Counseling
- Risk Factor Management
  - *Lipids, Smoking, Diabetes, Weight, etc.*
- Psychosocial Interventions

Multidisciplinary Care Team



Indications

- **Established**
  - Recent ACS (12 months)
  - Stable Angina
  - Post-CABG
  - Post-PCI
  - Post-Valve surgery
  - Post-LVAD
  - Post-Heart Transplant
  - Stable chronic HF

- **Emerging**
  - Symptomatic PAD
  - Metabolic Syndrome/Diabetes (High risk primary prevention)
  - Atrial fibrillation
  - HFpPF
  - PAH
  - SCAD
  - Congenital Heart Disease
  - Oncology patient at high-risk of cardiac disease
  - Hypertrophic Cardiomyopathy

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  - **SCAD**
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  - Oncology patient at high-risk of cardiac disease*
  - Hypertrophic Cardiomyopathy*

Historical Basis

- Prevailing dogma = strict 'Heart-rest' post ACS x 6 weeks
- Early mobilization considered malpractice
- 13.8% mortality with bed rest vs. 8.3% with "

In some cases the physician and in others the patient's family refused to accept this method of treatment. The prevailing view is that patients with cardiac disease are expected to die in bed. If fatalities occur out of bed, the physician is held culpable. It should be emphasized that

sociation

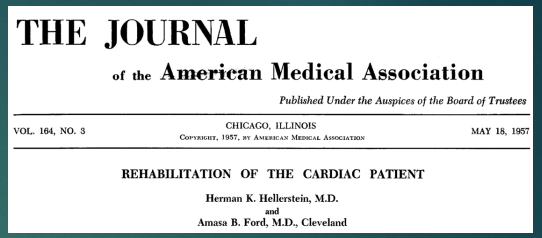
spices of the Board of Trustees

APRIL 19, 1952

Y THROMBOSIS

Rehabilitation Model

- "The practice of rehabilitation should not be below the dignity of the physician. He should derive as as much satisfaction from returning a coronary patient to competitive industry in a proper job as from making the diagnosis of monocytic leukemia or controlling a case of ventricular tachycardia"

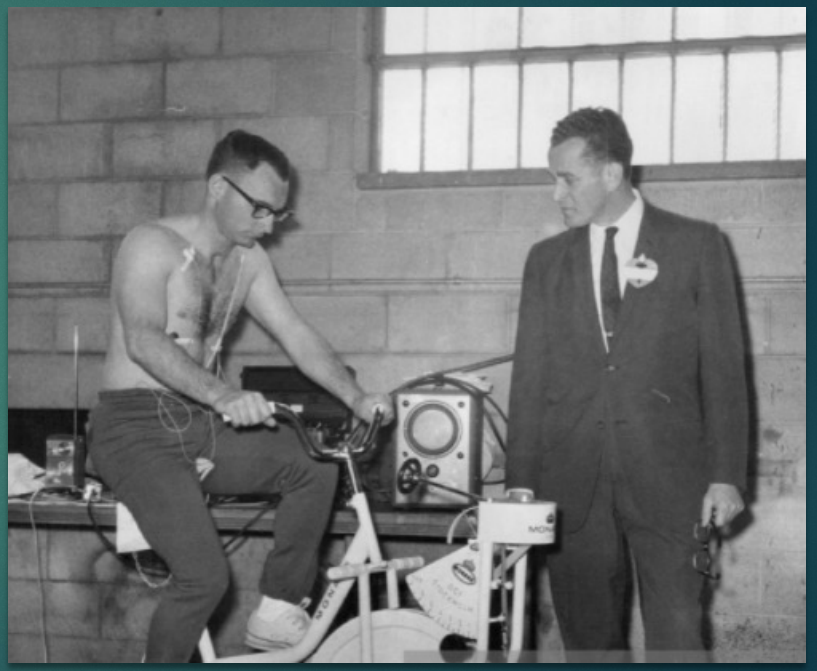


THE JOURNAL
of the American Medical Association
Published Under the Auspices of the Board of Trustees

VOL. 164, NO. 3 — CHICAGO, ILLINOIS — MAY 18, 1957

REHABILITATION OF THE CARDIAC PATIENT

Herman K. Hellerstein, M.D.
and
Amasa B. Ford, M.D., Cleveland



MI to Marathons

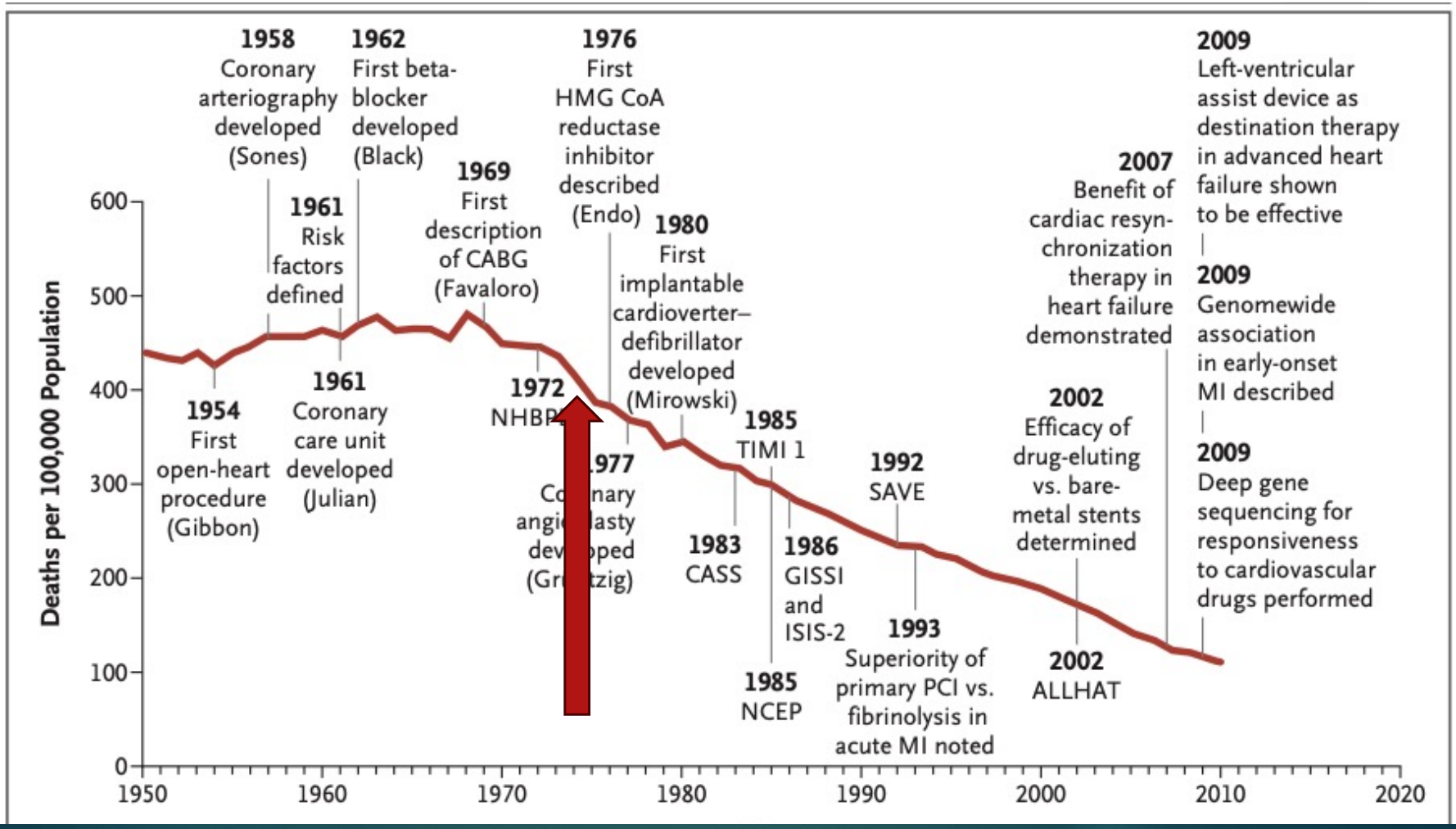
AMERICAN JOURNAL OF PHYSICAL MEDICINE
Copyright © 1973 by The Williams & Wilkins Co.
Vol. 52, No. 6
Printed in U.S.A.

SPECIAL REVIEW

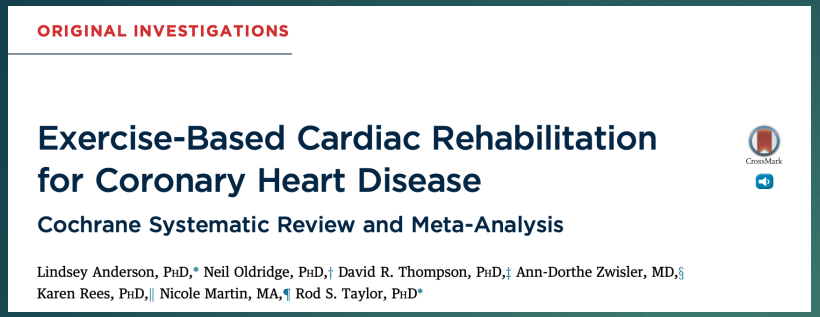
IMPORTANCE OF PHYSICAL ACTIVITY IN POST-CORONARY REHABILITATION[1]

T. KAVANAGH, M.D., D. PHYS. MED. (LONDON),[2] AND
R. J. SHEPHARD, M.D., PH.D.

problems. A few of our patients were taking Beta adrenergic blocking agents such as propranolol: ideally such patients should be excluded from a definitive trial, together with those receiving either post-ganglionic blocking agents or cardiac glycosides, since it is almost impossible to interpret the results of an exercise test when such drugs have been given. Nevertheless, such exclusions

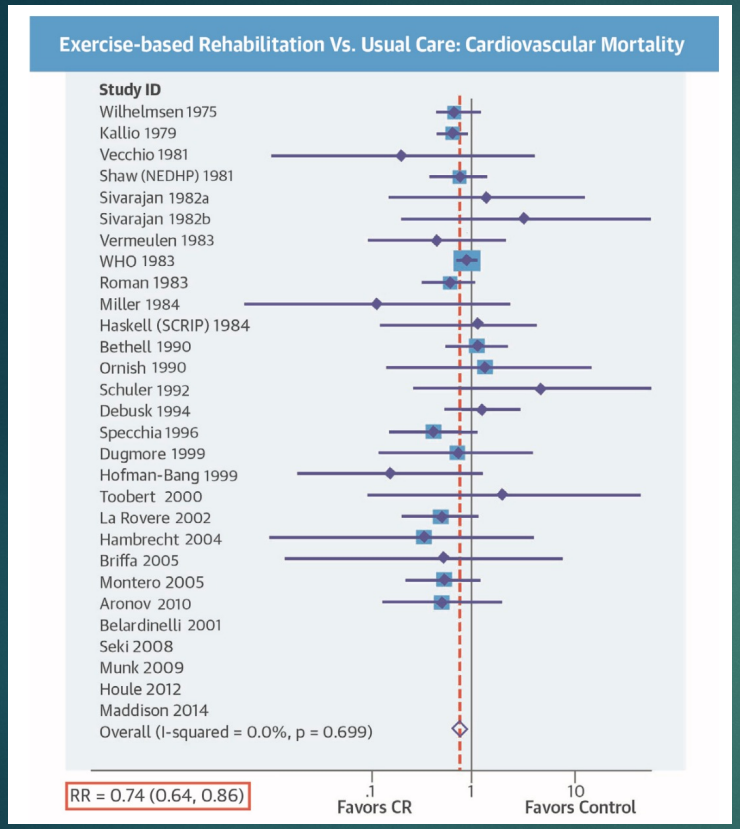


Nabel and Braunwald, N Engl J Med 2012;366:54-63

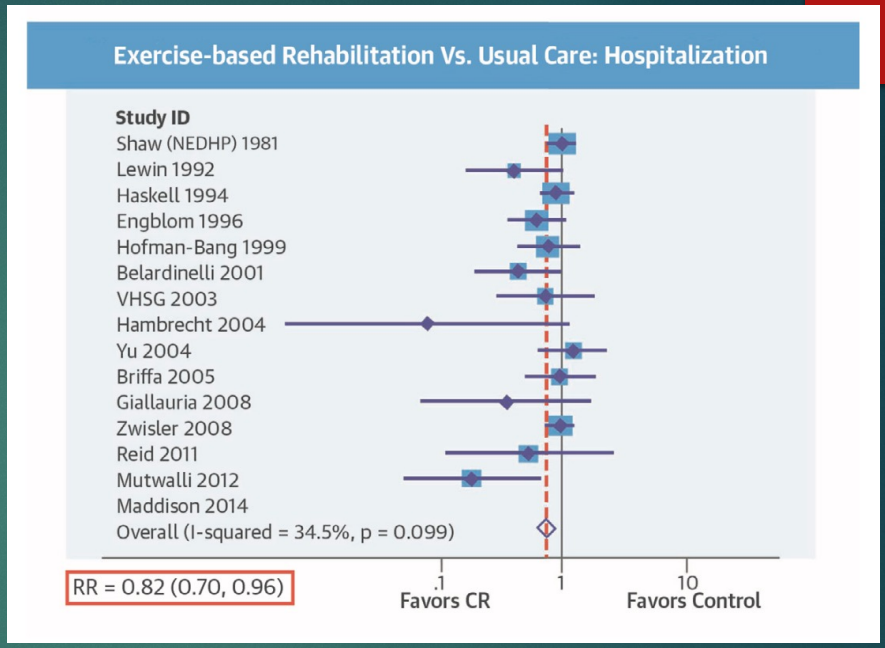


Cochrane

- Meta-analysis of 63 RCTs, 14,486 patients
- Outcomes: Total Mortality, CV Mortality, Morbidity, HRQOL, Cost-effectiveness
- RCTs comparing exercise-based vs. control with at least 6 months of follow-up.


Exercise-based Rehabilitation Vs. Usual Care: Cardiovascular Mortality
Study ID
Wilhelmsen 1975
Kallio 1979
Vecchio 1981
Shaw (NEDHP) 1981
Sivarajan 1982a
Sivarajan 1982b
Vermeulen 1983
WHO 1983
Roman 1983
Miller 1984
Haskell (SCRIP) 1984
Bethell 1990
Ornish 1990
Schuler 1992
Debusk 1994
Specchia 1996
Dugmore 1999
Hofman-Bang 1999
Toobert 2000
La Rovere 2002
Hambrecht 2004
Briffa 2005
Montero 2005
Aronov 2010
Belardinelli 2001
Seki 2008
Munk 2009
Houle 2012
Maddison 2014
Overall (I-squared = 0.0%, p = 0.699)
RR = 0.74 (0.64, 0.86)
.1
1
10
Favors CR
Favors Control

NNT = 37


Exercise-based Rehabilitation Vs. Usual Care: Hospitalization
Study ID
Shaw (NEDHP) 1981
Lewin 1992
Haskell 1994
Engblom 1996
Hofman-Bang 1999
Belardinelli 2001
VHSG 2003
Hambrecht 2004
Yu 2004
Briffa 2005
Giallauria 2008
Zwisler 2008
Reid 2011
Mutwalli 2012
Maddison 2014
Overall (I-squared = 34.5%, p = 0.099)
RR = 0.82 (0.70, 0.96)
.1
1
10
Favors CR
Favors Control

NNT = 22

Traditional Cardiac Rehab

- **3 phases**
  - Phase 1 = inpatient programs
    - *More historical (No current Phase 1 programs in BC)
  - Phase 2 = physician-supervised outpatient programs post-discharge (3-6months)
  - Phase 3 = non-ECG monitored maintenance programs
    - Can be at same facility as phase 2 or any other facility

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  - **Phase 2 = physician-supervised outpatient programs post-discharge (3-6 months)**
  - Phase 3 = non-ECG monitored maintenance programs
    - Can be at same facility as phase 2 or any other facility

Patient Journey: VGH Patients

- Referral received
- Triaged
- Placed on waitlist (guidelines recommend <30 days)
- Intake Appointments and Testing
  - Case manager assessment (RN/Exercise physiologist)
  - Exercise Stress Test, repeat bloodwork
  - MD assessment
    - Risk Factor modification - medication titration/initiation

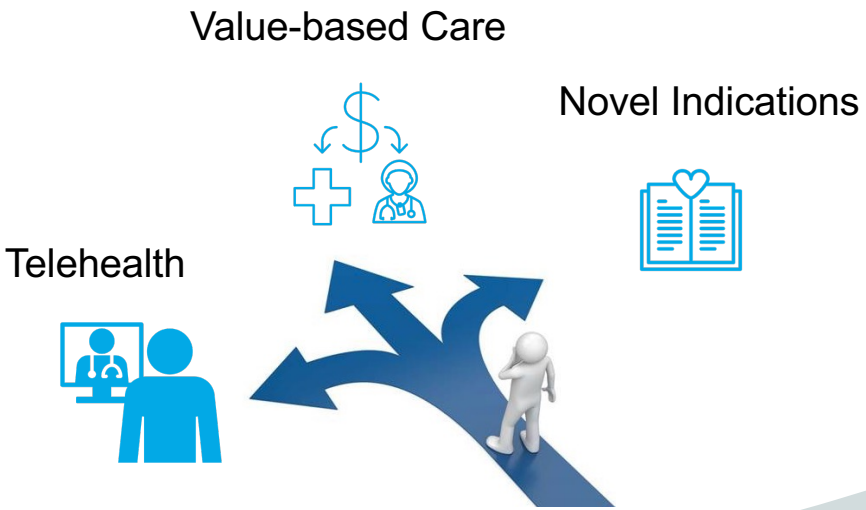
Patient Journey: VGH Patients

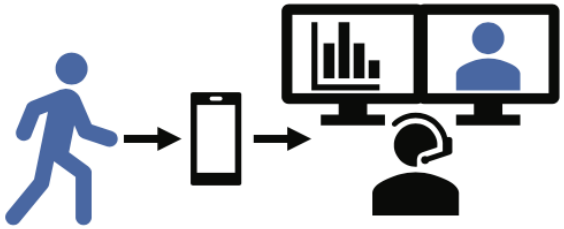
- Enrolled patients:
  - 6-month duration
  - Weekly exercise classes (24 monitored in total)
  - Education sessions
  - Dietician assessment and follow-up
  - Psychologist/psychiatrist assessment (if indicated)
  - Regular follow-up with case manager
  - MD assessment PRN
- Exit assessment:
  - Repeat bloodwork
  - MD evaluation (standard or PRN)
    - Review risk factor targets/thresholds – titrate/initiate medical therapy

Definition update

"Going forward, rather than a clearly defined intervention with 3 or 4 distinct phases, CR needs to evolve to maintain its status as a *value-based service that coordinates care across a wide continuum of secondary disease prevention*"

AACVPR Guidelines for Cardiac Rehabilitation Programs 6th Ed. 2020



Synchronous/In-Person 	CR patients and clinicians are in the same location at the same time. CR clinicians directly observe patient exercise. This includes center-based CR and may include locations such as community centers.
Synchronous/Real-time Audio-visual (Virtual) 	CR patients and clinicians are in different locations and engaging in real-time two-way audio-visual communication. CR clinicians observe patient exercise in real-time over video.
Asynchronous (Remote) 	Exercise occurs at times other than when staff and patients are communicating. Patients communicate logged data, such as exercise and/or vital signs, to CR clinicians over the phone or through digital devices. Patients and CR clinicians may also have periodic in-person, video, or telephone encounters.

Beatty et al. Circ Outcomes, 2021

THE CURRENT STATE OF CARDIAC REHABILITATION IN B.C. AND THE YUKON: SUMMARY REPORT

December 20, 2023

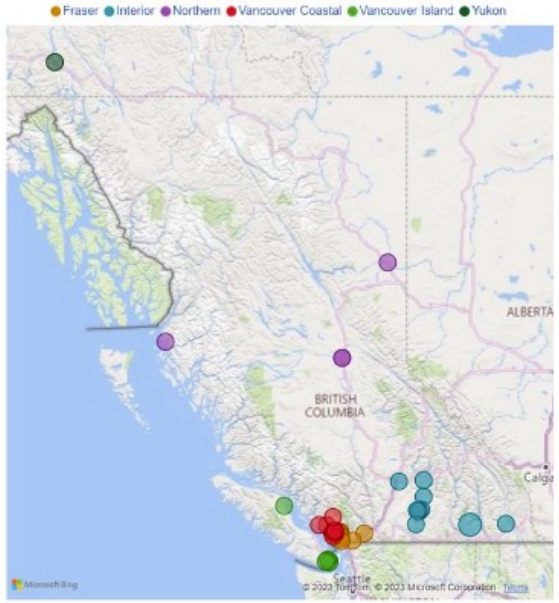


Figure 2. Map of CR services in B.C. and the Yukon.

An estimated 4000 patients/year in BC who meet guideline indications for Cardiac Rehabilitation Services do not receive it

Cardiac Services BC
Provincial Health Services Authority

Northern Health Core Components

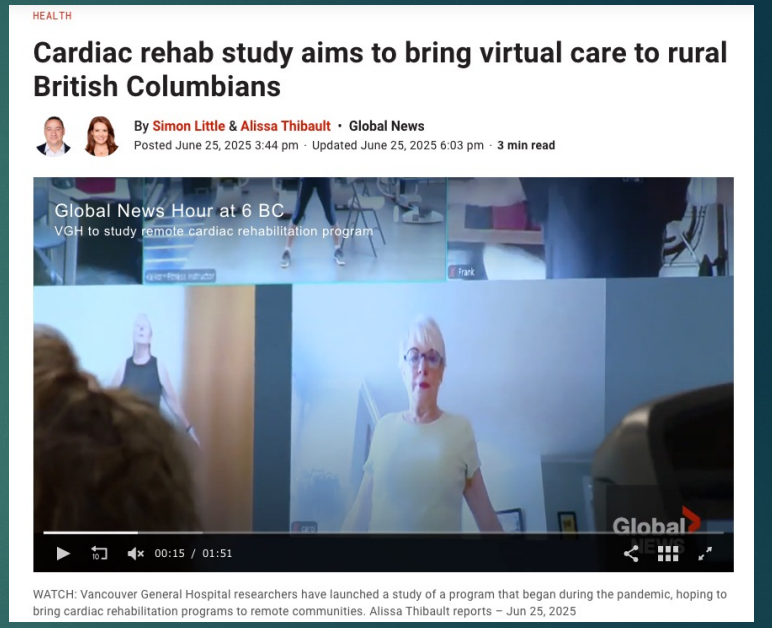
CR Program/City	Medical Assessment/Risk Stratification	Interprofessional Health Care Team	Exercise with Individualized Exercise Prescription	Heart Disease & Risk Factor Education	Behavioral Modification Strategies	Nutritional Counselling
NORTH Heart Function Clinic Cardiac Risk Reduction Education, Prince George			✓	✓		
Prince George Cardiac and Pulmonary Rehab Program, Prince George			✓	✓	✓	
Chronic Disease Management, Fort St John	✓	✓	✓	✓	✓	✓
Prince Rupert Health Promotions, Prince Rupert				✓		✓

VCR-Rural Project

Pilot project/study of Virtually Delivered Cardiac Rehab

Eligible patients:

- Guideline indication for CR
- Care received at VGH (in-patient or out-patient)
- Reside within Northern Health or Vancouver Coastal
- No access to in-person/local CR programs



PI: Dr. Nate Moulson

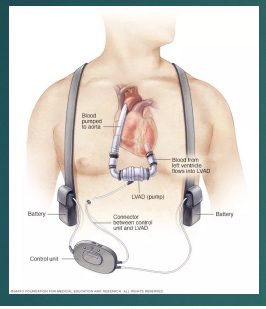
Project lead: Linda Sung

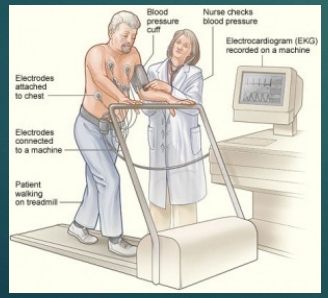
https://www.vchri.ca/research-study/exploring-virtual-rehabilitation-heart-health

Spectrum of exercise and CVD

End-stage/Severe CVD

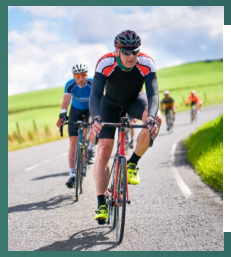
Supervised Cardiac Rehab

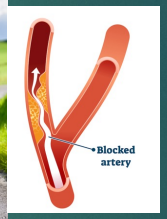




Exerciser with mild HF

Masters Athlete with CAD



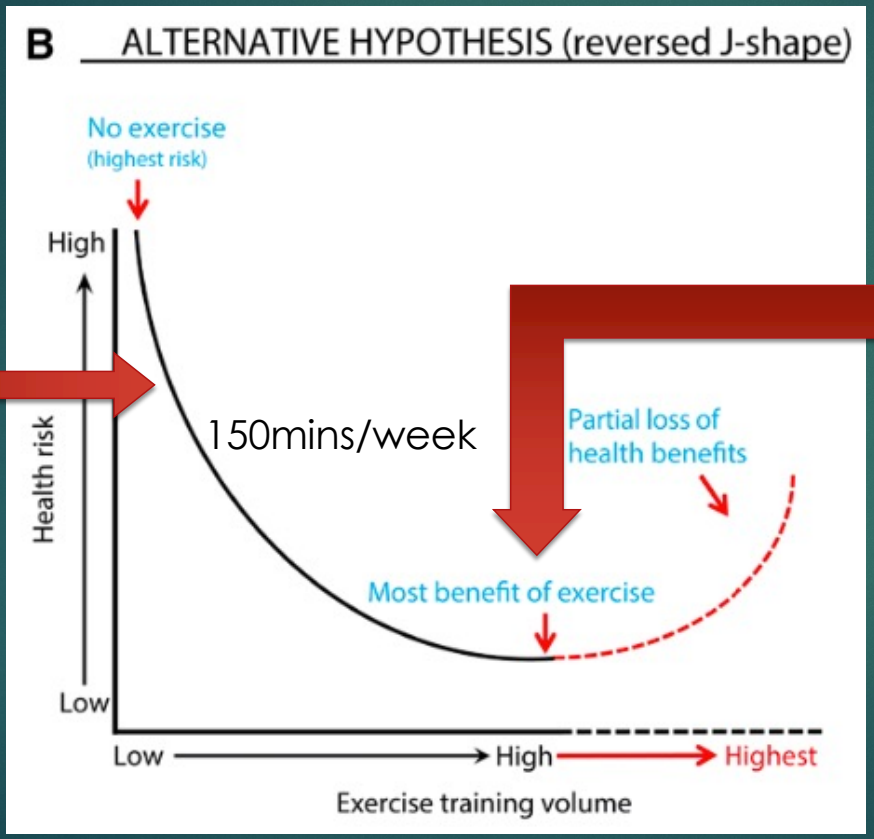


High Level Athletes with Cardiac Disease

Exercise and CVD

Exercise as Medicine

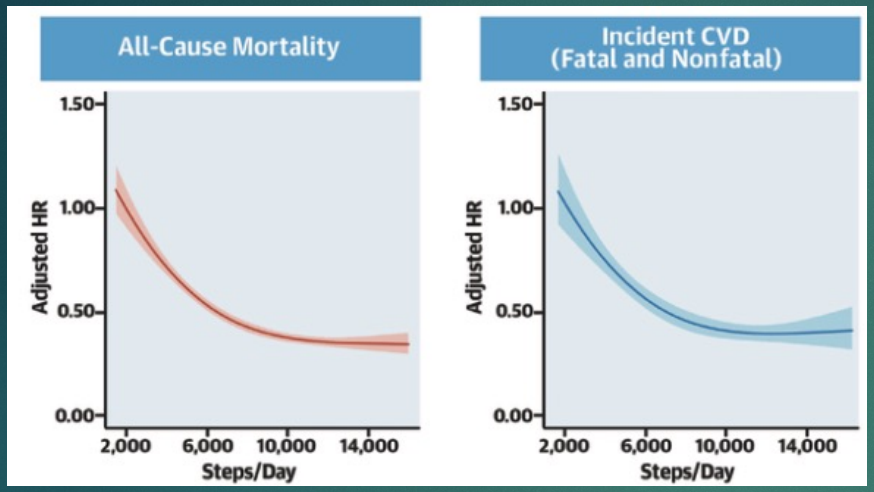
Most patients



Maximal benefit = Volumes 3-4x's current guideline minimum (450-600 mins/week OR 7.5-10 hrs/week)

Eijvogels et al, Curr Treat Options Cardio Med, 2018;20(84)

Step-Counts and CV outcomes



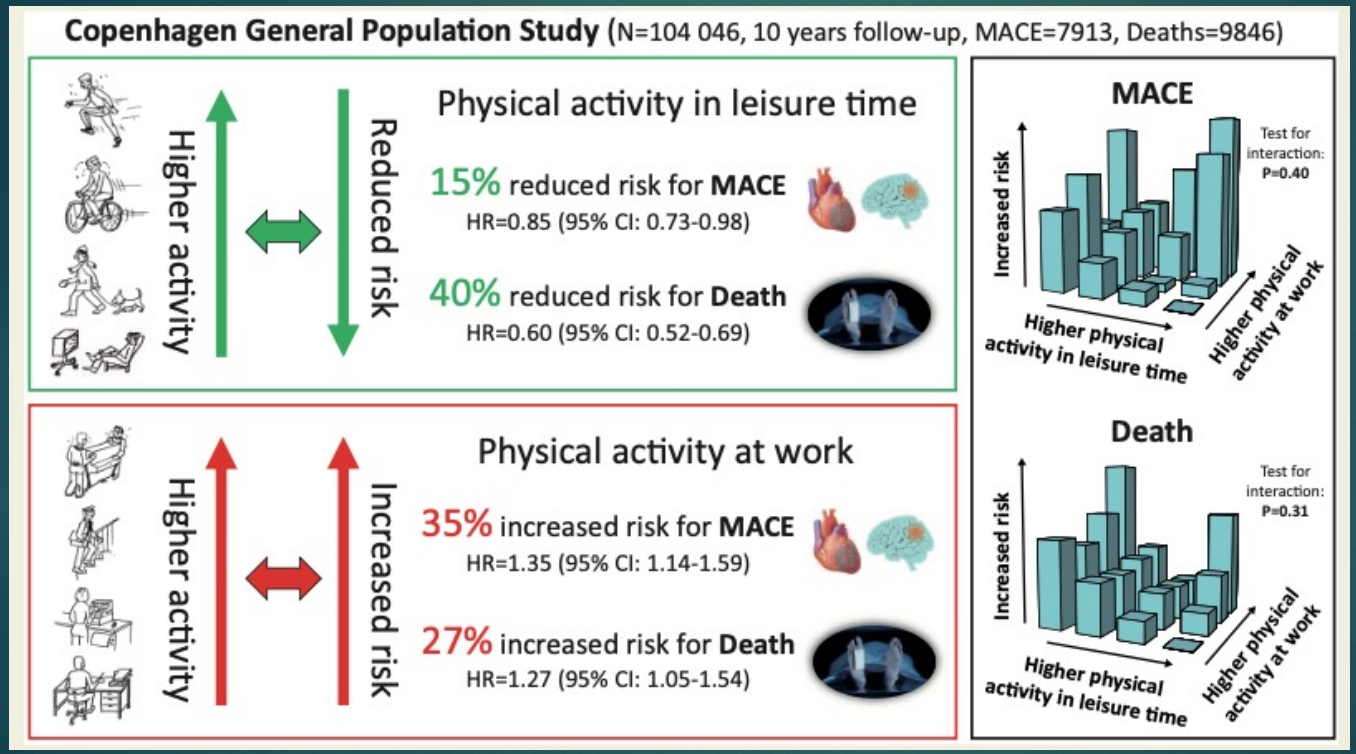
"Optimal dose" = ~9000

	Steps/day	Adjusted HR (95% CI)
Minimum dose	2,517	0.92 (0.84-0.99)
Optimum dose	8,763	0.40 (0.38-0.43)
Risk reduction at 16,000 steps	16,000	0.35 (0.30-0.40)

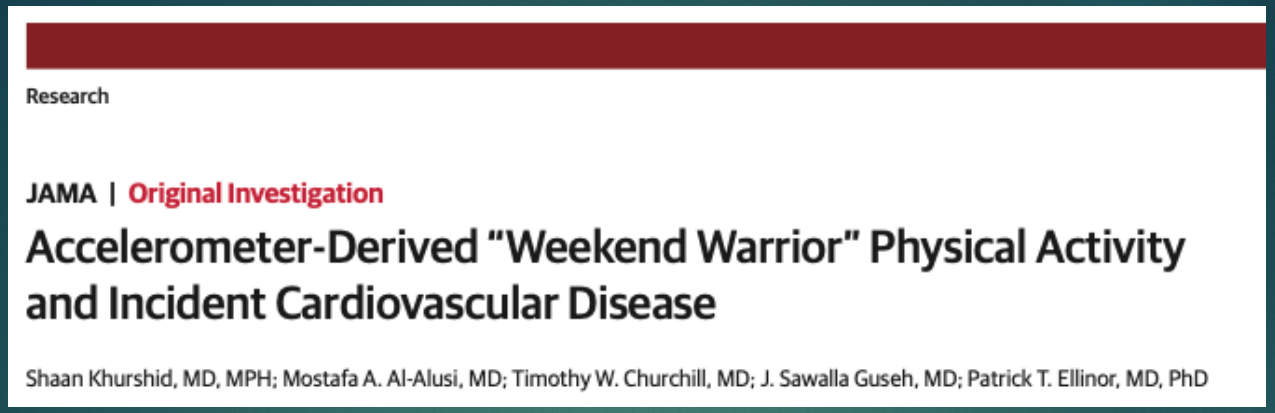
	Steps/day	Adjusted HR (95% CI)
Minimum dose	2,735	0.89 (0.79-0.99)
Optimum dose	7,126	0.49 (0.45-0.55)
Risk reduction at 16,000 steps	16,000	0.42 (0.33-0.53)

Stens et al, JACC, 2023

Occupational Physical Activity



Holtermann et al, EHJ, 2021



Research

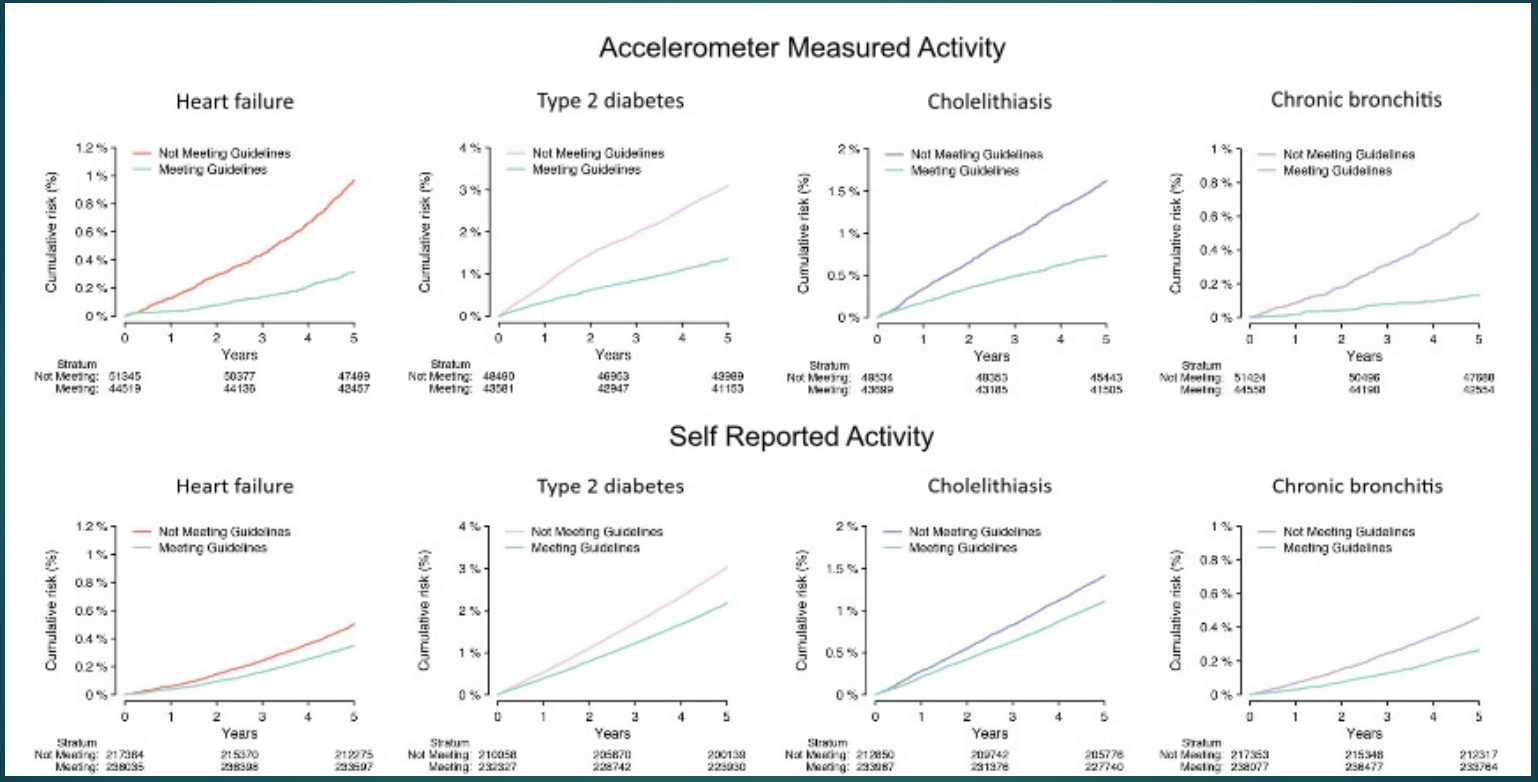
JAMA | Original Investigation

Accelerometer-Derived "Weekend Warrior" Physical Activity and Incident Cardiovascular Disease

Shaan Khurshid, MD, MPH; Mostafa A. Al-Alusi, MD; Timothy W. Churchill, MD; J. Sawalla Guseh, MD; Patrick T. Ellinor, MD, PhD

- In individuals obtaining 150mins or greater per week of moderate to vigorous exercise/physical activity there was no difference between those concentrating this into 1-2 days versus those spreading their exercise across the week

Accelerometer vs. Self Reported



Khurshid et al, npj digital medicine, 2022

Practical Considerations

- "Something is always better than nothing"
  - Standing is better than sitting
- "10,000" steps per has something to it
- Occupational physical activity doesn't count
- Weekend warrior pattern okay
- Track it with wearables if possible
  - "Medicine works only if you take it"

Sports Cardiology

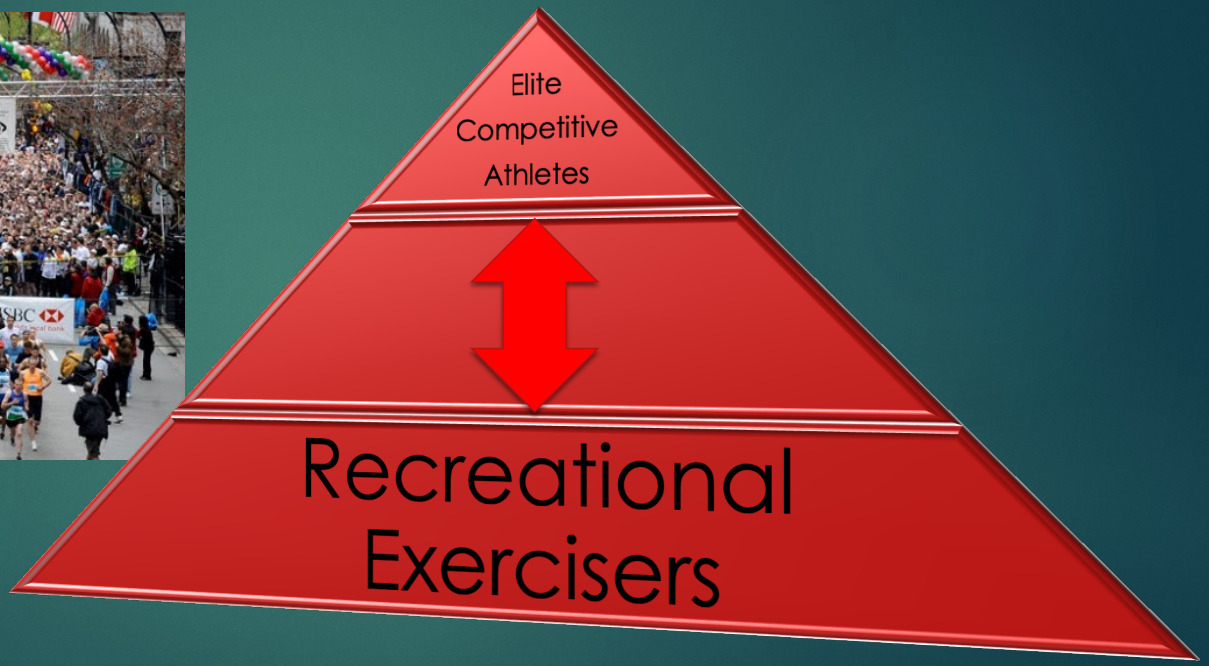
Subspeciality of Cardiology focused on the care of athletic individuals across the spectrum of performance and age

What/who is an athlete?

Definitions

1. Athlete (Competitive?) vs. Exerciser = Intent of exercise
2. Young (≤35) vs. ~~Old~~ Masters (>35)
3. Moderate vs. Vigorous
   - Moderate = 40-59% of functional capacity (VO2max or HRR)
     - 3-5.9 METS (*Brisk walking, light cycling*)
   - Vigorous = ≥60% of functional capacity (VO2max or HRR)
     - ≥6 METS (*Jogging, running, moderate cycling*)
   - **Below and above the anaerobic/lactate threshold → fitness dependent*

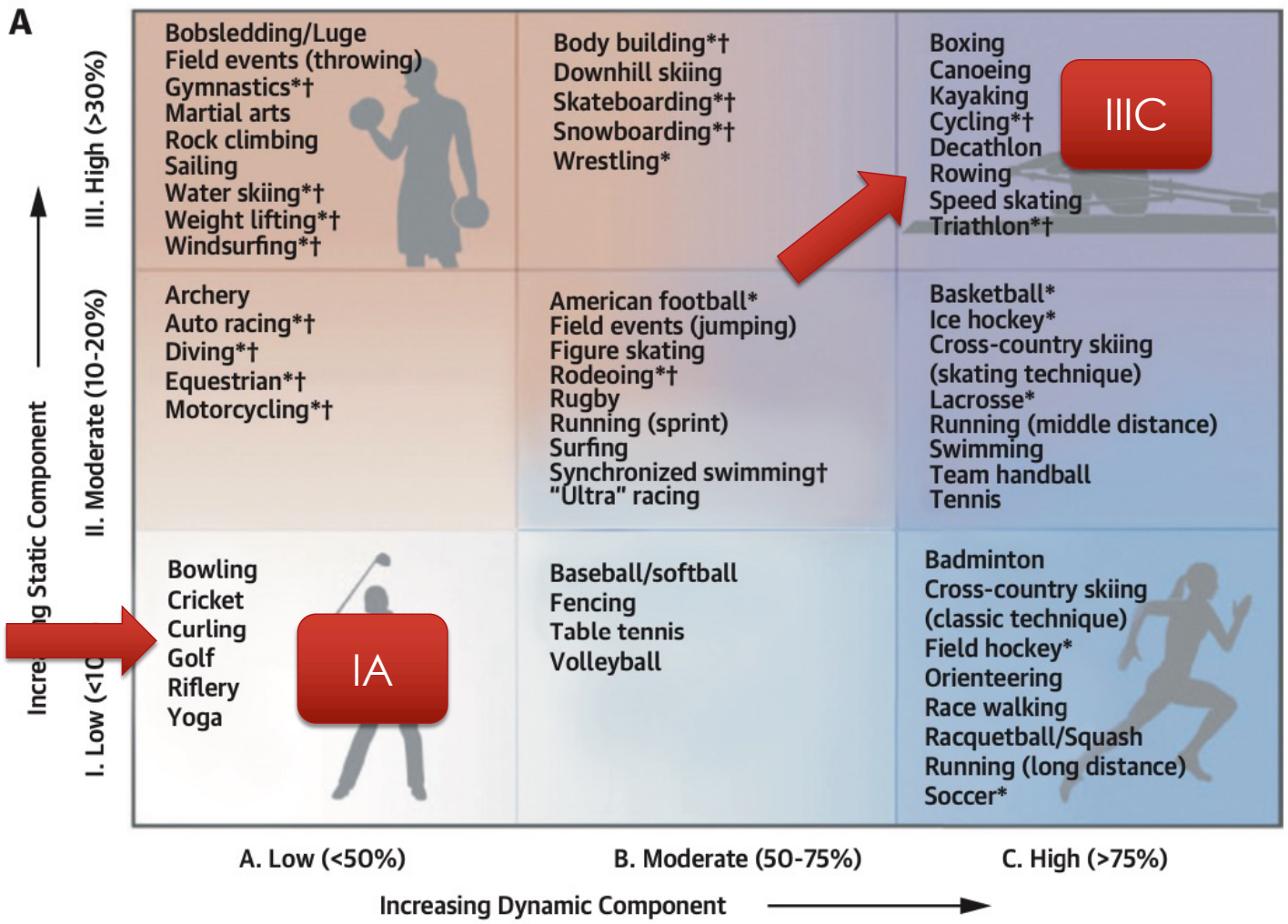
Exercisers vs. athletes?

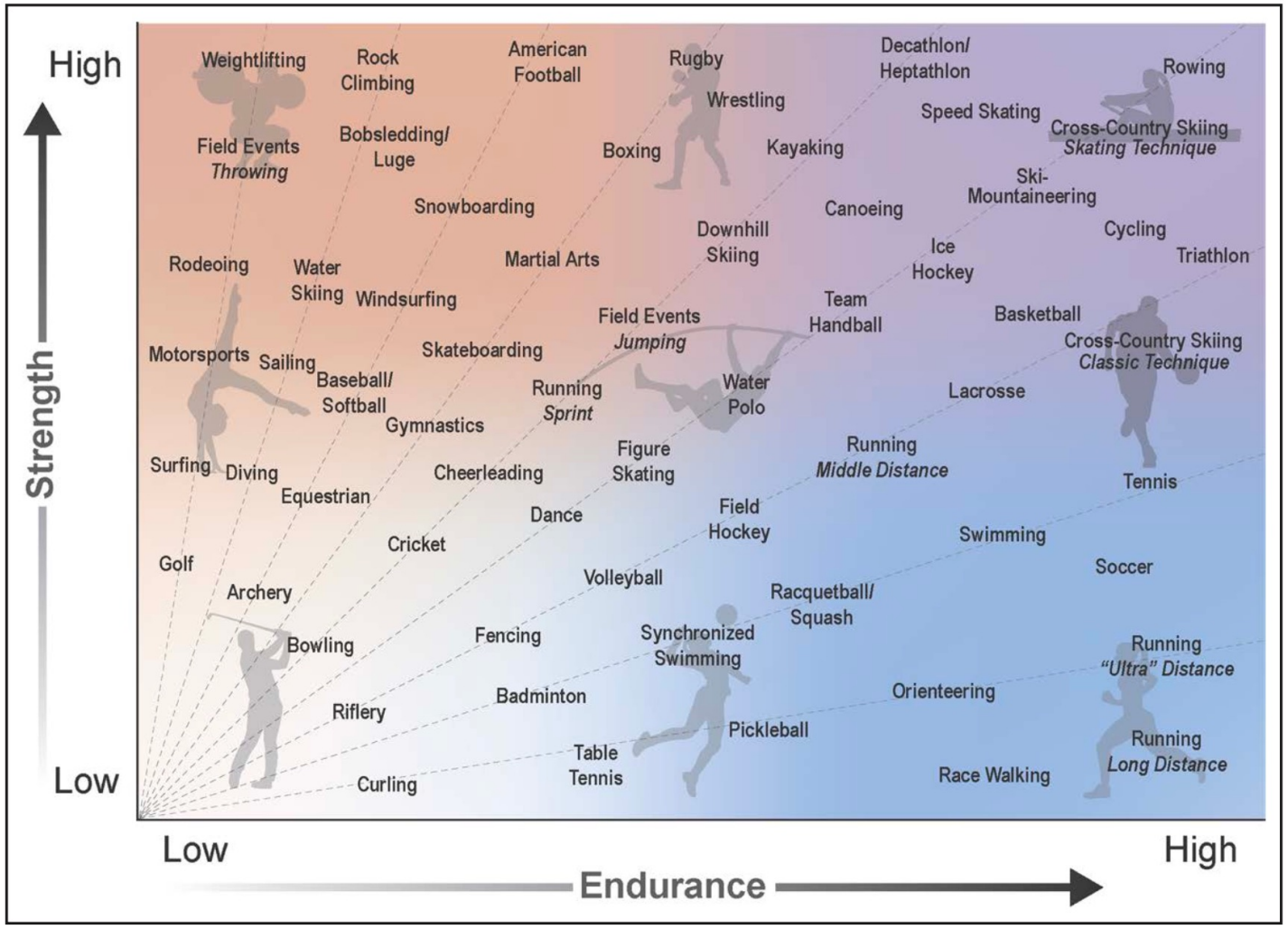


Dose and Dimensions

- Dimensions
  - Mode/Type of activity
  - Frequency
  - Duration
  - Intensity
- "Dose"
  - Intensity, duration and frequency
  - MET-Minutes/Week or MET-Hours/Week

Strath et al, Circulation, 2013;128:2259-2279


A
III. High (>30%)
II. Moderate (10-20%)
I. Low (<10
Increasing Static Component
Bobsledding/Luge
Field events (throwing)
Gymnastics*†
Martial arts
Rock climbing
Sailing
Water skiing*†
Weight lifting*†
Windsurfing*†
Body building*†
Downhill skiing
Skateboarding*†
Snowboarding*†
Wrestling*
Boxing
Canoeing
Kayaking
Cycling*†
Decathlon
Rowing
Speed skating
Triathlon*†
IIIC
Archery
Auto racing*†
Diving*†
Equestrian*†
Motorcycling*†
American football*
Field events (jumping)
Figure skating
Rodeoing*†
Rugby
Running (sprint)
Surfing
Synchronized swimming†
"Ultra" racing
Basketball*
Ice hockey*
Cross-country skiing
(skating technique)
Lacrosse*
Running (middle distance)
Swimming
Team handball
Tennis
Bowling
Cricket
Curling
Golf
Riflery
Yoga
IA
Baseball/softball
Fencing
Table tennis
Volleyball
Badminton
Cross-country skiing
(classic technique)
Field hockey*
Orienteering
Race walking
Racquetball/Squash
Running (long distance)
Soccer*
A. Low (<50%)
B. Moderate (50-75%)
C. High (>75%)
Increasing Dynamic Component



Kim et al, Circulation, 2025

Atherosclerotic CAD

- Long-standing chronic coronary syndrome (stable CAD)

Recommendations for exercise in individuals with long-standing chronic coronary syndrome

Recommendations	Class[a]	Level[b]
Risk stratification for exercise-induced adverse events is recommended in individuals with established (long-standing) chronic coronary syndrome (CCS) prior to engaging in exercise.[233]	I	C
Regular follow-up and risk stratification of patients with CCS is recommended.[233]	I	B
It is recommended that individuals at high risk of an adverse event from CAD are managed according to the current Guidelines on CCS.[233]	I	C
Competitive or leisure sports activities (with some exceptions such as older athletes and sports with extreme CV demands) should be considered in individuals at low risk of exercise-induced adverse events (*Table 11*).[233]	IIa	C
Leisure-time exercise, below the angina and ischaemic thresholds, may be considered in individuals at high risk of exercise-induced adverse events (*Table 11*), including those with persisting ischaemia.[233]	IIb	C
Competitive sports are not recommended in individuals at high risk of exercise-induced adverse events or those with residual ischaemia, with the exception of individually recommended skill sports.[233]	III	C

Pelliccia et al, EHJ, 2020

Atherosclerotic CAD

- Post-ACS or coronary revascularization procedure
- Avoidance of competitive sport or vigorous intensity exercise for at least 3 months post event (up to 12 months)

Table 11 High-risk features for exercise-induced adverse cardiac events in patients with atherosclerotic coronary artery disease[233]

- Critical coronary stenosis, >70% in a major coronary artery or >50% in the left main stem on coronary angiography, and/or FFR <0.8 and/or iFR <0.9
- Basal left ventricular ejection fraction ≤50% and wall motion abnormalities
- Inducible myocardial ischaemia on maximal exercise testing
- NSVT, polymorphic or very frequent ventricular premature beats, at rest and during maximal stress
- Recent ACS ± PCI or surgical revascularization (<12 months)

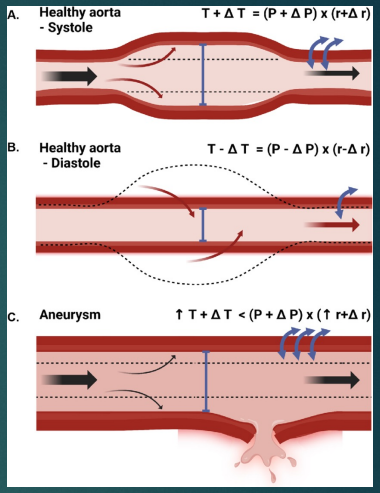
ACS = acute coronary syndrome; FFR = fractional flow reserve; iFR = instant flow reserve; NSVT = non-sustained ventricular tachycardia; PCI = percutaneous coronary intervention.

Ischemic Threshold in CAD

- **Anginal threshold**: threshold (HR) at which typical angina begins to occur
- **Ischemic threshold**: threshold (HR) at which 'ischemia occurs' (defined as angina and/or ischemia on ETT)
- **Prevailing recommendations**: Exercise should be prescribed/limited to 10bpm below the anginal/ischemic threshold (poor quality evidence)

Aortic Disease and Exercise

- Laplace Law
  - Tension = Pressure x diameter/wall thickness
- Increased Tension = Increased Risk of dissection/rupture
- Systolic BP in Weight-Lifters can exceed 400 mmHg



Aortic Diseases AHA/ACC Recommendations

Table 10. Clinical Considerations for Competitive Athletes With Aortopathy, Bicuspid Aortic Valve, or Spontaneous Coronary Artery Dissection

Approach to the athlete with thoracic aortic dilation or disease
General considerations
A comprehensive tomographic imaging evaluation of the entire thoracic aorta (and branch vessels, as indicated in certain HTAD) should be performed at least once in the evaluation of competitive athletes with thoracic aortic disease to assess for all sites of dilation as well as to screen for associated conditions (ie, coarctation of the aorta, branch vessel disease).
Clinical decision-making for competitive athletes with thoracic aortic disease should incorporate careful aortic measurements using standardized, guideline-recommended imaging techniques and normative values.
When comparing aortic measurements over time, images should be compared side by side rather than relying on previous imaging reports.
After initial diagnosis, the imaging follow-up intervals should be individualized to the specific aortic condition and the degree of aortic dilation. An initial 6- to 12-mo interval is recommended per established guidelines, with subsequent follow-up based on aortic size, underlying diagnosis, clinical features, and stability over time.
Multigenerational family history and genetic evaluation should be performed to evaluate for HTAD, which may influence risk stratification and management in competitive athletes with unexplained thoracic aortic dilation and any one of the following: • Aortic dilation with *z* score ≥ 3 • Family history of thoracic aortic disease or dissection, cerebral or peripheral aneurysm, or unexplained sudden death at a relatively young age • Other clinical features suggesting a heritable connective tissue disorder or other genetic pathogenesis
Unexplained aortic dilation is defined by a *z* score ≥3 and comprehensive multigenerational family history, imaging screening of parents, and genetic evaluation yields no substantial findings. However, competitive athletes with overt features of a connective tissue disorder may harbor a de novo genetic variant, and further evaluation with expert consultation should be considered.

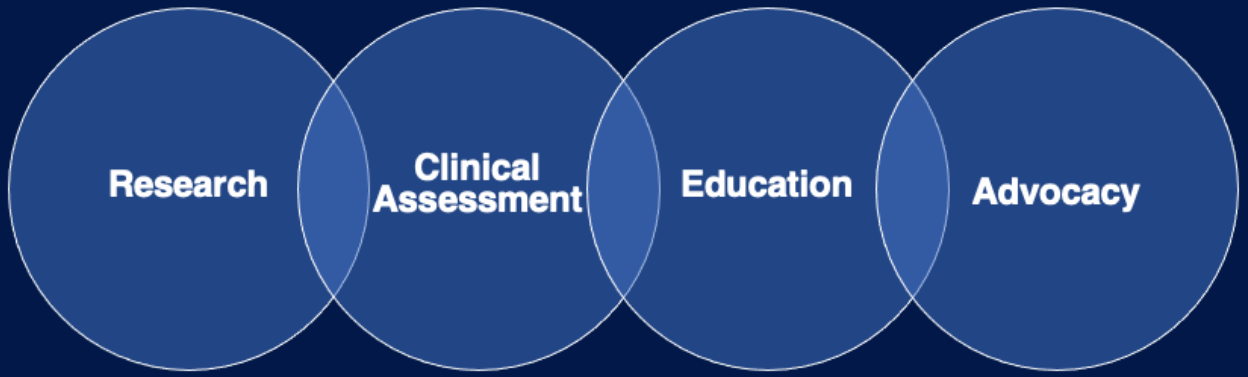
Unexplained dilation without a known familial heritable a
Specific cli ons
Competitive athletes with a tricuspid aortic valve and unexpla racic aortic dilation ≤42 mm can generally participate in com sports. Risk stratification should consider the degree of dila to body size.
Competitive sports participation for competitive athl mild to moderate thoracic aortic dilation (≥43–4 d with SDM, consultation with experts in aortic i- ogy, and longitudinal clinical surveillance.
The risks may outweigh the benefits of rticipation for competitive athletes with unexplained thoracic aortic dilation (≥45 mm). Competitive sport be considered in select cases with SDM, consultat n aortic disease or sports cardiology, and longitudinal ce.
Competitive athletes with unexplained ic dilation meeting surgical thresholds should not participate in competitive sports until surgical intervention (see Surgical repair, below).

After aortic dissection and after surgical repair
Competitive sports participation for competitive athletes with BAV and aortopathy who have undergone ascending thoracic aortic aneurysm repair is reasonable after complete sternal healing and with SDM, consultation with experts in aortic disease or sports cardiology, and longitudinal clinical surveillance.
With the exception of lower-intensity strength and endurance sports (see Section I, Figure 1), competitive athletes with HTAD who have undergone aortic aneurysm repair should not participate in competitive sports.
The risks of competitive sports participation are uncertain for competitive athletes who have undergone aneurysm resection for unexplained thoracic aortic dilatation. Competitive sports participation can be considered in select cases after complete sternal healing and with SDM, consultation with experts in aortic disease or sports cardiology, and longitudinal clinical surveillance.

Summary

1. Exercise is recommended for essentially all patients with CVD, but may require expert guidance
2. Cardiac Rehabilitation remains a guideline-based intervention for secondary prevention and high-risk primary prevention patients
3. Sports Cardiology is the subspecialty of Cardiology focused on the care of athletic individuals with CVD across the spectrum of performance and age

SPORTSCARDIOLOGYBC



Our center plays a leading role in sports cardiology research and determining best practices for clinically treating athletes, pre-participation evaluation of athletes and optimal training doses and methodology

Our goal is to assess and evaluate athletes to ensure optimal and safe participation in athletics and exercise

SCBC provides public education on safe participation in athletics through the dissemination of results from research investigation, the interpretation of clinical case studies and educational seminars.

SCBC educates the public on importance of CV health and how to prevent tragic CV events. These seminars include lunch and learn seminars, certification programs and CPR and AED training

Questions

"Those who think they have no time for bodily exercise will sooner or later have to find time for illness"

Earl of Derby

Exercise Prescription

ESC European Society of Cardiology

European Journal of Preventive Cardiology (2022) **29**, 230–245
doi:10.1093/eurjpc/zwab007

POSITION PAPER
Cardiac Rehabilitation

Exercise intensity assessment and prescription in cardiovascular rehabilitation and beyond: why and how: a position statement from the Secondary Prevention and Rehabilitation Section of the European Association of Preventive Cardiology

Dominique Hansen[1,2]*, Ana Abreu[3], Marco Ambrosetti [4], Veronique Cornelissen[5], Andreas Gevaert[6,7], Hareld Kemps[8,10], Jari A. Laukkanen[11,12], Roberto Pedretti[13], Maria Simonenko [14], and Matthias Wilhelm[15] Reviewers: Constantinos H. Davos [16], Wolfram Doehner[17,19], Marie-Christine Iliou[18], Nicolle Kränkel[19,20], Heinz Völler[21,22], and Massimo Piepoli[23]

Exercise Intensity

Table 2 **Classification of aerobic exercise intensity**[17]

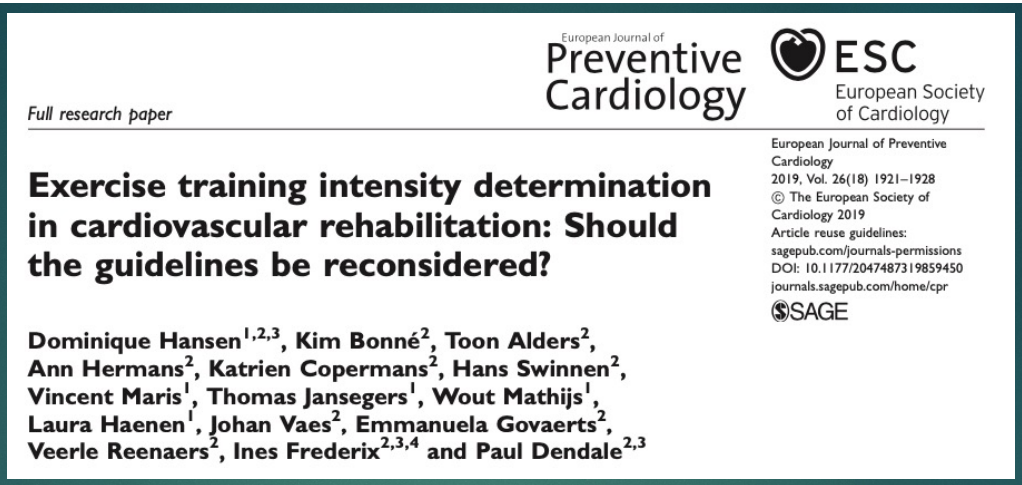
Intensity	VO_2max (%)	HRmax (%)	HRR (%)	RPE scale	Training zone
Low intensity, light exercise	<40	<55	<40	10–11	Aerobic
Moderate intensity exercise	40–69	55–74	40–69	12–13	Aerobic
High intensity	70–85	75–90	70–85	14–16	Aerobic + lactate
Very high intense exercise	>85	>90	>85	17–19	Aerobic + lactate + anaerobic

Reproduced with permission from reference.[17]

HR_{max}, maximal heart rate; HRR, heart rate reserve; RPE, ratings of perceived exertion; VO_{2peak}, peak oxygen uptake.

Karvonen Formula

- Based on the assumption HR and VO2 consumption are linear
- Training Heart Rate
  - Max Heart Rate Obtained on ETT
  - Desired Heart Rate Reserve Training zone
  - Lower end HR = Resting HR + (XX% [Max HR - Resting HR)
  - Upper end HR = Resting HR + (XX% [Max HR - Resting HR)



Full research paper

European Journal of Preventive Cardiology

ESC European Society of Cardiology

Exercise training intensity determination in cardiovascular rehabilitation: Should the guidelines be reconsidered?

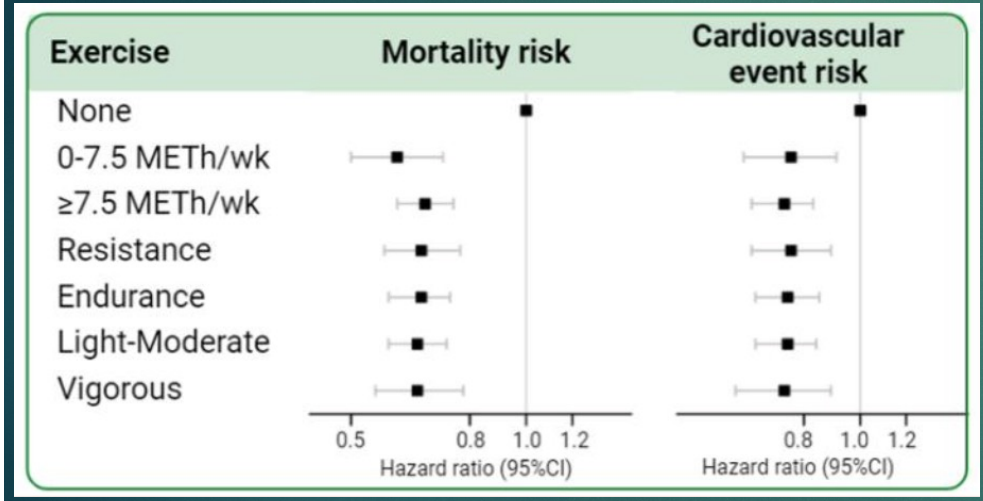
Dominique Hansen[1,2,3], Kim Bonné[2], Toon Alders[2], Ann Hermans[2], Katrien Copermans[2], Hans Swinnen[2], Vincent Maris[1], Thomas Jansegers[1], Wout Mathijs[1], Laura Haenen[1], Johan Vaes[2], Emmanuela Govaerts[2], Veerle Reenaers[2], Ines Frederix[2,3,4] and Paul Dendale[2,3]

European Journal of Preventive Cardiology
2019, Vol. 26(18) 1921–1928

DOI: 10.1177/2047487319859450
journals.sagepub.com/home/cpr
SAGE

- Cardiac Rehab/Disease Patients
- Compared to *physiologic threshold intensity* determination, %HRR and %HR peak correlated to the same exercise intensity domain ~50% of the time

Moderate vs. High Intensity

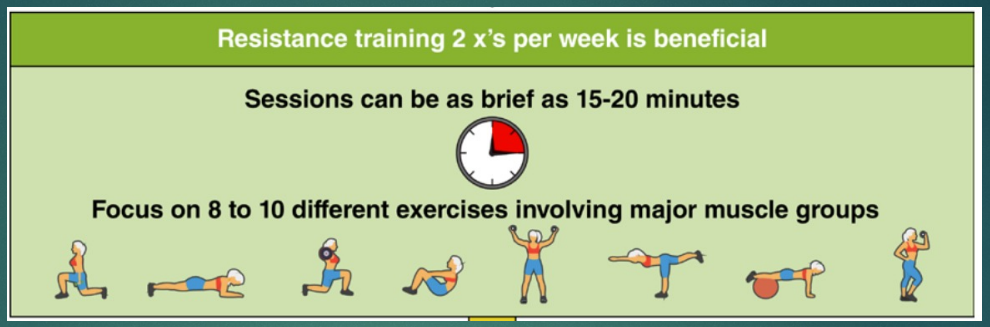


Conclusion

- Exercise reduces risk of all-cause mortality and recurrent cardiovascular events
- Different exercise types and intensities result in similar benefits
- Systemic inflammation and insulin resistance are the most important mediators

Bonekamp et al, EHJO, 2023

Resistance Training



Panel A Resistance Training Prescription Components

RT Intensity	Percent of 1-RM	Number of Reps	Frequency per week	Muscle Adaptation	Population
Low Intensity	<40% 1-RM	15-20 reps	≥ 2 days/week	Endurance	High risk patients
Moderate Intensity	40-60% 1-RM	8-12 reps	≥ 2 days/week	Strength and endurance	General Population
High Intensity	>80% 1-RM	1-6 reps	≥ 2 days/week	Strength	Healthy adults looking to optimize strength

Paluch et al, Circ, 2023