CSANZ Cardiac Rehabilitation Study Day 2022

Return to Sport Following Myocardial Infarction

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Outline

1. Definitions/scope
2. Risk of adverse cardiac events during exercise
3. Risk assessment to determine safe return to sport
4. Principles of shared-decision making
5. Additional learnings from return to sport guidelines following musculoskeletal injury
6. High intensity interval training
7. Sport specific considerations following sternotomy

Disclaimers…

"There are no clinical trials examining how competitive athletes with coronary artery diseases should be advised regarding vigorous intensity exercise in general, or in athletic competition in particular."

Thompson et al, 2015. Scientific Statement from the American Heart Association and American College of Cardiology

Current recommendations are based on case series, case reports and expert consensus.

Key References

Thompson et al. **AHA/ACC Scientific Statement: Eligibility and Disqualification Recommendations for Competitive Athletes with Cardiovascular Abnormalities: Task Force 8: Coronary Artery Disease.** J Am Coll Cardiology. 2014;66(21).

Borjesson et al. **Recommendations for Participation in Leisure Time or Competitive Sports in Athletes-Patients with Coronary Artery Disease: A Position Statement from the Sports Cardiology Section of the European Association of Preventive Cardiology (EAPC).** Eur Heart J. 2019;40(1).

Ardern et al. **2016 Consensus Statement on Return to Sport from the First World Congress in Sports Physical Therapy**, Bern. Br J Sports Med. 2016;0:1-12.

1. Definitions/Scope

"Sport" = Leisure time or competitive sport at any level that involves training at a high frequency, duration or intensity.

Also relevant for those who have **work related fitness requirements** e.g physical competency tests

2. Risk of adverse cardiac events during exercise

Relative Risk of Adverse Event During Exercise

The risk of an adverse cardiac events is transiently increased during vigorous intensity exercise relative to rest.

Transient risk of acute myocardial infarction (AMI) and sudden cardiac death (SCD) reported to be 6 – 17 times greater during vigorous exercise compared to at rest. (Albert et al 2000; Mittleman et al 1993)

Relative risk of an AMI both at rest and during vigorous exercise is less for those who already engage in regular physical activity.

(Albert et al 2000; Mittleman et al 1993)

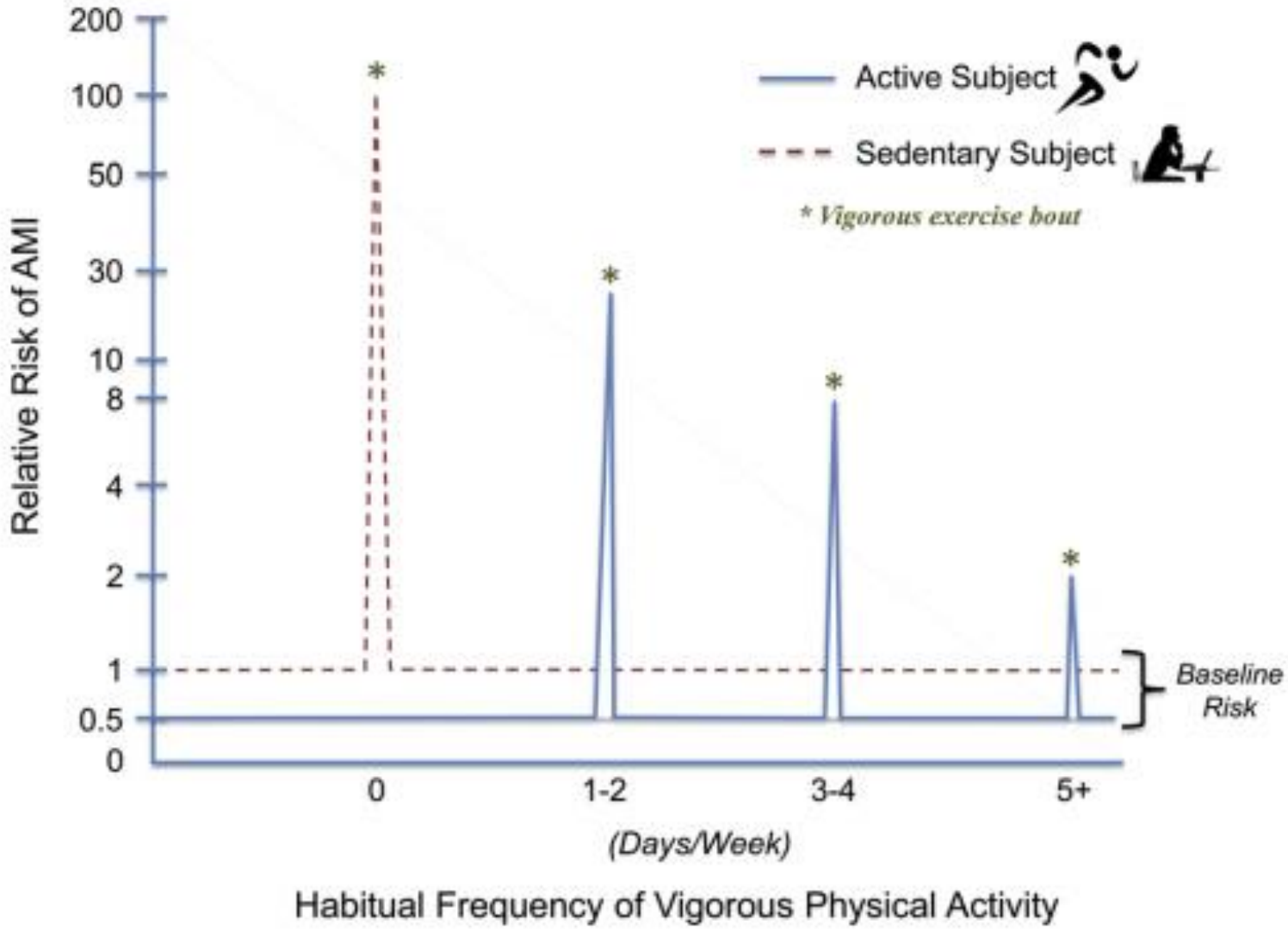


Image adapted from Mittleman et al. N Eng J Med 1993; 329(23):1677-1683

Absolute Risk of Adverse Events During Exercise

However … the actual incidence of AMI or SCD during exercise is very low.

General Population

- SCD occurs every 1.5 million episodes of vigorous exercise in men and every 36.5 million hours of moderate to vigorous exercise in women. (Whang et al 2006)

- One SCD per 396,000 hours of jogging. (Thompson et al 1982)

- Marathon runners: 0.54 cardiac arrests and 0.39 SCD per 100,000 running-hours. (Kim et al, 2012)

Absolute Risk of Adverse Events During Exercise

Cardiac Rehabilitation Populations

- One cardiac arrest per 111,006 patient-hours exercise (Van Camp et al, 1986)

- One cardiac arrest per 89,510 patient-hours exercise (Vongvanich et al, 1996)

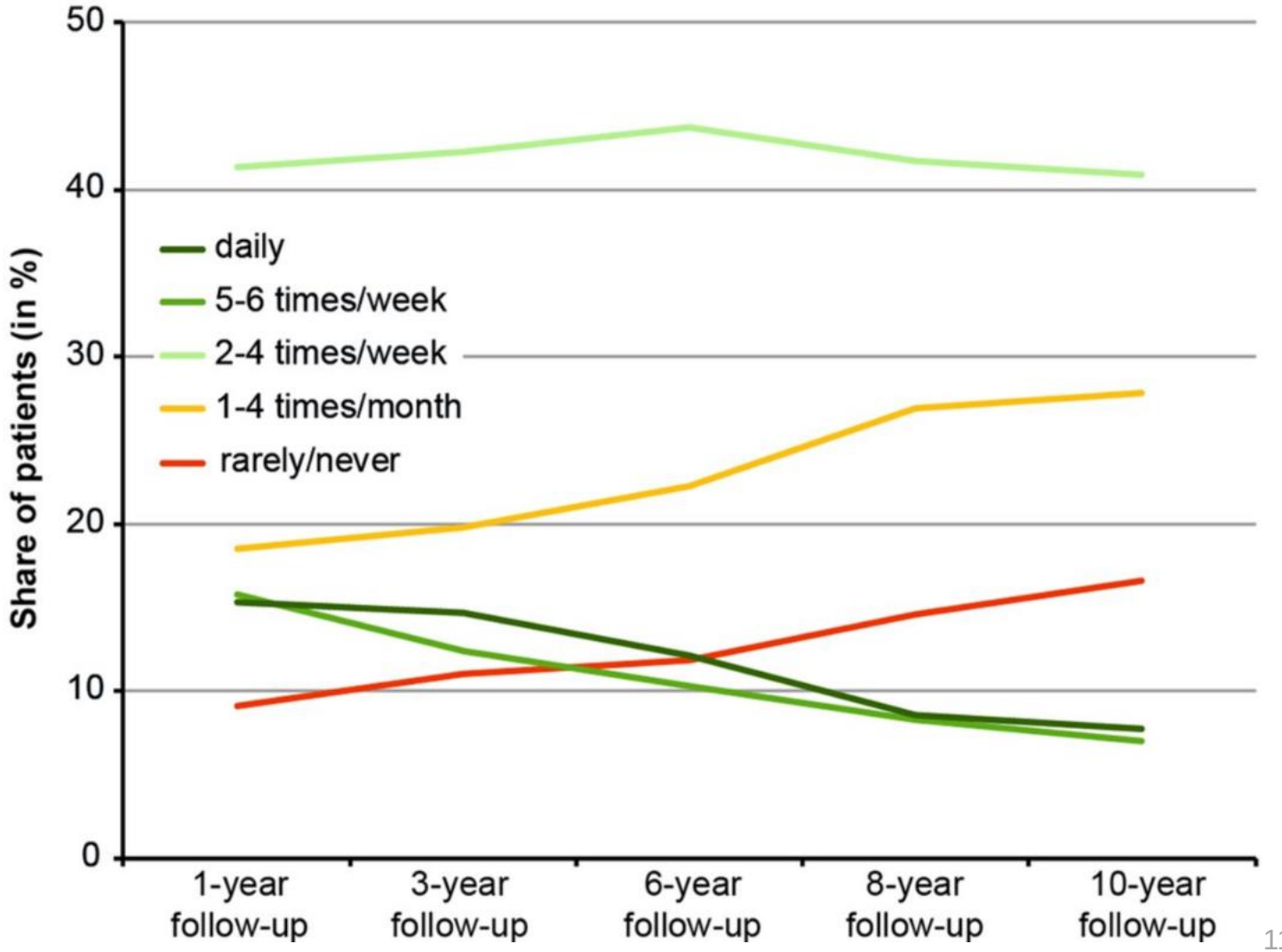
- One cardiac arrest per 97,418 patient-hours exercise (Franklin et al, 1998)

These findings suggest that cardiac events during exercise are rare (although there is still a risk!)

Risk of cardiac events and mortality for people with CAD

Followed approx. 1,000 people for 10 years post cardiac rehab.

Mons et al. Heart 2014;100:1043-1049



	Hazard ratios (confidence intervals)		
	Non-fatal CV events	**Cardiovascular mortality**	**All-cause mortality**
Daily	1.20 (0.54 – 2.69)	2.37 (1.05 – 5.34)	1.77 (0.90 – 3.47)
5-6 x/week	2.52 (1.24 – 5.12)	1.22 (0.43 – 3.46)	1.69 (0.81 – 3.50)
2-4 x/week	1.00 (ref)	1.00 (ref)	1.00 (ref)
1-4 x/month	1.34 (0.74 – 2.41)	1.53 (0.68 – 3.44)	1.74 (0.95 – 3.21)
Rarely/never	2.12 (1.12 – 4.02)	3.39 (1.62 – 7.10)	3.81 (2.17 – 6.70)

Those who rarely or never exercised had highest risk of non-fatal CV events, cardiovascular-related mortality and all-cause mortality (Mons et al. Heart 2014;100:1043-1049)

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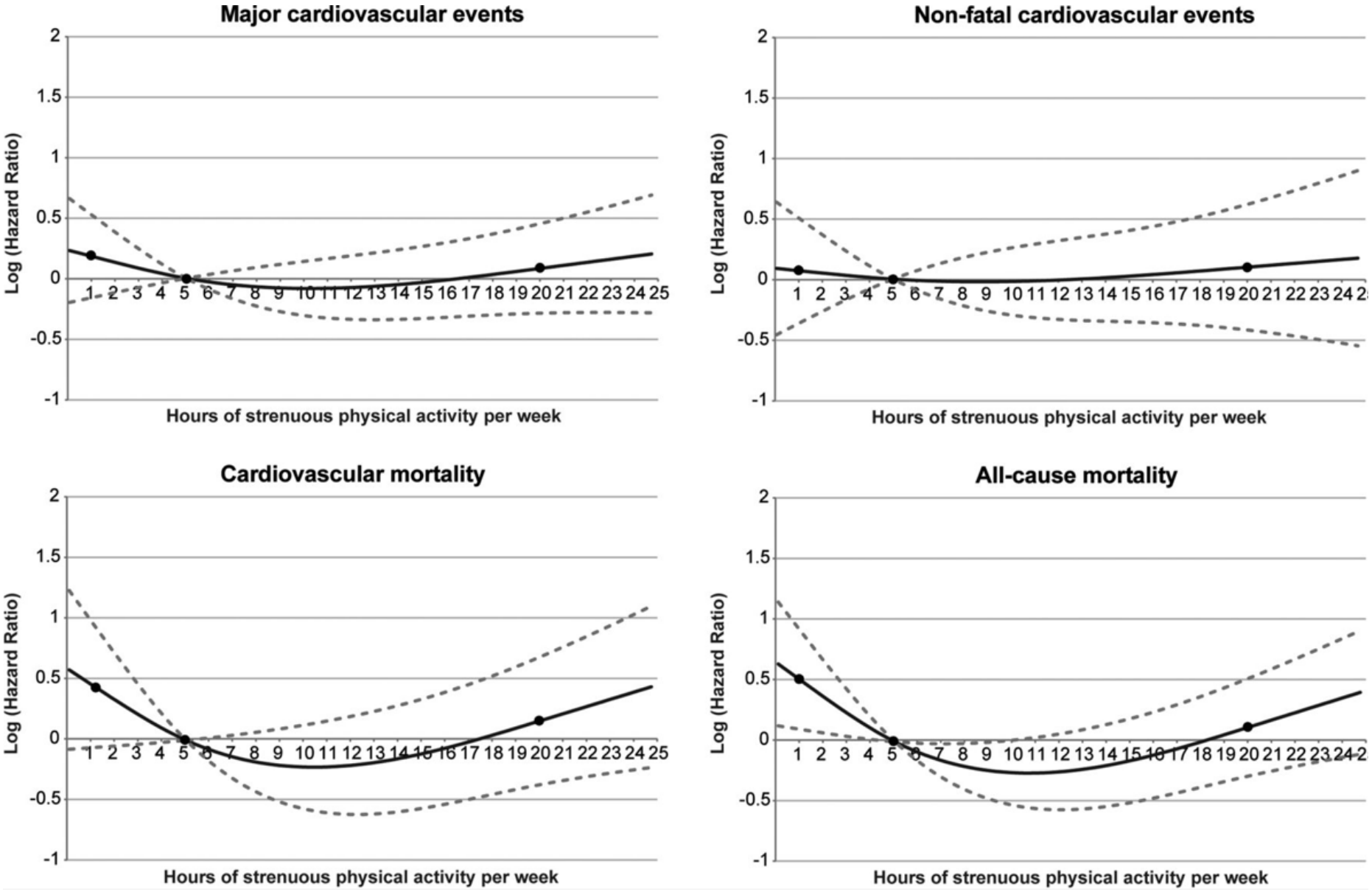
Intensive exercise training (≥7 x/week) increases cardiovascular mortality risk in patients with CAD. Mons et al. Heart 2014;100:1043-1049



Intensive exercise training (≥ 18 hours of strenuous exercise per week) increased mortality risk in patients with CAD. Mons et al. Heart 2014;100:1043-1049

Point 2 Summary …

Doing little or no exercise associated with worst outcomes.

Health benefits are seen with even low levels of physical activity.

However…it appears that daily, high intensity exercise may result in increased risk of mortality.

But … the overall incidence of adverse events during exercise is low.

"Benefits of regular physical activity and sport participation outweigh by far the risk for coronary events triggered by acute intensive physical activity."

(Borjesson et al; EAPC position statement, 2019)

3. Risk assessment to determine safe return to sport following myocardial infarction

What makes ‘sport’ more risky?

Higher intensity of exercise (to maximal exertion) → increased myocardial oxygen demand.

Increased time spent exercising at higher intensities e.g ↑ frequency and duration.

Competition associated with neuroendocrine changes?

Assessing risk for exercise-related cardiac events following myocardial infarction

Degree of luminal obstruction

Stability of the underlying plaque

Myocardial oxygen demand for the intended sporting activity

Ejection fraction

Presence and extent of ischaemia during exercise

Arrhythmias/electrical instability at rest or during exercise

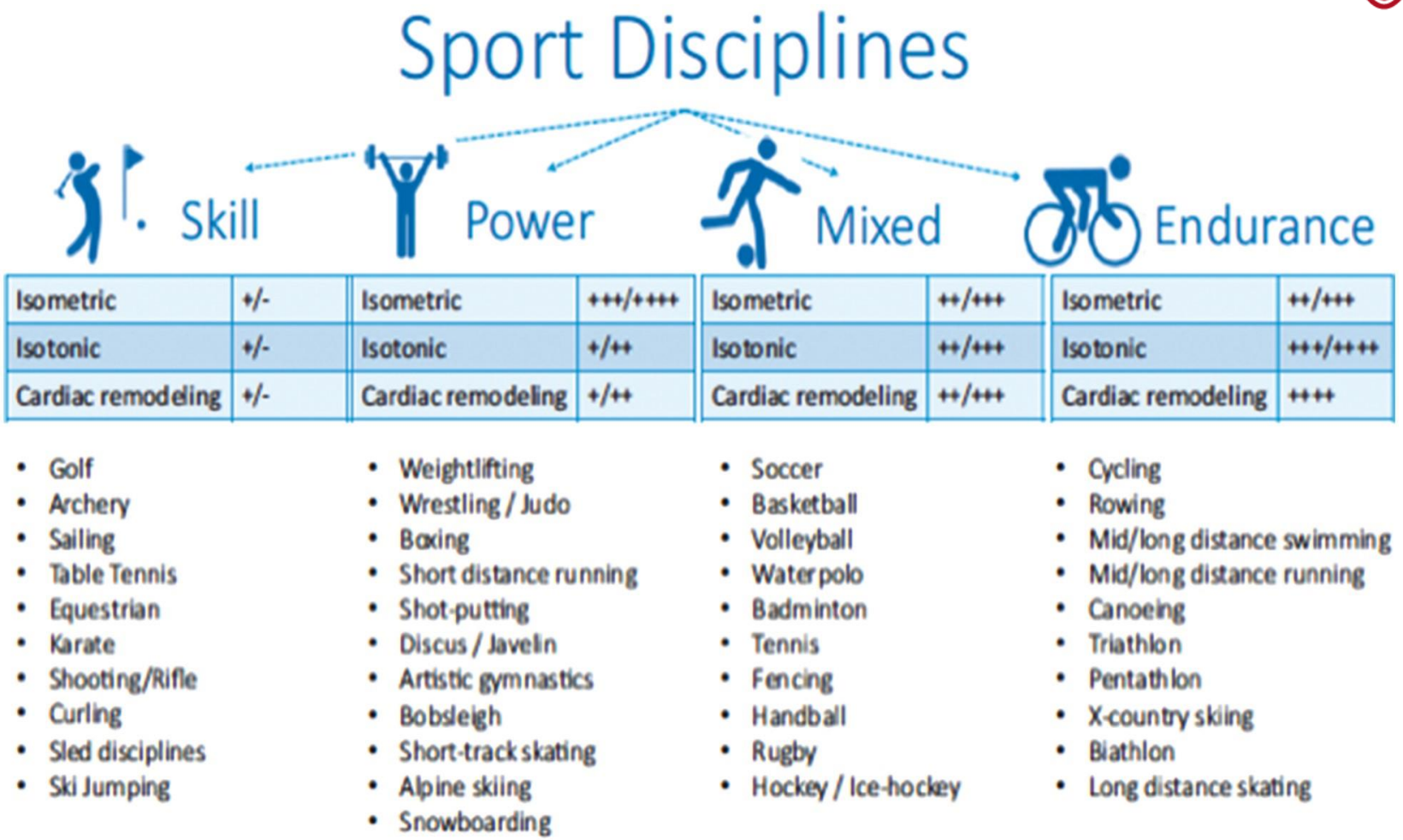


Figure 1 Schematic drawing of sport disciplines, divided into skill, power, mixed, and endurance type of exercise

Eur Heart J, Volume 40, Issue 1, 01 January 2019, Pages 13–18, https://doi.org/10.1093/eurheartj/ehy408

Low probability for exercise-induced cardiac event (all features must apply)	High probability for exercise-induced cardiac event (only one criteria must be met)
Absence of critical coronary stenosis (i.e <70%) of major coronary arteries or <50% of left main stem	Presence of critical coronary stenosis in at least one major coronary artery (>70%) or left main stem (>50%)
Ejection fraction ≥ 50%	Ejection fraction <50%
Absence of inducible ischaemia on maximal exercise testing	Exercise-induced ischaemia
Absence of arrhythmias at rest or during max exercise test	New left bundle branch block at low exercise intensity or immediately post exercise
Normal age-adjusted exercise capacity	Dizziness, syncope, dyspnoea, or angina at low exercise intensity
No wall motion abnormality	High degree of myocardial scarring

Return to sport guidelines – timing of return

American Heart Association:

Wait at least 3 months before commencing competitive sport participation (Class IIb recommendation; Level of Evidence C)

European Association of Preventive Cardiology:

Only restrict from competitive sport when a substantial risk of adverse event is present

?? Some suggest wait 1 – 2 years of aggressive lipid lowering therapy to allow for optimal myocardial healing and atherosclerotic plaque stabilisation

4. Shared decision making

In contemporary clinical practice, the return to sport decision should be a decision shared between all stakeholders.

Athlete needs to be informed of the risks of engaging in sustained high intensity exercise.

Acknowledge limitations in evidence/knowledge when sharing information with the patient.

5. Additional Learnings from Return to Sport Guidelines Following Musculoskeletal Injury

Ardern et al. 2016 Consensus Statement on Return to Sport from the First World Congress in Sports Physical Therapy, Bern. Br J Sports Med. 2016;0:1-12.

a) Defining Return to Sport

Return to sport success means different things to different people

e.g return to sustained participation in shortest possible time; return to a specific level of performance and/or prevention of new (or recurring) adverse events.

Contextual considerations

e.g physical demands of sport, athletes age or stage of career; type of sport played (team or individual, contact or non-contact); level of participation (amateur vs professional); significance of upcoming participation opportunities (championship event/competition).

a) Defining Return to Sport

Return to sport should be viewed as a continuum paralleled with recovery and rehabilitation

- Participating in training at lower levels;
- Physically active but not yet 'ready' (medically, physically and/or psychologically) to RTS

- Returned to defined sport, but not performing at desired level
- This may be 'success' for some

- The athlete has gradually returned to their sport and performing at or above their pre-injury (adverse event) level

b) Return to Sport vs Removal From Sport

The shared decision-making process may relate to:

- reducing loading (e.g reducing intensity, volume or level of competition)
- or cease participation altogether.

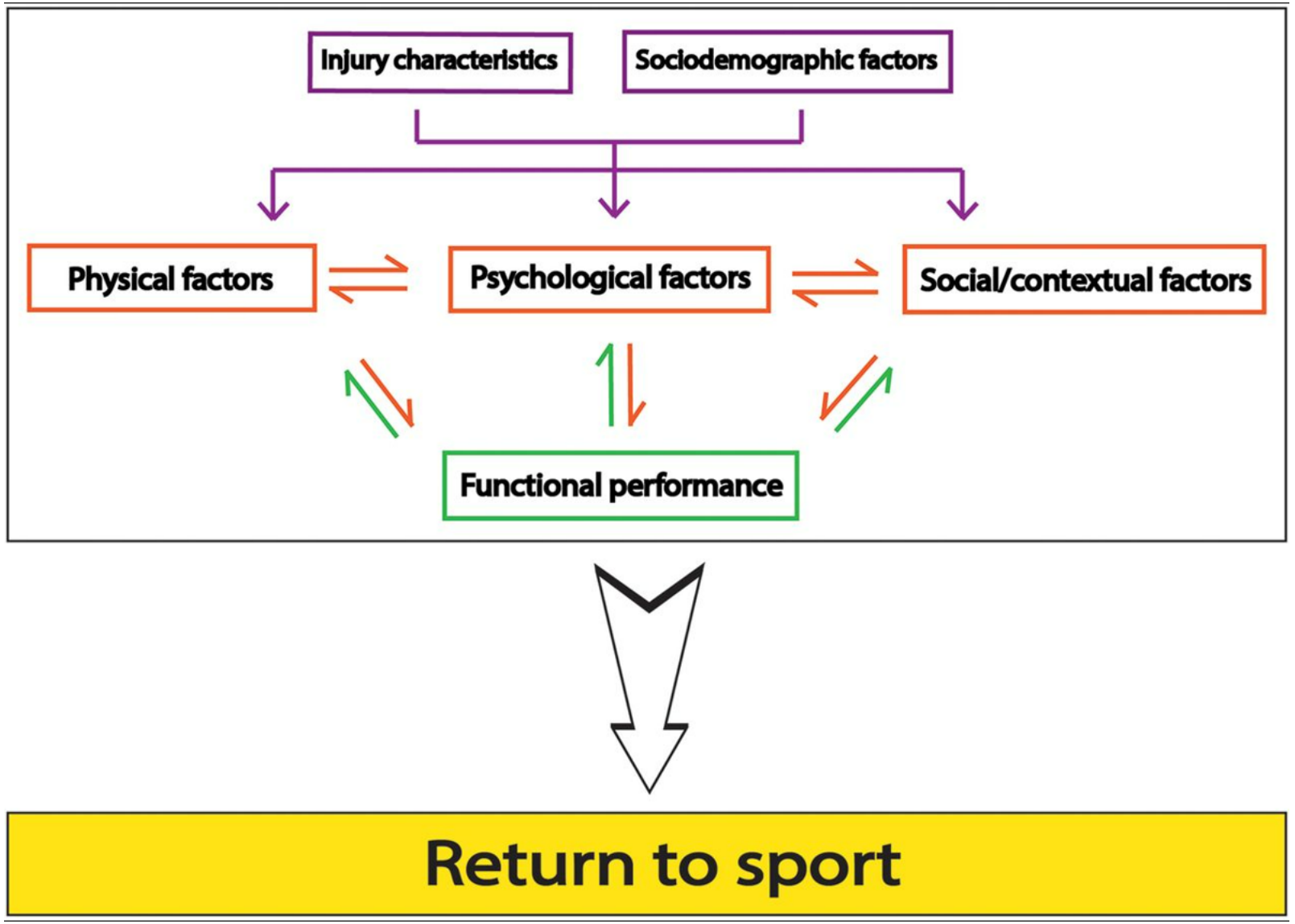
Health before sport

c) Models to help guide the return to sport process

The Strategic Assessment of Risk and Risk Tolerance (StARRT) Framework

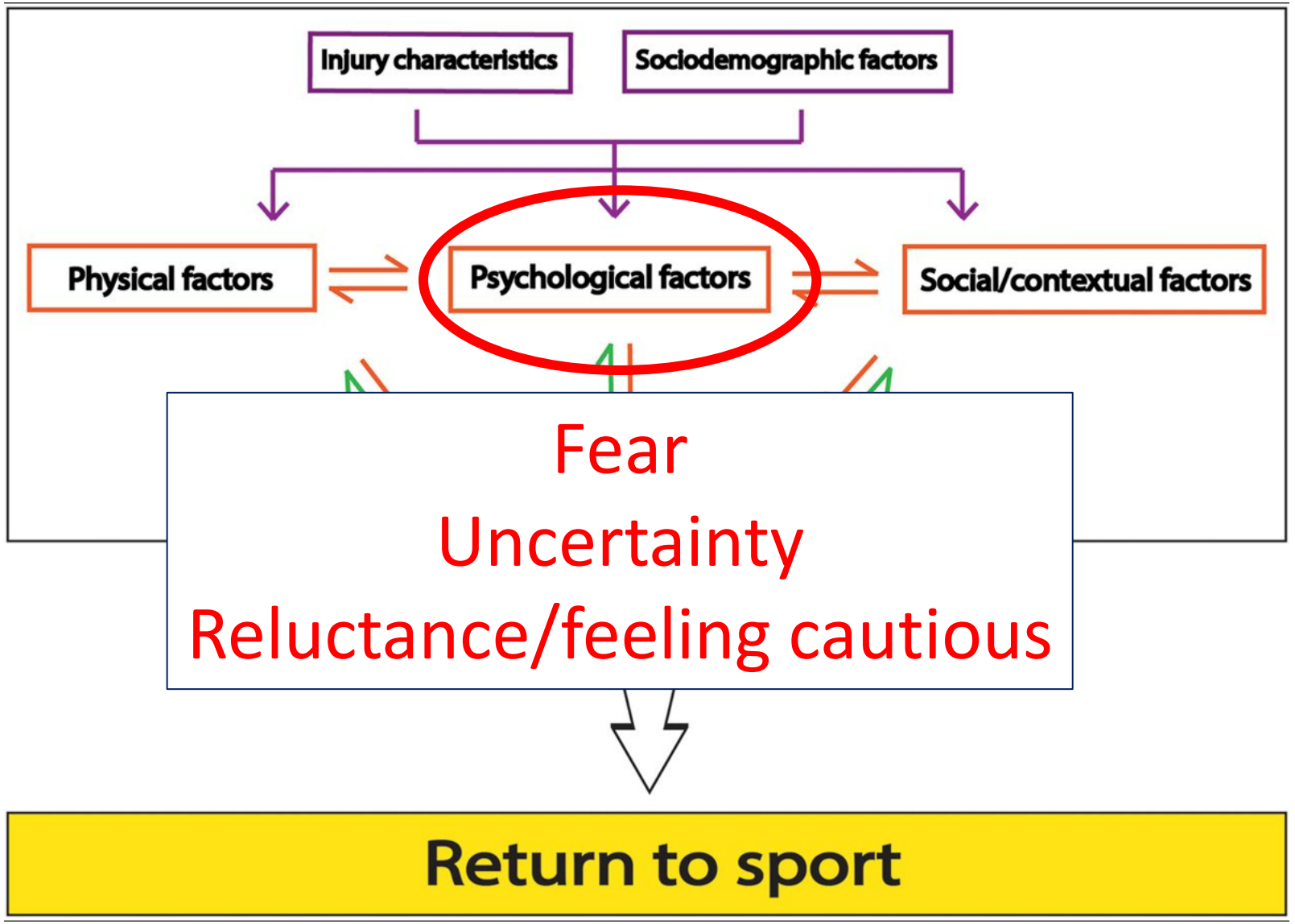
c) Models to help guide the return to sport process

Biopsychosocial Models



c) Models to help guide the return to sport process

Biopsychosocial Models



PSYCHOLOGICAL READINESS TO RETURN TO SPORT SCALE

Please rate your confidence to return to your sport on a scale from 0 - 100.

0 = no confidence at all

50 = moderate confidence

100 = complete confidence

1. My overall confidence to play is _____
2. My confidence to play without pain is _____
3. My confidence to give 100% effort is _____
4. My confidence to not concentrate on the injury is _____
5. My confidence in the injured body part to handle to demands of the situation is _____
6. My confidence in my skill level/ability is _____

Total _____
Add total and divide by 10 = ____

Scores between 50 and 60 suggest the athlete is psychologically ready to return to sports. Scores below 50 suggest that the athlete may not be ready psychologically to return to sports and needs more time to recover.

Summary of Points 3, 4 & 5:

Participate in a cardiac rehabilitation programme as a starting point

Complete a maximal, symptom limited exercise test (to determine presence of exercise induced ischaemia or arrhythmia; and determine appropriate exercise intensity)

Assess LV function

Undergo aggressive risk factor reduction with high-intensity statin therapy to reduce risk of plaque disruption

Engage in shared decision making with the patient

Consider the patients goals/expectations and psychological readiness to return to sport

High-risk individuals should be advised to restrict to low – mod intensity

6. High Intensity Interval Training

Dun et al. High-intensity interval training in cardiac rehabilitation. Clin Geriatr Med. 2019;35(4):469-487

13 studies in supervised cardiac rehabilitation settings; HIIT vs mod intensity training

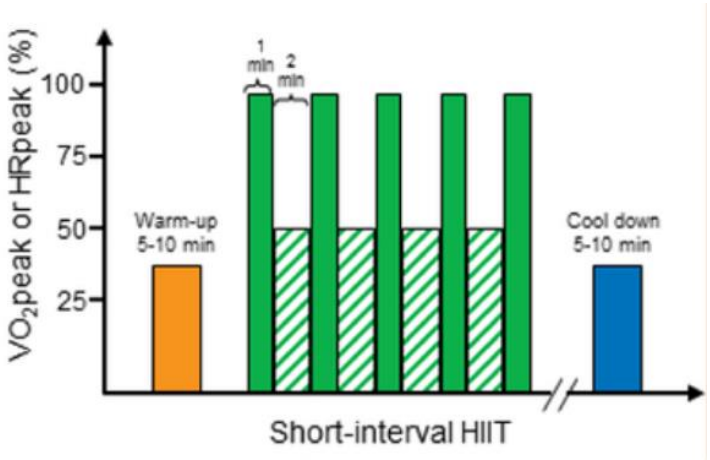
7 studies reported on adverse events:

- 4 studies had no adverse cardiovascular events
- 1 study had an AMI in the moderate intensity group
- 1 study had similar occurrences of ventricular arrhythmias, worsening HF; with only fatal MI in moderate intensity group
- 1 study: cerebral haemorrhage in HIIT groups

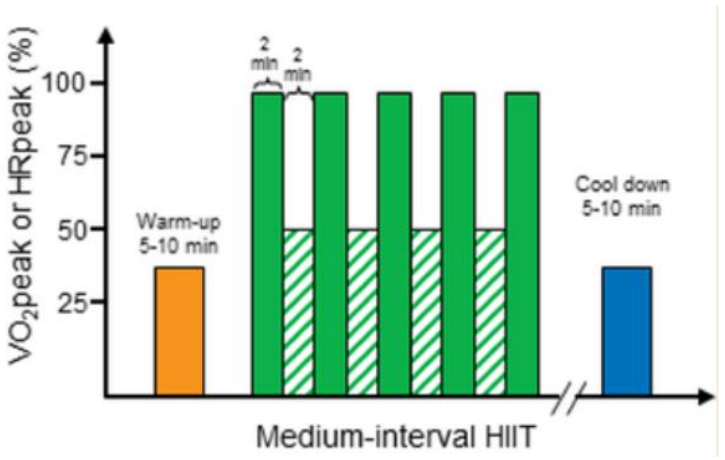
Differences in peak VO_2: 9 studies in favour of HIIT

4 studies no difference

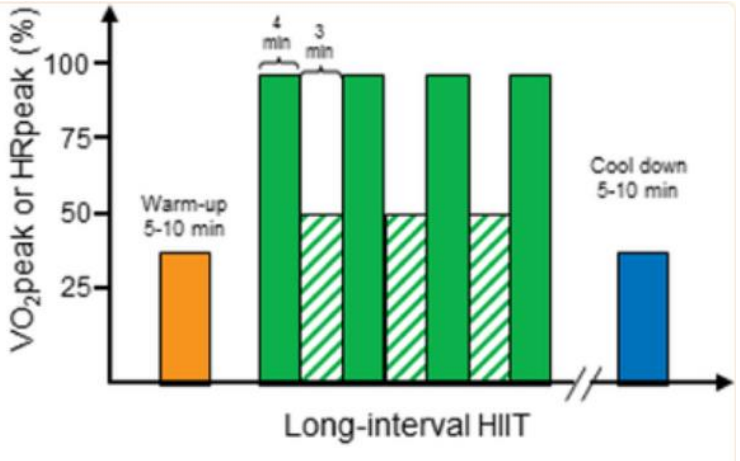
HIIT Prescription
Cardiac Rehabilitation Stage and Functional Capacity



Initial stage (0-4 weeks) and Low FC (≤ 5 METs)



Improvement (4-12 wks) or maintenance (>12 wks) stage and intermediate FC (METs 5 – 7)



Improvement or maintenance stage and high FC (≥ 7 METs)

Dun et al, 2019

High-intensity interval training

Paucity of data for HIIT in athletes with CAD in unsupervised setting though, so guidelines suggest limit HIIT to supervised settings.

If inducible ischaemia found on CPET then suggest avoiding HIIT until further investigated. (Keteyian et al, 2014)

7. Specific requirements for sports requiring loaded upper limb movements following sternotomy

Lack of literature exploring return to sports requiring loaded upper limb activities following sternotomy.

Can be guided by:

- Sternal healing times
- Biomechanical/kinesiological principles e.g KYMITT
- Psychological readiness
- Symptom responses

a) Sternal healing time

Shin et al., 2015:

- CT sternal assessment in 197 patients

- Complete union along entire sternum was seen in no patients at 3 months, 2 patients at 4-5 months, and 11 patients at 6 months

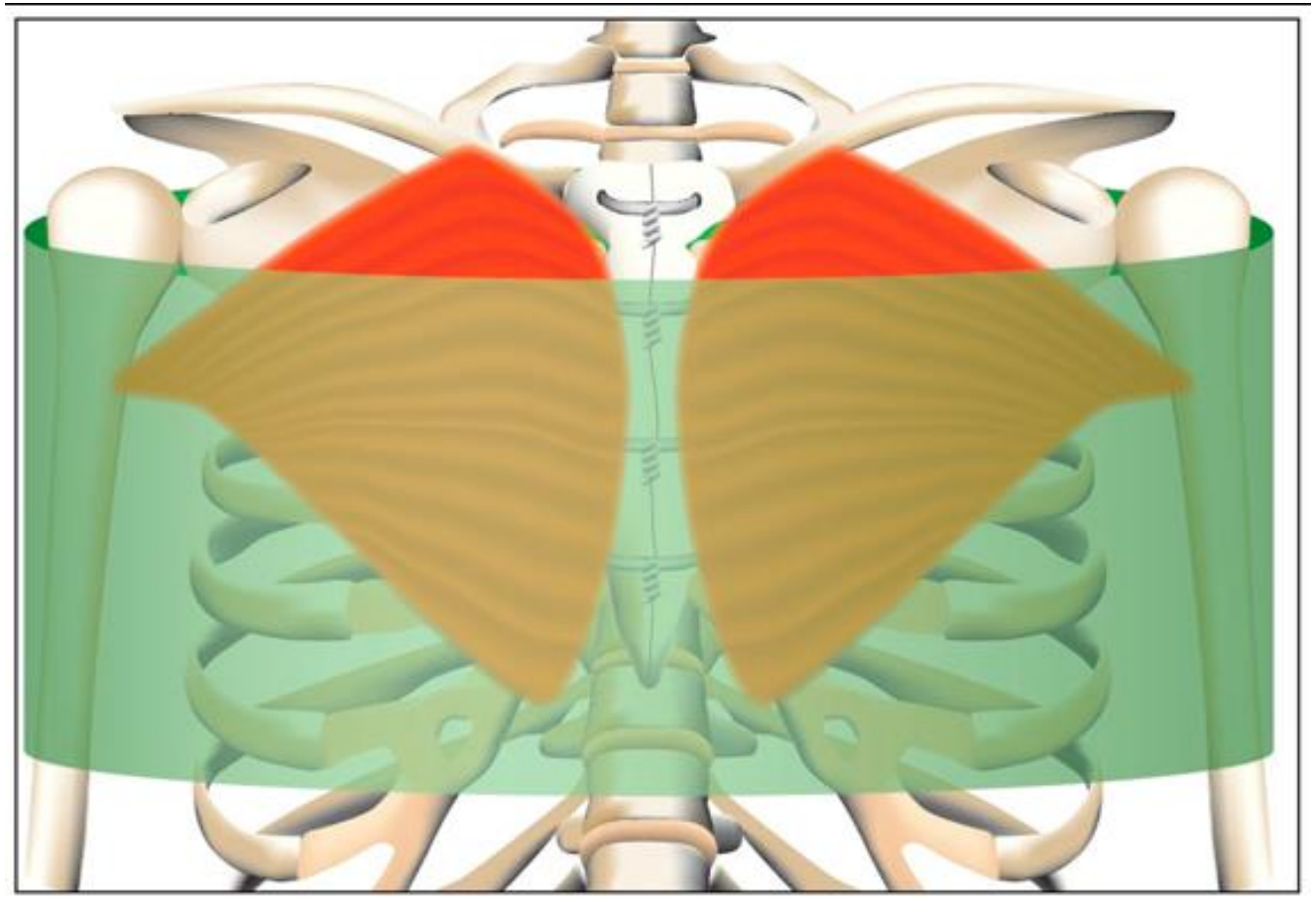
- At 6 months post-surgery, 34.5% showed poor healing

- Factors associated with poor healing: older age, diabetes and post-op renal dysfunction

Additional ref with similar data: Balachandran et al, 2019 – see Ref list.

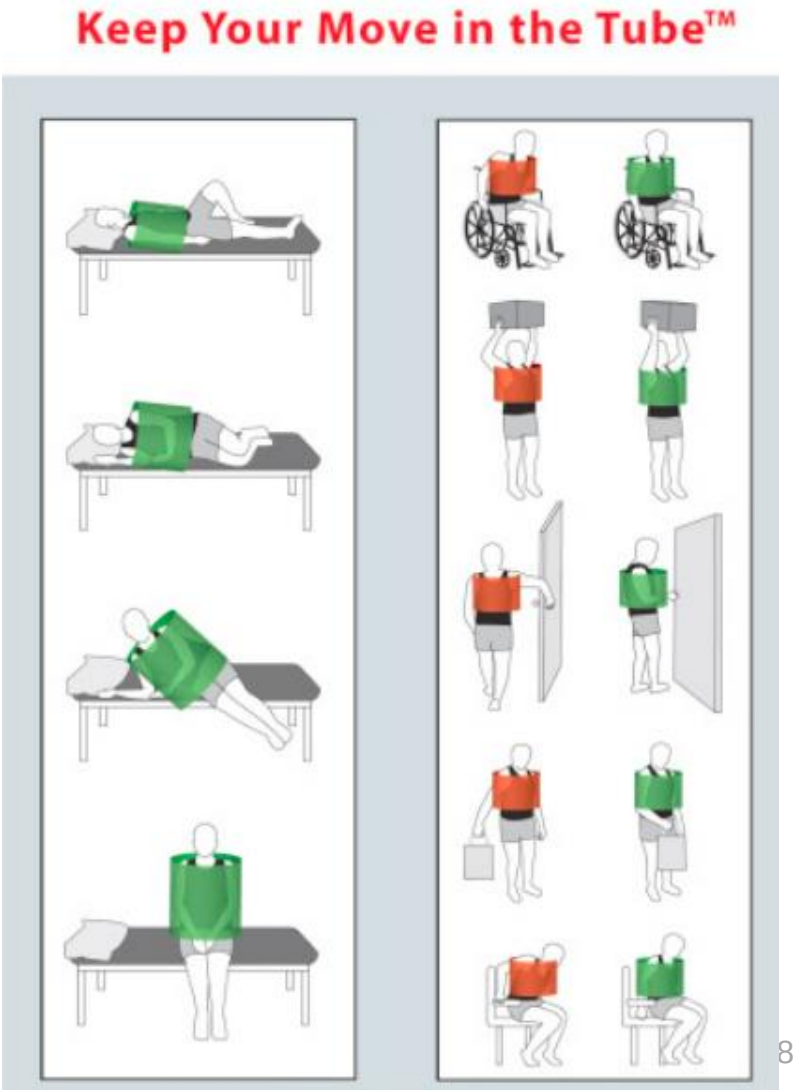
b) Biomechanical/kinesiological principles

Keep Your Move in the Tube



b) Biomechanical/kinesiological principles

Keep Your Move in the Tube



b) Biomechanical/kinesiological principles

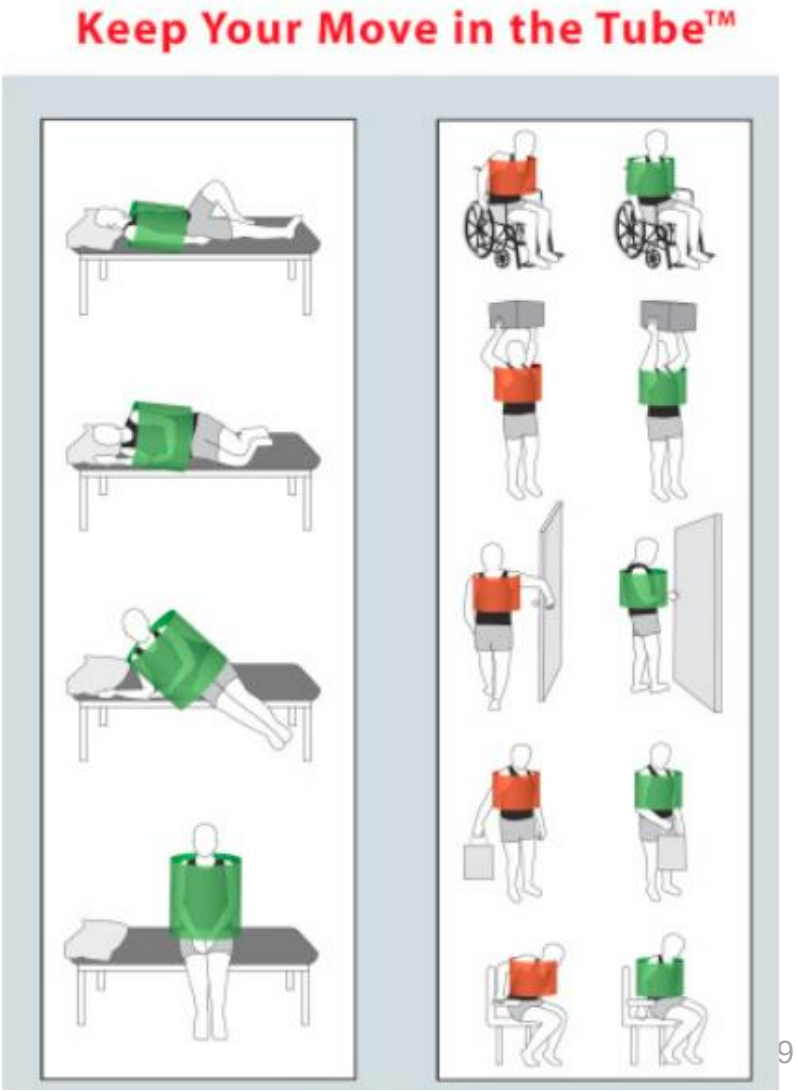
Keep Your Move in the Tube

When reintroducing loaded upper limb activities, start with loaded activities/exercises performed with arms ‘in the tube’, and progress to outside of the tube as pain and confidence allows.

e.g. Golf putting is ‘in the tube’

Cycling (leaning on handlebars is ‘in the tube’)

Swimming – freestyle, then backstroke, then butterfly & then breaststroke (?)



b) Biomechanical/kinesiological principles

Performing upper limb movements slowly exerts less force on sternum. (Swanson and LaPier, 2014)

c) Psychological readiness

Increase self-efficacy through gradual introduction of loaded arm activities prior to sport participation

e.g. Begin with low load upper limb resistance exercises

Increase repetitions before increasing load

Introduce movement patterns that mimic sport requirements:

unloaded → loaded

Perform movements/exercises slowly at first

d) Symptom Responses

?How much pain is acceptable/safe?

Injury rehabilitation principles (clinical principles):

- Ideally movements should be pain free, but discomfort during exercise up to 2-3/10 can be acceptable
- Discomfort/fatigue after exercise/loading common, as long as it is not severe or long-lasting e.g should not persist for more than a couple of hours after exercise, or be sore at night or the next morning

Summary

Return to sport decision making includes:

- Physical signs and symptoms to determine health risk
- Sporting requirements
- Patient goals e.g sport participation vs performance
- Psychological readiness
- Shared decision-making

Future research opportunities +++

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