Exercise Intensity and Interval Training

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Key Points

1) Interval training is a simple concept but application is hindered by its infinite variety and lack of standardized terminology.

2) Cardiorespiratory fitness is a critical health marker and strongly associated with risk for mortality and many chronic diseases.

3) Brief vigorous intermittent physical activity is a time-efficient strategy to improve health and reduce mortality risk.
My Disclosures and Limitations

1) I am a proponent of vigorous intensity interval training but it is merely one option on the “movement menu”.

2) I am an exercise physiologist with basic and applied interests but not at the “coal face” or engaged in direct translation.

3) I mainly conduct interventional studies on exercise responses in healthy and diseased states but not typically in older adults.

“This plan enables you to get fit: By yourself, At home... is not dependent on elaborate facilities or equipment (and requires only 11 minutes a day).”

Royal Canadian Air Force Pamphlet, Queens Printer, Ottawa, 1961.
A Conditioning Program For The Elderly

T. KAVANAGH, MD

*Interval Walking or Jogging*. I have found this to be most effective in achieving cardio-respiratory fitness.

the beginner can complete more work with less fatigue.

he can insure a level of activity vigorous enough to obtain a training effect, and yet not too strenuous to be dangerous.
Characterizing Interval Training

Intermittent bouts of relatively intense effort and recovery

Intensity

Characterizing Interval Training

How to classify effort?

Intensity (METs)

≥ 1.5

Light

3.0

Moderate

6.0

Vigorous

World Health Organization 2020 guidelines on physical activity and sedentary behaviour

Characterizing Interval Training

How to classify effort?

Intensity
(RPE /10)

7
Vigorous

5
Moderate

World Health Organization 2020 guidelines on physical activity and sedentary behaviour

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Characterizing Interval Training

How to classify effort?

Intensity
(RPE /10)

7
Hard 6-7 Vigorous activity, such as jogging, biking, or swimming, intense aerobic/cardio moves (increases your heart rate and makes you breathe harder and faster)

5
Moderate/Somewhat Hard 4-5 Brisk walking, moderate aerobic/cardio moves or other moderate activity that speeds up your heart rate without making you out of breath

World Health Organization 2020 guidelines on physical activity and sedentary behaviour

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Characterizing Interval Training

How to classify effort?

Intensity (%VO_{2\text{max}})

91  Near-maximal to maximal
64  Vigorous
46  Moderate
37  Light

Intensity (%HR_{\text{max}})

96  Near-maximal to maximal
77  Vigorous
64  Moderate
57  Light

https://www.acsm.org/education-resources/books/guidelines-exercise-testing-prescription

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Characterizing Interval Training

How to classify effort?

Intensity (RPE /20)

- Near-maximal to maximal
- Vigorous
- Moderate
- Light

https://www.acsm.org/education-resources/books/guidelines-exercise-testing-prescription

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Characterizing Interval Training

So what is “high-intensity”?

- Light
- Moderate
- Vigorous
- Maximal (“all out sprint”)
- Maximal (“aerobic”)
- Near-maximal to maximal

<table>
<thead>
<tr>
<th>Intensity</th>
<th>“Sprint Interval Training” (SIT)</th>
<th>“High-Intensity Interval Training” (HIIT)</th>
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<tbody>
<tr>
<td>~80% HR_{max}</td>
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Characterizing Interval Training

“Vigorous” intensity effort is well defined, scalable, and widely applicable

- Light
- Moderate
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- Maximal (“all out sprint”)
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<td>Physical Activity (WHO; CSEP): ≥6.0 METs, RPE 7-8/10</td>
<td>Exercise (ACSM): 64-90% VO_{2max} 77-95% HR_{max}, RPE = 14-17/20</td>
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“Vigorous” intensity effort is well defined, scalable, and widely applicable

Characterizing Interval Training

Meta-analysis of >100,000 people:

1-MET ↑ CRF = 13% ↓ mortality

Risk reduction comparable to:
- 7-cm ↓ in waist circumference
- 5-mm Hg ↓ in systolic BP
- 1 mmol ↓ in plasma glucose

Importance of Assessing Cardiorespiratory Fitness in Clinical Practice: A Case for Fitness as a Clinical Vital Sign

A Scientific Statement From the American Heart Association
Cardiorespiratory Fitness (CRF) is Measured as VO$_{2\text{max}}$

$VO_{2\text{max}} = SV \times HR \times (a - vO_2 \text{ diff})$

Martin Gibala, PhD

Sedentary obese adults (53 ± 8 y) performed either ~150 or ~300 min/wk of supervised continuous exercise at either ~50% or ~75% VO$_{2\text{max}}$ for 24 wk

“low-intensity exercise performed for about 150 min/wk may not be sufficient to improve CRF for a substantive proportion of adults”

...increasing exercise intensity (and amount) eliminated non-response.”

Older (~60 y), obese (BMI ≈ 30) people exercised 60 min/session, 5 d/wk for 4 months Continuous or Interval Walking (~66% HR$_{\text{max}}$) or non-training Control

“Interval walking is superior to energy-matched continuous walking (and) may therefore be a good option when considering which type of training...should be offered in primary care.”
Effect of exercise training for five years on all cause mortality in older adults—the Generation 100 study: randomised controlled trial

"We suggest that future guidelines... should be more specific in requiring that at least part of the physical activity should be performed at high intensity."

Stensvold et al. BMJ 2020;371:m3485. doi: 10.1136/bmj.m3485.
High-Intensity Interval Training for Patients With Cardiovascular Disease—Is It Safe? A Systematic Review

23 studies with 1117 participants (547 HIIT, 570 MICT) for AE reported up to 4 h post

Clinical Perspective

What Is New?

- High-intensity interval training appears to be relatively safe to conduct in patients with cardiovascular disease, including coronary artery disease and heart failure, within tertiary-care cardiac rehabilitation settings.

Characterizing Interval Training

Is there a sweet spot for ‘real world’ translation?

Intensity

Maximal (“all out sprint”)
Maximal (“aerobic”)
Near-maximal to maximal
Vigorous
Moderate
Light

A few brief vigorous efforts with relatively low time commitment
Brief Intense Stair Climbing Improves Cardiorespiratory Fitness

3 x 20-s efforts over 10 min, 3x/wk for 6 wk in young adults
“Climb the stairs as quickly and safely as possible, taking one step at a time.”

Peak HR ≤90%max
Mean HR ~80%max over 10 min
RPE ~15/20

Climbing Stair Climbing Cycling
0 25 30 35 40
VO2 (mL O2·kg⁻¹·min⁻¹)
Pre Post *

Stair Climbing

A 31-day time to surgery compliant exercise training programme improves aerobic health in the elderly

N = 18 adults aged ~67 (62-73 y) completed 12 sessions of cycle-based HIIT
5 bouts x 60-s at ~100% maximal aerobic power over ~15 min

"it is possible to improve cardiorespiratory fitness in healthy, older people within 31 days using a HIT exercise programme (that) was safe, acceptable, and not associated with any serious medical complications."

The physiological impact of high-intensity interval training in octogenarians with comorbidities

N = 28 adults aged 82±1 y completed 12 sessions of cycle-based HIT over 4 wk
5 bouts x 60-s at ~100% maximal aerobic power over ~15 min

"HIIT can be safely delivered to octogenarians with disease and is an effective, time-efficient intervention to improve physical function in a short time frame."
68 inactive adults (66-79 y) trained twice weekly for 3 months on a cycle ergometer

“3 months of watt-controlled supramaximal HIT improved cardiorespiratory fitness and cardiovascular function to a similar extent as MIT, despite half the training time.”

we observed high attendance, low drop-out rates (<6%), and no serious AEs.”

Equipment-free, unsupervised high intensity interval training elicits significant improvements in the physiological resilience of older adults.

N = 30 adults (71 ± 5 y) randomized to 12 sessions over 4 wk of equipment-free, supervised (in the laboratory) or unsupervised (at home) HIIT, or a no-intervention control (CON).

“short-term, time-efficient, equipment-free, HIIT (elicits) improvements in the CRF, (and) cardiometabolic health of older adults irrespective of supervision.”

Intensity

Exercise Snacks: A Novel Strategy to Improve Cardiometabolic Health

Hashim Islam1, Martin J. Gibala2, and Jonathan P. Little3

Brief (≤ 1 min) bursts of vigorous effort spread throughout the day

Untapping the Health Enhancing Potential of Vigorous Intermittent Lifestyle Physical Activity (VILPA): Rationale, Scoping Review, and a 4-Pillar Research Framework

VILPA = Brief bouts of vigorous movement undertaken as part of daily living

>25,000 ‘nonexercisers’ aged 62±8 in the UK Biobank over a follow-up of ~7 years

“The median daily VILPA duration of 4.4 min per day was associated with a 26%-30% reduction in all-cause and cancer mortality and a 32%-34% reduction in CVD mortality risk.”
Take Home Messages

1) Older individuals can perform a wide range of vigorous intensity interval training protocols that are generally well-tolerated.

2) Vigorous interval training can rapidly enhance cardiorespiratory fitness and other health markers in a time-efficient manner.

3) Vigorous interval training may enhance selected responses compared to a similar amount of lower intensity exercise.

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Thank you!

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