Exercise to reduce risk in healthy individuals:

New innovations in fitness and exercise training

Prof Wayne Derman
MBChB, BSc (Med) (Hons), PhD, FFIMS
Three Choices We Make On A Daily Basis are Going to Predict us Developing 4 Diseases THAT PRESENTLY KILL MORE THAN 65% OF PEOPLE ON PLANET EARTH!
What causes deaths in South Africans?

(\% total deaths by year: 1997-2015)

NCDs

Communicable diseases
HIV / TB / Malaria

Injuries

Would you least like to have?

- Smoker
- Be unfit
- Diabetes
- Hypertension
- Obesity
- Hypercholesterolaemia
Attributable Fractions (%) for All-Cause Deaths

40,842 Men & 12,943 Women, ACLS

- Low CRF
- Obese
- Smoker
- Hypertension
- High Chol
- Diabetes

Insufficient physical activity in South African females >18 years (% population)

WHO Global Status Report on NCDs – January 2015
Leisure time running reduces all cause and cardiovascular mortality
Duck-chul Lee et al., JACC, 2014;64;472-81
Quantum of risk reduction?

**Figure 2.** Risk reduction for all-cause mortality and chronic disease seen in physically active subjects.

Does regular (weekly) physical activity prolong life? How much activity? (life years gained after 40 years)

Exercise training (8 wks) & detraining: evidence for effects on plasma-derived endothelin-1 and NO

Nitric oxide (NOx, μmol/L)

<table>
<thead>
<tr>
<th></th>
<th>Pre</th>
<th>Post</th>
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<tbody>
<tr>
<td>0.0</td>
<td>20.0</td>
<td>40.0</td>
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(P <0.05)

Endothelin-1 (pg/mL)

<table>
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<tr>
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<th>Pre</th>
<th>Post</th>
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<tbody>
<tr>
<td>0.0</td>
<td>1.2</td>
<td>1.6</td>
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</table>

(P <0.05)

NO (potent vasodilator) & ET-1 (potent vasoconstrictor) were inversely affected by 8 wks exercise training (70%max, 1 hr, 3 x wk). All training-induced changes had returned to basal levels after 8 wks of detraining.

(Maeda et al., Life Sci 2016; 69(9): 1005-1016)
Mechanism of action: Inflammation

Milani et al, J Am Coll Cardiol 43; 1056-1061, 2004
1. **Duration:** > 30 minutes per session
2. **Frequency:** Most days of the week
3. **Intensity:**
   - 60-80% of maximum capacity (maximum heart rate: 220-age)
   - Able to just conduct conversation
   - Rating of perceived exertion (RPE)
4. **Type:**
   - Endurance (walking, jogging, cycling, swimming, other) (most days of the week)
   - Muscle strength and flexibility (2-3 per week)
Physical activity guidelines for 6-16 yrs

• (1 hour) or more of physical activity daily.
• Aerobic: Most of the 60 or more minutes a day should be either moderate- or vigorous-intensity aerobic physical activity and should include vigorous-intensity physical activity at least 3 days a week.
• Muscle & Bone -strengthening: As part of their 60 or more minutes of daily physical activity, children and adolescents should include muscle-strengthening physical activity on at least 3 days of the week.
Physical activity guidelines for 6-16 yrs

- It is important to encourage young people to participate in physical activities that are appropriate for their age, that are enjoyable, and that offer variety.
Physical activity guidelines for 6-16 yrs

• 1 hour WhatsApp or TV or gaming/ a day
It's not all about gym! Sitting is killing you

- Many people spend 9 hrs a day sitting
- 45,259 Norwegians
- Classified their work as time sitting, walking at work, lifting or heavy labor
- Followed for 14 years
- 4421 died
- Overall mortality increased with BMI
- Sitting associated with most deaths
- Heavy working, walking at work is protective
- Devices that measure sitting

Sitting at work raises all cause and CV mortality risk; Grunseit et al., 2012
Sitting for more than 3 hours a day appears to cut life short by 2.0 years, even among individuals who exercise regularly.

Another 1.4 years of life are lost by watching TV for more than 2 hours a day.

Sedentary behavior shortens life expectancy to almost the same degree as smoking (associated with 1.8-2.5 years of life lost) and more than obesity (associated with 0.30-1.08 years or life lost).

The future
The future
Exercise Guidelines: How far off are you?

Association of “Weekend Warrior” and Other Leisure Time Physical Activity Patterns With Risks for All-Cause, Cardiovascular Disease, and Cancer Mortality

Gary O’Donovan, PhD1,2; I-Min Lee, ScD3; Mark Hamer, PhD4,5; et al

Author Affiliations

JAMA Intern Med. Published online January 9, 2017. doi:10.1001/jamainternmed.20

Question  What are the associations of physical activity patterns with mortality?

Findings  This pooled analysis of population-based surveys included 63,591 adult respondents. All-cause mortality risk was approximately 30% lower in active vs inactive adults, including “weekend warrior” respondents who performed the recommended amount of 150 minutes of moderate or 75 minutes of vigorous activity from 1 or 2 sessions per week, insufficiently active respondents who performed less than the recommended amount from 1 or 2 sessions per week, and regularly active respondents who performed the recommended amount from 3 or more sessions per week.

Conclusions and Relevance  Weekend warrior and other leisure time physical activity patterns characterized by 1 or 2 sessions per week may be sufficient to reduce all-cause, CVD, and cancer mortality risks regardless of adherence to prevailing physical activity guidelines.
High Intensity Interval Training for Maximizing Health Outcomes

Trine Karlsen\textsuperscript{a, b, 1}, Inger-Lise Aamot\textsuperscript{b, c, 1}, Mark Haykowsky\textsuperscript{d}, Øivind Rognmo\textsuperscript{b},

Fig 1 – The principle of high intensity interval training (HIIT), which facilitates the execution of repeated high intensity aerobic work. The work-bouts are separated by ‘pauses’ of lower intensity exercise that allow for recovery, making an individual able to reengage in HIIT. Moderate intensity continuous training (MICT) on the other hand, is performed continuously over longer time, at lower exercise intensities.

Karlsen, Prog Cardiovasc Disease 2017
High-intensity interval training in patients with lifestyle-induced cardiometabolic disease: a systematic review and meta-analysis

Kassia S Weston.¹ Ulrik Wisløff.² Jeff S Coombes¹

Table 2  Protocol recommendations for HIIT

<table>
<thead>
<tr>
<th>Frequency</th>
<th>3×/Week</th>
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<tbody>
<tr>
<td>Duration</td>
<td>40 min</td>
</tr>
<tr>
<td>Modality</td>
<td>Treadmill/hill, cycle ergometer. Increasing speed or incline</td>
</tr>
</tbody>
</table>
| Intensity   | Interval=85–95% PHR  
             | Rest=passive—70% PHR |
| Interval times | 4×4 min intervals  
                | 3×3 min recovery |
| Warm-up     | 10 min at 60% PHR |
| Cool-down   | 5 min at 50% PHR |

HIIT, homeostasis model assessment-insulin resistance; PHR, peak heart rate.

High-intensity interval training in patients with lifestyle-induced cardiometabolic disease: a systematic review and meta-analysis

Kassia S Weston, Ulrik Wisløff, Jeff S Coombes

<table>
<thead>
<tr>
<th>Study</th>
<th>MD (95% CI)</th>
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<tbody>
<tr>
<td>Freyssin (2012)</td>
<td>2.80 (-0.01, 5.61)</td>
</tr>
<tr>
<td>Fu (2011)</td>
<td>3.6 (-0.15, 7.35)</td>
</tr>
<tr>
<td>Iellamo (2012)</td>
<td>0.5 (-0.15, 7.35)</td>
</tr>
<tr>
<td>Moholdt (2005)</td>
<td>2.70 (-1.18, 6.58)</td>
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<tr>
<td>Molmen-Hansen (2012)</td>
<td>5.70 (0.68, 10.72)</td>
</tr>
<tr>
<td>Roditis (2007)</td>
<td>-1.20 (-4.93, 2.53)</td>
</tr>
<tr>
<td>Rognmo (2004)</td>
<td>3.00 (-6.36, 12.36)</td>
</tr>
<tr>
<td>Shjerve (2008)</td>
<td>2.30 (-1.85, 6.45)</td>
</tr>
<tr>
<td>Tjonna (2008)</td>
<td>3.70 (-5.96, 13.36)</td>
</tr>
<tr>
<td>Wisloff (2007)</td>
<td>4.10 (2.53, 5.67)</td>
</tr>
<tr>
<td><strong>Total (95% CI)</strong></td>
<td><strong>3.03 (2.00, 4.07)</strong></td>
</tr>
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Heterogeneity: Chi² = 9.90; I² = 9%; P=0.36
Test for overall effect Z=5.75; P<0.001

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<tr>
<th>Adaptations occurring significantly more with HIIT compared to MICT</th>
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<tbody>
<tr>
<td>✅ ↑VO$_2$peak</td>
</tr>
<tr>
<td>✅ ↓Systolic and diastolic blood pressure</td>
</tr>
<tr>
<td>✅ ↑High density lipoproteins</td>
</tr>
<tr>
<td>✅ ↓Triglycerides and fasting glucose</td>
</tr>
<tr>
<td>✅ ↓Oxidative stress and inflammation</td>
</tr>
<tr>
<td>✅ ↓FATP-1 and FAS</td>
</tr>
<tr>
<td>✅ ↑Adiponectin, insulin sensitivity and β-cell function</td>
</tr>
<tr>
<td>✅ ↑PGC-1α</td>
</tr>
<tr>
<td>✅ ↑Maximal rate of Ca$^{2+}$ reuptake</td>
</tr>
<tr>
<td>✅ ↑Availability of nitric oxide</td>
</tr>
<tr>
<td>✅ ↑Cardiac function</td>
</tr>
<tr>
<td>✅ ↑Enjoyment of exercise</td>
</tr>
<tr>
<td>✅ ↑Quality of life</td>
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</tbody>
</table>

FATP-1, fatty acid transport protein 1; FAS, fatty acid synthase; HIIT, high-intensity interval training; MICT, moderate-intensity continuous training

Box 2  Suggested contraindications to high-intensity interval training (HIIT)

- Unstable angina pectoris
- Uncompensated heart failure
- Recent myocardial infarction (<4 weeks)
- Recent coronary artery bypass graft or percutaneous coronary intervention (<12 months)
- Heart disease that limits exercise (valvular, congenital, ischaemic and hypertrophic cardiomyopathy)
- Complex ventricular arrhythmias or heart block
- Severe chronic obstructive pulmonary, cerebrovascular disease or uncontrolled peripheral vascular disease
- Uncontrolled diabetes mellitus
- Hypertensive patients with blood pressure >180/110 (or uncontrolled)
- Severe neuropathy

The 6 Minute Exercise Bout?

- Warm up on stationary spinning bike for 2 min
- The cycle as fast as you can for 20 seconds
- Then recovery cycle for 1 minute
- Then max again for 20 seconds
- Repeat
- 6 minute routine in total
- Significant effects on insulin sensitivity & VO2
- Personalized exercise
- Medical clearance

Gibala et al., J Physiol 2012.
Burgomaster et al., J Physiol 2008
Stages of behaviour change:

1. Precontemplation (unaware of the problem)
2. Contemplation (aware of the problem and of the desired behavior change)
3. Preparation (intends to take action)
4. Action (practices the desired behavior)
5. Maintenance (works to sustain the behavior change)

Marketing & Communication Tasks

- Reinforce changes, reminder communications
- Facilitate action
- Educate
- Persuade and motivate
- Create awareness; change values and beliefs
Transport/planning innovation +66%
Transport innovations/technology
Where are we now and where is the future?

Technological Interfaces & Sensors
Brief Report

Pokémon Go: digital health interventions to reduce cardiovascular risk

Chayakrit Krittanawong, Mehmet Aydar, Takeshi Kitai

Cardiology in the Young (2017), 27, 1625–1626
doi:10.1017/S1047951117000749

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Where are we now and where is the future?
Where are we now and where is the future?
The Rise of Consumer Health Wearables: Promises and Barriers

Piwek et al., PLOS Medicine
February, 2016
StrongLifts 5×5 Workout: mobile app user guide

Nash Anderson, Saara Stevenson, Jenni Brozena

Power Pack

Get even better results with the Power Pack. Unlock it to get access to...

- Warmup Calculator
- Plate Calculator
- Assistance Work
- 3×5/3×3/1×3
- New Lock Screen Entry
- Google Fit integration
- CSV Exports

Figure 2  Instructional videos are provided for various exercises as well as warm-ups.

Figure 3  'Power Pack' features unlockable with purchase.

- Depression, Anxiety and Stress Questionnaire-21
- Perceived Stress Scale
- Dispositional Resilience Scale
- Recovery-Stress Questionnaire-52 item
- Low Energy in Females Questionnaire
- Epworth Sleepiness Scale
- Pittsburgh Sleep Quality Index, among others.
During exercise there is a 2-56 X higher risk of an acute serious medical complication (including primary cardiac arrest).

Exercise and the Cardiovascular System
Clinical Science and Cardiovascular Outcomes


Lavie et al., Circ Res. 2015;117:207-219
Why Has the Medical Community Neglected PA as a Treatment?

- Easier for physician to issue a prescription to reduce BP, cholesterol, glucose or BMI.
  - Medication adherence is very low (1 in 6 take meds as prescribed).
  - Reliance on pills transfers responsibility for health to doctor resulting in lower patient physical activity.

- Widespread belief we cannot change physical activity habits. However:
  - Evidence brief counseling and pedometer programs can increase physical activity.
  - We are able to convince patients to take insulin shots, Coumadin, chemotherapy, etc – why not exercise?
Goal?

- To make physical activity assessment and exercise prescription a standard part of the disease prevention and treatment paradigm for all patients
The Physical Activity Vital Sign

1. On average, how many days per week do you engage in moderate to strenuous exercise (like a brisk walk)? _____ days

2. On average, how many minutes do you engage in exercise at this level? _____ minutes

3. Total minutes per week (multiple #1 by #2) _____ minutes per week
What could be?: