Talk overview

- Paediatric origins of cardiovascular disease (CVD)
- Importance of vigorous intensity physical activity (PA) for improving health in youth
- High-intensity interval exercise (HIIE) as a model to promote health
- Key messages
- Other work in CHERC (if time)

CVD and mortality

- Non-communicable diseases deaths = 36 million people/year
  - CVD = 17.5 million
  - Cancer = 8.2 million
  - Respiratory diseases = 4 million
  - Diabetes = 1.5 million
  - ‘Big four’ explain 82% of NCD deaths
- Smoking, physical inactivity, diet and alcohol

CVD: UK data in 2014

~41,000 premature deaths in UK/year

Atherosclerosis and age

Atherosclerosis starts in childhood

Exposure to CVD risk factors promotes a covert, preclinical progression of the disease

What are CVD risk factors?

- Age
- Sex
- Family history
- Insulin Resistance
- HDL : LDL
- Blood Pressure
- Dyslipidaemia
- Obesity
- Low Fitness
- Smoking
- Total Cholesterol
- Physical inactivity

Exposure to CVD risk factors promotes a covert, preclinical progression of the disease
Atherosclerosis has its origins in childhood: The Bogalusa Heart Study

Autopsy studies on 204 young persons


Tracking of CVD risk

Teenagers with clustered CVD risk are 6 times more likely to present with clustered CVD risk factors in adulthood


Reducing risk is a priority: “Life’s Simple 7” steps

856 participants aged 12 to 18 y at baseline with 21 years follow-up


The number of ideal CV health markers in youth predicts future arterial health

~ 12 years older in terms of ‘vascular age’


Physical activity, fitness and health: a life course perspective

**Physical activity**

How much daily physical activity should 5–18 year olds be performing?

1 hr **MINIMUM!**

At what intensity?

- Moderate or vigorous

**Physical activity levels decline during adolescence**

**How many kids meet these guidelines?**

**How many 5 – 18 year olds achieve this?**

- Boys: 32%
- Girls: 24%

**How many 11 – 15 year olds achieve this?**

- Boys: 7%
- Girls: <1%

**Are 60 minutes per day enough?**

1732 boys and girls measured at 9 and 15 years


**Physical activity, fitness and health: a life course perspective**

- Children and adolescents are not doing enough physical activity

**Effectiveness of intervention on physical activity of children: systematic review and meta-analysis of controlled trials with objectively measured outcomes (EarlyBird 54)**

- Over 6,000 children in 30 studies (each > 4 weeks)
- The average physical activity intervention increased daily physical activity by:

  4 mins
• Over 11,515 11 – 16 year olds
• The average physical activity intervention increased daily moderate/vigorous physical activity by:

2 mins

21/11/2017

And now for some good news...

• CVD starts in childhood and is related to risk factor status
• CVD risk factors in youth predict CVD burden in adulthood
• Physical activity lowers CVD risk
• Current guidelines are a minimum of 60 min per day
• Most children fail to achieve this
• Evidence suggests that 90 min per day should be the minimum and interventions only increase activity by a small amount

Our programme of research

Quality, not quantity?

• Physical activity intensity, fitness and CVD risk
  — Observational studies
• Exercise intensity and CVD risk in youth
  — Experimental studies
• Acute and chronic exercise interventions
• Traditional and novel risk factors for CVD

Dr Bert Bond
Dr Emma Cockcroft
Adam Malik
Sascha Kranen
Ricardo Oliveira

Physical activity intensity, sedentary time, TV viewing and fitness on CVD risk: HELENA study

• 534 European adolescents (252 males) aged 14-16 years old
• Accelerometer derived PA and sedentary time
• TV viewing by questionnaire
• Cardiorespiratory fitness by 20m shuttle test
• Muscular fitness by handgrip strength

Aim: What are the associations of different PA intensities (MPA, VPA), total sedentary time, TV viewing, CRF and muscular fitness on CVD risk factors?

Which ‘lifestyle’ factor is most important?

Barker et al. (revise and resubmit)

Increasing levels of vigorous physical activity and fitness, and reducing light physical activity and TV viewing time, are important for improving health outcomes.
Research Q: What is the effect of 2 weeks of HIIT on traditional and novel CVD risk factors in adolescents?

- Sixteen 13-14 year olds (7 female) were recruited
  - 3 withdrawals due to illness (male, female) and unrelated injury (male)
- Four visits to the laboratory over a 3 week period
- "Traditional" and "novel" CVD risk factors pre, 24 h post and 72 h post

Visits 2-4

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<td>8:00</td>
<td>Fasted</td>
<td>Preparation</td>
</tr>
<tr>
<td>9:00</td>
<td>Postprandial</td>
<td>Preparation</td>
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</tbody>
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Blood vessel function (% diameter change)

- HIIE better than MIE:
  - Improving blood vessel health
  - Lowering blood pressure
  - Increasing fat oxidation
  - Improving control of blood glucose
  - Improving the regulation of the heart

- HIIE the same as MIE:
  - Lowering fat in the blood

HIIE may be a useful method to increase vigorous intensity physical activity and the health status of children and adolescents
Concern: HIIE will not be adopted or maintained


**Does HIIE evoke unpleasant feelings?**

Malik et al. (revise and resubmit).

HIIE evokes elevated feelings of:
- Success
- Excitement
- Reward

**HIIE vs MIIE**

HIIE at 90% maximum does not promote unpleasant feelings

HIIE at 100% maximum appears to evoke unpleasant feelings

Does HIIE evoke unpleasant feelings?

Malik et al. (in preparation).

**Quick recap**

Research programme: Quality, not quantity

- Vigorous intensity physical activity drives improvements in cardiovascular health (< 10 minutes per day)
- HIIE, a form of vigorous intensity physical activity, improves a range of health outcomes in youth
- HIIE is perceived to be more enjoyable than moderate intensity exercise and is not aversive if the intensity is ≤ 90% maximum
- HIIE could serve as a useful model to improve the health status in youth

Data presented are efficacy studies. What about the effectiveness of HIIE in the school setting?
HIIE in the school setting (n=15 studies)

**Study design**
- **Participants**
  - Median sample size = 55
  - 37% females
  - Age range: 9-17 y
  - Recruitment data (range: 19-97%, n=4)
- **Setting**
  - Primary (n=5)
  - Secondary (n=9)
  - Special education (n=1)
- **Comparative group**
  - PE lessons
  - Continuous aerobic exercise or HIIE

**Outcomes**
- ▲ cardiorespiratory fitness (11/15)
- ▼ waist circumference (4/6)
- ▼ % body fat (3/10)
- ▼ BMI (2/9)
- ▼ triglycerides (1/5)
- → glucose (4/5)


Which is more powerful for health: physical activity vs. fitness?

"Being unfit warrants consideration as a risk factor, distinctly from inactivity, and worthy of screening and intervention."


Interventions to improve fitness are important as fitness levels are declining

Data generated from 27 countries in children aged 6-19 year olds between 1958 to 2003.

*Fatness explains ~ 40% of the fall in aerobic fitness*


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- ▼ blood pressure (4/7)
- ▼ triglycerides (1/5)
- ↔ glucose (4/5)


**Prescription of HIIE in the school setting**

**Delivery:**
- Incorporate into PE
- Lunch breaks
- After school

**Duration:**
- 2-15 weeks (average = 7 weeks)

**Modality:**
- Running
- Cycling
- Cross-trainer
- Boxing
- Dance
- Drills (e.g. basketball)
- Skipping

**Intensity:**
- ~ 90% heart rate max
- Hard/very hard on exertion scale

**Number of work intervals:**
- 4 to 40

**Work interval duration:**
- 10 to 60 s

**Frequency:**
- 2-3 times per week


Blair et al. 2009 BISM
Example: Haytor View Primary School, Newton Abbott

• School initiative to increase understanding of physical activity and its impact on health
  – Staff, parents and pupils
• Incorporated vigorous activity into PE lessons and during the school day (e.g. breaks)
  – School booklet
  – Guide activities (skipping, running, jumping etc)

Take home messages #1

• CVD is the biggest killer and starts in childhood
• Physical activity can reduce CVD risk in youth
• But our kids are not active enough
• Public health guidelines call for 60 min per day
  minimum
• This should be closer to 90 min per day
• Attempts to increase physical activity in schools typically fail

Take home messages #2

• Performing ~ 8-10 minutes of daily vigorous intensity activity is cardio protective
• High-intensity exercise is a method to increase vigorous intensity activity and improves a range of health outcomes, including fitness
• High-intensity exercise appears enjoyable and is not associated with unpleasant feelings if performed below ~ 90% maximum
• Studies suggest high-intensity exercise may have merit in the school setting and represents an area for future research

Thanks to the @CHERC_UoE team

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• Exmouth Community College (Exmouth)
• Sidmouth College (Sidmouth)
• St Luke’s School (Exeter)
• West Exe School (Exeter)
CHERC

- Basic and applied paediatric exercise and health science
- Established 1986
- Currently have 6 staff, 10 PhD students and 3 research fellows
- Queen’s Anniversary Prize

CHERC – Bone research

- PRO-BONE study (EU funded)
  - Effect of sports participation on bone mass and geometry in young athletes
  - Swimmers, cyclists and soccer players
  - 3 year longitudinal study including 9 month intervention using plyometric jumps

CHERC – Young athlete

- Young athlete’s heart (Heart Research UK)
  - Cross-sectional study looking at size and function
    - Soccer players vs normal children
    - Children with septal defects
    - Techniques (ultrasound)
    - Training effects on cardiac size and function
- Health and wellbeing of adolescent runners (ESRC)
  - England Athletics
  - Overtraining incidence, symptoms and causes
  - Longitudinal data with addition of injury, training load, drop out

CHERC – Exercise medicine

- Exercise and adolescents with cystic fibrosis (CF Trust SRC)
  - Measurement of physical activity, facilitators and barriers
  - Interaction of CF and medication on exercise tolerance
  - Design of clinical tool to assess fitness
  - On-line platform to increase physical activity