Waving or drowning? Obesity, physical activity, sedentary behaviour and health

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Overview

• Are typical levels high or low for?
  – Obesity prevalence-in children, adults
  – MVPA in children & adolescents
  – Light intensity PA?
  – New(ish) sedentary behaviour constructs: sitting; breaks in sitting
Modern lifestyles
Waving or drowning?

Is obesity prevalence
High or low?

MVPA levels
High or low?
Active Healthy Kids Scotland Report Card 2013

- [www.activehealthykidsscotland.co.uk](http://www.activehealthykidsscotland.co.uk)
- Based on successful Knowledge Translation model, Active Healthy Kids Canada
- ‘State of the nation’ report
- Will grade 11 health categories from A-F
  - Including MVPA; obesity; diet; screen time
## Physical Activity Levels

THIS IS THE CORE GRADE IN THE REPORT CARD. Unfortunately, it remains an **F** for the sixth consecutive year, as objectively measured data indicate that only 7% of children and youth are meeting Canada’s guidelines of 60 minutes of physical activity a day.\(^6\)

How far off the mark are we? Achieving the guidelines is essential for health benefits, but it is encouraging to note that 44% of Canadian kids are getting 60 minutes of physical activity on 5 days of the week.\(^4\)

### Organized Sport & Physical Activity Participation
- 75% of kids aged 5–19 participate in organized physical activities or sport.\(^{1,11,23}\)
- Kids from higher-income families have a 25% higher participation rate than those from lower-income families.\(^{2,11}\)
- One soccer and baseball/softball study found that only 46% of practice time is spent being moderately or vigorously active.\(^{53}\)

### Active Play & Leisure
- 46% of kids aged 6–11 get 3 hours or less of active play (unstructured physical activity) per week, including weekends.\(^{1,13,25}\)

### Active Transportation
- 35% of kids aged 10–16 report using active transportation on the main part of their trip to school (33% walk, 2% bicycle).\(^{9,13}\)
- The percentage of Canadian kids who walk or wheel to school peaks at age 10 (approximately 35%) and then drops off.\(^{46}\)

### Screen-Based Sedentary Behaviours
- Children and youth get an average of 7 hours and 48 minutes of screen time per day.\(^{47}\)
- Only 19% of kids aged 10–16 report meeting Canadian Sedentary Behaviour Guidelines, which recommend no more than 2 hours of recreational screen time per day.\(^{9,13}\)

### Non-Screen Sedentary Behaviours
- Although it is difficult to separate out non-screen behaviours, kids under age 6 spend 73–84% of their waking hours sedentary, and kids aged 6–19 spend 63% of their free time (after school and weekends) sedentary.\(^{9,13}\)
- Numerous studies suggest that high levels of sedentary behaviour increase health risks in kids regardless of how active they are.\(^{9,13}\)

### Physical Education (PE)
- 67% of schools report that almost all of their students take PE classes from a PE specialist.\(^{1,12,25}\)
- The proportion of students who get the recommended 150 minutes of PE per week ranges from 15–65% across school grades.\(^{1,12}\)

### Sport & Physical Activity Opportunities at School
- More than half of schools in Canada with Grade 6–10 students offer several intramural and interschool sports.\(^{9,13}\)
- 77% of parents report their schools offer sport or activity programs outside of regular PE classes.\(^{1,12}\)

### School Infrastructure & Equipment
- 99% of school administrators report that students have regular access to a gymnasium during school hours.\(^{9,13}\)
- A large majority also report that students have access to outdoor facilities (89%) and gyms (84%) outside of school hours.\(^{9,13}\)

### School Policy
- 54% of middle and high schools have a committee that oversees physical activity policies.\(^{9,13}\)
- 53% report having improvement plans related to physical activity for the current school year.\(^{9,13}\)
IS ACTIVE PLAY EXTINCT?

2012
Active Healthy Kids Canada
Report Card on Physical Activity for Children and Youth
2014 GLOBAL SUMMIT ON THE PHYSICAL ACTIVITY OF CHILDREN
Bringing together leading researchers and practitioners to address the growing childhood physical inactivity crisis

REGISTER NOW! If your work touches child and youth physical activity, SIGN UP NOW to receive your summit e-invitation and future communications on important details, at www.activehealthykids.ca/summit

Presented by Active Healthy Kids Canada, publisher of the annual Report Card on Physical Activity for Children and Youth.
Obesity definition

Excess fatness
With increased disease risk
Low sensitivity of high BMI in adults

- as low as 50% in women when compared against fatness measures (Hortobagyi et al 1994 EJCN 48:369-375)
- many adults, esp. women, who are excessively fat do not have a high BMI
- High BMI is a +ve test for obesity, not obesity (excess fatness)
Underestimation of obesity (excessive body fatness) from BMI in adults, Shah & Braverman et al PLoS ONE 2012. 26% obese by BMI, 64% by fatness; misclassification greater in women
Accuracy of BMI defined obesity in children & adolescents

BMI with national reference data (e.g. UK 1990)
‘National’ references pre/post-obesity epidemic
Cole/IOTF 2000 definition (>8,000 citations)
More recent international reference (WHO)
Ethnic differences in the relationship between body mass index and percentage body fat among Asian children from different backgrounds

Ailing Liu\textsuperscript{1,2}, Nuala M. Byrne\textsuperscript{2}, Masaharu Kagawa\textsuperscript{3}, Guansheng Ma\textsuperscript{1}, Bee Koon Poh\textsuperscript{4}, Mohammad Noor Ismail\textsuperscript{4}, Kallaya Kijboonchoo\textsuperscript{5}, Lara Nasreddine\textsuperscript{6}, Trinidad Palad Trinidad\textsuperscript{7} and Andrew P. Hills\textsuperscript{2*}

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\textsuperscript{7}Department of Science and Technology, Food and Nutrition Research Institute, Manila, Philippines
UK 1990 BMI reference
Accuracy of obesity definitions compared, UK 1990 vs Cole/IOTF
Reilly et al IJO 2000

• n 4175 7y olds, ALSPAC
• Body fatness measured and excess defined
• Accuracy of
  – BMI with UK 1990 reference vs Cole/IOTF
• UK 1990 (95th centile)
  – Sensitivity 88%
  – Specificity 94%
  – Prevalence approx. 20% by end of primary school
• Cole/IOTF ‘obesity’
  – Sensitivity 46% in boys
  – Sensitivity 72% in girls
  – Prevalence approx. 5% by end of primary school (boys), 11% (girls)
Accuracy of simple definitions of childhood obesity, systematic review
Reilly et al Obes Rev 2010 11: 645-655

• ‘Accuracy’ = detection of
  – High fatness
  – Co-morbidities

• Comparisons
  – Cole/IOTF vs national
  – High BMI vs High waist

• Much higher sensitivity with national BMI references, no loss of specificity

• No evidence of benefit of waist vs BMI e.g. for co-morbidities
UK 1990 BMI reference
Association between WHO cut-offs for childhood overweight and obesity and cardiometabolic risk

Mercedes de Onis\textsuperscript{1,*}, Cecilia Martínez-Costa\textsuperscript{2}, Francisco Núñez\textsuperscript{2}, Georges Nguefack-Tsague\textsuperscript{3}, Angeles Montal\textsuperscript{2} and Juan Brines\textsuperscript{2}

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Summary so far: obesity prevalence

- Drowning not waving
  - Adults
  - Children & adolescents

- Low prevalence estimates helpful to doubters;
  - esp. if prevalence has ‘levelled off’
  - e.g. Rokholm et al 2010

- Other issues?
  - Avoiding a logic problem with low prevalence
  - Consistency with PA?
  - Low study power with IOTF definition
  - Avoiding differential definitions between boys and girls
Waving or Drowning?
in Physical Activity (MVPA)
Some high estimates e.g. Nader et al.
JAMA 2008, mean>3h/d at age 9
Lancet series 2012 physical activity surveillance in adolescents

Figure 5: Proportion of 13–15-year-old boys (A) and girls (B) not achieving 60 min per day of moderate to vigorous physical activity.
Under-representation in Physical Activity Research Interventions

Lancet Series 2012

Figure 3: Mismatch between world population and evidence for physical activity interventions as measured by scientific publications. Countries in this density-equalising map are resized according to country population (A) and number of times a country is reported to be included in a review (B).
Malaysians at Risk!

Obesity

1 in 3 Malaysian adults are overweight or obese *

Obesity is linked to many life-threatening chronic diseases such as diabetes, heart disease and cancer.

*Source: National Health and Morbidity Survey 2011 for adults aged 18 years and above, by the Ministry of Health Malaysia

Mean Actigraph cpm in 9y old Malaysians 330 (obese) vs 380 (non-obese), Sharifah et al under review
Many other benefits of taking a more international perspective

What are the causal effects of breastfeeding on IQ, obesity and blood pressure? Evidence from comparing high-income with middle-income cohorts

Marie-Jo A Brion,¹,²* Debbie A Lawlor,¹,² Alicia Matijasevich,³ Bernardo Horta,³ Luciana Anselmi,³ Cora L Araújo,³ Ana Maria B Menezes,³ Cesar G Victora³ and George Davey Smith¹,²
Modern lifestyles
Waving or drowning?

MVPA or PA levels typically
High or low?
### Prevalence – PA In Preschoolers

<table>
<thead>
<tr>
<th></th>
<th>Sirard cutpoints*</th>
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</thead>
<tbody>
<tr>
<td>Mean time Total PA(min/d)</td>
<td>127.2</td>
</tr>
<tr>
<td></td>
<td>(95% CI 124.8-129.6)</td>
</tr>
<tr>
<td>Meet Aust/UK/Can rec (3h/d)</td>
<td>5.1%</td>
</tr>
<tr>
<td>Meet NASPE rec (2h/d)</td>
<td>56.3%</td>
</tr>
</tbody>
</table>

Compare with 100% compliance with 100cpm cutpoint; 5.5h/d PA
Hinkley unpubl

In school-age children: all subgroups 100% compliance when lower cut-points used
McClure et al 2009 Child:Care, Health, Dev

*1204-1592cpm; Hinkley et al., 2012
Resolving the cutpoint conundrum?

Collect more evidence? (accelerometer calibration studies/ cross validations)

- Consider evidence quantity, quality, consistency;
- But we have an accumulation of apparently inconsistent calibration and cross validation evidence
Resolving the cutpoint conundrum - with independent methods?

- Independent accelerometry e.g. Actical in Canadian surveillance (CHMS, Colley et al)
- Direct observation
- Pedometers
- Energy expenditure-DLW (TEE and PAEE) e.g. Lancet example; short term EE measures
- Combined methods e.g. Heart rate
- Alternative approaches to PA classification/ machine learning etc
What young Scots children do all day
Objectively measured PA, PAEE, and TEE (DLW)
(Reilly et al Lancet 2004)
Why do we need to resolve the cutpoint conundrum, or move on from it?

• What is the ‘state of the nation’?

• Rationale for interventions
  – Solving the MVPA or PA logic problem
  – Are recommendations wrong?
  – Dose response information
  – Prioritising efforts
  – Ability to discriminate/ find high risk groups
What about light intensity physical activity?

Or total ‘volume’ of physical activity
Waving or Drowning in Light Intensity Physical Activity (LPA) ?

- Most PA is LPA & probably beneficial, directly and indirectly
- Some populations may have high LPA, low MVPA ?
Objectively measured physical activity levels of children and adolescents in rural South Africa: High volume of physical activity at low intensity

Eva Craig, Ruth Bland, and John Reilly

Abstract: There is limited evidence on objectively measured physical activity from Africa. This study quantified physical activity by accelerometry in rural South African children at ages 7, 11, and 15 years. Total physical activity was generally high (mean accelerometer counts per minute ranged 485–1017 across the 3 groups), but moderate- to vigorous-intensity physical activity was low: <1% of the sample met international recommendations. A low intensity, high volume of physical activity is present in rural South African children and adolescents.

Key words: body composition, obesity, exercise, physical activity, exercise intensity.


Mots-clés : intensité de l'exercice, obésité, activité physique, inactivité physique, équilibre énergétique.
Comparison of 7y olds in England vs. rural S.Africa, identical methods and cutpoints

Craig et al Appl Physiol Nutr Metab 2012
More direct evidence of possible benefits of LPA, in adolescents

Example from ALSPAC:
Large longitudinal study;
Objectively measured PA;
Confounders accounted for
Instructions for wearing the Actigraph activity monitor

• You should wear the Actigraph for 7 days, starting the morning after your visit to Teen Focus 3.
• Take off the Actigraph before you get into bed and record the time. It’s a good idea to leave it somewhere you will easily see it first thing in the morning, like on top of your clothes.
• Remember to wear the Actigraph every day. This is essential.
• Every morning, remember to put the Actigraph on as soon as you wake up or immediately after having a shower or bath.
• The Actigraph can be worn underneath or on top of your clothing (unless you are wearing heavy clothing such as an anorak then it should go underneath). Adjust the belt so that the Actigraph is positioned just above the right hipbone (see photo opposite). Make sure Actigraph is the right way up, with the little notch at the top. The Actigraph must fit tightly but comfortably against your body. Adjust the strap to make a snug and comfortable fit.
• The Actigraph must not get wet. Try and cover it up in heavy rain. Please remove it for swimming, having a bath or shower. Please remember to put in on again afterwards. Record on the time sheet the periods when the Actigraph was not worn (see example below).
• The Actigraph is quite delicate. Please try not to drop it as it may break.
• At the end of the measurement period, please return the Actigraph and the time sheet in the envelope provided. It is extremely important that the Actigraph is returned promptly.

<table>
<thead>
<tr>
<th>TIMESHEET</th>
<th>Time put ON</th>
<th>Time taken OFF</th>
<th>Reason for taking off</th>
<th>How much time spent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Day 1</td>
<td>Time put on in morning</td>
<td>7.30 am</td>
<td>11.00 am</td>
<td>Went swimming</td>
</tr>
<tr>
<td>Date</td>
<td>22/01/06</td>
<td>12.00 pm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time taken off at night</td>
<td>9.30 pm</td>
<td></td>
<td></td>
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</tbody>
</table>

If this document is used or modified acknowledgments must be given to Avon Longitudinal Study of Parents and Children, University of Bristol
Recent ALSPAC examples: different exposures for different outcomes

- **Fatness: MVPA matters**

- **Academic attainment: MVPA matters**
  - Booth et al under review

- **Bone health: VPA matters**
  - Sayers et al JCEM 2011

- **Blood pressure: LPA (total volume) matters**
  - Leary et al Hypertension 2008
Drowning in other constructs? (and ways of measuring them)

• Sedentary behaviour
  – Activities with low energy expenditure
  – Screen time measurement problems (e.g. Lubans et al 2011 review) but exposure v. high e.g. HBSC 2010
  – Sitting time
  – Fragmentation of sitting time, e.g. number of breaks in sitting
  – Standing?
WHY OUR CHAIRS ARE KILLING US

We are sitting ourselves to death. And even those who exercise before spending their day at a desk are in danger. LIFE, PAGE L1
Construct overload?
Overload in measurement options?
Letter to the Editor: Standardized use of the terms “sedentary” and “sedentary behaviours”

Sedentary Behaviour Research Network

And see Pate et al 2008,
The evolving definition of sedentary
activPAL sitting time, breaks in sitting, standing, Total PA, MVPA (Janssen et al under review)
Sedentary Behaviour Constructs- Which Matter?

• Accelerometry is emetic
• What can we measure well (enough)?
• What should we measure?
  – What matters to health?,
  – In both short and long-term
Sitting time & fragmentation of sitting in childhood

• Basic questions for both constructs:
  – Norms ? –waving or drowning ?
  – Determinants ?
  – Tracking ?
  – Modifiable ?
  – Relationship to short or long-term health outcomes ?

• Measurement complexity

• How to express the data (e.g. see Chastin et al, Alghaeed et al 2012)

• Interventions ?
SITTING FOR LONG PERIODS OF TIME CAN BE HAZARDOUS TO YOUR HEALTH!
Validity, Practical Utility, and Reliability of the activPAL™ in Preschool Children

GWYNETH DAVIES¹, JOHN J. REILLY², AMY J. MCGOWAN¹, PHILIPPA M. DALL³, MALCOLM H. GRANAT³, and JAMES Y. PATON¹

Objective measurement of posture and posture transitions in the pre-school child

Gwyneth Davies¹,², John J Reilly¹,³,⁴ and James Y Paton¹

Device settings & metrics for measuring breaks in sitting in pre-school children Alghaeed et al under review
Objective measurement of sitting time: inconsistent validation evidence in young children

- Criterion validity (vs direct observation) of Actigraph & activPAL in 4-6y olds
- Classification accuracy of sitting low
  - For Actigraph
  - For activPAL
  - De Decker et al MSSE early online
Preschool activPAL measured breaks in sitting function of device setting Alghaeed, Davies et al

Compare with Actigraph. Kwon et al MSSE 2012 44:1075
Normative data on breaks in sitting 5-15y (Iowa Study, Actigraph measured, Kwon et al 2012)

**FIGURE 2**—Means and 95% confidence intervals of the mean hourly frequency of sedentary breaks over periods of the day by age.
Prediction is very difficult—especially the future

Niels Bohr
Conclusions

• We are drowning in obesity (excessive fatness) and, probably, low MVPA
• More global perspective both necessary and informative
• We are drowning in screen time, but objective measures would be valuable
• Drowning in ways of quantifying other aspects of sedentary behaviour
Thank You

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