Assessing the role of physical activity and sedentary behaviour for metabolic health

John Speakman
Have declines in our physical activity been instrumental in the obesity epidemic?

The past

NOW
Changes in physical activity over time

1940-50s
Changing pattern of domestic chores
Handwashing
Mangle drying

1960s
Twin-tub

2000s
Automatic

Energy expenditure or energy intake??
Changes in physical activity over time

1950-60s
Shopping in many small local shops

1970s -1990s
‘One stop’ supermarket shopping

2010s
Internet ‘shopping’
Home delivery
Changes in physical activity over time

1950-60s

- 1951 No car: 86%
- 1 car: 13%
- 2 cars: 1%

2000s

- 2000 No car: 27%
- 1 car: 45%
- 2 cars: 23%
- >2 cars: 5%

2015

- 2015 No car: 22%
- 1 car: 45%
- 2 cars: 27%
- >2 cars: 6%

(UK Dept transport statistics HMSO 2017)
Changes in physical activity over time

TELEVISION

In 1955 only 30% of households owned a TV set.

TV was only broadcast for about 5 hours per day.

2000s +

TV ownership now almost universal.

85% of homes have multiple TV sets.

Viewing hours peaked in the late 1990s.

20% of 9 year old kids in the USA watch more than 6h TV each day.
Computers and mobile phones

June 29th 2007

Average Time Spent Per Day, 18+ in US

time spent on mobile has surged

while time spent on other media has only slowly declined

10 hours per day on screen time!!!
Too much of a good thing?

Remote controls

Electric Tooth brushes

Electric carving/bread knives

1955
How sedentary can we get?
How do we measure energy expenditure?

Glucose + 6 O$_2$ $\rightarrow$ 6 H$_2$O + 6 CO$_2$ + energy

Palmitate + 23 O$_2$ $\rightarrow$ 16 H$_2$O + 16 CO$_2$ + energy

We can measure energy use by measuring O$_2$ consumption and CO$_2$ production

Or just one of these

IF we know the dietary composition
Measuring VO2 and VCO2
Doubly-labelled water method

Isotope equilibration in total body water

- Enrichment
  - $^2\text{H}$
  - $^{18}\text{O}$

The difference between the rate of loss of $^{18}\text{O}$ and $^2\text{H}$

$\text{CO}_2$ production rate

TEE calculation
Daily Energy Expenditure

Physical Activity Level (PAL) = DEE/(BMR)

PAL = 2  Activity = 50%

PAL = 1.5  Activity = 30%

Components of Daily Energy Expenditure

Activity

BMR = rest
Maastricht  The Netherlands

Klaas Westerterp
PAL against year of publication
(not significant – p > .05)

Westerterp & Speakman (2008)
Int J. Obesity 32: 1256-1263
Has the lowest observed value got lower over time?
Lowest PAL in each year

\( r^2 = 11.0\%, F = 1.79, p = 0.20, \text{ ns} \)
But......

This is European data

Over interval 1985 to 2004 obesity (BMI > 30) increased from 5 to 10% in the Netherlands
DLW Literature review (1982 – 2004) 393 subjects in USA

Still <1000 individuals, still only to 2004
IAEA DLW database management group

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Klaas Westerterp  Bill Wong  Yosuke Yamada  Alexia Alford  Yaraslav Pynda

International Atomic Energy Agency
Atoms for Peace and Development
Energy expenditures (PAL) of African tribes peoples subsistence farming/hunter gathering

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<th>Population</th>
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<td><strong>MEAN</strong></td>
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</table>
If physical activity changes not related to obesity then why do we advise people to do it??

Most governments advise 150 mins moderate to vigorous PA per week

c. 30 mins /day
Exercise is beneficial ... it reduces all cause mortality.


Blair SN et al Influences of cardiorespiratory fitness and other precursors on cardiovascular disease and all-cause mortality in men and women. JAMA 1996; 276: 205-10
Also probably leads to increased longevity (Finland study)

Recent work also suggests that being sedentary has an independent negative impact on health biomarkers.
Have declines in our physical activity been instrumental in the obesity epidemic?
THANK YOU!