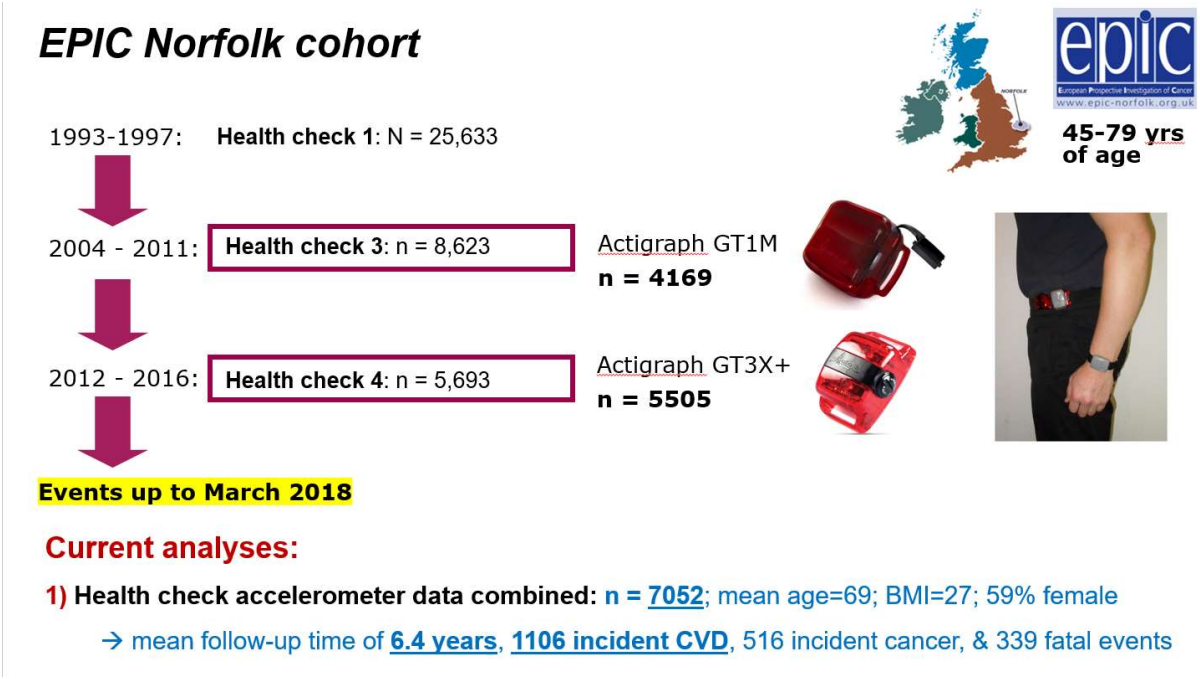
Study using wearable devices examines the different links between total and intensity of physical activity and sedentary behaviour on risk of cardiovascular disease and cancer

Many readers will already be aware that physical activity is good for our bodies and minds, and that spending too much time sedentary (sitting) tends to do the opposite for our health. Indeed, decades of observational studies have established dose–response relationships of higher duration and intensity of physical activity with reduced risk of cardiometabolic diseases and other health outcomes. However, much of this evidence has been based on self-reported measures of physical activity, which involves asking people how physically active and sedentary they are using questionnaires (cheaper and easier to implement in large population studies).

Physical activity is increasingly being measured using accelerometry devices which track intensity and duration of body movement. The use of accelerometers is an advance over self-report methods, which are prone to measurement error from imprecise and biased recall, and can thereby mask the true nature and magnitude of associations.

Our recent study using EPIC-Norfolk data is one such study which included waist-worn accelerometer measurements to track participants physical activity and sedentary behavuiour back in 2004-2016. In subsequent years, follow-up data on incident disease (cardiovascular and cancer) events and deaths were then captured to examine whether prior activity patterns were associated with later health outcomes (known as a prospective cohort study). Having access to a large sample of such detailed data on accelerometer-measured physical activity, with enough incident disease data and follow-up duration, is quite unique.

SLIDE 1



When integrating and analysing these data, we broke the physical activity down into four different kinds of activity:

1) **Total physical activity** per day (adding up ALL counts/movement registered on the accelerometer – so any form of activity)

2) Total time spent per day in **light** and **moderate-to-vigorous intensities** (i.e. counts above two specific counts per minute thresholds).

- *Light-intensity physical activity* can include slow walking, bathing, or other incidental activities that do not result in a substantial increase in heart rate or breathing rate.

- *Moderate-vigorous intensity activity* will raise your heart rate, and make you breathe faster, while vigorous-intensity activity making you breathe hard and fast. Examples include: brisk walking bicycling, dancing, swimming lengths, fitness exercise class, running, cross-country skiing, urban/Nordic pole walking etc. However, the intensity of the activity is dependent upon the effort exerted.

3) Total time spent per day **sedentary** (i.e. counts below a low counts per minute threshold that is likely to be mostly capturing sitting-related behaviours). Most desk-based office work, driving a car, and watching television are examples of sedentary behaviours, but these can also apply to those unable to stand, such as wheelchair users.

What we found

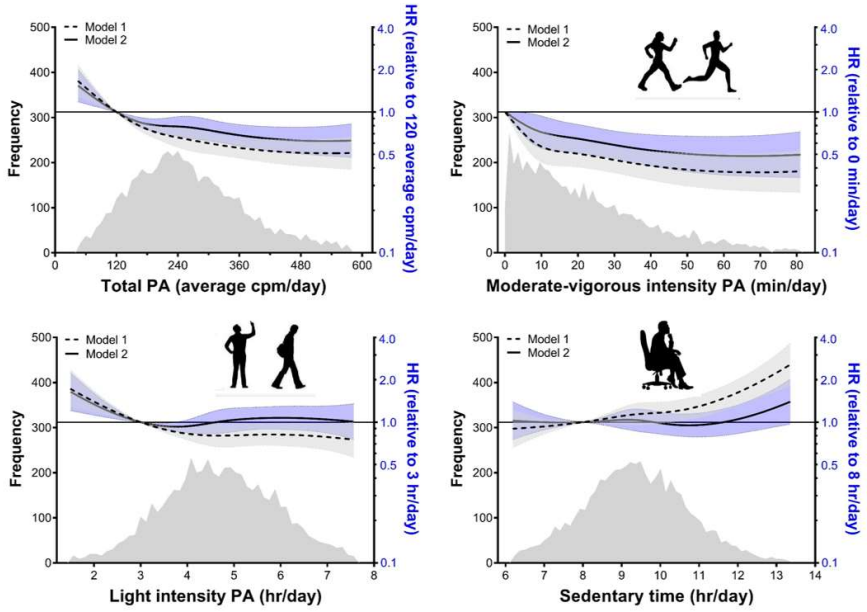
The three Figures below nicely show how the risk of having a disease or mortality event increases (hazard ratio above 1) or decreases (hazard ratio below 1) with increasing amounts of each kind of activity, relative to the 10^{th} percentile (or low levels) of that activity in the EPIC-Norfolk sample. For example, having a hazard ratio of 0.8 at a certain value of total activity (e.g. 240 counts/day) indicates a 20% decrease in the chance (or hazard) of having an early event, compared to the reference value at 120 counts/day. This method of statistical analysis (known as restricted cubic spline regression) is a useful way to assess whether associations with disease risk are linear (a straight line and dose-dependent) or more non-linear across the distribution of that activity in the EPIC-Norfolk sample.

Cardiovascular disease risk

After adjustment for several important lifestyle and demographic factors (model 2), we found that higher levels of total physical activity and moderate-vigorous physical activity were associated with lower incident cardiovascular disease risk in a nonlinear manner. That is, after an initially steeper decrease in hazard ratios, there was a flattening of the relationships. Associations for light-intensity activity and sedentary time were not as strong, although levels <3 hours/day of light-intensity activity were still associated with higher risk.

SLIDE 2

Incident cardiovascular disease (fatal/non-fatal)



Model 1: statistically adjusted for age & sex

Model 2: adjusted for lifestyle & demographic factors, & time in other activities

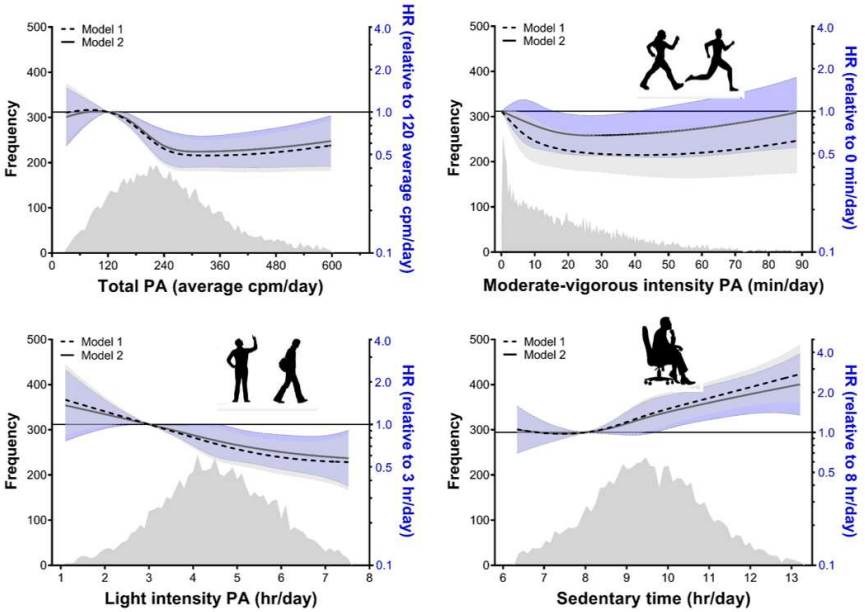
The grey histogram underneath the risk curves is the amount of people who spend a certain amount of time in each activity

Cancer risk and all-cause mortality

For cancer risk and all-cause mortality, associations generally followed directions similar to those for incident cardiovascular disease risk. However, associations for total physical activity and moderate-vigorous physical activity were weaker and less consistent, and tended towards no evidence of an association after an initially steep reduction in risk. Interestingly, consistently strong, and approximately linear, associations were observed for light-intensity physical activity and sedentary time in a beneficial direction.

SLIDE 3

Incident cancer (fatal/non-fatal)



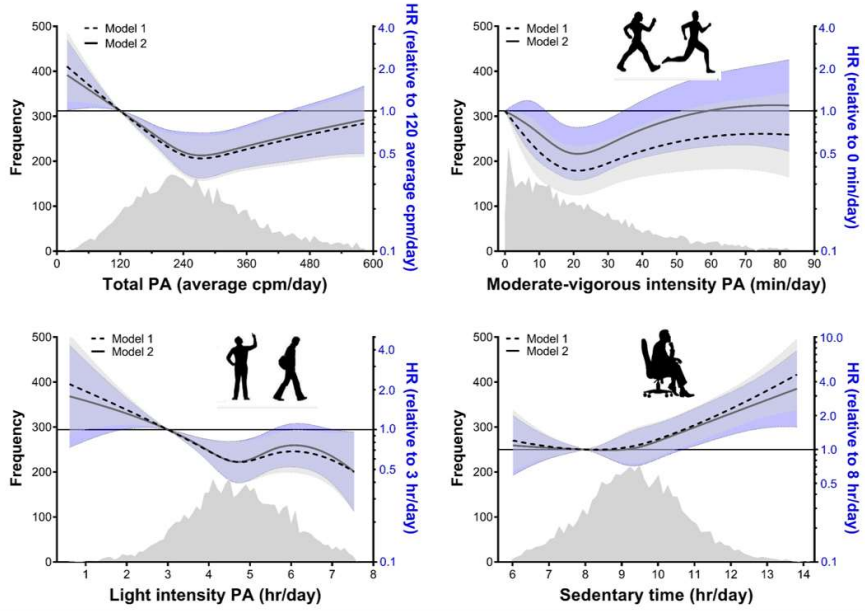
Model 1: statistically adjusted for age & sex

Model 2: adjusted for lifestyle & demographic factors, & time in other activities

The grey histogram underneath the risk curves is the amount of people who spend a certain amount of time in each activity

SLIDE 4

All-cause mortality



Model 1: statistically adjusted for age & sex

Model 2: adjusted for lifestyle & demographic factors, & time in other activities

The grey histogram underneath the risk curves is the amount of people who spend a certain amount of time in each activity

Summary

The findings highlight that different types of activity may be of differing importance for different health outcomes when measured in more detail. The results of this study suggest

that it seems to be important to be more physically active and at higher intensities to improve heart health and cardiovascular risk, whereas the time we spend sedentary and in light intensity activities seems to hold importance when it comes the risk of cancer and all-cause mortality. A consistent take-home message that comes through with all health outcomes is that 'all activity counts' towards reducing the risk of several important diseased outcomes. This is a message that is consistent with the very recent release WHO guidelines on physical activity and sedentary behaviour – which are well worth a read.

Some areas that we are now looking into in more detail now are whether the pattern or timing of activity, and how it is accumulated (i.e. in short or longer bouts), also matter for health. For example, does it matter if you sit for shorter or longer periods of time at once – or is it just the total volume of sitting that matters? This is something that is relevant to many currently, and a question that we could have only examined with the advent of more detailed accelerometer data in studies like EPIC-Norfolk.