General information – all projects

Projects

In groups, choose one of the following general topics to investigate in detail:

1) **Is it better to be active in the morning or evening, with respect to incident cardiovascular disease?**
2) **Is poor sleep associated with type 2 diabetes?**
3) **Are daily rhythms of activity/activity types associated with self-reported health?**
4) **How does "weekend warriors'" risk of incident cardiovascular disease compare with those who are more regularly inactive, and those who are not active?**
5) **Are wearable sensor measures of sedentary behaviour associated with incident cardiovascular disease?**

(You are welcome to play around with a couple at first, but please focus your final analysis on one in detail, rather than several superficially).

On Thursday, you will need to present a 10 – 15 minute presentation, explaining what you've looked into, why, what results you got, and how we should interpret them. There is a slide template to follow for this.

Scope of the project

There are several aspects you might consider in all projects:

- Definition of the exposure
- Specifics of the regression model
- Moving towards causal inference: confounding, reverse causation, bias
- Interpretation of the results
- Consistency of the results with existing literature

There are also several specific suggestions in each project. These are just suggestions: you don't need to address them all, and you are welcome to address other aspects!

Scripts

For each project, a very basic analysis is implemented in the form of a JuPyteR notebook (in the projects subfolder). This is a starting point and a source of ideas, and a long way from what the final analysis might look like. Please also note: these scripts focus on the regression modelling, to illustrate how you might go about this. However, as always, you will want to include in your results descriptive statistics describing the dataset and your exposure within it.

Data

These projects use:

- accelerometer-derived activity/behaviour variables
- demographic, lifestyle and physiological characteristics
- Hospital Episode Statistics and death data

All of what you need should be in the folder week2_cdt_data_challenge. Most of it should be in the data_after_prep.csv file we created on Monday. For the accelerometer-derived variables, you can use our summaries, or variables from your models from last week (or both).

Extras:

- If you want to define different (cardiovascular-related) health outcomes, use the 'addNewHES.py' script, which takes as input a CSV file with your current data, hesin_all.csv and a JSON file listing particular disease definitions, and returns a file with the extra HES definitions added. An example of how to run this in the command line is provided at the bottom of 1_Introduction:Setup from Monday's exercises.
- You may want to define new exposure variables, to address some aspect of the project. Using the summary variables to do this is very much within the scope of the project. You are also welcome to use the raw accelerometer data that you used last week to develop new exposure measures (e.g. different measures of sleep fragmentation). However, due to the limited time (as it takes > 24 hours to process on the BMRC system), you will not be able to apply any newly developed exposure measures to the whole UK Biobank dataset. (This is *not* a reason not to look into this angle- just a practical constraint!!)

Projects

1) Is it better to be active in the morning or evening, with respect to incident cardiovascular disease?

Popular articles frequently do the rounds talking about what time of day to exercise to achieve particular benefits: https://www.independent.co.uk/life-style/health-and-families/healthy-living/best-time-to-exercise-work-out-a8286536.html**.** Is there any truth to this?

Most (very limited) evidence comes from small mechanistic studies. Until recently, large cohort studies didn't have measures of activity that could easily quantify morning vs evening activity. (For example, it is difficult to ask people to self-report whether they are more active in the morning or evening).

This project explores whether there are differences in the associations of accelerometer-measured morning or evening activity with incident cardiovascular disease.

Project specific questions you might consider

- How should we quantify activity in the morning/ evening? Should we use overall acceleration, measures of specific activity types or something else entirely?
- How do we define morning and evening? Is a simple dichotomous split best, or could a measure capture the fact the day is a spectrum?
- How are measures at different times of day correlated? Does this introduce problems into the analysis?
- What confounders should this analysis be adjusted for? How can age be adjusted for in a Cox regression analysis for incident disease?
- Is chronotype (morningness/eveningness, a measure which is self-reported in UK Biobank) an effect modifier? (You are unlikely to be powered for this with incident disease- only ~ 9% are definite evening types for example- so if you do want to explore this, you might want to explore it cross-sectionally).

References

(1)

1. Chomistek AK, Shiroma EJ, Lee I. The Relationship between Time of Day of Physical Activity and Obesity in Older Women. 2017;13(4):416–8.

2) Is poor sleep associated with type 2 diabetes?

Poor sleep has been implicated in the aetiology of type 2 diabetes, and individuals with type 2 diabetes are at increased risk of a range of sleep disorders.

There are many aspects of poor sleep, such as duration, timing and quality.

This project explores how we quantify different aspects of poor sleep, and the link between different aspects of poor sleep and type 2 diabetes.

Project specific questions you might consider

- How can we quantify aspects of good sleep? In particular, how can we capture 'quality'?
- How are we defining the outcome (Type 2 Diabetes)? Is this a good definition? How could it be improved?
- How are the different aspects of good sleep associated with each other?
- What confounders should this analysis be adjusted for?
- Should shift workers be included in this analysis?

References

(2)(3)

2. Reutrakul S, Van Cauter E. Sleep influences on obesity, insulin resistance, and risk of type 2 diabetes. Metabolism. 2018;84:56–66.

3. Jones SE, Lane JM, Wood AR, van Hees VT, Tyrrell J, Beaumont RN, et al. Genome-wide association analyses of chronotype in 697,828 individuals provides insights into circadian rhythms. Nat Commun. 2019;

3) Are daily rhythms of activity/activity types associated with self-reported health?

Shift work has been associated with poor health in epidemiological studies. A hypothesised mechanism for this is that the disruption to behavioural rhythms this induces causes disruption to biological processes, which operate rhythmically (circadian rhythmicity) and are synced using both environmental and behavioural cues ('zeitgebers').

However, epidemiological evidence is limited; other factors (e.g. socioeconomic) may confound the association seen in shift workers, and until recently it was not possible to measure rhythms of activity in large-scale studies using devices. (Even studies using devices typically recommended removal for sleep).

This project explores whether daily rhythmicity of activity is associated with self-reported health.

Project specific questions you might consider

- How can daily rhythm be quantified? What is the interpretation of this quantification?
- Rhythms in which, if any, activity types are associated with self-reported health?
- What confounders should this analysis be adjusted for?
- Should shift workers be included in this analysis?

References

(4,5)

4. Dashti HS, Lane JM, Anderson SG, Schernhammer ES, Rutter MK, Saxena R, et al. Night Shift Work , Genetic Risk , and Type 2 Diabetes in the UK Biobank. Diabetes Care. 2018;41(April):762–9.

5. Lyall, L. M. et al. (2018) Association of disrupted circadian rhythmicity with mood disorders, subjective wellbeing, and cognitive function: a crosssectional study of 91 105 participants from the UK Biobank. Lancet Psychiatry, 5(6), pp. 507-514. (doi:10.1016/S2215-0366(18)30139-1)

4) How does "weekend warriors'" risk of incident cardiovascular disease compare with those who are more regularly inactive, and those who are not active?

In a society where most work is not active, and so most activity takes place in leisure time, certain patterns of activity emerge. One such pattern is so-called "weekend warriors", who meet WHO physical activity guidelines (at least 150 minutes of moderate or 75 minutes of vigorous activity per week) but do so in 1-2 sessions per week.

This project explores whether this "weekend-warrior" pattern is associated with different risk of incident cardiovascular disease.

Project specific questions you might consider

- How should we quantify "weekend-warrior"-ness? What is the interpretation of this quantification?
- How is weekend-warriorness associated (cross-sectionally) with other demographic and lifestyle characteristics?
- Is this measure affected by overall volume of activity? How should the analysis be adjusted for this?
- What confounders should this analysis be adjusted for? How can age be adjusted for in a Cox regression analysis for incident disease?

References

(6)

6. O'Donovan G, Lee IM, Hamer M, Stamatakis E. Association of "weekend warrior" and other leisure time physical activity patterns with risks for all-cause, cardiovascular disease, and cancer mortality. JAMA Intern Med. 2017;177(3):335–42.

5) Are wearable sensor measures of sedentary behaviour associated with incident cardiovascular disease?

In recent years, there's been increasing interest in *sedentary behaviour* as a possible health risk (some more than a little hyperbolic: http://standingatyourdesk.com/sitting-is-the-new-smoking/). Recent releases of guidelines on physical activity (e.g. https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/832868/uk-chief-medical-officers-physical-activity-guidelines.pdf) have suggested we should 'minimise the amount of time spent sedentary'.

However, most evidence comes from self-reported measures. These can be particularly problematic in the case of sedentary behaviour: for example, TV viewing time has often been used as a proxy for sedentary behaviour, but there is increasing recognition that TV viewing is often accompanied by a cluster of behaviours (such as snacking) which may explain associations seen.

This project investigates whether there is an association between accelerometer-derived measures of sedentary behaviour and incident cardiovascular disease.

Project specific questions you might consider

- Is the measure of sedentary behaviour used robust? Does it capture postural information, and not just activity intensity?
- What confounders should this analysis be adjusted for? How can age be adjusted for in a Cox regression analysis for incident disease?
- Do high levels of activity appear to mitigate associations seen with sedentary behaviour?
- How much are any associations seen with sedentary behaviour driven by the fact that sedentary behaviour is not physical activity?
- Are long bouts of unbroken sedentary behaviour associated with particular detriment?

References

(7–9)

7. van der Ploeg HP, Hillsdon M. Is sedentary behaviour just physical inactivity by another name? Int J Behav Nutr Phys Act. 2017;

8. Ekelund U, Steene-Johannessen J, Brown WJ, Fagerland MW, Owen N, Powell KE, et al. Does physical activity attenuate, or even eliminate, the detrimental association of sitting time with mortality? A harmonised meta-analysis of data from more than 1 million men and women. The Lancet 2016 p. 1302–10.

9. Tremblay MS, Aubert S, Barnes JD, Saunders TJ, Carson V, Latimer-Cheung AE, et al. Sedentary Behavior Research Network (SBRN) - Terminology Consensus Project process and outcome. Int J Behav Nutr Phys Act. 2017;14(1):1–17.

Bibliography

1. Chomistek AK, Shiroma EJ, Lee I. The Relationship between Time of Day of Physical Activity and Obesity in Older Women. 2017;13(4):416–8.

2. Reutrakul S, Van Cauter E. Sleep influences on obesity, insulin resistance, and risk of type 2 diabetes. Metabolism. 2018;84:56–66.

3. Jones SE, Lane JM, Wood AR, van Hees VT, Tyrrell J, Beaumont RN, et al. Genome-wide association analyses of chronotype in 697,828 individuals provides insights into circadian rhythms. Nat Commun. 2019;

4. Dashti HS, Lane JM, Anderson SG, Schernhammer ES, Rutter MK, Saxena R, et al. Night Shift Work , Genetic Risk , and Type 2 Diabetes in the UK Biobank. Diabetes Care. 2018;41(April):762–9.

5. Lyall L., Wyse CA, Graham N, Ferguson A, Lyall DM, Cullen B, et al. Association of disrupted circadian rhythmicity with mood disorders, subjective wellbeing, and cognitive function: a cross-sectional study of 91 105 participants from the UK Biobank. The Lancet Psychiatry [Internet]. 2018;5(6):507–14. Available from: http://ovidsp.ovid.com/ovidweb.cgi?T=JS&PAGE=reference&D=psyc14&NEWS=N&AN=2018-27895-025%0Ahttp://ovidsp.ovid.com/ovidweb.cgi?T=JS&PAGE=reference&D=emexa&NEWS=N&AN=2000766819

6. O'Donovan G, Lee IM, Hamer M, Stamatakis E. Association of "weekend warrior" and other leisure time physical activity patterns with risks for all-cause, cardiovascular disease, and cancer mortality. JAMA Intern Med. 2017;177(3):335–42.

7. van der Ploeg HP, Hillsdon M. Is sedentary behaviour just physical inactivity by another name? Int J Behav Nutr Phys Act. 2017;

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9. Tremblay MS, Aubert S, Barnes JD, Saunders TJ, Carson V, Latimer-Cheung AE, et al. Sedentary Behavior Research Network (SBRN) - Terminology Consensus Project process and outcome. Int J Behav Nutr Phys Act. 2017;14(1):1–17.