Author’s response to reviews

Title: Cross-sectional associations between personality traits and device-based measures of step count and sedentary behaviour in older age: the Lothian Birth Cohort 1936

Authors:

Iva Čukić (iva.cukic@ed.ac.uk)
Catharine Gale (cgale@exseed.ed.ac.uk)
Sebastien Chastin (Sebastien.Chastin@gcu.ac.uk)
Philippa Dall (Philippa.dall@gcu.ac.uk)
Manon Dontje (dr.m.l.dontje@gmail.com)
Dawn Skelton (Dawn.Skelton@gcu.ac.uk)
Ian Deary (iand@exseed.ed.ac.uk)

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Author’s response to reviews:

Thank you for the opportunity to respond to reviewer’s comments. We have responded individually point-by-point below, and have made changes to the text which are indicated by tracked changes.

Technical Comments:

1. We have noted that the corresponding author identified on the title page is different to the author on file in the editorial manager system. Please ensure that the corresponding author provided on the title page matches in the manuscript file and in the editorial manager system.

Response: We have changed the corresponding author from Dr Iva Čukić to Dr Philippa Dall in the editorial manager system. We have changed title page to match the corresponding author in the editorial manager system.

2. Authors Contributions: Sebastien FM Chastin and Philippa M Dall are missing.

Response: We have updated the contribution field to include contributions from all authors.
3. Please state clearly the role the funder(s) had in your study in the "funding" section of the declarations.

Response: We have clarified that the funder had no role in study design, data collection, analysis, data interpretation or writing the manuscript, in the declarations section (lines 363-370).

4. Please list all abbreviations used in your manuscript under the heading "Abbreviations" after the conclusions section. If no abbreviations are used in the manuscript, please state "Not applicable" in this section.

Response: We have added a list of abbreviations after the conclusions (lines 338-343). Additionally, we have removed one abbreviation (FDR for false discovery rate), as this was only used when also described fully.

5. Provide the heading for Conclusion and Declarations. The Declarations section should also be transferred before References.

Response: We have added the requested headings, and moved the declarations to before the references.

Editor Comments:

Associate Editor: This study would contribute better understandings for the effects of personality on physical activity and sedentary behavior among older adults. The topic would be suitable for our journal. However, both reviewers have given concerns for the treatments of the accelerometer data. They have commented that further data such as bouts, breaks and duration of sedentary behavior (comments from reviewer #1), and light or moderate-to-vigorous physical activity (comments from reviewer #2). Apart from the treatments of the accelerometer data, reviewer #2 has also given other concerns for your manuscript. Overall, I prize their comments.

Reviewer reports:

Yung Liao (Reviewer 1): This study examined cross-sectional associations between personality traits and objectively-measured physical activity and sedentary behavior in older age. Although the authors used optimal objective measures for physical activity and sedentary behavior, this study added limited evidence for this research area. I suggested the authors should further
examine the associations of different patterns of physical activity and sedentary behavior (i.e. bouts, breaks and duration) with personality traits in older adults.

Response to Reviewer 1:

We presented two aspects of sedentary behaviour, total time spent sitting and number of sit to stand transitions. The output from the activPAL monitor is generally presented as events (or bouts) which are continuous periods of a single category of activity, for example sitting. The end of each sitting bout is characterised by the change from a sitting posture to a standing posture. This transition thus represents both the end of a bout of sitting, and the start of an upright (standing and/or stepping) bout. Thus the outcome measure of number of sit to stand transitions represents both the number of sedentary bouts (the end of each bout), and the number of breaks in sitting (the start of a period of non-sitting). We have therefore presented in the current study both the traditional approach of total sedentary behaviour and an initial exploration of the pattern of sedentary behaviour, in the form of the number of bouts/breaks. We did not find significant associations of personality with either of these two outcome metrics. Additional in-depth exploration of the pattern of sedentary behaviour could have been conducted (for example exploration of the role of prolonged sedentary bouts). However, we had already conducted a large number of statistical tests, and without any initial finding of the potential influence of the basic pattern metric (number of breaks), we felt continued exploration (without a theoretical basis) was unwarranted, and have not conducted this analysis.

However, we acknowledge that this exploration of the pattern of sedentary behaviour was not very well explained in the original manuscript. We have made changes to the text to clarify the role of the outcome measure, and to place the null findings in context. Specifically, we have:

(1) Added an explanation to the descriptions of the outcome measures, to clarify which aspects of sedentary behaviour they represent (lines 126 to 134), which now reads:

“Three outcome measures were used. The average percentage of waking time spent sedentary per day (sedentary time) represented the total time spent in sedentary behaviour. The average number of sit-to-stand transitions was used to explore the pattern of sedentary behaviour. A sit-to-stand transition represents the start of a period of standing and/or stepping and a break in sedentary behaviour. This outcome measure, therefore, represented the total number of sedentary breaks each day, providing an indication of the pattern of accumulation of total sedentary behaviour. Finally, the average number of steps per day (step count) represented total physical activity.”
(2) Added detail to clarify and emphasise when referring to total sedentary behaviour and when referring to breaks in sedentary behaviour. This occurs at several places in the revised text, including:

subheadings in the results at lines 190 and 205; in the discussion at lines 231, 238 and 250; and in the conclusion at line 332.

(3) Added an explicit statement that the association of patterns of sedentary behaviour with personality have not been previously reported in the literature (lines 251-252).

(4) Added a paragraph in the discussion covering the potential association of patterns of sedentary behaviour with health, and stating the lack of association with personality reported in the current study (lines 297 to 303), and a new reference, which reads:

“In addition, the current study explored the association of personality traits with the pattern of accumulation of sedentary behaviour. There is evidence of some beneficial metabolic effects (e.g. glycemia) from experimental studies of the acute effects of regular breaks in sedentary behavior of at least light physical activity and from observational studies that a larger number of device-based measured breaks in sedentary behaviour was associated with reduced obesity. However, the current study did not find any association of personality with the number of device-based breaks in sedentary behaviour.”

Anne Chu (Reviewer 2): The primary research objective of this study was to examine the associations of personally traits of a Five Factor Model (FFM) and physical activity (PA) and sedentary behaviour (SB) in an elderly population using accelerometry-based measure. Overall the article is of decent quality and will be of interest to the community interested in caring for the elderly.

However, I have several queries and comments that need clarifications.

The main issue with the article is the assessment of only the step count but not physical activity intensity categories from the activPAL. I understand that this population might have very low-intensity PA due to old age, but the device is able to categorize activity as sedentary, light or MVPA; in which case I feel that the title shall not be stating "physical activity", but rather specifying "step count".

Response:
The statement that the device is able to categorize activity as sedentary, light or MVPA, is not completely straightforward.

The activPAL activity monitor is an accelerometer worn on the front of the thigh. Initially the monitor uses the inclination of the thigh (the component of gravity relative to axis of the accelerometer aligned with the thigh) to distinguish a sitting from an upright posture, categorising time as either sedentary (sit/lie) or upright (including standing and stepping). In terms of assessing sedentary behaviour, the activPAL is acknowledged as the preferred device-based measure and is regularly used as a criterion measure (Kozey-Keadle et al 2011, Sellers et al, 2016), which is why we selected this monitor to measure sedentary behaviour.

When individuals are upright, the activPAL monitor uses the acceleration pattern to identify stepping, and distinguishes between time spent standing and stepping. Additionally, when it identifies stepping activity, it provides the timing of individual strides (representing two steps) reporting the number of steps as a standard output and allowing the cadence (step rate) of walking events (bouts) to be calculated. The activPAL has good validity for reporting the time spent walking and the number of steps taken against observation in both adults (e.g. Sellers et al, 2016) and older adults (e.g. Grant et al, 2008).

The activPAL is not generally used to distinguish between intensity categories of physical activity. A number of different approaches have been taken towards categorising and reporting moderate to vigorous physical activity (MVPA) using activPAL output. The activPAL includes an embedded outcome of metabolic equivalents (METs), but it is based on a fixed value for bouts categorised as sitting or standing, and on cadence for bouts categorised as walking. This embedded algorithm has been validated for categorising MVPA in adults (Lyden et al, 2017), but the authors did change the embedded algorithm slightly (i.e. they did not use the standard activPAL output) before conducting their validation. An alternative approach, using the cadence of walking as a measure of intensity, is to set a threshold value for the average cadence of each walking event, summing the time spent in those judged to be MVPA. A threshold of 100 steps/minute has been used for adults (e.g. O’Dolan et al, 2018), which was selected based on several validation studies comparing cadence against oxygen consumption using both treadmill and overground walking (Abel et al, 2011; Harrington et al, 2012; Marshall et al, 2009). Finally, the raw acceleration output has been used as a ‘count’ value to establish a threshold for MVPA, but this has only been developed for children and adolescents, and has very limited validation (Harrington et al, 2011; Janssen et al, 2014).
An important point is that the exploration of the use of activPAL output to identify MVPA is limited, and has only been conducted in adults and children. It is likely that the threshold for cadence to identify walking as MVPA would be lower than 100 steps/minute. There is no work in establishing such a threshold for older adults, and we did not feel comfortable using a threshold developed for adults in this study. In our sample, the participants were aged about 79 with a range of health and activity levels (from 1,800 to 19,000 steps per day), and thus we would expect that the threshold for MVPA would vary from participant to participant. We therefore decided not to report physical activity categorised by intensity (as it was not clear this would be accurate and valid for our sample), but have reported number of steps taken, as a measure of the value of total physical activity. Although we could also have reported total time spent walking, this is also a measure of total physical activity not stratified by intensity and is highly correlated to step count, and thus only including one of these outcomes in the analysis is a parsimonious approach.

We feel that step count adequately represents the concept of physical activity in this article. However, we have replaced the term physical activity with step count in the title as suggested by the reviewer, to provide potential readers with a more specific idea of the manuscript content. We have also clarified that step count represents total physical activity in the methods section (lines 132 to 133), and added a sentence in the limitations section highlighting that we were only able to look at total physical activity and not intensity (lines 320 to 323):

“However, there are no available algorithms to reliably identify moderate intensity physical activity in older adults using the monitor, and we were unable to investigate the association of personality with physical activity intensity alongside the association with total physical activity (represented by step count).”

Also, I feel that the rationale of this paper is not strongly stated in the manuscript.

Response: We have expanded the text to more clearly articulate the rationale of the study (lines 89 to 98), which now reads.

“Understanding the associations of potential determinants such as personality traits with physical activity and sedentary behaviour can allow appropriate targeting of public health interventions. However previous research exploring the association of the five-factor model of personality traits
with device-based measures of physical activity sedentary behaviour, has either not been explored in older adults, or has been limited by small sample sizes and the lack of a postural measure of sedentary behaviour. The association of the pattern of accumulation of sedentary behaviour with personality traits has not been previously reported. Therefore, the aim of the current study was to examine cross-sectional associations between personality traits of the FFM, and device-based measures of physical activity and postural sedentary behaviour in a larger sample of older participants.”

Abstract.

1. Background - "Low levels of PA and high levels of SB…": Please rephrase to better reflect the gap, e.g. It is essentially 'device-based measures' rather than 'objective'. The field of PA is starting to avoid the word 'objective' for accelerometer assessments. There are many 'subjective' decisions in this, such as cut points. Hence, please amend the word objective to e.g. accelerometry-measured.

Response: We have changed objective to device-based, in the abstract and also in the title and throughout the text of the manuscript.

2. Methods - Please specify the type of "Regression model" used, was it linear/logistic regression?

Response: We have added that we used a linear regression model to the abstract (line 32).

Background.

Line 87- (≤ 1.5 metabolic equivalents (METs), missing one ")") in this line.

Response: Thank you we have corrected this.

Lines 96-97 - The authors cited rs and r from the same study, has the study used both pearson and spearman's correlation coefficient analysis methods?

Response: The study in question was a meta-analysis reporting mean effects size of correlation of personality traits (five factor model) to physical activity (all but one study using self-reported
physical activity). We used the term rs as a plural when reporting multiple values of r within a single bracket. We have now altered the text to clarify (line 68).

It will be helpful to elaborate and provide additional background on the five-factor model of personality for readers who are unfamiliar with this concept.

Response: We have provided additional information on the five-factor model in the introduction (lines 61-67), which now reads:

“Well-known correlates of self reported physical activity are personality traits of the Five Factor Model (FFM). 12,13 Personality traits are stable characteristics of ways of behaving and thinking. Although several different models exist, the commonly used FFM has five broad traits, neuroticism (the tendency to experience negative emotions), extraversion (the tendency to be sociable and outgoing), openness (the tendency to be creative and unconventional), agreeableness (the tendency to be trusting and modest), and conscientiousness (the tendency to be disciplined and organised).”

Methods.

Line 137 - Sedentary behaviour and physical activity was recorded continuously...activity "data were" recorded...

Response: We have corrected this (now line 116).

Personality traits.

So how was each dimension of the FFM calculated? i.e. Was it a likert-scale question? Please describe in more detail.

Response: We have added additional detail as to how the questions were asked and how the dimensions of the FFM were calculated from the IPIP. This now reads (lines 136-144):

“Personality was assessed using the 50-item International Personality Item Pool (IPIP) questionnaire, 27 that taps into the dimensions of the Five Factor Model (FFM). 28 Participants rated fifty statements with regard to how well they described themselves (e.g. “I am the life of the party”) on a 5-point Likert scale from very inaccurate to very accurate, with some items scored positively and some reversed. Dimensions are scored as the sum of statements (reversed as required) relating to that dimension (10 statements per dimension). The IPIP dimensions are Extraversion, Conscientiousness, Agreeableness, Emotional Stability (reflecting reversely scored
Neuroticism), and Intellect/Imagination (similar to Openness). The scale is a reliable and validated measure of the FFM dimensions. 29

Statistical analysis.

The authors did not justify the adjustment for the following factors in the following modes: Model 1 controlled for age and sex. Model 2 was the same as Model 1, and additionally controlled for BMI, and long-term illness.

Response: The selection of covariates was based on several common personal variables which have been previously shown to be related to both personality and physical behaviours (physical activity and sedentary behaviour). We have moved our original statement comparing our selection with previous research to be earlier in the section on covariates, and also expanded this to briefly justify the selection. This now reads (line 146-148):

“Personality traits, physical activity and sedentary behaviour have all been show to vary by age, gender, and health (including weight status), and the choice of covariates was made based on the recent research linking personality traits and device-based measures of physical activity.20”

Discussion.

What was the main public health importance/contribution of this paper that advanced the field?

Response: The relevance of investigating the associations of potential determinants of health behaviours is to provide evidence of suitable targets for public health interventions. This is true regardless of whether those potential determinants turn out to be associated with the health behaviour. We have added a paragraph to the discussion highlighting the public health importance of this study (lines 305-315), which reads:

“We have shown in a large group of community dwelling men and women aged approximately 79 in the UK, that personality traits were not key factors in whether people engage in total sedentary behaviour or how they break up their sedentary behaviour, after adjustment for age, gender, weight status and general health. Determinants of sedentary behaviour can be used to target interventions aiming to reduce and break up pronged sedentary behaviour. Personality traits represent substantially stable traits and are not ideal themselves as intervention targets. However, behaviours associated with personality traits might be. Moreover, understanding how personality traits interact with sedentary behaviour can help tailor intervention content and delivery. As other determinants of sedentary behaviour have been shown to be important (such as socio-economic deprivation), these represent more appropriate targets for public health interventions.”
Limitations - What about the generalizability of the results?

Response: Thank you for this comment. We have added a sentence (lines 325 to 326) to the limitations section to highlight this.

“Participants were all born in the same year, and lived in the United Kingdom, which may limit generalisability of the results.”

Line 284 - physical activity (e.g.33, 34) -&gt; ??

Response: We have moved the references out of the brackets (now line 272).

Lines 309 - 310: It is awkward to end this section with this single line here, "Our study is in line with previously reported lack of associations between personality and objectively measured sedentary behaviour.20"

Response: Thank you for this comment. We have expanded the discussion to incorporate discussion of the lack of association of personality with breaks in sedentary behaviour, which has added more detail to this sentence. The paragraph (lines 297 to 304) now reads:

“In addition, the current study explored the association of personality traits with the pattern of accumulation of sedentary behaviour. There is evidence of some beneficial metabolic effects (e.g. glycemia) from experimental studies of the acute effects of regular breaks in sedentary behavior of at least light physical activity and from observational studies that a larger number of device-based measured breaks in sedentary behaviour was associated with reduced obesity.41 However, the current study did not find any association of the five-factor model’s personality traits with the number of device-based breaks in sedentary behaviour.”

References used in the response:


O'Dolan CE, Grant M, Lawrence M, Dall PM. A randomised feasibility study to investigate the impact of prompts and education on the sedentary behaviour of office workers. Pilot and Feasibility Studies 2018; 4:33.