Author's response to reviews

**Title:** Socio-demographic, psychosocial and home-environmental attributes associated with adults’ domestic screen time

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**Author's response to reviews:** see over
Dear Dr. Giles-Corti,

The authors would like to thank you and the reviewers for the interest in our work and the decision to reconsider acceptance for publication of the manuscript after revision.

We carefully considered all comments and suggestions made by the reviewers. Please find below the complete list of changes, and our responses to each of the points made by the reviewers.

Our comments and explanations are in bold font, and the specific revisions added to the manuscript are in *Italics*.

Sincerely yours

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Comments of reviewer #1

General Comments: This manuscript seeks to examine individual, social, and home environmental correlates of sedentary behavior. The topic is relevant to the growing awareness that sedentary behaviors are independently related to health outcomes. Generally, the manuscript is well-written and provides new information.

Specific Comments:
Discretionary Revisions
1. Introduction
Lines 70-71: Adding a brief statement about the specific health findings would be helpful to readers.

We specified the health problems for which associations with the amount of sedentary time have been found on page 4, lines 73-79.

‘Recently, sedentary behaviors (involving prolonged sitting time; SB) also have been found to be associated with elevated risk of obesity, cardio-metabolic risk profile, diabetes, cardiovascular disease, specific cancers and overall and cardiovascular mortality [4-7]. These negative associations exist independent of the PA level and have been identified in cross-sectional and longitudinal studies addressing specific behaviors like television (TV) viewing, other screen-based entertainment and time spent sitting in cars, as well as in studies examining overall sitting time [4-11].’

Line 79: Is internetworldstats considered a valid source for this data?

We are not completely sure whether this website is a valid source, but the website assures the reader that the Internet usage information is recent and comes from trustworthy sources like Nielsen online, International Telecommunications Union, GfK and the US Census Bureau (www.internetworldstats.com). In our judgment, this is the most valid source available to obtain current information about Internet access in Belgium. We have now provided in the text the date on which we accessed the relevant information. Other sources that we could potentially provide would be less-accurate, definitive and certainly more out-of-date than is this source.

2. Measures
How was the Salmon measure adjusted?

The questionnaire to assess TV viewing time and leisure-time internet use was translated into the Dutch language, and instead of ‘last seven days’, we used ‘a usual week’ as a recall frame. Assessing usual behavior rather than behavior undertaken during the last seven days leads to a more stable measure. We specified this in the Methods on page 7, lines 134-138.
The original English-language questionnaire was translated into Dutch and instead of assessing the amount of SB during the last seven days, a ‘usual week’ version was used in this study. Assessing ‘usual’ behavior offers a more stable measure compared to assessing behaviors undertaken during the last seven days [24].

Please provide the scales and response options for psychosocial variables (1 to 5 or 0 to 4 scale? What did each option stand for (agree/disagree?)) to improve interpretation of Table 1 (put this information in footnote to table 1 as well).

We have now added this information to the Methods on page 8, lines 171-175 and as a footnote in Table 1 on pages 25-27 to make that table easier to understand.

Page 8, lines 171-175
All psychosocial correlates were rated on a five-point (one to five) Likert scale. For pros and cons of reducing screen time and social norm from family and friends, the response options ranged from ‘strongly disagree’ to ‘strongly agree’, while for self-efficacy about reducing screen time, the options ranged from ‘I think this is very difficult’ to ‘I do not think this is difficult at all’.

Footnote Table 1
a Size of the largest TV was positively scored on a five-point scale (1-5), ranging from 39cm to 139cm
b pros, cons, family social norm and friends social norm were positively scores on a five-point scale (1-5), ranging from ‘strongly disagree’ to ‘strongly agree’
c self-efficacy was positively scored on a five-point scale (1-5), ranging from ‘I think this is very difficult’ to ‘I do not think this is difficult at all’

3. Discussion
Another issue for the social norms item is they only consisted of one item for each friends and family.

Indeed, including multiple items for these constructs may have provided variables with stronger measurement properties. This is something that needs to be taken into consideration for future studies. We have added this issue as a possible explanation (pages 14-15, lines 330-334) for the unexpected results that were found for the association between social norm from family and leisure-time Internet use. Moreover, we have added a comment on the fact that only one item was used to measure social norm to the Limitations on pages 15-16, lines 351-357.

Pages 14-15, lines 330-334
Furthermore, the questions to assess social norm consisted of only one item for family and one item for friends and were derived from questions to measure social norm towards physical activity; thus, our findings might have differed if this factor would have been
assessed using multiple items and if more-specific questions to assess social norms towards SB would have been used.’

Study limitations on pages 15-16, lines 351-357

‘Fourth, some possibly important correlates (e.g. number of TVs in the bedroom, enjoyment of SB) were not included in the questionnaire or were only assessed with a limited number of questions (as was the case for how we assessed social norm from family and friends). These factors should be investigated more thoroughly in the future. Moreover, the validity of questions to assess social norm from family and friends towards domestic screen time needs to be examined.’

In the introduction, the authors discuss the importance of distinguishing correlates for sedentary behaviors from physical activity. Commenting on whether similar or different variables were found to be related to sedentary behaviors as compared to what has been found for physical activity would be helpful.

When comparing the correlates that were found in the present study to correlates that are usually found to be important to explain physical activity in adults, a number of similarities were apparent. For sedentary behaviors, psychosocial factors were of greater importance than were home-environment factors; and, self-efficacy, pros and cons appeared to be the most consistent correlates. In physical activity research, similar findings have been reported. We have added a paragraph to the Discussion on page 15, lines 336-345 in order to elaborate on these similarities.

‘When comparing the present findings to what has been reported in studies examining correlates of PA in adults, similar patterns can be identified. Self-efficacy is one of the most consistent correlates of PA, together with perceived benefits and barriers and social support [1]. Moreover, psychosocial factors (because they can be assessed in ways that closely match the behaviors of concern) usually explain a larger proportion of the variance in PA than do environmental attributes [42]. These similarities suggest that the use of behavior-specific correlates may lead to some findings that are comparable across different behavioral domains. This is interesting for future interventions, since focusing on self-efficacy and benefits/barriers towards health behaviors (including both PA and SB) might lead to positive effects on different outcomes.’

Comments of reviewer #2

This study examined socio-demographic, psychosocial and home environmental correlates of adults' TV viewing and Internet use in Belgium. In general, the design is appropriate and well described, the methods provide sufficient details, the data are sound, and the paper is properly structured. Regarding the data analyses, I am not convinced about the examination of moderating effects. Since demographic factors including sex, age and education level have been investigated in regression models, what additional information the authors expected to
Concerning the statistical analyses, we would like to clarify the importance of executing the moderator analyses in addition to the basic regression models. The socio-demographic factors were investigated as correlates of domestic screen time, so as a first step we included them in the regression models as independent variables, to examine the ‘main effects’. By doing so, we examined whether gender, age, educational level, employment status and BMI were associated with domestic screen time. Then, as a second step, we examined the moderating effects of the socio-demographic factors (gender, age, educational level) on the associations between home-environmental and psychosocial factors with domestic screen time. By doing so, we are able to examine whether these associations differed by gender, age and educational attainment. The absence of interaction effects suggested that similar psychosocial and home-environmental factors can be targeted in different subgroups (men and women, younger and middle-aged adults, lower- and more highly-educated adults). These results do not change anything in relation to the main effects of the socio-demographic factors, because these factors have been linked directly to domestic screen time. We have added the following comment to the Discussion section (lines 262-268) to clarify this matter for the reader:

‘By conducting analyses that examined sociodemographic attributes as both predictors of the main effects, and as moderators of the relationships of home environmental and psychosocial factors with domestic screen time, we were able to examine specifically whether these associations differed by gender, age and educational attainment. The absence of interaction effects suggested that similar psychosocial and home-environmental factors can be targeted in different subgroups (men and women, younger and middle-aged adults, lower- and more highly-educated adults).’

Major Compulsory Revisions
1. Conclusion in the Abstract is not precisely based on the findings, need to be revised.

We have revised the conclusion of the Abstract on page 4, lines 58-61. We summarized the most important correlates and emphasized the potential importance of addressing psychosocial factors and environmental attributes in efforts to decrease domestic screen time.

‘Educational level, age, self-efficacy and pros/cons were the most important correlates identified in this study. If further cross-sectional and longitudinal research can confirm these findings, tailored interventions focusing on both psychosocial and environmental factors in specific population subgroups might be most effective to reduce domestic screen time.’

2. Method: it is unclear how “social norm” items were selected (or developed) because I cannot find them in the study of Norman et al (Psychol Health, 2004) if I am not wrong.
Thank you for this thoughtful remark. Indeed, in the questionnaire of Norman and colleagues (2004) no questions were included to assess social norm. However, because social norm has been identified as an important correlate of physical activity, we wanted to include it as a potential correlate in the present study. Because no other questionnaires assessing psychosocial correlates of sedentary behavior were available, the social norm questions that we included were based on validated questions that have been used to assess social norm towards physical activity (De Bourdeaudhuij & Sallis, 2002; Deforche et al, 2004). We added this information to the Methods on page 8, lines 159-162 and lines 165-167. The use of these physical activity-based questions might be an explanation for the unexpected results on the associations between family social norm and leisure-time Internet use. We added this to the Discussion on pages 14-15, lines 330-334.

Page 8, lines 159-162
‘Psychosocial variables: All questions on psychosocial variables, except for social norm from family and friends, were derived from a validated questionnaire developed by Norman and colleagues [25] in the context of the PACE (Physician-based Assessment and Counseling for Exercise) study.’

Page 8, lines 165-167
‘The questions to assess social norm from family and friends were based on previously validated questions to measure social norms towards physical activity [26,27].’

Pages 14-15, lines 330-334
‘Furthermore, the questions to assess social norm consisted of only one item for family and one item for friends and were derived from questions to measure social norm towards physical activity; thus, our findings might have differed if this factor would have been assessed using multiple items and if more-specific questions to assess social norms towards SB would have been used.’

3. Table 2 is not properly displayed. Further, are there any significant differences among different categories/groups?

We changed the layout of this Table (Table 3 in the revised version). The statistical significance of differences between categories was not calculated, because the socio-demographic factors were included as independent variables in the regression analyses. The regression analyses show associations of socio-demographic variables with domestic screen time (age, educational level and BMI were associated with TV viewing time; educational level and employment status with leisure-time Internet use). In this context, such further tests of significance would be superfluous and potentially confusing for the reader.
4. Education level was associated with both TV viewing and Internet use, but in different directions. The authors suggested that financial aspect may be an explanation why people with low education spent less time using Internet. If it is the case, unemployment (usually link to poor financial status) should be negatively correlated with Internet use, which was contradictory to the results. More data should be provided here to support the speculation, i.e. % having at least one computer at home or % access to Internet in the subsamples of difference education level or employment status.

Indeed, lower educational attainment was associated with less Internet use, while unemployment was associated with more Internet use. ‘Unemployment’ also included ‘being retired’, so it might be that unemployment is less strongly related to financial status than educational level. We clarified the content of the term ‘unemployed’ in the Methods on page 7, lines 145-149 and in Table 1. Moreover, chi²-tests were performed to examine the association between employment status and having at least one computer at home. The chi² was significant (chi²=6.77, p=0.009). Working adults were more likely to have at least one computer at home compared to non-working/retired adults. So, it appears that working adults rather have a computer at home (93.9% versus 86.1%), but they might not use it very often, because they do not have as much discretionary time as unemployed or retired adults.

Page 7, lines 145-149
‘Socio-demographic variables: These included self-reported gender, age, educational attainment (primary, secondary, tertiary education), employment status (employed, not employed/retired), and body mass index (BMI; calculated using self-reported height and weight).’

We also conducted chi² tests to examine the association between educational level and ‘having at least one computer at home’. Again, the chi² was significant (chi²=9.9, p=0.002). Of the less-educated adults, 13.3% had no computer with Internet access, while only 4.6% of the higher-educated had no computer with Internet access at home. We added these findings to the Discussion on page 13, lines 285-289, in order to support our explanation.

Page 13, lines 285-289
‘Financial aspects may play a role: less-educated adults may have priorities other than buying a computer with Internet connection for leisure-time use. Our findings support this assumption: the prevalence of having no computer with Internet access at home was higher in less-educated adults compared to higher-educated adults (13.3% and 4.6% respectively, χ²=9.9, p=.002).’

5. The unexpected result was observed in the association of social norms with screen time. Having said that, it was unclear how these items were developed. How valid are these items? The four factors were all positively correlated to screen time (Table 1) which are also unexpected if I’m right. The meanings behind these constructs need to be clarified.
As mentioned in the response above to the second comment of Reviewer 2, the questions to assess social norms were based on studies examining social norm in relation to physical activity because no validated questions to assess social norms in relation to sedentary behaviors were available (see answer to comment 2 of this reviewer). The physical activity-related questions have been validated in adults and adolescents, but no additional validation study was done for these sedentary behavior-related questions. This is a shortcoming of the study and we added this to the limitations on pages 15-16, lines 351-357.

‘Fourth, some possibly important correlates (e.g. number of TVs in the bedroom, enjoyment of SB) were not included in the questionnaire or were only assessed with a limited number of questions (as was the case for how we assessed social norm from family and friends). These factors should be investigated more thoroughly in the future. Moreover, the validity of questions to assess social norm from family and friends towards domestic screen time needs to be examined.’

Indeed, the four social norm factors were all positively correlated to domestic screen time in the unexpected direction, but in the regression analyses, only family social norm remained a significant correlate of leisure-time Internet use. The unexpected direction of the correlations supports the hypothesis that these questions might assess behavior rather than attitudes towards behaviors (see our argument on page 14 in the manuscript) and that it is necessary in future research to examine the validity of these specific questions.

6. In Table 1, the correlation between self-efficacy reducing Internet use (sum of different items) and Internet use should be negative? (similar to SE reducing TV viewing) Need to check.

Thank you for this careful attention to detail. This is an error on our part. The correlation between self-efficacy towards reducing Internet use and the amount of leisure-time Internet use should be negative. We have changed this in Table 2.

Minor Essential Revisions
1. Page 6. line 112, 4,4% should be 4.4%.

This has been changed on page 6.

2. Page 6, line 120, be specific by consistent use of “domestic screen time” instead of “sedentary behaviors”.

This has been changed on page 7.
3. Page 7, line 150, give details on how the score was assigned, e.g ‘1’ means totally disagree to ‘5’ totally agree or vice versa.

We have added more details about the response scales for the psychosocial items on page 8, lines 171-175. We have also added a footnote to Tables 1 and 2, to improve the readability of the descriptive statistics and the bivariate correlations.

‘All psychosocial correlates were rated on a five-point (one to five) Likert scale. For pros and cons of reducing screen time and social norm from family and friends, the response options ranged from ‘strongly disagree’ to ‘strongly agree’, while for self-efficacy about reducing screen time, the options ranged from ‘I think this is very difficult’ to ‘I do not think this is difficult at all’.’

4. Table 1. If sum scores were used in the multiple regression models, what’s the point to provide the correlations between individual item with time in TV viewing and Internet use. The readability of this table is not good.

We agree that the readability of Table 1 was not good. Therefore, we decided to split Table 1 into two separate tables. In the revised version of the manuscript, socio-demographic characteristics and mean scores for the home-environmental factors, psychosocial factors and sedentary behaviors are shown in Table 1. The correlations between the psychosocial and home-environmental items and the outcome variables are provided in Table 2. In our opinion, it is informative to provide these specific correlations. Indeed, sum scores were used in the regression analyses, mainly because the number of independent variables would be too large compared with the number of participants in the present study (n=419) if all of the individual items were included in the regression analyses. However, for future studies, it will be of interest to understand which specific items might relate more-strongly to particular sedentary behaviors. This information can be helpful in decisions about which specific constructs would be most relevant for informing the development of interventions. Because few previous studies have examined these psychosocial factors in adults, understanding these associations will be informative for future research.

Comments of reviewer #3
This paper deals with an important subject by addressing sedentary specific correlates for two key sedentary behaviours in adults. There are few other examples in the literature so this paper makes a potentially important contribution. The manuscript would benefit from some revisions.

Major essential revisions
Abstract
1. More specific description of correlates in the abstract to replace ‘some correlates’
We specified the correlates in the Abstract on page 3, lines 43-45.

‘Respondents to a mail-out survey (n=419; 20-65 years; mean age 48.5 [12.1] years; 47.3% men) completed a questionnaire on sedentary behaviors and their potential socio-demographic, psychosocial and home environmental correlates.’

Introduction
2. The introduction needs to provide a clearer rationale why specifically TV viewing and internet use are of public health concern and/or evidence that they relate to sitting time if this is the basis for public health concern.

A growing body of evidence (from both cross-sectional and longitudinal studies) shows that sedentary behaviors are related to several health problems like obesity, diabetes and cardiovascular diseases, independent of the level of PA. The associations have not only been found for overall sitting time, but also for specific behaviors like TV viewing time, time spent using other screen-based entertainment like computers, and time spent sitting in cars, as well as for overall sitting time. Moreover, it has been shown that TV viewing time and leisure-time Internet use are associated with higher levels of other leisure-time sedentary behaviors. Furthermore, sedentary behavior in leisure-time is more subject to individual choice and might therefore be easier to change compared to other types of sitting (e.g. sitting at work). This supports the need to examine the multidimensional correlates of TV viewing time and Internet use. We have changed some of the paragraphs in the Introduction (page 4, lines 73-79 and page 5, lines 83-90) and added references to clarify that TV viewing time and Internet use are associated with health problems and with other leisure-time sedentary behaviors.

Page 4, lines 73-79
‘Recently, sedentary behaviors (involving prolonged sitting time; SB) also have been found to be associated with elevated risk of obesity, cardio-metabolic risk profile, diabetes, cardiovascular disease, specific cancers and overall and cardiovascular mortality [4-7]. These deleterious associations exist independent of the PA level and have been identified in cross-sectional and longitudinal studies addressing specific behaviors like television (TV) viewing, other screen-based entertainment and time spent sitting in cars, as well as in studies examining overall sitting time [4-11].’

Page 5, lines 83-90
‘Domestic screen time (TV viewing and leisure-time Internet use at home) has been related to negative health outcomes [7-9] and is one of the most prominent non-work related SBs of adults in developed countries [13]. Moreover, TV viewing and leisure-time computer use have been associated with higher levels of other leisure-time sedentary behavior [14,15]. Approximately 20% of the Belgian adults can be categorized as ‘heavy TV watchers’ (> three hours/day of TV viewing) [16] and 77.8% of the Belgian adult population has Internet access

3. Lines 96 to 97: Clarify how and why correlates were based on adolescent studies or remove this sentence.

We removed this sentence from the Introduction, because this was not a good place to clarify why correlates were based on adolescent studies. We added an explanation to the Methods on page 8, lines 162-164. With this explanation, we wanted to clarify that the questionnaire we used to assess psychosocial factors has been mainly used in adolescents. Because no specific adult questionnaires on psychosocial correlates of sedentary behaviors exist, we chose to use the questionnaire of Norman and colleagues (2004).

‘This questionnaire has been mainly used in adolescent research, but since no specific psychosocial questionnaires have been developed for use in adults yet, it was used as a basis for the present adult study.’

4. Lines 98-99: Provide evidence to support the statement that these factors are likely moderators for sedentary behaviours in adults.

We added three references on page 6, line 110 to support this statement. Few studies provide evidence on the moderating effects of socio-demographic factors on sedentary behaviors (Sugiyama et al, 2007), but many studies have examined the moderating effects of these factors on physical activity and found evidence of moderating effects (e.g. Spence et al, 2006; Shibata et al, 2009).


Spence JC, Plotnikoff RC, Rovniak LS, Martin Ginis KA, Rodgers W, Lear SA. Perceived neighbourhood correlates of walking among participants visiting the Canada on the move website. Canad J Publ Health 2006;97:S39-S44.


Methods
5. Sedentary behaviours: Please provide details of the approach to translation of the questionnaire items based on items from US and Australia. Was the reliability and validity of these translations confirmed? It’s not clear if the figures you cite are for the original or the translated version.
The reliability and the validity of the translated versions of the questionnaire were not examined specifically. Given the acceptable levels of reliability and validity of the English version, and the low likeliness that translation would result in the possibility of misinterpretation, we did not feel it was necessary to assess the reliability and validity of the translated questionnaire. The figures that were provided concern the original version of the questionnaire. To clarify this, we added a sentence on page 7, lines 134-141.

‘The original English-language questionnaire was translated into Dutch and instead of assessing the amount of SB during the last seven days, a ‘usual week’ version was used in this study. Assessing ‘usual’ behavior offers a more stable measure compared to assessing behaviors undertaken during the last seven days [24]. The English-language version of the questionnaire has fair to excellent reliability (intraclass-range from 0.56 to 0.82). Concurrent validity, assessed against a three-day behavioral log was fair-to-moderate with rho’s ranging from 0.20 to 0.60 [23].’

6. Correlates: There needs to be confirmation that the scales derived from the PACE materials are functioning in the same way in a different culture and age. Factor analyses need to be run to confirm the structure of the scales and Cronbach Alpha values for each subscale reported in the text. This is particularly important given the text provided on lines 280-287 where individual items have been singled out in the discussion. The paper either needs to demonstrate the psychometric robustness of the original PACE scales or revise these based on factor analyses where they are different in this Belgium population and use these in the analyses. At the moment it is a mix of the two. It could be helpful to provide a table in the methods of the scale items and associated alpha for the scale and details of any revisions from the original. Then the first table in the results could just deal with the associations. At the moment it’s quite cumbersome to read.

Factor analyses were run to check whether the original scales were applicable to the present data in adults. The internal consistency of the scales was moderate to good (Alphas ranged from 0.50 to 0.78), so we decided to keep the original scales in the analyses. Moreover, when using the original scales, it is possible to compare the results with other studies that have used the same questionnaire. We would like to thank the reviewer for the suggestion to split up the tables. In this revised version, socio-demographic characteristics and average scores for the psychosocial factors, home-environmental factors and sedentary behaviors are provided in Table 1, as well as the Cronbach Alphas of the psychosocial scales. In Table 2, the correlations between the home-environmental and psychosocial items and domestic screen time are shown. In the Methods (page 8, lines 167-171), we have added information about the computation of the different scales and the results of the factor analyses.

‘Table 1 shows the contents of the different questions. Computation of the relevant scales was based on the scoring protocol used in the PACE study [25]. Factor analyses confirmed the
applicability of the original scoring protocol [25] to the present data. Internal consistency of the scales was moderate-to-good, with Cronbach Alpha values ranging from 0.50 to 0.78 (Table 1).”

Discussion
7. The discussion drifts into speculation in places, e.g. 242 to 252. I appreciate there is limited literature but the text should be restricted to where there is some supportive evidence provided for these statements.

We have added references to the Discussion to support our statements and tried to provide more thorough explanations for some of the findings.

The present findings show that lower-educated adults spend more time watching TV. We strengthened the initial explanation (i.e. lower-educated might compensate their manual tasks during work by watching more TV in leisure-time) by providing some references that occupational physical activity moderates the association between socio-economic status and leisure-time physical activity. Consequently, adults with lower levels of educational attainment probably have higher levels of leisure-time sitting, including TV viewing. We have added this on pages 12-13, lines 275-283.

Moreover, in the initial version of the manuscript, financial reasons were discussed as a possible reason for the lower amount of leisure-time Internet use in lower-educated adults. We confirmed this by analyzing our own data: the prevalence of having at least one computer with Internet access in the home was significantly lower in less-educated compared to higher-educated adults. We added this to the Discussion on page 13, lines 285-289.

Pages 12-13, lines 275-283
‘A possible explanation for the findings could be that lower-educated adults, who spend most of their working day in manual tasks compensate by watching more TV in leisure-time. Previous study results have shown that occupational PA moderates the relationship between socio-economic status and leisure-time PA. Adults engaging in more PA during work were less active during leisure-time [34-36]. Consequently, they might have higher levels of leisure-time sitting, including TV viewing. Middle-aged adults might have more time to watch TV because they are less occupied (with childcare, work, etc) than are younger adults. Moreover, PA levels decrease with increasing age [1], so middle-aged adults might replace PA partly with more TV viewing time.’

Page 13, lines 285-289
‘Financial aspects may play a role: less-educated adults may have priorities other than buying a computer with Internet connection for leisure-time use. Our findings support this assumption: the prevalence of having no computer with Internet access at home was higher in less-educated adults compared to higher-educated adults (13.3% and 4.6% respectively, \( \chi^2 = 9.9, p = .002 \)).’