Cross-Sectional Associations between Home Environmental Factors and Domain-Specific Sedentary Behaviors in Adults: The Moderating Role of Socio-Demographic Variables and BMI

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Abstract: Despite the negative health effects of too much sitting, the majority of adults are too sedentary. To develop effective interventions, insight is needed into home environmental correlates of adults’ sedentary behaviors, and into the susceptibility of population subgroups to these home environmental cues. In total, 559 Flemish adults reported socio-demographics, weight and height, home environmental factors and domain-specific sedentary behaviors. Generalized linear modeling was conducted to examine main associations between home environmental factors and domain-specific sedentary behaviors, and to test the moderating role of socio-demographics and BMI on these associations. In case of significant interactions, stratified analyses were performed. Results showed that, among those who did use a computer/laptop during the last week, a one-unit increase in the number of computers or laptops was associated with 17% (OR = 1.17; 95% CI = 1.02, 1.34) and 24% (OR = 1.24; 95% CI = 1.08, 1.43) more minutes computer time per day, respectively. The proximity of the remote controller (p<0.001) and the number of televisions (p=0.03) were positively associated with television time, and the number of motorized vehicles (95% CI = 0.001, 0.12) was positively associated with the odds of participation in transport-related sitting time. The latter two associations were moderated by BMI, with significant positive associations limited to those not overweight. To conclude, home environmental factors were associated with domain-specific sedentary behaviors, especially in healthy weight adults. If confirmed by longitudinal studies, public health professionals should encourage adults to limit the number of indoor entertainment devices and motorized vehicles.

Keywords: context-specific sitting time; home environment; interaction; weight status

1. Introduction

Reducing sedentary behavior, which can be defined as any waking activity characterized by an energy expenditure ≤1.5 metabolic equivalents while being in a sitting, lying or reclining posture [1], has become an important public health goal worldwide [2]. Recent research using accelerometers has shown that adults (>18 years) spend on average 8.5 h/day sedentary [3,4]. This is alarming given the
证据表明久坐行为与身心健康问题存在正相关性[5]。

如生态学模型的四个领域——个体、社会、组织、环境及政策——所建议的那样，久坐行为受到多方面因素的影响，包括个体层面、社会层面、组织层面、环境层面及政策层面。一项由O’Donoghue和同事们进行的综述中列出的各个水平的相关因素，得出结论是，个体层面的社会经济特征同久坐行为相关性较为明显[7]。然而，这些因素很少是可改变的，因此对设计久坐行为干预措施的可变风险因素，例如，如环境因素的影响，应该给予重视。

之前的研究发现环境因素与久坐行为的相关性研究结果不一致，可能的原因在于环境因素往往不是针对特定的领域（如家庭久坐行为、工作相关久坐行为、休闲久坐行为或交通相关久坐行为），而且不是针对个体的直接生活环境（即，之前的关联性研究主要与社区特征有关）。然而，个体在直接生活环境中的暴露程度高于社区环境[9]。对于久坐行为，娱乐设备的存在和可获得性可能促使久坐行为[9]。

如生态学模型所暗示的那样，如由最近开发的“系统性久坐行为”（SOS）框架所映射的，家庭环境因素对久坐行为的可能影响因不同群体而异。更具体地说，我们预期家庭环境因素在一般情况下可能会对那些更长时间待在家的群体更为重要。例如，对于老年人来说，室内娱乐设备可能会更加重要，因为随着年龄的增长，其在功能和移动能力方面会有所下降[11]，以及有更多照顾责任。对于这些不同的人群而言，体重指数（BMI）可能也会影响环境因素同久坐行为的关系，因为超重和肥胖人群由于心理（如，更高的抑郁发生率），社会（如，较少的亲密朋友）和经济（如，更高的失业率）的劣势，可能会更长时间待在家[13,14]。了解这些和其他可能的社会经济/BMI调节因素是重要的，以识别出哪些（风险）群体受特定的家庭环境因素影响最大[15]。

因此，这项研究的目的是探索家庭环境因素与久坐行为（看电视时间、电脑使用时间、交通相关的久坐时间）之间的关系，并探索这些关系的调节作用，特别是社会经济因素和BMI[15]。

因此，这项研究的目的是探索家庭环境因素与久坐行为（看电视时间、电脑使用时间、交通相关的久坐时间）之间的关系，并探索这些关系的调节作用，特别是社会经济因素和BMI[15]。
2. Materials and Methods

2.1. Study Design

For the present study, cross-sectional survey data were collected as part of the Busschaert study [16,17] to determine correlates of sedentary behaviors in adults (25–60 years) and older adults (≥65 years).

2.2. Recruitment and Participants

The public service of Sint-Niklaas (i.e., city in Flanders, Belgium) randomly selected 1917 adults (25–60 years), and 961 older adults (≥65 years) from the municipal register. The recruitment process within this selected sample differed for the two age groups. Selected adults received an information letter and a paper-based questionnaire by regular mail in April 2013. Three weeks later, a reminder was sent. In total, 331 adults filled out the questionnaire (response rate: 17.5%), of which 30 adults were excluded because: their partner filled out the questionnaire (n = 21), they were not able to stand (n = 7), or they returned the questionnaire after the deadline was exceeded (n = 2). This resulted in a final sample of 301 adults (response rate: 15.8%).

The older adults received an information letter by regular mail in September 2013. As older adults may experience cognitive difficulties when responding to a paper-based questionnaire [18], they were contacted by telephone up to three times to make an appointment for a structured questionnaire interview at home. In total, 860 older adults could be reached by telephone, of which 293 agreed to participate (response rate: 30.5%). Of these, 35 older adults were excluded because: they were not able to participate due to illness (n = 30), they did not speak Dutch (n = 4), or they were not able to stand (n = 1). This resulted in a final sample of 258 older adults (response rate: 28.1%), who completed a face-to-face interview at home taken by different researchers. All researchers were thoroughly trained by the main researcher (i.e., an information...
session was organized on conducting the interviews, and all researchers were assisted during their first interview). Participants’ answers were written down by the interviewer on a paper-based questionnaire. All study participants provided written informed consent. The study protocol was approved by the Ethics Committee of the Ghent University Hospital (B670201317406).

2.3. Measures

All measures were collected using age-specific questionnaires developed by Busschaert et al. for assessing domain-specific sedentary behaviors and correlates in adults and older adults [19].

**Home environmental factors.** The assessed home environmental factors varied by domain-specific sedentary behavior. For TV viewing time, the number of TVs and the number of video players at home were asked, as well as the degree of agreement with the following statements ‘The remote controller (TV) can always be found close to me when I need it’ (further referred to as ‘Proximity of remote controller’), and ‘The couches at our place are comfortable to sit for a long time’ (further referred to as ‘Comfortable couches’). Both statements were rated using a five-point Likert scale ranging from totally disagree to totally agree. For computer time, the number of computers, and the number of laptops at home were asked. For transport-related sitting time, the number of motorized vehicles in the household was asked. Reliability scores of the above-mentioned items can be found in Supplementary Materials.

**Domain-specific sedentary behaviors.** Domain-specific sedentary behaviors were assessed by the following questions: During the last seven days, how much time did you spend sitting on an average day (1) while watching TV during leisure time; (2) while using a computer during leisure time; (3) while commuting; and (4) while moving from one place to another during leisure time. All domain-specific sedentary behaviors were asked separately for weekdays and weekend days, except sitting while commuting, which was asked for an average working day. As the vast majority of older Flemish adults aged 65 years and older are retired, sitting while commuting was not asked among older adults. Answer options ranged from zero minutes a day to more than seven hours a day. Each domain-specific sedentary behavior (during leisure time) on an average day was calculated by summing domain-specific sedentary behavior on a weekday, multiplied by five, and on a weekend day, multiplied by two, and by dividing this total by seven. For adults, transport-related sitting time was calculated by summing the time spend sitting while commuting, with the time spend sitting while moving from one place to another during leisure time. Test-retest reliability for domain-specific sedentary behaviors on an average day was excellent for computer use and commuting (ICC ranging from 0.83 to 0.95); good for TV viewing (ICC ranging from 0.63 to 0.82) and moderate for moving from one place to another during leisure time (ICC ranging from 0.22 to 0.73) (see Supplementary Materials) [19]. Validity for total sedentary behavior on an average day was moderate-to-good (Spearman’s $\rho = 0.49$ in adults, and 0.48 in older adults) [19].

**Socio-demographic variables and BMI.** Potential moderators included age, gender, family situation (single, partner but living apart, married or living with partner, widow/widower), having children (yes, no), educational attainment (primary school, art secondary education, vocational secondary education, technical secondary education, general secondary education, higher education [non-university], higher education [university]), and BMI. For the moderation analyses, age was dichotomized into adults (18–60 years) and older adults (≥65 years); family situation was dichotomized into living with or without a partner; educational attainment was dichotomized into having completed tertiary education, or not having completed tertiary education; and BMI was dichotomized into healthy weight (BMI < 25 kg/m²) and overweight/obese (BMI ≥ 25 kg/m²).

2.4. Statistical Analyses

Statistical analyses were performed using R version 3.1.2 (R Foundation for Statistical Computing, Vienna, Austria), and level of significance was set at $p < 0.05$. Descriptive statistics were calculated separately for adults and older adults, as well as for the total sample. Generalized linear models were used to examine the associations between home environmental factors and domain-specific sedentary time as the Kolmogorov-Smirnov test revealed non-normal distributions of some
dependent variables (i.e., computer time and transport-related sitting time). Variance inflation factors between the predictors never exceeded seven, and most were substantially less, indicating that no multicollinearity was present [20]. TV time was normally distributed and a generalized linear model with Gaussian variance and identity link function provided the best model fit based on Akaike’s Information Criterion (AIC). As computer time, and transport-related sitting time were positively skewed and contained a large number of zero counts, zero-inflated negative binomial (ZINB) models yielded the best model fit based on the Vuong test (the Vuong test showed that a zero-inflated negative binomial model was preferred over a negative binomial model) and the AIC (the AIC showed that a zero-inflated negative binomial model was preferred over a zero-inflated poisson model). ZINB models examined the associations with the odds of non-participation in computer time/transport-related sitting time. Simultaneously, among those who did use a computer/sit for transport during the last week, ZINB models examined the association with daily minutes of computer use/transport-related sitting time. Thus, one ZINB model might yield two regression coefficients for each independent variable: an odds ratio (OR) (for the association between the independent variable and the odds of not using a computer/sitting for transport) and a negative-binomial model regression coefficient (representing the proportional changes in minutes/day using a computer/sitting for transport with a one-unit increase in the independent variable for those who did use a computer/sit for transport).

Firstly, basic generalized linear models were built for each sedentary behavior including relevant environmental correlates to examine the main associations. Secondly, the cross-product terms of socio-demographic factors/BMI with home environmental factors were added to the basic models one by one to test the moderating effects of socio-demographic factors and BMI on the association between home environmental factors and domain-specific sedentary behaviors. Finally, when significant interactions were identified, stratified models were fitted for each subgroup. All analyses were adjusted for age, gender, educational attainment, number of children, family situation and BMI.

3. Results

3.1. Sample Characteristics

Sample characteristics from both adults (18–60 years) and older adults (>65 years) are presented in Table 1. Mean age of the total sample was 57.5 years (SD = 17.7), and just over half of the total sample was female, the majority was married or living with a partner, lower educated and had children. Mean TV time was 162.2 min/day (SD = 93.5). Median computer time was 22.5 min/day (Q1, Q3 = 0.00, 7.14) and median transport-related sitting time was 32.14 (Q1, Q3 = 15.00, 75.00) min/day.

Table 1. Sample characteristics from the study population.

<table>
<thead>
<tr>
<th>Sample Characteristics</th>
<th>Total (n = 559)</th>
<th>Adults (n = 301)</th>
<th>Older Adults (n = 258)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Socio-demographic variables and BMI</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Age:</strong> years, mean (SD)</td>
<td>57.5 (17.7)</td>
<td>43.3 (24.6)</td>
<td>74.0 (6.2)</td>
</tr>
<tr>
<td><strong>Gender:</strong> %</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>46.3</td>
<td>45.5</td>
<td>47.3</td>
</tr>
<tr>
<td>Female</td>
<td>53.7</td>
<td>54.5</td>
<td>52.7</td>
</tr>
<tr>
<td><strong>Family situation:</strong> %</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Single</td>
<td>11.9</td>
<td>12.2</td>
<td>11.7</td>
</tr>
<tr>
<td>Partner but living apart</td>
<td>4.9</td>
<td>7.0</td>
<td>2.3</td>
</tr>
<tr>
<td>Married/living with partner</td>
<td>73.8</td>
<td>79.0</td>
<td>67.7</td>
</tr>
<tr>
<td>Widow/widower</td>
<td>9.4</td>
<td>1.7</td>
<td>18.3</td>
</tr>
<tr>
<td><strong>Occupational status:</strong> ^: %</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Full-time job</td>
<td>-</td>
<td>71.9</td>
<td>-</td>
</tr>
<tr>
<td>Part-time job</td>
<td>-</td>
<td>17.1</td>
<td>-</td>
</tr>
<tr>
<td>Household</td>
<td>-</td>
<td>5.4</td>
<td>-</td>
</tr>
<tr>
<td>Unemployed/job-applicant</td>
<td>-</td>
<td>2.7</td>
<td>-</td>
</tr>
</tbody>
</table>
3.2. Main Associations of Home Environmental Factors and Domain-Specific Sedentary Behaviors and Moderating Effects of Socio-Demographic Variables and BMI

The results of the main associations and moderating effects are presented in Table 2. Results will be explained below per domain-specific sedentary behavior as categorized by the taxonomy of Chastin et al. [21].

**Television time.** The Gaussian model showed that the number of TVs, and the proximity of the remote controller were positively associated with TV time. For example, one additional TV was associated with 11.97 (SE = 5.59) more minutes TV time per day. Moderation analysis showed that the association between the number of TVs and TV time was affected by BMI. The number of TVs was only significantly associated with TV time in adults with a healthy BMI (see Table 3). Having a one-unit increase in the number of TVs was associated with an increase of 26.37 (SE = 8.27) minutes TV time per day for those with a healthy BMI.

**Computer time.** The logit model with computer time as dependent variable showed that a one-unit increase in the number of computers at home was associated with having a 99.8% lower odds of non-participation in computer time (OR = 0.002; 95% CI = 0.001, 0.013) and the number of laptops at home was associated with having a 99.6% lower odds of non-participation in computer time (OR = 0.004; 95% CI = 0.001, 0.014). In other words, adults with one additional computer at home had 500 (1/0.002) times higher odds of having used a computer/laptop, and adults with one additional laptop at home had 250 (1/0.004) times higher odds of having used a computer/laptop. The negative binomial model showed that, among those who did use a computer/laptop during the last week, a one-unit increase in the number of computers or laptops was associated with an increase of 17% (OR = 1.17; 95% CI = 1.02, 1.34) and 24% (OR = 1.24; 95% CI = 1.08, 1.43) more minutes computer time per day, respectively. No moderating effects of socio-demographics and BMI were found for computer time.

**Transport-related sitting time.** The logit model with transport-related sitting time as dependent variable showed that a one-unit increase in the number of motorized vehicles was associated with having 99.0% lower odds of non-participation in transport-related sitting time (OR = 0.01; 95% CI = 0.004; 95% CI = 0.001, 0.014). In other words, adults with one additional computer at home had 500 (1/0.002) times higher odds of having used a computer/laptop, and adults with one additional laptop at home had 250 (1/0.004) times higher odds of having used a computer/laptop. The negative binomial model showed that, among those who did use a computer/laptop during the last week, a one-unit increase in the number of computers or laptops was associated with an increase of 17% (OR = 1.17; 95% CI = 1.02, 1.34) and 24% (OR = 1.24; 95% CI = 1.08, 1.43) more minutes computer time per day, respectively. No moderating effects of socio-demographics and BMI were found for computer time.
In other words, adults with one more motorized vehicle in the household had 100 (1/0.01) times higher odds of having participated in transport-related sitting time. The negative binomial model showed that the association between the number of motorized vehicles in the neighborhood and transport-related sitting time among those who did sit for transport during the last week was moderated by BMI. Only transport-related sitting time of healthy weight people was affected by the number of motorized vehicles. BMI-stratified models showed that for healthy weight people, a one-unit increase in the number of motorized vehicles was associated with 11% (OR = 1.11; 95% CI = 1.00, 1.23) more minutes transport-relates sitting time per day among those who did sit for transport during the last week.

Socio-demographic factors did not moderate any of the associations between home environmental factors and domain-specific sedentary behaviors.

### Table 2. Main associations between home environmental factors and domain-specific sedentary behaviors and moderating effects.

<table>
<thead>
<tr>
<th>Outcome Variable</th>
<th>Correlates</th>
<th>Model</th>
<th>b (SE) (1/2)</th>
<th>(p) or 95% CI (4)</th>
<th>Moderator</th>
<th>(p) (5)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TV time</strong></td>
<td>Number of TVs</td>
<td>Gaussian</td>
<td>11.97 (5.59)</td>
<td>0.03</td>
<td>BMI</td>
<td>0.02</td>
</tr>
<tr>
<td></td>
<td>Number of video players</td>
<td>Gaussian</td>
<td>-2.83 (5.68)</td>
<td>0.62</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Proximity of remote controller</td>
<td>Gaussian</td>
<td>14.80 (3.42)</td>
<td>&lt;0.001</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Presence of comfortable couches</td>
<td>Gaussian</td>
<td>7.31 (4.08)</td>
<td>0.07</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Computer time</strong></td>
<td>Number of computers</td>
<td>ZINB: logit</td>
<td>0.002</td>
<td>0.001, 0.013</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ZINB: negative binomial</td>
<td>1.17</td>
<td>1.02, 1.34</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Number of laptops</td>
<td>ZINB: logit</td>
<td>0.004</td>
<td>0.001, 0.014</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ZINB: negative binomial</td>
<td>1.24</td>
<td>1.08, 1.43</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td><strong>Transport-related sitting time</strong></td>
<td>Number of motorized vehicles</td>
<td>ZINB: logit</td>
<td>0.01</td>
<td>0.001, 0.12</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ZINB: negative binomial</td>
<td>1.10</td>
<td>1.00, 1.22</td>
<td>BMI</td>
<td>0.03</td>
</tr>
</tbody>
</table>

SE = standard error; OR = odds ratio; Exp. b = antilogarithm of regression coefficient; 95% CI = 95% confidence interval; ZINB = zero-inflated negative binomial. Significant associations are presented in bold. \(1\) b-values were used in the Gaussian model, and represent the increase in minutes/day, with a one-unit increase in the predictor. \(2\) OR’s were used in the logit model. The logit model estimates the associations between the home environmental factors and the odds of non-participation in computer time/transport-related sitting time during the last week. \(3\) Exp. b’s were used in the negative binomial model. The negative binomial model estimate the associations between the home environmental factors and the time spent sedentary for those who did use a computer/sit for transport during the last week. The exponent of the b’s represent the proportional increase in minutes/day using a computer/sitting for transport during the last week with a one-unit increase in the predictor. \(4\) \(p\)-values were reported in case of a Gaussian model, 95% confidence intervals were reported in case of a ZINB. \(5\) \(p\)-value of the interaction effect.
Table 3. Socio-demographic and BMI stratified associations between home environmental factors and domain-specific sedentary behaviors.

<table>
<thead>
<tr>
<th>Outcome Variable</th>
<th>Association</th>
<th>Model</th>
<th>Stratified Analyses</th>
<th>Groups</th>
<th>b (SE)</th>
<th>OR or Exp. b</th>
<th>p or 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>TV time</td>
<td>Number of TVs * BMI</td>
<td>Gaussian</td>
<td>Healthy weight</td>
<td>26.37 (8.27)</td>
<td>&lt;0.001</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Overweight/obese</td>
<td>0.82 (7.31)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Transport-related sitting time</td>
<td>Number of motorized vehicles * BMI</td>
<td>Negative binomial</td>
<td>Healthy weight</td>
<td>1.11</td>
<td>1.00, 1.23</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Overweight/obese</td>
<td>0.96</td>
<td>0.82, 1.12</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

OR = odds ratio; 95% CI = 95% confidence interval; Exp. b = antilogarithm of regression coefficient. Significant associations are presented in bold. 1 b-values were used in the Gaussian model, and represent the increase in in minutes/day, with a one-unit increase in the predictor. 2 ORs were used in the logit model. The logit model estimates the associations between the home environmental factors and the odds of non-participation in computer time/transport-related sitting time during the last week. 3 Exp. b’s were used in the negative binomial model. The negative binomial model estimate the associations between the home environmental factors and the time spent sedentary for those who did use a computer/sit for transport during the last week. The exponent of the b’s represent the proportional increase in minutes/day using a computer/sitting for transport during the last week with a one-unit increase in the predictor. 4 p-values were reported in case of a Gaussian model, 95% confidence intervals were reported in case of a ZINB.

4. Discussion

The current study aims to understand (1) whether home environmental factors are related to (older) adults’ domain-specific sedentary behaviors; and (2) whether these associations are moderated by socio-demographic variables and BMI. In contrast to the findings of the earlier studies of Busschaert et al. [16,17], our regression analyses revealed multiple significant associations between the included home environmental factors and domain-specific sedentary behaviors, especially in healthy weight adults. Nevertheless, the direction of the associations remains unclear as the included environmental factors are related to adults’ immediate environment, and adults are having control over it. Adults with a higher exposure to indoor entertainment devices and motorized vehicles might display more sedentary behavior; however, it is also possible that adults who enjoy sedentary activities are more likely to purchase (more) indoor entertainment devices and motorized vehicles. In the latter case, targeting psychosocial factors might be more useful than focusing on environmental changes.

For TV time, two significant positive correlates were found, namely the number of TVs and the proximity of the remote controller. The number of TVs was the strongest correlate of TV time. This finding suggest that adults with more TVs at home, will be more likely to watch television. However, reverse causality is also possible. As such, it might be that adults will acquire more TVs to suit their preference for watching TV. Previous studies examining the association between the number of TVs and the amount of TV time showed mixed results. In the study of Van Dyck et al., no association was detected [22], whereas in the study of De Cocker et al. [23] and the study of Gorin et al. [24], a positive significant association was found. Important to note is that Gorin et al. found only a significant association in the healthy weight group (i.e., BMI < 25 kg/m²) [24]. This is in line with our results, as current stratified analyses also showed that the positive association between the number of televisions and television time was limited to those without overweight. As, to our knowledge, no previous studies have examined the association of the proximity of the remote controller with TV time, it is difficult to compare the present results with previous findings.

For computer time, both the number of computers and the number of laptops were significant positive correlates of computer time, suggesting that adults with more computer and laptops at home will be more likely to spend computer time. This corresponds with the finding of Van Dyck et al., who also identified the number of computers as a significant correlate of leisure-time Internet use [22]. Again longitudinal studies are needed to confirm the direction of the association, as it is also
possible that adults who make the investment to purchase more computers/laptops enjoy using them so much that changing the environment may not alter their sedentary behavior. The absence of moderating effects on the associations with computer time suggests that the number of computers and laptops is equally important for different subgroups. Importantly, the moderating effect of occupational status was not tested due to insufficient power.

Finally, the number of motorized vehicles was negatively associated with the odds of non-participation in transport-related sitting time. This is not surprising as previous research has indicated that the vast majority of transport-related sitting time exists of sitting in a car [25,26]. Stratified analyses showed that the association only applies in healthy weight adults. More research is needed to confirm this result, and to draw definite conclusions on the direction of the association, as adults in favor of car use might have been more prone to buy a car.

Highly remarkable, and in contrast to our expectations, are the lack of moderating effects of socio-demographic factors. Only BMI significantly affected the associations between home environmental factors and sedentary behaviors, in the way that the significant positive associations were limited to those without overweight. This is in contrast to our expectations, as we speculated that overweight/obese adults would be more affected by the home environment, because they tend to spend more time at home considering their psychological (e.g., higher odds of depression), social (e.g., less close friends) and economic (e.g., higher odds of unemployment) disadvantages compared to their healthy weight counterparts [13,14]. As current results suggest the opposite, it seems that healthy weight adults might be more susceptible to home environmental cues, and will thus probably be more affected by future home environmental interventions to reduce sedentary behavior compared to their overweight/obese counterparts. Unfortunately, the prevalence of sedentary behavior is especially alarming in the latter group [27].

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A first strength of this study is the use of reliable questionnaires to assess potential correlates of domain-specific sedentary behavior [19]. Moreover, the older adult questionnaires were conducted through face-to-face interviews, as older adults may experience cognitive difficulties when responding to a paper-based questionnaire [18]. In this way, more precise answers could be obtained as the interviewer could provide additional information if necessary. Another strength of this study was the inclusion of domain-specific environmental correlates of sedentary behaviors. Most previous studies have examined more general correlates, although it has been hypothesized that different domains of sedentary behavior are likely to have distinct correlates [6]. Moreover, the included correlates pertain to the very proximal and immediate home environment of the participants which was deemed a priority for research in the SOS framework [10].

Limitations of the current study include the cross-sectional study design, which does not allow for establishing causal relations. Secondly, the relatively low response rate of our study may have led to selection bias. Although there is a good representation of men (44%) and women (56%), and lower (46.5%) and higher (53.5%) educated individuals, as well as younger (from age 25 years) and older (up to age 99 years) adults [30], it remains plausible that those who are more concerned with their health were more likely to have completed the questionnaire. Finally, no objective measurements of domain-specific sedentary behaviors were used, whereby social desirability bias could not be excluded [31].
5. Conclusions

To conclude, preliminary evidence was found for associations between home environmental factors and domain-specific sedentary behaviors, especially in healthy weight adults. If further longitudinal studies can confirm these results, future public health messages should encourage adults to limit the number of indoor entertainment devices and motorized vehicles in order to reduce sedentary behavior.

Supplementary Materials: The following are available online at www.mdpi.com/1660-4601/14/11/1329/s1, Table S1: Test-retest reliability of home environmental factors and domain-specific sedentary behaviors, Data S1: Raw data.

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Abbreviations

- BMI: body mass index
- SOS: systems of sedentary behaviours
- TV: television
- AIC: Akaike's information criterion
- ZINB: zero-inflated negative binomial
- OR: odds ratio
- SD: standard deviation
- Q1–Q3: quartile 1–quartile 3
- CI: confidence interval

References


