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Soundy, Andrew

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# Associations between perceived neighbourhood environmental attributes and self-reported sitting time in patients with schizophrenia: A pilot study

Davy Vancampfort [a,b,*], Marc De Hert [a], Amber De Herdt [b], Andrew Soundy [c], Brendon Stubbs [d], Paquito Bernard [e], Michel Probst [a,b]

[a] University Psychiatric Centre KU Leuven, Campus Kortenberg, Department of Neurosciences KU Leuven, Kortenberg, Belgium
[b] Department of Rehabilitation Sciences KU Leuven, Leuven, Belgium
[c] School of Health and Population Sciences, College of Medicine and Dentistry, University of Birmingham, UK
[d] School of Health and Social Care, University of Greenwich, Southwood Site Avery Hill Road Eltham, London, UK
[e] Dynamics of Human Abilities and Health Behaviours, University of Montpellier, France

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ABSTRACT

Sitting behaviours may, independent of physical activity behaviours, be a distinct risk factor for multiple adverse health outcomes in patients with schizophrenia. In order to combat sitting behaviours health care providers and policy makers require further understanding of its determinants in this population group. The aim of the present study was to investigate the variance in sitting time explained by a wide range of community design and recreational environmental variables, above and beyond the variance accounted for by demographic variables. One hundred and twenty-three patients (42♀) with schizophrenia (mean age=41.5 ± 12.6 years) were included in the final analysis. The built environment was rated using the Instruments for Assessing Levels of Physical Activity and Fitness environmental questionnaire and sitting time was assessed using the International Physical Activity Questionnaire-short (IPAQ) version. Regression analysis showed that environmental variables were related to sitting time. The body mass index (BMI) and disease stage explained 8.4% of the variance in sitting, while environmental correlates explained an additional 16.8%. Clinical practice guidelines should incorporate strategies targeting changes in sitting behaviours, from encouraging environmental changes to the availability of exercise equipment.



## 1. Introduction

Sedentary behaviours refer to activities that do not increase energy expenditure substantially above a resting level (< 1.0 metabolic equivalent, MET). The term refers to activities such as sleeping, lying down, sitting, watching television, and other forms of screen-based entertainment (Pate et al., 2008). Current understanding of sedentary behaviour is less well developed than our understanding of physical activity behaviours in individuals with schizophrenia. Although sedentary behaviour may arguably be conceptualised as no more than the other side of the physical activity coin, it is a class of behaviours than can coexist and compete with physical activity. It is therefore important to distinguish between sedentary and physical activity behaviours, as they might be independent of each other (Owen et al., 2011). Thus, whilst there is some research consensus on the benefits of physical activity and understanding of the type and level of physical activity engagement (Vancampfort et al., 2009, 2010; Gorczynski and Faulkner, 2010; Scheewe et al., 2013), there is generally less understanding around sedentary behaviour and the factors that affect this behaviour in patients with schizophrenia. Recent studies have demonstrated that sedentary behaviour may, even independent of physical activity behaviours, be a distinct risk factor for multiple adverse health outcomes in patients with schizophrenia (Strassnig et al., 2012). It might be that those patients with schizophrenia who engage in sufficient physical activity, still spend the rest of their day in sedentary behaviours (Vancampfort et al., 2011). A recent study (Duvivier et al., 2013) in the general population showed that 1 h of daily physical activity cannot compensate the negative effects of sedentary behaviour on insulin level and plasma lipids if the rest of the day is spent sitting. Further to this, in patients with schizophrenia, sedentary behaviour is associated with metabolic abnormalities. For example, for

* Correspondence to: UPC KU Leuven, Campus Kortenberg. Leuvensesteenweg 517, B-3070 Kortenberg, Belgium. Tel.: +32 2 758 05 11; fax: +32 2 759 9879.
*E-mail address:* Davy.Vancampfort@uc-kortenberg.be (D. Vancampfort).

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each 1-h increase in overall sitting time, there is an increase in the odds of having the metabolic syndrome (OR=2.33; 95% CI=1.37–3.96; $P$=0.002) (Vancampfort et al., 2012a).

Thus, from a clinical and public health perspective, the sedentary behaviour among overweight and obese adults with schizophrenia is alarming, and points to an urgent need for interventions to decrease sedentary behaviours (Janney et al., 2013). It is therefore critical to research factors that contribute to inactivity in patients with schizophrenia. Specifically, it is important to consider what correlates there are towards sedentary behaviour, since currently little research has been able to establish this. However, indications from research on correlates of physical activity behaviour have been developing. Review evidence (Vancampfort et al., 2012b) suggests less physical activity to be associated with psycho-social factors (e.g., low self efficacy), cardio-metabolic co-mobilities, negative symptoms of the illness and side effects of medication. At the same time, socio-ecological models of physical activity (e.g., Sallis et al., 2006) highlight the importance of considering the impact the environment has on physical (in)activity, in addition to these other correlates.

In a recent study (Vancampfort et al., 2013) a consistent relationship between physical activity participation (total minutes of walking per week) and perceived built environment characteristics was identified, notably an association between emotional satisfaction with the individual's built environment. Built environments are the totality of places built or designed, including buildings, grounds around buildings, layout of communities, transportation infrastructure and parks and trails (Transportation Research Board and Institute of Medicine, 2005). In the general population overall sitting time per week has been associated with perceived aesthetics of the built environment and proximity of destinations (Van Dyck et al., 2012). It is however unclear whether neighbourhood environment characteristics are related to sitting time in patients with schizophrenia. With the emerging importance of prolonged sitting time as a chronic disease risk factor, it is important to identify factors that are associated with this kind of sedentary behaviour, not only to guide future research, but also to inform the developing health interest in rehabilitation programmes for patients with schizophrenia. Since physical activity and sitting behaviours might be independent of each other, it should not be assumed that sitting behaviours are necessarily lower in environments that promote physical activity. Thus, there is an urgent need to consider if neighbourhood characteristics are related to both sitting and physical activity behaviours, as this will provide evidence of the need for changes in the built environment.

The aim of the present cross-sectional pilot study was to investigate the variance in sitting time explained by a wide range of community design and recreational environmental variables, above and beyond the variance accounted for by demographic variables.

## 2. Methods

### 2.1. Participants and procedure

A cross-sectional multi-centre design was used, this incorporated 13 centres that treat patients with schizophrenia (see Acknowledgements). The centres were located across the five Dutch-speaking provinces of Belgium and accessed over a 4-month period (November 2012–February 2013). All patients had a DSM-IV diagnosis of schizophrenia (American Psychiatric Association, 2000) established by experienced psychiatrists, who were responsible for the patients' treatment. Patients were included if they were; inpatients or outpatients with schizophrenia, had a full or partial remittance in symptoms, and were able to concentrate for 20–25 min. Patients were excluded if they were located within an intensive supervision unit, or, experienced acute persecutory delusions. No incentive was provided for participation. The study procedure was approved by the 13 ethical committees based at each centre. All participants gave their written informed consent.

### 2.2. Demographic variables

The following demographic variables were assessed including; gender, age, education, living situation, working situation, treatment setting, disease stage and body mass index (BMI). Dichotomous variables were constructed for education (lower: vocational or technical training; higher: general education or college), living situation (alone or not alone), working situation (working or not working), treatment setting (in- versus out-patients) and disease stage (first-episode versus multi-episode patients).

### 2.3. Sitting behaviour

Participants were asked for the time spent sitting each day (expressed in hours and minutes per day) using the International Physical Activity Questionnaire-short form (IPAQ-SF) (Craig et al., 2003). A structured format required participants to recall the time they spend sitting on week days during the last 7 days. Examples of this include sitting within specific environments, such as, within the home (e.g., watching television), at work (sitting at a desk) and also considers leisure time (e.g., visiting a friend). If the respondent could not answer because the pattern of time spent varied widely from day to day, patients were asked "*what is the total amount of time you spent sitting last Wednesday*?" ($n$=19). Previous research (Faulkner et al., 2006) demonstrated that the IPAQ-SF is a reliable surveillance tool in patients with schizophrenia.

### 2.4. Built environment

The built environment was rated using the Instrument for Assessing Levels of Physical Activity and Fitness (ALPHA) environmental questionnaire (Spittaels et al., 2009). The following themes of the built environment within a neighbourhood were covered by the questionnaire: (a) types of residences (3 items), (b) distances to local facilities (8 items), (c) walking and cycling infrastructure (4 items), (d) maintenance of infrastructure (3 items), (e) neighbourhood safety (6 items), (f) pleasantness of the neighbourhood (4 items), (g) walking and cycling network (4 items), (h) home environment (6 items), and (i) workplace or study environment (10 items). Different answer categories were used in the different themes. A 5-point Likert scale was used for scale 1 (five levels of different types of residences: none, a few, some, and most all) and scale 2 (five levels of time to reach different local facilities: 1–5 min, 6–10 min, 11–20 min, 21–30 min, and >30 min). A 4-point Likert scale (strongly agree to strongly disagree) was used for scales 3–7 and a dichotomous answer category (yes or no) was used for scales 8 and 9. The neighbourhood was defined as the area within approximately 1 km that you could walk to in 10–15 min. Previous research demonstrated that ALPHA environmental questionnaire is a reliable and valid assessment tool for the built environment in patients with schizophrenia (Vancampfort et al., 2013).

### 2.5. Statistical analysis

Independent sample $t$-tests were used to assess difference between sitting time on bi-directional variables including gender, disease stage, treatment setting, education level, working situation, and living situation. Pearson product moment correlations were used to investigate association between sitting behaviour and environmental variables, age and BMI.

Before running the forced linear regression analysis, all variables (demographic and environmental) with low bivariate correlations with sitting behaviour ($P$>0.10) were omitted. As in accordance with previous research (De Bourdeaudhuij et al., 2003) the alpha value of 0.10 was chosen rather than the more stringent 0.05 value for the bivariate correlation analyses. This was selected, from a health promotion perspective, because all variables that might have some influence on sitting behaviour are reasonable to include in the regression analysis. A forced linear regression analysis was conducted to determine variance explained in sitting time, including demographical variables as a first block in the regression, followed by the environmental variables as a second block. This allows an estimation of the independent contribution of the environmental variables above and beyond the variance accounted for by demographic variables. Interaction effects were examined for significance ($P$<0.05), and if not significant, the model was re-run without the interaction term.

Table 2 presents the partial correlations after all blocks were entered, along with the adjusted $r^2$ values. A $P$<0.05 was considered to be significant in the forced linear regression analysis. Based on the recommendations by Weisberg (2005) regression diagnostics for outliers were conducted. Influence scores were investigated using Cook's distance (Cook, 1977), outliers were reported where Cook"s distance was >1. The statistical package SPSS version 20.0 (SPSS Inc., Chicago, IL) was employed for the data analyses.

**Table 1**
Descriptive items (mean and standard deviation and answer frequencies) of the ALPHA environmental questionnaire ($n=123$) and Pearson correlations between summary scores and sitting time (hours/day).

| Item/scale | None | A few | Some | Most | All | Mean ± S.D. | *R* sitting | *P* |
|---|---|---|---|---|---|---|---|---|
| **Types of residences** | | | | | | | | |
| *1.Residential density score*[a] | | | | | | *130.0 ± 53.3* | *0.14* | *0.11* |
| (a) Detached houses | 43 (35.0%) | 31 (25.2%) | 26 (21.0%) | 16 (13.0%) | 7 (5.7%) | | | |
| (b) Semi-detached townhouses | 18 (14.6%) | 29 (23.6%) | 28 (22.8%) | 34 (27.6%) | 14 (11.4%) | | | |
| (c) Apartment buildings or blocks of flats | 61 (49.6%) | 35 (28.5%) | 17 (13.8%) | 6 (4.9%) | 4 (3.3%) | | | |
| | **1–5 min** | **6–10 min** | **11–20 min** | **21-30 min** | **> 30 min** | **Mean ± S.D.** | ***R* sitting** | ***P*** |
| **Travel time to facilities** | | | | | | | | |
| *2.Walking distance to local facilities (land use mix diversity total score*[b] | | | | | | *20.7 ± 6.2* | *−0.07* | *0.44* |
| (a) Local shop | 51 (41.5%) | 34 (27.6%) | 19 (15.4%) | 8 (6.5%) | 11 (8.9%) | | | |
| (b) Supermarket | 23 (18.7%) | 36 (29.3%) | 33 (26.8%) | 17 (13.8%) | 14 (11.4%) | | | |
| (c) Local services | 26 (21.1%) | 34 (27.6%) | 34 (27.6%) | 16 (13.0%) | 13 (10.6%) | | | |
| (d) Restaurant | 37 (30.1%) | 41 (33.3%) | 23 (18.7%) | 11 (8.9%) | 11 (8.9%) | | | |
| (e) Fastfood restaurant | 19 (15.4%) | 17 (13.8%) | 29 (23.6%) | 20 (16.3%) | 38 (30.9%) | | | |
| (f) Bus stop | 66 (53.7%) | 32 (26.0%) | 15 (12.2%) | 7 (5.7%) | 3 (2.4%) | | | |
| (g) Sport and leisure facility | 26 (21.1%) | 31 (25.2%) | 29 (23.6%) | 19 (15.4%) | 18 (14.6%) | | | |
| (h) Open recreation area | 19 (15.4%) | 27 (22.4%) | 28 (22.8%) | 16 (13.0%) | 20 (24.4%) | | | |

| | **Strongly disagree** | **Somewhat disagree** | **Somewhat agree** | **Strongly agree** | **Mean ± S.D.** | ***R* sitting** | ***P*** |
|---|---|---|---|---|---|---|---|
| **Acceptance of statements** | | | | | | | |
| *3.Availability of infrastructure (total score)*[b] | | | | | *10.0 ± 2.1* | *−0.30* | *< 0.001*[*] |
| *Availability of sidewalks (total score)*[c] | | | | | *4.9 ± 1.1* | *−0.13* | *0.15* |
| *Availability of bike lanes (total score)*[d] | | | | | *5.0 ± 1.6* | *−0.31* | *< 0.001*[*] |
| (a) Sidewalks | 2 (2.4%) | 10 (8.1%) | 39 (31.7%) | 71 (57.7%) | | | |
| (b) Pedestrian zones | 84 (68.3%) | 24 (19.5%) | 9 (7.3%) | 6 (4.9%) | | | |
| (c) Special lanes, routes or paths to cycle | 16 (13.0%) | 16 (13.0%) | 46 (37.4%) | 45 (36.6%) | | | |
| (d) Traffic-free cycle routes | 47 (38.2%) | 37 (30.1%) | 23 (18.7%) | 16 (13.0%) | | | |
| *4.Total safety*[b] | | | | | *16.9 ± 3.7* | *−0.26* | *0.004*[*] |
| *Safety crime score*[e] | | | | | *8.6 ± 2.2* | *−0.24* | *0.008*[*] |
| *Safety traffic score*[f] | | | | | *8.3 ± 2.0* | *−0.22* | *0.015*[*] |
| (a) Dangerous to leave a bicycle locked | 24 (19.5%) | 37 (30.1%) | 39 (31.7%) | 23 (18.7%) | | | |
| (b) Not enough safe places to cross busy streets | 11 (8.9%) | 33 (26.8%) | 52 (42.3%) | 27 (22.0%) | | | |
| (c) Walking is dangerous because of the traffic | 7 (5.7%) | 33 (26.8%) | 51 (41.5%) | 32 (26.0%) | | | |
| (d) Cycling is dangerous because of the traffic | 14 (11.4%) | 30 (24.4%) | 57 (46.3%) | 22 (17.9%) | | | |
| (e) Dangerous during the day because of the level of crime | 6 (4.9%) | 20 (16.3%) | 45 (36.6%) | 52 (42.3%) | | | |
| (f) Dangerous during the night because of the level of crime | 11 (8.9%) | 26 (21.1%) | 45 (36.6%) | 41 (33.3%) | | | |

| **Item/scale** | **Strongly disagree** | **Somewhat disagree** | **Somewhat agree** | **Strongly agree** | **I don't know** | **Mean ± S.D.** | ***R* sitting** | ***P*** |
|---|---|---|---|---|---|---|---|---|
| **Acceptance of statements** | | | | | | | | |
| *5.Maintenance (total score)*[b] | | | | | | *9.3 ± 1.9* | *−0.28* | *< 0.001*[*] |
| (a) Sidewalks are well maintained | 8 (6.5%) | 20 (16.3%) | 54 (43.9%) | 40 (32.5%) | 1 (0.8%) | | | |
| (b) Cycling paths are well maintained | 12 (9.8%) | 23 (18.7%) | 45 (36.6%) | 35 (28.5%) | 8 (6.5%) | | | |
| (c) Open spaces well maintained | 2 (1.6%) | 5 (4.1%) | 54 (43.9%) | 58 (47.2%) | 4 (3.3%) | | | |
| | **Strongly disagree** | **Somewhat disagree** | **Somewhat Agree** | **Strongly agree** | | **Mean ± S.D.** | ***R* sitting** | ***P*** |
| *6.Aesthetics (total score)*[g] | | | | | | *11.7 ± 2.5* | *0.22* | *0.014*[*] |
| (a) A pleasant environment for walking or cycling | 10 (8.1%) | 18 (14.6%) | 57 (46.3%) | 38 (30.9%) | | | | |
| (b) Generally free from litter or graffiti | 11 (8.9%) | 28 (22.8%) | 59 (48.0%) | 25 (20.3%) | | | | |
| (c) Trees along the streets | 14 (11.4%) | 29 (23.6%) | 46 (37.4%) | 34 (27.6%) | | | | |
| (d) A lot of badly maintained, unoccupied or ugly building | 11 (8.9%) | 20 (16.3%) | 40 (32.5%) | 52 (42.3%) | | | | |
| *7.Connectivity (total score)*[h] | | | | | | *8.2 ± 2.0* | *−0.37* | *< 0.001*[*] |
| (a) Many shortcuts for walking | 15 (12.2%) | 28 (22.8%) | 49 (39.8%) | 31 (25.2%) | | | | |
| (b) Cycling is quicker than driving during the day | 21 (17.1%) | 31 (25.2%) | 37 (30.1%) | 34 (27.6%) | | | | |
| (c) Many road junction | 14 (11.4%) | 41 (33.3%) | 40 (32.5%) | 28 (22.8%) | | | | |
| (d) Many different routes for walking or cycling from place to place | 9 (7.3%) | 25 (20.3%) | 65 (52.8%) | 24 (19.5%) | | | | |
| | **Yes (%)** | **No (%)** | | | | **Mean ± S.D.** | ***R* sitting** | ***P*** |
| **Availability** | | | | | | | | |
| *8.Home environment (total score)*[b] | | | | | | *2.7 ± 1.2* | *−0.37* | *< 0.001*[*] |
| (a) Bicycle | 81 (58.7%) | 57 (41.3%) | | | | | | |
| (b) Garden | 87 (63.0%) | 51 (37.0%) | | | | | | |
| (c) Small sport equipment | 62 (44.9%) | 76 (55.1%) | | | | | | |
| (d) Exercise equipment | 45 (32.6%) | 93 (67.4%) | | | | | | |
| (e) Car | 89 (64.5%) | 49 (35.5%) | | | | | | |
| (f) Dog | 11 (8.0%) | 127 (92.0%) | | | | | | |

| | | | | | |
|---|---|---|---|---|---|
| *9.Workplace or study environment (n=43) (total score)*[b] | | | *4.8 ± 2.2* | *−0.036* | *0.821* |
| (a) Escalators | 21 (49.0%) | 22 (51.0%) | | | |
| (b) Stairs | 34 (0.79%) | 11 (21.0%) | | | |
| (c) Fitness centre/equipment | 13 (30.2%) | 30 (59.8%) | | | |
| (d) Bicycles provided by employer or school | 10 (23.3%) | 33 (76.7%) | | | |
| (e) A safe place to leave a bike | 26 (60.5%) | 17 (39.5%) | | | |
| (f) Enough car parking spaces | 28 (65.1%) | 15 (34.9%) | | | |
| (g) Showers and changing rooms | 26 (60.4%) | 17 (39.6%) | | | |
| (h) Exercise classes | 18 (41.8%) | 25 (58.2%) | | | |
| (i) Sports club | 11 (25.6%) | 32 (74.4%) | | | |
| (j) Employer subsidised public transport/cycling | 19 (44.2%) | 24 (55.8%) | | | |

ALPHA=Assessing Levels of Physical Activity and Fitness; SD=standard deviation; R sitting=Person correlation with sitting time (hours/day)

[a] Weighted by the following formula=item1a+(12 × item 1b)+(50 × item 1c).
[b] Total sum score of all items.
[c] Sum score of items 3a and 3b.
[d] Sum score of items 3c and 3d.
[e] Sum score of reversed items 4a, 4e and4f.
[f] Sum score of reversed items 4b, 4c, 4d.
[g] Sum score of items 6b, 6c, reversed 6d.
[h] Sum score of items 7b, 7c and 7d.
* Significance set at $P \leq 0.10$.

**Table 2**
Regression analysis of the contribution of demographic (Block 1) and environmental (Block 2) variables to sitting time (hours spent sitting per day) in patients with schizophrenia.

| Independent variables | Partial correlation with sitting time | *B* | SE | *β* | $R^2$ |
|---|---|---|---|---|---|
| *Demographical* | | | | | 0.084 |
| BMI | 0.22* | 0.09 | 0.04 | 0.17 | |
| Diagnosis (first-episode=1 versus multi-episode=0) | −0.19* | −1.30 | 0.67 | −0.16 | |
| *Environmental* | | | | | 0.252 |
| Aesthetics | −0.24** | −0.30 | 0.09 | −0.29 | |
| Home environment | −0.24* | −0.54 | 0.18 | −0.25 | |

BMI=body mass index; B=unstandardised coefficients; SE=standard error; and *β*=standardized coefficients.

* $P < 0.05$.
** $P < 0.01$.

## 3. Results

### 3.1. Participants

A total of 178 Belgian patients with a DSM-IV diagnosis of schizophrenia (American Psychiatric Association, 2000) were initially recruited. Thirty-two patients were not interested to participate, while eight cases were excluded due to missing data on at least one of the ALPHA variables included. Of the 138 patients, four participants provided sitting data based on the question what the total amount of time was they spent sitting last Wednesday. Fifteen patients reported that they were also not able to answer this question and were excluded from the analyses. There were no differences in demographical characteristics between participants ($n=123$) and decliners ($n=32$).

A total of 123 patients (42♀) with schizophrenia with a mean age 41.5 ± 12.6 years and a mean BMI of 27.8 ± 4.8 were included in the final analysis. Sixty-eight patients (55.3%) were outpatients, 15 patients were in their first-episode (12.2%). Participants were classified in a lower ($n=81$; 65.9%) and a higher educational level group ($n=42$; 34.1%). Forty-two patients (34.1%) were living alone. Seventeen patients (13.8%) were employed. Patients lived in 52 different cities or municipalities across the Flemish part of Belgium with the number of inhabitants ranging from 1000 to 170,000.

Patients self-reported sitting 5.9 ± 2.6 h per day.

### 3.2. Relationships of sitting time with demographic variables

Multiple-episode patients spent more time sitting than patients in their first episode (6.1 ± 2.7 versus 4.3 ± 2.0, $P=0.004$). No significant differences in sitting time were found between men and women (5.8 ± 2.7 versus 5.9 ± 2.5, $P=0.85$), between those patients living alone or together with others (5.9 ± 2.7 versus 5.9 ± 2.5, $P=0.96$), between higher and lower educated patients (5.6 ± 2.6 versus 6.4 ± 2.7, $P=0.11$), between those who work and those who are unemployed (5.3 ± 2.7 versus 6.0 ± 2.6, $P=0.31$), and between inpatients and outpatients (5.6 ± 2.4 versus 6.1 ± 2.8, $P=0.21$). While age ($r=0.12$, $P=0.16$) did not significantly correlate with sitting time, BMI ($r=0.25$, $P=0.005$) did.

### 3.3. Relationships of sitting time with environmental variables

Sitting time was significantly associated with: (a) the availability of infrastructure, especially bike lanes; (b) the maintenance of the infrastructure; (c) traffic safety and crime safety perception; (d) emotional satisfaction with the environment (=aesthetics); (e) connectivity of the environment; and (f) the availability of home equipment. Correlates with their respective *P*-values are presented in Table 1.

When looking at specific home equipment (see Table 1), especial the lack of availability to a bike ($P=0.02$) and to small sports equipment ($P<0.001$) were associated with more time spent sitting.

### 3.4. Variation in sitting time explained by demographic and environmental variables

Regression diagnostics revealed no cases with an undue influence on regression estimates with Cook's distance ranging from 0.000 to 0.132. These results were within the acceptable boundaries and were well below the benchmark of 1 for identifying

influential points. Results of the forced linear regression analysis are summarised in Table 2. For time spent sitting per day, 25.2% of the variance was explained by demographical and environmental variables. Further to this, 8.4% was explained by the demographical block and an additional 16.8% by the environmental block of variables.

## 4. Discussion

### 4.1. General findings

To the best of our knowledge, the present pilot study is the first to investigate environmental correlates of time spent sitting in patients with schizophrenia. Our data demonstrates that in accordance with the socio-ecological models of physical activity and sedentary behaviours (Sallis et al., 2006), specific environmental variables are significantly related to time spent sitting in patients with schizophrenia. This was most notable in those patients who perceive the built environment they live in as less enjoyable. Our findings are in accordance with previous research in healthy populations indicating that more positive perceptions of aesthetics are associated with a reduced total sitting time (Van Dyck et al., 2012). A potential reason for this association is that positive perceptions of environmental attributes might influence people to partially replace their motorised transportation with more-active modes of transportation (Van Dyck et al., 2012). In the same way patients with schizophrenia who do not have a bike or access to small exercise materials at home are spending more time sitting.

An additional interesting finding was that only 8.0% of the included patients were owners of a dog. A recent meta-analysis (Christian et al., 2013) showed that dog owners engage in more walking and physical activity than non-dog owners. A pilot study of Nathans-Barel et al. (2005) in patients with schizophrenia indicated that dog walking reduces anhedonia. Patients walking with a dog also showed an improvement in the use of leisure time. This way dog walking may contribute to the psychosocial rehabilitation and quality of life of patients with schizophrenia.

### 4.2. Practical implications

Previous clinical practice guidelines for reducing sitting behaviours in patients with schizophrenia place emphasis on educational aspects (e.g., focusing on the adverse effects of sitting behaviour, behaviour change skills), but do not place any emphasis on more sustainable and broader-reaching environmental and policy changes (Vancampfort et al., 2012a, 2012c). Future clinical practice guidelines should, at a minimum, incorporate different strategies that focus on targeting changes in sitting behaviours across several domains. This ranges from encouraging environmental changes (e.g. improving aesthetics of the environment) to increasing the availability of resources for recreational physical activity (e.g. low-cost access to a bike, to small exercise materials or to dog-walking).

### 4.3. Limitations and future research directions

This pilot study has several limitations which prevent us from making any firm conclusions. First, the analyses may have been underpowered due to the relatively small sample size.

Second, sitting can occur in multiple life domains including, leisure (e.g. TV watching time), work (e.g. screen use and desk time), and during motorised transport (motorised sitting time) and each of these is likely to have distinct environmental correlates. We were not able to measure all these different kind of sitting behaviours separately with the IPAQ-SF. This way, it is still an open question whether in patients with schizophrenia total sitting time or specific sitting behaviours are more strongly related to specific environmental characteristics and in extension also to various health outcomes. For example, future research could examine if time spent watching television might be associated with the perception of the built environment. It might for example be hypothesised that people who self-select low-walkable neighbourhoods because they want to avoid walking may also prefer sedentary leisure pursuits like watching TV.

Third, the use of self-report of time spent sitting has limitations. For instance, Celis-Morales et al. (2012) demonstrated that compared with a more objective measurement (accelerometers) of time spent sitting, the IPAQ to determine sitting time slightly (13%) underestimated the time spent sitting which led to a significant underestimation of the steepness of the dose-response relationship between sitting time and metabolic risk factors related to insulin resistance. In this study, the presence of a trained researcher, who prompts the respondents and tries to prevent socially desirable answers, might have helped to reduce in part the underreporting of sitting time.

Fourth, a cross-sectional design was used, which precluded determination of causality. Therefore, prospective studies are urgently needed to examine in more detail temporal associations among environmental variables and sitting and physical activity behaviours. For example, this could be undertaken by examining the change in sitting behaviours among patients with schizophrenia moving from one environment to another.

Fifth, we did not include variables such as psychiatric and psychomotor symptoms, antipsychotic medication use and the socio-economic status. Future studies should therefore investigate the potential moderator effect of different psychiatric and psychomotor symptoms, antipsychotic medication use and socio-economic status. In the present study we excluded patients with persecutory delusions since due to their acute symptoms these patients would perceive their environment as more threatening and confusing.

Sixth, since our data were collected only in autumn and wintertime, we did not control for seasonal variation in built environment perception and physical activity and sitting behaviour. It is known that for example levels of physical activity might to some degree vary with seasonality (Humpel et al., 2002).

Another possible limitation is that objective environmental measurements such as a geographic information system were not included and thus the perceptions of patients could not be compared with objective data. However, one has to take into account that objective and subjective measures of the built environment are two different concepts. Previous studies (McGinn et al., 2007; Lackey and Kaczynski, 2009; Prins et al., 2009; Lin and Moudon, 2010) investigating the association between the built environment and physical activity behaviour identified a low to moderate agreement between objective and subjective measures. Thus, compared to the objective measured environment, perceptions of the environment may either have a greater (Prins et al., 2009) impact on physical activity behaviour or vice versa (Lin and Moudon, 2010).

Lastly, policy makers need to consider how to build communities so they reduce sitting behaviours.

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