Which psychological, social and physical environmental characteristics predict changes in physical activity and sedentary behaviors during early retirement: A longitudinal study

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Background: In the context of healthy ageing, it is necessary to identify opportunities to implement health interventions in order to develop an active lifestyle with sufficient physical activity and limited sedentary time in middle-aged and older adults. The transition to retirement is such an opportunity, as individuals tend to establish new routines at the start of retirement. Before health interventions can be developed, the psychological, social and physical environmental determinants of physical activity and sedentary behaviors during early retirement should be identified, ideally with longitudinal studies. The aim of this paper was first to examine whether psychological, social and physical environmental factors at the start of retirement predict longitudinal changes in physical activity and sedentary behaviors during the first years of retirement. Second, moderating effects of gender and educational levels were examined.

Methods: This longitudinal study was conducted in Flanders, Belgium. In total, 180 recently retired (>1 month, <2 years at baseline) adults completed a postal questionnaire twice (in 2012-2013 and two years later in 2014-2015). The validated questionnaire assessed socio-demographic information, physical activity, sedentary behaviors, and psychological, social and physical environmental characteristics. Multiple moderated hierarchic regression analyses were conducted in SPSS 22.0.

Results: Higher perceived residential density ($p<0.001$) and lower aesthetics ($p=0.08$) predicted an increase in active transportation (adjusted $R^2=0.18$). Higher baseline self-efficacy was associated with an increase in leisure-time physical activity ($p=0.001$, adjusted $R^2=0.13$). A more positive vision on old age ($p=0.04$) and perceiving less street connectivity ($p=0.001$) were associated with an increase in screen time (adjusted $R^2=0.06$). Finally, higher baseline levels of modeling from friends ($p=0.06$) and lower perceived land use mix access ($p=0.09$) predicted an increase in car use (adjusted

R^2=0.06). Some moderating effects, mainly of educational level, were found. *Discussion:* Walkability characteristics (residential density and land use mix access) and self-efficacy at the start of retirement are the most important predictors of longitudinal changes in active transportation and leisure-time physical activity. Few moderating effects were found, so health interventions at the start of retirement focusing on both individual and environmental factors could be effective to increase physical activity in recently retired adults. No firm conclusions can be drawn on the importance of the examined predictors to explain change in car use and screen time, possibly other factors like the home environment, or automatic processes and habit strength are more important to explain sedentary behaviors.

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Abstract

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Discussion: Walkability characteristics (residential density and land use mix access) and self-efficacy at the start of retirement are the most important predictors of longitudinal changes in active transportation and leisure-time physical activity. Few moderating effects were found, so

health interventions at the start of retirement focusing on both individual and environmental factors could be effective to increase physical activity in recently retired adults. No firm conclusions can be drawn on the importance of the examined predictors to explain change in car use and screen time, possibly other factors like the home environment, or automatic processes and habit strength are more important to explain sedentary behaviors.

Introduction

Globally, life expectancy has increased steadily over the last decades. Between 2000 and 2050, the proportion of adults older than 60 years of age is expected to double from 11% to 22% (i.e. from about 605 million to more than a billion) (World Health Organization, 2014). This trend induces major societal challenges, like an increase in health care costs due to age-related chronic diseases (e.g. cardio-vascular diseases, type 2 diabetes, sarcopenia) (Organization for Economic Cooperation and Development, 2006). In middle and older age Adopting and adhering to a healthy lifestyle with sufficient levels of physical activity (PA), limited sedentary time and a healthy diet, is needed to reduce risks for chronic diseases and mortality (Knoops et al, 2004; King, Mainous & Geesey, 2007). In that context, it is necessary to identify opportunities to develop healthy lifestyles in middle-aged and older adults in order to promote healthy ageing.

The transition to retirement can be seen as such an opportunity. Retirement can be defined as ‘a permanent and complete withdrawal from the labor force’ and goes together with important changes in time availability and flexibility, social networks, income and financial security, which can all impact adults’ lifestyles, both positively and negatively (Kim & Moen, 2002; Barnett,

Van Sluijs & Ogilvie, 2012). Currently available evidence shows that PA and sedentary behaviors rather develop adversely during early retirement: total PA tends to decrease when making the transition to retirement, and this decrease is probably caused by a decrease in work- and transport-related PA that is insufficiently compensated by an increase in leisure-time PA (Slingerland et al, 2007; Touvier et al, 2010; Lahti et al, 2011; Barnett et al, 2014). Retirement has also been associated with an increase in specific sedentary behaviors like TV viewing and reading, and a decrease in occupational sitting and car use (Touvier et al, 2010; Barnett et al, 2014; Sprod et al, 2015; Van Dyck et al, unpublished findings).

Nonetheless, retirement can also be seen as a transition during which individuals rethink habitual behaviors and establish new routines (Jonsson, Josephsson & Kielhofner, 2001). Persons who are about to retire or retired recently seem to be particularly receptive to behavior change (e.g. smoking cessation) (Lang et al, 2007). So, early retirement seems to be a promising stage to implement interventions to stimulate middle-aged and older adults to develop/maintain a healthy lifestyle.

Before one can develop interventions aiming to increase PA and/or decrease sedentary behaviors during early retirement, it is necessary to identify the specific psychological, social and physical environmental determinants of these behaviors during early retirement. A few qualitative studies examined these determinants by conducting focus group interviews with the target group (Barnett, Guell & Ogilvie, 2012; McDonald et al, 2015; Kosteli, Williams & Cumming, 2016; Van Dyck et al, unpublished findings). These studies identified that several intrapersonal (e.g. self-efficacy, self-regulatory strategies, outcome expectations, social norms and beliefs on ageing

and retirement, need for personal challenges, perceived health benefits of PA, financial constraints, loss of daily structure), interpersonal (e.g. social support, social roles and responsibilities) and physical environmental factors (e.g. opportunities to be active, physical barriers like poorly maintained sidewalks) can be important motives for (insufficient) PA in recently retired adults. To our knowledge, only one qualitative study already examined potential determinants of sedentary behaviors during early retirement (Van Dyck et al, unpublished findings) and concluded that in this age group knowledge on the negative effects of sedentary behaviors is absent, inducing a lack of motivation to decrease sedentary behaviors.

Besides this qualitative evidence also studies with quantitative data are needed to confirm the importance of the determinants that emerged from previous focus group studies. To our knowledge, no previous quantitative studies examined the multidimensional correlates of PA and sedentary behaviors in this specific target group of recently retired adults. Ideally, such studies should use a longitudinal design in order to draw conclusions on whether specific factors at the start of retirement predict changes in PA and sedentary behaviors during early retirement, and to make it possible to develop effective health interventions focusing on specific determinants at the start of retirement.

Therefore, the first aim of this paper was to examine whether psychological, social and physical environmental factors at the start of retirement predict longitudinal changes in leisure-time PA, active transportation, screen time and car use during the first years of retirement. Because changes in PA and sedentary behaviors during early retirement have been shown to be dependent of gender and socio-economic status (Mein et al, 2005; Chung et al, 2009; Barnett, Van Sluijs &

116 Ogilvie 2012; Barnett et al, 2014), the second aim was to examine whether gender and
117 educational level moderate the associations examined in the first aim.
118
119 **Materials and methods**
120
121 This study was conducted in Ghent (250,000 inhabitants, 156.18 square km (60.3 square miles),
122 1601 inhabitants/square km), Flanders, Belgium. Baseline data were collected in two waves, a
123 first wave in December 2012 and a second wave in May 2013. Follow-up data were similarly
124 collected in two waves, two years after baseline data collection (December 2014, May 2015).
125
126 *Procedures and participants*
127
128 The data used for this paper were part of a larger study in adults around retirement age where at
129 baseline, individuals who retired recently (>1 month, <5 years of retirement) and individuals
130 who planned to retire within the next 18 months were targeted. However, because this paper
131 aims to examine whether psychological, social and physical environmental factors assessed at
132 the beginning of retirement, can predict changes in PA and sedentary behaviors during early
133 retirement, only the data of individuals who are at the start of their retirement (>1 month, <2
134 years of retirement) are used. More details on the procedures of the larger study and the selection
135 of the analytical sample for the current paper, can be found below.
136
137 In Flanders, the formal retirement age of the current workforce over 50 years of age lies between
138 58 and 65 years (http://www.onprvp.fgov.be), but official records with information on retirement

139 status are not publicly available. Consequently, the Public Service of Ghent selected a random
140 sample of 7500 58 – 65 year old adults from the municipal register for the study. At baseline, all
141 these adults received an invitation letter with information on the study (2500 adults in December
142 2012, 5000 adults in May 2013). Only adults who planned to retire within the next 18 months,
143 and those who had been retired for more than one month but less than five years could
144 participate in the large-scale study. Retired adults needed to be retired from their main
145 occupation, but engaging in voluntary work was allowed. Furthermore, as PA was one of the
146 outcome variables, participants had to be able to walk 100 meters without assistance in order to
147 be eligible. Adults who were willing to participate in the study and met the inclusion criteria,
148 received a postal questionnaire (with a pre-stamped envelope to return the questionnaire)
149 including questions on socio-demographic characteristics, psychological, social and physical
150 environmental factors, PA and sedentary behaviors, and physical and mental health. In total, 597
151 adults (455 retired, 142 planning to retire) returned a complete questionnaire. Because it is
152 unknown how many of the 7500 addressed adults were eligible to participate in the study, it is
153 not possible to calculate the response rate.
154
155 After two years (December 2014 and May 2015) these 597 adults received the same postal
156 questionnaire again (follow-up measurements). In total, 463 adults (77.6%) returned a complete
157 questionnaire at follow-up. Of these 463 participants, five were not yet retired, three did not
158 report the month/year of retirement, and 9 participants had not been working before they
159 officially retired (seven housewives and two disabled persons). Consequently, the final sample
160 that completed both baseline and follow-up measurements of the large-scale study consisted of
161 446 participants (341 adults who were already retired at baseline and 105 adults who retired

between baseline and follow-up). For this paper, the 105 adults who were not retired yet at baseline and adults who had been retired for more than two years at baseline (n= 161) were excluded from the analyses. This lead to a final analytical sample of 180 adults who were at the start of retirement at baseline.

The study protocol was approved by the ethics committee of the Ghent University Hospital (B670201215326). Written informed consent was obtained from all participants.

Measures

Dependent variables: Changes in physical activities and sedentary behaviors

Self-reported PA was assessed with the International Physical Activity Questionnaire (IPAQ; long past seven days version). PA assessed by the IPAQ showed good reliability (intra-class correlations range from 0.46 to 0.96) and fair-to-moderate criterion validity compared against accelerometers (median ρ=0.30) in a 12-country study (Craig et al, 2003). Frequency (number of days) and duration (minutes/day) of PA in different domains were queried. Based on this information, separate estimates of weekly minutes of active transportation (sum of walking and cycling for transport) and leisure-time PA (sum of leisure-time walking, cycling and moderate-to-vigorous PA (MVPA)) were calculated.

Self-reported minutes/week of car use and screen time (sum of TV viewing time and computer use) were assessed using a translated (Flemish) version of the leisure-time sedentary behavior questionnaire developed by Salmon and colleagues (2003). The English-language version of the

questionnaire has fair to excellent reliability (intra-class 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 (Salmon et al, 2003).

Predictors: Psychological, social and physical environmental characteristics

All psychological variables assessed in the questionnaire were derived from previous studies in adults and adolescents (Marcus et al, 1992; De Bourdeaudhuij & Sallis, 2002; Deforche et al, 2004; De Bourdeaudhuij et al, 2005; English Longitudinal Study of Ageing, available at http://elsa-project.ac.uk). Five categories of psychological variables were included: perceived benefits of PA, perceived barriers towards PA, self-efficacy, vision on retirement and vision on old age. Scales were constructed for perceived benefits of PA (e.g. losing weight, enjoyment; mean of six items, Cronbach's alpha (α)=0.56), perceived barriers (e.g. feeling to old, fear for injuries, bad weather; mean of 11 items, α=0.87), self-efficacy (e.g. being active even when not feeling well, being active even without a sport partner; mean of five items, α=0.82) and vision on old age (e.g. old age is accompanied by loneliness, we can learn a lot from old people; mean of 11 items, α=0.65). Vision on retirement consisted of two items that were analyzed separately: 'I perceive retirement as a start for slowing down' and 'I perceive retirement as a start for a more active lifestyle'. All items were scored on a five-point scale with a higher score reflecting more positive psychological profiles, except for the self-efficacy items, which were scored on a three-point scale (I know I cannot, I think I can, I know I can).

Social variables included modelling, social support and social cohesion of the neighborhood. All variables were derived from previous studies in adults (Sallis et al, 1987; Sampson, Raudenbush & Earls, 1997; De Bourdeaudhuij & Sallis, 2002). Modelling consisted of three items (modelling from partner, friends, (grand)children) that were assessed using a seven-point scale (higher score = more perceived modelling). These items were analyzed separately due to low internal consistency ($\alpha<0.50$). Scales were constructed for social support (e.g. how often do friends support you to be active; six items, $\alpha=0.85$) and social cohesion of the neighborhood (e.g. people in my neighborhood can be trusted, this is a close-knit neighborhood; five items, $\alpha=0.82$). These items were scored on a five-point scale ranging from strongly disagree to strongly agree (higher score = more positive social characteristics).

To assess perceived physical environmental factors, the Dutch version of the NEWS questionnaire was used (De Bourdeaudhuij, Sallis & Saelens, 2003). Physical environmental subscales included were residential density, land use mix diversity, land use mix access, street network connectivity, infrastructure and safety for walking and cycling, traffic safety, crime safety and aesthetics. Calculation of these subscales was based on the official NEWS scoring guidelines (available at http://sallis.ucsd.edu), with a higher score reflecting a more positive environmental perception. The Dutch NEWS has acceptable to good reliability (intraclass correlation coefficients between 0.40 and 0.97) and acceptable validity (coefficients between 0.21 and 0.91) (De Bourdeaudhuij, Sallis & Saelens, 2003). All environmental factors were rated on a four-point scale, except for residential density (three-point scale) and land use mix diversity (five-point scale).

230 Socio-demographic covariates and moderators

231 Self-reported socio-demographics included gender, age, weight, height and educational level
232 (primary, secondary, tertiary education). BMI was calculated by dividing the weight (kg) by the
233 height (m) squared. For the analyses, educational level was dichotomized into high education
234 (i.e. tertiary education) versus low education (i.e. primary and secondary education).

235

236 *Statistical analyses*

237

238 All data were analyzed using SPSS 22.0 and multiple moderated hierarchic regression analyses
239 were conducted to solve the research questions. In a first step, measures of change in PA (active
240 transportation and leisure-time PA) and sedentary behaviors (screen time and car use) between
241 baseline and follow-up were created by regressing the PA and sedentary behavior measures at
242 follow-up onto their respective baseline values. Based on these regression outcomes, residualized
243 change scores were computed. These scores can be interpreted as the amount of
244 increase/decrease in PA or sedentary time between baseline and follow-up, independent of
245 baseline scores. Furthermore, they eliminate autocorrelated error and regression to the mean
246 effects and are therefore preferable to simple change scores (Cohen & Cohen, 1985; Bland &
247 Altman, 1994).

248

249 In a second step, multicollinearity ($r>0.60$) between the predictors (psychological, social and
250 physical environmental characteristics) was analyzed. Only between perceived land use mix
251 access and land use mix diversity ($r=0.65$) and between self-efficacy and perceived barriers
252 towards PA ($r=0.62$) multicollinearity was present. Consequently, only the predictor with the

253 strongest correlation with the dependent variable was included in the regression analyses. In a
254 third step, bivariate correlations between the potential predictors and the outcome variables were
255 examined. Only predictors that had a correlation with the dependent variable of $p<0.15$ were
256 included in the regression models (Tabachnik & Fidell, 2007).
257
258 In a final step, multiple moderated hierarchic regression analyses were conducted to examine
259 whether psychological, social and physical environmental factors at the start of retirement
260 predicted changes in PA and sedentary behaviors during early retirement, and the moderating
261 effects of gender and educational level. Eight regression models were constructed, two for each
262 dependent variable (residualized change scores of active transportation, leisure-time PA, screen
263 time and car use). In a first block, the socio-demographic covariates (gender, age, BMI,
264 educational level) were entered. In a second block, the psychological, social and physical
265 environmental factors (predictors; baseline values) were entered as independent variables. In the
266 third block, the cross-products (gender × predictor or educational level × predictor) were added
267 to examine the moderating effects of gender (four models, one for each dependent variable) and
268 educational level (four models). In case of significance, separate regression models (men versus
269 women or high versus low educational level) were run to interpret the direction of the
270 interaction. Statistical significance was set at 0.05 but because of the small study sample,
271 marginally significant results ($p<0.10$) were also reported.
272
273 **Results**
274

Baseline descriptive statistics of the study sample are presented in Table 1. In summary, 48.6% of the sample was male, mean age was 62.5 (2.1) years, 45.5% of the sample had a low educational level (i.e. no college or university degree) and mean BMI was 25.4 (3.9) kg/m². Average values of the psychological, social and physical environmental factors, and of the outcome variables (PA and sedentary behaviors) can also be found in Table 1.

Before conducting the multiple moderated hierarchic regression analyses, bivariate correlations between the potential predictors and the outcome variables were run. Only predictors with a correlation of $p<0.15$ with the dependent variable, were included in the regression models. For change in active transportation, the following nine predictors were included: self-efficacy, perceiving retirement as a start for slowing down, modelling from (grand)children, neighborhood social cohesion, residential density, land use mix access, street connectivity, infrastructure/safety for walking and cycling and aesthetics. Six predictors were included in the model for change in leisure-time PA: perceived benefits, self-efficacy, perceiving retirement as a start for being active, modelling from partner, land use mix access and traffic safety. Vision on old age and street connectivity were included as predictors in the model for change in screen time. Finally, modelling from friends, residential density and land use mix access were included in the model for change in car use.

Insert Table 1 near here

298 *Psychological, social and physical environmental predictors of changes in PA and moderating*
299 *effects of gender and educational level*
300
301 Results of the regression analyses are presented in Table 2. Perceived residential density
302 (β=0.41, p<0.001) and perceived aesthetics (β=-0.18, p=0.08) were (marginally) significant
303 predictors of changes in active transportation (adjusted R^2=0.179). Higher perceived residential
304 density and lower perceived aesthetics at baseline were related to an increase in active
305 transportation. Educational level moderated the relation between modelling from (grand)children
306 and change in active transportation (β=0.66, p=0.09). In participants with a low educational
307 level, no association was found between modelling from (grand) children and change in active
308 transportation (β=0.06, p=0.68) whereas in participants with a high educational level, higher
309 modelling from (grand)children was related to an increase in active transportation (β=0.22,
310 p=0.06). No other moderating effects, neither of educational level, nor of gender could be
311 identified with regard to change in active transportation.
312
313 Regarding change in leisure-time PA, baseline self-efficacy was the only significant predictor (β
314 =0.32, p=0.001; adjusted R^2=0.134). Higher baseline levels of self-efficacy were associated with
315 an increase in leisure-time PA. Educational level moderated the relation between vision on
316 retirement (i.e. retirement is a start for a more active lifestyle) and change in leisure-time PA
317 (β=-0.67, p=0.045). In participants with a low educational level, a more positive vision on
318 retirement was related to an increase in leisure-time PA (β=0.35, p=0.002) while in participants
319 with a high educational level, no association was found (β=0.06, p=0.56). No other moderating
320 effects of educational level or gender could be identified.

321

322 _____

323 Insert Table 2 near here

324 _____

325

326 *Psychological, social and physical environmental predictors of changes in sedentary behaviors*

327 *and moderating effects of gender and educational level*

328

329 Results of the regression analyses are presented in Table 3. Baseline vision on old age (β=0.16,

330 p=0.04) and perceived street connectivity (β=-0.25, p=0.001) were significantly related to change

331 in screen time (adjusted R^2=0.064). A more positive vision on old age and perceiving less street

332 connectivity were associated with an increase in screen time. Educational level and gender were

333 no significant moderators of any of the associations.

334

335 Regarding change in car use, baseline modeling from friends (β=0.21, p=0.06) and perceived

336 land use mix access (β=-0.20, p=0.09) were (marginally) significant predictors (adjusted

337 R^2=0.058). Higher baseline levels of modeling from friends and lower perceived land use mix

338 access were associated with an increase in car use. Educational level and gender were marginally

339 significant moderators of the relation between modelling from friends and change in car use

340 (β=0.63, p=0.06 and β=-0.54, p=0.08). In females (β=-0.01, p=0.94) and participants with a low

341 educational level (β=0.04, p=0.83) no relation could be identified. In males (β =0.23, p=0.10)

342 and participants with a high educational level (β=0.24, p=0.07), higher baseline levels of

343 modelling from friends were marginally significantly associated with an increase in car use. No
344 other moderating effects were found.
345
346 _____
347 Insert Table 3 near here
348 _____
349
350 **Discussion**
351
352 To our knowledge, this was the first quantitative study with a longitudinal design examining the
353 multidimensional correlates of PA and sedentary behavior in recently retired adults. This paper
354 aimed to examine whether psychological, social and physical environmental factors at the start of
355 retirement can predict longitudinal changes in leisure-time PA, active transportation, screen time
356 and car use during the first years of retirement. Furthermore, potential moderating effects of
357 gender and educational level were examined.
358
359 Overall, the results showed that only a limited number of the included factors was associated
360 with changes in PA and sedentary behaviors. Some moderating effects, mainly of educational
361 level, were found, suggesting that to a certain extent, distinct approaches are probably needed to
362 optimally reach high- and low-educated individuals in future interventions. Furthermore, the
363 explained variance of the correlates was considerably larger for changes in PA (13.4% for
364 change in leisure-time PA and 17.9% for change in active transportation) than for changes in
365 sedentary behaviors (5.8% for change in car use and 6.4% for change in screen time). This could

366 be due to the fact that the content of the questions to assess the psychological, social and physical
367 environmental factors primarily focused on PA and not specifically on sedentary behaviors; for
368 instance, modelling was assessed by asking how often the participants'
369 partner/friends/(grand)children were physically active, and perceived barriers/benefits were
370 queried towards PA. Only the questions about participants' vision on retirement, vision on old
371 age, social cohesion of the neighborhood and specific physical environmental factors (e.g.
372 residential density, aesthetics) were more general and did not focus specifically on PA. Until
373 now, almost no studies examining potential correlates of sedentary behaviors used questions
374 specifically related to sedentary behaviors, mainly because this type of research is still in its
375 infancy, and little is known about its potential correlates: theoretical frameworks are also
376 lacking. Future research should elucidate this issue by including questions that focus more
377 specifically on sedentary behaviors in order to find out whether including such factors can
378 increase the explained variance.
379
380 When examining the results in more detail, it can be concluded that the physical environmental
381 perceptions (residential density, aesthetics and land use mix access) were mainly important to
382 explain changes in active transportation and car use. Also in previous (cross-sectional) studies in
383 adults and older adults, transportation PA was more frequently related to the physical
384 environment than recreational PA (Van Cauwenberg et al, 2011; Van Holle et al, 2012).
385 Walkability characteristics like residential density and land use mix access have been
386 consistently associated with active (and passive) transportation in adults (Van Holle et al, 2012),
387 but evidence in older adults is less consistent (Van Cauwenberg et al, 2011; Bauman et al, 2012).
388 The present study adds evidence for the importance of the built environment in recently retired

adults and confirms the assumption that living in a high walkable neighborhood can be beneficial to increase active transportation and reduce car use. So, as emphasized in previous studies in adults (Heath et al, 2006; Bauman et al, 2012; Sallis et al, 2016) health interventions should pay attention to optimizing neighborhoods for active transportation, and to make people who live in less walkable environments aware of the possibilities that do exist in their neighborhood. In that way, not only adults, but also the specific group of recently retired adults can potentially be reached. Neighborhood aesthetics were inversely related to change in active transportation in the current study. However, also in previous studies inconsistent results have been found for aesthetics, both in adults (Van Holle et al, 2012) and in older adults (Van Cauwenberg et al, 2011). This might be because high walkable neighborhoods that have important characteristics to stimulate active transportation like high residential density and high land use mix access, are mainly located in urban regions, that are often not very aesthetically pleasing.

Self-efficacy ((i.e. confidence in the ability to be active without a sport partner, when not having a lot of time, when not feeling well and when the weather is not good) was the only factor that predicted a positive change in leisure-time PA in the total sample. Previous studies already showed that self-efficacy is amongst the most important determinants of leisure-time PA in (older) adults (Caudroit, Stephan & Le Scanff, 2011; Koeneman et al, 2011; Bauman et al, 2012). Nonetheless, it was somewhat surprising that no other psychological or social factors were related to change in leisure-time PA since results of previous focus group studies in recently retired adults identified several specific intra- and interpersonal correlates of leisure-time PA, like social support, perceived health benefits, financial constraints, etcetera (Barnett, Guell & Ogilvie, 2012; McDonald et al, 2015; Kosteli, Williams & Cumming, 2016; Van Dyck

et al, unpublished findings). The current quantitative study could not confirm these previous qualitative results. The importance of self-efficacy confirms that future interventions should be multi-dimensional and combine an individual with an environmental focus, in order to increase different types of PA in recently retired adults (Sallis, Owen & Fisher, 2008).

Unexpected results were found regarding the correlates of change in screen time: adults with a positive vision on old age and those who perceived higher street connectivity showed an increase in screen time. These findings are opposite to what one would expect, which confirms the assumption that correlates that focus on PA seem not really suitable to be linked to sedentary behaviors. Previous literature on the multidimensional correlates of sedentary behaviors in (older) adults is very limited, but the available evidence also showed inconsistent associations of street connectivity and other aspects of the physical environment with sedentary behaviors: some studies found negative associations (Sugiyama et al, 2007; King et al, 2010), while other studies found no or positive associations (Kozo et al, 2012; Teychenne, Ball & Salmon, 2012; Chastin et al, 2015). Furthermore, it might be that other factors like the home environment, or automatic processes and habit strength are more strongly related to changes in screen time than the currently included variables (Conroy et al, 2013). Consequently, more studies focusing on other sedentary behavior-specific correlates are needed.

Some moderating effects of educational level and gender were identified: higher levels of modelling from (grand)children only predicted an increase in active transport in high-educated adults, while only in low-educated adults, a more positive vision on retirement (i.e. perceiving retirement as a start for a more active lifestyle) predicted an increase in leisure-time PA. The two

435 other moderating effects were in the unexpected direction (i.e. in men and high-educated adults,
436 higher modelling from friends predicted an increase in car use). Because only four of the forty
437 examined moderating effects were significant, one can presume that generic interventions
438 focusing on men and women, as well as low- and high-educated retired adults have the potential
439 to be effective. Emphasizing specific aspects in low- or high-educated adults, like a focus on
440 modelling from grand(children) in high-educated adults or on obtaining a positive vision on
441 retirement in low-educated adults, could increase the effectiveness of such interventions.
442
443 Strengths of this study firstly include its longitudinal design. Second, we focused specifically on
444 adults who are at the start of retirement, which is an important but currently understudied group
445 in health research. Third, a broad range of PA and sedentary behaviors were examined while
446 previous studies mainly focused on either leisure-time PA or TV viewing time, and not on active
447 transportation or car use. Furthermore, some limitations should be acknowledged. First, a
448 relatively small sample of recently retired adults participated in the study, limiting the power of
449 our analyses, the generalizability of our findings, and possibly inducing selection bias. Second,
450 only self-reported PA and sedentary behaviors were included. As the use of questionnaires is
451 subject to several biases (e.g. recall bias, social desirability), it is recommended to combine this
452 with objective assessments of PA and sedentary time in future studies. Third, most included
453 predictors primarily focused on PA and not specifically on sedentary behaviors. Future studies
454 should include sedentary-specific predictors to further unravel the determinants of changes in car
455 use, screen time and other sedentary behaviors.
456
457 **Conclusions**

458

459 In conclusion, this study showed that walkability characteristics (perceived residential density
460 and land use mix access) and self-efficacy at the start of retirement can predict longitudinal
461 changes in active transportation and leisure-time PA. Few moderating effects of gender and
462 educational level were found, so health interventions at the start of retirement, focusing on both
463 individual and physical environmental factors could be effective to increase PA in recently
464 retired adults. No firm conclusions can be drawn on the importance of the examined predictors to
465 explain change in car use and screen time, possibly other factors like the home environment, or
466 automatic processes and habit strength are more important to explain sedentary behaviors.

467

468 **References**

469

470 Barnett I, Guell C, Ogilvie D. 2012. The experience of physical activity and the transition to
471 retirement: a systematic review and integrative synthesis of qualitative and quantitative evidence.
472 *International Journal of Behavioral Nutrition and Physical Activity* 9: 97. doi: 10.1186/1479-
473 5868-9-97.

474

475 Barnett I, van Sluijs E, Ogilvie D, Wareham NJ. 2014. Changes in household, transport and
476 recreational physical activity and television viewing time across the transition to retirement:
477 longitudinal evidence from the EPIC Norfolk cohort. *Journal of Epidemiology and Community*
478 *Health* 68: 747-753. doi: 10.1136/jech-2013-203225.

479

480 Barnett I, van Sluijs EMF, Ogilvie D. 2012. Physical activity and transitioning to retirement: a
481 systematic review. *American Journal of Preventive Medicine* 43: 329-336. doi:
482 10.1016/j.amepre.2012.05.026.
483
484 Bauman AE, Reis RS, Sallis JF, Wells JC, Loos RJF, Martin BW, for the Lancet Physical
485 Activity Series Working Group. 2012. Correlates of physical activity: why are some people
486 physically active and others not? *Lancet* 380: 258-271. doi: 10.1016/S0140-6736(12)60735-1.
487
488 Bland JM, Altman DG. 1994. Regression towards the mean. *British Medical Journal* 308: 1499.
489
490 Caudroit J, Stephan Y, Le Scanff C. 2011. Social cognitive determinants of physical activity
491 among retired older individuals: an application of the health action process approach. *British*
492 *Journal of Health Psychology* 16: 404-417. doi: 10.1348/135910710X518324.
493
494 Chastin SFM, Buck C, Freiberger E, Murphy M, Brug J, Cardon G, et al. 2015. Systematic
495 literature review of determinants of sedentary behaviour in older adults: a DEDIPAC study.
496 *International Journal of Behavioral Nutrition and Physical Activity* 12: 127. doi:
497 10.1186/s12966-015-0292-3.
498
499 Chung S, Domino ME, Stearns SC, Popkin BM. 2009. Retirement and physical activity: analyses
500 by occupation and wealth. *American Journal of Preventive Medicine* 36: 422-428. doi:
501 10.1016/j.amepre.2009.01.026.
502

503 Cohen J, Cohen P. 1985. *Applied multiple regression/correlation for the behavioral sciences.* 2nd
504 ed. Hillsdale: Erlbaum.
505
506 Conroy DE, Maher JP, Elavsky S, Hyde AL, Doerksen SE. 2013. Sedentary behavior as a daily
507 process regulated by habits and intentions. *Health Psychology* 32: 1149-1157. doi:
508 10.1037/a0031629.
509
510 Craig CL, Marshall AL, Sjöström M, Bauman AE, Booth ML, Ainsworth BE, et al. 2003.
511 International Physical Activity Questionnaire: 12-country reliability and validity. *Medicine &*
512 *Science in Sports & Exercise* 35: 1381-1395.
513
514 De Bourdeaudhuij I, Sallis JF. 2002. Relative contribution of psychological determinants to the
515 prediction of physical activity in three population based samples. *Preventive Medicine* 34: 279-
516 288.
517
518 De Bourdeaudhuij I, Sallis JF, Saelens BE. 2003. Environmental correlates of physical activity in
519 a sample of Belgian adults. *American Journal of Health Promotion* 18: 83-92.
520
521 De Bourdeaudhuij I, Lefevre J, Deforche B, Wijndaele K, Matton L, Philippaerts R. 2005.
522 Physical activity and psychosocial correlates in normal and overweight 11 to 19 year olds.
523 *Obesity Reviews* 13: 1097-1105.
524

Deforche B, De Bourdeaudhuij I, Tanghe A, Hills AP, De Bode P. 2004. Changes in physical activity and psychosocial determinants of physical activity in children and adolescents treated for obesity. *Patient Education & Counseling* 55: 407-415.

Federal Pensions Service Belgium. Available at: http://www.onprvp.fgov.be Accessed on May 18 2016.

Heath G, Brownson R, Kruger J, Miles R, Powell KE, Ramsey LT, et al. 2006. The effectiveness of urban design and land use and transport policies to increase physical activity: a systematic review. *Journal of Physical Activity & Health* 3: S55-S76.

Jonsson H, Josephsson S, Kielhofner G. 2001. Narratives and experience in an occupational transition: a longitudinal study of the retirement process. *American Journal of Occupational Therapy* 55: 424-432.

Kim JE, Moen P. 2002. Retirement transitions, gender, and psychological well-being: a life-course, ecological model. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences* 57: 212-222.

King AC, Goldberg JH, Salmon J, Owen N, Dunstan D, Weber D, et al. 2010. Identifying subgroups of US adults at risk for prolonged television viewing to inform program development. *American Journal of Preventive Medicine* 38: 17-26. doi: 10.1016/j.amepre.2009.08.032.

548 King DE, Mainous AG 3rd, Geesey ME. 2007. Turning back the clock: adopting a healthy
549 lifestyle in middle age. *The American Journal of Medicine* 120: 598-603.
550
551 Knoops KT, de Groot LC, Kromhout D, Perrin AE, Moreiras-Varela O, Menotti A, et al. 2004.
552 Mediterranean diet, lifestyle factors, and 10-year mortality in elderly European men and women:
553 the HALE project. *Journal of the American Medical Association* 292: 1433-1439.
554
555 Koeneman MA, Verheijden MW, Chinapaw MJM, Hopman-Rock M. 2011. Determinants of
556 physical activity and exercise in healthy older adults: a systematic reviews. *International Journal*
557 *of Behavioral Nutrition and Physical Activity* 8: 142. doi: 10.1186/1479-5868-8-142.
558
559 Kosteli M, Williams SE, Cumming J. 2016. Investigating the psychosocial determinants of
560 physical activity in older adults: a qualitative approach. *Psychology & Health* 31: 730-749. doi:
561 10.1080/08870446.2016.1143943.
562
563 Kozo J, Sallis JF, Conway TL, Kerr J, Cain K, Saelens BE, et al. 2012. Sedentary behaviors of
564 adults in relation to neighborhood walkability and income. *Health Psychology* 31: 704-713. doi:
565 10.1037/a0027874.
566
567 Lahti J, Laaksonen M, Lahelma E, Rahkonen O. 2011. Changes in leisure-time physical activity
568 after transition to retirement: a follow-up study. *International Journal of Behavioral Nutrition*
569 *and Physical Activity* 8: 36. doi: 10.1186/1479-5868-8-36.
570

Lang IA, Rie NE, Wallace RB, Guralnik JM, Melzer D. 2007. Smoking cessation and transition into retirement: analyses from the English Longitudinal Study of Ageing. *Age and Ageing* 36, 638-643.

Marcus BH, Selby VC, Niaura RS, Rossi JS. 1992. Self-efficacy and the stages of exercise behavior change. *Research Quarterly for Exercise and Sport* 63: 60-66.

McDonald S, O'Brien N, White M, Sniehotta FF. 2015. Changes in physical activity during the retirement transition: a theory-based, qualitative interview study. *International Journal of Behavioral Nutrition and Physical Activity* 12: 25. doi: 10.1186/s12966-015-0186-4.

Mein GK, Shipley MJ, Hillsdon M, Ellison GT, Marmot MG. 2005. Work, retirement and physical activity: cross-sectional analyses from the Whitehall II study. *European Journal of Public Health* 15: 317-322.

Organization for Economic Cooperation and Development. 2006. Study projects growing pressure on public health spending over and above effects of ageing society. Paris, France. Organization for Economic Cooperation and Development. Available at: http://www.oecd.org Accessed April 20 2016.

Sallis JF, Cerin E, Conway TL, Adams MA, Frank LD, Pratt M, et al. 2016. Physical activity in relation to urban environments in 14 cities worldwide: a cross-sectional study. *Lancet* 387: 2207-2217. doi: 10.1016/S0140-6736(15)01284-2.

Sallis JF, Grossman RM, Pinski RB, Patterson TL, Nader PR. 1987. The development of scales to measure social support for diet and exercise behaviors. *Preventive Medicine* 16: 825-836.

Sallis JF, Owen N, Fisher EB. 2008. Ecological models of health behavior. In Glanz K, Rimer BK, Viswanath K, eds. *Health behavior and health education: Theory, research and practice.* San Francisco, CA: Jossey-Bass, 465-486.

Salmon J, Owen N, Crawford D, Bauman A, Sallis JF. 2003. Physical activity and sedentary behavior: a population-based study of barriers, enjoyment and preference. *Health Psychology* 22: 178-188.

Sampson RJ, Raudenbush SW, Earls F. 1997. Neighborhoods and violent crime: a multilevel study of collective efficacy. *Science* 277: 918-924.

Slingerland AS, van Lenthe FJ, Jukema JW, Kamphuis CBM, Looman C, Giskes K, et al. 2007. Aging, retirement, and changes in physical activity: prospective cohort findings from the GLOBE Study. *American Journal of Epidemiology* 165: 1356-1363.

Sprod J, Ferrar K, Olds T, Maher C. 2015. Changes in sedentary behaviours across the retirement transition: a systematic review. *Age and Ageing* 44, 918-925. doi: 10.1093/ageing/afv140.

Sugiyama T, Salmon J, Dunstan DW, Bauman AE, Owen N. 2007. Neighborhood walkability and TV viewing time among Australian adults. *American Journal of Preventive Medicine* 33: 444-449.

Tabachnik BG, Fidell LS. 2007. *Using multivariate statistics.* 5th ed. Boston: Allyn and Bacon: p. 140.

Teychenne M, Ball K, Salmon J. 2012. Correlates of socio-economic inqualities in women's television viewing: a study of intrapersonal, social and environmental mediator. *International Journal of Behavioral Nutrition and Physical Activity* 9: 3. doi: 10.1186/1479-5868-9-3.

Touvier M, Bertrais S, Charreire H, Vergnaud AC, Hercberg S, Oppert JM. 2010. Changes in leisure-time physical activity and sedentary behaviour at retirement: a prospective study in middle-aged French subjects. *International Journal of Behavioral Nutrition and Physical Activity* 7: 1-14. doi: 10.1186/1479-5868-7-14.

Van Cauwenberg J, De Bourdeaudhuij I, De Meester F, Van Dyck D, Salmon J, Clarys P, et al. 2011. Relationship between the physical environment and physical activity in older adults: a systematic review. *Health & Place* 17: 458-469. doi: 10.1016/j.healthplace.2010.11.010.

Van Holle V, Deforche B, Van Cauwenberg J, Goubert L, Maes L, Van de Weghe N, et al. 2012. Relationship between the physical environment and different domains of physical activity in

638 European adults: a systematic review. *BMC Public Health* 12: 807. doi: 10.1186/1471-2458-12-
639 807.

640

641 World Health Organization. 2014. *10 Facts on ageing and the life course.* Geneva, Switzerland.

Table 1(on next page)

Baseline descriptive characteristics of the study sample (n=180)

[a] positively scored on a five-point scale [b] positively scored on a three-point scale [c] positively scored on a seven-point scale [d] positively scored on a four-point scale

Table 1: Baseline descriptive characteristics of the study sample (n=180)

Variable	
Socio-demographic covariates	
Gender (%)	
Men	48.6
Women	51.4
Age (mean (SD))	62.5 (2.1)
Educational level (%)	
High educational level	54.5
Low educational level	45.5
Body Mass index (mean (SD))	25.4 (3.9)
Predictors (mean (SD))	
Psychological factors	
Perceived benefits [a]	3.6 (0.6)
Perceived barriers [a]	4.1 (0.7)
Self-efficacy [b]	2.1 (0.54)
Vision on retirement [a]	
Retirement = slowing down	2.5 (1.1)
Retirement = more active life	3.2 (1.1)
Vision on old age [a]	3.5 (0.5)
Social factors	
Modelling from partner [c]	4.5 (2.2)
Modelling from friends [c]	4.2 (1.9)
Modelling from (grand)children [c]	5.0 (1.5)
Social support [a]	3.6 (1.0)
Neighborhood social cohesion [a]	3.6 (0.7)
Physical environmental factors	
Residential density [b]	192.6 (77.8)
Land use mix diversity [a]	3.0 (0.8)
Land use mix access [d]	3.2 (0.8)
Street network connectivity [d]	2.9 (0.5)
Infrastructure and safety for walking and cycling [d]	2.5 (0.5)
Traffic safety [d]	2.5 (0.6)
Crime safety [d]	3.0 (0.6)
Aesthetics [d]	2.5 (0.6)
Dependent variables (mean (SD))	
Physical activity (min/week)	
Active transportation	240.8 (253.0)
Leisure-time physical activity	312.4 (359.2)
Sedentary behaviors (min/week)	
Screen time	1425.4 (777.2)
Car use	320.0 (387.8)

[a] positively scored on a five-point scale

[b] positively scored on a three-point scale

[c] positively scored on a seven-point scale

[d] positively scored on a four-point scale

Table 2(on next page)

Multiple moderated hierarchic regression analyses: associations with changes in PA and moderating effects of educational level and gender

PA = physical activity, CI = confidence interval, Adj = adjusted * Block 3A: regression model with educational level as a moderator ¥ Block 3B: regression model with gender as a moderator

Table 2: Multiple moderated hierarchic regression analyses: associations with changes in PA and moderating effects of educational level and gender

Dependent variable	Predictors	Adj R^2	β value	95% CI	p-value
Change in active transportation	Block 1 (sociodemographic covariates)	0.009			
	Block 2	0.188			
	Self-efficacy		0.01	-0.31, 0.37	0.88
	Retirement = slowing down		0.10	-0.08, 0.25	0.30
	Modelling from (grand)children		0.12	-0.04, 0.19	0.22
	Neighborhood social cohesion		-0.05	-0.35, 0.20	0.60
	Residential density		**0.41**	**0.002, 0.008**	**<0.001**
	Land use mix access		0.07	-0.18, 0.34	0.55
	Street network connectivity		-0.12	-0.64, 0.19	0.28
	Infrastructure/safety for walking and cycling		0.11	-0.27, 0.70	0.39
	Aesthetics		**-0.18**	**-0.58, 0.03**	**0.08**
	Block 3A*	0.180			
	Educational level × self-efficacy		0.21	-0.53, 0.85	0.64
	× retirement = slowing down		-0.03	-0.38, 0.34	0.91
	× modelling from (grand)children		**0.66**	**-0.04, 0.50**	**0.09**
	× neighborhood social cohesion		0.39	-0.44, 0.81	0.56
	× residential density		0.02	-0.005, 0.006	0.94
	× land use mix access		0.76	-0.16, 1.03	0.15
	× street network connectivity		0.36	-0.69, 1.15	0.62
	× infrastructure/safety for walking and cycling		-0.22	-1.21, 0.90	0.77
	× aesthetics		-0.02	-0.77, 0.74	0.97
	Block 3B¥	0.152			
	Gender × self-efficacy		-0.30	-0.96, 0.47	0.50
	× retirement = slowing down		0.07	-0.35, 0.43	0.84
	× modelling from (grand)children		0.37	-0.13, 0.38	0.33
	× neighborhood social cohesion		0.23	-0.46, 0.68	0.70
	× residential density		-0.47	-0.01, 0.002	0.22
	× land use mix access		0.31	-0.44, 0.77	0.59
	× street network connectivity		0.67	-0.45, 1.28	0.34
	× infrastructure/safety for walking and cycling		-0.72	-1.57, 0.54	0.34
	× aesthetics		-0.41	-0.96, 0.39	0.41

Change in leisure-time PA	Block 1 (sociodemographic covariates)	0.065			
	Block 2	0.199			
	Perceived benefits		0.03	-0.25, 0.35	0.74
	Self-efficacy		**0.32**	**0.26, 0.94**	**0.001**
	Retirement = more active life		0.08	-0.09, 0.24	0.37
	Modelling from partner		0.05	-0.05, 0.10	0.55
	Land use mix access		0.06	-0.14, 0.28	0.51
	Traffic safety		0.14	-0.04, 0.45	0.10
	Block 3A*	0.204			
	Educational level × perceived benefits		0.30	-0.48, 0.79	0.63
	× self-efficacy		0.26	-0.46, 0.88	0.54
	× retirement = more active life		**-0.68**	**-0.69, -0.01**	**0.045**
	× modelling from partner		-0.17	-0.21, 0.10	0.39
	× land use mix access		0.18	-0.34, 0.54	0.65
	× traffic safety		-0.22	-0.68, 0.38	0.57
	Block 3B¥	0.168			
	Gender × perceived benefits		0.35	-0.52, 0.89	0.61
	× self-efficacy		-0.17	-0.84, 0.55	0.68
	× retirement = more active life		-0.05	-0.38, 0.32	0.88
	× modelling from partner		0.07	-0.13, 0.18	0.76
	× land use mix access		-0.34	-0.64, 0.26	0.41
	× traffic safety		-0.26	-0.71, 0.34	0.49

PA = physical activity, CI = confidence interval, Adj = adjusted

* Block 3A: regression model with educational level as a moderator

¥ Block 3B: regression model with gender as a moderator

Table 3(on next page)

Multiple moderated hierarchic regression analyses: associations with changes in sedentary behaviors and moderating effects of gender and educational level

PA = physical activity, CI = confidence interval * Block 3A: regression model with educational level as a moderator ¥ Block 3B: regression model with gender as a moderator

Table 3: Multiple moderated hierarchic regression analyses: associations with changes in sedentary behaviors and moderating effects of gender and educational level

Dependent variable	Predictors	Adj R^2	β value	95% CI	p-value
Change in screen time	Block 1 (sociodemographic covariates)	0.052			
	Block 2	0.116			
	Vision on old age		**0.16**	**0.02, 0.61**	**0.04**
	Street network connectivity		**-0.25**	**-0.69, -0.17**	**0.001**
	Block 3A*	0.105			
	Educational level × vision on old age		0.02	-0.59, 0.62	0.97
	× street network connectivity		-0.04	-0.54, 0.50	0.93
	Block 3B¥	0.105			
	Gender × vision on old age		-0.07	-0.65, 0.57	0.91
	× street network connectivity		0.11	-0.46, 0.60	0.80
Change in car use	Block 1 (sociodemographic covariates)	-0.015			
	Block 2	0.058			
	Modelling from friends		**0.21**	**-0.01, 0.24**	**0.06**
	Residential density		-0.14	-0.005, 0.001	0.26
	Land use mix access		**-0.20**	**-0.54, 0.04**	**0.09**
	Block 3A*	0.084			
	Educational level × modelling from friends		**0.63**	**-0.01, 0.51**	**0.06**
	× Residential density		-0.20	-0.01, 0.004	0.54
	× Land use mix access		-0.67	-1.11, 0.27	0.23
	Block 3B¥	0.080			
	Gender × modelling from friends		**-0.54**	**-0.47, 0.02**	**0.08**
	× Residential density		0.05	-0.006, 0.007	0.89
	× Land use mix access		0.57	-0.26, 0.95	0.26

PA = physical activity, CI = confidence interval

* Block 3A: regression model with educational level as a moderator

¥ Block 3B: regression model with gender as a moderator