**Neighbourhood perceptions and older adults’ wellbeing: does walking explain the relationship in deprived urban communities?**

**Abstract**

There is increased awareness of the role of the urban landscape in promoting walking to counter the negative health and wellbeing impacts of age-related immobility. Consideration of neighbourhood design is particularly relevant in the context of local urban regeneration projects, which are designed to have positive health and wellbeing outcomes. However, few studies explicitly investigate how the environment influences walking and wellbeing for older adults living in a deprived urban area.

There are strong conceptual and empirical links between walking, the urban environment and mental wellbeing. Many studies have separately demonstrated pairwise associations between all three components. In this paper we address these three concepts empirically, using structural equation modelling to explore walking as a mediator between the perceived social and built environments and mental wellbeing for older adults in deprived urban areas.

We found direct and indirect relationships between neighbourhood perceptions and wellbeing. Walking partially mediates relationships between social contact, neighbourhood quality, local amenity use, safety and mental wellbeing. Although neighbourhood problems and the quality of local services and amenities are associated with mental wellbeing, walking is not an explanatory pathway in our model. The relationship between walking and wellbeing is weaker than expected.

While promoting walking as a means of achieving positive mental wellbeing among older adults is important for “active ageing”, it is also necessary to consider the context in which this takes place, recognising that walking is not the only potential causal pathway between environment and wellbeing. Where walking is relied upon for transport, the wellbeing implications may be more complex. Given the strong associations between car ownership and wellbeing, future research should explore whether mobility and accessibility, rather than walking itself, is more important for older adults’ wellbeing.

**Keywords: deprived urban communities; mobility; wellbeing; neighbourhood environment; ageing**

1. **Introduction**

A large body of research has addressed the links between environment, walking and mental wellbeing. However, relatively few studies have considered the relationships between all three concepts simultaneously, especially with respect to older adults living in deprived urban areas. In attempting to redress this, we examine how the urban environment may support walking as a means of transport and whether that influences wellbeing. Physical health benefits related to physical activity are often considered a pathway between well designed urban environments and wellbeing, although others, including those of social engagement, accessibility, and safety and security, may link the two (Burton, 2015). We consider the wellbeing benefits of walking to include, but not be limited to, those of physical activity in general.

Active travel is attracting increasing policy attention as a mechanism to support healthy and sustainable urban development. Studies usually assume that walking will have positive health and wellbeing impacts, although this assumption has been questioned.. For example, for single mothers who relied on walking for transport, unpleasant environments, combined with stress and fatigue, meant that walking was detrimental to their wellbeing (Bostock, 2001). Therefore, while walking as a mode of active travel could promote population health and wellbeing, more attention needs to be paid to different populations groups and urban contexts to avoid perpetuating social exclusion and health inequalities for marginalised groups (Stafford and Baldwin, 2018).

This raises the question of whether connections between walking and wellbeing hold among people for whom walking for transport is not a choice. Walking as a mode of transport is particularly important for older adults and those who live in deprived areas, yet has been relatively little studied in this context. Older adults’ ability to drive can deteriorate with age meaning that walking often constitutes a greater proportion of their travel. People living in deprived urban areas are more likely to have difficulties affording transport and to rely on walking for their daily mobility (Ogilvie et al., 2008). For example, in the sample of older adults living in deprived areas considered in this study, only 22.4% of households owned a car, suggesting that walking for transport is probably important to them.

Ensuring the mobility needs of those groups who are most likely to be vulnerable to transport-related social exclusion is important from a transport justice perspective. Mobility and, consequently, transport systems can both promote and limit the quality of life and wellbeing of populations. Individuals without access to a car are more likely to walk, which can be health-promoting, but in a car-dependent society (Cahill, 2010) they risk exclusion from accessing destinations that are important for health and wellbeing.

Nordbakke and Schwanen (2013) conceptualise three ways in which mobility influences wellbeing. First, being mobile facilitates access to destinations and social connections that are important for health and wellbeing. Second, being mobile can have physical health benefits through the physical activity undertaken while moving. Finally, having the means to be mobile or to access important places can be important for feelings of wellbeing, even if that potential mobility is not made use of.

The relationship between walking, as a form of mobility, and wellbeing is particularly pertinent to older adults (Lampinen et al., 2006), given that these people may be less physically capable than the young and therefore may be less mobile (Schwanen and Páez, 2010).

The relationships between the urban environment, walking (or physical activity) and health and wellbeing attract an increasing degree of interest among health researchers (Koohsari et al., 2013). Considerable effort has been expended to determine the personal, residential, neighbourhood and community factors that influence the wellbeing of urban populations, and how the urban landscape can be better designed to sustain health and wellbeing (Dannenberg et al. 2012). Urban environments may influence health and wellbeing in a number of ways, but the potential of the design of places to influence active travel is increasingly recognised. Such a relationship assumes that the built environment influences health and wellbeing because of the behaviours (e.g., walking) that it supports.

In addition to its role as a mode of transport, walking is undertaken for other reasons, especially by older adults (Bergland et al., 2010). Given its potential physical health and mental wellbeing benefits — active older adults have a lower risk of falls, cardiovascular disease and obesity-related conditions, for example— it is increasingly promoted as part of “active ageing” agendas..

Relationships between environment and wellbeing are usually indirect (Burton, 2015), and few studies have explored their causal pathways. There are numerous studies of pairwise relationships between environment, mobility and wellbeing, but all three aspects have seldom been addressed simultaneously, especially in the context of older people. Given the tendency for older adults’ personal physical capabilities to decline, the neighbourhood environment is particularly likely to influence their mental wellbeing since they are likely to spend more time in the local environment than younger people (Gale et al., 2011). The neighbourhood environment can promote positive mental wellbeing by enabling walking (Sugiyama and Ward Thompson, 2007a) but few studies that have examined this pathway have addressed walking and health separately, but instead have assumed positive associations between them.

Our research project has previously examined the relationships between physical activity and wellbeing [reference removed for peer review], neighbourhood environment and walking behaviour [reference removed for peer review] and the neighbourhood environment and wellbeing [reference removed for peer review] in adults of all ages. Other studies have explored the relationship between the physical and social environment and walking (Franke et al., 2013; McCormack et al., 2014; Ogilvie et al., 2008; Van Cauwenberg et al., 2011) and between walking and mental wellbeing (Cerin et al., 2009). Ogilvie et al. (2008) studied the same deprived urban context as featured in this study, and we extend their study by examining wellbeing outcomes accruing from the environment and walking.

Sugiyama and Ward Thompson (2007b) found independent relationships between perceived environmental support and walking, and environmental support and physical and mental health, suggesting that the environment is important for wellbeing, both directly and, by facilitating walking, indirectly. Shortt et al. (2014)conceptualise walking as the pathway between the environment and physical health inequalities, although they assume a relationship between physical activity and health, which may not pertain to non-recreational walking (Christiansen et al., 2014; Ogilvie et al., 2008; Shortt et al., 2014). Assumed relationships between walking and health might not hold in the deprived urban context of our study, since walking for transport is usually more common among more deprived populations, while their health outcomes are typically poorer.

Many of the environmental and social factors associated with wellbeing are similar to those associated with walking. There is therefore a need to unpick these relationships to determine whether associations between the urban environment and wellbeing can be explained by, or are independent of, walking.

We use structural equation modelling to explore walking as a mediator of relationships between the built and social environment and the mental wellbeing of a sample of adults aged 60 years or more, who were living in deprived communities in Glasgow, UK, that were undergoing various residential and neighbourhood regeneration activities.

We conceptualise that there can be direct links and, via walking, indirect links between the built and social environments and wellbeing (Figure 1).

[Figure 1]

* 1. *Research aims*

We explore walking as a mediator of the relationship between perceptions of the environment and mental wellbeing for older adults in deprived urban communities, addressing the following research questions:

* How is the frequency of walking among older adults related to mental wellbeing?
* Which social and built environment factors are important for older adults’ (a) wellbeing and (b) walking in deprived urban communities?
* Does the frequency of walking among older adults mediate between the social and built environment and wellbeing in a deprived urban context?
1. **Material and Methods**
	1. *Study context*

Our study was conducted in Glasgow as part of the [study name removed for peer review], an investigation of the consequences of major residential, neighbourhood and community regeneration programmes. This study examines cross-sectional data from the third wave of a survey of residents, conducted in 2011.

4,269 Glasgow residents were interviewed in their homes in the spring or summer of 2011. 95 per cent of these people were living in one of 15 specific deprived neighbourhoods, the remainder living elsewhere in the city, having moved from one of the study areas at some time during the previous 5 years. The overall survey response rate was 45.4 per cent. The analyses presented here feature only respondents who were British citizens, aged 60 years or more. Only those with complete data for the variables examined were included in the final analytical sample of 1,071 respondents.

The questionnaire sought information about respondents’ personal and residential circumstances, their physical and mental health, their recent physical activity and their opinions and experiences of their homes, neighbourhoods and communities.

Ethical approval was given by the NHS Scotland B MREC committee (no. 05/MRE10/89).

* 1. *Analytical approach*

For the descriptive analysis, variables of interest are summarised as percentages (categorical variable classes) and means and standard deviations (continuous variables).

We use structural equation modelling to explore the simultaneous direct and indirect relationships between neighbourhood perceptions and mental wellbeing with walking as a mediator (Figure 2). We use a diagonally weighted least squares estimator (WLSMV) to accommodate the ordinal nature of the walking frequency variable. It uses diagonally weighted least squares (DWLS) to estimate the model parameters and the full-weight matrix to compute robust standard errors (Rosseel, 2012).

We used SPSS v.22.0 (IBM Corp., Armonk, NY) for descriptive analyses and the lavaan (v0.5-18) package in R (v 3.0.2) for structural equation modelling.

* 1. *Sample composition*

The composition of the sample is summarised in Table 1. A high proportion (almost 60 per cent) of the sample was female, close to the proportion in the overall population of these areas (58.3%). Almost half of the respondents (47 per cent) were in the youngest age group (60-69 years), whilst only around one in seven were aged 80 years or more. The majority (83 per cent) were retired, and 12.5 per cent claimed to be of working age but without a job (mainly men aged 60-64 years). Almost three in five of the respondents lived alone. Only approximately one in eight of the respondents had more than the most basic Scottish educational qualification (the School Leaving Certificate, SLC). Access to a car was uncommon (slightly more than a fifth of those interviewed). Slightly fewer than half of the respondents lived in a house, while just under a fifth lived in a flat in a high-rise block. Three-quarters of participants were social-renters.

Overall, 60.7 per cent of respondents reported at least one long-term physical condition. By far the most common ailments, reported by half of the participants, were of a cardiovascular or respiratory nature. Musculoskeletal and neurophysiological conditions were cited by a small minority (6.4 per cent) of respondents. Just over a fifth of people claimed to suffer from at least one other type of long-term physical health condition. It should be noted that there is no indication of the severity of any of these conditions.

Given our focus on a specific population group, the sample cannot be considered representative. We cannot be sure how representative our sample is of the older populations in the study areas, since these neighbourhoods comprise non-standard geographies and because data are not readily available for the specific age groups considered here.

[Table 1]

* 1. *Mental wellbeing measure*

Mental wellbeing is measured using the Warwick-Edinburgh Mental Wellbeing Scale (WEMWBS) (Tennant et al., 2007). Scores are derived from five-point frequency-scale responses to 14 positively phrased statements about respondents’ subjective happiness and effective psychological functioning over the previous two weeks. The scale has good psychometric properties (Stewart-Brown et al., 2009). Responses are usually summed to give scores between 14 (poorest mental wellbeing) and 70 (best mental wellbeing), but here we conceptualise mental wellbeing as an endogenous latent variable with 14 measured indicator variables (see below). In confirmatory factor analysis, the latent wellbeing variable explained significant variation in each of the 14 components and the model fit was acceptable (CFI=0.921; RMSEA=0.08), confirming the measure to be appropriate for the sample. We included error covariance between some items, as detailed in Table 2, to improve the model fit.

[Table 2]

* 1. *Walking measure*

Walking is an endogenous variable in our analysis because it is explained by other variables in the model. The frequency of neighbourhood walking was assessed from the question “*In the last seven days, on how many days did you walk in your neighbourhood for at least 20 minutes at a time?*”, which elicits responses of 0 to 7 days (respondents who replied “don’t know” or who refused to respond were excluded from the sample). The question aimed to address neighbourhood walking for the purposes of doing errands or as a leisure activity. While it is an arbitrary measure, 20 minutes was chosen for the wider survey because it is equivalent to a 10-minute round trip of around 800 m in an adult population, a threshold that is commonly used in such studies (Ogilvie et al., 2008) to distinguish those who walk in the local area from those who do not. We recognise the limitations here because our analytical sample is older than the general adult population, and so may walk more slowly, but we are limited by the data collected in the overall study.

* 1. *Measures of the social and built environment*

The importance of the neighbourhood and social environment for the health and mental wellbeing of older adults in particular is well established (Yen, Michael, and Perdue 2009). We used several of the variables surveyed in the wider study that measured self-reported perceptions (rather than objective measures) of the built and social environments. They were chosen because they were based on factors of known importance to community wellbeing, and because they had been related to walking and wellbeing in our previous research (references removed for peer review). Six of them are exogenous latent variables in the model and three are manifest variables, as outlined below.

* + 1. *Neighbourhood quality*

We included four indicator variables in our latent measure of neighbourhood quality: attractive buildings; attractive environment; quiet and peaceful environment and parks and open spaces.

* + 1. *Neighbourhood problems*

We considered two latent variables for neighbourhood problems: incivilities and environmental problems. The indicator variables are shown in Table 3.

* + 1. *Quality and use of local services and amenities*

We used three measures to capture the quality and use of local services: first, a latent variable of the quality of local services that included policing, street cleaning, public transport street lighting and paths (Table 2), and two derived variables representing the use of one or more of four retail amenities (post office; small/local grocers; supermarket; retail or shopping centre) and of six non-retail amenities (sport facilities, swimming pool or gym; social venues; park or play area; library; community centre) in the past 7 days.

* + 1. *Social contact*

We measured social contact using a latent variable based on three measures of frequency of contact: with family, friends and neighbours. We also included a manifest variable to indicate whether respondents lived with anyone as an indicator of social contact.

* + 1. *Personal safety*

We measured perceptions of safety using a manifest variable: *Feelings of safety walking in the dark* (1=very unsafe/never walk alone after dark; 5=very safe), which is designed to capture perceptions of personal and crime-related safety in the neighbourhood.

* 1. *Sociodemographic, personal and residential characteristics and health*

We included car ownership and education (in the absence of an income measure and as a proxy for socio-economic status) as measured variables. Additionally, car use is likely to be related to walking in its own right as people who use a car typically walk less frequently for transport.

Respondents were asked whether they had suffered regularly from any of several health problems (skin conditions, allergies; breathing problems, asthma, bronchitis; heart, high blood pressure, circulatory problems; stomach, liver, kidney, digestive problems; migraine, frequent headaches; any other condition specified by respondent) during the previous twelve months. We reclassified these responses into three groups of long-term health conditions: cardiovascular or respiratory illness; musculoskeletal or neurophysiological illness likely to impede walking; any other physical health problem. Mental health conditions were not included in the analysis due to their strong negative association with mental wellbeing.

We adjusted the model to account for sociodemographic, personal and residential characteristics including gender (male; female), age group (60-69; 70-80; 80+ years), household type (living alone; living with 1+ person), employment and education (none, up to SLC, or don’t know; above SLC).

1. **Results**

The results showing the relationship between each of the exogenous (predictor) variables and the two endogenous (outcome) variables, walking and mental wellbeing, are shown in Table 3 and Figure 3.

[Table 3]

[Figure 3]

The model fit indices (CFI=0.93; RMSEA=0.04) were acceptable and close to the cut-off values of 0.95 (CFI) and 0.06 (RMSEA) suggested by Hu and Bentler (1999).

* 1. *Associations with mental wellbeing*

Social contact, perceived neighbourhood quality and environmental neighbourhood problems had the strongest direct, positive associations with wellbeing. Cardiovascular and respiratory health conditions had the strongest, direct negative association with wellbeing.

As expected, neighbourhood walking was positively associated with mental wellbeing, although the small coefficient, predicting an increase in WEMWBS score of only 0.04 for each extra day of neighbourhood walking, cannot be considered substantive.

All of the neighbourhood perception variables except for perceived quality of local amenities were significantly associated with mental wellbeing. Neighbourhood quality (B=0.15) and the quality of local services (B=0.17) were positively associated with mental wellbeing. The two neighbourhood problem variables had opposing associations with mental wellbeing: incivilities were negatively associated (B=-0.18), but, surprisingly, environmental problems were positively associated with wellbeing (B=0.27). Using retail (B=0.09) and non-retail (B=0.12) amenities was associated with better mental wellbeing, whereas no significant associations were found with the perceived quality of any amenities.

Social contact was positively associated with wellbeing (B=0.25), as expected. Living alone was associated with a 0.07-point lower WEMWBS score than for those who do not live alone. Cardiorespiratory health problems (B=-0.19) and other physical health conditions (B=-0.16) were associated with worse mental wellbeing, although this was not the case for musculoskeletal health problems.

Age was associated with higher mental wellbeing scores, whereby those aged 70-79 years and 80 years or older reported higher mental wellbeing scores than those in the youngest age group (60-69 years). Those who reported that they would feel safe walking alone in their neighbourhood after dark reported higher mental wellbeing scores than those who would not feel safe. Owning, or having regular access to a vehicle was also associated with higher mental wellbeing scores. Women reported higher mental wellbeing scores than men in our sample (B=0.14) and those with educational qualifications had higher wellbeing scores than those without (B=0.12).

* 1. *Associations with walking*

Use of local retail and non-retail amenities, social contact and perceived neighbourhood quality were most strongly associated with walking more frequently in the local area. Car ownership was most strongly associated with a lower frequency of walking. Feeling safe walking in the dark was also associated with walking more frequently in the local neighbourhood (B=0.07). Neighbourhood problems were not significantly associated with walking. Car ownership (B=-0.47), cardiorespiratory (B=-0.18) and other physical health (B=-0.21) conditions, as well as increasing age (age 70-79 years, B=-0.15; 80+ years, B=-0.35) were associated with a lower frequency of walking. Finally, those with educational qualifications walked more frequently than those without (B=0.30).

* 1. *Walking as a mediator*

Walking is included in our model as a mediating variable. It is endogenous because it is explained by other variables in the model, but it also explains another variable (wellbeing). The model structure means that because there is a significant, though weak, positive association between walking and wellbeing, any exogenous variables significantly associated with walking in the structural equation model can be interpreted as having an indirect effect on wellbeing, through walking, in addition to any direct effects they may have on wellbeing. Where there are both direct and indirect relationships between an exogenous variable and mental wellbeing, walking *partially* mediates the relationship of that variable with wellbeing. Therefore, if our social and built environment variables are directly and indirectly associated with wellbeing, walking partially explains why they are associated with wellbeing. If the relationships are *only* indirect, then that variable is only associated with wellbeing because it supports walking, which is itself a positive influence on wellbeing. For example, the conceptual diagram (Figure 1) indicates that the built environment may influence wellbeing directly, but also indirectly as a result of the influence of the built environment on walking, which in turn influences wellbeing. This relationship between walking and wellbeing is confirmed in our model, so any significant relationships between predictor variables and walking are interpreted as being significant indirect relationships with wellbeing.

Walking can therefore be interpreted as a mediator of perceptions of neighbourhood quality and of social contact with positive mental wellbeing. Although these variables were independently associated with mental wellbeing, people who had positive perceptions of neighbourhood quality or higher levels of social contact and who also walked more frequently in the local area tended to have higher mental wellbeing scores. Similarly, walking was a significant mediator of the effect of the use of local amenities on mental wellbeing.

Feeling safe walking in the dark was directly and indirectly linked to better mental wellbeing through more frequent neighbourhood walking. Less frequent walking among those with cardiorespiratory (B=-0.2) and other physical health problems (B=-0.17) partially explained why the physically unwell tended to report worse mental wellbeing. Older age was negatively associated with walking and positively associated with wellbeing. The unstandardised total effects were positive (Age 80+ years, B =0.12). Household vehicle ownership was associated with less walking but better mental wellbeing. The unstandardised total effects were positive (B =0.07). This suggests that, despite the negative effects of car ownership on walking behaviour, having access to a vehicle is still better overall for mental wellbeing in older households.

In summary, social contact, neighbourhood quality, use of local amenities, physical health conditions and feeling safe walking in the neighbourhood at night have significant effects on wellbeing, which can be partially explained by neighbourhood walking. Neighbourhood problems and the perceived quality of local amenities have significant effects on mental wellbeing that cannot be explained by walking. Age and car ownership both have a negative relationship with walking, meaning that they have a negative indirect effect on wellbeing. However, this is overridden by positive direct effects between both car ownership and age, and wellbeing.

1. **Discussion**

*4.1 Perceptions of the neighbourhood, walking and mental wellbeing: links*

Our findings reinforce the importance of social contact, neighbourhood quality, local amenities and perceptions of safety for neighbourhood walking and mental wellbeing in populations of older people and add to the existing body of knowledge by providing empirical evidence that walking partially explains the associations of these factors with mental wellbeing.

Neighbourhood incivilities had a direct negative relationship with mental wellbeing, but did not influence walking in our sample. This suggests that walking may be utilitarian rather than a positive choice in deprived communities, helping to explain the weak associations with wellbeing. It is difficult to explain why environmental neighbourhood problems such as vandalism, graffiti, litter, damaged properties and vacant land, poor air quality and traffic would be positively associated with mental wellbeing. This finding runs contrary to our expectation and to previous evidence that neighbourhood problems are negatively associated with wellbeing (Jones et al., 2014). If the positive relationships between neighbourhood problems and walking were stronger, one explanation might be that such neighbourhood problems are more visible to those who are outside more often and who also have higher mental wellbeing scores. For example, Mason et al. (2013) found positive associations between adults perceiving drug problems and neighbourhood walking, and Ross and Mirowsky (2001) reported that people in areas with more problems were more likely to walk, a finding they ascribed to poverty. However, the observed non-significant positive association between environmental neighbourhood problems and frequency of walking is not strong enough to support this argument.

In fact, we found no associations between perceptions of neighbourhood problems and walking, in line with many other studies (Yen et al., 2009; Foster et al., 2012; Foster and Giles-Corti, 2008; Giles-Corti et al., 2013; Kerr et al., 2015; Fisher et al., 2004; Echeverría et al., 2008), although objective measures have been found to be important (Yen et al., 2009). This is supported by our finding regarding the importance of local services, which, although self-reported, may be considered more ‘objective’ than responses to questions about *perceptions* of neighbourhood problems.

There may also be an issue of reverse causation: we recognise that our measure is of *perceived* neighbourhood problems and that those with higher wellbeing scores may report neighbourhood problems to be more serious and/or numerous than those with poorer mental wellbeing. For example, those with higher wellbeing scores may be more concerned about the neighbourhood environment and therefore report problems more often, or those with lower wellbeing may perceive environmental incivilities to be less of a concern because they have adapted to adverse circumstances. An objective measure of neighbourhood problems would be needed to explore this further.

We found that social contact among older adults is important for the mental wellbeing and frequency of walking outdoors. Living alone is associated with poorer wellbeing, after controlling for social contact. With policy efforts increasingly directed towards “ageing in place” it will become more common for older people to live at home on their own, with fewer opportunities for social contact, especially when their reduced physical mobility restricts them from getting outdoors . Our results suggest that the positive associations of walking with mental wellbeing do not entirely counter the negative effects of living alone. It is therefore vital that policies promoting living at home longer consider all ways in which reduced mobility might impact wellbeing of ageing populations. While physical activity is likely to be important for some, reduced social contact is also threatened by reduction in mobility. It may be that these results are specific to the deprived urban context that we are studying. Nevertheless, this challenges assumptions that efforts to promote walking will necessarily lead to positive outcomes for all people in all places, and policy should take this nuance into account.

In contrast to finding no association with neighbourhood problems, those with more *positive* perceptions of local services such as street cleaning, public transport, street lighting and pavements have better mental wellbeing, but, counter to expectation, this is not explained by levels of neighbourhood walking. Positive perceptions of the quality of services provided might be associated with better wellbeing, due to same-source bias, given that the environmental and health reports are from the same individuals. However, Jones et al. (2014) suggested that associations between perceived neighbourhood and wellbeing are robust to same-source bias, and Elliott et al. (2014) found positive associations, even after controlling for personality.

We expected the perceived quality of local amenities to be positively associated with levels of both walking and wellbeing, but this was not true in either case. On the other hand, the *use* of local retail and non-retail amenities was positively associated with both walking and mental wellbeing. Walking in the local area therefore partially explains the higher wellbeing scores of those who use local amenities. Those not using amenities locally may either not be using amenities at all or using them somewhere other than their own neighbourhood. Given the nature of our sample (in which only 22.4% of households own a car), the former is more likely: older adults who may be confined to their home are less likely to be able to get out and use local amenities, with negative consequences for walking and wellbeing, although they may use other modes of transport to access more distant destinations. This is further supported by an examination of sources of walking in the sample, which suggests that most walking is functional, to run errands in the local neighbourhood. On this basis, the relationship between use of local amenities and walking is not surprising and nor is the finding that those not doing such day-to-day activities report lower levels of wellbeing, as this is probably also indicative of restricted mobility, which itself has negative associations with wellbeing.

Frequency of walking partially mediates the relationship between feeling safe in the dark and positive mental wellbeing, but there is also an independent effect. This may be because the assessment of feeling safe walking after dark measures latent concepts of ontological security rather than purely feeling safe when outside, suggesting that positive perceptions of the environment can be beneficial to wellbeing even if that environment is not experienced directly.

Poorer physical health is associated with lower levels of mental wellbeing, which is further reduced through less frequent walking among those with poor physical health. This would suggest that encouraging even low levels of walking among those with physical health conditions has the potential to mediate some of their negative wellbeing consequences. Although age is positively associated with wellbeing, less frequent walking among the oldest age group has a negative effect on wellbeing, reinforcing the findings of other studies. However, overall, age is positively associated with mental wellbeing. This association between age and mental wellbeing concurs with the findings of the Scottish Health Survey, wherein WEMWBS scores were highest for 65 to 74-year-olds but decreased again after 75 years of age (Scottish Government, 2015).

The positive association of car ownership with wellbeing might arise for three reasons. First, car ownership is often used as a proxy for income, and socioeconomic status is associated with higher levels of wellbeing (Jones et al., 2014). Second, giving up using a car in older age is often a response to declines in functional and independent mobility (Musselwhite and Shergold, 2013), both of which negatively affect wellbeing. Third, the car provides mobility and access to destinations and other people, which are in themselves important for wellbeing. Nordbakke and Schwanen’s (2013) conceptualisation of the links between mobility and wellbeing suggest physical activity as one of several components. Therefore, in this case, while walking itself is associated with better wellbeing, so are other forms of mobility (e.g., car use). For older adults living in deprived urban areas the ability to get out and about and to access destinations and social connections may be important for wellbeing, regardless of how that mobility is achieved. The wellbeing benefits associated with walking do partially explain why the built and social environments influence wellbeing, but relationships are not as strong as we might expect.

The negative associations of car ownership with walking are also expected, given that walking for transport is more common among those who do not own a car (Ogilvie et al., 2008). However, this means that car ownership has a complicated relationship with wellbeing. The overall effect in our model is positive but small. Having a car appears to boost wellbeing, regardless of its negative effects on walking frequency (and thereby wellbeing). However, we suggest that this complex relationship requires more research in which the life course is considered. Individuals who have never owned a vehicle may experience stronger positive effects of walking on wellbeing in older age, although the long-term impacts of low income, a likely circumstance for our respondents, should not be ignored. However, if a lack of car ownership is related to declining functional mobility among adults who have always owned a car, the negative consequences for mental wellbeing of the loss of car ownership may be greater than any positive effects of more walking, especially as the ability to walk may also be limited at this point. This highlights the need to consider walking, mobility and mental wellbeing among older adults more holistically than usual. Policies aimed at promoting health and wellbeing through transport should focus not only on the health benefits associated with active travel, but also on the importance of accessibility and mobility for wellbeing, by whichever mode that might be provided. In the longer term, strategies aimed at reducing societal car dependence through urban planning and promotion of sustainable and inclusive mobility will be the best means of supporting wellbeing. However, in the short term, policies aimed at travel behaviour change and active ageing should not perpetuate exclusion of those who already rely on active travel for their daily mobility in car-centric urban (and rural) areas.

The strength of the relationship between neighbourhood walking and mental wellbeing was not as strong as expected, possibly because walking activity was utility-based rather than recreational. If walking is regarded as a necessity rather than as a leisure pursuit or a chosen activity then the relationship with wellbeing may not be positive. Christiansen et al. (2014) reported positive relationships between walkable neighbourhoods and walking that persisted after controlling for self-selection and across life stages, but only for people with above-median incomes. This suggests that the importance of the environment for walking may be attenuated in lower-income areas, as also suggested by Shortt et al. (2014), Ogilvie et al. (2008) and (Bostock, 2001), because walking is necessary, regardless of environmental conditions.

However, we do find associations between the built and social environment and frequency of walking. The relatively weak association between walking and wellbeing, coupled with the stronger direct associations between built and social environments with wellbeing and with walking, lend support to policy approaches that focus on improving the urban realm and providing safe, high-quality urban environments. Such environments can support walking and have direct associations with wellbeing. They may also enhance the experience of walking, thereby strengthening relationships between walking and wellbeing in a similar manner to the associations found in less-deprived areas. Attention should be paid to the type of environment in which waling occurs, rather than approaches focussing solely on promoting walking as an individual health behaviour.

*4.2. Limitations*

Our survey was undertaken in the summer months and we must recognise the temporal variation in mobility of the older population. Poor weather is likely to limit mobility in the winter months (Hjorthol 2012)*.* For those who have experienced a fall or who have a fear of falling, mobility could be severely restricted at particular times of year, highlighting the potential for seasonal variation in the relationships between the environment, mobility and mental wellbeing in an ageing population.We have assumed that the relationship between walking and wellbeing is linear, as is commonly the case in such studies. However, our results suggest that this may not be the case. For example, walking on 7 days of the week because it is the only form of transport available may not be pleasurable or, in that case, conducive to positive mental wellbeing, as also suggested by Bostock (2001). The role of the car in providing accessibility, mobility and wellbeing for older adults was not the focus here but is worthy of further research given our findings.

We recognise that our measure of walking does not cover all forms of independent neighbourhood mobility for older adults. For example, we do not know whether those using mobility scooters or wheelchairs would have interpreted their mobility as ‘walking’ and whether the wellbeing effects would be similar. Our measure of walking might be unsuitable for predicting differences in mental wellbeing. For example, Parker et al. (2008) found that objective measures of walking obtained from pedometers were better than self-reported measures at predicting wellbeing.

For Lawton (1980), perceptions of the environment equate with quality of life and, in this sense, it is perhaps unsurprising that we find strong links between perceptions of the environment and mental wellbeing. Using objective measures of the built environment would help disentangle the relationships of perceived and objective measures of the built environment with mental wellbeing.

1. **Conclusions**

Regeneration and policy initiatives that seek to improve the quality of the neighbourhood environment should be designed to increase walking (Longo et al., 2015), and to improve mental wellbeing among older residents in deprived communities. However, our results suggest caution should be exercised in assuming that changes to the neighbourhood environment will lead to changes in walking frequency and subsequently wellbeing among ageing populations in deprived communities. While the neighbourhood environment has associations with wellbeing, these are not always explained by walking.

Several aspects of our analysis indicate that there may be an element of necessary, utility walking for the people in our sample, which may limit the positive impacts of walking on their wellbeing. Walking is already a frequent and widespread mode of transport in deprived areas, but if it is not a chosen activity and is undertaken in relatively unpleasant environments then it may not always be positive for wellbeing, even though we did find a small positive effect. This should temper our expectations of the possible health outcomes of interventions to increase levels of walking in deprived neighbourhoods. However, efforts to improve the urban realm, alongside facilitating accessibility and mobility for older adults, are likely to support the wellbeing of this population group and may lead to an environment that is more supportive of walking for pleasure rather than purely out of necessity. This is not to deny the importance of walking, but to recognise the relevance of the environment in which it takes place, if there are to be benefits for wellbeing.

Efforts need to be directed towards more appropriate environmental design as part of the regeneration process to ensure that the positive wellbeing effects of walking in pleasant environments are realised. Policy is increasingly concerned with designing the environment and encouraging active travel in order to improve wellbeing. In deprived urban environments, where walking is a necessary mode of transport, the role of the environment in relation to walking, and the importance of walking for wellbeing may be limited. In the context of ageing in place, the regeneration of deprived urban environments needs to take a more holistic approach to the design of outdoor environments (Rosenberg and Everitt, 2001) to accommodate the mobility needs of an ageing population.

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**Table 1. Sample characteristics**

|  |  |  |  |
| --- | --- | --- | --- |
|  |  |  | Days walking in neighbourhood in last 7 days |
| Characteristic | Category | Percentage in sample | Mean | SD | p |
| **Sociodemographic, personal and residential:** |  |  |  |  |  |
| Gender | Male | 41.4 | 2.60 | 2.930 | 0.865 |
|  | Female | 58.6 | 2.57 | 2.869 |
| Age group | 60-69 years | 46.8 | 2.98 | 2.938 | <0.001 |
|  | 70-79 years | 39.0 | 2.45 | 2.882 |
|  | 80+ years | 14.2 | 1.66 | 2.518 |
| Employment status | Retired/not working | 95.3 | 2.53 | 2.877 | 0.006 |
|  | Working | 4.7 | 3.65 | 3.035 |
| Household type | Living alone | 57.9 | 2.45 | 2.822 | 0.072 |
|  | Living with 1+ person | 42.1 | 2.77 | 2.981 |
| Education | None/SLC/dk\* | 87.8 | 2.47 | 2.853 | <0.001 |
|  | >SLC | 12.2 | 3.41 | 3.048 |
| Vehicle ownership/access | No/dk\* | 77.6 | 2.73 | 2.932 | 0.002 |
|  | Yes | 22.4 | 2.08 | 2.700 |
| Built form of home | House | 45.6 | 2.54 | 2.935 | 0.554 |
|  | Low-rise flat or tenement | 35.9 | 2.55 | 2.868 |
|  | High-rise flat | 18.5 | 2.79 | 2.843 |
| Tenure | Social-rented | 74.2 | 2.51 | 2.877 | 0.128 |
|  | Private sector | 25.8 | 2.81 | 2.931 |
| **Long-term health conditions:** |  |  |  |  |  |
| Cardiovascular and respiratory | No | 50.1 | 2.79 | 2.883 | 0.022 |
|  | Yes | 49.9 | 2.39 | 2.892 |
| Musculoskeletal and neurological affecting movement | No | 93.6 | 2.63 | 2.913 | 0.064 |
|  | Yes | 6.4 | 1.97 | 2.524 |
| Other physical conditions | No | 77.6 | 2.69 | 2.905 | 0.035 |
|   | Yes | 22.4 | 2.25 | 2.830 |

\* dk, don’t know

**Table 2. Latent variables and their component manifest variables**

|  |  |  |
| --- | --- | --- |
| Latent variable | Measured variables | Fit indices |
| Neighbourhood environment quality | 4 items: attractive buildings; attractive environment; quiet and peaceful environment; parks and open spaces (1=very poor; 5=very good) | CFI=1; RMSEA=0 |
| Neighbourhood problems (incivilities) | 9 items: violence against the person, including assaults and muggings; people being insulted, pestered or intimidated in the street; people being attacked or harassed because of their skin colour or ethnic origin; people using or dealing drugs; people being drunk or rowdy in public places; gang activity; teenagers hanging around on the street; nuisance neighbours or problem families; house break-ins or burglaries (1=not a problem; 3= serious problem) | CFI=0.961; RMSEA=0.08 |
| [includes the following error covariances: |
|  Drugs and alcohol |
|  Gangs and teen loitering |
|  Alcohol and teen loitering |
|  Alcohol and gangs |
|  Drugs and teen loitering] |
| Neighbourhood problems (environmental) | 5 items: vandalism, graffiti, deliberate damage to property or vehicles; rubbish or litter lying around; vacant or derelict buildings and sites; bad smells, poor air quality; amount or speed of traffic. (1=not a problem; 3= serious problem) | CFI=0.981; RMSEA=0.048 |
| Quality of local services | 5 items: policing; street cleaning; public transport; street lighting; paths and pavements. (1=very poor; 5=very good) | CFI=0.961; RMSEA=0.059 |
| Quality of local amenities | 3 items: availability of good quality fruit and vegetables; community and social venues; shops. (1=very poor; 5=very good) | CFI=1; RMSEA=0 |
| Social contact | 3 items: frequency of meeting relatives; meeting friends; talking to neighbours (1=never; 5=most days) | CFI=1; RMSEA=0 |

**Table 3.** Estimates from the structural equation model

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Wellbeing |  | Frequency of walking |  |  |  |
| Variable | Estimate | SE | p | Standardised estimate |   | Estimate | SE | p | Standardised estimate |   | Indirect effects | Total effects |
| Frequency of walking | 0.039 | 0.018 | 0.027 | 0.088 |  | - | - | - | - |  |  |  |
| Social contact | 0.247 | 0.055 | 0.000 | 0.190 |  | 0.417 | 0.128 | 0.001 | 0.141 |  | 0.016 | 0.263 |
| Neighbourhood quality | 0.154 | 0.043 | 0.000 | 0.198 |  | 0.251 | 0.113 | 0.026 | 0.141 |  | 0.010 | 0.164 |
| Neighbourhood problems (incivilities) | -0.175 | 0.065 | 0.007 | -0.132 |  | 0.181 | 0.177 | 0.304 | 0.060 |  | 0.007 | -0.168 |
| Neighbourhood problems (environmental) | 0.267 | 0.107 | 0.012 | 0.216 |  | 0.240 | 0.265 | 0.365 | 0.085 |  | 0.009 | 0.276 |
| Quality of local services | 0.167 | 0.070 | 0.017 | 0.153 |  | -0.145 | 0.173 | 0.404 | -0.058 |  | -0.006 | 0.161 |
| Quality of local amenities | 0.055 | 0.041 | 0.180 | 0.063 |  | -0.031 | 0.102 | 0.761 | -0.015 |  | -0.001 | 0.054 |
| Use of local retail amenities | 0.093 | 0.042 | 0.026 | 0.074 |  | 0.994 | 0.101 | 0.000 | 0.344 |  | 0.039 | 0.132 |
| Use of local non-retail amenities | 0.117 | 0.038 | 0.002 | 0.097 |  | 0.410 | 0.085 | 0.000 | 0.149 |  | 0.016 | 0.133 |
| Feel safe walking alone locally after dark | 0.054 | 0.011 | 0.000 | 0.171 |  | 0.065 | 0.023 | 0.005 | 0.090 |  | 0.003 | 0.057 |
| Living alone | -0.068 | 0.033 | 0.037 | -0.067 |  | -0.099 | 0.076 | 0.193 | -0.042 |  | -0.004 | -0.072 |
| Access to vehicle | 0.084 | 0.040 | 0.034 | 0.070 |  | -0.474 | 0.089 | 0.000 | -0.171 |  | -0.018 | 0.066 |
| Cardiorespiratory health condition | -0.192 | 0.033 | 0.000 | -0.190 |  | -0.178 | 0.072 | 0.013 | -0.077 |  | -0.007 | -0.199 |
| Musculoskeletal health condition | 0.037 | 0.059 | 0.530 | 0.018 |  | -0.215 | 0.164 | 0.190 | -0.046 |  | -0.008 | 0.029 |
| Other physical health condition | -0.164 | 0.037 | 0.000 | -0.135 |  | -0.210 | 0.089 | 0.018 | -0.076 |  | -0.008 | -0.172 |
| Age (70-79 years) | 0.129 | 0.034 | 0.000 | 0.125 |  | -0.147 | 0.078 | 0.059 | -0.062 |  | -0.006 | 0.123 |
| Age (80+ years) | 0.132 | 0.048 | 0.006 | 0.091 |  | -0.354 | 0.121 | 0.003 | -0.107 |  | -0.014 | 0.118 |
| Sex (female vs. male) | 0.139 | 0.032 | 0.000 | 0.135 |  | 0.072 | 0.074 | 0.329 | 0.031 |  | 0.003 | 0.142 |
| Employed | 0.110 | 0.078 | 0.155 | 0.046 |  | 0.237 | 0.178 | 0.182 | 0.044 |  | 0.009 | 0.119 |
| Educational qualifications | 0.121 | 0.049 | 0.015 | 0.078 |   | 0.301 | 0.108 | 0.005 | 0.085 |   | 0.012 | 0.133 |



Figure 1. Conceptual model of relationship between environmental perception, walking and mental wellbeing.



Figure 2. Significant relationships grouped by the relationships of exogenous variables with endogenous variables in the model (e.g., the first three variables have a positive relationship with wellbeing and no relationship with walking).