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Article

Neighbourhood greenspace is associated with a slower decline in physical activity in older adults: A prospective cohort study

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ABSTRACT

Maintaining physical activity in later life is important for maintaining health and function. Activity outdoors, such as walking, jogging and cycling, may provide an accessible, sociable and practical solution, but maintaining outdoor mobility may be a challenge in later life. Providing green environments which are supportive of physical activity may facilitate this, yet research into how greenspace could be best used is inconclusive. This study evaluates the role of greenspace in protecting against decline in physical activity over time in older adults.

Data from the European Prospective Investigation of Cancer Norfolk, UK, cohort 1993–2009 (N = 15,672) was used. Linear regression modelling was used to examine the association between exposure to greenspace in the home neighbourhood and change in overall, recreational and outdoor physical activity measured in terms of metabolic equivalent cost (MET) in hours/week. Mediation analysis was conducted to assess if dog walking explained the relationship between greenspace and physical activity change. Models were adjusted for known and hypothesised confounders.

People living in greener neighbourhoods experienced less of a decline in physical activity than those living in less green areas. Comparing change for those living in the greenest versus least green quartiles, participants showed a difference in overall physical activity of 4.21 MET hours/week (trend P = 0.001), adjusted for baseline physical activity, age, sex, BMI, social class and marital status. This difference was 4.03 MET hours/week for recreational physical activity (trend P < 0.001) and 1.28 MET hours/week for outdoor physical activity (trend P = 0.007). Dog walking partially mediated the association between greenspace and physical activity change, by 22.6% for overall, 28.1% for recreational and 50.0% for outdoor physical activity (all P < 0.001).

Greenspace in the home neighbourhood may be protective against decline in physical activity among older people as they age. Dog walking is a potential mechanism in this relationship, and warrants further investigation as a way of maintaining physical activity in later life.

1. Introduction

Retaining physical and psychological function in later life is an important part of 'active ageing' (World Health Organisation, 2002) through the ability to maintain independence in activities of daily living (McCusker, Kakuma, & Abrahamowicz, 2002). Remaining physically active helps prevent the age-related decline in physical (Paterson & Warburton, 2010) and cognitive (Carvalho, Rea, Parimon, & Cusack, 2014; Blondell, Hammersley-Mather, & Veerman, 2014) function, and associated loss of independence (Paterson, Govindasamy, Vidmar, Cunningham, & Koval, 2004). However, we become less physically active as we age, particularly during the transition into retirement where increased leisure time activity typically does not compensate the loss of work-based activity (Zantinge, van den Berg, Smit, & Picavet, 2014). Early intervention is necessary to encourage physical activity before the process of functional decline begins (Hebert, 1997).

Outdoor recreation, including walking, jogging and cycling, may be the best source of physical activity for older people, as it can be incorporated in daily life (Ogilvie et al., 2007), has been shown to lead to a decrease in all-cause mortality and chronic disease (Zhao et al., 2015), it facilitates social contact (World Health Organisation, 2002), can result in higher levels of physical activity (Kerr et al., 2012) and may provide additional health benefits over engaging in activity indoors (Thompson Coon et al., 2011). However, maintaining outdoor mobility may be a challenge

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in later life, as individuals are at increased risk of sensory or physical impairment with age, and may be subject to environmental barriers (Mollenkopf et al., 2004; Yeom, Fleury, & Keller, 2008).

Physical activity levels are determined by individual characteristics and shared factors such as the natural and built environment (McCormack & Shiell, 2011). One key aspect of the natural environment is both presence of, and access to, green spaces which may encourage higher levels of physical activity for recreation and transport (Paquet et al., 2013; Van Cauwenberg et al., 2011). Mobility and function in older adults has been associated with proximity to (Rosso, Auchincloss, & Michael, 2011), and quality of greenspace and green infrastructure in the built environment (Tzoulas et al., 2007), such as the presence of recreational facilities and clean environments (Wu, Prina, & Brayne, 2015), spaces that are designed according to the expressed need of individuals (Ward Thompson, 2013; Kerr, Rosenberg, & Frank, 2012), and factors of urban planning and design (Durand, Andalib, Dunton, Wolch, & Pentz, 2011). The relationship between physical activity and greenspace has been shown to be independent of preferences in self-selection of home location (Handy, Cao, & Mokhtarian, 2006). Whilst there is some cross-sectional evidence of a positive association between greenspace, its use for physical activity and health, findings are generally equivocal in the literature. This may in part be due to a lack of prospective studies of physical activity trajectories over time (Lee & Maheswaran, 2011). In addition, few studies have focused on specific domains of physical activity that may be associated with exposure to greenspace (Lachowycz & Jones, 2011). A particular example is recreational walking which makes an important contribution to overall physical activity in older people (Tse, Wong, & Lee, 2015). Finally, the mechanisms and moderators, including personal, social and environmental factors which help to explain the relationship between the environment and physical activity have not been well evaluated (Van Cauwenberg et al., 2011; Annear et al., 2014). For example, dog walkers are more likely to achieve higher levels of physical activity than others (Cutt, Giles-Corti, & Knuiman, 2008), and as dog walking often occurs in greenspace (Richards, McDonough, Edwards, Lyle, & Troped, 2013), it may be one mechanism that explains higher levels of physical activity and sense of community in greener areas (Lachowycz & Jones, 2013; Toohey, McCormack, Doyle-Baker, Adams, & Rock, 2013). This lack of understanding limits our ability to provide greenspace or physical activity interventions that are most supportive of active ageing.

This analysis evaluates the role of greenspace in protecting against decline in physical activity over time in older adults, and considers potential mechanisms. It uses the European Prospective Investigation of Cancer (EPIC)-Norfolk cohort study in the UK, which provides data on a wide range of health and lifestyle factors, obtained over a 7.5 year follow-up period in a population-based sample of more than 25,000 adults (Ward Thompson, 2013).

2. Materials and methods

2.1. Study design and setting

The initial survey for EPIC-Norfolk was conducted between 1993 and 1997 (First Health Check, 1HC), recruiting 25,639 residents of the region of East Anglia, attending 35 general practice surgeries situated in the county of Norfolk (Day et al., 1999). The sample for this analysis included 15,672 participants with self-reported measures of physical activity from the Second Health Check conducted between 1998 and 2000 (2HC, Follow-up 2, from here referred to as 'baseline' for the purposes of this analysis) and a postal questionnaire administered between 2006 and 2009 (from here referred to as 'follow-up'). This allowed the examination of change in physical activity over time.

2.2. Physical activity

Physical activity at baseline and follow-up was self-reported in the validated Physical Activity Questionnaire (EPAQ2) (EPIC-Norfolk, 2016; Wareham et al., 2002). Participants reported the number of times and average duration over the past year which they engaged in different activities, within the domains of recreational, household, transport and occupational activity. Weekly energy expenditure was estimated by multiplying the time spent in each activity (number of hours per week) by the metabolic equivalent cost (MET) of each activity (Ainsworth et al., 2011). Overall physical activity was calculated by summing energy expenditure over all four domains. For this analysis, three measures of physical activity were used: overall and recreational activity plus a third category of activities that we hypothesised might take place outdoors in greenspace – walking, cycling and jogging. Absolute change in each measure of physical activity was calculated by subtracting values at baseline from those at follow-up.

2.3. Exposure to neighbourhood greenspace

The main explanatory variable was the percentage of land cover in the participant's home neighbourhood that was classified as greenspace. This was measured at baseline, unless participants were known to be at a different address by the time of follow-up. In these cases, as information on the exact date of moves was unavailable, we measured the average neighbourhood greenness for the two addresses. The ArcGIS 10.1 geographic information system (GIS) software (ESRI, 2012), was used to delineate neighbourhood boundaries around participants' home locations defined according to their home postcode (zip code). Every postcode was geo-located using the UK Ordnance Survey Code-Point® database (Ordnance Survey, 2014), which provides a set of coordinates depicting the average latitude and longitude of all mail delivery locations within each postcode. On average, each postcode contains 15 addresses.

Neighbourhoods are typically defined as the area within 800 m (approximating to a ten minute walk) of a home location (Dalton, Jones, Panter, & Ogilvie, 2013). However, recent research from studies employing global positioning systems to track movement suggests that 800m may be overly conservative (Boruff, Nathan, & Nijenstein, 2012), and that individuals typically travel greater distances to access resources and be physically active (Hurvitz & Moudon, 2012). Indeed, Hillsdon, Coombes, Griew, and Jones (2015) suggest that most activity is undertaken outside of the proximal home environment (800 m), even for older adults (56.3%), noting that there was little variation according to age. Given that information on actual movement patterns for the participants of EPIC-Norfolk was not available, the sensitivity of findings to neighbourhood definition was examined by employing three neighbourhood measures: 800 m, 3 km and 5 km. To compute each measure, a circular buffer was used to measure the proportion of the area of each circle that was greenspace.

The estimates of neighbourhood greenspace were generated using data from the Centre for Ecology and Hydrology Land Cover Map of the UK (2007) (Centre for Ecology & Hydrology (CEH), 2013), which is derived from satellite images and digital cartography. It records the dominant land use type, based on a 23 class typology, in 25 m by 25 m size grid cells with greenspace being classified as cells that contain broadleaved and coniferous woodland, arable land, improved grassland, semi-natural grassland, mountain, heath and bog for the purposes of this analysis. All of these types of greenspace are potentially accessible locations for