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Neighborhood walkability moderates the association between low back pain and physical activity: A co-twin control study

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ABSTRACT

The aim of this study was to investigate whether neighborhood walkability moderates the association between low back pain (LBP) and physical activity (PA), using a co-twin design to control for genetics and shared environmental factors. A cross-sectional analysis was performed on 10,228 twins from the Washington State Twin Registry with available data on LBP from recruitment surveys between 2009 and 2013. LBP within the past 3 months was our exposure variable. Our outcome variables were sufficient moderate or vigorous-intensity PA (MVPA, defined as at least 75 min of vigorous-intensity PA, or 150 min of moderate-intensity PA per week), and walking (≥150 min per week). Neighborhood walkability, estimated using the commercially available Walk Score®, was our moderator variable. After controlling for the influence of genetics and shared environment, individuals reporting LBP were significantly less likely to engage in sufficient MVPA if they lived in a neighborhood with high walkability (OR = 0.59, 95%CI: 0.36–0.96). There was no association between LBP and sufficient MVPA for individuals living in a neighborhood with low walkability (OR = 1.27, 95%CI: 0.93–1.72), demonstrating that walkability is a significant moderator of the association between LBP and PA (interaction $p = 0.013$). These findings were similar for the association between LBP and walking (high walkability OR = 0.42, 95%CI: 0.22–0.78; low walkability OR = 0.71, 95%CI: 0.46–1.12), although the interaction was not significant ($p = 0.700$). Neighborhood walkability moderates the association between LBP and PA. Our results highlight the importance of targeting interventions promoting PA towards individuals with LBP living in a neighborhood with good walkable access to amenities.

1. Introduction

Low back pain (LBP) is a global problem, resulting in disability (Murray et al., 2012) and an enormous financial burden across many countries (Gore et al., 2012; Wenig et al., 2009). Physical activity (PA) is commonly recommended for the management (van Middelkoop et al., 2010) and prevention of LBP (Steffens et al., 2016), with the important additional health benefits of increasing cardiorespiratory fitness and reducing the risk of non-communicable diseases (e.g. cardiovascular disease) (Global Recommendations on Physical Activity for Health, n.d.). Among commonly prescribed interventions for LBP, structured exercise programs appear to increase PA engagement in the short-term (Nassif et al., 2011; Hagen et al., 2010), but have failed to demonstrate long-term PA adoption (Kuukkanen et al., 2007; Sorensen et al., 2010; Bendix et al., 1998).

Despite numerous interventions employing a biopsychosocial approach, evidence appears to demonstrate limited benefits of these individual approaches on long-term adoption and maintenance of PA (Leonhardt et al., 2008). A shortcoming of these approaches may include a lack of consideration for the influence of external environmental factors (e.g. the physical or “built” environment). Furthermore, interventions for LBP on an individual level are costly, and may contribute to the substantial economic burden of LBP (Gore et al., 2012; Wenig et al., 2009). Therefore, a broader understanding of how environmental factors influence PA in people with LBP is warranted, and may aid the management of LBP at a population level.

Changes to the built environment to improve walkability is an approach that holds promise for increasing PA engagement at the population level, with individuals living in a neighborhood with high walkability more likely to engage in PA than individuals living in a neighborhood with low walkability (Global Advocacy for Physical Activity (GAPA) the Advocacy Council of the International Society for Physical Activity and Health (ISPAH), 2012; Van Holle et al., 2012). Walkability is used to quantify the extent the built environment

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surrounding the residence (neighborhood) promotes physical activity, most notably walking, for numerous purposes. Measures of neighborhood walkability incorporate information on environmental characteristics, for example the walkable distance to nearby amenities such as parks, shops, restaurants, fitness centres, etc. However, it is unclear how walkability impacts PA levels in people with LBP. Individuals experiencing LBP may be less likely to practice regular PA if they live in a neighborhood with low walkability. Conversely, they may be less likely to engage in PA despite living in an environment which promotes it. Therefore, to get a clearer understanding of the barriers to PA engagement in people with LBP, it is important to consider how walkability influences PA levels in this population.

Genetic and shared (familial) environmental factors have also been shown to substantially contribute to the variance of chronic and disabling LBP (Ferreira et al., 2012), PA engagement (de Vilhena Santos et al., 2012), and play a role in influencing residential selection (Duncan et al., 2012). It is possible that an individual's genetics (or family environment) could be a confounder between LBP and PA, and recent research investigating risk factors for LBP has utilized twins as a method of controlling for the effects of genetics and shared environment (Dario et al., 2015).

The aim of this study is to investigate whether walkability moderates the association between LBP and PA, using a cross-sectional co-twin design to control for the effects of genetics and shared environment.

2. Methods

2.1. Participants and data collection

The sample for this cross-sectional study was drawn from the Washington State Twin Registry (WSTR), a community-based registry of adult twins. Information regarding characteristics and data collection procedures can be found elsewhere (Afari et al., 2006). Participants completed a recruitment survey containing items on demographics (age, sex, race, education, marital status), health conditions (self-reported and physician diagnosed), and health-behaviours (PA, sleep quality, smoking, alcohol intake). There were 10,228 twins with data on LBP from the recruitment surveys between 2009 and 2013, forming the basis for this study. All recruitment and data collection procedures were approved by the local Institutional Review Board.

2.2. Zygosity ascertainment

Questions regarding childhood similarities between twins, for example, “As children were you and your twin as alike as 2 peas in a pod or of ordinary family resemblance?” were used to determine zygosity, with an agreement of 95–98% when compared to zygosity determined by biological markers (Eisen et al., 1989).

2.3. Exposure variable

Data on the presence of LBP within the last 3 months was collected in the recruitment survey and based on the following question: “In the past 3 months, have you had back pain that lasted for at least one day?”.

2.4. Moderator variable

Walkability served as our moderator variable and was assessed via Walk Score®, a publically available web-resource (www.walkscore.com) with good validity and reliability for estimating walkable access to nearby amenities (Carr et al., 2011). Walk Score® has been shown to significantly correlate with numerous objective (e.g. residential density, street connectivity) and subjective measures (e.g. perceived access to amenities) of the built environment (Carr et al., 2010). The Walk Score® algorithm calculates the walkable distance to 13 equally-weighted categories of amenities including: grocery stores, coffee shops, restaurants, bars, movie theatres, schools, parks, libraries, book stores, fitness centres, pharmacies, hardware stores, and clothing or music stores. Participant's residential addresses were entered into the Walk Score® website; values from each category were summed and normalized to yield a total Walk Score® from 0 to 100, where a higher score (higher walkability) represents shorter walkable distances to nearby amenities. We categorized Walk Score® into tertiles, and dichotomised it at the highest tertile.

2.5. Outcome variables

Data on moderate or vigorous-intensity PA (MVPA) and total walking time per week were collected in the recruitment survey and served as our outcome variables.

2.5.1. Assessment of PA

Data on MVPA was used to determine whether individuals met the World Health Organization PA guidelines for adults aged 18–64 (considered sufficiently active) (Global Recommendations on Physical Activity for Health, n.d.). The PA guidelines recommend a minimum of 75 min vigorous-intensity PA, 150 min moderate-intensity PA, or 150 min combined MVPA per week, accumulated in multiple bouts (Global Recommendations on Physical Activity for Health, n.d.). Questions regarding MVPA were adapted from a validated brief assessment tool (Smith et al., 2005). Moderate-intensity PA was assessed by the following question: “Over the past 4 weeks, how many days during a typical week did you exercise moderately for at least 30 minutes?”. Moderate-intensity PA was described as exercise causing only light sweating, or slight to moderate increases in breathing or heart rate, including brisk walking, bicycling for pleasure, golf, and dancing. Vigorous-intensity PA was assessed by a similar question: “Over the past 4 weeks, how many days during a typical week did you exercise vigorously for at least 20 minutes?”. Vigorous-intensity PA was described as exercise causing heavy sweating, or large increases in breathing or heart rate, including running, lap swimming, aerobics classes, and fast bicycling. Participants engaged in at least five days of moderate-intensity PA, or at least 4 days of vigorous-intensity PA, or engaged in a combination of moderate and vigorous-intensity PA of at least 150 min per week (e.g. three days of moderate-intensity PA and three days of vigorous-intensity PA would give a total of at least 150 min), were considered sufficiently active (dichotomised variable).

In a sub-sample of 104 twins who wore accelerometers and GPS devices over a two-week period in an ongoing funded study, subjective MVPA correlated significantly with objectively measured MVPA ($r = 0.46$, $p < 0.01$) (Duncan, G. Unpublished observations, 2016).

2.5.2. Assessment of walking

Total walking time per week was assessed by the following questions: i) “How many days during a typical week do you walk for recreation, exercise, to get from place to place, or for any other reasons in your neighborhood?”; and ii) “When you walk in your neighborhood, about how many minutes, on average, do you spend walking each time you walk?” For question ii) participants could select the following options: “<15”, “15”, “30”, “45”, “60”, “75”, “90 or more”. To calculate total walking time we considered “<15” as 7.5 min, “90 or more” as 90 min, and the rest of the values as outlined. Responses to questions i) and ii) were multiplied and then dichotomised as ≥150 min and <150 min of walking per week. This cut-off was based on meeting the PA guidelines since walking is commonly considered a form of moderate-intensity PA (Haskell et al., 2007).

2.6. Assessment of confounding variables

Data on age, sex, body mass index (BMI), smoking, educational attainment, sleep quality, depression, and leisure sitting time were