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Does neighborhood walkability moderate the effects of intrapersonal characteristics on amount of walking in post-menopausal women?

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ARTICLE INFO

ABSTRACT

This study identifies factors associated with walking among postmenopausal women and tests whether neighborhood walkability moderates the influence of intrapersonal factors on walking. We used data from the Women's Health Initiative Seattle Center and linear regression models to estimate associations and interactions. Being white and healthy, having a high school education or beyond and greater non-walking exercise were significantly associated with more walking. Neighborhood walkability was not independently associated with greater walking, nor did it moderate influence of intrapersonal factors on walking. Specifying types of walking (e.g., for transportation) can elucidate the relationships among intrapersonal factors, the built environment, and walking.

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1. Introduction

Engaging in a physical activity such as regular walking has health benefits for people of all ages, including post-menopausal women. Health benefits include a reduction in all cause mortality (Physical Activity Guidelines Advisory Committee, 2008), improvement in risk factors for heart disease and stroke (i.e., hypertension, insulin resistance, diabetes, dyslipidemia, obesity, and physical inactivity) and a reduction in the incidence of clinical cardiovascular events (LaMonte et al., 2000; Lee et al., 2001; Thompson et al., 2003), a reduction in the incidence of colon and breast cancer (Lee, 2003), improvement in symptoms and functioning in individuals with osteoarthritis (Bean et al., 2004; Fransen et al., 2004), and improvement in the symptoms of depression (Dunn et al., 2005), among many other benefits. Despite the recognized health benefits of physical activity, fewer than 10% of women 40 years of age and above are sufficiently

active to achieve health benefits (150 min/week of moderate physical activity) based upon accelerometer data (Troiano et al., 2008; Tucker et al., 2011). In older adults, physical activity decreases with advancing age, and at each age group women are less active than men (Evenson et al., 2012). The promotion of physical activity, in particular walking for health, is a major public health challenge. Understanding the factors that influence older, post-menopausal women's walking for health is critical in order to develop and target effective interventions to increase the number of older post menopausal women who are sufficiently active to achieve health benefits.

Multiple domains can influence women's physical activity, including biological, behavioral, social, and environmental. Ecological models describe multiple levels of interacting factors, such as environmental, social, and intrapersonal, that influence behavior (Stokols, 1992) and have been applied to describe influences on physical activity behavior (Sallis et al., 2006; Spence and Lee, 2003). Intrapersonal factors including age, prior history of physical activity, race/ethnicity, education, and socio-economic status are associated with physical activity in women (Eyler et al., 2002; King et al., 2000; Masse and Anderson, 2003). Women who are

older, of a minority race/ethnicity or have lower income or educational attainment participate in less leisure time physical activity compared to women who are younger and white or have a higher income or educational attainment (Marshall et al., 2007). In postmenopausal women (above age 55 years), previous participation in vigorous physical activity at younger ages, lower body mass index, higher socioeconomic status, and better overall health are associated with greater levels of vigorous physical activity (Evenson et al., 2002).

Built environment walkability factors, such as street connectivity, esthetics, access to exercise facilities or parks, proximity to destinations (shops, restaurants), and residential density are associated with physical activity (Eyler et al., 2003; Pikora et al., 2006; Saelens et al., 2003a, 2003b), and with walking (Saelens and Handy, 2008). There appears to be a differential association of walkability factors on walking by race/ethnicity, with walkability factors having stronger associations among whites in one study (Frank et al., 2004) and weaker associations among Asians in another (Wen et al., 2007). Associations between walking and walkability factors also differ by age (Shigematsu et al., 2009). For example, residential density was associated with leisure walking in adults under age 65 years but not in adults over age 65 years (Shigematsu et al., 2009). Furthermore, there are gender differences in environmental influences on physical activity (Bengoechea et al., 2005) and walking (Foster et al., 2004). In older women, the presence of enjoyable scenery, hills and others exercising in the neighborhood are all associated with greater physical activity (King et al., 2000).

Ecological models and empirical work to date both show that specific factors can influence walking behavior, either directly or in interaction with another factor. Intrapersonal factors such as race/ethnicity, age and income are all independently associated with walking behavior; these factors also appear to affect the relationship between the walkability of an environment and walking behaviors. It is therefore important to understand potential interactions of intrapersonal and environmental factors and their associations with walking. If characteristics of the built environment, such as walkability, moderate the influence of intrapersonal factors on walking in post menopausal women, this can inform the tailoring of built environment interventions and could have significant policy implications for the allocation of resources to promote walking for health in older women.

The interaction between intrapersonal and environmental factors and the impact on level of physical activity or walking has not been well studied in postmenopausal women. Our study addressed this gap. Our first aim was to examine associations between intrapersonal and environmental factors and weekly energy expended on walking (metabolic equivalent or METs) in postmenopausal women. The second aim was to test whether there are interaction effects between neighborhood walkability and each of these intrapersonal characteristics on the amount of walking in postmenopausal women.

2. Methods

This study used data from the Women's Health Initiative (WHI) and the Walkable and Bikable Communities (WBC) project to link data on neighborhood walkability, intrapersonal characteristics, and walking.

2.1. Data sources

The Women's Health Initiative (WHI) is a set of prospective multicenter clinical trials and an observational study of postmenopausal women aged 50–79 years designed to evaluate specific hormone therapy, dietary pattern and calcium/vitamin D

interventions in relation to the prevention of cardiovascular disease, cancer, and osteoporotic fractures. In order to be eligible for the WHI participants needed to be postmenopausal, which was defined as no menstrual period for at least 6 months if age 55 years or older and no menstrual period for at least 12 months if ages 50–54 years (Hays et al., 2003). Women were enrolled between 1993 and 1998 at 40 US Clinical Centers in either the clinical trial (CT) or observational study (OS). The Seattle Clinical Center was one of the early Centers to start recruitment. Data were collected at baseline and yearly in the CT and at baseline, year 3 and then annually in the OS. The WHI study methods are described in more detail elsewhere (Anderson et al., 2003; Hays et al., 2003).

The Walkable and Bikable Communities (WBC) project (2001–04) developed an empirically-derived walkability index based on environmental factors correlated with walking a sufficient amount to achieve health benefits in 88 noncontiguous square miles located within King County, Washington (Moudon et al., 2007). The index was based on 608 randomly selected men and women within randomly selected households living in walkable areas of the county. Respondents completed a 27-minute survey over the telephone, which included data on minutes of walking per week in the neighborhood, neighborhood perceptions, individual household characteristics, and attitudes about the environment. Each participant's household was geocoded, and 200 individual-level objective environmental factors were identified from parcel level data in a Geographic Information Systems (GIS) database. Environmental measures included distance to closest walking destinations (e.g. shops, parks, restaurants) up to 3 km from each participant's home, and count and density of neighborhood destinations within a 1 km buffer of homes. Multilevel modeling estimated the likelihood of a participant walking 150 min per week (the amount needed to achieve health benefits), 1–149 min per week, or not walking at all, using individual and household level variables from the survey and objective environmental variables of the neighborhood. The WBC walkability index provides probabilities (0–100) of walking sufficiently for health (> 150 min per week) in King County. Full details on the development of this index are available elsewhere (Lee et al., 2006; Moudon et al., 2007). The index has been positively associated with walking in both older men and women but not with body mass index (Berke et al., 2007b) and it showed an inverse association with depressive symptoms in older men (Berke et al., 2007a).

2.2. Dataset development

We appended data from the WHI Seattle Clinical Center OS ($n=1,617$) and the CT ($n=1743$) and assigned each woman a walkability score from the WBC project based on her geocoded home address. We excluded observations of WHI participants who lived outside the WBC sample areas. The study sample thus included women who were enrolled in the WHI Seattle Clinical Center Cohort (either the CT or OS) and lived within the geographic areas with a WBC index during 2000–2002.

We matched the WBC index with the WHI data using the geocoded addresses of the WHI participants and their corresponding survey data for any matched address falling in the years 2000–2002. Thus, the exposure (walkability) and outcome (walking) are both in the years 2000–2002. The dataset represents a pooled-cross-sectional time series where individuals are represented at least once and possibly as much as four times in the resulting pooled dataset. How often an individual appears in the data depends on whether her residence matched the WBC sampling frame and her survey fell within the 2000–2002 timeframe. For example, if a woman lived within the WBC sampling