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## Does the built environment moderate the relationship between having a disability and lower levels of physical activity? A systematic review

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### ABSTRACT

The relationship between the built environment and physical activity has been well documented. However, little is known about how the built environment affects physical activity among people with disabilities, who have disproportionately higher rates of physical inactivity and obesity. This study is the first systematic review to examine the role of the built environment as a moderator of the relationship between having a disability (physical, sensory or cognitive) and lower levels of physical activity. After conducting an extensive search of the literature published between 1990 and 2015, 2039 articles were screened, 126 were evaluated by abstract and 66 by full text for eligibility in the review. Data were abstracted using a predefined coding guide and synthesized from both qualitative and quantitative studies to examine evidence of moderation. Nine quantitative and six qualitative articles met the inclusion criteria. Results showed that most research to date has been on older adults with physical disabilities. People with disabilities described how aspects of the built environment affect neighborhood walking, suggesting a positive moderating role of features related to safety and aesthetic qualities, such as benches, lighting and stop light timing. There were mixed results among studies that examined the relationship quantitatively. Most of the studies were not designed to appropriately examine moderation. Future research should utilize valid and reliable built environment measures that are more specific to disability and should include people with and without disabilities to allow for testing of moderation of the built environment.

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### 1. Introduction

Based on the World Health Survey of 59 countries, the average prevalence of disability is around 18% among adults age 18 and older (World Health Organization, 2011). People with disabilities comprise 22% of the U.S. adult population, or 53.3 million people (Courtney-Long et al., 2015) and is a population made up of individuals who experience limitations in physical mobility (difficulty walking or unable to walk), sensory function (vision and hearing difficulties), and/or cognition (intellectual disabilities). Individuals with physical disabilities are the largest subgroup (13.0%) (Courtney-Long et al., 2015).

People with disabilities have been described as an unrecognized health disparate population (Krahn et al., 2015). For example, when compared to people without disabilities, people with disabilities were more likely to report no physical activity (47.1% vs. 26.1% respectively)

*Abbreviations:* PRISMA, Preferred Reporting Items for Systematic Reviews and Meta-Analyses; GIS, Geographic Information Systems; LTPA, Leisure Time Physical Activity.

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(Carroll et al., 2014) or be obese (41.6% vs. 29.1% respectively) (Froehlich-Grobe et al., 2013).

Physical inactivity can contribute to obesity (Liou et al., 2005), increased healthcare costs and utilization (Arterburn et al., 2005), depression (Liou et al., 2005) and secondary health conditions (Rasch et al., 2008) among people with disabilities. Whereas participation in physical activity has been shown to positively benefit people with disabilities (Rimmer, 2005; Van der Ploeg et al., 2004) in terms of weight loss (Rimmer et al., 2000), psychosocial improvements (Rimmer et al., 2000), self-efficacy (Zemper et al., 2003), and a higher quality of life (Buffart et al., 2009).

While the benefits of engaging in regular physical activity are well-known, people with disabilities experience many barriers that make physical activity opportunities more challenging to access. There have been numerous studies examining perceived barriers and facilitators to physical activity among people with disabilities (Bloemen et al., 2015). Major access barriers to physical activity have include lack of accessible physical activity sites and transportation to these sites (Rimmer et al., 2004). The accessibility of the design of pedestrian infrastructure as well as the maintenance of the infrastructure have been described as barriers to outdoor walking among people with disabilities (Kirchner et al., 2008; Rosenberg et al., 2013).

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Searching for new ways to address the lack of physical activity among people with disabilities has become an international focus. Both the United Nations Conventions on the Rights of Persons with Disabilities and the United Nations Educational, Scientific and Cultural Organization aim to address inequities that individuals with disabilities experience by addressing individual rights, inclusion, and access to physical activity and sports (UNESCO, 2015; United Nations, 2006). In the United States, one of the Healthy People 2020 objectives is to, “Reduce the proportion of people with disabilities who report physical or program barriers to local health and wellness programs” (Healthy People 2020, 2015).

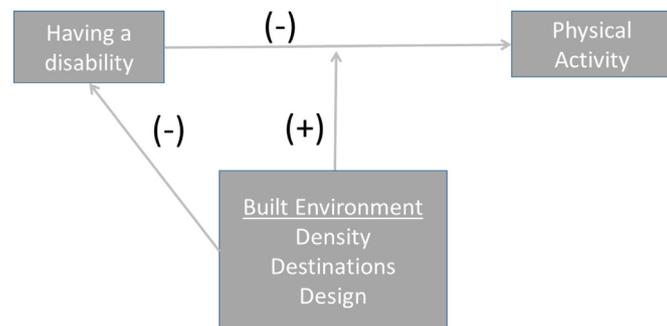
### 1.1. The built environment and physical activity

The built environment has been described as having 3 dimensions: density, destinations and design (Cervero and Kockelman, 1997). Density represents the population density of a neighborhood and areas of higher residential density have been associated with increased walking (Frank et al., 2005). The number and variety of Destinations in a local area that one has access to is associated with increased physical activity (Brownson et al., 2009; Fan and Jin, 2014; Khan et al., 2009; Papas et al., 2007). Lastly, the Design of the built environment includes the aesthetics, the sidewalk infrastructure, pedestrian safety and crime (Sallis et al., 2012). Street connectivity (Grasser et al., 2013) and land use mix (McCormack and Shiell, 2011) have been associated with physical activity individually and as part of neighborhood walkability indices (Frank et al., 2010).

It is unclear whether the built environment measures used for the general population are specific enough to capture elements of the built environment that impact an individual with a disability. People with disabilities experience additional barriers based on the quality of the pedestrian infrastructure, and the accessibility of destinations as defined by the American’s with Disabilities Act Accessibility Guidelines (ADAAG) (U.S. Access Board, 2014). It is important to understand how these barriers affect physical activity among people with disabilities.

### 1.2. The built environment as a moderator for low physical activity levels among persons with disabilities

Reducing barriers in the built environment aids individuals with disabilities in independently moving throughout communities and using community fitness and recreation facilities (Rimmer et al., 2004). Fig. 1 shows a conceptual model of the interaction between the built environment, disability and physical activity. It illustrates the hypothesized role of the built environment as a moderator for the relationship between having a disability and lower levels of physical activity. A moderator is a ‘third variable’ that influences the strength of the relationship between the independent and dependent variables (Baron and Kenny,



**Fig. 1.** Model of built environment moderation A model that hypothesizes the built environment (comprised of density, destinations and design) as a positive moderator of the relationship between having a disability and lower levels of physical activity. A negative relationship is also shown between the built environment and disability, based on previous literature.

1986). In this case, we hypothesize that a supportive built environment may decrease the strength of the relationship between having a disability and lower physical activity. In the same way, poorly designed built environments may increase the strength of this relationship. Having disability as an independent variable is a way to model disability as a characteristic instead of as an outcome. Disability does vary with different life circumstances and with age. Work among those who have studied older adults with physical disabilities suggests that the built environment may further the disablement process (Clarke et al., 2008). To show this complexity, the model also shows a line from the built environment to disability with a negative sign, indicating that environments with more barriers may lead to reduced mobility.

A search of the academic literature found no previous systematic reviews that have examined the role of built environment factors in moderating the association of having a disability with lower levels of physical activity. There have been several reviews identifying factors associated with physical activity in people with disabilities but not focused on the built environment (Bloemen et al., 2015; Bult et al., 2011; Jaarsma et al., 2014). A few have focused on the environment’s effect on participation for people with disabilities but not physical activity (Anaby et al., 2013; Bodde and Seo, 2009). None have examined whether there is evidence that the built environment is a moderator. Therefore, this systematic review seeks to explore:

- (1) Whether built environment factors moderate the association between having a disability and lower levels of physical activity?
- (2) How the built environment, physical activity and disability have been operationalized?
- (3) Which disability types have been most studied?
- (4) Where are there gaps in the research?

## 2. Methods

A predefined review protocol was developed that outlined search strategy, data extraction and assessment of the quality of studies. The existing literature was searched using advanced search terms and Boolean operators (see Appendix A). Databases searched included PubMed, Web of Science, NARIC (National Rehabilitation Information Center), CINAHL, Embase, and ProQuest Dissertations & Theses Database. The search included studies published between 1990 and 2015 because in 1990 the Americans with Disabilities Act (ADA) was passed. Contact was made with 5 authors who have published on aspects of the association of built environment factors and physical activity for people with disabilities to ask about unpublished work and suggestions for seminal publications in this area. An ancestry approach was employed to identify articles from the bibliographies of the publications that met the review criteria but weren’t found in the databases based on the original search criteria (Cooper, 2010).

Following PRISMA guidelines for reporting, (Moher et al., 2009) the following steps were used for identifying, screening, evaluating eligibility and deciding on inclusion. After removing duplicates from the combined results of the 6 databases, the first author screened all studies by title. Then, two authors (YE and KV) independently examined the remaining potential articles by abstract and subsequently by full text, discarding studies based on the inclusion/exclusion criteria. The percent agreement for articles to include was measured between the 2 authors. A consensus based approach was used to reach a final set of articles to include in the study.

The inclusion criteria were as follows: The target population had to be persons with disabilities, or for studies that included both individuals with and without disabilities, the authors had to report independent findings for those with disabilities. Descriptions of the sample had to fit into one of the six measures of disability used by the US Census Bureau that includes, hearing, vision, cognitive, ambulatory, self-care, and independent living difficulties (full definition in Appendix B)

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