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Planning walkable neighbourhoods: Are we overlooking diversity in abilities and ages?

Abstract

Despite growing numbers of studies on planning walkable neighbourhoods, few have included people with diverse abilities across the age spectrum. This article demonstrates a need for more inclusion of human diversity in walkable neighbourhoods research to better inform policy, planning and design interventions that are spatially and socially just for all ages and all abilities. Our study addresses this through a critical review of the literature, highlighting existing research practices, known person-environment influences on walkability, and limitations within current knowledge. We recommend future integrated and inclusive research directions to encapsulate diversity of abilities and ages in walkable neighbourhood studies.

Keywords: walkability; neighbourhood; disability; older people; children; young people

Subject classification codes: include these here if the journal requires them

Introduction

Walkable¹ neighbourhoods are those that are pedestrian focussed; affording people the choice and opportunity to move about safely and effortlessly to services, facilities and transport in their neighbourhood without the use of a motor vehicle (Owen et al. 2004a, 2007; Hooper, Giles-Corti, and Knuiman 2013). The rationale for planning walkable neighbourhoods is two-fold. Firstly, there is a well-established link between wellbeing, physical activity and neighbourhood environment-design that emphasises the need for neighbourhood designs to promote healthy active living (e.g. Handy et al. 2002; Frank et al. 2007; Dempster 2008; Johnson and Marko 2008; Rydin et al. 2012). Secondly, the campaign for sustainable communities (e.g. Berke, 2002; Soltani and Bosman 2005; Van-Dyck et al. 2012) promotes new urbanism and smart-growth planning approaches to reduce environmental pollution and

unsustainable transport practices (e.g. Giles-Corti and Donovan 2003; Saelens et al. 2003). Repositioning the low density, pedestrian unfriendly neighbourhoods to walkable, ecologically and socially rich places has been a central focus for planners (Giles-Corti et al. 2008; Hooper et al. 2013).

Despite efforts to improve environments for pedestrians, a noted problem in this field is the limited recognition of the diversity of abilities and ages of pedestrians. Walkability research is underpinned by an assumption of an adult able-body walker. Where diversity, such as children, people with disabilities and older people, are studied it has often been in silos, examining one marginalised population at a time. Furthermore, in planning, the needs of dominant groups are often prioritised over others, leading to standardisation of walkable neighbourhood planning and design. Failing to capture the diversity of pedestrians and their variable needs can result in planning and design interventions that perpetuate barriers and exclusion to walking.

Walkable Neighbourhood for All

Going for a walk in the neighbourhood is one of the most affordable and universal activities performed by individuals (Kerr, Rosenberg, Frank 2012). Yet, research shows that walking affordance in car-dependent suburbs of developed countries is difficult and sometimes denied to particular individuals and groups because of a mismatch between their spatial needs and the environment. Most impacted by this incongruence are seniors (Richard et al. 2009, 2013; Chaudhury et al. 2012; Mahmood et al. 2012; Scharlach et al. 2013); children (Nordström 2010; Broberg, Kyttä and Fagerholm 2013; Freeman and Tranter 2012); and people with impairments (Imrie 1996, 2001, 2012; Clarke et al. 2008; Freedman et al. 2008; Gray, Zimmerman and Rimmer 2012).

People with impairments (e.g. sensory, cognitive, mobility), encounter significant built environmental barriers in performing everyday life activities, such as going for a walk. Scholarly work in urban planning and design over the past two decades (Imrie 1996, 2001, 2012; Gleeson 2001; and Boys 2014), shows how built environment features (lack of

pathway connectivity, poor legibility, limited or unmaintained infrastructure e.g., footpaths/sidewalks) have imposed mobility and social participation restrictions for people with diverse impairments. The reasons for the perpetuation of non-inclusive built environments are many, but include: standardized norms held about the body and space that underpin planning and design decisions (Imrie 2003, 2012; Boys 2014; Stafford and Volz 2016), and limited incorporation of the Universal Design (UD) concept in urban planning and design pedagogy (Harrison, Busby, Horgan 2015; Lewis 2009).

Planning and designing for diversity across abilities and ages is not a new concept. The need for creating accessible built environments was established back in the 1950s/60s prompted by returning injured veterans and the disability civil rights movement in western societies. The enactment of the United Nations' Convention on the Rights of Persons with Disabilities in 2006 reinforced the right to accessible built environments to engender inclusion and full participation by all people. Additionally, the concept of UD sought to promote inclusive built environment design for the continuum of the population. Mace, in 1997, founder of UD, defined it as:

The design of products and environments to be usable by all people, to the greatest extent possible, without the need for adaptation or specialized design (The RL Mace Universal Design Institute 2015, para 2).

Notwithstanding its broad applicability, UD has been applied primarily to buildings and products, rather than to neighbourhood planning (Stafford and Baldwin 2015).

In spite of these known barriers, needs and rights, there has been limited consideration of abilities and ages when planning walkable neighbourhoods. This is alarming given the sizeable portion of the population who fall into known spatial marginalization categories of 'children', 'older people' and 'persons with disabilities'. The World Bank (2014a) reported that in the world's highest income countries, children under 14 years comprised 17 percent of the population (19 percent in Australia), with older people (65yr+) making up 16 percent (14 percent in Australia). An estimated 15 percent of the total world's population lives with a

disability, with one-fifth of those estimated to have a significant impairment (The World Bank 2014b, World Health Organisation [WHO] 2011). This means that at least one-third of the population are vulnerable to marginalization by built environment practices.

Therefore, it is essential to take a more integrated approach inclusive of diverse abilities and ages in planning walkable neighbourhoods. The American Planning Association (2012) proposed that a multi-generational approach should consider UD and smart growth principles simultaneously in order to meet the needs of various ages and abilities of inhabitants (Ghazaleh et al. 2011). Yet in practice there are few examples of such an approach. The 8-80 Cities non-for-profit organisation (2014) has offered a multi-age perspective in its *Doable Cities* reader but diversity in ability across ages is not effectively discussed, signifying a 'one-size-fits-all' approach to mobility. On the other hand, although guidelines like *Complete Streets: Guidelines for Urban Street Design*, (Institute of Public Works Engineering Australasia Queensland Division (IPWEAQ) (2010) and *Guide Information for Pedestrian Facilities* (Austroads 2013) acknowledge diverse inhabitants, they provide little detail about how to address specific ages and abilities, including the application of UD. We suggest that the lack of detail in planning policies and guidelines may be due to the limited data on human diversity within mainstream walkable neighbourhoods research, thus perpetuating spatial exclusion and injustice for some marginalised groups.

This article identifies gaps in walkable neighbourhoods research through a critical review of the literature. Three key aims frame the review. The first aim is to understand how diverse ages and abilities are currently researched in terms of research design and methods. Secondly, where diversity is present in studies, we examine what characteristics are known to help make neighbourhoods walkable. Thirdly, to inform future research, we identify what gaps remain relating to planning walkable neighbourhoods that are responsive to human diversity (such as seniors, children and young people, and people with disabilities). From this review, we argue that this agenda can only be progressed by taking a more integrated research approach inclusive of people with a range of abilities and impairments across ages.

Such data will help to generate more inclusive and detailed walkable street guidelines invaluable for planning and design practice.

Critical Review of the Literature

To address the key aims, a comprehensive literature search on the topic *walkable neighbourhoods* was conducted and included dimensions specifically related to this study. These dimensions include: i) *walkability* and *walkable neighbourhoods* for its currency in both academia and planning practice; ii) *neighbourhoods* as it is the specific scale of interest in the study; iii) *built environment* as opposed to urban environment due to recognition that walkable neighbourhoods are not just urban in nature (e.g. rural residential); and iv) spatially marginalized groups including *children, older people and those with disability*.

The search included English-language peer reviewed articles published from 2000 to 2016 using various combinations of the above four terms in Ebscohost, ProQuest and Quickfind² databases. This included studies from the USA, Australia, Canada and New Zealand, countries with shared tensions of urban sprawl (Giles-Corti et al. 2008), plus Europe and Asia to capture methodological advances.

Those studies with a focus on physical activity and chronic disease rather than the built environment were omitted. We identified a total of 96 articles to critically review. At this point, we considered we had reached a point of saturation where further searches were unlikely to reveal additional insights into the three research questions outlined above. Also noted in this review was the dominance of articles located in health journals as opposed to planning journals, which may be indicative of a lack of investigation of this matter by planning researchers and the reason for lack of detail in planning policy and guidelines.

Thematic analysis of the 96 peer-reviewed journal articles included coding according to type (e.g. empirical research, literature review), and inclusion of diversity in abilities across three areas: i) methodological approach and methods, ii) age cohort of participants, and iii) environmental characteristics promoting walkable neighbourhoods for diverse abilities and ages. We next present the review outcomes, according to each research aim,

starting with research approaches and methods, followed by known characteristics of walkable neighbourhoods for groups vulnerable to spatial marginalisation. We conclude by addressing the third aim, indicating directions for future research.

Research Aim One: How well do research designs and methods capture diverse abilities and ages?

Studying *walkability* at the neighbourhood scale captures dual purposes of walking, as a physical activity and as a form of transport (Owen et al. 2004a, Owen et al. 2004b). *Walking as a physical activity* is closely associated with health and wellbeing, play, and social interaction. *Walking as a form of transport*, whilst also having health and social benefits, is generally associated with sustainability principles and the attempt to reduce urban sprawl.

Both cases depends on an environment which people perceive and experience as conducive to walking. Methods for assessing walkability comprise of: i) objective observational measures such as walking catchments, indices and GIS/spatial data for analysis of the physical forms of neighbourhoods; and ii) self-reported instruments of people's perceptions of walkability and participatory methods (e.g. photovoice³) to capture the deeper meaning and experiences of walking. This study reviewed the methods in the literature, analyzing how studies captured diversity of age and ability.

Walking catchments and indices

Urban and transport planning research has concentrated on walking as a form of transport to foster urban development that maximizes the amount of residential, business and other facilities within walking distance of public transport (i.e. TODs - Transport Oriented Development) . This utilitarian focus has been underpinned by the notion of *walking catchments* (pedsheds), described by *walkability indices*. *Walking catchments* are associated with service areas linked to public transport facilities (El-Geneidy et al. 2014). The concept is used by planners and engineers to argue for strategic densification and inform street design and public transportation routes and access locations. Whilst an average range of distances

from home to transport facilities such as bus stops may provide guidance for decisions regarding transport routes (El-Geneidy et al. 2014), the robustness and general application of these measurements, i.e. 400m catchment and 800m catchment, have been questioned (El-Geneidy et al. 2014; Ker and Ginn 2003). Calculation of time and distances to these thresholds are based on average adult walking speed (1.22m/s or 4 feet/ sec) (Dumbaugh 2008, 20).

This review of the literature raises questions about who is ignored by the traditional pedshed and the omission of influences other than distance – such as walking speed, topography, weather, and the presence of continuous footpaths. Dumbaugh (2008) reported that older adults often walk at speeds much less than the average speeds used to calculate thresholds. Likewise Oxley, Fildes and Dewar (2004) showed that people with mobility impairments who use a cane or crutch walked at an average speed of 2.66 feet/second (0.81m/s), those with rheumatoid arthritis walked at 2.46ft/s (0.75 m/s) and people using a walker at 2.07 ft/s (0.63m/s). This revealed vast differences compared to the average adult walking speed of 4 f/s (1.22m/s) (Dumbaugh 2008). These differences in walking speed should inform transport planning and street design for pedestrians (e.g. crossing placement, rest points, and the timing of traffic and pedestrian lights).

In addition to walking speed, gradient and topographical features as well as climate play a role in walking thresholds. For example, Duncan et al (2008) found that rainfall has a substantial effect on children's walking activity in New Zealand whereas Remmers et al. (2016) found that temperature had a greater effect on children's physical activity in an Australian study. Baldwin, Osborne, and Smith (2012) found that older people in the sub-tropics will not walk uphill to a bus shelter unless it is very close, nor will they expose themselves to rain or mid-day sun. Our review suggests that future research should ensure that pedestrian walking thresholds and catchment information are more responsive to the heterogeneous nature of neighbourhood residents and their walking habits.

Walkability indices have been used extensively in urban and transport research to assess physical form and the properties of neighbourhoods that promote walking. Walkability indices are generally studied by objective means such as field observations, census data, survey and geographical information systems (GIS) derived measures (Frank et al 2010; Hajna et al. 2013). While population/residential density, land-use and street-network connectivity have been used as indicators of walkability (e.g. Handy et al. 2002; Saelens et al. 2003; Owen et al. 2007; Wells and Yang 2008; Frank et al. 2010; Hajna et al. 2013; Van Dyck et al 2012, 2013), others (Chin et al. 2008; Ellis et al. 2016) suggest that footpath connectivity and network are more appropriate measures. The presence of footpaths, playgrounds and parks are also included in children's walkability studies (Buck et al. 2014; Olivier et al. 2016). Indeed, Stafford's (2013) research found that presence of connecting footpaths, rather than street connectivity, was a key influence on walking and moving about the neighbourhood for children 9-12 years old with mobility impairments who use mobility aids and devices. These examples illustrate the risk of using measures based solely on the average adult or from a utilitarian focus.

Studies have shown that GIS can provide the same level of detail as captured at the street level (Hajna et al. 2013), although Wells and Yang (2008, 318) have suggested that future studies using "GIS-based environmental measures should use a range of scales (fine grain through to broadly defined neighbourhoods)". While the use of a Digital Elevation Model (DEM) has enabled the capture of topography so that slope can be incorporated into a walkability index, Klein et al. (2015) suggested a need for validation through surveying practices, perceptions and attitudes.

Although indices of physical/built form have a place in understanding neighbourhood walkability, on their own, they cannot determine the walkability of neighbourhoods for both transport and recreational types of walking for diverse populations (Henson 2000; Hajna et al. 2013). Furthermore they cannot be "one size fits all" measures (Manaugh and El-Geneidy 2011, 309). Other aspects of person-environment interactions to consider are: personal (e.g.

age, gender and physiology), socio-cultural (e.g. participation), socio-economic (Manaugh and El-Geneidy 2011), perception of environments (Winkel, Sagert and Evans 2009; Hajna et al. 2013; Richard et al. 2013) and personal safety (Rothman et al 2014; Pollack et al 2014). Henson (2000) reinforced this complexity by stating that in addition to indices regarding walking catchment or level of services, social-cultural issues must also be considered. These include cultural attitudes to walking, type of residential area (urban, non-urban, rural), ages (senior, adults, children) and various impairments (e.g. mobility, cognitive and sensory). Many of these aspects can be assessed through self-report measures.

Self-report instruments

The use of subjective self-report measures and instruments in neighbourhood walkability research is an indication of a shift towards measuring other important influences on neighbourhood walkability. Self-report measures such as Walkability Scales, administered through surveys or questionnaires, have been developed and applied by multidisciplinary research teams led by public health and social scientists to capture perceptions of neighbourhood environment quality, activity level and experiences of walking in the neighbourhood. Our review found that self-report walkability instruments are numerous and varied, with the Neighbourhood Environment Walkability Scale (NEWS) and its adaptations being the most common. The NEWS scale, developed in 2002, has 83 items and measures self-reported perceptions of: residential density, proximity, street connectivity, places for walking and cycling, neighborhood surroundings, neighborhood safety, and neighborhood satisfaction (Saelens et al. 2003). This instrument has been made in to an abbreviated format (NEWS-A) (Cerin et al. 2006; Cerin et al. 2009) as well as adapted for different countries (Van Dyck et al. 2012; Cerin, Lee et al 2013; Cerin et al. 2014; Adlakha et al. 2016), youth (NEWS-Y), and older adults using abbreviated modified form (NEWS-A modified) (Barnett et al. 2016; Stames et al. 2014) or the specific Chinese senior version (NEWS-CS) (Cerin et al. 2010).

Despite its use and validation, the NEWS alone does not provide a complete picture of person-environment interaction, particularly lived experiences and relationship to other important factors such as the physical barriers and social interactions that influence walking behaviour. Similarly, no specific items capture different impairments and relationships to the environment (Grey et al. 2012), although increasingly surveys include perceptions of neighborhood safety, social cohesion and social connectedness. There appears to be an underlying assumption that mobility is the same for everyone (Stafford and Baldwin 2015).

Overlooking diversity in abilities across age cohorts is not only related to the NEWS but the majority of walkability scales. This was illuminated by Grey et al.(2012) who reviewed 95 built environment instruments (82 of which focused on measuring walking) and found that only 26 had some applicability to people with disabilities. Of the 26, 10 were specifically related to people with disabilities or older people (Gray et al. 2012) such as the Quick Pathways Accessibility Tool - Q-PAT (Rimmer et al. 2009), Facilitators and Barriers Survey/Mobility -FABS/M (Gray et al. 2008) and Accessibility Instruments Measuring Fitness and Recreation Environments (Rimmer et al. 2004). The other 16 contained a few items pertaining to disability, the majority of which were related to access such as kerb ramps and streets (Gray et al. 2012). Gray et al. (2012) suggested that there is a significant need for the incorporation of not only diverse populations in walkability studies, but inclusion of items that capture issues pertaining to people with sensory, cognitive, and mobility impairments.

Other suggestions by Gray et al. (2012, 97) include incorporating UD principles (such as perceptual information; size and space in both approach and use; flexibility; and simple and intuitive environments). Gray et al. (2012, 97) suggested the need for “higher specificity” in the measurement of accessible items (e.g. sidewalk width, kerb ramp, gradient/slope) as a way to better identify and understand influences and affordances on walking for the diverse population. This would provide more detailed information and inclusive representation of the diversity of inhabitants’ needs and define thresholds to inform the planning and design of walkable neighbourhoods. Without these inclusions there is a risk

of only representing an ableist view of the body and movement in space (Imrie 2012), and thus perpetuate spatial injustice for particular neighbourhood inhabitants.

Participatory methods

An emerging approach to studying walkability is through participatory methodologies (e.g. phenomenology or ethnography) and methods (e.g. photovoice and activity-based interviews) that seek to develop an in-depth understanding of the person-environment experience. Studies using these methods include those of older people (e.g. Baldwin et al. 2012; Buman et al. 2013; Novek and Menec 2014) and children (e.g. Broberg et al. 2013; Horton et al. 2014) or those with disabilities (Stafford 2013; 2017). The focus of these studies is to understand walkability as a lived dimension and what influences this experience, because as the famous urban designer, Gehl (2011) noted, “there is more to walking than walking”.

The benefits of participatory methods is that they are transformative (Finlay 2011); they deepen our understanding of practice and processes that can lead to improving planning and design interventions (e.g. Andrews et al., 2012; Ruggeri 2014) and clarify taken-for-granted everyday actions (Seamon 2000). They also have benefits for participants: they are more reflexive and participant driven; promote change agency; and involve those often excluded from traditional research and engagement practice (Finlay 2011).

Research into the everyday practice of walking is significantly underdeveloped (Andrews et al. 2012; Middleton 2011; Horton et al. 2014), especially in relation to diverse bodies (Andrews et al. 2012). There is a greater focus on spatial data and instruments resulting in a gap in research, that overlooks the important “everyday practices” of going for a walk, and subsequently what this means in the lives of people of diverse ages and abilities (Andrews et al. 2012; Middleton 2011; Horton et al. 2014). Furthermore even where such research has been done, the results have not been well incorporated into transport policy and planning practice (Middleton 2011). Use of these more participatory and lived approaches

would highlight the complexity and interrelationships of people's behavior in particular environments and help to identify interventions to improve the environment for walking.

What is clear from our review, is that multiple methods provide a better understanding of the characteristics of walkable neighbourhoods for diverse inhabitants.

Research Aim Two: What are the characteristics of walkable neighbourhoods for those of different ages and abilities?

Humans require neighbourhood environments that respond and reflect their diversity in order to engender walking for all ages and abilities. This review, however, has found no study of walkability across all age groups of children and young people, adults and seniors that included people with various impairments. To the best of our knowledge, no studies compare similarities and differences in how people in different age categories with diverse abilities experience their neighbourhoods, and the features they need to enable walking for recreation or transport.

Our review found a number of cross-age group walkability studies of adults, that are inclusive of young adults (over 18 years) (e.g. Giles-Corti and Donovan 2003), older people (e.g. Zegras, Lee and Ben-Joseph 2012) and the spectrum of adults – young to old (Shigematsu 2009). Only a few studies have compared young people or children under 18 years with adults (e.g. Biddulph 2012; Cerin et al. 2013; Van Dyck et al. 2013). In addition, the intent of these studies was to either develop comparative measures for self-assessment tools (Cerin, Conway et al 2013) or compare person-environmental influences. For example, Van Dyck et al. (2013) compared adolescents' and adults' environmental perception of walking but diversity in abilities was not specified. They found that young people had different environmental perceptions to adults with regard to neighbourhood walkability, and concluded that more attention is needed on the multidimensional research of adolescents, examining the interplay between socio-demographic, psychosocial, and physical environmental attributes. This reinforces the importance of understanding different groups of people's experiences, perceptions and needs in order to promote walking affordance. We

next describe current knowledge about walkability in relation to three groups: children, older people, and those with disabilities.

Children

Without taking into account disability, children have received significant attention from researchers in the context of walkable neighbourhoods (e.g. Carver, Timperio, and Crawford 2008, 2012; McAllister 2008; Giles-Corti et al. 2009, 2011; de Vries et al. 2010; Nordström 2010; Timperio et al. 2010; Gallimore, Brown and Werner 2011; Freeman and Tranter 2012; Broberg 2013; Van Dyck et al. 2013; Villanueva et al. 2014; Oliver et al. 2016). Key themes in the literature include independent mobility, walking to school, physical activity, and child health. Gender, socio-cultural context, and built environment form and features were found to enable or preclude children's independent mobility around their neighbourhood (e.g. Villanueva et al. 2014; Freeman and Tranter 2012; Christensen and O'Brien 2003, Cunningham and Jones 2002; Gleeson 2006; Holloway and Valentine 2000; Kytä 2004).

Many studies identify perceptions of both children and their parents (e.g. Villanueva et al. 2014; Oliver et al. 2016). Parent's perceptions of the environment play a significant role in children's capacity to be spatially mobile (Tranter 2006). For example, parental fear of traffic is linked to the decline in children walking to school and activities undertaken from their home (McMillan 2005, 2007; Tranter 2006; Giles-Corti et al. 2009, 2011; Villanueva et al. 2014). Along with car culture, parental fear influences children's opportunity to be spatially mobile (Holloway and Valentine 2000; Tranter and Pawson 2001; Cunningham and Jones 2002; Gleeson 2006; Tranter 2006; Freeman and Tranter 2012).

Gender also plays a role in children's independence, both in spatial range of movement and in the use of transport, but studies are inconsistent possibly due to ages of participants and specific location (Cunningham and Jones 2002; Christensen and O'Brien 2003; Kytä 2004; Spilsbury 2005; Brown et al. 2008).

Physical aspects of the neighbourhood influence walking and independent mobility at a macro and micro level. At a macro level, density, proximity and street connectivity

influence walking and particularly independent mobility of children. For example, walking to school studies by Gallimore et al. (2011) and Timperio et al. (2006) found that walking was supported when routes were direct and avoided exposure to traffic and arterial roads.

Conditions of the street and aesthetics of the urban form, in particular, have also been shown to shape both perceived and actual ease of mobility around the street (Gilbert and O'Brien 2005; McMillian 2005, 2007; Giles-Corti et al. 2009). While studies of able-bodied children (Freeman 2006; Freeman and Tranter 2012) found the presence of footpaths in neighbourhoods influenced walking, it was critically important in the walking affordance of children with mobility impairments (Stafford 2013).

Street patterns influence street use by child pedestrians. Grid-like patterns have been shown to support walking for transport over streets with cul-de-sacs due to their disruption in street connectivity. In contrast, research on children showed the cul-de-sac (Handy, Cao and Mokhtarian 2008; Southworth and Ben-Joseph 2004) and streets with closed traffic routes (Biddulph 2012) support children's social and physical play. Biddulph's (2012) study concluded that streets designed as home zones (reflecting Woonerf street design criteria⁴) were beneficial for children due to their involvement in longer periods of physical activity in their street. He also found that traffic speed reduction (20mph /30kph) and low traffic volume, along with the nature of the street treatment, facilitated walking and play. The study concluded that successful street design should consider play opportunity and the passing through of pedestrians, as they both promote activity and social interaction (Biddulph 2012). Such findings raise questions about generic promotion of grid-like streets.

Similar contradictions among studies are evident in research on density and walkability for children. Broberg's (2013) study which examined neighbourhood built environment, independent mobility and affordance, noted that moderate density as opposed to high density supported independent mobility and affordance of children. In contrast, adult studies suggest higher density neighbourhoods afford walking (e.g. Handy et al. 2002; Saelens et al. 2003; Owen et al. 2007; Wells and Yang 2008; Frank et al. 2010; Van Dyck et

al. 2012; Hajna et al. 2013; Van Dyck et al. 2013). Thus more work is needed to ascertain what density range affords all inhabitants, not just “able-bodied” and “adults”, who are walking for both transport and physical-social activity in their neighbourhood. The new urbanism approach to planning communities has been shown by Gallimore et al. (2011) to help improve walking for children, particularly to school. This is a promising sign though more can be learnt about everyday habits and perceptions of children’s spatial mobility in their neighbourhood, particularly beyond the home-school route and taking into account diverse abilities and mobilities of children.

Older people - with and without impairments

One of the most researched spatially marginalized groups in relation to walkability and neighbourhood environments over the past ten years has been older people. A significant catalyst for this research is the need for the global community to support ageing-in-place given the increasing active yet ageing population (American Planning Association 2012; WHO 2007). Organizations such as WHO (2007), and researchers (Long 2011; Baldwin et al. 2012) have suggested a significant barrier to this goal is the mismatch between ageing and built environments. For example, few built spaces and transportation corridors consider the needs of different groups in ways that could support mobility, cognitive and sensory abilities (Kerr et al. 2012).

The largest numbers of studies of older people reviewed were based in North America (USA and Canada), though more recent studies also include case studies in other continents and cultures such as in Europe (Marquet and Miralles-Guash 2015; Ward Thompson et al. 2014) and Asia (Cerin Sit et al 2013; Nyunt et al. 2015; Adlakha et al. 2016). Many studies focused on planning and age friendly neighbourhoods to support walking (Rosenberg and Everitt 2001; Judd et al. 2010; Kerr et al. 2012; Green 2013) and social participation (Michael, Green and Farquhar 2006; Richard et al. 2009, 2013; Chaudhury et al. 2012; Mahmood et al. 2012). The needs of older adults with impairments in regard to walking and built environments were well recognised (e.g. Ritter, Straight and Evans 2002; Oxley, Fildes

and Dewar 2004; Crews and Zavotka 2006; Levasseur et al. 2011). Barnett et al. (2016) identified specific neighborhood characteristics that differently affect older adults with hearing and vision impairments and degenerative disease (). All of these studies seek to establish how to engender ageing-in-place by focusing on person-environment transactions.

Proximity to social infrastructure, services and destinations is an important indicator of walking affordance (Michael et al. 2006; Ploufee and Kalche 2010; Kerr et al. 2012) with some suggestion of gender differences (Marquet and Miralles-Guash 2015). Studies investigated the qualities of the environments in relation to resident's perceptions of their walkability, friendliness of their neighbourhoods, and social participation (Michael et al. 2006; Richard et al. 2009, 2013; Scharlach 2009; Long 2011; Menec et al. 2011; Chaudhury et al. 2012, 2016; Mahmood et al. 2012; Scharlach et al. 2013; Towne et al. 2016). Common physical environment characteristics supportive of active ageing and walkability reflect both macro and micro aspects. Macro aspects include street connectivity (Scharlach 2009; Long 2011; Menec et al. 2011; Scharlach et al. 2013), density (Chaudhury et al. 2012, access to public transport, facilities and shops (Cerin, Sit, Barnett et al. 2013; Nyunt et al. 2015), safety, aesthetics, and lack of pollution (Cerin, Lee Barnett et al. 2013; Nyunt et al. 2015). Micro aspects tend to afford travel such as resting places, shade, and level well-maintained footpaths (Baldwin et al. 2012), the placement of kerb ramps, distance between lights, and traffic light timing (Lockett, Willis and Edwards 2005; Michael et al. 2006; Adam et al. 2012). Kerr et al. (2012, 46) identify both macro and micro aspects in their review - "traffic, poor pedestrian access to shopping stores and fall hazards are particularly important in the decision to walk in the local area".

A substantial knowledge base about the environmental indicators promoting walk affordance now exist from the growing studies on walkability and older people. Social infrastructure and services, traffic and pedestrian infrastructure, public transport and aesthetics all influence the walking activity of older people (Michael et al. 2006). Perceived and actual qualities of the physical form play a key role in older people's decision to walk

(Baldwin et al. 2012; Lockett et al. 2005; Michael et al. 2006). However, the variations of influences identified in the different studies reinforce that greater clarification is needed about gender, culture, thresholds for various abilities and ages, and that these may be location-specific.

People with Disabilities

Taking a walk, for leisure or transportation purposes, in a neighbourhood is an act often taken-for-granted. Yet, for some people, such as people with disabilities, their opportunity to go for a walk can be constrained because their neighbourhood does not support walking for diverse impairments (Clark et al. 2008; Stafford 2013). Furthermore, while disability cuts across all ages, class and ethnicity, the literature review found no studies that looked at disabilities across the age-groups in relation to walkable neighbourhoods. Rather, impairments were located in very few studies, mostly as a secondary factor to older people or ageing related to health decline (see Crews and Zavotka 2006; Levasseur et al. 2011; Oxley et al. 2004; Ritter, Straight and Evans 2002).

From a planning perspective this lack of recognition of people with diverse impairments across the ages is a concern, because without considering and understanding the continuum of needs, accessible and spatially just neighbourhoods for walking cannot be achieved. Research undertaken by planning and geography scholars over two decades, such as Imrie (1996, 2001, 2012); Pullin (2009) and Gleeson (2001), has continued to illustrate the barriers in cities, parks and streets due to oversight of diversity, as well as a reliance on standardization of human body and scale (Andrews et al. 2012; Imrie 2003; Stafford 2014; Stafford and Volz 2016). The scholarly research suggests a need to rethink how we consider the diversity of abilities and ages to ensure access and facilitation of walking in neighbourhoods.

The few studies of disability and walkable neighbourhoods have highlighted both macro and micro barriers to moving about neighbourhood environments. Micro details make a significant difference (e.g. Ritter, Straight and Evans 2002; Oxley et al. 2004; Crews and

Zavotka 2006; Evans et al. 2007; Clark et al. 2008; Levasseur et al. 2011). One of the most significant needs relate to footpath presence, connectivity and conditions (cracks or unevenness) along with appropriately placed and designed kerb ramps, crossings, and pedestrian refuges (Clark et al. 2008; Stafford 2013; Stafford and Baldwin 2015). For example, Clark et al.'s (2008) study reinforced that street and sidewalk conditions impacted greatly on the mobility of adults with severe physical impairment. Stafford's (2013) research with older children with mobility impairments revealed how lack of footpaths and kerb ramp connectivity, as well as parked cars on the street, driver behaviour and road speeds can inhibit their movement around their streets.

Another significant consideration is circulation and ease of movement, that is, being able to move, enter, and orientate oneself in the built environment without encountering environmental barriers or restrictions (Crews and Zavotka 2006; Evans et al. 2007; Clark et al. 2008). Distance to travel and walking speed, as mentioned earlier in this article, varies amongst people depending on mobility and impairment, and as such needs to be considered in street and place-making design such as provision of seating/rest points (Dumbaugh 2008; Oxley et al. 2004). Evans et al.'s (2007) study found use of power wheelchairs provided young participants with disabilities with greater independence and ability to be more involved in activities in outdoor environments. However, they also found that the use of the power wheelchair was affected by physical conditions of roads, topography and climate (Evans et al. 2007).

While the number of studies is limited, this review identified important insights into built environment features to support walking in neighbourhood for people with disabilities. The review suggest a need for more research inclusive of diversity of impairments in order to engender walkable neighbourhoods for all. Like the studies of older people which recommended that vision and mobility need to be better considered in walkable neighbourhood research, our review suggests a need to better consider the diversity in impairments (mobility, sensory, cognitive) across the ages.

Research Aim Three: The gaps and future focus

Emerging from this review is the understanding that we do not have a well synthesized knowledge of walkable neighbourhoods for the diversity of inhabitants. This is evident from the substantial research on both children and older people that identify built environment factors that influence walking in neighbourhoods, but lack of comparison and synthesis of data between the groups. Furthermore, research involving age specific participants, like children and adults, takes a narrow view of mobility and lacks the explicit inclusion of participants with impairments. For example, research has focused on able-bodied children on the home-school route, but has rarely included youth or children with impairments, nor have many studies included the range of purposes of walking. Studies of older people and walkability inconsistently differentiate types of impairments such as vision, mobility, and cognition. When impairment is considered, it is often in association with older people and not across the age spectrum. The principles of UD which foster design for the continuum of ages and abilities, are seldom considered or applied at the neighbourhood level, which would contribute micro details for built environment design.

The lack of comparative studies that synthesize the range of needs has resulted in a gap in understanding of the thresholds for the different groups in enabling walking for different purposes. Future studies and data synthesis capturing diversity across ages and abilities will be important in order to identify the range of environmental factors (physical and social) that act as barriers and facilitators (Mahmood et al. 2012) and to identify critical points for further intervention. Understanding of both macro and micro details is essential for design guidelines to be inclusive and just.

We suggest that the lack of integration and limited insight into diverse needs is related to the range of methods used for walkability studies. We make four observations about these methods:

- 1) Walkability indices help us understand built environment attributes that are useful in design for able-bodied adults (density, landuse and street network connectivity), but do

not capture differences in mobility due to age and impairments, or different purposes of walking or activity (such as play as opposed to transport). Connectivity focuses on cars and streets, rather than permeable linkages and pedestrian focused footpath connectivity. There were contradictions in density studies. High density may contribute to people walking for transport, but there is some indication that these environments may be too intensive for some children (see Broberg et al. 2013) and older people, thus restricting their mobility and posing perceived and actual safety concerns (e.g. Clarke et al. 2008; Plouffe and Kalache 2010; Chaudhury et al. 2012). The review raises questions in terms of what are the thresholds for different users.

- 2) Walking catchments (pedsheds) are based on the average adult walking speed, and do not take into consideration the range of ages, abilities, and environmental factors. The review suggests a need to broaden the metrics of pedsheds, and reconsider how we think about walking catchments.
- 3) Self-report assessments are extensive in understanding perception of walkability though limited in understanding impairment and built environmental influences on mobility, making the assumption that mobility is the same for everyone, usually an adult able-bodied walker.
- 4) A lack of participatory methods result in little exploration of lived experiences (such as the everyday practices of walking), in spite of the acknowledgement of the benefits of alternative and mixed methods (Andrews et al. 2012).

The review concludes that to improve data about diverse ages and abilities with regards to walkable neighbourhoods, methods need to be broadened and be more inclusive of the range of participants and of methods. Firstly, research must explicitly capture diversity of inhabitants such as the range of age cohorts and impairments (sensory, mobility and cognitive) (Gray et al. 2012), that reflect demographic data. Studies could explicitly recruit participants of diverse ages and abilities, through peak body organisations and local council community development or social planning sectors to ensure the range of impairments is

captured across age groups. A collaborative approach by researchers in different locations using a similar range of mixed methods and mix of participants would increase reliability and wider application of research outcomes to inform design interventions.

Secondly, walkability catchment and indices need to be expanded to be more relevant to all ages and abilities. This can include capturing a variety of factors that take into account walking speed, gradient/slope, footpath connectivity, infrastructure condition, weather/climate, and shade/shelter in addition to current measures of time and distance. Assessments of built environment and pedestrian infrastructure needs to consider play and social-interaction points, crossing placement, rest points, timing of traffic and pedestrian lights in line with the range of needs. This may need referencing to, and re-consideration of international and country specific design standards and legislation. Other measures of competence, confidence, safety, and purpose (travel, play) need to be included.

Thirdly, by using more participatory methods, we will expand access to a range of people who may otherwise be overlooked or are researched by proxy (i.e. through other people) (Stafford 2017). Such methods include photovoice (Baldwin et al. 2012; Buman et al. 2013; Mahmood et al. 2012). Different methods could facilitate a focus on the tacit habitual routines undertaken with respect to the act of going for a walk (Middleton, 2011), and subsequently what this means in the lives of people of diverse ages and abilities. These methods can be used by themselves or in conjunction with surveys or interviews. The use of mixed methods would help to capture both macro and micro level details of street design to better identify conditions and thresholds favorable for walking and social activities for different ages and abilities. Such data will better inform more integrated planning interventions.

In terms of limitations, this review has specifically focused on literature regarding the range of ages and abilities, however we acknowledge that there are other marginalized groups such as minority cultures, indigenous peoples, lower socioeconomic status (SES) and

developing countries, whose needs are often ignored in terms of design of walkable neighbourhoods; research is starting to address these areas. We reviewed English language literature only, yet there may be useful research unavailable to us due to language. We acknowledge that a compilation of planning recommendations from the various studies in relation to the different marginalized sectors, and a comparison to existing guidelines would have been a useful contribution, but was beyond the scope of this article. As a result, though, a fourth suggestion for future research is to compile planning recommendations arising from such studies, acknowledging that some may be strategic, location, climate or site specific, and test them using mixed methods in a study that includes the range of participants.

Conclusion

Failing to capture diversity in ages and abilities in current walkable neighbourhood research has potentially resulted in data-informed practices and guidelines that perpetuate the exclusion of spatially marginalized groups. Our review suggests that a large reason for this is that mainstream walkability research is based on the assumed able-body walker, and seldom reflects diversity in how people may move, occupy and inhabit space differently (Andrews et al. 2012). Standardization in planning and design results in the spectrum of needs not being addressed and the occurrence of spatial exclusion (Imrie 2012; Gleeson 2001). However, we also know that approaches that seek to plan and design for diversity rather than standardization, such as UD, seek to achieve environments that are beneficial and more useable for all (Mace 1997). This was reinforced by Ghazaleh et al. (2011, 12) who suggested that “Universal design (UD) standards improve the liveability of homes and neighborhoods, not only for the elderly and the disabled, but for every member of the community”.

Studies have often only examined one marginalised group at a time, thus making synthesis difficult and time consuming for the planner to interpret their needs in practice. Hurdles to translate research and knowledge to practice are a problem that perpetuates physical and social barriers. If we continue along this research path, then we risk continuing to exclude a significant percentage of the population from participating in the benefits of

walking for health, socializing, experiencing nature, and promoting sustainability. To change this, strategic and master planning must be better informed by integrated research that captures diversity in ages and abilities. Such research will inform micro and macro planning and design to achieve walkable neighbourhoods that are socially and spatially just for all.

Notes

¹ While the term is contested (Forsyth and Southworth 2008), we use it here broadly (not literally) to include the ability for all people to be able to move through and have access within a neighbourhood.

² A university program that accesses multiple databases at one time along with books and other materials.

³ Photovoice is a method whereby the participants take photos that represent their perspectives on a topic and share them in an interview or a focus group. The photos combined with text result in 'participant-generated data' that reveal and illustrate underlying views (Carlson et al 2006; Baldwin et al. 2012).

⁴ Woonerf is a European concept that emerged in 1970s in Netherlands. The concept views the street as a social shared space as opposed to dominant vehicle focused where the view of the street is a carriage way for vehicles (Appleyard, Bruce, and Lindsey Cox, "At Home in the Zone: Creating Livable Streets in the U.S." Planning 72.9 (2006): 30-35.

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