CHARACTERISTICS OF THE PHYSICAL ENVIRONMENT THAT INFLUENCE OLDER ADULTS' PREFERENCE FOR AND USAGE OF OUTDOOR AREAS: A SYSTEMATIC REVIEW OF THE LITERATURE

A Thesis

by

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ABSTRACT

Research indicates that access to outdoor environments may provide an opportunity for seniors' emotional and physical renewal. However, even though older adults have been reported to value the outdoors, many times the outdoor spaces are underutilized. Numerous studies have shown that older adults' outdoor use is strongly related to the physical environmental design. To determine which design characteristics are perceived by older adults as influencing outdoor usage, both positively and negatively, and in both private and public settings, this study performed a systematic review of the literature resulting in a comprehensive, objective, and reliable overview of all the identified relevant evidence. The review procedure incorporated extensive structured database search, selection of studies using inclusion and exclusion criteria, quality appraisal of the included studies, and integrated synthesis of the study findings. The review included 33 primary studies reflecting qualitative, quantitative, and mixed methods research. Reported environmental influences on outdoor use related to aesthetics; safety and security such as stable seating and shade; accessibility concerns including distance to the outdoor space; activities including walking and socializing; and the physical and sensory elements associated with nature experiences. Older adults also reported personal influences including a sense of freedom, variety, and a connection to surrounding life and past times. The results enable evidence-based design decisions to be made that would positively impact the potential outdoor use, resulting in benefits to health and well-being.

DEDICATION

I dedicate this thesis to my husband, Charlie. He has always been there for me with advice, encouragement and support, making an immeasurable impact on my life.

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1. INTRODUCTION

1.1 Background

1.1.1 The aging population

The world population is aging at an unprecedented rate. Globally there were 7 billion people in 2012 of which 562 million (8%) were 65 years or older. By 2015, the older adult cohort had increased by another 55 million (He, Goodkind, & Kowal, 2016). In the US, those aged 65 years or older numbered 46.2 million or 14.5% of the total population in 2014. By 2060, this number is expected to more than double to approximately 98 million (US Department of Health and Human Services, 2016). People are living longer, fertility rates are declining, and a large number of post WWII baby boomers are entering old age (Bloom, Canning, & Lubet, 2015; World Health Organization, 2014). This aging of the population has a wide range of implications including an increased societal need and expenditure for healthcare services.

1.1.2 Health effects of aging

1.1.2.1 Cognitive abilities

Age-related cognitive decline has become a worldwide health concern creating significant financial and societal issues (Deary et al., 2009) with many individuals affected by the age of 70 (Fillit & Butler, 1997). These skills are critical and can affect older adults' ability to perform necessary daily activities (Harada, Natelson Love, &Triebel, 2013; Klimova, Valis, & Kuca, 2017). Greiner, Snowdon and Schmitt (1996) found that nuns of advanced years with initial low normal cognitive function that progressed to impaired function were twice as likely to experience loss of independence in performing their daily activities, such as bathing and feeding, compared to those having an initial high normal cognitive function.

1.1.2.2 Mobility

Age-associated limitations in mobility are often the first disabilities encountered and can affect older adults' ability to safely perform the daily tasks necessary at home and in the community in order to maintain independence (Farage, Miller, Ajayi, & Hutchins, 2012; Fried, Bandeen-Roche, Chaves, & Johnson, 2000). When older adults are more sedentary, their muscles become weak which can affect their balance (Farage et al., 2012). Falls are the foremost cause of fatal and nonfatal injuries among older people and are commonly caused by gait and balance disorders (Cuevas-Trisan, 2017). Falls are also very costly. The medical cost of fatal and non-fatal falls for older adults aged 65 and older in the US was estimated to be approximately $50 billion in 2015 (Florence et al., 2018).

1.1.2.3 Sensory functions

Sensory impairment has been commonly associated with aged adults (Fischer et al., 2009). The senses of smell and taste can decline considerably with age (Doty, 2018) and losses in vision are common in older people (Farage et al., 2012). Vision changes may include an increase in sensitivity to glare, a loss of sensitivity in color contrast and a perceived dullness to colors as aging continues (Stuen & Faye, 2003). Loss in hearing is a chronic condition affecting an estimated 63.1% of US adults aged 70 years and older (Lin, Thorpe, Gordon-Salant, & Ferrucci, 2011). Hearing loss may significantly affect an individual's functional abilities and the desire to socially interact (Ciorba, Bianchini, Pelucchi, & Pastore, 2012). Research suggests that adults with hearing loss living in rural settings may be more prone to social isolation than auditory deficit adults in urban settings (Hay-McCutcheon, Reed, & Cheimariou, 2018).

1.1.2.4 Increased risk of disease and chronic conditions with aging

With aging comes a greater risk for heart disease and cancer along with other noncommunicable diseases and conditions such as Alzheimer's, strokes and diabetes (Centers for Disease Control and Prevention, 2013). In 2013, two out of three older people in the US had multiple chronic conditions with the subsequent treatment of these conditions accounting for 66% of the US healthcare expenditure (Centers for Disease Control and Prevention, 2013). As the population continues to age and chronic conditions become more prevalent, these figures will change (Olson, Reiland, Davies, & Koehler, 2018). By 2030, an estimated 150 million people in the US will have a chronic condition requiring long-term care (Centers for Disease Control and Prevention, 2013). Thus, the demand for long-term care institutions, such as assisted living facilities and skilled nursing homes, will rise dramatically (Joseph, Choi, & Quan, 2016).

1.1.3 Nature's healing potential for older adults

1.1.3.1 Benefits of nature for older adults

A rapidly growing literature suggests that spending time in natural outdoor environments may provide a vital opportunity for an older person's emotional and physical renewal. Simulated views of nature scenes and views of nature through a window have been shown to produce beneficial health effects (Gamble, Howard, & Howard, 2014; Tang & Brown, 2006). Blood pressure and heart rate can be lowered, stress can be alleviated, functional capacity can be improved, and longevity can be increased (Tang & Brown, 2006; Rodiek, 2002; Kono, Kai, Sakato, & Rubenstein, 2004; Takano, Nakamura, & Watanabe, 2002; Whear et al., 2014). A well-designed and attractive outdoor space can also encourage health-promoting activities.

Improved cardiorespiratory function has been shown to be a result of substantial routine walking by older adults (Wong, Wong, Pang, Azizah, & Dass, 2003). Frequent social interaction by older people has been linked to a reduced risk of dementia and less depressive symptoms (Wang, Karp, Winblad, & Fratiglioni, 2002; Sugisawa, Shibata, Houghman, Sugihara, & Liang, 2002).

1.1.4 Outdoor natural environments for older adults

In spite of potential benefits and the fact that most residential care facilities for older adults include some form of an outdoor space, usage has been reported to be low (Rodiek, 2006b; Cutler & Kane, 2005; Cranz & Young, 2005). A study involving 40 skilled nursing homes located in 5 states found that 32.2% of the residents interviewed who were physically able to go outdoors went outdoors as little as once a month (Cutler & Kane, 2005). This may give the impression that older adults are not interested in going outdoors. But research has shown this to be untrue. Older adults have self-reported the many benefits they derive from nature and the high value they place on their outdoor spaces (Cranz & Young, 2005; Kearney & Winterbottom, 2006; Rodiek, 2006a). Numerous studies have shown that usage is strongly related to the environmental design of these spaces (Heath & Gifford, 2001; Rodiek, Boggess, Lee, Booth, & Morris, 2013; Rodiek & Lee, 2009). An inadequate or unsupportive design can discourage older people from using the outdoors (Heath & Gifford, 2001). Given the diversity of outdoor environments, their attributes, and reports that usage is strongly related to design, it is important to ask which attributes are most influential in older people's choice of which outdoor space to visit.

1.1.4.1 Intent of study

This study's intent was to identify and synthesize the existing evidence provided by seniors on the way they feel their outdoor natural environments should be designed. *Characteristics* of the physical environment refer to a wide range of both tangible and intangible attributes, such as vegetation, water features, benches, a feeling of security, the fragrance of flowers, and a place to reflect. The term *natural environment* includes any environment that has a reasonably verdant overall appearance (Bowler, Buyung-Ali, Knight, & Pullin, 2010). The research encompasses outdoor spaces accessible to older people in both public and private settings such as personal gardens, long-term care facilities, parks, and other neighborhood open spaces.

Planners and designers of outdoor spaces meant for multiple user types commonly make design decisions based on what they feel will attract the majority of users. This study is intended to provide a practical resource for designers, decision-makers, and care-workers to assist them in more fully realizing and thus supporting the environmental needs and wishes of older adults. A better understanding by environmental designers relative to the attributes which encourage outdoor use by older adults may result in a design that has a substantial impact on their health and well-being (Rodiek & Lee, 2009).

1.2 Research questions

1.2.1 Comprehensive synthesis of empirical evidence lacking from literature

With increasing attention on the aging population, a significant research has focused on understanding older adults' needs and desires in relation to their living environment. As an example, a recent study revealed that a simple micro scale feature such as a bench placed at

opportune locations in the neighborhood was valued by older adults as a way to help them maintain their mobility and cultivate social connections (Ottoni, Sims-Gould, Winters, Heijnen, & McKay, 2016). While there are various published guidelines for designing exterior environments for the aged, the literature is currently lacking a comprehensive synthesis of primary empirical research focusing on older adults' preferences for specific attributes of both public and private outdoor environments. The study's aim was to determine *which* outdoor attributes are most important to seniors. In order to fully understand why specific attributes are important, the study also examined *in what way* these spaces function and are experienced (Bengtsson & Carlsson, 2013).

1.2.2 Methodology used to answer the research questions

A *systematic review* of the literature was performed to explore the question of which physical environmental features and qualities influence, both positively and negatively, older adults' decision to go outdoors and which outdoor space to visit. Other questions that guided the study were:

1. In what way are these features and qualities important to older adults?
2. How are outdoor areas used and experienced by older adults?
3. What improvements to outdoor areas could further encourage use?

A preliminary *scoping search* was performed to identify existing reviews, obtain a cursory assessment of the extant primary research that was relevant to the research questions, identify the databases that indexed these types of studies, and to determine the appropriate methods for conducting the systematic review.

1.3 Theoretical framework

The following sections review some of the prominent concepts and theories on the connection between humans and nature including works on humans': 1) inclination towards nature, 2) restorative response to natural environments, and 3) preference for specific environmental attributes.

1.3.1 The need for nature

1.3.1.1 Biophilia

Biophilia theorizes that humans have an inherent need to affiliate with all other living organisms (Wilson, 1984). The theory posits that humans have an innate predilection for non-human organisms that are essential to their physical and emotional well-being. The inclination to affiliate with nature stems partly from ancestral humans' dependence on nature for basic survival needs, such as food and water. This biological tendency is hypothesized to be an evolved genetic trait that disposes humans to form strong emotional, cognitive, and physical relationships with nature (Gullone, 2000). According to Zelenski and Nisbet (2014), natural selection favored those with the ability to form these affiliations, thus evolving into an inherited adaptation in human beings.

Research argues that evidence exists to support Wilson's assertion that humans' affiliation with nature is an inherited trait while other research asserts that corroborating scientific evidence of a genetic predisposition to nature is negligible or inconclusive at best and more rigorous research is required (Gullone, 2000; Simaika & Samways, 2011; van den Born, Lenders, de Groot, & Huijsman, 2001). A recent study suggests that how much a person feels restored is directly

related to the setting's biophilic quality and how much that person feels a connection with nature (Berto, Barbiero, Barbiero, & Senes, 2018). The study defined *biophilic quality* as "the environment's naturalness, functional, and aesthetic value" (Berto et al., 2018, p. 1). If biophilia is an innate need to be with other life forms, such as vegetation, would an environment lacking plants result in a negative effect on humans? A study by Grinde and Patil (2009) explored this question and after reviewing numerous empirical studies, concluded that not being able to see plants can have an undesirable effect on human health or quality of life "although the demonstrated effects are not overwhelming" (p. 2339).

1.3.1.2 Nature's importance today

The world has been witnessing a dramatic increase in urbanization over the past decades. More than 50% of the global population is now residing in urban centers and this percentage is expected to increase to 68% by 2050 (United Nations, 2018). As a result of urban migration, people are spending more time indoors than past generations with the concomitant decrease in regular access to nature, either by choice or lack of available natural spaces. A study by Hu (2011) reports that Type 2 diabetes has become a worldwide health crisis that may be partially attributed to the rapid rise in urbanization. Other research suggests that decreased opportunities to experience nature as a result of urbanization may be linked to an increased risk of depression (Bratman, Hamilton, Hahn, Daily, & Gross, 2015). However, rigorous research supporting the biophilia hypothesis as a causal theory for the increase in certain health conditions is still needed (Depledge, Stone, & Bird, 2011).

1.3.2 Nature and the restorative experience

Substantial literature exists exemplifying how nature provides an opportunity for better health and well-being. The Attention Restoration Theory (Kaplan & Kaplan, 1989) and the Stress Reduction Theory (Ulrich et al., 1991) are two different yet interacting positions on how nature influences restorative responses in humans. The former is centered on nature's role in the recovery of focused attention and the latter on nature's role in the recovery from stress.

1.3.2.1 The Attention Restoration Theory

The Attention Restoration Theory (ART) proposed by Kaplan and Kaplan (1989), is a psycho-functionalist theory contending that humans are drawn to a natural setting to restore their ability to focus attention. The theory posits that many routine daily activities require considerable mental effort to concentrate for extended time periods referred to as *directed attention* (Kaplan, 1995). Directed attention relies on the mental ability to suppress the copious distractions in life. When the ability to suppress these distractions becomes overwhelmed and mental exhaustion sets in, the capacity for directed attention is significantly diminished (Kaplan, 1995). A natural setting has inherently intriguing distractions and triggers an effortless shift to a form of attention response referred to as *fascination* which allows directed attention to be minimalized thus recovering directed attention from mental fatigue (Kaplan, 1995). The theory asserts that this initial response to the environment is a cognitive response requiring considerable mental processing of information concerning the setting (Hartig, Mang, & Evans, 1991).

The theory presumes that humans can also be fascinated by stimuli that have a possible high intensity and detrimental effect (e.g. ambulance sirens), thus requiring additional need for

directed attention to focus away from that stimulation (Kaplan & Berman, 2010; Berman, Jonides, & Kaplan, 2008). These stimuli are typically characteristic of urban environments, consequently making them less restorative than natural settings (Kaplan & Berman, 2010). Thus, the term *soft fascination* was conceived to denote a state of gentle or modest fascination with aesthetically appealing stimuli (Kaplan, 1995; Kaplan & Berman, 2010).

Fascination is a central quality of a restorative environment in ART. However, the environment must afford additional qualities to make renewal more likely (Kaplan, 1995). The environment must also provide: 1) a sense of *being away* from routine mental tasks, 2) *extent* which is the feeling of connectedness to a whole larger world to be explored, and 3) *compatibility* which occurs when the environment's demands do not pose an obstacle to the user's needs (Kaplan, 1995; Kaplan & Berman, 2010). The theory contends that natural settings are typically strong in these qualities (Hartig, Evans, Jamner, Davis, & Gärling, 2003; Kaplan & Kaplan, 1989).

Research has tested Kaplans' theory. An experimental study explored the relationship between both a low and a high attentional fatigue condition in a subject and their preference for a walk in a forest or in a city as a means for restoration (Hartig & Staats, 2006). The study found that the walk in nature was preferred over the urban setting for both fatigue conditions and that preference was more profound with a higher level of fatigue.

1.3.2.2 The Stress Recovery Theory

The Stress Recovery Theory (SRT) developed by Ulrich and colleagues (Ulrich et al., 1991) posits that people possess an innate proclivity to seek out a natural environment to relieve stress

effects brought upon by overtaxing or menacing events. Stress effects are typically heightened states of physiological arousal and negative emotions (Berto, 2014). The theory asserts that exposure to non-threatening natural stimuli initiates an innate aesthetic and restorative response to enable recovery from the effects of stress. The theory presumes the response to nature is an immediate affective, i.e., emotional, reaction rather than a cognitive response (Ulrich et al., 1991).

Early humans lived in a natural environment and stress was a part of daily life (e.g., finding food and shelter or keeping safe from threatening wildlife and weather) and the capacity for nature to restore was essential for survival. The SRT's psycho-evolutionary framework presumes that humans evolved with an innate ability for stress-reducing responses to natural environments and content (Hartig et al., 2003). The evolutionary position also presumes that because the species evolved in a natural setting, humans are more adapted to a natural rather than an urban environment (Ulrich et al., 1991). Consequently, artificial or urban environments will not evoke an equal positive response and the subsequent psycho-physiologically restorative effect as natural settings (Ulrich, 1999). Joye and van den Berg (2011) suggest that the fundamental tenet of SRT is that recovery from a stressful condition will be faster and more profound in an "unthreatening" natural environment than an "unthreatening" urban environment (p. 262). Their study investigated the feasibility of the hypothetical assertion that a restorative response to nature or its elements is an evolved adaptive trait. Focusing on the SRT evolutionary framework for their analysis, the study concluded that the available empirical evidence and contentions fail to definitively support the hypothesis (Joye & van den Berg, 2011).

Evolution theory posits that the human species is genetically designed for its way of life. Environmental factors that are not congruent with what humans have become adapted to can generate fear stimulating an acute stress response (Grinde, 2005; Grinde & Patil, 2009). People use different coping strategies to deal with daily stressors (e.g., work deadlines and distracting noise), such as listening to soothing music or taking a walk. Some stress is inevitable in daily life but continued unnecessary stress can be detrimental to health. Too much stress can lead to anxiety disorders and a reduced quality of life (Grinde, 2005).

In a study by Ulrich et al. (1991), 120 subjects watched a stress-inducing video followed by videos of both natural and urban settings. Stress recovery was determined by physiological measures and self-reports. The study found that positive changes in attention, emotion, and physiological levels, such as muscle tension, were more pronounced after subjects viewed the natural settings compared to the urban settings (Ulrich et al., 1991). Another study by Roe et al. (2013) using cortisol concentrations as an outcome measurement of stress, found lower stress levels among people living in neighborhoods with substantial amounts of green vegetation.

1.3.3 Environmental preferences in nature

When theorizing on human environmental preferences, both the spatial and psychological environmental properties are taken into account (Dosen & Ostwald, 2016). Substantial literature has sought to elucidate the correlation between various spatial environmental characteristics and human emotions. While many rigorous studies validate the ubiquitous preference for natural settings and content, environmental preference theorists argue different positions to explain human response to environments.

1.3.3.1 Habitat theory and prospect-refuge theory

Historical accounts propose that humans evolved for millions of years as hunters and gatherers in a savanna-like environment characterized by properties that helped ensure their survival (Gullone, 2000). The habitat theory (Appleton, 1975) takes the evolutionary adaptation position to explain modern humans' positive affective response to environments and content that are reflective of humans' original savanna-like habitat (Dawes & Ostwald, 2014). Appleton's (1975) prospect-refuge theory divides this preferred environmental model into these properties: *prospects, refuges*, and *hazards*. The theory posits that humans innately perceive landscapes as safe and aesthetically pleasing if they have the spatial properties that allow them to observe potential hazards while not being observed (Dosen & Ostwald, 2016). *Prospect* offers the unhindered ability to see potential *hazards* (e.g., wild animals and inclement weather) and needed resources (e.g., water and food) from a distant vantage point. *Refuge* offers the ability to find shelter or hide from likely threats (Dawes & Ostwald, 2014).

1.3.3.2 Research based on prospect-refuge theory

Although the prospect-refuge theory takes an evolutionary functionalistic approach to environmental preference and selection, modern humans no longer need to evaluate a natural environment on the basis of survival needs. Stating that the available evidence supporting this theory is primarily supported by qualitative methodology, Dosen and Ostwald (2016) provided a meta-analysis comparing thirty-four relevant quantitative studies. They found that evidence for prospect and refuge varied among the studies, and the study setting was a significant determining variable. Findings from the studies included in the meta-analysis with natural settings provided

evidence for, against, and neutral for both prospect and refuge properties. Findings from studies with urban and interior settings provided evidence for prospect but generally were neutral for refuge (Dosen & Ostwald, 2016).

1.3.3.3 Information model on environmental preferences

The information model on environmental preferences theoretically contends that cognitive processing of information about the environment is related to a preference or aesthetic response (Kaplan, 1987; Kaplan, Kaplan, & Brown, 1989). In other words, the model argues that a user's environmental perception is based on the information the user is able to extricate from the environment. The model focuses on four spatio-cognitive space properties, referred to as informational variables, or predictor variables, that influence preference: *coherence, legibility, complexity,* and *mystery* (Kaplan, 1987). Coherence and legibility enable the user to feel safe and comfortable in the space while complexity and mystery entice the user to explore in order to gather more information about the space. The model proposes that a preferred environment would reflect all four properties, allowing the user to understand the environment while also encouraging further exploration. The model also proposes a possible evolutionary biological component underlying the variables found to predict preference (Kaplan, 1987). The ability of ancestral humans to recognize certain information properties that would enable them to better survive in a primitive world would have been a selected adaptive trait (Hartig, 1993).

1.3.3.4 Theory of affordances

The ecological theory of affordances was pioneered by Gibson (1979). The concept suggests that people assess the physical environment in terms of what purpose or need it may possibly fulfill

rather than assessing its intrinsic qualities. *Affordances* are what and how well the environment or feature offers, or affords, a user's targeted outcome or behavior (Rodiek, Nejati, Bardenhagen, Lee, & Senes, 2016). In other words, the actual physical characteristic itself is not the focus, but rather the function it can provide for the user and to what level. The concept that non-visual landscape characteristics, such as function and affect, can be instrumental in preference decisions by older adults has been demonstrated in research (Gibb, 2001). The theory has an evolutionary biological component positing that humans are adapted to prefer an environment they perceive as affording them safety and security (Dorwart, 2015).

1.3.4 Summary

The theories and concepts discussed provide a theoretical foundation for this study. Theorists contend that humans have evolved with an inherent affiliation towards natural environments and content. They assert that natural environments and content have the ability to initiate innate psycho-physiologically restorative responses in humans. They also contend that humans' preference for specific natural environmental properties is influenced by an evolutionary component. However, modern lifestyles and cultures continue to change at a rapid pace driven largely by advancing technology and urban migration (Gullone, 2000; Depledge, Stone, & Bird, 2011). The environments most people live in today are extraordinarily different than the natural environments of ancestral hunters and gatherers. Continued expansion of urban environments has resulted in a concomitant loss of natural environments. Consequently, theorists are also arguing the question whether the species has the ability to continue to adapt to an environment that is increasingly different from the environment humans evolved in without any significant

detrimental effect. Non-adaptive behaviors, such as low fertility and sedentary lifestyles, can already be witnessed in modern urban society (Irons, 1998).

1.4 History and research on healing nature

1.4.1 Healing nature in the past

People across cultures and through thousands of years have shared the intuitive belief that contact with nature can be beneficial to their health and well-being (Ulrich et al., 1991). Restorative gardens focusing on greenery, sunlight and fresh air appeared through the ages at healing temples in ancient Greece, courtyards in medieval monastic communities, and hospitals in the 17th and 18th centuries. In the 19th century, landscape architect Frederick Law Olmsted created and promoted the use of green spaces in urban areas for city dwellers' physical and mental health (Heath & Gifford, 2001). However, in time the idea that nature could assist in healing was mostly forgotten, superseded by the desire for drugs and technology that were found to be highly successful in addressing the more acute conditions, and nature came to be regarded as merely decoration (Cooper Marcus & Barnes, 1999a; Moore, 2007).

1.4.2 Healing nature in modern times

Empirical evidence from a seminal study by Ulrich (1984) significantly revived the belief that nature could assist in healing. The study compared patients recovering from the same surgery who were assigned to identical hospital rooms with the exception that some had a view of trees and some had a view of a brick wall. The study found that patients with a nature view had better postoperative results including less needed pain medication, fewer days in the hospital following surgery, and a more positive emotional state (Ulrich, 1984). Evidence from two research

programs using rigorous methodology based on different theoretical models consistently supported nature's capacity to elicit restorative responses in people (Hartig et al. 1991). A research program by Kaplan and Kaplan (1989) conducted studies to support their Attention Restoration Theory on nature's ability to reduce mental fatigue thus restoring the ability to concentrate. A separate program by Ulrich and colleagues (Ulrich et al., 1991) conducted studies to substantiate their Stress Reduction Theory on the natural environment's ability to elicit restorative responses to stress. Both theories were discussed in the previous section.

1.4.3 Current research on healing nature

Today a substantial and continually growing research exists evidencing how outdoor natural environments can affect beneficial health consequences in people. For example, a study by Tennessen and Cimprich (1995) questioned whether the ability to focus attention would be greater for students with a dormitory view of more natural settings compared to those with less natural views. Using standard tests and self-ratings, the study concluded that the students with a more natural view possessed greater directed attention abilities than those with less natural or built views. Though the study did acknowledge that the sample size and composition, along with the lack of a baseline measurement for *directed attention*, should be considered in the findings (Tennessen & Cimprich, 1995). A more recent study sought to determine the health benefits related to using urban parks. The study measured physical and mental responses of young males as they took a brief walk in a city park and along a city street. The findings indicated that the walk in the park resulted in lower heart rates and anxiety levels than the walk on the street (Song et al., 2014). Still, this current body of knowledge is just the beginning of understanding the full

breadth of salutary effects that experiencing nature can provide (Sandifer, Sutton-Grier, & Ward, 2015).

1.5 Nature and older adults' health

1.5.1 Research on older adults and healing nature

In 1997, Stoneham and Jones reported that scant research focused on older adults and how appropriate outdoor design could lead to better health and well-being. With individuals over the age of 60 now making up an increasing portion of the world population, considerable research exists focusing on the various determinants of health for this cohort (Murphy, Miyazaki, Detweiler, & Kim, 2010; Chen & Janke, 2012; Gamble, Howard, & Howard, 2014) though issues, such as the diverse methods used in the studies to measure health outcomes, can make understanding and generalizing the findings problematic at times (Senes, Fumagalli, Crippa, & Bolchini, 2012).

1.5.2 Older adults value nature

Older adults have reported the high importance they place on being able to access the outdoors (Kearney & Winterbottom, 2006; Cranz & Young, 2005; Rodiek, 2006a). An available outdoor space gives older individuals the opportunity to leave their residential unit and enjoy a natural setting. In one study, a nursing home resident exclaimed: "I love to get outdoors. I see the effect it has on me. It's the best thing they ever started out here" (Raske, 2010, p. 341). Nature's ability to affect a positive health response has been explored as a possible non-pharmacological intervention in numerous health-related studies with seniors (Day, Carreon, & Stump, 2000;

Detweiler et al., 2012). The following is a brief overview of selected research investigating the relationship between nature and the potential beneficial health outcomes in older adults.

1.5.3 Physical health benefits

1.5.3.1 Reduced incidences of falls

As mentioned earlier in this work, the high incidence of falls for people aged 65 and over and the medical costs associated with these falls are placing a significant burden on the healthcare system (Florence et al., 2018). Research has explored the possibility of a nature intervention to reduce the number of falls by older people. For example, when a new wander garden was provided for the older dementia-care residents, falls decreased by 30% in a 12-month timeframe (Detweiler, Murphy, Kim, Myers, & Ashai, 2009). A reduction in dispensed psychiatric and antipsychotic medication was also seen during this time and suggested a possible favorable effect in the quality of life from this intervention. Chen and Janke (2012) investigated gardening as an approach to decrease the risk factors for falls by older people. Their findings suggest that gardening in itself did not directly affect fall rates, but indirectly through its ability to positively affect measures of balance, gait speed, and self-reported health status.

1.5.3.2 Improved cardiovascular function

Simply viewing nature has also been shown to evoke positive health responses in older adults. A controlled quasi-experimental study by Tang and Brown (2006) revealed that viewing a natural landscape resulted in consistently lower systolic and diastolic blood pressures and heart rates in older female nursing home residents when compared to the control of having no view to the

outside landscape. Blood pressures and heart rates also declined when viewing a built landscape but the change was less pronounced and less consistent among the subjects.

1.5.3.3 Reduced pain

Nature-related sensory stimuli have been used as a means of distraction to reduce pain (Kline, 2009). Lembo et al. (1998) investigated whether interventions of simulated ocean sights and/or sounds would reduce older adults' discomfort levels during a routine flexible sigmoidoscopy. Effects were measured with the two stimuli combined and with audio stimulus alone. The study found that patients receiving both the audio and visual stimuli experienced significantly less abdominal discomfort than those with neither intervention or with only the audio stimulus.

1.5.4 Psychological health benefits

1.5.4.1 Modulated stress responses

Physiological measures and self-reported findings support the relationship between accessing nature and stress reduction. An experimental study by Rodiek (2002) hypothesized that time spent in a local park garden would reduce stress in nursing home residents. Salivary cortisol levels, a hormone related to stress, were measured before and after subjects' time spent performing the same activities in an outdoor garden and an indoor classroom. The results confirmed that cortisol levels were significantly lower in the subjects after time spent in the garden compared to the indoor setting (Rodiek, 2002).

1.5.4.2 Lowered levels of agitation

Murphy et al. (2010) observed lower agitation levels in older dementia patients after spending time in a wander garden. The study purported that the rate at which agitation declined was associated with the patient's ambulation status. More succinctly, patients that could walk unassisted would experience reduced agitation even with infrequent to moderate garden use while non-ambulatory patients may not experience reduced anxiety even with a high frequency of visits.

1.5.4.3 Lessened depressive symptoms

The prevalence of depressive symptoms among older adults is an issue of significant concern in the public health field with an estimated 15% of those living in communal residences affected by the condition (Hassanin, 2015). A study by Rappe and Kivelä (2005) investigated the perceived effects of a garden visit on long-term care residents' depressive symptoms with a high percentage of self-rated depression. Using a standard self-rating depression scale, participants reported an improvement in their sleep, mood and ability to focus after spending time in the garden. Additional effects reported from the garden visit were a sense of healing and tranquility (Rappe & Kivelä, 2005).

1.5.5 Cognitive health benefits

1.5.5.1 Improved attention and intellectual activities

Nature's ability to constructively affect cognitive functioning in older people has been supported by research (Berman et al., 2008). Kono et al. (2004) established a relationship between positive changes in functional capacity and intellectual activities of ambulatory frail elders living at home

and frequent access to outdoor environments. An outcome-based study by Ottosson and Grahn (2005) using standard tests to measure attention levels in geriatric home residents before and after a one-hour rest in a natural setting and in a familiar indoor room found the garden rest resulted in a significantly enhanced ability to concentrate compared to the indoor setting. Simulated nature scenes have also been shown to evoke the salutatory effects of nature. Even if an older person is unable to physically access nature, health benefits can be obtained by simply seeing nature. A study by Gamble, Howard, and Howard (2014) revealed that viewing nature scene simulations for only a short time significantly improved the executive attention in older adults compared to urban scenes.

Additional studies with older people have confirmed nature's impact on health indicators such as improved recovery from physical disabilities, decreased urinary incontinence, significant improvements in sleep duration, and fewer occasions of verbal anxiety (Fujita, Fujiwara, Chaves, Motohashi, & Shinkai, 2006; Jacobs et al., 2008; Connell, Sanford, & Lewis, 2007).

1.5.6 Engaging in activities that promote health

1.5.6.1 Walking and exercise

Along with the direct health benefits derived from contact with nature, outdoor environments can encourage health-promoting activities. Studies have shown that nearby green spaces in neighborhoods can encourage physical activities such as walking (Pikora et al., 2002; Bedimo-Rung, Mowen, & Cohen, 2005) and evidence substantiates that routine walking improves cardiorespiratory function in older people (Wong et al., 2003). A study with a large sample of older adults found a significant increase in longevity for those residing near walkable public

green spaces (Takano, Nakamura, & Watanabe, 2002). In a controlled trial, aerobic exercise programs were shown to be more effective as a therapeutic intervention than conventional medication in reducing depression in older adults (Blumenthal et al., 1999).

1.5.6.2 Horticulture

Research has demonstrated that horticulture activities as therapeutic modalities may reduce stress levels, improve physical function, and promote mental stimulation in older individuals (Barnicle & Midden, 2003; Han, Park, & Ahn, 2018; Infantino, 2004/2005). Horticulture activities can also provide a means for creative self-expression and a change to everyday life for older individuals (Burgess, 1989). Gardening has been shown to provide subjective benefits, such as feelings of connection to the past, pride, and independence (Burgess, 1989; Wang & Glicksman, 2013). Even the care of one simple houseplant has been shown to improve an older individual's self-reported well-being by creating a sense of anticipation, responsibility and even company (Collins & O'Callaghan, 2008).

1.5.6.3 Social interaction

Outdoor environments can facilitate engagement in additional healthy behaviors. For example, older adults consider neighborhood green spaces as important venues to spend time and socially engage with others (Noon & Ayalon, 2018) and frequent social contact has been linked to a reduced dementia risk and less depressive symptoms in older people (Wang et al., 2002; Sugisawa et al., 2002). A study by Milligan, Gatrell, and Bingley (2004) found that communal gardening was perceived by older adults as a valued facilitator to social contact. Additional research by Wolff (2013) suggests that by providing an atmosphere that fosters social interaction,

nursing homes can improve residents' quality of life by simply giving them the opportunity to make friends. Having in-house friends was shown to positively impact their emotional health and lifestyle contentment (Wolff, 2013).

1.6 Outdoor usage related to design

1.6.1 Outdoors are underutilized

Research now acknowledges that getting outdoors can be advantageous for older adults. Sources have demonstrated that being in nature or simply viewing nature can result in beneficial health outcomes (Tang & Brown, 2006; Ottosson & Grahn, 2005). Numerous studies have also reported that while older adults' value being outdoors and are somewhat cognizant of the many health benefits to be gained by getting outdoors, outdoor use is low (Cranz & Young, 2005; Heath & Gifford, 2001; Kono, et al., 2004; Kearney & Winterbottom, 2006). Underutilization has been attributed to many factors such as weather conditions, personal health status, unavailable assistance, and facility staff attitudes (Cutler & Kane, 2005; Rappe, Kivelä, & Rita, 2006; Rodiek, 2006b; Sugiyama & Ward Thompson, 2007). However, significant research has revealed that the underuse is strongly related to space design and planning (Heath & Gifford, 2001; Cutler & Kane, 2005; Rodiek et al., 2013; Rodiek & Lee, 2009).

1.6.2 Unsupportive design can discourage use

There is increasing evidence of the relationship between an appropriately designed outdoor space and institutionalized residents' overall well-being (Othman & Fadzil, 2015; Brawley, 1992; Brawley, 2006). Research substantiates that as people get older, common age-related physical and cognitive changes may begin to detrimentally affect their ability to negotiate their living

environments (Fujita et al., 2006). Consequently, whether an environment supports these changes or not is of significant concern to older adults (Sugiyama & Ward Thompson, 2007). An unsupportive design can be a strong deterrent when older adults are considering using an outdoor setting (Health & Gifford, 2001). For example, conditions such as rough walking surfaces and inadequate seating can pose serious physical challenges (Kearney & Winterbottom, 2006). Common design elements such as poorly designed doorways can become barriers to accessing the outdoors (Rodiek, Lee, & Nejati, 2014). As functional disabilities become more pronounced in later life, the physical environment's supportive possibility plays a major role in influencing older adults' behavior (Sugiyama & Ward Thompson, 2007). The opinion that the garden at a multi-care facility was not designed to adequately support the residents' needs was a prominently voiced concern during a post occupancy evaluation by Heath and Gifford (2001). Appropriate outdoor design reflecting age-sensitive features is critical to accommodate the special needs of frail older individuals (Artmann et al., 2017).

1.6.3 Outdoor designs typically not reflective of older adults' predilections

Reports indicate that most residential care environments for older adults include some type of outdoor space (Rodiek, 2006b; Cutler & Kane, 2005; Cranz & Young, 2005). However, outdoor space design is often given secondary importance to the interior design and is frequently thought of as only decorative embellishments (Cranz & Young, 2005; Rodiek et al., 2013). The design's intention could be to project an overall appealing image to attract new residents (Reynolds, 2011). Outdoor spaces are commonly a reflection of what those in charge feel is an overall aesthetically pleasing design (Stoneham & Jones, 1997) or what will fulfill the most needs of the majority of users (Rodiek, 2008). Individual expression and choice may be limited by the desire

to create a homogenous landscape. However, even when outdoor environments are designed by well-intentioned professionals, the space has the possibility to evoke a more institutional feeling rather than expressing the residents' predilections (Detweiler et al., 2012; Cranz & Young, 2005).

1.6.4 Older adults should be consulted on design

Residents are typically not consulted about the outdoor programming (Cutler & Kane, 2005; Duffy, Baily, Beck, & Barker, 1986). However, when asked to participate in the design process, the nursing home residents in a study by Senes et al. (2012) valued having a voice in the decisions being made about their garden. Studies have confirmed that significant differences in environmental design preferences can exist between the residents and the facility staff/administration and professional designers (Duffy et al., 1986; Senes et al., 2012). Another study argues that long-term care residents' own appraisal can be considered the "gold standard" in assessing quality of life determinants because many inherently subjective factors can be evaluated only by the users (Kane et al., 2003, p. 240). Similar research has argued that when designing outdoor areas, input from the residents themselves is essential in order to fully and accurately understand what is important to them (Bengtsson, Hagerhall, Englund, & Grahn, 2015; Loukaitou-Sideris, Levy-Storms, Chen, & Brozen, 2016; Zeisel, 2007).

1.6.5 Supportive design can promote usage

Designing and implementing an outdoor space that is perceived to fulfill older adults' needs and wishes can promote a higher use level (Rodiek et al., 2013). And research has shown the positive relationship between the frequency of going outdoors and beneficial health outcomes in older

adults (Fujita et al., 2006; Kono et al., 2004). While considering older adults' special needs, the design should also inspire and encourage activities appropriate for the very fragile to the fittest in the cohort (Bengtsson & Carlsson, 2005). This study's intention was to provide a comprehensive evidence synthesis as voiced by older adults, or their proxies, regarding the attributes that influence their decision to go outdoors. In long-term care residential communities for older adults, the staff has extensive and invaluable knowledge pertaining to those in their charge and typically accompany frail residents when outdoors (Bengtsson & Carlsson, 2005; Senes et al., 2012). Consequently, a study with a sole sample of nursing home staff members providing their insights on how the residents' experienced and used the outdoors was also included in the study.

1.7 Significance of the study

1.7.1 Gap in the literature

Currently, knowledge about the specific features and qualities that attract older adults outdoors is fragmented among numerous studies. In the past, other reviews have typically focused on either a specific outdoor setting or a specific population. This study reports the evidence from a wide range of outdoor settings, both public and private, and all older adult populations. The study fills a gap in the literature by providing a comprehensive and rigorous synthesis of the existing knowledge which is currently lacking from the literature.

1.7.2 Empirical evidence from older adults themselves

Many existing design guidelines on outdoor spaces for older adults are anecdotal, based on expert opinion, or the result of less rigorous studies. Studies included in this review queried the older adults themselves on their perception of what attracts or hinders their outdoor use. The

study's expectation was to provide policy-makers, designers, and providers of outdoor environments for older adults with explicit knowledge of what older adults want. Evidence-based design decisions could then be made that would positively impact the potential outdoor use resulting in benefits to health and well-being.

2. METHODS

2.1 Research design

2.1.1 Study team and software tools

The study team consisted of three members: 1) a subject matter expert, 2) a systematic review methods expert and medical librarian, and 3) the author. Online software tools were employed to expedite the review process. Both *Rayyan* and *RefWorks* bibliographic management software programs were used to assist in tracking the selection process and the management of citations (Ouzzani, Hammady, Fedorowicz, & Elmagarmid, 2016).

2.1.2 Systematic reviews

The study aimed to provide a comprehensive knowledge base of the attributes that have been reported to significantly influence older adults' use of outdoor environments. To accomplish this goal, a *systematic review* was performed to compile a comprehensive, objective, and reliable overview of all the identified relevant evidence. S*ystematic* reviews are distinguishable from traditional literature reviews by their explicit and systematic approach (Khan, Kunz, Kleijnen, & Antes, 2003) employing transparent and reproducible methods to identify, select, assess the quality, and synthesize the findings from relevant work (Booth, Sutton, & Papaioannou, 2016; Cook, Mulrow, & Haynes, 1997). Systematic reviews are considered an effective methodical process for gathering, managing, summarizing, and comprehending extensive data (Petticrew & Roberts, 2006). A study by Moher, Tetzlaff, Tricco, Sampson and Altman (2007) estimated that 2,500 new English language systematic reviews were indexed each year in Medline alone.

2.2 Framework for conducting the systematic review

The review followed a framework similar to the commonly-used and validated approach in the *JBI Reviewers' Manual* developed by the Joanna Briggs Institute (JBI), an internationally recognized research organization, and included structured database searches, inclusion and exclusion criteria, quality appraisal, and synthesis of the data (Pearson et al., 2014; Aromataris & Munn, 2017). The JBI mixed methods review approach incorporates different types of data to evaluate the effectiveness of a specific intervention or clinical trial (e.g., qualitative, quantitative) (Aromataris & Munn, 2017; Pearson et al., 2014). This review also incorporated qualitative and quantitative evidence but differed from the standard JBI approach by: 1) not specifically evaluating the effectiveness of an intervention or clinical trial but rather investigating the diverse physical environmental characteristics that influence older adults' preference and use of outdoor spaces, and 2) not drawing up recommendations for clinical practice with assigned levels of evidence. The JBI approach seemed more appropriate than other well-known approaches such as the Cochrane Collaboration reviews and Campbell Collaboration reviews which commonly focus on the evidence from interventions in randomized trials (Ahrentzen & Tural, 2015; Annear et al., 2014; Littell & White, 2018).

2.2.1 Mixed methods studies and mixed methods reviews

For clarification, in this work a *mixed methods study* is defined as research that combines both qualitative and quantitative methods at the primary study level (Pluye & Hong, 2014). The term *mixed methods review* is defined in this work as a review that is designed to integrate evidence from different types of research (Pearson et al., 2014). This review type has also been referred to as a *mixed studies review* and a *mixed methods synthesis* (Pluye, Gagnon, Griffiths, & Johnson-

Lafleur, 2009; Harden & Thomas, 2005).By synthesizing all the available evidence on a given topic, a mixed methods review will have thoroughly addressed a complex phenomenon and be better positioned to inform policy and practice (Pearson et al., 2014; Hong, Gonzalez-Reyes, & Pluye, 2018).

2.2.2 Steps of the systematic review

The systematic review was conducted according to the following distinct steps (Aromataris & Munn, 2017):

1. Formulate a clear and precise review question
2. Define inclusion and exclusion criteria
3. Search for relevant work
4. Screen and select studies
5. Extract study data
6. Appraise the study quality
7. Analyze and synthesize the data
8. Interpret and present the results

Each step will be discussed in detail in the following sections with the exception of Step 1 which was described previously in Section 1.2.

2.2.3 Define inclusion and exclusion criteria

Establishing the criteria for the inclusion and exclusion of studies *a priori* is one requisite of a systematic review that sets it apart from a narrative review (O'Connor, Green, & Higgins, 2008).

By defining the eligibility criteria *before* the studies were identified, the possibility of bias affecting the review findings was diminished (O'Connor & Sargeant, 2015). Also important is including a criterion that defines the study designs that are eligible and ineligible for the review (Uman, 2011). As stated in the inclusion criteria below, all quantitative, qualitative, and mixed methods studies were eligible. There was also no restriction in regard to publication status or publication year (Nowell, White, Mrklas, & Norris, 2015).

The review includes outdoor spaces that are in proximity to older adults' residential settings and widely applicable to the general senior population. Private outdoor spaces can include gardens at residential homes and congregate living complexes such as retirement communities and assisted living facilities. Public outdoor areas can be greenway trails, parks, and other neighborhood outdoor spaces. The term *neighborhood open space* refers to parks within the community and the common open areas and routes that are used to get to the park (Alves et al., 2008).

2.2.3.1 Inclusion criteria

The inclusion criteria were formed from the research questions. To be included in the review, the study had to meet the following criteria:

1. Published in the English language.
2. Included older adults 60 years of age and older (CDC, 2016).
3. Reports primary (original) research.
4. May include quantitative, qualitative or mixed methods study designs.
5. Provides empirical evidence on a feature or quality that influences the preference or use of an outdoor space by older adults.

6. Outdoor spaces relate to areas that are in proximity of older adults' private or congregate residences.

2.2.3.2 Exclusion criteria

If the study focused on either of the following, the study was excluded from the review:

1. Outdoor spaces specifically designed for people with dementia
2. Outdoor spaces which are not accessible from the older adult's residential setting (e.g., spaces at hospitals, clinics)

Outdoor areas specifically designed for people with advanced dementia are outside the scope of this study. Very specific features and qualities must be considered when designing environments for older adults with dementia to support their cognitive- and perception-related abilities (Rodiek & Schwarz, 2007; Rodiek et al., 2016). While outdoor spaces for persons with dementia have been widely established, little is actually known about how and if users respond to certain elements and whether specific environmental provisions encourage use (Cohen-Mansfield & Werner, 1999; Rodiek & Schwarz, 2007).

2.2.4 Search for relevant work

The search to identify relevant research was exhaustive within the study parameters and employed multiple strategies. The systematic review's literature search sought to uncover all the relevant evidence with the intention of minimizing bias (Booth et al., 2016). In contrast, the search process in a narrative review is typically not systematic and consequently may result in

the review examining only a subgroup of studies that were found or chosen by the reviewer (Uman, 2011).

2.2.4.1 Search strategies

Electronic database searches that enable relatively easy and fast access to a wide diversity and quantity of literature have become the most common strategy to locate relevant work (Counsell, 1997). The search for qualitative, quantitative, and mixed methods research was extensive and included 12 databases germane to the topic including: Agricola, Environment Complete, PubMed, Medline, AgeLine, GreenFILE, Garden, Landscape & Horticulture Index, Urban Studies Abstracts, Avery Index to Architectural Periodicals, PsycINFO, SportDiscus, CINAHL, and SocINDEX. Additional search strategies were employed to locate further pertinent work not identified during the database search including the searching of reference lists in relevant studies and books.

2.2.4.2 Identifying search terms

Database queries typically only scan the title, abstract, and keyword content. To ensure a rigorous search and identification of all possible relevant evidence, the search terms were developed from key *concepts* (*sets*) that were found to be ubiquitous in the title, abstract, and keyword text of previously identified relevant studies. The four concepts were: 1) population, 2) setting, 3) outdoors, and 4) data collection method. Examples of the search terms developed from the concept of *population* were: *elderly*, *older adults*, and *aged*. A complete list of search terms by concept is shown in Appendix E. The search applied combinations of the various search terms from each concept using Boolean operators. All database searches were documented.

2.2.5 Screening and selection of studies

2.2.5.1 Step 1

Once the search process was concluded and feasibly relevant studies were identified, the studies were screened to determine selection for the review. All studies were screened using a two-step procedure. In Step 1, each study was initially screened by title and abstract with yes/no screening questions. The main purpose of the initial screening was to remove studies clearly not related to the topic. Duplications were also identified at this step. A study must receive a "yes" to all of the following questions to advance to Step 2 of the screening procedure.

1. Is the study in the English language?
2. Does the study include older adults as participants?
3. Is the study about outdoor environments?

2.2.5.2 Step 2

In Step 2, the study was then screened more thoroughly by full text using yes/no screening questions based on the inclusion and exclusion criteria. A study needed to receive a "no" to question 1 and a "yes" to questions 2 through 5 to be selected for inclusion in the review. A single failed criterion was sufficient for a study to be excluded from the review. All excluded studies were tagged with a label denoting the first criterion the study failed to meet and were documented.

1. Is the outdoor space specifically designed for people with advanced dementia?
2. Are the older adults age 60 years or over?

3. Does the study provide empirical evidence on an outdoor environmental characteristic that influences the preference or use of an outdoor environment by older adults?
4. Does the study report primary research?
5. Does the study relate to an outdoor setting that can be easily reached from older adults' private or congregate residences?

2.2.6 Extraction of data

This step systematically extracted (coded) key descriptive characteristics from each study included in the review onto an extraction form (Appendix A). Given that existing standard instruments are typically designed for extracting data from studies related to clinical interventions or programs, an appropriate form was developed to accommodate the diverse study designs in this review. Extracted data included bibliographic and descriptive information such as study focus, study design and methods, participant and setting characteristics, sampling strategy, and findings. The information is detailed in a tabular summary for each of three study designs included in the review (quantitative, qualitative, and mixed methods) in the Results section of this work.

2.2.7 Appraisal of study quality

Critical appraisal aims to assess the methodological quality of the studies that were selected for inclusion in the review. Since the review included qualitative, quantitative, and mixed methods primary research, a separate standard instrument was used to rigorously assess each of the three study designs. Quantitative studies were assessed using the Critical Appraisal of a Cross-Sectional Study (Survey) Checklist from the Center for Evidence Based Management (CEBMa)

(Center for Evidence Based Management, 2014). Qualitative studies were appraised using the JBI Critical Appraisal Checklist for Qualitative Research (Lockwood, Munn, & Porritt, 2015). Mixed methods studies were evaluated using the Mixed Methods Appraisal Tool (MMAT) (Hong et al., 2018). General topics assessed included the presence of a clearly focused research question(s), the appropriateness of the study methodology, data collection method, sample selection, and data analysis. Each study was critically appraised by the author and the systematic review methods expert and medical librarian with any disagreement resolved through consensus.

2.2.8 Analysis and synthesis of the data

2.2.8.1 Narrative form of synthesis

The heterogeneity of the study topics and results included in the review precluded statistical pooling of the findings; thus, synthesis of the study findings was presented in narrative form (Petticrew & Roberts, 2006). A narrative form is considered to be a pragmatic strategy for consolidating diverse data from a wide array of study methodologies (Bélanger, Rodriquez, & Groleau, 2010; Firn, Preston, & Walshe, 2016). Annear et al. (2014) contend the benefits of employing a narrative approach when tasked with evaluating, synthesizing and assimilating dissimilar evidence. The narrative approach has been applied in numerous systematic reviews to synthesize diverse findings related to older adults' quality of life and physical environment issues (Annear et al., 2014; Joseph et al., 2016; Levy-Storms, Chen, & Loukaitou-Sideris, 2018; Xu, Kane, & Shamliyan, 2013).

2.2.8.2 Synthesis of the studies

Preliminary synthesis followed a *segregated* framework where syntheses were conducted separately for each of the three types of primary study designs (quantitative, qualitative, and mixed methods). The initial syntheses consisted of abstracting descriptive study characteristics and creating a tabular evidence summary, along with a textual summary. The findings from all of the study types were integrated using a convergent qualitative synthesis to transform the findings into qualitative data based on predefined themes (Pluye & Hong, 2014) formed from the research questions. The predefined themes were: 1) environmental features and qualities, 2) activities engaged in when outdoors, 3) access to nature, and 4) potential experiences of the outdoors. The data was interpreted into a narrative summary (Section 4) and tabular matrices (Appendices B, C, and D).

2.3 Standards for reporting the systematic review

A systematic and uniform method is critical when *conducting* research but is also vital when *reporting* research (Vrabel, 2015). The JBI endorses the *Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA)* for reporting systematic reviews, and many journals specify adherence to PRISMA (Aromataris & Munn, 2017; Moher, Liberati, Tetzlaff, Altman, The PRISMA Group, 2009; Vrabel, 2015). Therefore, this review followed the PRISMA standards for reporting the systematic review and developed a flow diagram of the search and selection process (Moher et al., 2009).

3. RESULTS

3.1 Descriptive analysis

3.1.1 Identification and selection of studies

A modified flow diagram (Moher et al., 2009) shown in Figure 1 depicts the results of the search and selection process described in the Methods section.

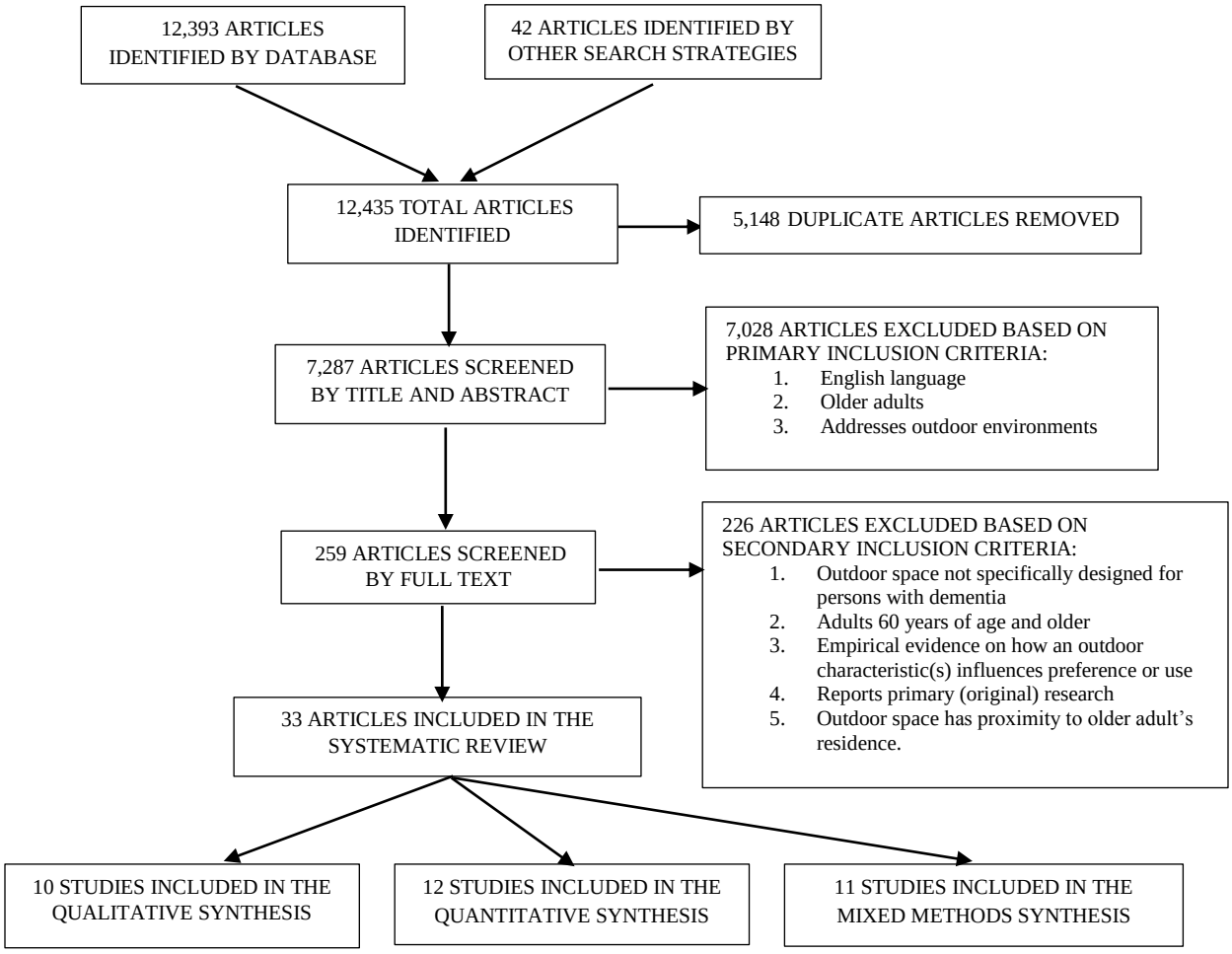

Figure 1. Flow diagram of search and selection process

The systematic literature search identified a total of 12,435 feasibly relevant articles, including 12,393 articles from all database queries and 42 articles from other search strategies. A total of 5,148 duplicates were identified and removed. A two-step screening and selection procedure, described previously in Section 2.2.5, was then applied to the results. In Step 1, 7,287 articles were initially screened by title and abstract against primary inclusion criteria resulting in the pool of potential articles being significantly reduced by 7,028 articles. Step 2 final screening of the remaining 259 articles was by full text resulting in 226 articles being excluded that did not meet the additional secondary inclusion criteria. This resulted in 33 studies being selected for the review. The 33 selected studies consisted of 10 qualitative studies, 12 quantitative studies, and 11 mixed methods studies.

3.1.2 Excluded studies

The majority of identified articles that were excluded during the initial screening were irrelevant to the topic. However, this was anticipated since the search was structured to be more sensitive than specific in order to maximize the capture of potentially relevant research. Many studies excluded during the secondary screening procedure did not address a specific characteristic that influenced older adults' outdoor use or preference and instead sought to determine a natural environment's effect on older adult health. A noticeably prevalent topic was potential health benefits in relationship to seniors' physical activity levels, mainly walking. Copious research investigated the possible impact of objective and subjective street level and neighborhood environmental correlates on senior walking and when relevant included in the review.

3.1.3 General characteristics of included studies

The review was successful in identifying 33 relevant articles published between 1997 and 2017 that met the inclusion criteria. The study designs included qualitative and quantitative descriptive research along with studies combining both components. One study focused on interior environments as well as exterior environments. Search and retrieval from within the article was performed to extricate the relevant evidence.

3.1.3.1 Study participants

While all included studies focused on older adults, variation occurred among the samples. The participants ranged from 60 to 104 years of age. Sample sizes ranged from 5 to 1,988 older adults with 54.5% having ≤ 50 participants and 30% having ≤ 20 participants. The larger sample sizes occurred in the quantitative studies using survey designs. One study focused exclusively on nursing home staff members using focus groups to explore their insights on residents' experiences and outdoor use. The sample consisted of 14 females aged 20 to 60 years with employment spans from a couple of months to approximately 20 years. The remaining study samples were mixed gender, with females being the majority.

3.1.3.2 Study settings

The included studies covered a wide range of different settings. The majority (N=18) were long-term care communities, with skilled nursing as the most prevalent. Additional settings included public parks and greenways (N=7), neighborhood opens spaces (N=4), low-income housing complexes (N=2), a retirement community (N = 1) and a study using simulated urban landscape scenes (N = 1). Geographically, the studies were a relatively heterogeneous group. Locations

included: 14 from the USA, 5 from Sweden, 5 from Britain, 3 from Canada, and 1 each from Taiwan, China, Italy, Netherlands, Norway, and Turkey.

3.1.4 Quality of included studies

In the assessment of research, a distinction is made between the terms *quality* and *risk of bias*, with the choice of term noticeably varying within research contexts (Higgins & Altman, 2008; Viswanathan et al., 2012). *Assessing the risk of bias* has been referred to as measuring the risk that the study's findings, including estimate of clinical effect, reflect bias as a result of the study design or conduct (Viswanathan et al., 2012). In other words, are the results believable? Systematic reviews also frequently use the term *assessment of methodological quality* to imply that the study was appraised for adherence to a high standard of quality during study execution (Higgins & Altman, 2008; Viswanathan et al., 2012). Given that the studies included in this review are not clinical contexts and are mostly preference-based, the author submits that assessing the risk of bias is relatively less critical when compared to studies investigating the effectiveness of clinical interventions. The review's objective was to identify and understand the evidence, as determined by the inclusion and exclusion criteria, related to the attributes that influence older adults' preference and outdoor use. Therefore, though the definition of the term *quality* varies considerably relative to study assessment (Viswanathan et al., 2012), the review focused mainly on appraising the methodological quality of the included studies.

3.1.4.1 Assessment criteria

The general assessment criteria included the appropriateness of the study methodology, data collection instrument(s), sampling strategy, measurement, and method of analysis. Quantitative

studies were also assessed for sample representativeness, the probability of measurement validity and reliability, and whether statistical significance and confidence intervals were determined. Additional qualitative study appraisal included whether the theoretical or cultural perspective and the possible researcher influence on the study and vice versa were addressed and whether the participants and their voices were adequately represented. Mixed methods studies were also assessed for the appropriateness of using different components to answer the research question(s) and if the components were effectually integrated.

3.1.4.2 Assessment scoring

Unlike some systematic reviews, this review did not exclude studies based on quality assessment. Given that the design of outdoor spaces for older adults is a relatively new and limited focus in literature and that the review also sought to illustrate comprehensively the extent to which the review topic had been explored, all evidence was considered important. A separate instrument appropriate to the study type was referenced for the appraisal. A quality score was calculated based on the criteria met by the study. A scoring system was adapted from literature. A quality criterion that was met was given a "2" score, an unclear criterion was given a "1" score, and a not reported criterion was given a "0" score (Farrance, Tsofliou, & Clark, 2016). An overall quality score was calculated as a percentage of a possible perfect score. A score of 0 - 33% was considered "poor," 34 - 66% was considered "satisfactory," and 67 - 100% was considered "good" (Titus, Young, Nassen, & Ownhouse, 2016). Study quality was assessed by two reviewers and any disagreement was resolved by discussion and consensus. The individual study scores for the qualitative, quantitative, and mixed methods studies are shown in Tables 1, 2, and 3 respectively.

3.1.4.3 Results of the assessment

Overall, the included studies had clear research question(s), used appropriate methodology, suitable data collection techniques, and reported findings substantiated by the data. The average score for the qualitative studies was 70.5%. The main limitations were: 1) the theoretical stance behind the research question was not evident, 2) the researcher's possible systematic personal and cultural bias on the study and vice versa was not addressed, and 3) ethical issues were not explicitly considered. However, when taking into account the qualitative research methodology, studies that are less than perfect in quality might still afford useful insights (Noyes, 2010). The quantitative studies scored an average of 68.6%. The main limitations included: 1) the need to address possible confounding factors, 2) the possibility of bias being introduced in the sampling, and 3) confidence intervals not being reported. The mixed methods studies scored an average of 85.3%. Inadequately integrating the different components to answer the research question(s) and scant details explaining the interpretation of the qualitative component were recurrent limitations. In summary, the quality criteria fulfillment differed across the studies; however, the overall study quality was "good" as defined by the scoring system described previously.

3.2 Synthesis of the studies

3.2.1 Synthesis of the qualitative studies

3.2.1.1 Descriptive data

The following descriptive data were extracted from the 10 qualitative studies and developed into a tabular evidence synthesis: author, aim, setting and participants, design and methods (Table 1). Three studies were conducted in the US, two in Sweden, two in Britain, two in Canada, and one

in Italy. Sample sizes ranged from 5 to 81 participants with the smaller samples in skilled nursing home settings. Participant ages across all studies ranged between 60 – 99 years old. Participant age was not given in two studies. Since both studies recruited low-income older adult individuals as participants, the studies were included. The 10 settings included 5 skilled nursing homes, 2 public parks, a low-income housing complex, a multi-care facility, and a neighborhood open space. A range of data collection methods were utilized including semi-structured interviews, focus groups, and observation. Analysis techniques mainly consisted of content analysis or thematic analysis.

Table 1 Characteristics of qualitative studies

Article	Aim	Setting and Participants (N)	Design/Methods	Study Quality*
Bengtsson & Carlsson (2005)	Understand how the outdoors is experienced and used by residents through staff insights	3 Nursing homes Staff N = 14, 20 – 60 yrs., all female Sweden	Focus groups Thematic analysis using meaning condensation	Good
Bengtsson & Carlsson (2013)	Identify what outdoor features are important and in what way as perceived by residents and next of kin	3 nursing homes Residents N = 12, 74 – 96 yrs. (avg. = 86 yrs.) Next of kin: N = 7, 50 – 83 yrs. Sweden	Phenomenology Interviews This study parallels and complements their 2005 study.	Good
Burton & Sheehan (2010)	Identify the relative importance of interior and exterior design features that are perceived to affect well-being and quality of life	20 care homes (nursing/residential) Residents N = 81, (avg. = 85 yrs.) 59 female and 22 male. UK	Interviews using photo comparisons (as prompts for discussion)	Good
Cranz & Young (2005)	Follow-up of a previous study. Explore the reasons why the outdoors is still underutilized and propose design recommendations	Low income housing complex for older adults and the physically disabled. Residents N = 5, no ages given, Staff: N = 4 CA, USA	Observations Interviews with staff and residents	Satisfactory
Heath & Gifford (2001)	To determine if the pre-construction design goals were perceived as being met relative to functionality and aesthetics	Multi-level care facility Residents N = 17, (avg. = 77.3 yrs.), 41.2% males. Staff N = 80, family N = 57, volunteers N = 36 Victoria, British Columbia, Canada	POE Interview Survey with Likert-type scale	Satisfactory

Table 1. Continued

Article	Aim	Setting/Participants (N)	Design/Methods	Study Quality*
Jacobs & Dahl (2004)	Explore and identify the needs of older adults relative to their leisure activities in public park settings	10 regional public parks Older park visitors N = 10, 65 – 75 yrs. Park personnel N = 4 Setting only described as Midwestern	Grounded Theory methodology. Semi-structured interviews with park visitors and park personnel. Theoretical saturation	Good
Loukaitou-Sideris et al. (2016)	Identify the positives and negatives related to low income senior use of neighborhood inner city parks to inform park planners	Inner city neighborhood parks Seniors: N = 39, no ages given Los Angeles, CA, USA	Focus groups	Good
Ottoni et al. (2016)	Explore how neighborhood benches affect older adults' perception of well-being and mobility, therefore, their social environment	Neighborhood open spaces N = 50, 61 – 89 yrs. Vancouver, Canada	Semi-structured interviews (Interviewed 28 participants in 2012 and interviewed 22 of the same in 2016)	Good
Raske (2010)	Explore the relationship between the design and use of an enabling garden and nursing home residents' quality of life	Rural nursing home Residents N = 16, 65 – 99 yrs. (avg. = 81.4 yrs.), males = 6, and females = 10 Family members N = 6, Staff N = 15, Small Midwestern town, USA	Interviews with residents, family members, staff, and garden club volunteers. Open ended questions Content analysis	Good
Senes et al. (2012)	To include resident participation in a garden design to better understand what encourages their use	Nursing home Residents N = 11, 75 – 85 yrs., 7 female and 4 male Staff N = 20 Milano, Italy	Participatory design Separate focus groups with staff and residents Content analysis	Good

*A quality score was calculated based on how well the study met the criteria described in Section 3.1.4.2

3.2.1.2 Overview of qualitative studies in long-term care settings

Two studies aimed to identify factors related to nursing home residents' positive outdoor experiences, one with staff members as participants and the other with residents and family members. Identified themes encompassed safety, security, and privacy concerns (Bengtsson & Carlsson, 2005; Bengtsson & Carlsson, 2013). A large study with 81 participants sought to characterize both the indoor and outdoor design factors that residents at 20 care homes perceived as most affecting their well-being. Analysis of resident comments identified "views out to greenery*"* as the most frequently mentioned design element related to their perceived contentment (Burton & Sheehan, 2010, p. 250).

Another study explored how an enabling garden design impacted residents' use and perceived life happiness at a rural nursing home (Raske, 2010). Garden design and construction was a collaborative effort between the local community garden club and the nursing home with the residents involved in all phases. The residents perceived that gardening along with the concomitant social contact with other residents and project members positively influenced their self-contentment and made them feel connected to the outside community. Another study involved a collaborative effort between staff and residents to design a garden at a skilled nursing home. The participatory study design used separate focus groups to better understand which garden attributes influenced garden use. Findings identified opportunities for physical therapy and socializing along with water elements and walking paths to be the most attractive elements (Senes et al., 2012).

3.2.1.3 Overview of qualitative studies in multi-residential settings

A study using post occupancy evaluation methodology sought to determine if 8 therapeutic courtyard gardens at a large 225-bed multi-care facility were meeting the pre-construction design goals focused on motivating use while being safe for the residents (Heath & Gifford, 2001). The majority of residents responded that the existing mobility-aid accessible walking paths, seating, raised garden beds, and handrails met their safety needs and motivated them to use the garden. However, a much smaller percentage felt that the existing trees for shade and evening lighting were adequate. Interestingly, even though each garden had its own design theme and goal, the gardens were not evaluated separately. Following up on a previous post occupancy evaluation that found the courtyard garden at a low-income senior and disabled housing project to be appreciated but seldom used by the residents, a study by Cranz and Young (2005) found that the garden was still valued but remained underutilized. The study proposed possible reasons for this discrepancy and recommended design changes such as adding more shaded and private areas.

3.2.1.4 Overview of qualitative studies in neighborhood open spaces

Two studies sought to better understand older adults' perception of park design relative to their needs and preferences. The first study compared the older park visitors' reported needs to those perceived by the park administration with the goal to inform park planning and policy. Using grounded theory methodology and 10 regional park settings, the study findings supported adding abundant seating, flora/fauna identification signage, and trail-side educational programs, though inconsistency was found between the two cohorts' reports suggesting further research (Jacobs & Dahl, 2004). A more recent study asked low-income inner-city seniors what they liked and disliked about using the neighborhood parks. Typically these users are in small residences

without private yards or other outdoor space and need the park to serve as a pleasant place for socializing, exercising, and to simply enjoy nature (Loukaitou-Sideris et al., 2016). Responses clearly indicated that current park design and programming were not addressing all of their special needs and desires (Loukaitou-Sideris et al., 2016). Safety issues, such as cracked sidewalks and busy streets, together with personal security issues within and en route to the park were significant concerns. Responses also included the request for "seniors-only" parks (Loukaitou-Sideris et al., 2016, p. 236). In another study, Ottoni et al. (2016) asked seniors how they utilized the benches placed within their neighborhood. Participants responded that the benches were incorporated into their daily walking routes allowing them to better maintain their mobility, meet new people, and enjoy just being outside.

3.2.2 Synthesis of the quantitative studies

3.2.2.1 Descriptive data

The following descriptive data were extracted from the 12 quantitative studies and developed into a tabular evidence synthesis: author, aim, setting and participants, design and methods (Table 2). Four studies were conducted in the US, three in Britain, two in Sweden, and one each in the Netherlands, Norway, and Turkey. Studies utilized descriptive survey and cross-sectional designs. Sample sizes ranged from 23 to 1,501 participants with 3 studies having samples over 1,000 participants. Participant ages across all studies ranged between 33 – 104 years old. The low figure of 33 years was in a sample of residents from 68 assisted living facilities with a mean age of 83.9 years. Therefore, a decision was made to include the study in the review. In another study, participant age was not given. Since the study setting was a nursing home, the study was included. The settings included 4 neighborhood open spaces, 3 assisted living communities, 3

skilled nursing homes, a retirement community campus, and a public park. All studies used a questionnaire for data collection and employed a form of statistical analysis.

Table 2. Characteristics of quantitative studies

Article	Aim	Setting/Participants (N)	Design/Methods	Study Quality*
Alves et al. (2008)	Explore the relative importance of outdoor attributes that influence older adults' preferences for neighborhood open spaces	Neighborhood open spaces N = 237, 60 – 97 yrs., (avg. = 74.71 yrs.) 90% lived at home and 10% in sheltered care Britain	Survey design Questionnaire Choice-based conjoint analysis Statistical analysis	Good
Aspinall, Ward Thompson, Sugiyama, Brice, & Vickers (2010)	Explore the relative importance of specific outdoor attributes in local open space frequented by older adults	Neighborhood open spaces Participants N = 237, 60 – 97 yrs. Britain	Survey design Questionnaire Choice based conjoint analysis Sensitivity analysis Statistical analysis	Satisfactory
Bengtsson et al. (2015)	Assess outdoor environments at nursing homes to identify perceived preferred features/qualities	3 nursing homes in urban settings Older pensioners served as proxies N = 23, (avg. = 72 yrs.), 20 female, 6 male Staff N = 23 Southern Sweden	Cross case analysis design Semantic environmental description (SMB) questionnaire using scale Statistical analysis	Satisfactory
Dahlkvist, Nilsson, Skovdahl, & Grahn (2014)	Explore resident and staff perceptions of gardens/patios in residential homes for older adults	87 residential living homes Residents: N = 415, (avg. = 85.2 yrs.), 286 females, 129 males, Staff N = 667 Northern Sweden	Cross-sectional descriptive design Mailed questionnaire with 5-point scale Statistical analysis	Satisfactory
Joseph & Zimring (2007)	Explore how the characteristics of indoor and outdoor path segments may be related to where older adults choose to walk for leisure and for walking to destinations	3 retirement community campuses (CCRCs) N = 114, 72 – 81 yrs. 47 male, 67 female Atlanta, GA, USA	Survey design Questionnaires Statistical analysis	Satisfactory
Kemperman & Timmermans (2014)	Explore the relationship between social interaction and the various attributes of greenspaces in the immediate environment of older adults	Neighborhood green spaces N = 1,501, 60 – 95 yrs., 40.9% male, 59.1% female. Netherlands	Survey design Data obtained from a national representative sample of people 60 yrs. and older surveyed by the Dutch ministry Bayesian statistics	Satisfactory

Table 2. Continued

Article	Aim	Setting/Participants (N)	Design/Methods	Study Quality*
Nordh, Alalouch, & Hartig (2011)	Explore the relative importance of specific environmental attributes of small urban parks that influence choice when looking for restoration	Small urban parks N = 21, 60 + yrs. (Total participants all age groups: N = 254) Oslo, Norway	Survey design Web-based questionnaire (text only) Choice-based conjoint analysis Statistical analysis	Good
Oguz, Cakci, Sevimli, & Ozgur (2010)	Identify the outdoor activities and features preferred by residents of nursing homes in Ankara, Turkey	3 nursing homes N = 138, Ages not given 55% male and 45% female. Ankara, Turkey	Survey design Questionnaire Statistical analysis	Good
Rodiek & Fried (2005)	To further understand how the physical outdoor environment supports usage by determining specific preferences	14 assisted living facilities N = 133, 63 – 99 yrs. (avg. = 83.97 yrs.), 77% female. South central TX, USA	Survey design Questionnaire using photo comparison Ratio scales Statistical analysis	Good
Rodiek et al. (2013)	Investigate the potential financial benefits of improved outdoor spaces that affect a high level of satisfaction, thus usage, resulting in increased referrals	68 assisted living facilities Residents N = 1,140, 42 – 104 yrs. (avg. = 84.1 yrs.), 77.9% female. Staff N = 432 Houston, TX; Chicago, IL; and Seattle, WA, USA	Survey design Data were used from a previous study	Good
Rodiek & Lee (2009)	Explore how the design can promote or discourage outdoor use by residents at assisted living facilities	68 assisted living facilities Residents N = 906, 33 – 104 yrs. (avg. = 83.9 yrs.), 79% female. Staff N=432 Houston, TX; Chicago, IL; and Seattle, WA, USA	Survey design Data were used from a previous study. Highly preferred features were extrapolated to increased usage.	Good
Sugiyama, Ward Thompson, & Alves (2009)	Explore neighborhood open space attributes that are related to older adult contentment and outdoor activities	Neighborhood open spaces N = 271, age 65 and older (avg. = 75 yrs.), 60% female Britain	Survey design Mailed questionnaire with Likert-type scale	Satisfactory

*A quality score was calculated based on how well the study met the criteria described in Section 3.1.4.2

3.2.2.2 Overview of quantitative studies in neighborhood open spaces

Alves et al. (2008) explored older adults' relative preference of 13 neighborhood open space characteristics identified in previous research. Highly preferred elements included abundant greenery and wildlife. Negative influences were dog fouling and indication of vandalism. Aspinall, Ward Thompson, Sugiyama, Brice, and Vickers (2010) also explored older people and

their perceived comparative value of various neighborhood open space attributes as a further development of an earlier study (Alves et al., 2008). Results indicated that a well-maintained space with abundant trees and other vegetation, accessible restrooms, and interesting activities to watch attracted older adults to local parks. Sugiyama, Ward Thompson, and Alves (2009) found a relationship between pleasant, safe, and walkable neighborhood open spaces and older adults' life contentment. Kemperman and Timmermans (2014) concluded from survey data that safe and easily accessible green spaces positively affected social contact levels between older people within a neighborhood. The study findings also suggested a direct relationship between higher levels of perceived green vegetation and increased social interaction. Nordh, Alalouch, and Hartig (2011) found that grass, water, and flowers were very influential when seniors were deciding on an outdoor venue for health renewal. Interestingly, the results also suggested a positive association between older age and the greater the importance of flowers in making that decision.

3.2.2.3 Overview of quantitative studies in long-term care settings

Three of the more robust studies in terms of sample size, research design, and analysis explored how specific outdoor design features at assisted living communities affected resident use and preference levels (Rodiek & Fried, 2005; Rodiek et al., 2013; Rodiek & Lee, 2009). Preferred attributes identified were abundant vegetation and seating, wildlife, and pleasant views to the surrounding area. Accessibility concerns included seating, doorways, and walkways. Findings also emphasized the importance of site-specific design considerations (Rodiek et al., 2013). Bengtsson et al. (2015) used a semantic environmental descriptor instrument to assess and compare an envisioned perfectly designed outdoor garden with the existing gardens at three

nursing homes. Being that the residents were too frail to participate, older adult pensioners were selected as proxies. The assessment concluded that a close-to-perfect space would exude a larger park-like ambiance with abundant vegetation. In another study, nursing home residents responded that they enjoyed going outside to walk and socialize; however, lack of shade or inadequate seating negatively influenced these activities (Oguz et al., 2010). Dahlkvist et al. (2014) assessed the existing gardens/patios at 87 residential skilled nursing/dementia care communities and explored resident and staff perceptions on garden use. Existing positive attributes included water elements, lawns, and colorful plantings. Suggested design additions included stable seating in sun, shade and near walkways, and accessible restrooms.

3.2.2.4 Overview of quantitative studies in multi-residential settings

Joseph and Zimring (2007) investigated the relationship between indoor and outdoor path characteristics and where older adults chose to walk at 3 retirement community campuses. Preferred pathways were comprised of path segments of various lengths connected in a network, afforded appealing destinations, and had attractive views.

3.2.3 Synthesis of the mixed methods studies

3.2.3.1 Descriptive data

The following descriptive data were extracted from the 11 mixed methods studies and developed into a tabular evidence synthesis: author, aim, setting and participants, design and methods (Table 3). Six studies were conducted in the US, and one each in Canada, Sweden, Britain, China, and Taiwan. Sample sizes ranged from 20 to 1,988 participants. Participant ages across all studies ranged between 44 - 101 years old. The 44 years was the low end of the age range for a

sample of long-term care residents across three facilities. However, since the average age in the sample was 83 years, a decision was made to include the study in the review. In one study, participant age was not given. Since the study setting was a nursing home, the study was included. The settings included 3 residential housing facilities with multiple levels of care, 3 assisted living communities, a neighborhood park, a greenway trail, a skilled nursing home, a community green space, and a study using simulated views of urban landscapes. Data collection methods included assessment instruments, interviews, observation, focus groups, and questionnaires with Likert-type scales. Analysis techniques included statistical, content, and thematic analysis.

Table 3. Characteristics of mixed methods studies

Article	Aim	Setting/Participants (N)	Design/Methods	Study Quality*
Cutler & Kane (2005)	Assess the available outdoor amenities at nursing homes and residents' perceptions of these spaces	40 nursing homes comprised of 131 nursing units. N = 1,988 No ages given California, Florida, Minnesota, New Jersey, and New York, USA	Used data from another study. Interviews Assessment of physical environment checklist with scale Descriptive statistics	Good
Dorwart (2015)	Explore older adults' preferences in greenway trail design that affords physical activity.	Greenway trail - paved surface that connects a commercial shopping center to a community park. N = 30, 65 – 82 yrs. N. Carolina, USA	Observations Unstructured interviews Questionnaire using photo elicitation with Likert-type scale Content analysis, statistical analysis	Good
Gibb (2001)	Exploratory research of seniors' landscape preferences relative to the concepts of naturalness and enclosure.	Scenes of urban landscapes N = 34, 65 – 84 yrs. 38% male, 62% female. Guelph, Canada	Interviews Sorting of photographs Content and context analyses	Good
Kearney & Winterbottom (2006)	Assess the importance, use, barriers, and benefits of outdoor spaces at long-term care facilities.	3 urban long-term care facilities N = 40, 44 – 101 yrs., (avg. = 83 yrs.) 79.5% female Seattle, WA, USA	Structured interviews and scaled assessment Content analysis Statistical analysis	Good

Table 3. Continued

Article	Aim	Setting/Participants (N)	Design/Methods	Study Quality*
Ottosson & Grahn (2005)	Determine the effect of outdoor use on physiological outcomes. Also determine residents' preferred outdoor environmental attributes	Geriatric homes N = 15, 67 – 97 yrs., (avg. = 86 yrs.), 13 female, 2 male. Mårtenslund in Lund, Sweden	Interview Questionnaire with Likert-type scale. Statistical analysis	Good
Pleson et al. (2014)	To learn how older adults perceive and use community green spaces in Taipei, Taiwan	7 community green spaces N= 19, 60+ yrs. 58.9% female Observations N = 755, 60+ yrs. Taipei, Taiwan	Structured interviews Thematic analysis Descriptive statistics Statistical analysis	Good
Rodiek (2006a)	To identify the relative importance of physical environmental features that either positively or negatively influence outdoor use	14 assisted living facilities N = 108, 61 - 97 yrs. Southeast TX, USA	Focus groups Written survey questionnaire with Likert-type scale Content analysis Descriptive statistics	Good
Rodiek et al. (2014)	Examine the perceived problems with doorways and the associated effect on resident outdoor use	68 assisted living facilities N = 906 (avg. = 84 yrs.), 77.9% female Houston, TX, Chicago, IL, Seattle, WA; south-central TX, USA	Used data from 2 previous studies. Environmental audit tool Questionnaire with Likert-type scale Content analysis Statistical analysis	Good
Stoneham & Jones (1997)	Explore sheltered home residents' perceptions on the value and use of outdoor space and in what way this differs from their previous life.	Sheltered residential housing N = 106, 60 – 94 yrs.; 84 females, 22 males Britain	Semi-structured interviews Questionnaires Statistical analysis	Good
Wang & Glicksman (2013)	Investigate low-income seniors' perceptions of the benefits of participating in a community garden activity.	3 low-income senior housing buildings N = 20 (avg. = 71.5 yrs.), 70.5% female Philadelphia, PA, USA	Focus groups Survey Thematic analysis	Satisfactory
Zhai & Baran (2017)	Explore pathway design characteristics that encourage older adults to walk in public parks	2 neighborhood parks N = 46, (avg. = 77 yrs.) Beijing City, China	Observations Interviews Descriptive statistics Correlation analysis	Good

*A quality score was calculated based on how well the study met the criteria described in Section 3.1.4.2

3.2.3.2 Overview of mixed methods studies in multi-residential settings

Sheltered housing for older adults is focused on providing an environment that supports the needs of the residents while fostering independence (Stoneham & Jones, 1997). When residents were asked to characterize how the landscaping was valued and used, the concept of helping create a more home-like image was most mentioned (Stoneham & Jones, 1997). Sitting outside in good weather was given as a frequent activity along with a place for solitude or a place for socializing. The findings also revealed a clear relationship between relocating to an institutional residential setting and a significant decline in the diversity and duration of outdoor activities the residents actively engaged in compared to their previous life. The relationship between spending time in a garden and the ability to concentrate and reduce stress was studied in geriatric residences by Ottosson and Grahn (2005). However, the study also questioned residents on what their preferred outdoor environment would afford. Responses were numerous and included the enjoyment of fresh air, sunlight, and the sight, smell, and sounds of nature. When seniors at a low-income housing complex were asked why they participated in community gardening, the overwhelming response was the fresh vegetables. However, the psychological rewards of gardening were equally as important by creating something to look forward to and a sense of responsibility (Wang & Glicksman, 2013).

3.2.3.3 Overview of mixed methods studies in long-term care settings

A large study by Cutler and Kane (2005) assessed the existing outdoor environmental amenities at 40 nursing homes totaling 131 units located in 5 states. A sitting area outside the front entrance where the residents could watch all the surrounding activity and interact with others coming and going was a favorite place when provided by the facility. Other identified attributes

that were successful in providing residents with access to nature included views to colorful landscapes and simple things like potted flowers on windowsills. The study also reported that nearly 50% of the 1,988 residents sampled were never asked to participate in the outdoor programming. Interestingly, the study also identified a relationship between a higher resident capacity and number of floors and less outdoor space committed for resident use.

In a study by Kearney and Winterbottom (2006), residents of three urban long-term care facilities were asked which environmental features influenced them to go outdoors. Having an outdoor space with abundant and varied vegetation was strongly preferred. Having window views of greenery, birds, and other people were also considered important across sites. Another similar study by Rodiek (2006a) queried the residents at 14 assisted living facilities regarding features that influenced their outdoor use and reported positive influences of walking paths, shade and sitting areas, greenery, and attractive views. Negative influences included poor maintenance, accessibility, and safety issues. Rodiek et al. (2014) investigated residents' perception of exterior doorway designs at 68 assisted living facilities. The perceived ease of getting outdoors along with the levels of walking and use were found to be negatively influenced by specific doorway characteristics. Identified issues included self-locking doors, doors that closed too quickly or required excessive force to open, and thresholds and landings that were difficult to traverse.

3.2.3.4 Overview of mixed methods studies in neighborhood open spaces

Zhai and Baran (2017) queried older adults regarding pathway design characteristics that encouraged them to walk in public parks. Positive responses given were comfortable walkways,

a visual connection to water, and plenty of seating and flowers. Attributes that influenced the use of community green spaces (public parks) by older people in Taiwan were close proximity to their residence, organized activities such as dancing classes, and walking paths (Pleson et al., 2014). In another study, Dorwart (2015) asked older people concerning preferences for specific design elements relative to their use of community greenway trails for physical activity. The participants identified curving paths with a variety of routes, frequent places to sit, nearby water elements, and paved surfaces as highly preferred characteristics. Gibb (2001) explored whether seniors' preferred a natural compared to a built landscape and whether they preferred a sense of openness compared to a sense of enclosure using photographs of urban landscape scenes. Findings indicated that the senior participants preferred a mix of natural and built elements, along with a sense of enclosure. Preference for lush and diverse vegetation, vertical enclosures that provided filtered light, and elements that offered overhead sheltering exemplified these preferences.

3.2.4 Convergent qualitative synthesis

A final synthesis integrated the findings from the qualitative, quantitative, and mixed methods studies using a convergent qualitative synthesis method to transform the findings into qualitative data based on predefined themes (Pluye & Hong, 2014) formed from the research questions. The predefined themes were: 1) environmental features and qualities, 2) activities engaged in when outdoors, 3) access to nature, and 4) potential experiences of the outdoors. The data were interpreted into a narrative summary presented in the following section and into tabular matrices (Appendices B, C, and D).

4. INTERPRETATION OF THE FINDINGS

Interpretation of the findings is structured into a narrative summary according to the four predefined themes. The older population is characterized by a wide range of physical and cognitive abilities and many diverse outdoor spaces are available to them. While this review provides knowledge on the preferred features and qualities expressed by seniors, the outdoor design needs to address the context and the users' level of needs.

4.1 Environmental features and qualities

4.1.1 Accessibility

The outdoor garden space has been referred to as an extension of the indoor living space (Pearson, Hopper, & Simon, 2005). With that in mind, locating the outdoor space where it is easy to get to and can be easily seen makes sense. Literature refers to an "indoor/outdoor connection" (Rodiek, 2008, p. 5). Spatial location was reported in numerous study findings as a significant factor relevant to outdoor use. As an example, a solarium with skylights and expansive windows with direct access to an attractive outdoor patio went unused because the residents felt it was too far from their rooms (Cutler & Kane, 2005). Older adults typically spend the majority of their time indoors (Rodiek & Fried, 2005). If the space is situated in close proximity to where people spend considerable time and can be seen from many windows, then people will most likely use the garden (Kearney & Winterbottom, 2005; Rodiek & Lee, 2009; Bengtsson & Carlsson, 2013). Locating exterior doors that are convenient and easily visible from these high use interior areas can also encourage use. An assisted living resident commented "Outside doors are not close to my room" (Rodiek, 2006a, p. 101). One study suggested providing multiple outdoor opportunities (e.g., garden, balcony, walking area), rather than just

one so accessing an outdoor space is easier and not perceived as too far and strenuous (Kearney & Winterbottom, 2006). Locked doors can also prevent outdoors spaces from being used (Cutler & Kane, 2005**).** Weather conditions can also limit accessibility when outdoor spaces are not appropriately designed with adequate protections (Kearney & Winterbottom, 2006).

4.1.1.1 Visual and auditory accessibility

Visual and auditory contact with the building and staff while outdoors was important for older adults. Nursing home staff reported that the residents felt secure on the patio if the building windows were open and they could hear sounds coming from inside (Bengtsson & Carlsson, 2005). On the other hand, another study found that the patio's close proximity to the windows made the residents feel they were "invading the privacy of others" and the space went unused (Cutler & Kane, 2005, p. 43). Older adults' ability to find their way once in the outdoor space can be hindered by age-related cognitive factors. In one study, decorative elements placed strategically in the garden facilitated orientation. Design guidelines have also suggested using signage to assist with navigation to the garden (Cooper Marcus & Barnes, 1999b).

4.1.1.2 Accessibility to neighborhood open spaces

Accessibility was also a concern for older adults wanting to use local parks and other open spaces in their neighborhood. With many older adults being physically challenged or requiring a mobility aid, the distance to a park alone can present a major obstacle. Loukaitou-Sideris et al. (2016) reported a direct relationship between the accessibility of neighborhood open spaces and the probably that the space will be used by seniors to walk. Seniors expressed a need for accessible practical facilities that provide comfort while outdoors in public places such as

restrooms, water stations, and enclosed shelters (Loukaitou-Sideris et al., 2016; Alves et al., 2008; Rodiek, 2006a; Sugiyama et al., 2009).

4.1.2 Safety and privacy

4.1.2.1 Doorways and seating

Accessible doorways were repeatedly reported by older adults as important factors in determining whether to go outdoors. Doorways designed with low thresholds, easy to traverse paved landings, and doors that open easily and close slower can assist in making the outdoors more accessible especially for those using mobility aids (Rodiek et al., 2014; Rodiek et al., 2013). Results from a survey sent to 53 subject matter experts on designing for the aged clearly indicated that "doors open with little effort" was a significant determinant of outdoor use in long-term care settings (Rodiek et al., 2013, p. 227). Seniors also requested automatic doors that are easy to activate and doorways without steps (Bengtsson & Carlsson, 2013; Raske, 2010). Well-designed transition zones with comfortable seating both inside and outside the exterior doorway will assist seniors to acclimate to the change in environments (Cranz & Young, 2005; Rodiek & Lee, 2009). Providing windows in the interior zone to preview the outdoors even from a wheelchair will also help facilitate acclimation (Rodiek et al., 2016). Stable and secure seating with a variety of options including moveable and static seating in both sun and shade oriented to maximize different attractive views was very important to seniors (Rodiek & Lee, 2009; Rodiek & Fried, 2005; Rodiek, 2006a).

4.1.2.2 Comfort in public places

Older adults also expressed additional safety concerns relative to their use of public parks and other neighborhood open spaces. Heavy traffic en route, sidewalks in poor condition, inadequate nighttime lighting, and indications of vandalism, all negatively influenced use. Personal safety was reflected in concerns about possible criminal activity (Sugiyama et al., 2009). Pathways that were heavy with vegetation reduced visibility to the surrounding area and made older adults feel less safe. Abundant trees in parks and other open spaces significantly influenced high use, not just because of their aesthetic value, but also for their utility in providing shade.

4.1.2.3 Familiarity

Outdoor environments that are easily recognizable can contribute to a sense of security (Bengtsson & Carlsson, 2005). Creating and maintaining a familiar atmosphere is an important consideration when designing environments for older adults especially those who are highly cognitively impaired (Bengtsson & Carlsson, 2005). One study maintained that being able to see the outdoor space from inside can help residents become familiar with their environment (Bengtsson & Carlsson, 2013). Complicated outdoor spaces, such as gardens consisting of multiple garden rooms with no visual connection, can result in disorientation (Bengtsson & Carlsson, 2013). In contrast, another study found that separate areas within the common open space was expressed as a desired feature for individuals requiring privacy (Burton & Sheehan, 2010).

4.1.2.4 Privacy

Older adults' need for more privacy was also evident in the findings (Burton & Sheehan, 2010; Cutler & Kane, 2005). Providing forms of enclosure characterized by a degree of openness while still maintaining a sense of privacy helped them feel more comfortable outdoors. Enclosure provided protection from unwanted viewing or intrusions while still allowing visual contact with the surrounding area. Enclosure can be achieved in various ways other than the common fencing. Examples identified in the studies were supportive vertical elements such as a vine on a trellis that filters the sunlight or a short wall which still maintains the view beyond the space (Bengtsson et al., 2015). Subdividing the larger common open space into smaller semi-private niches enabled the vulnerable residents to feel more comfortable outdoors because they can go to "their spot" (Cranz & Young, 2005, p. 86). However, findings from another study found that spaces perceived to be confining were considered a barrier to use.

4.2 Activities engaged in when outdoors

This study found that older adults engaged in a wide range of outdoor activities, both passive and active, in both private and public settings. Consequently, outdoor design should accommodate this mix and reflect age-appropriate features to ensure enjoyment along with safety. An environment that provides meaningful activities was clearly important.

4.2.1 Walking

Across the studies, walking was the most mentioned physical activity that attracted older adults to the outdoors. This finding was anticipated given that literature has reported walking as a very popular physical activity among older people (Marsh et al., 2015). However, literature has also

shown that older adults' walking habits are related to the environmental attributes of where they choose to walk (Feskanich, Willett, & Colditz, 2002; Joseph & Zimring, 2007). Abundant and comfortable seating at frequent intervals along walking paths encouraged older adults to walk especially the more physically challenged. Seniors preferred paved walkways that were easily accessible, sufficiently wide for mobility aids and were also well-maintained with level, smooth, non-glare, and non-skid surfaces (Bengtsson & Carlsson, 2013; Burton & Sheehan, 2010; Rodiek, 2006a). In one study the cars parked adjacent to the sidewalk posed an obstacle due to overhanging bumpers (Rodiek, 2006a). Physical safety elements, such as handrails along paths, were also reported as helping encourage older adults to walk (Bengtsson & Carlsson, 2005).

Walking paths preferred by older adults in public places, such as greenway trails and parks, afforded comfortable shaded seating at frequent intervals (Jacobs & Dahl, 2004). Seniors preferred walking paths characterized by multiple route options, were curved and had path segments that gave the illusion of disappearing from sight adding more intrigue and interest to the walking experience. Older adults indicated both hard and soft path surfaces were favored for walking. Paths comprised of varied length segments networked together that provided interesting destinations, attractive views, and were near water were also preferred characteristics (Dorwart, 2015; Joseph & Zimring, 2007).

4.2.2 Structured and unstructured activities

Older adults engaged in both structured and unstructured activities. Some seniors engaged in exercising, but few details were provided. This is congruent with literature asserting that very little knowledge exists about the role structured or unstructured exercising plays in the daily

physical activities of older adults (Tudor-Locke, Jones, Myers, Paterson, & Ecclestone, 2002). Not surprisingly, gardening was mentioned frequently as a favorite activity (Wang & Glicksman, 2013). Gardening is an activity that can be done alone or in a group; however, gardening with others can encourage socializing (Swann, 2010). In one study, community vegetable gardening offered the additional benefit of feeling connected to the local community (Wang & Glicksman, 2013). Provisions for an available watering system, special gardening tools, mobility aid-accessible raised beds, and a shaded pergola made gardening more accessible to older adults (Raske, 2010). Other structured activities enjoyed by older people were group activities including dance and exercise classes, barbecues, board games, lawn bowling, and badminton (Pleson et al., 2014). Unstructured favorite activities included having picnics, cycling, and even sunbathing. Places to sit, relax, read, or just watch children play were also highly desired (Ottosson & Grahn, 2005; Sugiyama et al., 2009).

4.2.3 Socializing

Socializing was a further compelling reason for older adults to go outdoors and was mentioned in multiple studies. The social aspect of being outdoors enabled new social networks to be formed within the immediate outdoor space and with others in the near neighborhood. Separate areas were requested for socializing with family, friends, other residents and staff (Stoneham & Jones, 1997). Interestingly, one study found that nursing home residents who had single rooms spent more time outdoors than other residents as a venue for social interaction (Oguz et al., 2010). This exemplifies the need for older people to reestablish social connections after moving into care communities. Easy access to green neighborhood open spaces was found to facilitate higher levels of social contact among older adults in the local area (Kemperman & Timmermans, 2014).

4.3 Access to nature

4.3.1 Abundant nature

Older adults enjoyed experiencing nature in a variety of settings – patio gardens at congregate care communities, courtyard gardens at low-income senior housing, greenway trails, public parks, and other neighborhood open spaces. However, the findings across studies were strikingly consistent and made a clear case for including abundant natural elements in outdoor settings. Preference indicators that consistently emerged were lush vegetation including trees, shrubs, colorful flowers, and vines. Another highly favored feature was water in the form of ponds, lakes, and fountains. Interestingly, research has shown that as older adults' age, the access to flowers and water becomes more important to them (Nordh et al., 2011). Abundant wildlife such as birds, butterflies, and rabbits also brought great enjoyment. Private and quiet places with comfortable seating oriented to attractive views were conducive for enjoying the nature experience. Expanses dominated by soft vegetation with less hard surface materials were also favored (Burton & Sheehan, 2010; Oguz et al., 2010). One study referred to watching the seasonal change occurring in the outdoors as allowing the nursing home residents to follow "the rhythm of life in nature" (Bengtsson & Carlson, 2005, p. 60).

4.3.2 Sensory experiences of nature

Older adults' preference for natural elements transcended the element's actual physical presence. Clearly identified were the many sensory stimulations that nature afforded providing positive distraction. Older adults wanted to see, hear, smell, and feel nature. Colorful plants offered sensory stimulation through visual variety (Kearney & Winterbottom, 2000). In one study, a

resident responded: “I love to touch and talk to the plants” (Raske, 2010, p. 344). Older adults wanted to taste nature articulately expressed in a nursing home resident’s statement: “The fresh tomatoes taste so good” (Raske, 2010, p. 344). They wanted to see nature in motion, for example, fish swimming in a pond and birds coming and going to feeders (Raske, 2010). One resident stated that “Going out helped him focus on something else” (Bengtsson & Carlsson, 2013, p. 397). These excerpts suggest that older adults’ outdoor experiences are characterized not only by the physical environmental attributes encountered but also by a highly emotional dimension. This pattern of preferences can be attributed to the theories discussed earlier in this paper which posit that humans inherently want to be in nature, have preferences for specific nature elements, and that nature can possibly make them feel better.

4.4 Potential experiences of the outdoors

4.4.1 Connection to surrounding life

Older people are still very interested in connecting with the world beyond their typically limited living environments. A seating area at the front entrance to the building where long-term care residents could gather and greet visitors while also watching vehicles and deliveries coming and going was reported as a favorite outdoor pastime in numerous studies (Bengtsson & Carlsson, 2005; Cutler & Kane, 2005; Rodiek, 2009). In an effort to get the residents outdoors more, a joint community garden program was set up with the local garden association and a youth organization (Cutler & Kane, 2005). Not only were the residents now able to garden, but they also got the benefit of lots of fresh air, met new people, and felt part of the local community. In another study, the facility provided golf carts for the staff to take the residents to see the gardens of nearby residences. The golf cart rides also enabled residents to enjoy the fresh air and meet

people in the outside community (Cutler & Kane, 2005). A joint project to create an enabling garden resulted in a positive connection between nursing home residents and people in the local community exemplified in a staff member's quote: "The garden has definitely been a bond between the nursing home and the community. I mean it has really, really brought people together" (Raske, 2010, p. 343). Another study found that neighborhood "benches become like porches," allowing mobility-limited seniors to get outdoors and socialize with other people outside their immediate living environment (Ottoni et al., 2016, p. 33) The enjoyment received from being outdoors and watching the surrounding activity is exemplified in a nursing home resident's quote: "Somehow it's the impression of life, I think" (Bengtsson & Carlsson, 2013, p. 396).

Window views to outdoor life were also very important especially for the many older adults with mobility or cognitive limitations that prevented them from going outside unattended. With the staff in residential care communities being busier than ever, this can occur quite frequently. Views of green landscapes and activities occurring in nearby areas were recurrent favored features described as taking advantage of "*borrowed*" views in one study (Kearney & Winterbottom, 2006, p. 24). Nursing home residents were able to connect with nearby life by watching athletic events at the high school across the street from a top floor window (Cutler & Kane, 2005). In another study, residential care designs that afford windows oriented to off-site broad expanses of nature and local activities were described as giving the residents' "*windows to the world*" (Cutler & Kane, 2005, p. 44).

4.4.2 Connection to past times

Being outdoors can bring back memories of childhood experiences and create enjoyment for many older people. One nursing home resident was quoted as saying "I love the feeling when I'm out in the garden. It takes me back to my childhood" (Raske, 2010, p. 344). Including plants that evoke memories can relate older adults to their past life. In one study, a nursing home resident exclaimed: "Look at that hydrangea, I had one when I . . ." (Bengtsson & Carlsson, 2005, p. 61). Other older adults also expressed a desire to do things they did prior to moving to congregate care. A nursing home resident connected to the past by being able to mow the facility lawn daily (Cutler & Kane, 2005). Many older adults identified vegetable gardening with their past life (Cranz & Young, 2005; Collins & O'Callaghan, 2008). Age-appropriate features, such as raised beds, enabled the older adults in multiple studies to continue to garden.

4.4.3 Variety and choice

Older adults enjoyed the sense of freedom, variety, and change the outdoors gave them (Bengtsson & Carlsson, 2013; Burton & Sheehan, 2010). In one study, nursing home residents considered going outdoors as offering them a positive "change in scenery" (Kearney & Winterbottom, 2006, p. 18). Outdoor space that offered different areas for different functions including places to be alone or to socialize and areas for small or large group activities where the noise does not disturb others were preferred. Options in spatial layout, for example, seating areas in sun and shade with diverse views and walking paths of various lengths and different routes, were important to seniors. One study suggested creating several outdoor spaces (e.g. patio, garden, and a balcony) so the different areas could be used alternately (Kearney & Winterbottom, 2006). Gardening activities at a nursing home also supported a sense of

autonomy, as reflected in a resident's statement: "The garden lets me follow my own interests" (Raske, 2010, p. 345).

4.4.4 Support for individual needs

Literature focusing on designing environments for older adults typically considers the subject users as a group entity most likely because the majority of the research is conducted in long-term care facilities and other senior congregate residential settings. This study found that older adults want the outdoor environment to be supportive of their individual needs. For some residents, vegetable gardening provided something to look forward to and a sense of responsibility (Wang & Glicksman, 2013). A female nursing home resident tending her "secret garden" outside her residential unit exemplified older adults' desire to have something of their own (Cranz & Young, 2005, p. 84). Allotment gardening was thoroughly enjoyed by older adults by providing them with their own garden plot (Cranz & Young, 2005). These examples highlight the importance of also considering an individual approach when designing the outdoors for older people.

In one study, nursing home residents perceived a joint project with the local garden club to construct an enabling garden as positively affecting their relationships with the other residents (Raske, 2010). One resident commenting on harvesting the vegetables with other residents enthusiastically stated: "He picks a bag of cherry tomatoes for me to eat" (Raske, 2010, p. 343). The staff members also enjoyed the joint activities. One member stated: "The staff gets such a kick seeing the residents in the garden. They tell one another stories about the residents doing things out in the garden" (Raske, 2010, p. 346).

4.5 Barriers to outdoor use

The individual's personal physical and cognitive limitations and unavailable staff assistance have been reported as the most prominent barriers to going outdoors (Kearney & Winterbottom, 2006). Many negative comments were also expressed by older adults relating to the absence or inadequate presence of the preferred attributes mentioned earlier. For example, prominent issues concerned accessibility and safety including difficult doorways, low visibility, unsafe walking paths, and inadequate or uncomfortable seating in both sun and shade.

However, additional negative influences were considered barriers to outdoor use. Many were associated with how the space was planned and maintained. Noise generated by gas powered lawn mowers used by the maintenance crew was amplified in an enclosed courtyard garden making it difficult to socialize and relax (Cranz &Young, 2005). A greenway trail located near an automobile overpass was affected by the noise and exhaust fumes (Dorwart, 2015). An unattractive view resulted from locating a nursing home patio in close proximity to a parking lot (Cutler & Kane, 2005). Lack of adequate maintenance included unpruned shrubs that blocked the sunlight and view while also making the inside feel confining. Unmowed lawns created a risk of slipping. Smoking areas that were not isolated were considered very offensive (Heath & Gifford, 2001; Senes et al., 2012). Barriers in public settings included dog fouling, signs of vandalism, and fear of crime (Alves et al., 2008; Aspinall et al., 2012; Sugiyama et al., 2009). Interestingly, when older park visitors were asked to determine the relative importance of park attributes, one study found that a negative attribute, namely dog fouling, was the most important factor when deciding to visit a park (Alves et al., 2008). While some of these issues are not directly related to

the design of the outdoor space, such as fear of criminal activity, they significantly influenced the use of public open spaces by older adults.

5. CONCLUSIONS

Based on the responses from older adults in the studies reviewed, many design characteristics influenced their outdoor use. Findings indicate that they are highly motivated to go outdoors if they perceive the environment provides not only aesthetic beauty, but also makes them feel comfortable. The older adult cohort is characterized by a wide diversity of cultural, societal, demographical, and health characteristics. Design attributes that are supportive of their special needs will attract them to the outdoors.

5.1 Key findings

Seniors want abundant safe and stable seating in both shade and sun. Doorways should be easy to traverse with paved landings and doors that open easily and close slowly. Paved walkways need to be level, wide, and free of cracks and obstacles to enable easy access for wheelchairs and other mobility aids. Outdoor spaces that are easy to get to and are visible from multiple locations where older adults spend considerable time can encourage use. Window views of green landscapes, activities and people in the surrounding area can help make older adults feel connected to the outside world and life especially for those unable to go outdoors.

The older adult cohort reflects a wide diversity of characteristics and functional abilities which dictate different patterns of park use and needs (Levy-Storms, Chen, & Loukaitou-Sideris, 2018). Older adults indicated that age-appropriate features such as frequent shaded seating areas along walking paths, accessible restrooms, water stations, and enclosed shelters significantly influenced their use of public parks. Neighborhood open spaces and parks were favorite venues

for physical activities and socializing in both small and large groups. Providing separate areas for both group and individual activities, such as exercise classes and reading, and playgrounds to watch children play were important to older adults.

Finally, the outdoors as an access to nature was very important to older adults. They delighted in nature's physical attributes such as abundant greenery, colorful flowers, and wildlife. They wanted to enjoy the sensory experience of nature - touching and smelling the plants, hearing the water splash in a fountain, and feeling the warmth of the sun. Being able to simply watch the seasons change, fish swimming in a pond, or birds coming and going to feeders provided enjoyable distractions.

This review resulted in several other findings. First, the predefined themes were not mutually exclusive. Many preferred attributes impacted more than one theme. For example, walking was a favorite *activity*, while the preferred walkway characteristics were mostly *safety* concerns. Second, tangible or perceived barriers to outdoor access can result either from preferred attributes being absent or inadequate or from undesirable elements being present. Third, although the review was able to identify 33 relevant studies, the existing literature contains relatively little research solely focused on identifying older adults' preferred outdoor physical environmental features and qualities.

5.2 Limitations of the study

The quality of the included studies was good overall. However, many included studies utilized data from a small sample of older adults which reduced the ability to generalize the results. This

has been shown to be a frequently encountered challenge when conducting research with frail older adults who are quite often unable to participate (Joseph et al., 2016). This review reported the findings from a relatively limited and heterogeneous sample of studies. Bias may be present in any research and the author acknowledges that bias may have influenced the findings of this review and/or the included studies. This review sought to limit the risk of bias by employing systematic review methodology and the search of an uncommonly large number of databases for relevant evidence. However, bias may have infiltrated the findings due to limiting the selected studies to the English language.

The systematic review search process revealed a lack of experimental designs on the study topic. The studies included in the review were qualitative and quantitative descriptive designs which preclude causal inference. Although this review was successful in identifying 33 relevant studies, the question of what attributes definitively influence older adults' preference and outdoor use, along with the mechanisms that affect this behavior, remains to be fully validated. Additional research with larger samples and experimental methods is needed to strengthen the findings presented in this report.

This study's intent was to identify the essential elements that older adults feel are important when planning and designing outdoor environments. Older adults are typified from the frailest to the most resilient (Annear et al., 2014). The findings suggest broad design guidelines and are not meant to be definitive. The older adult cohort reflects a wide range of cultural backgrounds, functional abilities, and sociodemographic characteristics that should be considered when developing design strategies (Ahrentzen & Tural, 2015; Joseph et al., 2016). For example, a

study by Alves, Gulwadi and Cohen (2005) found that cultural heritage influenced the type of nature-related outdoor activities preferred by Anglo-American and Hispanic seniors. There is also a wide diversity of outdoor environments available to older adults with a wide range of associated attributes. Even though the review included a varied array of outdoor settings, every outdoor space has its unique variables or properties that could also influence an older adult's decision. The study findings were also limited to the countries represented in the included studies. Findings from one setting may not apply elsewhere. Consequently, special attention should be given to the importance of context-specific design considerations.

The study was not intended to determine which features or qualities have what effects if any on health or to imply that certain features or qualities will affect health outcomes. The study did not equate *preference* with *restorative quality* for any feature or attribute. The study treated the user's need for restoration and their perceived possibility of any feature or attribute providing restoration as determinants of preferences (Purcell et al. 2001; Staats et al., 2003; Hartig & Staats, 2006).

5.3 Directions for future research

In the past, literature reviews focusing on older adults and outdoor environments have targeted a specific setting or a specific population segment. This study fills a gap in the literature by identifying and synthesizing evidence from the entire range of outdoor settings and older adult populations. The study's focus was to provide a comprehensive evidence synthesis as voiced by older adults themselves. However, the review process identified numerous studies that also included insights from residential facility staff members. Some discrepancies were noted

between the residents' and the staffs' perceptions of outdoor design and use. Interestingly, in one study the garden design was evaluated more harshly by the staff. Discrepancies were also found between the responses from older park visitors and park management staff regarding the perception on how the park programming and design met seniors' needs. Future review should explore these disjunctions further.

The transition to a residential care community has been shown to result in a significant decrease in the frequency of going outdoors and the range of activities engaged in when outdoors (Stoneham & Jones, 1997). However, the study by Stoneham and Jones revealed that sheltered home residents were not engaging in many of the available outdoor activities even though they were physically able to do so. When the residents were asked the reason for no longer gardening, "too old" was a prevalent response (Stoneham & Jones, 1997, p. 22). Social and cultural norms expected of aged people may have influenced this self-perception (Stoneham & Jones, 1997). However, the feeling of being too old to engage in an outdoor activity while still possessing the physical capability to perform that activity is an attitude that can possibly be modified. Future research could explore the impact of introducing interventions intended to evoke a feeling of youthful enthusiasm.

5.4 Implications for practice

The ability to effectively create aesthetically pleasing, functional, and supportive outdoor spaces is dependent on the full understanding of how these spaces are utilized and experienced by older adults (Bengtsson & Carlsson, 2013). Many existing design guidelines are anecdotal, based on professional wisdom, theoretical grounds, or the result of less rigorous studies. By identifying

original empirical evidence and synthesizing the findings in a rigorous, transparent and methodical manner, this study was successful in identifying many of the attributes that affect older adults' outdoor use.

An aesthetically pleasing outdoor space will not by itself ensure optimal use. A successful design also supports older adults' physical, psychological and social needs (Othman & Fadzil, 2015). This study offers strong evidence that physical environmental characteristics play a significant role in older adults' decisions on outdoor use. The information presented in this study will be valuable to those stakeholders involved in designing or providing outdoor spaces for older individuals. Where budgetary constraints are an issue, these findings will allow design decisions to be made that may provide positive financial advantages through improvement in older adults' health outcomes.

Given the aging population in many countries along with the concomitant rise in healthcare costs for those individuals, research should target ways to enhance older adults' emotional and physical health. Findings from this study suggest that even small changes can possibly bring positive rewards. Residents were "content to just sit in the sunshine with their eyes shut" on a small nursing home patio (Bengtsson & Carlsson, 2005, p. 55). A simple bench placed along the path of their daily travels helped seniors stay more mobile and enabled them to socialize with others in the neighborhood (Ottoni et al., 2016). A seating area at the front entrance to a long-term care facility enabled the residents to engage with visitors and feel connected to the outside world (Cutler & Kane, 2005). And a simple house plant on a windowsill made an older person happy (Collins & O'Callaghan, 2008). The benefit and enjoyment that older adults receive from

the outdoors is eloquently captured in a nursing home resident's quote: "When you come to the garden you feel somewhat more alive" (Bengtsson & Carlsson, 2005, p. 60).

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APPENDIX A

DATA EXTRACTION

Date of extraction:
Citation:
Extractor's name:
Aim of the study:
Study Type:
___ Published article – refereed
___ Published article – not refereed
___ Technical Report
___ Dissertation/thesis
___ Conference Proceeding
___ Abstract/presentation
___ Book/chapter
___ Other *Specify*:

Study Design
___ Quantitative *Describe*:
___ Qualitative *Describe*:
___ Mixed methods *Describe*:
___ Experimental
Description of the intervention:
Primary outcome measure(s):
How were outcomes measured?

Study Characteristics
A. Location of Study:
___ USA *Describe:*
___ Other *Specify:*
___ not reported
B. Description of Sample:
___Sample size (N): _____
___Age Range: _____
___Mean Age: _____
___Gender: ____ Male ____Female
____ Gender not reported
___Mixed sample of older and younger individuals
___Entire eligible population
___Probability sampling (utilizes some form of random selection)

___ Convenience/self-selected sample
___ Purposive (selective, subjective) sample
___ Additional characteristics:

C. Study Setting:
___ Urban ___ Rural ___ Mixed ___ Not reported
___ Public place, e.g., park, greenway, neighborhood open space
_ __Skilled nursing Home
___ Assisted living Facility
___ Retirement community
___ Single family home
___ Multi-family/apartment
___ Other *Specify:*
___ Additional information:

D. Method/Instrument:
___ Observation
___ Interview
___ Focus Group
___ Questionnaire
___ Record review
___ Photo comparison or photo elicitation
___ Other *Describe:*
___ Unreported
___ Additional information:

E. Measurement (quantitative designs) - Technique used to facilitate evaluation and quantification of behaviors and attitudes, characteristics, and opinions.
___ Checklist
___ Likert scale
___ Other *Describe:*

F. Approach to Data Analysis
____ Statistical *Describe:*
____ Narrative *Describe:*
____ Other *Describe:*

Findings of the Study:

APPENDIX B

QUALITATIVE studies - interpretation of findings	Bengtsson & Carlsson, 2005	Bengtsson & Carlsson, 2013	Burton & Sheehan, 2010	Cranz & Young, 2005	Heath & Gifford, 2001	Jacobs & Dahl, 2004	Loukaitou-Sideris, et al., 2016	Ottoni et al., 2016	Raske, 2010	Senes et al., 2012
Environmental features and qualities										
Physical location – distance, size, or layout	X	X	X		X		X			X
Window views – easy to see	X	X	X	X	X				X	
Seating	X	X	X	X	X	X	X	X		
Doorways (e.g., doors, thresholds, landings)	X	X		X	X				X	
Climate sensitivity/control (e.g., shade, enclosed shelters)	X	X	X	X	X		X		X	X
Transitions				X						
Walkways	X	X	X	X	X		X		X	X
Visual or auditory contact with indoors										X
Privacy (e.g., enclosure, sub-territories) and/or openness	X	X	X	X			X		X	X
Familiarity (e.g., orientation, legibility)	X	X			X		X			
Nuisances (e.g., noise, glare, uncontrolled dogs, smoking)				X	X		X			X
Other comfort features (e.g., handrails, lighting, signage, raised beds)	X	X		X	X	X	X		X	X
Safety in and en route to public spaces (e.g., traffic, fear of crime)							X			
Maintenance	X	X	X				X			X
Practical facilities (e.g., restrooms, water stations, cafes)							X			
Activities engaged in when outdoors										
Walking	X	X	X	X	X	X	X	X		X
Socializing	X	X			X		X	X		X
Gardening				X	X		X		X	X
Structured activities (e.g., dance classes, board games, barbecues)	X	X		X	X		X	X		X
Unstructured activities (e.g., relaxing, watching children, reading)	X	X		X	X		X	X	X	X
Access to nature										
Variety of greenery (e.g., trees, shrubs, potted plants)	X	X	X	X			X	X	X	X
Flowers and color	X	X	X				X	X	X	
Water features (e.g., ponds, fountains)	X	X			X		X			X
Wildlife/pets	X	X	X		X		X	X	X	X
Interact with nature (e.g., touch, smell, hear, taste, fresh air)	X	X					X	X	X	
Nature in motion (e.g., fish ponds, birdbaths, seasonal change)	X	X								
Potential experiences in the outdoors										
Connect to the outside world (e.g., greet visitors, interact with community)	X	X							X	
Connect to past (e.g., familiar plants, past hobbies)	X	X							X	
Variety and choice	X	X	X	X			X		X	X
Supports individual needs (e.g., relationships, responsibility, belonging)				X					X	
Visual contact off-site (e.g., landscapes, people, activities)	X	X		X						

APPENDIX C

QUANTITATIVE studies - interpretation of findings	Alves et al., 2008	Aspinall et al., 2010	Bengtsson et al., 2015	Dahlkvist et al., 2014	Joseph & Zimring, 2007	Kemperman & Timmermans, 2014	Nordh et al., 2011	Oguz, et al., 2010	Rodiek & Fried, 2005	Rodiek, et al., 2013	Rodiek & Lee, 2009	Sugiyama et al., 2009
Environmental features and qualities												
Physical location – distance, size, or layout	X	X	X	X		X			X	X	X	X
Window views – easy to see				X				X	X	X	X	
Seating	X	X		X				X	X	X	X	
Doorways (e.g., doors, thresholds, landings)				X					X	X	X	
Climate sensitivity/control (e.g., shade, enclosed shelters)			X	X				X	X	X	X	
Transitions									X			
Walkways	X	X	X	X	X				X	X	X	X
Visual or auditory contact with indoors											X	
Privacy (e.g., enclosure, sub-territories) and/or openness			X	X				X			X	
Familiarity (e.g., orientation, legibility)			X									
Nuisances (e.g., noise, glare, uncontrolled dogs, smoking)	X	X		X								X
Other comfort features (e.g., handrails, lighting, signage, raised beds)			X	X				X				X
Safety in and en route to public spaces (e.g., traffic, fear of crime)	X	X				X						X
Maintenance	X	X	X			X				X	X	X
Practical facilities (e.g., restrooms, water stations, cafes)	X	X		X								X
Activities engaged in when outdoors												
Walking	X	X	X	X	X			X	X		X	X
Socializing						X		X		X		X
Gardening				X				X				
Structured activities (e.g., dance classes, board games, barbecues)											X	X
Unstructured/personal activities (e.g., relaxing, watching children, reading)	X	X					X				X	X
Access to nature												
Variety of greenery (e.g., trees, shrubs, potted plants)	X	X	X	X		X	X		X	X	X	X
Flowers and color			X	X			X	X	X	X		
Water features (e.g., ponds, fountains)	X	X	X	X			X	X				
Wildlife/pets	X	X		X								
Interact with nature (e.g., touch, smell, hear, taste, fresh air)			X	X				X				
Nature in motion (e.g., fish ponds, birdbaths, seasonal change)				X								
Potential experiences in the outdoors												
Connect to the outside world (e.g., greet visitors, interact with community)										X	X	
Connect to past (e.g., familiar plants, past hobbies)					X							
Variety and choice			X							X	X	
Supports individual needs (e.g., relationships, responsibility, belonging)			X									
Visual contact off-site (e.g., landscapes, people, activities)			X	X	X			X	X	X	X	

APPENDIX D

MIXED METHODS studies - interpretation of findings	Cutler & Kane, 2005	Dorwart, 2015	Gibb, 2001	Kearney & Winterbottom, 2006	Ottosson & Grahn, 2005	Pleson et al., 2014	Rodiek, 2006a	Rodiek et al., 2014	Stoneham & Jones, 1997	Wang & Glickman, 2013	Zhai & Baran, 2017
Environmental features and qualities											
Physical location – distance, size, or layout	X			X		X	X	X			
Window views – easy to see	X			X			X	X			
Seating	X			X			X		X		X
Doorways (e.g., doors, thresholds, landings)	X			X			X	X			
Climate sensitivity/control (e.g., shade areas, enclosed shelters)	X			X			X				X
Transitions								X			
Walkways	X	X			X		X				X
Visual or auditory contact with indoors							X				
Privacy (e.g., enclosure, sub-territories) and/or openness	X		X						X		X
Familiarity (e.g., orientation, legibility)	X										
Nuisances (e.g., noise, uncontrolled dogs, smoking)		X			X	X					
Other safety features (e.g., handrails, lighting, signage, raised beds)										X	X
Safety in and en route to public spaces (e.g., traffic, fear of crime)		X				X					
Maintenance				X			X				
Practical facilities (e.g., restrooms, water stations, cafes)											
Activities engaged in when outdoors											
Walking		X	X		X	X	X	X			X
Socializing	X		X	X		X			X	X	
Gardening	X			X					X	X	
Structured activities (e.g., dance classes, board games, barbecues)	X			X	X	X			X		
Unstructured activities (e.g., relaxing, watching children, reading)	X		X	X	X	X			X		
Access to nature											
Variety of greenery (e.g., trees, shrubs, potted plants)	X	X	X	X	X		X		X	X	
Flowers and color	X		X	X	X		X		X		X
Water features (e.g., ponds, fountains)	X	X	X	X			X				X
Wildlife/pets	X		X	X	X		X		X		
Interact with nature (e.g., touch, smell, hear, taste, fresh air)				X	X		X			X	
Nature in motion (e.g., fish ponds, birdbaths, seasonal change)	X				X		X				
Potential experiences in the outdoors											
Connect to the outside world (e.g., greet visitors, interact with community)	X			X		X					
Connect to past times (e.g., familiar plants, past hobbies)	X								X	X	
Variety and choice		X		X					X	X	
Supports individual needs (e.g., relationships, responsibility, belonging)				X					X	X	
Visual contact off-site (e.g., nearby landscapes, people, activities)	X		X	X	X		X				

APPENDIX E

SEARCH TERMS BY CONCEPT

Population
Older adults
Seniors
Elderly
Geriatric
Adult
Older person
Older people
Elder
Aged

Setting
Environment
Physical environment
Parks
Urban parks
Green space
Recreational
Recreation areas
Nursing home
Playgrounds

Outdoors
Natural/nature
Physical
Outdoors
Garden
Landscape
Horticulture

Data Collection Method
Questionnaires
Surveys
Interviews
Mail surveys
Telephone surveys
Photovoice
Qualitative
Perception
Perceive
Preference
Preference measures