PROGRAM IN ENVIRONMENTAL DESIGN

Emily Chinowsky

URBAN PARKS AS HEALERS

Designing Parks for High-Impact Chronic Pain

Joey Pedras. 2021. Liberty State Park. https://unsplash.com/photos/z02wlrl3PhM.

Emily Greenwood, Program in Environmental Design, Primary Advisor
Dr. Colleen Reid, Department of Geography, Secondary Advisor
Maryanne Fantalis, Program in Environmental Design, Honors Council Representative

ABSTRACT

High-impact chronic pain causes significant daily activity restrictions for people and is becoming a leading research topic. Recent research demonstrates the benefits of physical activity for reducing chronic pain. Concurrently, the physical and mental health benefits of green space are an increasing topic of study.

This thesis synthesizes these two research areas through a systematic review of the literature on chronic pain management through physical activity and the health benefits of green space. These two bodies of research are separately filtered to identify the specific factors that improve health outcomes, coded by their frequency of success, and combined together to create recommendations for urban park design.

A variety of pathways, areas for programmed activities, and ecological diversity are key elements for urban parks to have the most significant health benefit.

These findings form the basis of a new set of design recommendations for urban parks that enhance the pain management regimen for individuals with high-impact chronic pain.

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INTRODUCTION

Landscape architects have explored the importance of green space to public health since Frederick Olmsted (Central Park Conservancy n.d.). Through decades of integrating green space into the urban landscape, the importance of parks to the health and wellbeing of the general public has become increasingly apparent. Today, with the COVID-19 pandemic, the importance of these green spaces to public health is gaining further attention beyond just the promotion of a healthy lifestyle (Kleinschroth and Kowarik 2020). The importance of green space to an individual's health is increasingly apparent, prompting questions as to the potential of parks to address specific medical issues.

High-impact chronic pain (HICP) is one prevalent medical condition that could be addressed with increased attention to green space. HICP is a new category of chronic pain that causes daily activity restrictions and affects almost 20 million people in the United States (Zelaya et al. 2020). While this condition can cause debilitating pain, medications and non-medication-based therapies can help reduce pain (Task Force 2019). Specifically, physical activity has been proven to reduce pain sensitivity by 60% (Polaski et al. 2019).

Landscape architecture has complemented traditional healthcare facilities through individual elements, such as wellness gardens. While this is a significant contribution, green spaces also benefit mental and physical health when separate from the hospital setting (Ulrich 1984; Konijnendijk van den Bosch et al. 2013). Broadening the scope of landscape architecture for health allows urban parks to target a more extensive range of users.

This paper utilizes the established systematic review methodology to analyze research on chronic pain management strategies and elements of green spaces that improve health. From this methodology, this thesis seeks to answer the question: **how can urban park design help reduce the effects of high-impact chronic pain?**

LITERATURE REVIEW

2.1 Introduction

This literature review examines two areas of research relevant to the development of park design recommendations for reducing the intensity of high-impact chronic pain. First, high-impact chronic pain is explored by looking at demographics, current pain management strategies, and contributing factors to worsened pain. Then, the health benefits of urban green spaces are reviewed to understand the benefits of urban parks. The benefits are broken down into physical health and mental health. The physical health benefits of green space will be discussed in terms of how green spaces improve physical activity and decrease the severity of certain health conditions. Finally, the mental health benefits of green space will be addressed through stress reduction and increased social cohesion.

2.2 High-Impact Chronic Pain

High-impact chronic pain (HICP) is defined as pain "associated with substantial restriction of participation in work, social, and self-care activities for six months or more" (IPRCC 2016). This term was first introduced in the U.S. National Pain Strategy in 2016. Although pain has been a topic of research since the 1600s, chronic pain went unexplained (Bernard et al. 2018). In the late 1800s, psychiatrists and psychoanalysts began to believe that chronic pain was a sign of mental or emotional conditions. By the 1920s, people with chronic pain were seen as lying, avoiding work, or drug abusers (Meldrum 2003). It was not until after World War II, when soldiers returned to civilian life and still experienced pain from war injuries, that chronic pain gained recognition in the United States (Bernard et al. 2018). However, there is still a legacy of belief within the medical community that chronic pain is psychologically-based, which leads to dismissive behavior from primary care physicians and often prevents many individuals from receiving the clinical assistance that is required (Pikoff 2020). Today the U.S. Department of Health and Human Services (HHS) has a 10-year goal of "helping people with high-impact chronic pain safely manage their pain and reduce its impact" (HHS 2021). HICP's growing attention spotlights the importance of this thesis' research.

In 2016, the Centers for Disease Control and Prevention (CDC) conducted a National Health Interview Survey that was the first collection of chronic pain demographic information. The study found that 8% of adults had HICP (Dahlhamer et al. 2018), which is slightly more than the population of New York (US Census Bureau 2021). Additionally, females were more likely to have HICP than males, and the likelihood of HICP almost tripled over the age of 45. HICP was more common in people without a college degree, unemployed, below the Federal Poverty Level, with public health insurance or uninsured, and people who were non-Hispanic White and non-Hispanic Black (Dahlhamer et al. 2018). Furthermore, a 2005 study by Nguyen et al. (2005) found that people with limited education and unemployed were less likely to consult a primary care provider for their pain, showing that some groups more likely to have HICP are less likely to consult a physician, therefore indicating a need for non-medical pain relief.

Chronic pain impairs physical and mental health, causing a lower quality of life. People stop participating in daily activities for fear of increasing pain, which worsens mental health due to the lack of

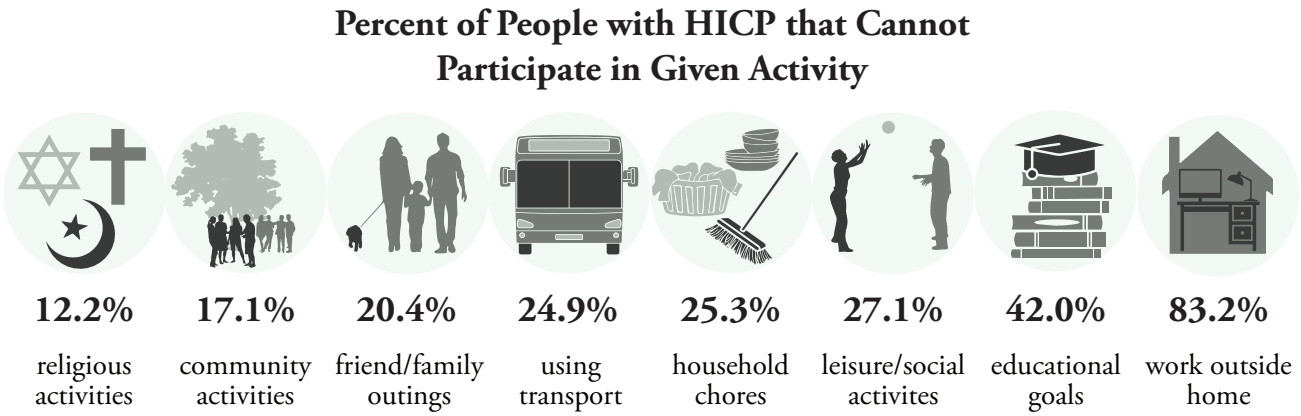


Figure 2.1 Percent of people with high-impact chronic pain that cannot participate in given activity. Data from Pitcher et al. 2019.

socialization and decreased involvement in activities (Katz 2002). Furthermore, a study by Pitcher et al. (2019) found that 55% of people with HICP experience at least two major activity limitations. These prevent basic needs from being met, such as grocery shopping and meal preparation, socializing with friends, caring for small children, and earning an income. Furthermore, six of the eight activities involve socialization. Socializing is crucial as it reduces the impact of stress, provides coping strategies, improves self-identity and worth, and decreases the incidence rate and severity of some diseases (Cohen 2004). The combination of the lack of socializing with an inability to perform daily activities results in a continuously escalating situation where pain increases, the individual cannot perform activities or socialize, and mental health challenges escalate.

Additionally, the mental health effects of pain make HICP all-encompassing. People with HICP are over twice as likely to have daily or weekly depression than people with chronic pain and almost five times as likely as those without chronic pain. Furthermore, people with chronic pain are more than twice as likely to have suicidal ideation. People with HICP are also more likely to experience daily or weekly anxiety, fatigue on most days, difficulty concentrating, and take medication for depression or anxiety (Pitcher et al. 2019). Many factors cause this association, but often the cause is centered around the fear of having pain forever. This causes "feelings of anxiety, sadness, grief and anger […] and may lead to the emergence of a mental disorder" (Holmes, Christelis, and Arnold 2013).

Based on these everyday limitations and escalating mental health challenges, numerous studies have been conducted on pain management strategies, including the use of non-steroidal anti-inflammatory drugs (NSAIDs), opioids, and other over-the-counter and prescription medications (Task Force 2019). These medications reduce pain, but they can have harmful side effects, particularly opioids. Opioids are beneficial for certain patients with chronic pain and are usually prescribed after many other treatments have failed (Huang Hall 2020). However, the rate of opioid misuse in people with chronic pain who take opioids is between 21% and 29% (Vowles et al. 2015). Due to the opioid epidemic, research into other pain management strategies has become more significant (CDC 2021). For example, in a study by Krebs et al. (2018), NSAIDs created the same pain reduction as opioids in chronic back pain and

osteoarthritis pain.

Medications are critical in treating chronic pain, but non-pharmacological approaches have also been explored, including exercise and mental health interventions. Alternative treatments are not replacements for medications but are meant to reduce the amount needed to manage pain (Ambrose and Golightly 2015).

A growing understanding of the mechanisms that allow physical exercise to manage pain has been central to increasing this non-pharmacological approach. Through these advances, it has been found that physical activity can intervene in chronic pain and decrease pain sensitivity by 60%, making it an effective strategy for HICP (Task Force 2019; Polaski et al. 2019). The decrease in pain sensitivity occurs because endorphins are released during exercise, which "can effectively block pain and can produce feelings of relaxation" (Sullivan et al. 2012). However, physical activity has multiple benefits for individuals with HICP. Physical activity can be broken down into aerobic exercise, strength training, and flexibility, all of which are beneficial for chronic pain (Sullivan et al. 2012). A comprehensive program that combines strength, flexibility, and aerobic exercise can offset pain that emanates from deconditioning, weakness, tightness, and lack of balance (S. P. Cohen, Vase, and Hooten 2021). Furthermore, when people are inactive, they can develop comorbidities, including "obesity, hypertension, cardiovascular and respiratory diseases, diabetes, depression, etc" (Bagchi, Moriyama, and Raychaudhuri 2011). These comorbidities are some of the leading causes of death in the U.S. (Ahmad and Anderson 2021). Thus, the benefits of exercise validate the need for physical activity interventions in park design.

In addition to the growing focus on exercise-based therapy, psychological interventions are becoming

Figure 2.2 Recommended types of exercise in each physical activity category. Recommendations from Ambrose and Golightly 2015.

a critical component to reducing the impact of pain. Cognitive-behavioral therapy (CBT) focuses on creating new thinking patterns and is the most common psychological intervention for pain management (Hassett and Williams 2011). Mindfulness and biofeedback also improve mental health by bringing awareness to the body and reducing sensations through relaxation (Kaiser, Mooreville, and Kannan 2015). A relatively new area of research examines interdisciplinary approaches that combine mindfulness and exercise, such as yoga, pilates, and tai chi; the exercise component reduces pain, while the psychological component improves mental health and relaxation (Sullivan et al. 2012).

Although there are current non-pharmacological

treatment options available, like those mentioned above, many barriers prohibit participation; patients cite travel distance, cost of treatment, and lack of treatment availability as reasons that these resources are not used (Becker et al. 2017).

2.3 Background of Urban Parks

Green space is defined as "land that is partly or completely covered with grass, trees, shrubs, or other vegetation" and includes cemeteries, community gardens, and parks, which are the focus of this research (EPA n.d.). Urban parks are a subset of green space and are defined as delineated open space areas, mostly dominated by vegetation and water, and generally reserved for public use (Konijnendijk van den Bosch et al. 2013). Research conducted on open spaces, a subset of green spaces, is also applicable to urban parks in terms of their benefits and attributes. However, as described in this thesis, urban parks have specific existing and potential benefits that go beyond those provided by general green space.

One of the first large-scale public parks in the United States was Central Park in Manhattan, New York. Designed by Frederick Law Olmsted and Calvert Vaux in 1858, Central Park was created to help "escape from the stresses of urban life" (Central Park Conservancy n.d.). During this time, it was thought that gasses from decomposition, called miasma, caused disease (Martensen 2009). People thought that open space would sanitize miasma, so Central Park became referred to as the "lungs of the city." While Louis Pasteur's germ theory disproved the theory of miasma, the health benefits of Central Park were immense because of the unhygienic state of New York at that time (Central Park Conservancy 2020). Since then, urban green spaces have proven beneficial for many ailments, such as allergies, obesity, immune system function, and depression (WHO 2017).

Figure 2.3 Aerial view of Central Park, New York. (Photograph by Central Park Conservancy. 2020. "Before Central Park: Native Americans, European Settlers, Immigrant Communities, and Seneca Village." Central Park Conservancy. July 21, 2020. https://www.centralparknyc.org/articles/stories-from-before-central-park.)

With over 80% of the United States population now living in urban areas, urban green spaces are becoming a significant topic of research from a health standpoint (US Census Bureau n.d.). In 1984, Roger Ulrich determined that patients in a hospital who had a view of a tree from their window were in the hospital for fewer days following their recovery, compared to those who had a view of a brick wall. Furthermore, the patients with views of trees took fewer painkillers and had fewer post-surgical complications (Ulrich 1984). Although his research did not take into account a more active city view, Ulrich's study provided a foundation for further research on this topic.

The Trust for Public Land has set a goal that "every community has safe, equitable access to a high-quality park within a 10-minute walk of home" (The Trust for Public Land n.d.). However, nearly one out of every three people living in the United States do not have access to a park within a ten-minute walk (Chapman et al. 2021). In 2021, a study conducted by The Trust for Public Land examined the green space in the 100 most populated cities in the United States. Of those 100 cities,

only two cities had all residents living within a ten-minute walking distance to a park, and thirteen cities had less than 50% of residents living within walking distance (The Trust for Public Land 2021). However, when comparing park walkability in the 38 largest cities in the United States from 2012 to 2021, 37 cities increased the number of people within a 10-minute walking distance to a park, with an average increase of about 18% (The Trust for Public Land 2012; 2021). Seeing this increase in access to parks emphasizes the importance of making parks useful and enjoyable to all.

2.4 Physical Health Benefits of Parks

As introduced above, a recurring theme in urban research studies has focused on the relationships between urban green space and physical health. The physical health benefits of urban green spaces started being recorded in 2003 by de Vries et al. These studies build on, but are distinct from, studies focusing on the psychological benefits of exposure to nature, reviewed below, which are often cited as key benefits for exposure to nature. In the study of health benefits, the investigators used self-reported health indicators, demographic and socioeconomic data, and living environments to establish an association that people living in greener environments have better perceived health and report fewer symptoms. The researchers utilized a variety of tools including GIS mapping, vital sign recording, and surveys to determine specific benefits from physical activity in natural settings. In each case, the researchers used controlled studies to obtain physiological data from which to compare those individuals who engaged in physical exercise to those who either did not use the park, or used the park environment solely for relaxation. The overall findings determined that physical exercise has direct benefits for heart disease, diabetes, blood pressure, colon cancer, and weight control among others (Bedimo-Rung, Mowen, and Cohen 2005).

From a demographic perspective, the effects are even more significant in people with lower education levels, lower household income, and the elderly (de Vries et al. 2003). These findings are significant because these same groups have a higher reported prevalence of HICP (Zelaya et al. 2020). Maas et al. (2006) added to the conclusions of de Vries et al. by stating that all measures of lower socioeconomic status create a stronger tie to the benefits of physical exercise. Based on these findings, this thesis focuses on urban parks as they are easily accessible and free.

A core question in the research on urban parks has been the identification of relationships between the access to urban greenspaces and the amount of physical activity in which individuals engage. This question continues to gain importance as evidence shows that a majority of men and women do not meet recommended activity levels (Coombes, Jones, and Hillsdon 2010). However, there is conflicting evidence as to whether the existence alone of green space results in greater physical activity. One representative study found that access to urban green spaces increases physical activity, reduces the rate of obesity, and possibly reduces cardiovascular and respiratory morbidity (Konijnendijk van den Bosch et al. 2013). The study found that individuals living further from green spaces were less likely to meet guideline physical activity levels. However, when looking at just the use of green spaces for recreational activity, several studies find that just having access is not sufficient for greater usage (Hillsdon et al. 2006). The existence of the green space is beneficial to physical health, if people choose to use it. And while proximity is a significant factor, it is not the only factor.

A second area of interest for green space researchers is understanding what features of urban green spaces and parks may be the most beneficial in encouraging physical activity. Gladwell et al. (2013)

found that having a diversity of options, including biodiversity, is important to encouraging physical activity, as the perception of physical exercise effort diminishes with a varied environmental context. However, similar to the results of Hillsdon et al. above, Copeland et al. (2017) found that having the equipment is not sufficient by itself, as individuals perceive equipment as beneficial, but without marketing and programming, they do not take full advantage of the opportunity. Conversely, while outdoor fitness equipment shows improvements in health, walking outdoors has been found to be a more accessible way to improve health (Grigoletto et al. 2021). McCormack et al. (2010) found that parks with walking paths and trails were visited more often than parks containing sports-related facilities. This is especially true for senior citizens with park usage among this group emphasizing the use of trails for walking as exercise on a regular basis (Duan et al. 2018).

While these research efforts demonstrate the many actual and potential health benefits from parks, there is limited research on how urban green space design could reduce pain as part of physical health benefits. Existing research has produced mixed findings in terms of this specific benefit. One study found a negative relationship between the amount of vegetation cover and high levels of pain in women (Ihlebæk et al. 2018). However, the authors believe this negative relationship may occur due to other factors including the sedentary lifestyles outside of park visits. Similarly, Lee and Maheswaran (2011) found that while benefits for pain were indicated, it was difficult to exclude confounding factors due to the length of time it takes for medical issues to exhibit and due to limited populations. In contrast, another theoretical study believes that urban green spaces could reduce the global burden of disease (Stanhope, Breed, and Weinstein 2020). Yet another study found that physically being in a green space increases pain tolerance levels (Li et al. 2021). This lack of consistent results in terms of the benefits of urban green spaces in terms of the level of benefits for pain reduction is the specific gap that this thesis is addressing as it focuses on specifically designing urban parks with this goal in mind.

2.5 Mental Health Benefits of Parks

The mental health benefits of parks and greenspace have been a topic of health and nature advocates for over a century. John Muir (1901) once stated that "thousands of tired, nerve-shaken, over-civilised people are beginning to find out that going to the mountains is going home; that wildness is a necessity." The 1970s witnessed a significant increase in this field of study under the term "environmental psychology" as the benefits of green space in urban planning emerged as a new focal point in planning. The core of these research efforts was a focus on studying individual responses to exposure to natural environments. Key examples of these research efforts were the studies conducted by Ulrich et al. over a two-decade period (Ulrich 1984; Ulrich et al. 1991; Ulrich 1993; Ulrich et al. 2008). In each of these studies, similar to others during this period, individuals were interviewed or surveyed to determine their responses to exposure to natural environments. The evidence-based results of these efforts covered a diverse set of health concerns including recovery from procedures, stress reduction, and response to hospital design. The overall theme of the results of these studies is that natural landscapes have a calming psychological effect which results in a reduced stress emotional state (Ulrich 1983). Specifically, the reduced visual complexity of a natural scene, the reduced feeling of threats, and the feeling of spaciousness combine to make an individual relaxed and reduce daily anxiety.

In this era, Driver et al. (1980), based on both personal and related research, published 14

specific psychological benefits of urban forests and greenspace. Similarly, Kaplan (1983) detailed the psychological benefits of access to nature in several contexts including parks, open spaces, and gardens. Malakoff (1994) encapsulated these benefits as people-plant interactions and emphasized how the interaction with plants is a common bond that leads to the development of healthy human communities. Finally, Brown and Jameton (2000) provide an overview of this transitional period where the psychological benefits of gardens, parks, and greenspace were being studied and realized with a particular emphasis on stress-reduction of these urban components. Of particular note in this review is the large body of literature that was developing in plant-people connections and the understanding that natural environments can have benefits across gender, racial, and economic divides to promote community building by bringing individuals together to collectively combat issues such as food security and environmental health.

The 2000s ushered in a broader focus on the mental health benefits of green space as medical studies began to reinforce urban planning studies in the role that green space plays in supporting mental health. In particular, European and Australian mental health researchers surveyed thousands of individuals to determine relationships between green space and mental health. Barton and Pretty (2010) provide a statistical analysis of over 1,200 participants in the UK where both short-term (5-10 minutes) and long-term (full-day) exposure to green exercise resulted in positive increases in self-esteem and mood. Similarly, Sugiyama et al. (2008) found in a study of 1,895 Australians that green space access in neighborhoods resulted in individuals being 1.6 times more likely to have enhanced mental health than those who do not have ready access to green space. Continuing the international support of these findings, Nielsen and Hansen (2007), in a study of 1,200 Danes, found statistical significance that access to a garden and green space resulted in reduced stress and increased mental health. Finally, in a wide-ranging overview of studies, Gies (2006) emphasizes the role of exposure to parks and the natural world in improving mental health conditions including attention-deficit disorder (ADD), coping with challenges, brain development, and social community. In the United States, Beyer et al. (2014) bring accessibility down to the neighborhood level by addressing the mental health benefits of neighborhood green space through the use of the National Land Cover Database. In this study of almost 2,500 individuals in Wisconsin, the authors found "associations between green space and mental health are significant and sizeable and persist with different measurement techniques" (Beyer et al. 2014).

More recently, researchers established that proximity to green spaces, supported activities in urban parks and green spaces, as well as the frequency of exposure to natural environments had statistically significant benefits for a broad cross-section of individuals. Proximity to greenspace is highlighted by research conducted by Sturm and Cohen (2014), who found that people living less than 400 meters from an urban park had far better mental health; mental health significantly declined at farther distances. Similarly, Nutsford, Pearson, and Kingham (2013) found that individuals with access to green space within three kilometers had a significant reduction in anxiety and mood disorders. In particular, usable green space was a primary contributor to this reduction with participants having opportunities to interact with the natural world. Alcock et al. (2014) extended this focus on accessibility to green space by focusing on the mental health benefits of moving to a greener area to increase the frequency of greenspace interaction. In this study, respondents began to display benefits in the year prior to the move and then showed

statistically significant improvement for the three years following the move. Finally, van den Berg et al. (2016) focused on the benefits to the mental health of individuals not only having access to green space, but actually utilizing the green space. In their study of four European cities, the results across all cities showed higher scores on mental health surveys from individuals who frequented urban green spaces.

Complementing the focus on accessibility of green space is the recent work addressing broader social and equity factors that impact mental health such as social cohesion. Ayala-Azcárraga, Diaz, and Zambrano (2019) added to the findings that the activities offered at parks and the social cohesion created are key factors in the mental health benefits of urban parks. The different activities at parks, such as sports, rest, and play, accommodate various people with diverse backgrounds. This promotes interactions between people, leading to social cohesion. The study also found that greater "naturalness" of parks was related to positive mental health. Furthermore, users stated they had better physical states and life satisfaction. Wan, Shen, and Choi (2021) added to this knowledge base through a systematic review of studies that found that three aspects of green spaces impacted the development of social cohesion; the physical characteristics of the space, the layout of the space, and the level of maintenance of the space combined to significantly predict social cohesion. Based on these and similar studies, Hunter et al. (2019) put forward that a key element to building on the mental health benefits of green space is to plan and design features from the start that focus on long-term health and social benefits, including management and maintenance plans.

2.6 Conclusion/Gap of Knowledge

There is currently a gap in the connection between the design of parks and the health benefits they provide. By creating data-driven design recommendations aimed at improving health, parks could help reduce the burden of disease. In particular, people with HICP serve as a model for building these recommendations because these people have the most significant pain. By focusing on the most severe cases, the same effects will appear in less severe cases of chronic pain. Literature shows that mental health management and exercise can benefit people with chronic pain. By using existing medical studies to inform design through recommendations that emerge from research, the opportunity exists to create design recommendations that specifically address the needs of people living with HICP. Based on this opportunity, this thesis focuses on the potential for urban park design to help reduce the effects of HICP.

How can urban park design help reduce the effects of high-impact chronic pain?

METHODOLOGY

3.1 Introduction

This thesis uses the approach of a systematic review of journal articles to identify factors of green space that improve health outcomes as well as factors specifically related to high-impact chronic pain that reduce symptoms. Systematic reviews follow a series of specified steps: determine the question, review the literature, filter the studies, assess the quality, calculate the outcome measures, and interpret the results (Gopalakrishnan and Ganeshkumar 2013).

As the two areas of research are disparate from each other, the systematic review process was conducted twice, once with each area of study, to properly filter articles that span the breadth of these two areas. Outlined below are the steps of the method chosen as well as the strengths and limitations of the chosen method.

3.2 Rationale Behind Chosen Methodology

The foundation of this research lies in the idea of combining two areas of research, high-impact chronic pain and urban park design for medical therapy, to provide design recommendations that enhance health outcomes for the population of individuals with HICP. To achieve this outcome, a research method is required that elicits the latest developments in each area that can be combined to develop appropriate recommendations. As both research areas are relatively new, few professionals have experience or expertise in modifying urban park design specifically for public health purposes. Thus, interviewing experts either directly or through surveys, which is a standard methodology in design recommendation efforts, is not a viable approach. Additionally, since identifying individuals who have HICP or similar afflictions runs into privacy issues that go beyond the scope of this effort, the potential to survey these individuals is not appropriate. Finally, using observation techniques to observe individuals using a specific park is not appropriate since few parks have intentionally made these modifications, and thus, reachable parks are not available for observation studies.

The inability to use these standard design research approaches creates several issues including: the lack of expertise significantly reduces the potential for primary sources to provide direct input into what factors should be considered in the study; the lack of precedents reduces the potential to develop recommendations from critically acclaimed design installations; health privacy issues inhibit the ability to directly obtain information from individuals with HICP. Furthermore, in terms of working with individuals with HICP, the lack of resources available to do an accepted pain study of a large population would make it difficult to understand if there were true associations between the tested design variables and improved health or if other confounding factors caused the result. The combination of these limitations requires a methodology outside the standard design research approaches, but which allows a final outcome of design recommendations.

In determining an appropriate methodology to overcome the identified limitations of standard approaches, the evaluative criteria included that the methodology: allowed for a large body of research to be analyzed and synthesized across disciplinary boundaries, the technique minimized bias in the research results being studied from issues such as confirmation bias that may occur due to inappropriate survey or interview techniques, and the technique must be applicable to multiple bodies of knowledge as this effort synthesizes both

design and public health data.

The methodology selected in response to these criteria and the stated limitations is a systematic review. A systematic review is formally defined in the Cochrane Handbook for Systematic Reviews of Interventions as follows:

> A systematic review attempts to collate all empirical evidence that fits pre-specified eligibility criteria in order to answer a specific research question. It uses explicit, systematic methods that are selected with a view to minimizing bias, thus providing more reliable findings from which conclusions can be drawn and decisions made (Higgins et al. 2019).

The Canadian Institutes of Health Research updated this definition into the PRISMA statement which defines systematic reviews as follows:

> A systematic review is a review of a clearly formulated question that uses systematic and explicit methods to identify, select, and critically appraise relevant research, and to collect and analyze data from the studies that are included in the review (Moher et al. 2009).

The systematic review methodology allows for the analysis and synthesis of existing research studies to extract key findings with the explicit goal of answering a research question by using a series of defined steps. More than 8,000 systematic reviews are published each year in the field of public health, making it one of the most common research methodologies utilized for examining multiple research efforts to extract key findings (Chalmers and Fox 2016). As seen in Figure 3.1, these steps formalize the study review process to narrow the population of potential studies down to a set that specifically addresses the question of interest. At the core of the process is the identification of potential research studies previously published, the narrowing of the studies by specific filters, and the extraction of key findings based on relevance to the research question. By using peer-reviewed studies for appropriateness of technique, the systematic review does not rely on an individual study for final conclusions. Rather, by combining multiple studies, the systematic review brings together related efforts into a single focal point based on the research question thus reducing the possibility of bias or relying on a study with inappropriate research methodology. In the context of the current thesis research, the systematic review process allows for a review of a broad range of existing public health and design research efforts to synthesize the findings into a single set of design recommendations following an established methodological approach.

In summary, the use of the systematic review methodology addresses the limitations of typical design research methods by eliminating the need for the author to directly interview experts, interview individuals with the specific health condition, observe individuals in a specific location, or evaluate imperfect precedents. The systematic review process also addresses the critical requirements to reduce bias, work across multiple disciplines, and allow for the synthesis of multidisciplinary results. Concurrently, the systematic review methodology allows the research to incorporate a breadth of studies on effective strategies for HICP as well as studies on the effectiveness of urban parks in enhancing physical and mental health. The inclusion of this breadth of studies then allows for the synthesis of findings into a single set of recommendations that reflect the combined research of both fields of study.

3.3 Implementation of Methodology

The implementation of the systematic review for this thesis followed the process diagrammed in Figure 3.1. Specifically, the four steps of identification, screening, eligibility, and inclusion were systematically followed to produce a final

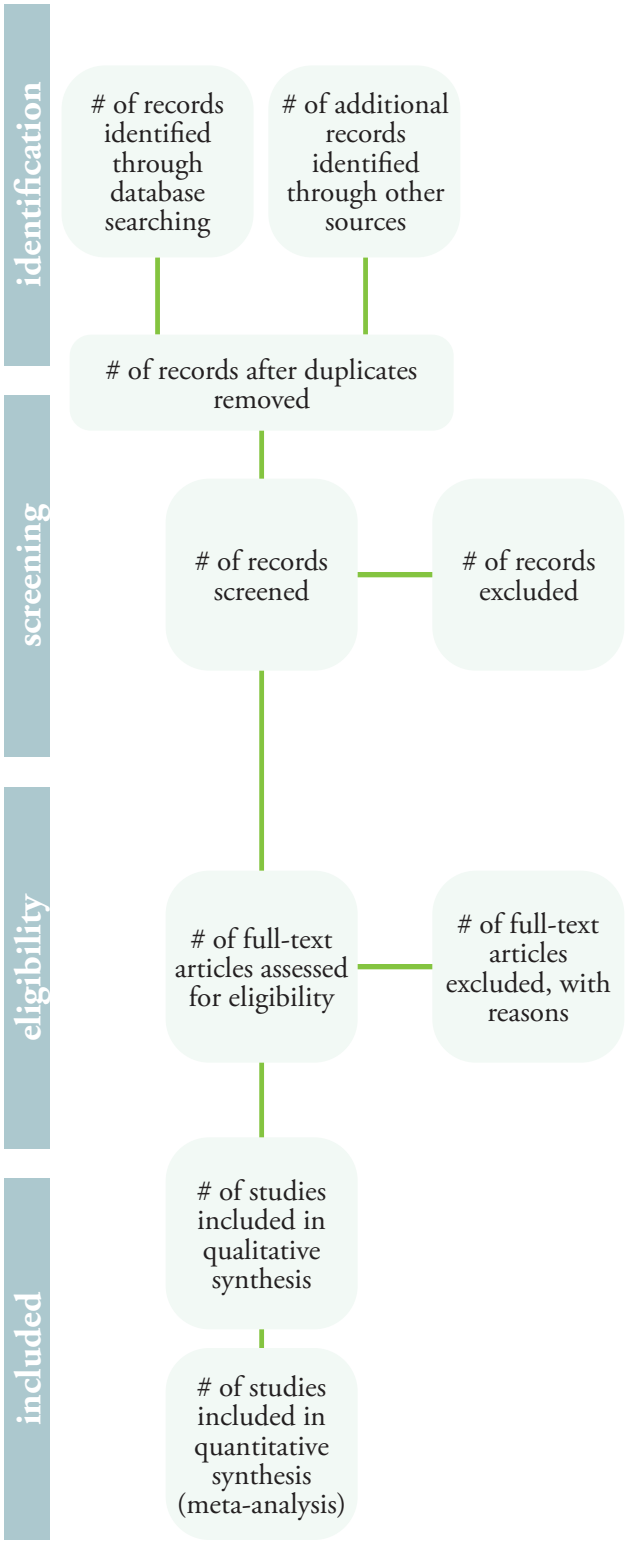


Figure 3.1 Diagram of systematic review methodology. Adapted from Moher et al. 2009.

set of research articles used to develop the final recommendations. As detailed above, this process is the core that every research effort in the public health domain is required to follow to be considered a valid systematic review. In the context of the current research effort, the individual steps are detailed below. The underlying emphasis in each step was to remain focused on the overall research objective of providing recommendations for urban park design to support individuals with HICP. Keeping this as the focal point enabled the research process to remain in scope and ensured that each study selected for the final group was directly related to the overall research question.

3.3.1 Identification of Articles

The first step in the systematic review process is to identify the population of studies that may potentially be used to answer the research question. Identifying this population requires selecting one or more databases of research articles that contain the full population of research articles relevant to the research question. As detailed by Jahan et al. (2016), an extensive search strategy utilizing authoritative databases minimizes bias in the review process. The databases supporting the research question in this thesis were selected based on established guidelines for selecting sources (Bain 2022). For the medical component of this research that addresses physical activities that reduce HICP, the identification process identified the PubMed database as the authoritative resource for relevant articles. Similarly, for articles on the physical and mental health benefits of green space, the Web of Science was identified as the authoritative resource for the design elements. Both databases were used to identify articles in the two bodies of research to ensure thoroughness and completeness.

The next step in the identification process was to identify the population of articles that would be used as the initial set from which to filter. This

identification process requires the use of keywords to narrow the thousands of potential studies in the databases down to an initial group that has the direct potential to address the research question. Through this process, eligibility criteria are established to form the boundaries of the systematic review (Jahan et al. 2016). In the current effort, the two research bodies had multiple topics from which keyword searches were made to establish criteria. For the HICP research, there were keyword searches related to exercise and keyword searches related to mental health. For the urban park benefit research, keyword searches were related to mental health, physical health, and exercise. The set of keywords for each topic used for the identification process are shown in the following diagram.

The conclusion of the identification process for HICP pain management through physical activity and mental health management resulted in the identification of 242 articles. These articles cover research from posttraumatic stress symptoms from chronic pain to adventure therapies.

The conclusion of the identification process for the health benefits of green space resulted in the identification of 807 articles. These articles cover research from forest walking to sensory engagement.

3.3.2 Screening

The second step in the systematic review process is to screen the initial population of articles by comparing the abstracts of each article against the research question and excluding articles not directly related to the topic of interest. In the abstract review, articles relating to non-pharmaceutical

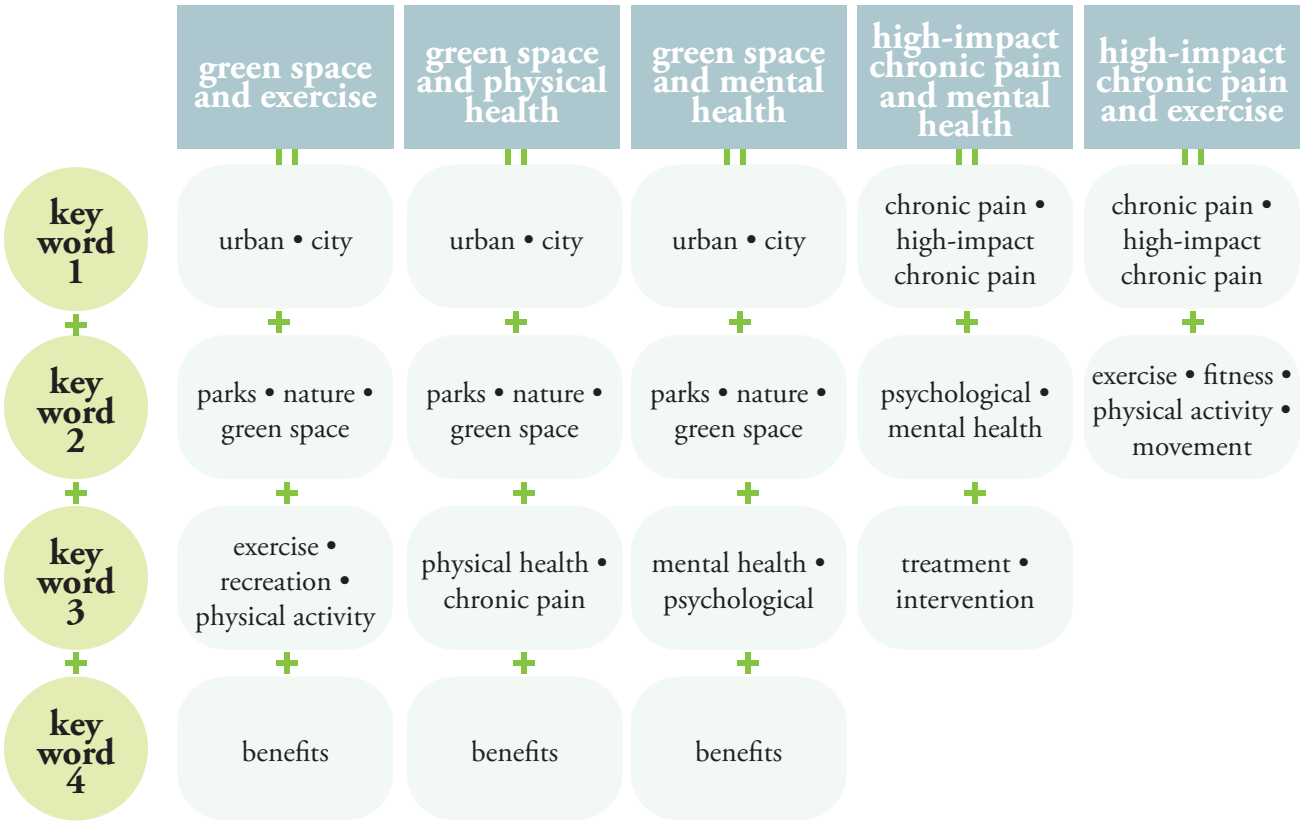


Figure 3.2 Diagram of keyword searches used to identify articles for systematic review.

therapies outside of utilizing green space as well as new medications for pain were eliminated from the HICP population. Concurrently, articles on urban green spaces' impacts on climate change and social cohesion were removed from the green space population. The conclusion of the abstract review process reduced the eligible population to 97 HICP articles and 273 green space articles.

3.3.3 Eligibility

The third step in the systematic review process was determining the eligibility of studies based on full-text analysis, also referred to as content analysis. In particular, the introductions, results, and conclusions of the articles provided key information to determine eligibility. The eligibility process is where a focus is put on the specific parameters and results of a study. Eliminating studies that did not have the appropriate study populations, did not focus on the appropriate outcome, or introduced factors outside the focus of the current research are all examples of why an article could be filtered out during the eligibility process. As with the screening of the abstracts, the key to this phase is retaining the focus on the overall research question to avoid introducing subjectivity and bias.

Of particular interest in the eligibility phase was the elimination of articles in the HICP population that could not associate specific physical activity factors with positive outcomes for HICP treatment. Similarly, articles were eliminated from the green space population that did not clearly state the factors of physical or mental health benefits of green space. These eligibility screenings eliminated studies that may have addressed physical activity benefiting HICP or the role of urban parks in enhancing physical health, but which failed to provide specific results that could be synthesized into broader recommendations. This left a population of articles where each article concluded with specific results and/or recommendations regarding either the role of physical exercise or mental health treatment in HICP, or enhancing physical and mental health through urban parks.

This left a total of 123 articles, 87 green space articles and 36 HICP articles, for the Included phase of the systematic review process.

3.3.4 Included

The final step in the systematic review process is to conduct a final review of the studies to determine what studies should be included in the final review set. In this review process, the full-text of the articles was reviewed specifically against the research question to obtain a set of final articles where each may contribute to developing new design recommendations. A key element of this final review process is to ensure that articles are not eliminated for any reason other than they may not directly address the research question. As other factors such as type of study were included in previous filtering stages with the specific purpose of developing a set that met the research criteria, the inclusion of additional factors in the final stage could lead to a bias in the final outcome (Needleman 2002).

Given the guideline to not include additional factors in the final stage, the final filtering focused on eliminating studies that did not include specific findings related to the research question. In this case, the final filtering focused on eliminating any papers that did not include recommendations, associations, or guidelines that were based on the trials or summaries reported in the paper. In this manner, the final set for the Included phase were papers with results that could be combined to form the final recommendations for the report. The conclusion of this final filtering process resulted in 30 papers related to HICP recommendations and 65 papers related to urban park usage.

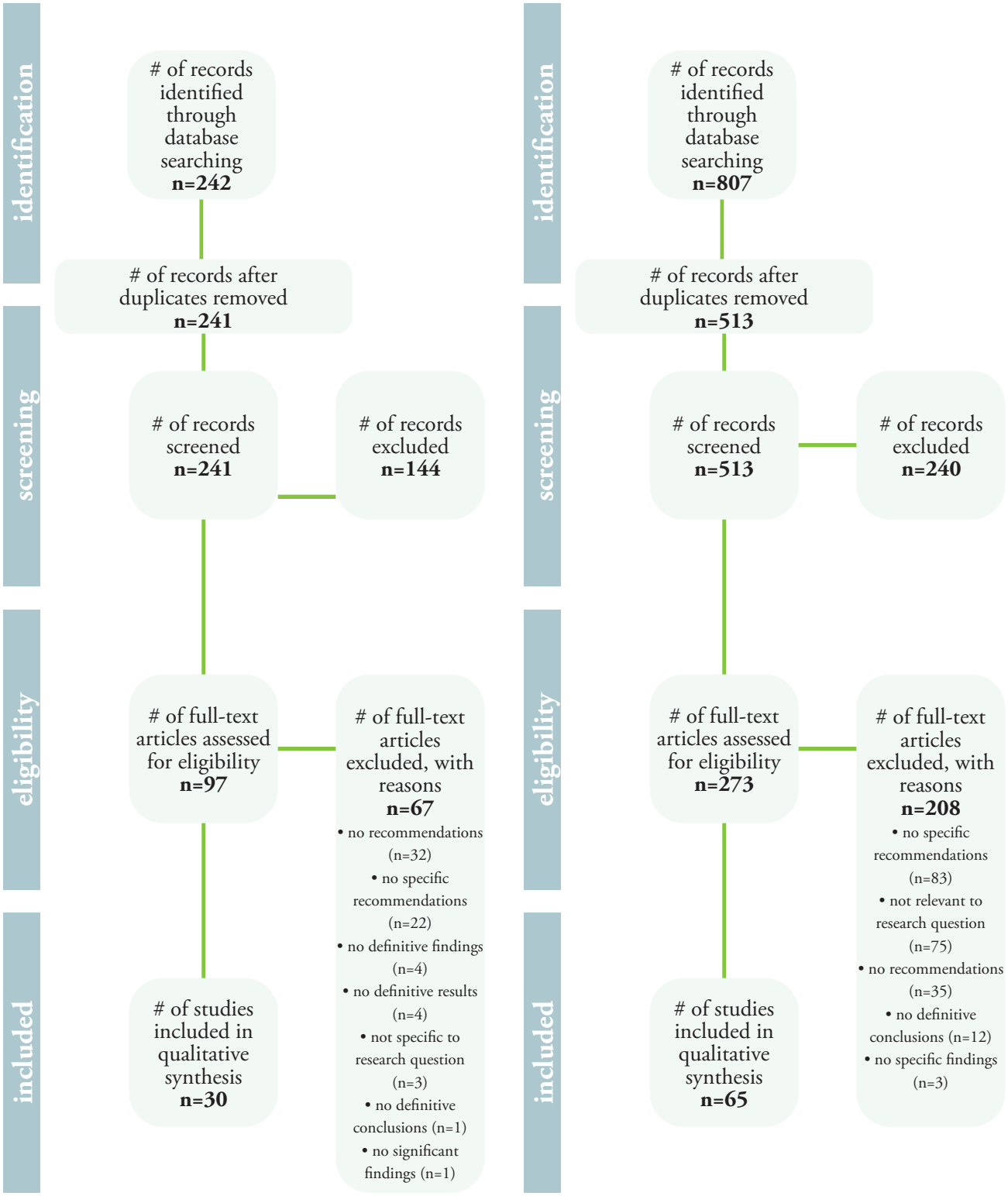


Figure 3.3 Diagram of systematic review methodology with exclusion criteria for high-impact chronic pain articles (left) and green space articles (right).

3.4 Qualitative Coding

Once the final set of papers was determined from the screening and filtering process, the process of extracting and combining recommendations and findings from this study commenced. In a systematic review, there are two possible paths that can be taken in analyzing data, quantitative and qualitative. In a quantitative approach, statistical methods are employed to develop a meta-analysis. This approach is typically implemented when large sample sets are available and the focus is on determining the agreement among studies and the validity of individual findings (Simunovic, Sprague, and Bhandari 2009). This approach has the advantage of providing a statistical lens on the data for an additional level of confidence in the findings. However, it is only relevant in cases where large data sets can be parsed on specific factors such as age or gender. Public health studies incorporate meta-analysis techniques typically when population or longitudinal studies are undertaken on large groups of individuals (Mosteller and Colditz 1996).

While a quantitative approach has the advantage of statistical inquiry and confidence analysis, it is not appropriate in areas where the data is less categorical or the focus is on exploration and discovery. Specifically, in cases where the data is primarily narratives, or the data is from small sample sizes, qualitative methods provide the flexibility to iterate within the process and focus on emergent discovery where the findings emerge as further data and studies are reviewed (Tolley et al. 2016). When these qualitative techniques are incorporated, the analysis is formally referred to as a systematic review. This is the process adopted for this study as the research question required an emergent process of finding the specific recommendations for HICP patients.

The specific qualitative approach adopted for this thesis was to conduct a content analysis of the final set of papers to extract common findings through a process of coding keywords and phrases. In this process, each paper was read and key findings related to associations and recommendations were highlighted and included in a spreadsheet to allow for frequency analysis.

The completion of the coding process provided the opportunity to combine categories into key takeaways. The key results then provided the seeds for a summative analysis where the findings could be interpreted into key findings. For example, the coding of studies that highlighted the benefits of walking and walking trails in treating HICP led to the key recommendation that walking trails should be included in urban parks for the benefit of increasing walking as therapeutic exercise. This process was repeated over the course of the coded phrases to develop individual recommendations. The totality of these key findings then formed the foundation of the recommendations presented in this research. In this manner, the methodology followed the protocols laid out for systematic reviews by established bodies and captured in the PRISMA statement.

3.5 Limitations of Chosen Methodology

The systematic review method is well-established in the public health domain. As detailed in this section, thousands of systematic reviews of research are performed each year. The reviews cover all areas of public health and provide a benefit by bringing numerous and diverse research results together into summaries that spotlight findings across the studies. The explicit guidelines for a proper systematic review make the methodology repeatable for numerous topics. However, the use of this methodology does have limitations.

First, a systematic review relies on secondary sources to develop new conclusions and recommendations.

This method requires the researcher to select studies adopting appropriate research methods in the process of generating results. There is a chance that these individual studies may not have implemented their methods appropriately and thus the secondary use of the data could incorporate those original issues. Thus, a limitation of the method is the dependence on the researcher to filter out primary sources that may not meet the standards required in the systematic review.

Second, the systematic review methodology could introduce bias in the filtering process if the rules for filtering are not followed explicitly. Bias should not enter the filtering process if the guidelines for a systematic review are followed by the researcher. The filtering process should be restricted to a focus on the research question and on primary results that directly answer the question as stated. However, it is possible for a researcher to start including other primary studies by broadening the context of the research question, or including studies that are not objective in their findings, or including studies that the researcher may find interesting but are not related to the core question.

Finally, the systematic review method has a limitation in that primary sources are being reinterpreted in a secondary study. While this is not an issue where quantitative results are being synthesized into a larger data set and analyzed, if the individual studies are all qualitative in nature, then the systematic review would be combining qualitative results into new qualitative results. This process introduces opportunities for bias, misinterpretation, and misuse of the previous results. In the cases where qualitative results are being used, the baseline requirement to focus on the research question needs to remain at the forefront of the effort to minimize the misuse of primary data.

RESULTS

4.1 Introduction

Chronic pain management is advancing in both pharmacological and non-pharmacological areas. The non-pharmacological treatment area is seeing significant gains in the inclusion of exercise, mental health support, and nature exposure as part of an overall pain management regimen. Studies demonstrate that individuals who participate in activities such as yoga, strength training, and walking obtain relief from chronic pain. As a result of these findings, alternative treatment options are becoming central components of chronic pain treatments. Concurrently, the medical benefits of green space in urban areas are being documented in multiple studies, building on a decade of research in the area. These studies are finding that green spaces provide both medical and psychological benefits to individuals living in urban areas. In particular, these spaces create improved psychological outlooks, as well as overall health benefits.

The results of the research conducted in this thesis bring green space benefits and chronic pain management together in a series of recommendations for urban parks to serve as non-pharmacological aids in treating individuals with chronic pain. The following sections introduce these recommendations through a series of steps that reflect the systematic review methodology employed in this effort. First, the final results of the coding process are presented for both urban parks and non-pharmacological treatment of HICP. These results are each presented together with recommendations based on the findings from the coding process. These individual recommendations are then combined into a set of final recommendations that represent the overall contribution from this effort.

4.2 Park Coding Results

The results of the coding effort detailed in the previous chapter are presented in Table 4.1. As illustrated, the analysis of the studies included in the effort resulted in seven general categories. The categories are composed of related factors addressing similar issues within park design. The seven categories are summarized as follows:

- Frequency/Intensity/Duration - Factors addressing the level of use for individual parks
- Green/Natural Elements - Factors addressing the natural elements that enhance a park's usage and support for activities
- Activities - Individual activities that are typically found in a park environment
- Other Physical Attributes - Broad set of physical characteristics of parks including amenities and fitness support areas
- Other Factors - Non-physical attributes of parks that have been found to be important to users and impact frequency of use
- Management Attributes - Operational factors that need to be addressed to enhance park usage
- Improvements - Benefits of park usage for individuals as identified through research studies

While Natural Elements and Improvements might be expected because they focus on existing and proposed conditions, respectively, the remaining categories cover a range of topics from specific activity support to park management. Of these, Physical Attributes has the most subcategories with eleven, and Other Factors has the least with three.

As expected, the coding process for parks resulted in a significant number of papers focused on the natural attributes of parks. Specifically, research

Frequency, Intensity, and Duration		**Natural Attributes**	**46**	**Management Attributes**	
high greenness intensity	23	biodiversity	15	quality	6
longer duration	11	trees/tree canopy	14	aesthetics	3
increased frequency	3	water	8	maintenance	2
		lawns	5	cleanliness	2
Physical Attributes		natural topography	4	safety	1
walking trails	11	seasonality	3		
facilities/amenities	9	flowerbeds	2	**Other Factors**	
sports fields/courts	4	minimal grass	2	calm/less noise exposure	5
large park size	4			sensory experiences	3
open areas	3	**Activities**	**20**	programming	1
views	3	walking	9		
fitness equipment	3	socializing	8	**Improvements Tracked**	
visibility/openness	2	cycling	4	improved mood	42
play equipment	2	jogging	2	better physical health	21
plazas	1	water activity	1	more frequent exercise	19
lights	1	commuting	1	longer exercise duration	4
				decreased pain	4

Table 4.1 Results of coding park journal articles, grouped by similar themes.

is increasing on the benefits of biodiversity and specific types of green space. Significant attention is also placed on the types of activities that should be supported in a park, as well as the maintenance and safety requirements to promote park usage.

The most common improvements that were tracked in the papers were improved mood, better physical health, and more frequent exercise. The recommendations presented below are anticipated to provide similar benefits as they were developed based on these original findings. Specific factors from these studies have been coded and are incorporated into the final recommendations and the sample interventions presented with the guidance.

Each of these areas identified during the coding process influenced and is reflected in the recommendations presented in the next section.

4.3 Park Recommendations

The process of moving from coding to recommendations focused on creating summary recommendations that reflected the key findings from the coding process. Therefore, the items presented in Figure 4.1 do not represent a one-to-one correspondence with the coding categories. Instead, the recommendations reflect combinations of elements from the seven categories. For example, biodiversity in parks reflects coding categories including high-greenness intensity, large park size, biodiversity, trees/tree canopy, flower beds, minimal grass, aesthetics, and sensory experience. As each of the recommendations reflects multiple

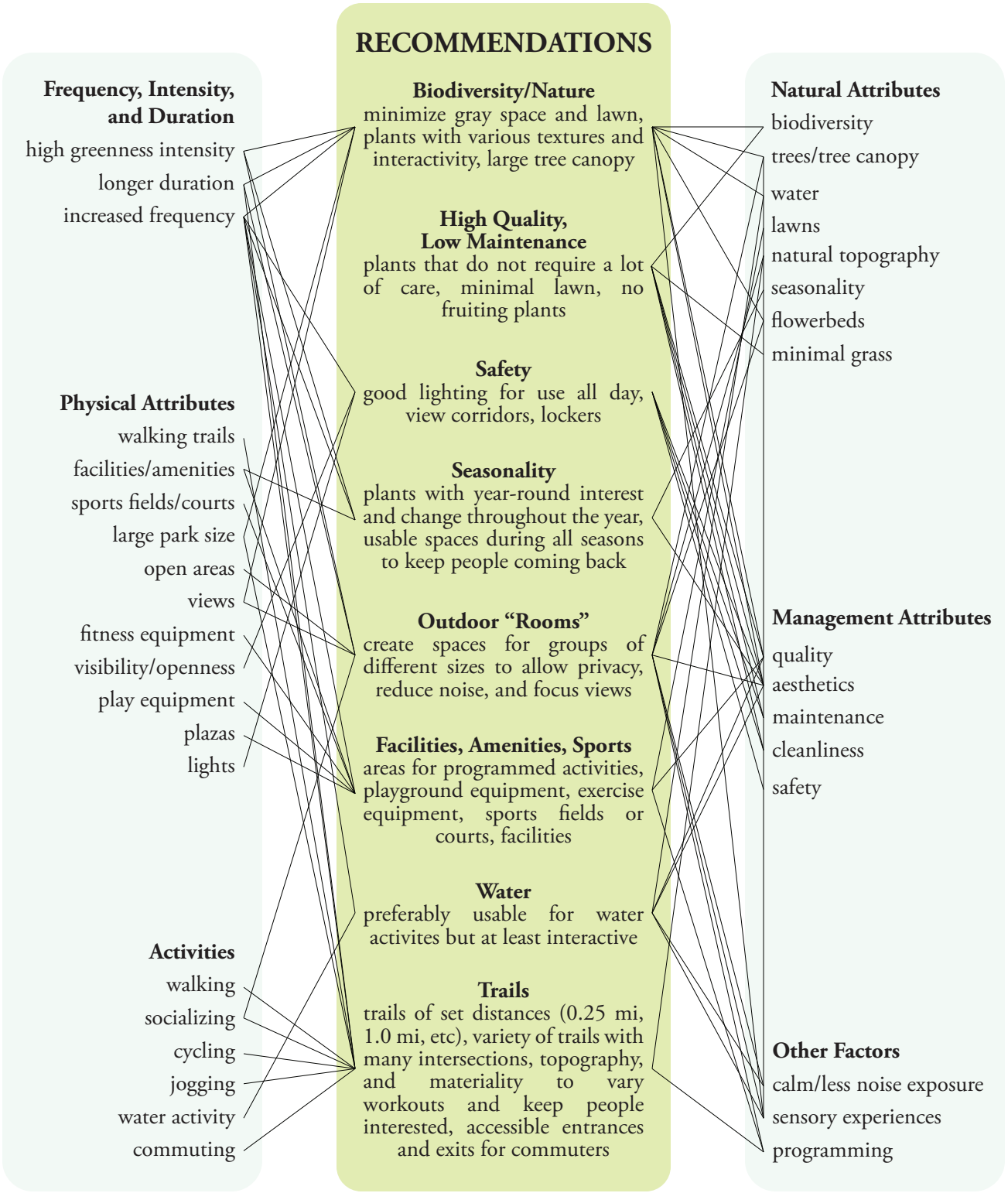


Figure 4.1 Diagram of eight park recommendations showing which factors from the journal article coding were combined to make each recommendation.

coding categories, there is no exclusive relationship between recommendations and categories. Rather, the coding categories inform a broader recommendation that reflects the influence of multiple categories. These recommendations are intended to be guidelines that designers and managers of urban parks should follow. For example, recommendations related to greenness and amenities are targeted at design, while recommendations focusing on safety and maintenance are targeted at operations. The combination of these perspectives is meant to produce a park that is both welcoming to users, as well as supportive of regular and repeated use.

4.4 HICP Coding Results

The coding effort for the HICP research papers followed the same process as that used for urban parks. As with parks, the transition from coding to HICP recommendations initially focused on developing categories of factors. Similar to the urban park category development, the HICP categories group similar factors under representative headings. The seven categories developed from the HICP papers are as follows:

- Frequency/Intensity/Duration - Factors related to the level of exercise found to benefit individuals with HICP
- Movement Therapies - A range of movement-based therapies identified as beneficial for HICP treatment
- Exercise - Factors related to the general types of exercise, aerobic, strength, and stretching,

Frequency, Intensity, and Duration		**Categories of Exercise**	**27**	**Other Factors**	
moderate-high intensity	7	aerobic exercise	8	self-efficacy	4
2-3x/week	2	strength training	5	motivation	3
at least 30 minutes	2	flexibility	4	support of others	2
low-moderate intensity	1	combination	4	good attitude/experience	1
Movement Therapies	**12**	**Recommended Exercise**		**Improvements Tracked**	
tai chi	7	walking	7	decreased pain	27
yoga	6	body awareness exercises	1	increased functioning	12
multidisciplinary rehab	3	pool exercises	1	improved mood	10
mindful stress reduction	2	cycling	1	reduced fear of exercise	7
pilates	2			improved quality of life	6
qigong	2	**Other Methods**		greater resiliency	1
dance	1	psychological therapies	5		
		going outside	1		

Table 4.2 Results of coding chronic pain journal articles, grouped by similar themes.

that are beneficial for HICP

- Types of Exercise - A group of exercises not included in movement therapies that are recommended for individuals with HICP
- Other Methods - Non-exercise based therapies that complement exercise to provide HICP improvement
- Other Factors - Factors related to the individual's role in successfully benefitting from exercise

Improvements - Factors related to HICP benefits that can be achieved from exercise

The seven categories can be broadly divided into two groups: benefits and therapies. This reflects the two general focal points in medical research; determining new treatments for conditions and determining the efficacy of treatments that are put in place. The benefits group includes both physical and psychological benefits. Similarly, the therapy group consists of both movement therapies and guidelines for intensity and duration. The combination thus provides an overall perspective on how exercise can offer a non-pharmacological approach to HICP treatment.

The improvements tracked in these journal articles were significant to the final recommendations as decreased pain, increased functioning, and improved mood were top priorities in the development of the recommendations. While decreased pain and improved mood are important benefits, increased function and improved quality of life are even more vital to people with HICP because of the potential to participate fully in daily activities that had to previously be missed. Furthermore, reduced fear of exercise and greater resiliency are also crucial because they both increase motivation and improve self-efficacy, which are important factors to increasing exercise adherence and will further decrease pain.

4.5 HICP Recommendations

The recommendations derived from the HICP coding categories are not a one-to-one correspondence. Rather, the guidance represents the overall themes in the categories. From the therapies perspective, the recommendations detail the variety of beneficial treatments to individuals with HICP. These are divided between long-established therapies, including support for walking and cycling, and emerging therapies, such as movement therapies that have positive initial results according to research results.

From the operational concerns perspective, the recommendations focus on creating a welcoming environment and supporting an exercise regimen. For the former, there is an emphasis on creating a safe environment to encourage individuals to visit a park. For the latter, the guidance is to encourage individuals to keep a sustained exercise regimen of three times a week for thirty minutes each day. Combined, these recommendations focus on creating a welcoming and supportive environment that will encourage individuals to engage in the level of exercise required to benefit HICP.

4.6 Final Recommendations

The final recommendations presented in this study combine the urban park and HICP guidance into a single set intended to support HICP therapy through urban park design and management. The development of the set focused on combining related items from the two individual groups into a single representative set. The set is divided into recommendations having to do with nature (green) and the built environment (blue). This set intends to fill the gap in knowledge of how urban parks can be leveraged to address medical conditions, in this case, HICP.

Each recommendation is summarized below, including the factors addressed and examples of

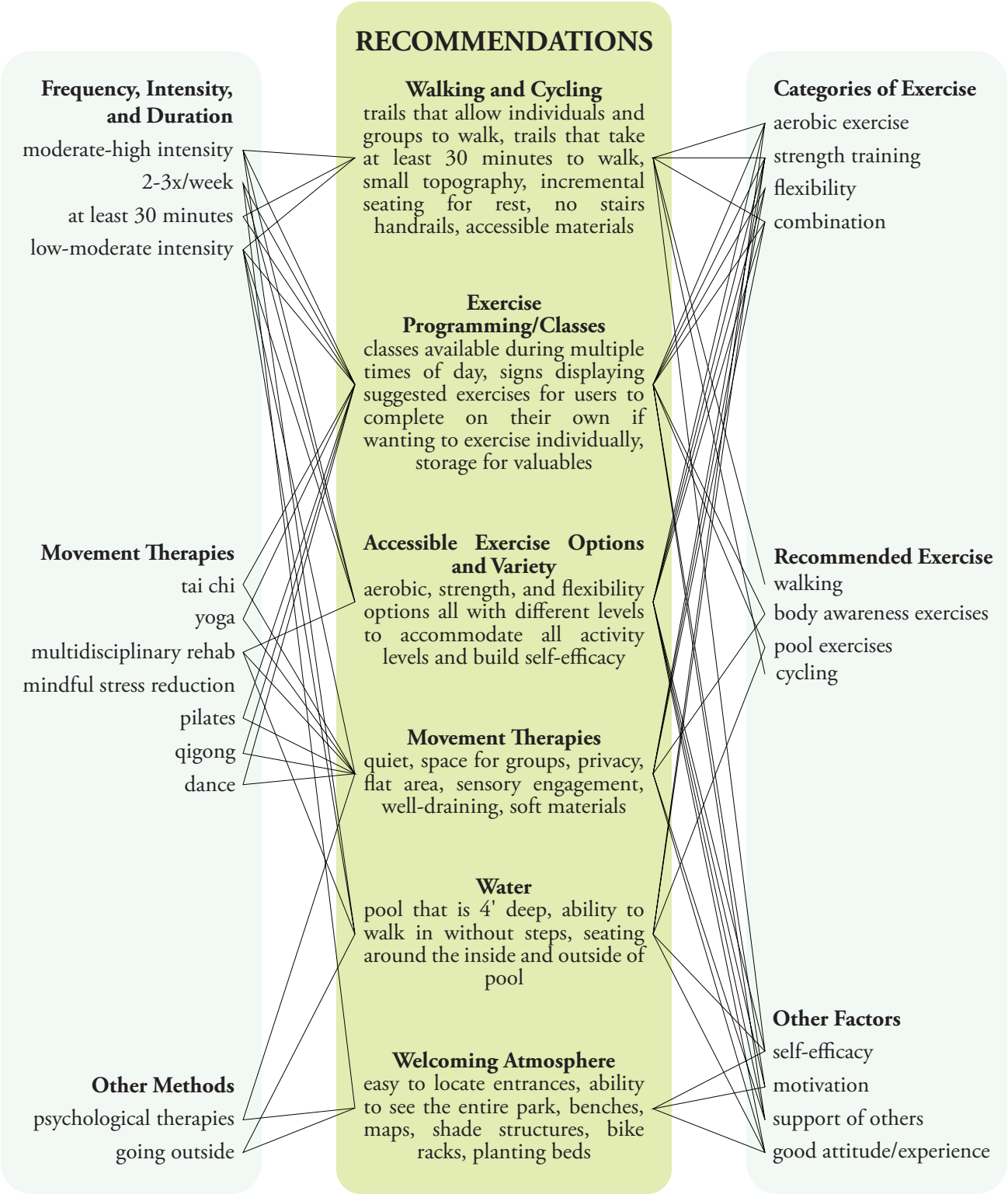
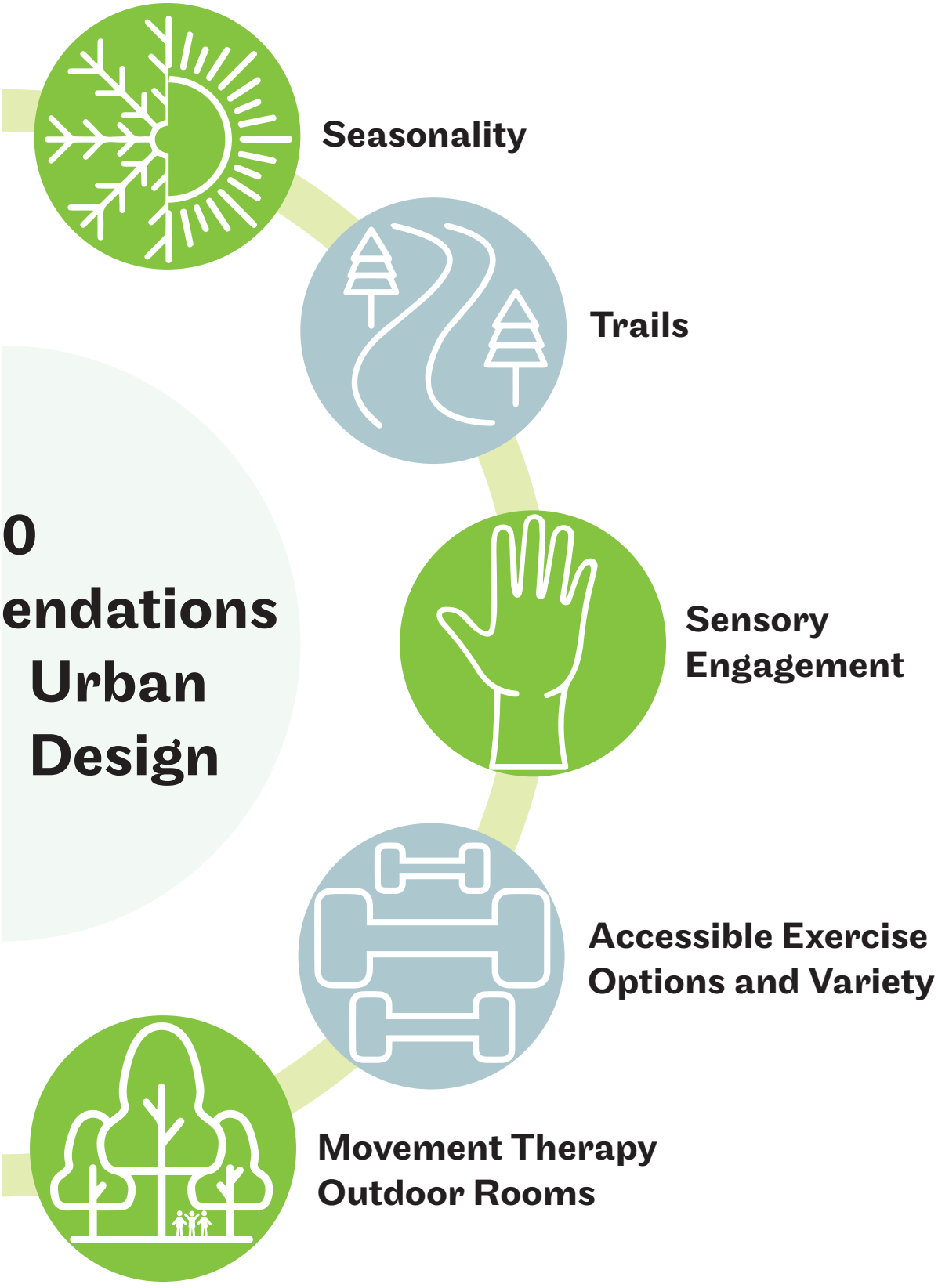


Figure 4.2 Diagram of six chronic pain recommendations showing which factors from the journal article coding were combined to make each recommendation.

suggested interventions. The interventions do not represent an exhaustive list and are intended to be an introductory set of examples. Additionally, the interventions could be appropriate for multiple recommendations and are not intended to be exclusive for the single guidance point. The overall focus on the guidance, however, does not change. As detailed in the following sections, each item addresses a group of factors and is intended to be implementable in a broad range of urban park scenarios.

Figure 4.3 Final recommendations.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endations
Urban
Design
Seasonality
Trails
Sensory
Engagement
Accessible Exercise
Options and Variety
Movement Therapy
Outdoor Rooms

Welcoming Atmosphere and Safety

The user's first impression of a space is crucial to getting them to use the space, and safety is a key element in people returning, as well as for creating an environment that allows for relaxation. Hence, parks should be designed to be welcoming from all entrances and feel safe.

Suggested Interventions

To create a welcoming environment, entrances to the park should be easy to locate and have view corridors to see the entire park. Seating areas and amenities, such as benches, shade structures, and bicycle racks should be placed near the entrances. A map of the park should also be located at the entrance for wayfinding. Additionally, planting beds and other natural features will help draw people in from the busy urban area.

For safety, view corridors are also important to ensure there are no places to hide. In semi-private areas, tall grasses, deciduous trees, or other plants that are not dense should be used to create the feeling of enclosure without blocking sightlines. Lighting is also a key element for safe park use at night. Lighting should be sufficient to illuminate the entire park and not leave any dark areas. Finally, lockers should be included in the design for users to store their belongings while exercising without the fear of having them stolen.

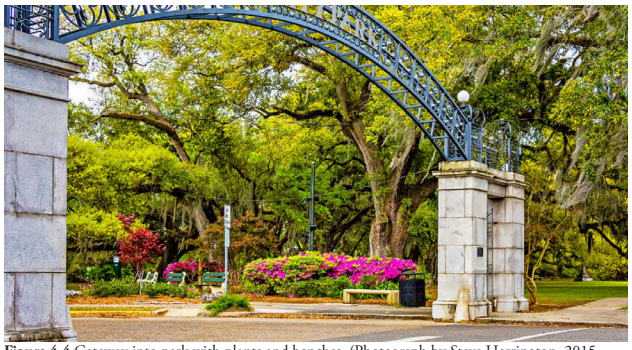

Figure 4.4 Gateway into park with plants and benches. (Photograph by Steve Harrington. 2015. City Park Entrance. https://fineartamerica.com/featured/city-park-entrance-steve-harrington.html.)

Figure 4.5 Sightlines. (Photograph by City of Boulder. 2014. Foothills Community Park. https://www.10best.com/destinations/colorado/boulder/boulder/attractions/foothills-community-park/.)

Figure 4.6 Outdoor lockers. (Photograph by Gantner Group. 2017. Lockers 2 Attraction. https://www.gantner.com/lockers-2-attraction/.)

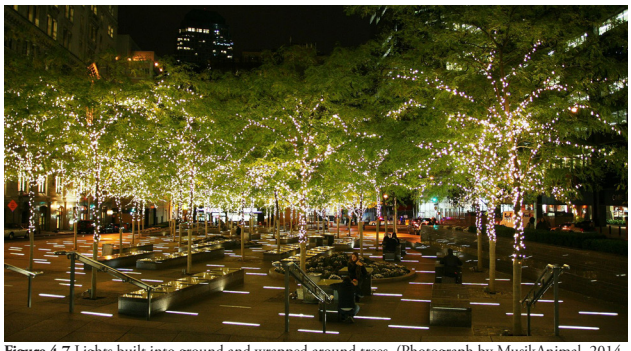

Figure 4.7 Lights built into ground and wrapped around trees. (Photograph by MusikAnimal. 2014. Zuccotti Park. https://en.wikipedia.org/w/index.php?title=Zuccotti_Park&oldid=1038300662.)

High Quality, Low Maintenance Nature

Parks that are well-maintained are more likely to be used; however, natural areas with biodiversity in species are more desirable. Therefore, parks should be designed with vegetation that requires little maintenance, while still being aesthetically pleasing.

Suggested Interventions

Native plants allow for high-density plantings that require little maintenance. Native plants are acclimatized to the weather conditions of the area, meaning that watering the vegetation will be minimal or nonexistent. Native plantings also allow the plants to follow their natural lifecycles, which reduces the need for maintenance and pruning. Additionally, plants should be chosen that do not drop fruits or seeds as another way to minimize maintenance.

Lawns should be kept to a minimum, as they require a significant amount of water to look attractive and require regular maintenance from spring to autumn. In areas where lawns may be desired but will not have heavy foot traffic, ground-covers are recommended as a low-maintenance solution.

Gray infrastructure should be kept to a minimum, as green space is more desirable in parks. Natural materials, such as wood and stone, should be used instead of concrete for their permeability and aesthetic cohesion.

Figure 4.8 Colorado native planting bed. (Photograph by Denver Botanic Gardens. n.d. Native Collection. https://www.botanicgardens.org/our-collections/living-collections/native-collection.)

Figure 4.9 Thyme groundcover. (Photograph by High Country Gardens. n.d. Pink Chintz Creeping Thyme. https://www.highcountrygardens.com/perennial-plants/thyme/thymus-pink-chintz-nm.)

Figure 4.10 Low maintenance maple tree. (Photograph by Paul Cox. 1988. Acer Grandidentatum. https://www.wildflower.org/plants/result.php?id_plant=acgr3.)

Figure 4.11 Premeable accessible stone path. (Photograph by TRUEGRID Paver. 2020. The Many Benefits of Permeable Walkways. https://www.truegridpaver.com/permeable-walkways/.)

Facilities, Amenities, Sports

Facilities, amenities, and sports fields/courts cover a broad range of designed park features. Amenities are the anchor facilities to draw users into parks and are key to encouraging exercise. The quality and diversity of these elements are signs of a high-quality park and in turn are the most frequently used.

Suggested Interventions

Spaces of different sizes should be made for programmed fitness classes of various sizes. Twenty square feet per individual is a typical yoga studio size and can be used as a guide for creating an appropriately sized area. These areas should be flat and well-draining for enjoyable exercise experiences.

Playground equipment is also an important part of the park design so children can also exercise and enjoy the park. Playgrounds should be located away from the entrances for safety reasons.

Exercise equipment should be spread throughout the park to promote movement between stations. Wayfinding signs should help users navigate from one place to another.

Facilities should be located centrally in the park for easy access. A plaza should surround the facility for outdoor events.

Sports fields and courts should also be included.

Figure 4.12 Space for exercise class. (Photograph by Denver Botanic Gardens. 2021. Sunrise Vinyasa Yoga. https://303magazine.com/2021/06/summer-outdoor-workouts-2021/.)

Figure 4.13 Park gathering area with facilities and plaza. (Photograph by Design Concepts. n.d. Centennial Center Park. https://www.dcla.net/center-park.)

Figure 4.14 Outdoor fitness equipment. (Photograph by COLMEX. n.d. Fitness Parks for Everyone. https://www.colmex.eu/.)

Figure 4.15 Basketball court. (Photograph by Charlottesville Parks & Recreation. n.d. Basketball Court Washington Park 2. https://webtrac.charlottesville.gov/wbwsc/webtrac.wsc/iteminfo.html.)

Water

Water features draw people to parks, improve mental health, provide calming noise, and are more desirable to exercise near. Therefore, parks should be designed with multiple forms of water features.

Suggested Interventions

Moving water, such as a stream or fountain, can create a calming soundscape and should be placed in calmer areas of the park. People prefer exercising near water, so trails and flat grassy areas to exercise should be situated around a pond. In drier climates where water features are not feasible, bioswales can be used to create water areas when available.

Water features should act as catchment areas for rainwater on the site to create a sustainable water system and prevent flooding in the park. This requires topography that angles toward the water feature.

If a pool is being considered on the site, it should be four feet deep for pool exercises. The pool should also have a sloped entrance so users have the ability to walk into the pool. Finally, seating should be placed along the inside edges of the pool for rest.

Figure 4.16 Seating area next to stream. (Photograph by City of Sugar Land. n.d. Oyster Creek Park Stream and Seating. https://www.sugarlandtx.gov/facilities/facility/details/Oyster-Creek-Park-13.)

Figure 4.17 Pond with trails. (Photograph by Mike Newman. 2019. Hazel Evans Walking Trail. https://arkokhiker.org/outdoors/fort-smith-carol-ann-cross-park-hazel-evans-walking-trail/.)

Figure 4.18 Bioswale catchment area. (Photograph by Cornell University. n.d. Botanic Gardens Bioswale. https://sustainablecampus.cornell.edu/campus-initiatives/land-water/sustainable-landscapes-trail/botanic-gardens-bioswale.)

Figure 4.19 Pool with walk-in entrance. (Photograph by Active England. 2020. Chagford Lido. https://activeenglandtours.com/top-10-hidden-swimming-spots-in-the-south-west/.)

Motivational and Informational Signage

Lack of motivation and fear of pain are two of the main factors that prevent people from exercising. Motivational and informational signage would help encourage people to exercise, remove the stigma around chronic pain, and explain to people with HICP how they can exercise safely.

Suggested Interventions

Motivational signage should be placed throughout the park, especially near therapy trails and fitness equipment. Signs should address both frequency (two to three times per week) and duration (thirty minutes) of exercise.

Maps and other wayfinding signs should also be included to help guide people through the park.

Informational signage should include the benefits of exercise and parks. They should also explain the basics of HICP to educate users on these additional benefits of the park. All fitness equipment and areas for individual exercise should include signs of how to complete the exercise as well as options for levels of difficulty.

Figure 4.20 Motivational sign. (Photograph by AdobeStock. 2021. Great Things. https://www.wewishes.com/top-15-inspirational-achievement-quotes-about-success-and-greatness/.)

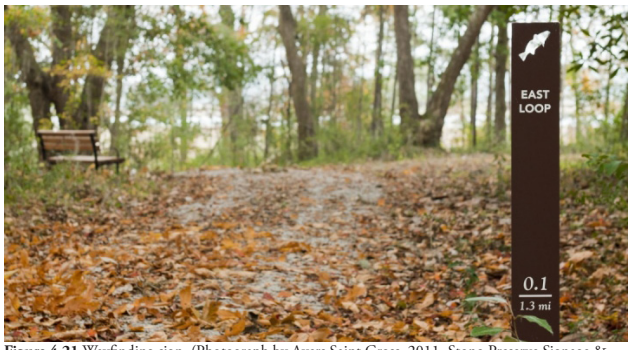

Figure 4.21 Wayfinding sign. (Photograph by Ayers Saint Gross. 2011. Stono Preserve Signage & Wayfinding. https://ayerssaintgross.com/portfolio/coc-dixie-graphics/.)

Figure 4.22 Informative signange. (Photograph by Katherine Gorge. 2021. Walking Track Interpretive Signage - Nitmiluk. https://interpretivedesign.com.au/portfolio/interpretive-projects/walking-track-interpretive-signage/.)

Figure 4.23 Fitness instructional sign. (Photograph by Boex. n.d. National Trust Outdoor Gym. https://www.boex.co.uk/portfolio/national-trust-outdoor-gym/.)

Movement Therapy Outdoor Rooms

Movement therapies engage both the body and the mind, making them highly beneficial for HICP. Outdoor "rooms" should be created in the park for these movement therapies that are semi-private to reduce noise and prevent self-consciousness.

Suggested Interventions

Planting beds and trees are helpful in creating outdoor rooms. Height and density are the two key factors in delineating where one "room" ends and the other begins; the denser and taller the vegetation, the more separate the areas feel. Shrubs and coniferous trees will create more enclosure than most grasses, perennials, and deciduous trees. Denser plantings can also function as a sound barrier as well as hide unwanted views.

Topography also divides spaces and can serve as a sound barrier; by lowering or elevating an area, the spaces become differentiated. For a more significant delineation of space, a combination of plantings and topography can be used. Additionally, raised planting beds create a physical wall, which also serves as a clearer separation of areas. Finally, changes in materiality will also separate spaces, such as a change from lawn to stone.

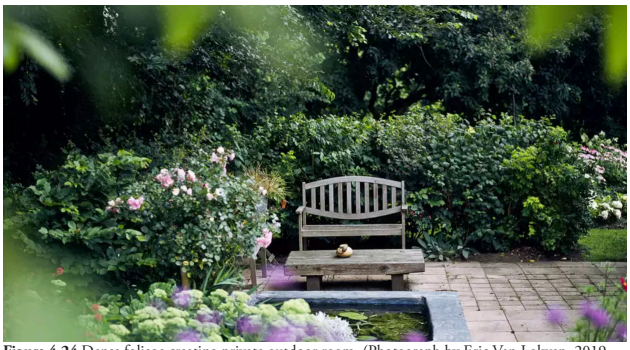

Figure 4.24 Dense foliage creating private outdoor room. (Photograph by Eric Van Lokven. 2019. How to Create Garden Rooms. https://www.thespruce.com/how-to-create-garden-rooms-4125822.)

Figure 4.25 Perennial planting bed creating semi-private outdoor room. (Photograph by Park Yoga. n.d. Park Yoga Class. https://parkyoga.co/.)

Figure 4.26 Topography creating separate spaces. (Photograph by Rob 't Hart. 2012. Fort Werk Aan 't Spoel. https://worldlandscapearchitect.com/fort-werk-aan-t-spoel-culemborg-netherlands-rietveld-landscape-atelier-de-lyon-with-anouk-vogel/.)

Figure 4.27 Topography and materiality dividing spaces. (Photograph by Miran Kambič. 2016. Koper Central Park. https://worldarchitecture.org/article-links/epnzv/enota-completes-a-new-central-park-with-undulating-urban-elements-in-coastal-town-of-slovenia.html.)

Accessible Exercise Options and Variety

A lack of self-efficacy is one of the biggest deterrents for individuals with HICP, and inhibits individuals from gaining the full benefits of exercise. Therefore, parks need to provide a variety of exercise options at different levels to allow users to feel successful and continue exercising.

Suggested Interventions

To make exercise accessible to all, there must be a combination of programmed fitness classes, instructional signs, and fitness equipment. This allows users to choose the modality that they prefer for physical activity. Additionally, all categories of exercise (aerobic exercise, strength training, and flexibility) should be included in the programming.

Classes should be offered at multiple times of day and on weekends to accommodate various schedules.

Signs and fitness equipment should be dispersed throughout the park. Both should be placed in semi-private, flat, grassy areas to create a safe environment for exercising.

Multiple levels of all exercises should be created so users can feel successful, not cause injury, and be able to improve and continue with fitness in the park.

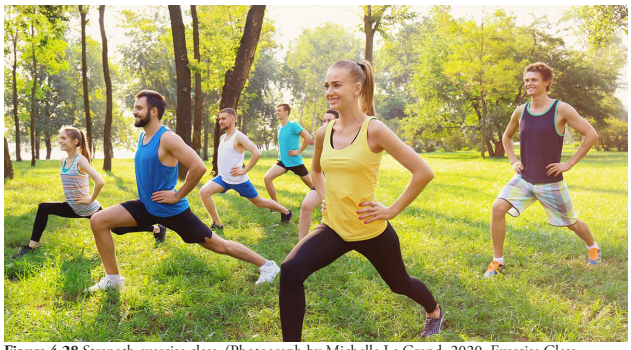

Figure 4.28 Strength exercise class. (Photograph by Michelle Le Grand. 2020. Exercise Class. https://good2grand.com.au/the-top-5-ways-to-start-exercising-successfully/.

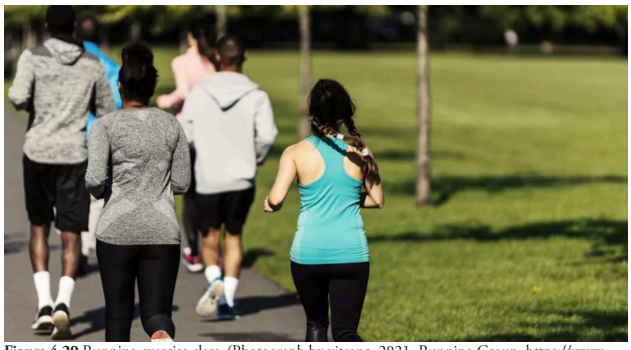

Figure 4.29 Running exercise class. (Photograph by vitranc. 2021. Running Group. https://www.verywellfit.com/how-to-find-a-running-group-2911226.)

Figure 4.30 Exercise instructional sign. (Photograph by Clint Moodie. 2021. Signage. https://www.moodie.com.au/?tag=fitness.)

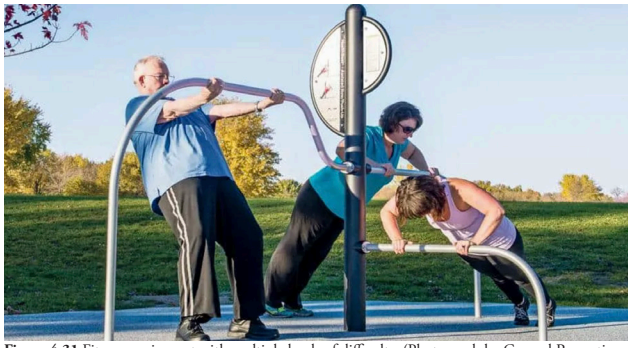

Figure 4.31 Fitness equipment with multiple levels of difficulty. (Photograph by General Recreation Inc. n.d. HealthBeat Outdoor Fitness System. https://www.generalrecreationinc.com/outdoor-fitness-equipment/.)

Sensory Engagement

Sensory engagement allows users to interact with their surroundings as well as focus on the present, creating an environment that improves mental health and encourages frequent visits. This requires that multiple senses be engaged through various areas in the park.

Suggested Interventions

Plants with various textures should be used for sight and touch stimulation. Inflorescence, such as umbels, and leaves, such as pinnately compound, can provide visual and tactical interest. Grasses also move in the wind and add textural engagement. Plants with thorns should be avoided. Color is also a key component of visual engagement. Color variation should be utilized both for flowers and the greenery so there is visual interest even when the plants are not in bloom.

For auditory engagement, there are two components: reducing city noise and enhancing natural sounds. To reduce unwanted noise, a sound barrier should be created using topography, dense plantings, or strategically placed site facilities. Water features create pleasant sounds that can also cover some outside noise. When there is a breeze, plants, especially deciduous trees and grasses, can also provide whispering sounds. Finally, pollinator-friendly plants attract birds and other pollinators that provide an inviting soundscape.

Figure 4.32 Planting palette focused on texture. (Photograph by Philippe Perdereau. 2017. Jardin Privé. http://www.diptyqueparis-memento.com/en/the-gardens-of-piet-oudolf/.)

Figure 4.33 Inflorescence and color. (Photograph by Piet Oudolf. 2017. Hauser & Wirth Somerset. https://detroit.curbed.com/2017/12/27/16821554/garden-designer-piet-oudolf-belle-isle-project.)

Figure 4.34 River with small waterfall creates sound. (Photograph by City of Sugar Land. n.d. Oyster Creek Park River. https://www.sugarlandtx.gov/facilities/facility/details/Oyster-Creek-Park-13.)

Figure 4.35 Songbird on sunflower. (Photograph by National Geographic. 2017. Sunflower with Bird. https://www.nationalgeographic.com/books/article/top-10-plants-to-attract-songbirds.)

Trails

Walking is one of the most prevalent activities in parks and is one of the most recommended exercises for HICP. Thus, trails specifically designed for the needs of people with HICP are required in parks.

Suggested Interventions

Trails should connect to all park entrances for commuters who want to walk or cycle to work.

For accessibility, trails should be designed with materials that do not get slick when wet, are not uneven, and are permeable to prevent flooding. Handrails should be continuous along therapy-designated trails and frequently along the rest of trails for users requiring stability. Benches should also be placed at intervals throughout to allow for rest. Stairs should not be included.

For exercise purposes, trails should be designed with pathways of set distances, such as quarter-mile, half-mile, or one mile to allow users to easily track how far they walked. These trails should also intersect frequently to give users many options of paths to take and choose how far they want to walk. Trails should be wide enough for pairs of individuals to exercise together. Additionally, trails should change materiality and include small topographic changes for strength and balance training.

Figure 4.36 Paths for commuting. (Photograph by iGlobal Desk. 2021. Walk to Work. https://www.iglobalnews.com/iwellness/health-fitness/why-a-walk-in-the-park-may-be-the-answer-to-work-stress.)

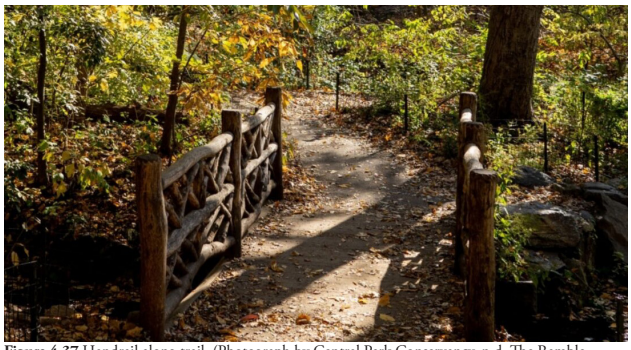

Figure 4.37 Handrail along trail. (Photograph by Central Park Conservancy. n.d. The Ramble. https://www.centralparknyc.org/locations/the-ramble.)

Figure 4.38 Frequent seating along path. (Photograph by Fox Lake. n.d. Riverside Park. https://www.cityoffoxlake.org/facilities/facility/details/Riverside-Park-5.)

Figure 4.39 Trail with multiple paths, small topography, and wide enough for groups. (Photograph by Ingfbruno. 2013. Central Park. https://en.wikipedia.org/w/index.php?title=Central_Park&oldid=1073011888.)

Seasonality

More frequent visits to parks and more frequent exercise both lead to improved health, and therefore parks should be designed to be used in all seasons. This requires spaces that can be used in all weather conditions and a design that interests people to come back throughout the year.

Suggested Interventions

The addition of indoor facilities would allow for programmed classes to occur in all weather conditions. Facilities should be situated so they create minimal shade in the park during the winter months and block the wind. This would mean facilities should be put on the northern part of the site in the northern hemisphere.

Shade structures can also be beneficial year-round. By orienting a roof in the proper direction, the sun would be blocked in the summer and allowed in during the winter. Furthermore, by using an impervious material, the covered area would be kept dry from rain and snow. Thus, creating both large and small shade structures would be beneficial to accommodate group exercise classes.

Plants should be selected for year-round interest. This can be done with evergreens, perennials with various inflorescences that retain their structures in the winter, and plants with berries that stay colorful through the winter. Bloom times should also be coordinated to take advantage of the full growing season. Deciduous trees with autumn interest are also desirable and should be planted on the southern part of the site to block the sun in the summer and let light in during the winter.

To reduce allergens in the summer and allow for better use of parks during those months, low-allergen plants should be selected. Additionally, female plants do not produce pollen, and only produce fruit if pollinated, so female-only beds are preferred wherever possible.

Figure 4.40 Shade structure with openings for winter sun. (Photograph by Superior Shade. 2020. Juan Tabo Hills Park. https://srpshade.com/inspirations/parks-recreation-shade-projects/juan-tabo-hills-park.)

Figure 4.41 Colorful leaves in autumn. (Photograph by Rachel Schulkin. 2021. Columbia Park. https://parkways.seattle.gov/2021/09/22/best-parks-to-take-in-beautiful-fall-colors/.)

4.7 Summary

Urban parks provide a unique opportunity to design for reducing high-impact chronic pain. Following the systematic review process, coding the two bodies of research resulted in coded factors such as “lawns” to capture the key ieas in the papers. These individual factors were then combined into lists of HICP and Urban Park categories such as “biodiversity” and “exercise”. From these lists, a set of HICP and Urban Park recommendations was created that reflected the respective categories. Finally, these lists were combined to create the final ten recommendations presented in this thesis.

The ten recommendations have positive outcomes on increasing park usage, safety, and quality. However, the biggest impacts can be seen on health outcomes. Both mental and physical health is improved by these recommendations, with pain reduction being seen in all the recommendations. Table 4.3 shows the final recommendations and the measures that would be improved by each recommendation. As seen in the table all recommendations are expected to decreased pain.

	Improves Safety	Improves Park Quality	Increases Greenness	Increases Duration of Use	Increases Frequency of Use	Improves Overall Physical Health	Improves Mental Health	Decreases Pain
Welcoming Atmosphere and Safety								
High Quality, Low Maintenance Nature								
Facilities, Amenities, Sports								
Water								
Motivational and Informational Signage								
Movement Therapy Outdoor Rooms								
Accessible Exercise Options and Variety								
Sensory Engagement								
Walking Trails								
Seasonality								

Table 4.3 Expected improvements based on each recommendation.

CONCLUSIONS

5.1 Implications

The topics of pain reduction, physical health, and mental health within the context of urban parks have been focal points for urban planners, epidemiologists, and landscape architects for decades. While the documented benefits of parks vary in each of these areas, there is global consensus among researchers that urban parks can play a central role in the health of a community. The implication of this thesis in relation to the overall field of urban park design is the potential to enhance park design to specifically benefit individuals with High-Impact Chronic Pain (HICP). As detailed in the literature review, individuals utilize parks as part of their exercise and fitness routines when the park provides equipment or programs that meet their specific needs. However, as documented, the absence of these specific elements results in a decline of usage and subsequent physical health benefits for community members. Therefore, the opportunity exists to utilize parks to focus on specific concerns such as HICP if the appropriate design measures are included in the park design. The recommendations developed in this thesis can serve as a starting point for enhancing urban parks in the specific area of HICP control and maintenance.

Since the time of developing Central Park in New York City, parks have been intended to provide health benefits in urban settings. While the specific benefits have changed over time as new health information has been developed, the underlying objective remains: to benefit the physical and mental health of the community. With almost 20 million people in the United States experiencing HICP, the potential to benefit a significant number of people with a physical and accompanying mental health condition cannot be overlooked. However, these individuals require specific enhancements to urban parks to achieve these benefits.

This thesis puts forward a series of recommendations specifically for urban parks to support individuals with HICP. The recommendations are intended to be ones that can be incorporated into existing or new parks with minimal changes to the overall park design. Of particular importance are the recommendations related to pathways, ecology, and structured exercise areas. The first of these, pathways, has potentially the largest implication for park designers as it moves pathways from purely a design element to one which has specific health implications. While pathways have always been a central design element in urban parks, creating pathways with the explicit intent of aiding individuals with HICP places guidelines on the development of these paths. For example, individuals with HICP require paths that have changes in elevation, reduced height stairs, and options for different distances of walks depending on their capabilities. These elements are no longer just for aesthetic or general health objectives, but rather serve to provide the mental and physical stimuli required for HICP patients.

The second of the primary recommendations, ecology diversity, could have the greatest implication for urban park designers as it challenges existing planting palettes. Rather than focusing on a limited vegetation palette which may fit other constraints and objectives, the need for biodiversity encourages designers to consider a broader range of vegetation alternatives for an individual park. While this may seem of less importance to the average user, individuals with HICP gain the greatest benefits by regularly partaking in exercise activities such as walking. To support this continued activity, researchers have documented that biodiversity is a

key element for keeping individuals motivated to exercise and obtain the associated benefits.

Finally, having space in parks specifically designed for structured exercise activities such as tai chi or pilates has implications for the spatial layout of urban parks. While many parks have open areas for general play, or structured areas for traditional sports such as soccer or baseball, an area designed specifically to support structured exercise may be less commonly considered and implemented. Issues that are important to address include the evenness of the ground, the grass or groundcover utilized, the rapid drainage capability, the acoustics of the area, and if appropriate, protection from common weather issues such as rain or heat. Incorporating such an area will notably enhance the ability to host the exercise classes that benefit individuals with HICP specifically, and the community in general. However, the intentionality required for these spaces may not be a standard consideration for many urban park designers.

These primary recommendations provide examples of the implications to urban park design that emerge from this thesis. However, the implications for individuals with HICP are also significant. Specifically, if urban park designers begin to incorporate the recommendations outlined in this work, individuals with HICP have an enhanced opportunity to address their pain through exercise within these appropriately designed urban parks. The opportunity to partake in exercise classes in appropriate settings would provide the structured exercise that has been found to benefit these individuals by keeping them motivated as well as enhancing mobility. Similarly, the opportunity to experience biodiverse parks provides the experiential motivation to further their exercise regimens and build the aerobic fitness that is associated with reducing HICP. Finally, having the opportunity to walk along pathways that are specifically designed with the intention of increasing the strength and mental self-assuredness required to address HICP can provide the incremental improvements that give individuals with HICP hope and enhanced mental health.

In summary, the implications from this research for individuals with HICP are significant in terms of both physical and mental health. With 20 million individuals experiencing this condition, the potential exists to impact populations over a widespread geographic area. Equally important, the implication is that this research can enhance awareness among urban park designers of the potential for their work to improve the lives of individuals with HICP. By incorporating a set of foundational design recommendations, both new and existing urban parks can be transformed to achieve the health goals originally espoused for landmarks such as Central Park.

5.2 Conclusion

The opportunity exists to: 1) design urban parks for the benefit of those individuals with HICP, and 2) to raise awareness around the benefits of exercise in green space as a treatment for HICP. Both existing parks and future parks can be enhanced through additions and modifications that should have minimal impacts on the design of the parks. These modifications can significantly enhance the lives of individuals with HICP. As documented in this thesis, this opportunity is based on data-driven medical research that highlights the beneficial impacts of activities such as walking, aerobic exercise, and stretching. However, achieving this benefit is not without challenges. One such challenge is to provide the setting where individuals with HICP can take advantage of the activities leading to the greatest physical and mental benefits. Another challenge is based on the inequity of distribution of urban parks which requires urban planners to

consider how every individual has access to these facilities. Finally, another challenge is to change the perspective of many people that an urban park can be enjoyed safely as part of a treatment regimen. The recommendations in this thesis are a starting point to addressing these challenges and to ensuring that individuals with HICP have the opportunity to achieve the benefits that urban parks can provide.

Additionally, the recommendations are an opportunity to provide health benefits without fundamentally changing design concepts. The minimal cost implications and the lack of a need for a design or medical specialist means that these recommendations can be easily incorporated into future designs and modifications. This is essential to achieving widespread implementation and the associated impact for individuals with HICP.

5.3 Implementation of Recommendations

The transition of the presented recommendations from concepts to implementation requires adoption by urban communities, the profession, and the education system. Simply including these elements in a park design does not ensure usage by community members.

Urban Communities

The developed recommendations can be incorporated into an urban park plan that includes program development, marketing, and long-term maintenance. While it has been shown that accessibility of parks is a factor in usage rates, additional items including a welcoming environment and safety are equally important to enhancing urban park usage. Incorporating the recommendations into park designs will provide confidence to community members that urban parks will assist in physical and mental health selfcare.

Landscape Architecture Profession

The recommendations presented in this thesis are building blocks on which urban park design can provide greater physical and mental health benefits. The recommendations can be adopted by a firm and enhance a design with the specific goal of addressing physical and mental health. Individuals with HICP will be specific beneficiaries, but the community in general will benefit through physical and mental health attention. The example interventions presented with each recommendation are the starting point for achieving these benefits.

Education System

The potential for urban parks to benefit physical and mental health builds on the movement towards greater interdisciplinarity in design education. The recommendations for enhancing urban park design should serve as curriculum enhancements to provide students with a broader perspective on the role of urban parks. The discussion of this broader role of parks can lead to a new perspective on the role of landscape architects in the overall healthcare system.

In conclusion, landscape architecture can move beyond being a complement to traditional healthcare facilities through elements such as wellness gardens. Landscape architecture can be a focal point in the comprehensive healthcare of communities. By designing urban parks to address specific medical conditions, urban parks can serve both the general purpose of play and recreation, and the specific purpose of supporting physical and mental health. HICP is only one potential condition that can benefit from intentional landscape design. However, it is a starting point with 20 million potential beneficiaries just in the United States. The presented set of design and park management recommendations are the research contribution and the starting point to meeting the needs of these individuals.

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APPENDICES

Appendix A - Park Journal Articles Excluded in Eligibility Phase and Reasons

Study Details	Reason Filtered
Aldous, David. "The benefits of green space: greening our cities and surrounds." Australasian Parks and Leisure 9, no. 4 (2006): 6-8.	No recommendations
Aldous, D. E. "Social, environmental, economic, and health benefits of green spaces." In XXVII International Horticultural Congress-IHC2006: International Symposium on Horticultural Plants in Urban and Peri-Urban 762, pp. 171-186. 2006.	No recommendations
Ambrey, Christopher L. "An investigation into the synergistic wellbeing benefits of greenspace and physical activity: Moving beyond the mean." Urban Forestry & Urban Greening 19 (2016): 7-12.	No Specific Findings
Astell-Burt, Thomas, Xiaoqi Feng, and Gregory S. Kolt. "Green space is associated with walking and moderate-to-vigorous physical activity (MVPA) in middle-to-older-aged adults: findings from 203 883 Australians in the 45 and Up Study." British Journal of Sports Medicine 48, no. 5 (2014): 404-406.	No recommendations
Ayala-Azcárraga, Cristina, Daniel Diaz, and Luis Zambrano. "Characteristics of urban parks and their relation to user well-being." Landscape and urban planning 189 (2019): 27-35.	No Specific Findings
Barbosa, Olga, Jamie A. Tratalos, Paul R. Armsworth, Richard G. Davies, Richard A. Fuller, Pat Johnson, and Kevin J. Gaston. "Who benefits from access to green space? A case study from Sheffield, UK." Landscape and Urban planning 83, no. 2-3 (2007): 187-195.	No Specific Findings
Barton, Jo. "The effects of green exercise on psychological health and well-being." PhD diss., University of Essex, 2009.	No specific recommendations
Barton, Jo, Rachel Bragg, Carly Wood, and Jules Pretty, eds. Green exercise: Linking nature, health and well-being. Routledge, 2016.	No specific recommendations
Barton, Jo, Rachel Hine, and Jules Pretty. "The health benefits of walking in greenspaces of high natural and heritage value." Journal of Integrative Environmental Sciences 6, no. 4 (2009): 261-278.	No specific recommendations
Bertram, Christine, and Katrin Rehdanz. "The role of urban green space for human well-being." Ecological Economics 120 (2015): 139-152.	No specific recommendations
Beyer, Kirsten MM, Andrea Kaltenbach, Aniko Szabo, Sandra Bogar, F. Javier Nieto, and Kristen M. Malecki. "Exposure to neighborhood green space and mental health: evidence from the survey of the health of Wisconsin." International journal of environmental research and public health 11, no. 3 (2014): 3453-3472.	No specific recommendations
Bin, J. I. A. N. G. "The Road to a Healthy City: The Benefits of Urban Nature for Mental Health." Urban and Rural Planning (2018).	No recommendations
Bixby, Honor, Susan Hodgson, Léa Fortunato, Anna Hansell, and Daniela Fecht. "Associations between green space and health in English cities: an ecological, cross-sectional study." PLoS One 10, no. 3 (2015): e0119495.	No definitive conclusions
Bojorquez, Ietza, and Lina Ojeda-Revah. "Urban public parks and mental health in adult women: Mediating and moderating factors." International Journal of Social Psychiatry 64, no. 7 (2018): 637-646	No specific recommendations
Brito, Henrique S., Eliana V. Carraça, António L. Palmeira, José P. Ferreira, Veronica Vleck, and Duarte Araújo. "Benefits to Performance and Well-Being of Nature-Based Exercise: A Critical Systematic Review and Meta-Analysis." Environmental science & technology (2021).	No recommendations
Brown, Caroline, and Marcus Grant. "Biodiversity and human health: What role for nature in healthy urban planning?." Built Environment 31, no. 4 (2005): 326-338.	No specific recommendations
Browning, Matthew, and Kangjae Lee. "Within what distance does "greenness" best predict physical health? A systematic review of articles with GIS buffer analyses across the lifespan." International journal of environmental research and public health 14, no. 7 (2017): 675.	No specific recommendations
Brymer, Eric, Jedda Crabtree, and Robert King. "Exploring perceptions of how nature recreation benefits mental wellbeing: a qualitative enquiry." Annals of Leisure Research 24, no. 3 (2021): 394-413.	No specific recommendations
Brymer, Eric, Keith Davids, and Liz Mallabon. "Understanding the psychological health and well-being benefits of physical activity in nature: an ecological dynamics analysis." Ecopsychology 6, no. 3 (2014): 189-197.	No specific recommendations

Burrows, Eve, Margaret O'Mahony, and Dermot Geraghty. "How urban parks offer opportunities for physical activity in Dublin, Ireland." International journal of environmental research and public health 15, no. 4 (2018): 815.	No specific recommendations
Callaghan, A., G. McCombe, A. Harrold, C. McMeel, G. Mills, N. Moore-Cherry, and W. Cullen. "The impact of green spaces on mental health in urban settings: A scoping review." Journal of Mental Health 30, no. 2 (2021): 179-193.	No recommendations
Chow, Hsueh-wen. "Outdoor fitness equipment in parks: a qualitative study from older adults' perceptions." BMC public health 13, no. 1 (2013): 1-9.	No specific recommendations
Cleary, Anne, Anne Roiko, Nicola W. Burton, Kelly S. Fielding, Zoe Murray, and Gavin Turrell. "Changes in perceptions of urban green space are related to changes in psychological well-being: Cross-sectional and longitudinal study of mid-aged urban residents." Health & place 59 (2019): 102201.	No specific recommendations
Cohen-Cline, Hannah, Eric Turkheimer, and Glen E. Duncan. "Access to green space, physical activity and mental health: a twin study." J Epidemiol Community Health 69, no. 6 (2015): 523-529.	No recommendations
Cohen, Deborah A., Bing Han, Catherine J. Nagel, Peter Harnik, Thomas L. McKenzie, Kelly R. Evenson, Terry Marsh, Stephanie Williamson, Christine Vaughan, and Sweatha Katta. "The first national study of neighborhood parks: Implications for physical activity." American journal of preventive medicine 51, no. 4 (2016): 419-426.	No specific recommendations
Cohen, Deborah A., Terry Marsh, Stephanie Williamson, Kathryn Pitkin Derose, Homero Martinez, Claude Setodji, and Thomas L. McKenzie. "Parks and physical activity: why are some parks used more than others?." Preventive medicine 50 (2010): S9-S12.	No specific recommendations
Cohen, Deborah A., Thomas L. McKenzie, Amber Sehgal, Stephanie Williamson, Daniela Golinelli, and Nicole Lurie. "Contribution of public parks to physical activity." American journal of public health 97, no. 3 (2007): 509-514.	No specific recommendations
Dadvand, Payam, and Mark Nieuwenhuijsen. "Green space and health." In Integrating human health into urban and transport planning, pp. 409-423. Springer, Cham, 2019.	No specific recommendations
De Jong, Kim, Maria Albin, Erik Skärbäck, Patrik Grahn, and Jonas Björk. "Perceived green qualities were associated with neighborhood satisfaction, physical activity, and general health: Results from a cross-sectional study in suburban and rural Scania, southern Sweden." Health & place 18, no. 6 (2012): 1374-1380.	No definitive conclusions
De Ridder, Koen, V. Adamec, A. Bañuelos, Michael Bruse, M. Bürger, O. Damsgaard, J. Dufek et al. "An integrated methodology to assess the benefits of urban green space." Science of the total environment 334 (2004): 489-497.	No specific recommendations
de Vries, Sjerp. "The impact of intervening in green space in Dutch deprived neighbourhoods on physical activity and general healt..." Community Health 70 (2016): 147-154.	No definitive conclusions
De Young, Raymond, Kif Scheuer, Terry Brown, Thomas Crow, and Jana Stewart. "Some psychological benefits of urban nature: Mental vitality from time spent in nearby nature." Nova Science Publishers, 2017.	No specific recommendations
Dean, Julie, Kate van Dooren, and Philip Weinstein. "Does biodiversity improve mental health in urban settings?." Medical hypotheses 76, no. 6 (2011): 877-880.	No definitive conclusions
Di Nardo, Francesco, Rosella Saulle, and Giuseppe La Torre. "Green areas and health outcomes: a systematic review of the scientific literature." Ital J Public Health 7, no. 4 (2010): 402-13.	No definitive conclusions
Dinda, Santanu, and Subrata Ghosh. "Perceived benefits, aesthetic preferences and willingness to pay for visiting urban parks: A case study in Kolkata, India." International Journal of Geoheritage and Parks 9, no. 1 (2021): 36-50.	No specific recommendations
Donnelly, Aoife A., and Tadhg E. MacIntyre, eds. Physical activity in natural settings: green and blue exercise. Routledge, 2019.	No specific recommendations
Douglas, Owen, Mick Lennon, and Mark Scott. "Green space benefits for health and well-being: A life-course approach for urban planning, design and management." Cities 66 (2017): 53-62.	No specific recommendations
Edwards, Peggy, and Agis D. Tsouros. A healthy city is an active city: a physical activity planning guide. World Health Organization. Regional Office for Europe, 2008.	No specific recommendations
Ekkel, E. Dinand, and Sjerp de Vries. "Nearby green space and human health: Evaluating accessibility metrics." Landscape and urban planning 157 (2017): 214-220.	No recommendations
Evenson, Kelly R., Fang Wen, A. M. Y. Hillier, and Deborah A. Cohen. "Assessing the contribution of parks to physical activity using GPS and accelerometry." Medicine and science in sports and exercise 45, no. 10 (2013): 1981.	Not relevant to research question
Febbraio, Mark A. "Health benefits of exercise—more than meets the eye!." Nature Reviews Endocrinology 13, no. 2 (2017): 72-74.	Not relevant to research question
Fiuza-Luces, Carmen, Alejandro Santos-Lozano, Michael Joyner, Pedro Carrera-Bastos, Oscar Picazo, José L. Zugaza, Mikel Izquierdo, Luis M. Ruilope, and Alejandro Lucia. "Exercise benefits in cardiovascular disease: beyond attenuation of traditional risk factors." Nature Reviews Cardiology 15, no. 12 (2018): 731-743.	No specific recommendations

Flowers, Elliott P., Paul Freeman, and Valerie F. Gladwell. "Enhancing the acute psychological benefits of green exercise: An investigation of expectancy effects." Psychology of Sport and Exercise 39 (2018): 213-221.	No specific recommendations
Floyd, Myron F., John O. Spengler, Jay E. Maddock, Paul H. Gobster, and Luis Suau. "Environmental and social correlates of physical activity in neighborhood parks: An observational study in Tampa and Chicago." Leisure sciences 30, no. 4 (2008): 360-375.	No specific recommendations
Foley, Ronan, Michael Brennan, Oludunsin Arodudu, Gerald Mills, Tine Ningal, and Malachy Bradley. Green and Blue Spaces and Health: A Health-led Approach. EPA Research Report). Retrieved April 14, 2020, from www. epa. ie, 2016.	No specific recommendations
García de Jalón, Silvestre, Aline Chiabai, Alyvia Mc Tague, Naiara Artaza, Amaia de Ayala, Sonia Quiroga, Hanneke Kruize, Cristina Suárez, Ruth Bell, and Timothy Taylor. "Providing access to urban green spaces: A participatory benefit-cost analysis in Spain." International Journal of Environmental Research and Public Health 17, no. 8 (2020): 2818.	Not relevant to research question
Gascon, Mireia, Margarita Triguero-Mas, David Martínez, Payam Dadvand, Joan Forns, Antoni Plasència, and Mark J. Nieuwenhuijsen. "Mental health benefits of long-term exposure to residential green and blue spaces: a systematic review." International journal of environmental research and public health 12, no. 4 (2015): 4354-4379.	No recommendations
Gies, Erica. "The health benefits of parks." The Trust for Public Land (2006): 1-24.	No specific recommendations
Godbey, Geoffrey, and Michael Blazey. "Old people in urban parks: An exploratory investigation." Journal of leisure research 15, no. 3 (1983): 229-244.	Not relevant to research question
Godbey, Geoffrey, Andrew Mowen, and V. A. Ashburn. The benefits of physical activity provided by park and recreation services: The scientific evidence. Ashburn, VA: National Recreation and Park Association, 2010.	No specific recommendations
Grabow, Maggie L., Scott N. Spak, Tracey Holloway, Brian Stone Jr, Adam C. Mednick, and Jonathan A. Patz. "Air quality and exercise-related health benefits from reduced car travel in the midwestern United States." Environmental health perspectives 120, no. 1 (2012): 68-76.	Not relevant to research question
Groenewegen, Peter P., Agnes E. Van den Berg, Sjerp De Vries, and Robert A. Verheij. "Vitamin G: effects of green space on health, well-being, and social safety." BMC public health 6, no. 1 (2006): 1-9.	No specific recommendations
Hagerty, John K., T. H. Stevens, P. Geoffrey Allen, and T. More. "Benefits from urban open space and recreational parks: a case study." Journal of the Northeastern Agricultural Economics Council 11, no. 1 (1982): 13-20.	No specific recommendations
Han, Ke-Tsung, and Po-Ching Wang. "Empirical examinations of effects of three-level green exercise on engagement with nature and physical activity." International Journal of Environmental Research and Public Health 15, no. 2 (2018): 375.	No specific recommendations
Hartig, Terry, Agnes E. Berg, Caroline M. Hagerhall, Marek Tomalak, Nicole Bauer, Ralf Hansmann, Ann Ojala et al. "Health benefits of nature experience: Psychological, social and cultural processes." In Forests, trees and human health, pp. 127-168. Springer, Dordrecht, 2011.	Not relevant to research question
Ho, Ching-Hua, Laura Payne, Elizabeth Orsega-Smith, and Geoffrey Godbey. "Parks, recreation and public health." Parks & Recreation (Ashburn) 38, no. 4 (2003): 18-27.	Not relevant to research question
Hoehner, Christine M., Ross C. Brownson, Diana Allen, James Gramann, Timothy K. Behrens, Myron F. Floyd, Jessica Leahy et al. "Parks promoting physical activity: synthesis of findings from interventions in seven national parks." Journal of Physical Activity and Health 7, no. s1 (2010): S67-S81.	No specific recommendations
Holbrook, Allyson. "The green we need: an investigation of the benefits of green life and green spaces for urban dwellers' physical, mental and social health." (2009).	No specific recommendations
Houlden, Victoria, Scott Weich, João Porto de Albuquerque, Stephen Jarvis, and Karen Rees. "The relationship between greenspace and the mental wellbeing of adults: A systematic review." PloS one 13, no. 9 (2018): e0203000.	No specific recommendations
Huang, Terry TK, Katarzyna E. Wyka, Emily B. Ferris, Jennifer Gardner, Kelly R. Evenson, Devanshi Tripathi, Gabriel Martinez Soto et al. "The Physical Activity and Redesigned Community Spaces (PARCS) Study: Protocol of a natural experiment to investigate the impact of citywide park redesign and renovation." BMC public health 16, no. 1 (2016): 1-12.	No recommendations
Irvine, Katherine N., Richard A. Fuller, Patrick Devine-Wright, Jamie Tratalos, Sarah R. Payne, Philip H. Warren, Kevin J. Lomas, and Kevin J. Gaston. "Ecological and psychological value of urban green space." In Dimensions of the sustainable city, pp. 215-237. Springer, Dordrecht, 2010.	No specific recommendations
James, Philip, Konstantinos Tzoulas, Mags D. Adams, Alan Barber, John Box, Juergen Breuste, Thomas Elmqvist et al. "Towards an integrated understanding of green space in the European built environment." Urban Forestry & Urban Greening 8, no. 2 (2009): 65-75.	No recommendations
Janicki, Rachelle. "Finding Headspace: A Knowledge Synthesis of the Effects of Urban Green Space on Mental Health." (2017).	Not relevant to research question

Febbraio, Mark A. "Health benefits of exercise—more than meets the eye!." Nature Reviews Endocrinology 13, no. 2 (2017): 72-74.	Not relevant to research question
Fiuza-Luces, Carmen, Alejandro Santos-Lozano, Michael Joyner, Pedro Carrera-Bastos, Oscar Picazo, José L. Zugaza, Mikel Izquierdo, Luis M. Ruilope, and Alejandro Lucia. "Exercise benefits in cardiovascular disease: beyond attenuation of traditional risk factors." Nature Reviews Cardiology 15, no. 12 (2018): 731-743.	No specific recommendations
Jorgensen, Anna, and Paul H. Gobster. "Shades of green: measuring the ecology of urban green space in the context of human health and well-being." Nature and Culture 5, no. 3 (2010): 338-363.	No recommendations
Kabisch, Nadja, and Roland Kraemer. "Physical activity patterns in two differently characterised urban parks under conditions of summer heat." Environmental Science & Policy 107 (2020): 56-65.	No specific recommendations
Kaczynski, Andrew T., Gina M. Besenyi, Sonja A. Wilhelm Stanis, Mohammad Javad Koohsari, Katherine B. Oestman, Ryan Bergstrom, Luke R. Potwarka, and Rodrigo S. Reis. "Are park proximity and park features related to park use and park-based physical activity among adults? Variations by multiple socio-demographic characteristics." International Journal of Behavioral Nutrition and Physical Activity 11, no. 1 (2014): 1-14.	No specific recommendations
Kaczynski, Andrew T., Luke R. Potwarka, Bryan JA Smale, and Mark E. Havitz. "Association of parkland proximity with neighborhood and park-based physical activity: variations by gender and age." Leisure Sciences 31, no. 2 (2009): 174-191.	Not relevant to research question
Kaiserman, Joanna Grace. "Urban Nature for Well-being: Design Recommendations for Psychological Benefits in Urban Public Spaces." PhD diss., 2017.	Not relevant to research question
Kanters, Micheal A. "The health benefits of parks and recreation." Illinois Parks and Recreation 27, no. 1 (1996): 27-30.	Not relevant to research question
Kaplan, Rachel. "The psychological benefits of nearby nature." Timber Press, 1992.	No specific recommendations
Kaplan, Stephen. "The restorative benefits of nature: Toward an integrative framework." Journal of environmental psychology 15, no. 3 (1995): 169-182.	No recommendations
Keefe, Francis J. "Behavioral assessment and treatment of chronic pain: current status and future directions." Journal of Consulting and Clinical Psychology 50, no. 6 (1982): 896.	Not relevant to research question
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Wolf, Kathleen. "The health benefits of small parks and green spaces." Parks & Recreation. 52 (4): 28-29. 52, no. 4 (2017): 28-29.	No specific recommendations
Wolf, Kathleen, and Elizabeth Housley. "The benefits of nearby nature in cities for older adults." Annapolis, MD: The TKF Foundation (2016).	Not relevant to research question
Wolf, K. L. "With plants in mind: Social benefits of civic nature." Master Gardener 2, no. 1 (2008): 7-11.	Not relevant to research question
Wood, Carly, Rachel Bragg, and Jules Pretty. "The benefits of green exercise for children." Green Exercise: Linking nature, health, and well being (2016): 46-52.	Not relevant to research question
Wood, C. J., and N. Smyth. "The health impact of nature exposure and green exercise across the life course: A pilot study." International journal of environmental health research 30, no. 2 (2020): 226-235.	No specific recommendations
Wooller, John-James, Jo Barton, Valerie F. Gladwell, and Dominic Micklewright. "Occlusion of sight, sound and smell during Green Exercise influences mood, perceived exertion and heart rate." International Journal of Environmental health research 26, no. 3 (2016): 267-280.	Not relevant to research question
Wyles, Kayleigh J., Mathew P. White, Caroline Hattam, Sabine Pahl, Haney King, and Melanie Austen. "Are some natural environments more psychologically beneficial than others? The importance of type and quality on connectedness to nature and psychological restoration." Environment and Behavior 51, no. 2 (2019): 111-143.	no recommendations
Yeh, Hsiao-Pu, Joseph Antony Stone, Sarah May Churchill, Jonathan Stephen Wheat, Eric Brymer, and Keith Davids. "Physical, psychological and emotional benefits of green physical activity: An ecological dynamics perspective." Sports Medicine 46, no. 7 (2016): 947-953.	no recommendations
Yuen, John WM, Katherine KP Chang, Frances KY Wong, Fiona Y. Wong, Judy YM Siu, H. C. Ho, M. S. Wong, Janice Ho, K. L. Chan, and Lin Yang. "Influence of urban green space and facility accessibility on exercise and healthy diet in Hong Kong." International Journal of Environmental Research and Public Health 16, no. 9 (2019): 1514.	No specific recommendations
Zhou, Xiaolu, and Masud Parves Rana. "Social benefits of urban green space: A conceptual framework of valuation and accessibility measurements." Management of Environmental Quality: An International Journal (2012).	no recommendations

Appendix B - HICP Journal Articles Excluded in Eligibility Phase and Reasons

Study Details	Reason Filtered
Ambrose, Kirsten R., and Yvonne M. Golightly. "Physical exercise as non-pharmacological treatment of chronic pain: why and when." Best practice & research Clinical rheumatology 29, no. 1 (2015): 120-130.	No specific recommendations from study results
Bartlett, David B., Leslie H. Willis, Cris A. Slentz, Andrew Hoselton, Leslie Kelly, Janet L. Huebner, Virginia B. Kraus et al. "Ten weeks of high-intensity interval walk training is associated with reduced disease activity and improved innate immune function in older adults with rheumatoid arthritis: a pilot study." Arthritis research & therapy 20, no. 1 (2018): 1-15.	No specific recommendations from study results
Bérubé, Mélanie, Géraldine Martorella, Caroline Côté, Céline Gélinas, Nancy Feeley, Manon Choinière, Stefan Parent, and David L. Streiner. "The Effect of Psychological Interventions on the Prevention of Chronic Pain in Adults: A Systematic Review and Meta-analysis." The Clinical Journal of Pain 37, no. 5 (2021): 379-395.	No specific recommendations from study results
Boonstra, Anne M., Michiel F. Reneman, Roy E. Stewart, Marcel W. Post, and Henrica R. Schiphorst Preuper. "Life satisfaction in patients with chronic musculoskeletal pain and its predictors." Quality of life research 22, no. 1 (2013): 93-101.	No specific recommendations from study results
Breivik, Harald, Beverly Collett, Vittorio Ventafridda, Rob Cohen, and Derek Gallacher. "Survey of chronic pain in Europe: prevalence, impact on daily life, and treatment." European journal of pain 10, no. 4 (2006): 287-333.	No definitive results from study
Butchart, Amy, Eve A. Kerr, Michele Heisler, John D. Piette, and Sarah L. Krein. "Experience and management of chronic pain among patients with other complex chronic conditions." The Clinical journal of pain 25, no. 4 (2009): 293	No recommendations from study
Cote, Julie N., and Marie K. Hoeger Bement. "Update on the relation between pain and movement: consequences for clinical practice." The Clinical journal of pain 26, no. 9 (2010): 754-762.	No recommendations from study
Crawford, Cindy, Courtney Lee, and Todd May. "Physically oriented therapies for the self-management of chronic pain symptoms." Pain Medicine 15, no. S1 (2014): S54-S65.	No recommendations from study
Cunha, Carolina Ortigosa, Lívia Maria Sales Pinto-Fiamengui, Fernanda Araújo Sampaio, and Paulo César Rodrigues Conti. "Is aerobic exercise useful to manage chronic pain?." Revista Dor 17 (2016): 61-64.	No recommendations from study
Da Luz Jr, Mauricio Antonio, Leonardo Oliveira Pena Costa, Fernanda Ferreira Fuhro, Ana Carolina Taccolini Manzoni, Naiane Teixeira Bastos Oliveira, and Cristina Maria Nunes Cabral. "Effectiveness of mat Pilates or equipment-based Pilates exercises in patients with chronic nonspecific low back pain: a randomized controlled trial." Physical therapy 94, no. 5 (2014): 623-631.	No definitive results from study
de Heer, Eric W., Marloes MJG Gerrits, Aartjan TF Beekman, Jack Dekker, Harm WJ Van Marwijk, Margot WM De Waal, Philip Spinhoven, Brenda WJH Penninx, and Christina M. Van Der Feltz-Cornelis. "The association of depression and anxiety with pain: a study from NESDA." PloS one 9, no. 10 (2014): e106907.	No recommendations from study
Demyttenaere, Koen, Ronny Bruffaerts, Sing Lee, Jose Posada-Villa, Vivianne Kovess, Matthias C. Angermeyer, Daphna Levinson et al. "Mental disorders among persons with chronic back or neck pain: results from the World Mental Health Surveys." Pain 129, no. 3 (2007): 332-342.	No recommendations from study
Driscoll, Mary A., Robert R. Edwards, William C. Becker, Ted J. Kaptchuk, and Robert D. Kerns. "Psychological interventions for the treatment of chronic pain in adults." Psychological Science in the Public Interest 22, no. 2 (2021): 52-95.	No recommendations from study
García-Correa, Hansel R., Lida J. Sánchez-Montoya, Jorge E. Daza-Arana, and Leidy T. Ordoñez-Mora. "Aerobic Physical Exercise for Pain Intensity, Aerobic Capacity, and Quality of Life in Patients With Chronic Pain: A Systematic Review and Meta-Analysis." Journal of Physical Activity and Health 18, no. 9 (2021): 1126-1142	No recommendations from study
Gatchel, Robert J. "Comorbidity of chronic pain and mental health disorders: the biopsychosocial perspective." American Psychologist 59, no. 8 (2004): 795.	No recommendations from study
Glombiewski, Julia Anna, Jens Hartwich-Tersek, and Winfried Rief. "Depression in chronic back pain patients: prediction of pain intensity and pain disability in cognitive-behavioral treatment." Psychosomatics 51, no. 2 (2010): 130-136.	No recommendations from study
Hasanpour-Dehkordi, Ali, Arman Dehghani, and Kamal Solati. "A comparison of the effects of Pilates and McKenzie training on pain and general health in men with chronic low back pain: a randomized trial." Indian journal of palliative care 23, no. 1 (2017): 36.	No significant findings

Heapy, Alicia A., Hallie Tankha, Diana M. Higgins, Mary Driscoll, Kathryn M. LaChappelle, Joseph L. Goulet, Eugenia Buta, John D. Piette, Robert D. Kerns, and Sarah L. Krein. "Incorporating walking into cognitive behavioral therapy for chronic pain: safety and effectiveness of a personalized walking intervention." Journal of Behavioral Medicine 44, no. 2 (2021): 260-269.	No recommendations from study
Hendrick, P., A. M. Te Wake, A. S. Tikkisetty, L. Wulff, C. Yap, and S. Milosavljevic. "The effectiveness of walking as an intervention for low back pain: a systematic review." European Spine Journal 19, no. 10 (2010): 1613-1620.	No definitive findings
Hoffman, Martin D., and Debi Rufi Hoffman. "Does aerobic exercise improve pain perception and mood? A review of the evidence related to healthy and chronic pain subjects." Current pain and headache reports 11, no. 2 (2007): 93-97.	No recommendations from study
Howe, Catherine Q., and Mark D. Sullivan. "The missing 'P'in pain management: how the current opioid epidemic highlights the need for psychiatric services in chronic pain care." General hospital psychiatry 36, no. 1 (2014): 99-104.	No recommendations from study
Hviid, Jens-Christian Trojel, Jonas Bloch Thorlund, and Henrik Bjarke Vaegter. "Walking increases pain tolerance in humans: an experimental cross-over study." Scandinavian Journal of Pain 19, no. 4 (2019): 813-822.	Study results were not specific to research question
Hylands-White, Nicholas, Rui V. Duarte, and Jon H. Raphael. "An overview of treatment approaches for chronic pain management." Rheumatology international 37, no. 1 (2017): 29-42.	Study results were not specific to research question
Joypaul, Shirdhya, Fiona Kelly, Sara S. McMillan, and Michelle A. King. "Multi-disciplinary interventions for chronic pain involving education: A systematic review." PloS one 14, no. 10 (2019): e0223306.	Study results were not specific to research question
Kawi, Jennifer, Nada Lukkahatai, Jillian Inouye, Diane Thomason, and Kirsten Connelly. "Effects of exercise on select biomarkers and associated outcomes in chronic pain conditions: systematic review." Biological research for nursing 18, no. 2 (2016): 147-159.	No specific recommendations from study results
Kerns, Robert D., John Sellinger, and Burel R. Goodin. "Psychological treatment of chronic pain." Annual review of clinical psychology 7 (2011): 411-434.	No recommendations from study
Ketenci, Ayşegül, and Mert Zure. "Pharmacological and non-pharmacological treatment approaches to chronic lumbar back pain." Turkish Journal of Physical Medicine and Rehabilitation 67, no. 1 (2021): 1.	No recommendations from study
King, Kristi McClary, and Olivia Estill. "Exercise as a Treatment for Chronic Pain." ACSM's Health & Fitness Journal 23, no. 2 (2019): 36-40.	No recommendations from study
Kroll, Heather R. "Exercise therapy for chronic pain." Physical Medicine and Rehabilitation Clinics 26, no. 2 (2015): 263-281.	No recommendations from study
Landry, Bradford W., Philip R. Fischer, Sherilyn W. Driscoll, Krista M. Koch, Cynthia Harbeck-Weber, Kenneth J. Mack, Robert T. Wilder, Brent A. Bauer, and Joline E. Brandenburg. "Managing chronic pain in children and adolescents: a clinical review." PM&R 7, no. 11 (2015): S295-S315.	No recommendations from study
Lerman, Sheera F., Zvia Rudich, Silviu Brill, Hadar Shalev, and Golan Shahar. "Longitudinal associations between depression, anxiety, pain, and pain-related disability in chronic pain patients." Psychosomatic medicine 77, no. 3 (2015): 333-341.	No recommendations from study
Li, Hansen, Xing Zhang, Shilin Bi, Yang Cao, and Guodong Zhang. "Can residential greenspace exposure improve pain experience? A comparison between physical visit and image viewing." In Healthcare, vol. 9, no. 7, p. 918. Multidisciplinary Digital Publishing Institute, 2021.	No definitive results for recommendations
Lima, Lucas V., Thiago SS Abner, and Kathleen A. Sluka. "Does exercise increase or decrease pain? Central mechanisms underlying these two phenomena." The Journal of physiology 595, no. 13 (2017): 4141-4150.	No recommendations from study
Lunde, Claire E., and Christine B. Sieberg. "Walking the tightrope: a proposed model of chronic pain and Stress." Frontiers in neuroscience 14 (2020): 270.	No recommendations from study
Majeed, Muhammad Hassan, Ali Ahsan Ali, and Donna M. Sudak. "Psychotherapeutic interventions for chronic pain: Evidence, rationale, and advantages." The International Journal of Psychiatry in Medicine 54, no. 2 (2019): 140-149.	No recommendations from study
Meeus, Mira, Jo Nijs, Paul Van Wilgen, Suzie Noten, Dorien Goubert, and Ivan Huijnen. "Moving on to movement in patients with chronic joint pain." Pain 1, no. 10 (2016): 23-35.	No specific recommendations from study
Miller, Clint T., Patrick J. Owen, Christian A. Than, Jake Ball, Kate Sadler, Alessandro Piedimonte, Fabrizio Benedetti, and Daniel L. Belavy. "Attempting to separate placebo effects from exercise in chronic pain: A systematic review and meta-analysis." Sports Medicine (2021): 1-28.	No definitive findings
Mior, Silvano. "Exercise in the treatment of chronic pain." The Clinical journal of pain 17, no. 4 (2001): S77-S85.	No specific recommendations from study
Myhr, Arnhild, and Liv Berit Augestad. "Chronic pain patients—Effects on mental health and pain after a 57-week multidisciplinary rehabilitation program." Pain Management Nursing 14, no. 2 (2013): 74-84.	No recommendations from study

Nijs, Jo, Enrique Lluch Girbés, Mari Lundberg, Anneleen Malfliet, and Michele Sterling. "Exercise therapy for chronic musculoskeletal pain: innovation by altering pain memories." Manual therapy 20, no. 1 (2015): 216-220.	No specific recommendations from study
Nijs, Jo, Eva Kosek, Jessica Van Oosterwijck, and Mira Meeus. "Dysfunctional endogenous analgesia during exercise in patients with chronic pain: to exercise or not to exercise?." Pain physician 15, no. 3S (2012): ES205-ES213.	No specific recommendations from study
Outcalt, Samantha D., Kurt Kroenke, Erin E. Krebs, Neale R. Chumbler, Jingwei Wu, Zhangsheng Yu, and Matthew J. Bair. "Chronic pain and comorbid mental health conditions: independent associations of posttraumatic stress disorder and depression with pain, disability, and quality of life." Journal of behavioral medicine 38, no. 3 (2015): 535-543.	No specific recommendations from study
Paley, Carole A., and Mark I. Johnson. "Physical activity to reduce systemic inflammation associated with chronic pain and obesity." The Clinical journal of pain 32, no. 4 (2016): 365-370.	No recommendations from study
Park, Juyoung, and Anne K. Hughes. "Nonpharmacological approaches to the management of chronic pain in community-dwelling older adults: A review of empirical evidence." Journal of the American Geriatrics Society 60, no. 3 (2012): 555-568.	No specific recommendations from study
Parker, Romy, Emma Bergman, Anelisiwe Mntambo, Shannon Stubbs, and Matthew Wills. "Levels of physical activity in people with chronic pain." South African Journal of Physiotherapy 73, no. 1 (2017): 1-7.	No definitive findings
Peng, Philip WH. "Tai chi and chronic pain." Regional Anesthesia & Pain Medicine 37, no. 4 (2012): 372-382.	No specific recommendations from study
Polaski, Anna M., Amy L. Phelps, Matthew C. Kostek, Kimberly A. Szucs, and Benedict J. Kolber. "Exercise-induced hypoalgesia: A meta-analysis of exercise dosing for the treatment of chronic pain." PloS one 14, no. 1 (2019): e0210418.	No definitive findings
Rice, David, Jo Nijs, Eva Kosek, Timothy Wideman, Monika I. Hasenbring, Kelli Koltyn, Thomas Graven-Nielsen, and Andrea Polli. "Exercise-induced hypoalgesia in pain-free and chronic pain populations: state of the art and future directions." The Journal of Pain 20, no. 11 (2019): 1249-1266.	No specific recommendations from study
Roditi, Daniela, and Michael E. Robinson. "The role of psychological interventions in the management of patients with chronic pain." Psychology research and behavior management 4 (2011): 41.	No specific recommendations from study
Saragiotto, Bruno T., Christopher G. Maher, Tie P. Yamato, Leonardo OP Costa, Luciola C. Menezes Costa, Raymond WJG Ostelo, and Luciana G. Macedo. "Motor control exercise for chronic non-specific low-back pain." Cochrane Database of Systematic Reviews 1 (2016).	No definitive conclusions
Sheng, Jiyao, Shui Liu, Yicun Wang, Ranji Cui, and Xuewen Zhang. "The link between depression and chronic pain: neural mechanisms in the brain." Neural plasticity (2017).	No specific recommendations from study
Skou, Søren T., Alessio Bricca, and Ewa M. Roos. "The impact of physical activity level on the short-and long-term pain relief from supervised exercise therapy and education: a study of 12,796 Danish patients with knee osteoarthritis." Osteoarthritis and cartilage 26, no. 11 (2018): 1474-1478.	No specific recommendations from study
Sluka, Kathleen A., James M. O'Donnell, Jessica Danielson, and Lynn A. Rasmussen. "Regular physical activity prevents development of chronic pain and activation of central neurons." Journal of applied physiology 114, no. 6 (2013): 725-733.	No recommendations from study
Stålnacke, Britt-Marie. "Life satisfaction in patients with chronic pain–relation to pain intensity, disability, and psychological factors." Neuropsychiatric disease and treatment 7 (2011): 683.	No recommendations from study
Stubbs, Brendon, Davy Vancampfort, Nicola Veronese, Trevor Thompson, Michele Fornaro, Patricia Schofield, Marco Solmi, James Mugisha, Andre F. Carvalho, and Ai Koyanagi. "Depression and pain: primary data and meta-analysis among 237 952 people across 47 low-and middle-income countries." Psychological medicine 47, no. 16 (2017): 2906-2917.	No recommendations from study
Teh, Carrie Farmer, Alan Zaslavsky, Charles F. Reynolds III, and Paul D. Cleary. "Effect of depression treatment on chronic pain outcomes." Psychosomatic medicine 72, no. 1 (2010): 61	No recommendations from study
Tse, Mimi MY, Vanessa TC Wan, and Suki SK Ho. "Physical exercise: does it help in relieving pain and increasing mobility among older adults with chronic pain?." Journal of clinical nursing 20, no. 5-6 (2011): 635-644.	No specific recommendations from study
Tsuji, Hironori, Tomoko Tetsunaga, Tomonori Tetsunaga, Keiichiro Nishida, Haruo Misawa, and Toshifumi Ozaki. "The factors driving self-efficacy in intractable chronic pain patients: a retrospective study." Journal of Orthopaedic Surgery and Research 14, no. 1 (2019): 1-6.	No specific recommendations from study
Tunks, Eldon R., Robin Weir, and Joan Crook. "Epidemiologic perspective on chronic pain treatment." The Canadian Journal of Psychiatry 53, no. 4 (2008): 235-242.	No recommendations from study
Turk, Dennis C., and Bill McCarberg. "Non-pharmacological treatments for chronic pain." Disease Management & Health Outcomes 13, no. 1 (2005): 19-30.	No recommendations from study

Twillman, Robert K. "Mental disorders in chronic pain patients." Journal of pain & palliative care pharmacotherapy 21, no. 4 (2007): 13-19.	No recommendations from study
Valenza, M. C., J. Rodríguez-Torres, I. Cabrera-Martos, A. Díaz-Pelegrina, M. E. Aguilar-Ferrándiz, and Y. Castellote-Caballero. "Results of a Pilates exercise program in patients with chronic non-specific low back pain: a randomized controlled trial." Clinical rehabilitation 31, no. 6 (2017): 753-760.	No specific recommendations from study
Van Middelkoop, Marienke, Sidney M. Rubinstein, Arianne P. Verhagen, Raymond W. Ostelo, Bart W. Koes, and Maurits W. van Tulder. "Exercise therapy for chronic nonspecific low-back pain." Best practice & research Clinical rheumatology 24, no. 2 (2010): 193-204.	No specific recommendations from study
von Trott, Philipp, Anna Maria Wiedemann, Rainer Lüdtke, Anett Reißhauer, Stefan N. Willich, and Claudia M. Witt. "Qigong and exercise therapy for elderly patients with chronic neck pain (QIBANE): a randomized controlled study." The Journal of Pain 10, no. 5 (2009): 501-508	No definitive results
Williams, A. C., M. K. Nicholas, P. H. Richardson, C. E. Pither, D. M. Justins, J. H. Chamberlain, V. R. Harding, J. A. Ralphs, S. C. Jones, and I. Dieudonné. "Evaluation of a cognitive behavioural programme for rehabilitating patients with chronic pain." British Journal of General Practice 43, no. 377 (1993): 513-518.	No specific recommendations from study
Wilson, Anna C., and Tonya M. Palermo. "Physical activity and function in adolescents with chronic pain: a controlled study using actigraphy." The Journal of Pain 13, no. 2 (2012): 121-130.	No specific recommendations from study
Zis, Panagiotis, Argyro Daskalaki, Ilia Bountouni, Panagiota Sykioti, Giustino Varrassi, and Antonella Paladini. "Depression and chronic pain in the elderly: links and management challenges." Clinical interventions in aging 12 (2017): 709.	No recommendations from study

Study Details	Study Design	Target Group	Significant Findings
Akpinar, Abdullah. "How is quality of urban green spaces associated with physical activity and health?." Urban forestry & urban greening 16 (2016): 76-83.	Survey	(n=420)	People used urban green spaces more frequently if they were close, of good quality, maintained, and clean. People had better mental health with more frequent exercise. Better physical health was associated with longer duration of exercise as well as open/ visible and large green space.
Akpınar, Abdullah. "Green exercise: how are characteristics of urban green spaces associated with adolescents' physical activity and health?." International journal of environmental research and public health 16, no. 21 (2019): 4281.	Personal Interviews	adolescents ages 13-19 (n=384)	Adolescents have better health and exercise more in nature when there are open areas, play and outdoor fitness equipment, exercise trails, sports fields, trees, lawns, and flowerbeds.
Aliyas, Zeinab. "Physical, mental, and physiological health benefits of green and blue outdoor spaces among elderly people." International journal of environmental health research 31, no. 6 (2021): 703-714.	Questionnaire	random sample of elderly participants (n=978)	People who used blue space had better self-reported health.
Astell-Burt, Thomas, and Xiaoqi Feng. "Association of urban green space with mental health and general health among adults in Australia." JAMA network open 2, no. 7 (2019): e198209-e198209.	Survey	adults over 45 (n=46786)	Exposure to 30% or more tree canopy was associated with less psychological distress and fewer incidences of fair to poor general health, while exposure to 30% or more grass was associated with psychological distress and more incidences of fair to poor general health.
Astell-Burt, Thomas, Xiaoqi Feng, and Gregory S. Kolt. "Mental health benefits of neighbourhood green space are stronger among physically active adults in middle-to-older age: Evidence from 260,061 Australians." Preventive medicine 57, no. 5 (2013): 601-606.	Survey	adults over 45 (n=260061)	People living in the most green neighborhoods were less sedentary and had a lower risk of psychological distress.
Barton, Jo, and Jules Pretty. "What is the best dose of nature and green exercise for improving mental health? A multi-study analysis." Environmental science & technology 44, no. 10 (2010): 3947-3955.	Meta Analyses	10 studies (n =1252)	Short durations of green exercise had large benefits. Green environments improved mood and self-esteem, with blue spaces showing greater effects.
Birch, Jo, Clare Rishbeth, and Sarah R. Payne. "Nature doesn't judge you–how urban nature supports young people's mental health and wellbeing in a diverse UK city." Health & Place 62 (2020): 102296.	interviews and workshops	participants ages 17-27 (n=24)	Mental health benefits were seen most frequently in green spaces with trees, open space, views, and water.
Brown, Scott C., Joanna Lombard, Kefeng Wang, Margaret M. Byrne, Matthew Toro, Elizabeth Plater-Zyberk, Daniel J. Feaster et al. "Neighborhood greenness and chronic health conditions in Medicare beneficiaries." American journal of preventive medicine 51, no. 1 (2016): 78-89.	Survey	Medicare beneficiaries (n=249405)	Better health was seen in areas with higher greenness.
Browning, Matthew HEM, Kangjae Lee, and Kathleen L. Wolf. "Tree cover shows an inverse relationship with depressive symptoms in elderly residents living in US nursing homes." Urban Forestry & Urban Greening 41 (2019): 23-32.	Quantitative analysis	US nursing homes (n=9186)	Greater tree cover around the facility was associated with fewer depressive symptoms.

Buxton, Rachel T., Amber L. Pearson, Claudia Allou, Kurt Fristrup, and George Wittemyer. "A synthesis of health benefits of natural sounds and their distribution in national parks." Proceedings of the National Academy of Sciences 118, no. 14 (2021).	Meta Analyses	36 publications	Nature sounds (animals, wind, and water) decreased annoyance, stress, and pain as well as increased mood and cognitive functioning.
Calogiuri, Giovanna, Grete G. Patil, and Geir Aamodt. "Is green exercise for all? A descriptive study of green exercise habits and promoting factors in adult Norwegians." International journal of environmental research and public health 13, no. 11 (2016): 1165.	Descriptive Study	Adults (n=2168)	The most popular type of weekly exercise was green exercise, especially in the forest and by the sea. One of the most important factors for people to exercise in green spaces was that the green space support physical activity.
Carter, May, and Pierre Horwitz. "Beyond proximity: The importance of green space useability to self-reported health." EcoHealth 11, no. 3 (2014): 322-332.	Mixed Methods	4 neighbor-hoods	Green space quality was associated with better self-reported health. The most significant green space factors that were associated with better health outcomes were retention, proximity, and visitation.
Chen, Tingting, Wei Lang, and Xun Li. "Exploring the impact of urban green space on residents' health in Guangzhou, China." Journal of Urban Planning and Development 146, no. 1 (2020): 05019022.	Questionnaire Survey	Adults (n=938)	Poor health and stress were associated with accessibility, distribution, and frequency of green space use.
Cox, Daniel TC, Danielle F. Shanahan, Hannah L. Hudson, Richard A. Fuller, Karen Anderson, Steven Hancock, and Kevin J. Gaston. "Doses of nearby nature simultaneously associated with multiple health benefits." International journal of environmental research and public health 14, no. 2 (2017): 172.	Survey	(n=1000)	Better mental and social health, as well as increased physical activity, were associated with higher nature doses. Minimum nature dose threshold decreased levels of depression.
Du, Hongyu, Fengqi Zhou, Yongli Cai, Chunlan Li, and Yanqing Xu. "Research on public health and well-being associated to the vegetation configuration of urban green space, a case study of Shanghai, China." Urban Forestry & Urban Greening 59 (2021): 126990.	Field Investigation	visitors of 6 parks (n=647)	Health and wellbeing were associated with an accessible lawn, blue space, fitness facility, and plaza.
Dzhambov, Angel M., Iana Markevych, Terry Hartig, Boris Tilov, Zlatoslav Arabadzhiev, Drozdstoj Stoyanov, Penka Gatseva, and Donka D. Dimitrova. "Multiple pathways link urban green-and bluespace to mental health in young adults." Environmental research 166 (2018): 223-233.	General Health Questionnaire	Students (n=720)	More green space cover was related to better mental health and increased physical activity.
Fan, Yingling, Kirti V. Das, and Qian Chen. "Neighborhood green, social support, physical activity, and stress: Assessing the cumulative impact." Health & place 17, no. 6 (2011): 1202-1211.	Quantitative analysis	(n=1544)	Parks create social support, which lowers stress.
Feng, Xiaoqi, and Thomas Astell-Burt. "Residential green space quantity and quality and symptoms of psychological distress: a 15-year longitudinal study of 3897 women in postpartum." Bmc Psychiatry 18, no. 1 (2018): 1-11.	Longitudinal Study	women (n=3897)	Park quality was related to lower psychological distress and serious mental illness.

Francis, Jacinta, Lisa J. Wood, Matthew Knuiman, and Billie Giles-Corti. "Quality or quantity? Exploring the relationship between Public Open Space attributes and mental health in Perth, Western Australia." Social science & medicine 74, no. 10 (2012): 1570-1577.	Quantitative analysis	(n=911)	High quality public open spaces were associated with low psychological distress.
Fuller, Richard A., Katherine N. Irvine, Patrick Devine-Wright, Philip H. Warren, and Kevin J. Gaston. "Psychological benefits of greenspace increase with biodiversity." Biology letters 3, no. 4 (2007): 390-394.	Interviews	(n=312)	Greater biodiversity in green spaces have psychological benefits.
Gaikwad, Archana, and Kiran Shinde. "Use of parks by older persons and perceived health benefits: A developing country context." Cities 84 (2019): 134-142.	Mixed research	(n=20)	Social connections increase physical activity participation and provide psychological health benefits.
Gascon, Mireia, Gonzalo Sánchez-Benavides, Payam Dadvand, David Martínez, Nina Gramunt, Xavier Gotsens, Marta Cirach et al. "Long-term exposure to residential green and blue spaces and anxiety and depression in adults: A cross-sectional study." Environmental Research 162 (2018): 231-239.	Descriptive Study	adults (n=958)	High greenness was related to lower odds of having depression or having taken medication for psychological treatment.
Hall, Charles R., and Melinda J. Knuth. "An update of the literature supporting the well-being benefits of plants: part 2 physiological health benefits." Journal of Environmental Horticulture 37, no. 2 (2019): 63-73.	Research Review		Plants provide physiological health benefits, which improves quality of life. Plants improve factors, such as rehabilitation and sleep, and increase physical activity.
Han, Bing, Deborah A. Cohen, Kathryn Pitkin Derose, Terry Marsh, Stephanie Williamson, and Laura Raaen. "How much neighborhood parks contribute to local residents' physical activity in the City of Los Angeles: A meta-analysis." Preventive medicine 69 (2014): S106-S110.	Meta Analysis	83 parks	Parks are related to moderate-to-vigorous exercise, and programming and activities draw people to parks.
Han, Jin-Woo, Han Choi, Yo-Han Jeon, Chong-Hyeon Yoon, Jong-Min Woo, and Won Kim. "The effects of forest therapy on coping with chronic widespread pain: Physiological and psychological differences between participants in a forest therapy program and a control group." International journal of environmental research and public health 13, no. 3 (2016): 255.	Case-Control Trial	employees (n=61)	Forest therapy improved physiological measures and quality of life, while decreasing pain and depression.
Han, Ke-Tsung. "The effect of nature and physical activity on emotions and attention while engaging in green exercise." Urban Forestry & Urban Greening 24 (2017): 5-13.	Randomized control trial	college students (n=116)	Attention and emotions were improved with 15 minutes of low-to-moderate physical activity in 40% visible green space. Low intensity physical activity was also better for not increasing fatigue.
Hansmann, Ralf, Stella-Maria Hug, and Klaus Seeland. "Restoration and stress relief through physical activities in forests and parks." Urban forestry & urban greening 6, no. 4 (2007): 213-225.	field survey	(n=164)	Green space decreased headaches and stress and improved mood. The effects increased with longer duration and more intense physical activity.

Hazer, Meghan, Margaret K. Formica, Susan Dieterlen, and Christopher P. Morley. "The relationship between self-reported exposure to greenspace and human stress in Baltimore, MD." Landscape and urban planning 169 (2018): 47-56.	survey	(n=323)	Every additional hour per week exposed to green space decreased self-reported stress.
Hofmann, Mathias, Christopher Young, Tina M. Binz, Markus R. Baumgartner, and Nicole Bauer. "Contact to nature benefits health: Mixed effectiveness of different mechanisms." International journal of environmental research and public health 15, no. 1 (2018): 31.	Questionnaire	volunteer gardeners (n=85)	Cortisol levels were lower with increased time spent in nature and physical activity.
Hsu, Hung-Pin. "Providing an attractive environment for people to engage in health activities: Serving with landscape." International Journal of Conceptual Structures and Smart Applications (IJCSSA) 4, no. 2 (2016): 38-54.	Survey and In Depth Interviews	city residents (n=683)	Aesthetics increase frequency and duration of physical activities in parks.
Hug, Stella-Maria, Terry Hartig, Ralf Hansmann, Klaus Seeland, and Rainer Hornung. "Restorative qualities of indoor and outdoor exercise settings as predictors of exercise frequency." Health & place 15, no. 4 (2009): 971-980.	Survey	members of fitness centers (n=319)	Outdoor environments were more restorative and therefore increased frequency of physical activity.
Hunter, Ruth F., Hayley Christian, Jenny Veitch, Thomas Astell-Burt, J. Aaron Hipp, and Jasper Schipperijn. "The impact of interventions to promote physical activity in urban green space: a systematic review and recommendations for future research." Social science & medicine 124 (2015): 246-256.	Systematic review	(n=12)	Physical activity programs increase urban green space use and physical activity.
Ihlebæk, Camilla, Geir Aamodt, Renata Aradi, Bjørgulf Claussen, and Kine Halvorsen Thorén. "Association between urban green space and self-reported lifestyle-related disorders in Oslo, Norway." Scandinavian journal of public health 46, no. 6 (2018): 589-596.	Questionnaire	(n=8638)	Greater greenness was related to fewer mental disorders.
Irvine, Katherine N., Sara L. Warber, Patrick Devine-Wright, and Kevin J. Gaston. "Understanding urban green space as a health resource: A qualitative comparison of visit motivation and derived effects among park users in Sheffield, UK." International journal of environmental research and public health 10, no. 1 (2013): 417-442.	Qualitative Content Analysis of interview questions	park users (n=312)	People were more likely to use parks because of walking, green space quality, and children. Effects of using parks were relaxation, positive emotions, and spiritual wellbeing.
James, Peter, Rachel F. Banay, Jaime E. Hart, and Francine Laden. "A review of the health benefits of greenness." Current epidemiology reports 2, no. 2 (2015): 131-142.	Research Review		Greenness increases physical activity and protects against poor mental health.
Kaczynski, Andrew T., Luke R. Potwarka, and Brian E. Saelens. "Association of park size, distance, and features with physical activity in neighborhood parks." American journal of public health 98, no. 8 (2008): 1451-1456.	Observational study	adult residents around 33 parks (n=380)	People were more likely to exercise in parks with more features, and facilities were more important than amenities.

Kendal, D., K. Lee, C. Ramalho, K. Bowen, and J. Bush. "Benefits of urban green space in the Australian context." (2016).	Research Review		Green spaces that are open and attractive are important to physical activity. Natural elements raise pain threshold and help with physical healing. Reducing city noise exposure and increasing biodiversity improves psychological health.
Klaperski, Sandra, Elena Koch, Daniel Hewel, Anja Schempp, and Jana Müller. "Optimizing mental health benefits of exercise: The influence of the exercise environment on acute stress levels and wellbeing." Mental Health & Prevention 15 (2019): 200173.	Field Study	collegiate sports participants (n=140)	Exercise lowers stress levels and improves wellbeing, and outdoor exercise amplified these results.
Kothencz, Gyula, Ronald Kolcsár, Pablo Cabrera-Barona, and Péter Szilassi. "Urban green space perception and its contribution to well-being." International journal of environmental research and public health 14, no. 7 (2017): 766.	Survey	visitors to urban green spaces (n=227)	Better perceived green spaces benefit wellbeing.
Krenichyn, Kira. "'The only place to go and be in the city': women talk about exercise, being outdoors, and the meanings of a large urban park." Health & place 12, no. 4 (2006): 631-643.	Interviews	Adult women park users (n=41)	Natural physical features drew users to the park and restored mental capacities.
Li, Dongying, Yujia Zhai, Yayuan Xiao, Galen Newman, and De Wang. "Subtypes of park use and self-reported psychological benefits among older adults: A multilevel latent class analysis approach." Landscape and urban planning 190 (2019): 103605.	Survey	older visitors of 15 parks (n=200)	Park use increased relaxation and contention while decreasing anxiety and depression.
Liu, Hongxiao, Feng Li, Juanyong Li, and Yuyang Zhang. "The relationships between urban parks, residents' physical activity, and mental health benefits: A case study from Beijing, China." Journal of environmental management 190 (2017): 223-230.	Questionnaire	(n=308)	Park users participate in more forms of physical activity, which restored moods and energy levels. Nature also enhanced relaxation and self-perceived confidence.
Liu, Hongxiao, Hai Ren, Roy P. Remme, Huifu Nong, and Chunhua Sui. "The effect of urban nature exposure on mental health—a case study of Guangzhou." Journal of Cleaner Production 304 (2021): 127100.	Survey	(n=1274)	Blue space and park exposure reduce the risk of depression and improve wellbeing.
Mackay, Graham J., and James T. Neill. "The effect of "green exercise" on state anxiety and the role of exercise duration, intensity, and greenness: A quasi-experimental study." Psychology of sport and exercise 11, no. 3 (2010): 238-245.	Quasi-experimental	outdoor exercise participants (n=101)	Green exercise reduced anxiety, and higher greenness had more substantial benefits.
McMorris, Owen, Paul J. Villeneuve, Jason Su, and Michael Jerrett. "Urban greenness and physical activity in a national survey of Canadians." Environmental research 137 (2015): 94-100.	Survey	Canadians ages 20 and older (n=69910)	People living in the most green areas were more likely to exercise.
Nordh, Helena, Chaham Alalouch, and Terry Hartig. "Assessing restorative components of small urban parks using conjoint methodology." Urban forestry & urban greening 10, no. 2 (2011): 95-103.	Survey	Adult residents (n=154)	Structural elements, including trees and grass, were more important to park choice than decorative elements.

Pietilä, Miisa, Marjo Neuvonen, Katja Borodulin, Kalevi Korpela, Tuija Sievänen, and Liisa Tyrväinen. "Relationships between exposure to urban green spaces, physical activity and self-rated health." Journal of outdoor recreation and tourism 10 (2015): 44-54.	Quantitative analysis	Finns age 15-74 (n=2323)	Urban and suburban green spaces have different requirements for use; in suburban areas, recreation should be emphasized, while in urban areas, physical activity from active commuting is the key to getting residents of exercise.
Pratiwi, Prita Indah, Qiongying Xiang, and Katsunori Furuya. "Physiological and psychological effects of viewing urban parks in different seasons in adults." International Journal of Environmental Research and Public Health 16, no. 21 (2019): 4279.	Randomized control trial	adults over 55 (n=12)	Viewing urban parks, specifically greenery and cherry blossoms, improved relaxation.
Pun, Vivian C., Justin Manjourides, and Helen H. Suh. "Association of neighborhood greenness with self-perceived stress, depression and anxiety symptoms in older US adults." Environmental Health 17, no. 1 (2018): 1-11.	Questionnaire	community-dwellers aged 57-85 (n=4118)	Greenness decreased perceived stress, with greater results seen in summer. Increased greenness also caused increased physical activity.
Reid, Colleen E., Jane E. Clougherty, Jessie LC Shmool, and Laura D. Kubzansky. "Is all urban green space the same? A comparison of the health benefits of trees and grass in New York City." International journal of environmental research and public health 14, no. 11 (2017): 1411.	Quantitative analysis	New York City adults (n=1281)	People living in the area with the highest tree density had better self-reported health.
Schipperijn, Jasper, Peter Bentsen, Jens Troelsen, Mette Toftager, and Ulrika K. Stigsdotter. "Associations between physical activity and characteristics of urban green space." Urban forestry & urban greening 12, no. 1 (2013): 109-116.	Questionnaire	Danish adults (n=1305)	People were more likely to exercise in urban green spaces with paths, natural elements, amenities, lights, and pleasant views.
Shanahan, Danielle F., Robert Bush, Kevin J. Gaston, Brenda B. Lin, Julie Dean, Elizabeth Barber, and Richard A. Fuller. "Health benefits from nature experiences depend on dose." Scientific reports 6, no. 1 (2016): 1-10.	Survey	Brisbane residents aged 18–70 (n=1538)	Rate of depression were lower in people who made long visits to green spaces. Social cohesion was greater in people who visited green spaces more frequently. Longer duration and increased frequency were both linked to higher levels of physical activity.
Shanahan, Danielle F., Lara Franco, Brenda B. Lin, Kevin J. Gaston, and Richard A. Fuller. "The benefits of natural environments for physical activity." Sports Medicine 46, no. 7 (2016): 989-995.	Research Review		Green spaces are important for physical activity, and green exercise has greater benefits than other physical activity.
Shores, Kindal A., and Stephanie T. West. "The relationship between built park environments and physical activity in four park locations." Journal of Public Health Management and Practice 14, no. 3 (2008): e9-e16.	Observational study	park visitors (n=2113)	People using parks with built elements, especially sport courts, playgrounds, and paths, were more active.
Smith, Joyce. 2020. "Urban Green Spaces Improve Mental Health in Australian Residents | NHRI." National Health Research Institute, November. https://www.naturalhealthresearch.org/urban-green-spaces-improve-mental-health-in-australian-residents/.	Survey	city dwellers (n=46786)	A greater urban tree canopy is associated with better health and less psychological distress.

Song, Chorong, Harumi Ikei, Bum-Jin Park, Juyoung Lee, Takahide Kagawa, and Yoshifumi Miyazaki. "Psychological benefits of walking through forest areas." International journal of environmental research and public health 15, no. 12 (2018): 2804.	Randomized control trial	Japanese male university students (n=585)	Walking through forested areas improves mood more than walking through city areas.
Stewart, Orion T., Anne Vernez Moudon, Alyson J. Littman, Edmund Seto, and Brian E. Saelens. "The association between park facilities and duration of physical activity during active park visits." Journal of urban health 95, no. 6 (2018): 869-880.	Survey	adults (n=372)	Longer durations of physical activity were associated with each additional exercise facility.
Stewart, Orion Theodore, Anne Vernez Moudon, Alyson Littman, Edmund Seto, and Brian E. Saelens. "The association between park facilities and the occurrence of physical activity during park visits." Journal of leisure research 49, no. 3-5 (2018): 217-235.	Quantitative analysis	adults (n=225)	The more physical activity facilities in a park, the higher the probability that the user will be active during that visit.
Sugiyama, Takemi, Eva Leslie, Billie Giles-Corti, and Neville Owen. "Associations of neighbourhood greenness with physical and mental health: do walking, social coherence and local social interaction explain the relationships?." Journal of Epidemiology & Community Health 62, no. 5 (2008): e9-e9.	Survey	adults (n=1895)	People who perceived that their neighborhood was highly green had higher odds of better mental and physical health. Increased greenness was also related to walking and social coherence.
Van den Berg, Magdalena, Mireille van Poppel, Irene van Kamp, Sandra Andrusaityte, Birute Balseviciene, Marta Cirach, Asta Danileviciute et al. "Visiting green space is associated with mental health and vitality: A cross-sectional study in four european cities." Health & place 38 (2016): 8-15.	Questionnaire	(n=3748)	Better mental health and vitality were associated with longer times visiting green spaces.
Wang, Ruoyu, Boyi Yang, Yao Yao, Michael S. Bloom, Zhiqiang Feng, Yuan Yuan, Jinbao Zhang et al. "Residential greenness, air pollution and psychological well-being among urban residents in Guangzhou, China." Science of the Total Environment 711 (2020): 134843.	Quantitative analysis	residents of 35 neighbor-hoods	Psychological wellbeing was related to high greenness, high tree coverage, and high grass coverage.
Wang, Zhipeng, Siyi Xing, Bo Zhang, Wanning Liang, and Yating Zhu. "How Does Urban Park Affect People's Health? An Empirical Study Based on Xiaoyaojin Park in Hefei." In IOP Conference Series: Earth and Environmental Science, vol. 610, no. 1, p. 012016. IOP Publishing, 2020.	Questionnaire	Park users (n=206)	There is a correlation between physical health, mental health, duration of park use, and satisfaction with the park environment. Physical health is associated with activity facilities, while mental health is associated with satisfaction with plants.
Wood, Emma, Alice Harsant, Martin Dallimer, Anna Cronin de Chavez, Rosemary RC McEachan, and Christopher Hassall. "Not all green space is created equal: biodiversity predicts psychological restorative benefits from urban green space." Frontiers in psychology 9 (2018): 2320.	Survey	park users (n=128)	The more site facilities an urban green space has, the greater the biodiversity. Biodiversity also predicts the restorative benefit of the space.

Wood, Lisa, Paula Hooper, Sarah Foster, and Fiona Bull. "Public green spaces and positive mental health–investigating the relationship between access, quantity and types of parks and mental wellbeing." Health & place 48 (2017): 63-71.	Quantitative analysis	residents (n=492)	Larger green spaces are associated with better mental wellbeing. Mental health was related to nature as well as sports and recreational activity.
Zhai, Yujia, Dongying Li, De Wang, and Cheng Shi. "Seniors' Physical Activity in Neighborhood Parks and Park Design Characteristics." Frontiers in Public Health 8 (2020): 322.	Field Study	senior participants (n=234)	People walk more in parks that are larger, have more trails, outdoor fitness equipment, and larger natural areas.

Study Details	Study Design	Target Group	Significant Findings
Barry, Lisa C., Robert D. Kerns, Zhenchao Guo, Bao D. Duong, Lynne P. Iannone, and M. Carrington Reid. "Identification of strategies used to cope with chronic pain in older persons receiving primary care from a Veterans Affairs Medical Center." Journal of the American Geriatrics Society 52, no. 6 (2004): 950-956.	Survey	Patients ages 65-90 (n=245)	Patients utilize a broad set of coping strategies to deal with pain. Only 50% of strategies have at least a moderate level of success.
Blyth, Fiona M., Lyn M. March, Michael K. Nicholas, and Michael J. Cousins. "Self-management of chronic pain: a population-based study." Pain 113, no. 3 (2005): 285-292.	Survey	Adults over 18 with chronic pain (n=474)	Self-management of chronic pain was found to focus on passive techniques (medications) in 2/3 of respondents. Remaining respondents focus on exercise as self-management technique. Passive self-management techniques were found to result in more frequent health-care visits.
Cha, Bo Kyoung, and Chang Seung Park. "A comparison of pain, pain interference and fatigue according to the level of physical activity in the elderly with chronic pain." Journal of Korean Academy of Community Health Nursing 22, no. 2 (2011): 162-172.	Controlled Study	Elders with Chronic Pain (n=116)	Elderly patients can benefit from increased physical activity in their daily routines. Physical activity can influence the level of pain and interfere with pain.
Chatzitheodorou, Dimitris, Chris Kabitsis, Paraskevi Malliou, and Vassilis Mougios. "A pilot study of the effects of high-intensity aerobic exercise versus passive interventions on pain, disability, psychological strain, and serum cortisol concentrations in people with chronic low back pain." Physical therapy 87, no. 3 (2007): 304-312.	Controlled Study	Patients receiving primary care (n=20)	Aerobic exercise alleviates chronic low back pain as well as reducing psychological stress. Regular exercise is required to achieve results.
Chatzitheodorou, Dimitris, Savvas Mavromoustakos, and Styliani Milioti. "The effect of exercise on adrenocortical responsiveness of patients with chronic low back pain, controlled for psychological strain." Clinical rehabilitation 22, no. 4 (2008): 319-328.	Controlled Clinical Trial	Physical therapy patients with low back pain (n=64)	A 30% reduction in pain was experienced by patients doing regular high-intensity aerobic exercise. These individuals also experienced a 25% reduction in anxiety and depression.
Chopin, Suzzette M., Christina M. Sheerin, and Brian L. Meyer. "Yoga for warriors: An intervention for veterans with comorbid chronic pain and PTSD." Psychological Trauma: Theory, Research, Practice, and Policy 12, no. 8 (2020): 888.	Open-trial design	Veterans with chronic pain and PTSD (n=49)	Participants reported an overall reduction in PTSD symptoms over the 4-year period of the study. Participants also had significant improvement in their ability to participate in social activities.
Chou, Roger, Richard Deyo, Janna Friedly, Andrea Skelly, Robin Hashimoto, Melissa Weimer, Rochelle Fu et al. "Nonpharmacologic therapies for low back pain: a systematic review for an American College of Physicians clinical practice guideline." Annals of internal medicine 166, no. 7 (2017): 493-505.	Systematic review	9 studies of randomized trials of non-medication treatmentt	Movement therapy such as tai chi is effective in reducing low-back pain. Mindfulness-based stress reduction is an effective self-treatment to support exercise.
Dezutter, Jessie, Koen Luyckx, and Amy Wachholtz. "Meaning in life in chronic pain patients over time: Associations with pain experience and psychological well-being." Journal of behavioral medicine 38, no. 2 (2015): 384-396.	Longitudinal study	Belgian chronic pain patients (n=273)	Patients that adjusted to chronic pain over time had a better outlook on life experiences. Pain intensity has a strong negative effect on life perspectives.

Ferro Moura Franco, Katherinne, Dorine Lenoir, Yuri Rafael dos Santos Franco, Felipe Jose Jandre Reis, Cristina Maria Nunes Cabral, and Mira Meeus. "Prescription of exercises for the treatment of chronic pain along the continuum of nociplastic pain: a systematic review with meta-analysis." European Journal of Pain 25, no. 1 (2021): 51-70.	Systematic Review	50 randomized control trials of exercise impact on chronic pain (n=3562)	Exercise regimens are successful in reducing chronic pain if the exercises are appropriately matched with the specific pain. Effectiveness is dependent on regular exercise of 2-3 times per week with 30-to-60 minute durations.
Geneen, Louise J., R. Andrew Moore, Clare Clarke, Denis Martin, Lesley A. Colvin, and Blair H. Smith. "Physical activity and exercise for chronic pain in adults: an overview of Cochrane Reviews." Cochrane Database of Systematic Reviews 4 (2017).	Systematic Review	21 systematic reviews including 381 studies (n=37,143)	Physical activity and exercise has few adverse effects for chronic pain and may improve pain severity and physical function. Variable effects were found for quality of life and psychological benefits.
Hayden, Jill A., Maurits W. Van Tulder, Antti V. Malmivaara, and Bart W. Koes. "Meta-analysis: exercise therapy for nonspecific low back pain." Annals of internal medicine 142, no. 9 (2005): 765-775.	Meta Analysis	61 randomized, controlled trials (n=6390)	Exercise therapy was found to be slightly effective for chronic back pain, especially in populations receiving health care. Inconsistent findings for what specific types of exercise programs provide the most benefit.
Hooten, W. Michael. "Chronic pain and mental health disorders: shared neural mechanisms, epidemiology, and treatment." In Mayo Clinic Proceedings, vol. 91, no. 7, pp. 955-970. Elsevier, 2016.	Research Review		Chronic pain and mental health issues are tied together through neural mechanisms. Practitioners should ask patients with chronic pain about mental health issues.
Karlsson, Linn, Björn Gerdle, Esa-Pekka Takala, Gerhard Andersson, and Britt Larsson. "Experiences and attitudes about physical activity and exercise in patients with chronic pain: a qualitative interview study." Journal of pain research 11 (2018): 133.	Qualitative Interview Study	Adults with chronic pain in a pain rehabilitation program. (n=16 women and 2 men)	Patients had a greater positive outlook when they engaged in physical activity and exercise. A lack of self-efficacy interrupted potential gains and achievement levels desired by the individuals.
Kichline, Tiffany, and Christopher C. Cushing. "A systematic review and quantitative analysis on the impact of aerobic exercise on pain intensity in children with chronic pain." Children's Health Care 48, no. 2 (2019): 244-261.	Systematic Review	11 studies of empirical research involving children under 18 years of age (n=411)	A small, but significant benefit was found for aerobic exercise in terms of chronic pain. Long-term results were inconclusive due to study design.
Kong, Ling Jun, Romy Lauche, Petra Klose, Jiang Hui Bu, Xiao Cun Yang, Chao Qing Guo, Gustav Dobos, and Ying Wu Cheng. "Tai chi for chronic pain conditions: a systematic review and meta-analysis of randomized controlled trials." Scientific reports 6, no. 1 (2016): 1-9.	Systematic Review	18 randomized controlled trials with chronic pain and tai chi exercise (n=1260)	Tai chi was found to be an effective tool for reducing chronic pain. It appears that results were greater for individuals who engaged in tai chi for at least three months.

La Touche, Roy, Karla Escalante, and María Teresa Linares. "Treating non-specific chronic low back pain through the Pilates Method." Journal of Bodywork and Movement Therapies 12, no. 4 (2008): 364-370.	Systematic Review	3 studies with adults with chronic pain (n=141)	The Pilates method was found to be effective in all studies under review. Improvement in general function. All studies emphasize consistent exercise programs to achieve full benefits.
Landmark, Tormod, Pål Romundstad, Petter C. Borchgrevink, Stein Kaasa, and Ola Dale. "Associations between recreational exercise and chronic pain in the general population: evidence from the HUNT 3 study." PAIN® 152, no. 10 (2011): 2241-2247.	Survey	Adults in Norway (n=46533)	Chronic pain was reduced when individuals engaged in consistent exercise programs. Individuals able to exercise three times-per-week for 30 minutes a day had the greatest benefits.
Lee, Courtney, Cindy Crawford, and Eric Schoomaker. "Movement therapies for the self-management of chronic pain symptoms." Pain Medicine 15, no. S1 (2014): S40-S53.	Systematic Review	146 randomized controlled trials on pain self-management	Movement therapy shows positive results for chronic pain. Therapies that also lead to a state of calm are found to have multiple benefits.
Mannerkorpi, Kaisa, and Chris Henriksson. "Non-pharmacological treatment of chronic widespread musculoskeletal pain." Best Practice & Research Clinical Rheumatology 21, no. 3 (2007): 513-534.	Systematic Review	31 randomized controlled studies on non-medication therapy	All forms of exercise showed benefits when done at frequency and duration. Exercise was also found to enhance self-image for the individuals.
Murtezani, A., H. Hundozi, N. Orovcanec, S. Sllamniku, and T. Osmani. "A comparison of high intensity aerobic exercise and passive modalities for the treatment of workers with chronic low back pain: a randomized, controlled trial." Eur J Phys Rehabil Med 47, no. 3 (2011): 359-66.	Randomized Control Trials	Exercise class (n=50) and control group (n=51)	Individuals from the exercise class had significant reduction in pain at the 12-week study point. High intensity aerobic exercise showed notable benefits.
O'Connor, Seán R., Mark A. Tully, Brigid Ryan, Chris M. Bleakley, George D. Baxter, Judy M. Bradley, and Suzanne M. McDonough. "Walking exercise for chronic musculoskeletal pain: systematic review and meta-analysis." Archives of physical medicine and rehabilitation 96, no. 4 (2015): 724-734.	Systematic Review	26 studies with adults diagnosed with chronic pain (n=2384)	Walking regimens were found to provide benefits for participants. Durations of 6-12 months were found to be required to develop notable differences from other treatments.
O'Riordan, Cliona, Amanda Clifford, Pepijn Van De Ven, and John Nelson. "Chronic neck pain and exercise interventions: frequency, intensity, time, and type principle." Archives of physical medicine and rehabilitation 95, no. 4 (2014): 770-783.	Quantitative Design Studies	16 studies of individuals in multimodal exercise regimens	Exercise at least 3 times per week for 6-12 weeks including multiple exercise modalities results in notable benefits. Strength and endurance exercises should both be included in the routine.
Perruchoud, Christophe, Eric Buchser, Lisa M. Johanek, Kamiar Aminian, Anisoara Paraschiv-Ionescu, and Rod S. Taylor. "Assessment of physical activity of patients with chronic pain." Neuromodulation: Technology at the Neural Interface 17 (2014): 42-47.	Narrative Review	8 studies of various forms of physical activity.	Implantable devices are providing greater accuracy of information regarding exercise and pain. Objective measurement of benefits from exercise is needed to develop specific exercise regimens.

Posadzki, Pawel, Dawid Pieper, Ram Bajpai, Hubert Makaruk, Nadja Könsgen, Annika Lena Neuhaus, and Monika Semwal. "Exercise/physical activity and health outcomes: an overview of Cochrane systematic reviews." BMC Public Health 20, no. 1 (2020): 1-12.	Systematic Review	150 systematic reviews were included focusing benefits of exercise on pain (n=27671)	Mortality rates are reduced when individuals are active. Pain is reduced as the frequency of exercise increases with all studies showing benefits of exercise on chronic pain.
Shim, Minjung, R. Burke Johnson, Susan Gasson, Sherry Goodill, Richard Jermyn, and Joke Bradt. "A model of dance/movement therapy for resilience-building in people living with chronic pain." European Journal of Integrative Medicine 9 (2017): 27-40.	Mixed Methods Study	Individuals with chronic pain in dance movement therapy (n=22)	Dance movement therapy resulted in statistically significant improvement after a 10-week session. Both social and physical improvements were observed in participants.
Skelly, Andrea Clare, Roger Chou, Joseph R. Dettori, Judith A. Turner, Janna L. Friedly, Sean D. Rundell, Rongwei Fu et al. "Noninvasive nonpharmacological treatment for chronic pain: a systematic review." (2018).	Systematic Review	218 journal articles	Reduced pain and improvements in function are related to mind-body practices, acupuncture, CBT, multidisciplinary rehabilitation and exercise.
Suh, Jee Hyun, Hayoung Kim, Gwang Pyo Jung, Jin Young Ko, and Ju Seok Ryu. "The effect of lumbar stabilization and walking exercises on chronic low back pain: a randomized controlled trial." Medicine 98, no. 26 (2019).	Randomized Control Trials	People with Lower Back Pain (n=48)	Lower back pain was decreased with physical activity. People doing stabilization exercises and walking exercise increased their exercise frequency, and people doing stabilization exercises increased their exercise duration as well.
Sullivan, Amy Burleson, Judith Scheman, Deborah Venesy, and Sara Davin. "The role of exercise and types of exercise in the rehabilitation of chronic pain: specific or nonspecific benefits." Current pain and headache reports 16, no. 2 (2012): 153-161.	Research Review		Exercise improves physical capacity, increases independence and functioning, and decreases anxiety, depression, morbidity, and mortality
Verbrugghe, Jonas, Anouk Agten, Sjoerd Stevens, Dominique Hansen, C. B. O. E. Demoulin, Bert O. Eijnde, Frank Vandenabeele, and Annick Timmermans. "Exercise intensity matters in chronic nonspecific low back pain rehabilitation." Med Sci Sports Exerc 51, no. 12 (2019): 2434-2442.	Randomized Control Trial	People with chronic nonspecific low back pain (n=38)	People performing high-intensity exercise had greater improvements, such as reducing pain, increasing function, than those performing moderate-intensity exercise.
Wang, Chenchen. "Role of Tai Chi in the treatment of rheumatologic diseases." Current rheumatology reports 14, no. 6 (2012): 598-603.	Research Review		Tai chi improves both physical and mental health. Physically, tai chi increases balance, muscular strength, physical function, and cardiovascular fitness. Mentally, it improves quality of life and reduces anxiety, stress, and depression.

Appendix E - Park Factors from Coding that Final Ten Recommendations Address

	Welcoming Atmosphere and Safety	High Quality, Low Maintenance Nature	Facilities, Amenities, Sports	Water	Motivational and Informational Signage	Movement Therapy Outdoor Rooms	Accessible Exercise Options and Variety	Sensory Engagement	Trails	Seasonality
high greenness intensity	X	X						X		X
longer duration	X					X		X	X	
increased frequency	X		X	X				X	X	X
walking trails			X				X		X	
facilities/amenities	X		X							X
sports fields/courts			X				X			
large park size		X							X	
open areas	X		X			X				
views	X	X						X	X	
fitness equipment			X				X			
visibility/openness	X					X				
play equipment			X				X			
plazas			X							
lights	X									
biodiversity	X	X						X		X
trees/tree canopy	X	X				X		X		X
water	X			X				X		X
lawns			X			X				
natural topography								X	X	
seasonality		X						X		X
flower beds		X						X		
minimal grass		X								
walking							X		X	
socializing						X			X	
cycling							X		X	
jogging							X		X	
water activity				X			X			
commuting									X	
quality	X	X	X	X		X		X		
aesthetics	X	X		X		X		X		X
maintenance	X	X				X				X
cleanliness	X	X						X		
safety	X				X					
calm/less noise exposure	X					X		X		
sensory experiences		X		X		X		X		X
programming			X	X	X	X	X			X

Appendix F - HICP Factors from Coding that Final Ten Recommendations Address

	Welcoming Atmosphere and Safety	High Quality, Low Maintenance Nature	Facilities, Amenities, Sports	Water	Motivational and Informational Signage	Movement Therapy Outdoor Rooms	Accessible Exercise Options and Variety	Sensory Engagement	Trails	Seasonality
moderate-high intensity				X					X	
2-3x/week	X						X			
at least 30 minutes						X			X	
low-moderate intensity				X		X			X	
tai chi						X	X			
yoga						X	X	X		
multidisciplinary rehab				X		X		X		
mindful stress reduction						X		X		
pilates						X	X			
qigong						X	X			
dance						X	X			
aerobic exercise			X	X			X		X	
strength training				X			X		X	
flexibility						X	X			
combination				X		X	X		X	
walking							X		X	
body awareness exercises				X		X	X			
pool exercises				X			X			
cycling							X		X	
psychological therapies						X		X		
going outside	X	X		X		X		X	X	X
self-efficacy				X	X		X		X	
motivation	X				X		X		X	
support of others			X		X	X	X			X
good attitude/experience	X	X		X	X	X	X		X	

Appendix G - Implementation Evaluation Tool

The implementation of all ten recommendations may be difficult in any given park due to budgets, physical location, and existing conditions. However, each recommendation can be seen as an improvement and a step towards achieving a park that serves individuals with HICP as well as general users of the park. The table below provides a simple communication mechanism to convey the level of implementation for the recommendations for either an existing or proposed park. The example to the right illustrates how it might be used for an individual park evaluation. While the goal is to have complete implementation for all recommendations, the table should be considered a point from which to start the conversation towards implementing a park that serves the community for both physical and psychological requirements.

	Level of Implementation				
	None No Implementation	Minimal Recommendation is in place to a minimal standard	Satisfactory Recommendation is in place to a standard acceptable to the average user	Complete Recommendation would be satisfactory to the majority of users	Implementation Notes
Welcoming Atmosphere and Safety					
High Quality, Low Maintenance Nature					
Facilities, Amenities, Sports					
Water					
Motivational and Informational Signage					
Movement Therapy Outdoor Rooms					
Accessible Exercise Options and Variety					
Sensory Engagement					
Trails					
Seasonality					

	Level of Implementation				
	None No Implementation	Minimal Recommendation is in place to a minimal standard	Satisfactory Recommendation is in place to a standard acceptable to the average user	Complete Recommendation would be satisfactory to the majority of users	Implementation Notes
Welcoming Atmosphere and Safety	Lack of lighting in parking lots and along trails.				Consider new lighting design to provide lighting at entrances and along trails.
High Quality, Low Maintenance Nature		Native plants are used in multiple areas. Several large lawn areas require significant maintenance.			Increase native plantings through removal of lawn particularly along trails.
Facilities, Amenities, Sports			Ballfields are in place but minimal indoor facilities are in place for exercise classes in the winter.		Consider adding a multipurpose room that can be divided for multiple size classes throughout the year.
Water			Several fountains in place including interactive fountains for hot weather. No natural water features.		Consider adding small ponds for relaxation areas.
Motivational and Informational Signage				Signage in place describing exercise options. Additional signage specific to HICP could be useful.	Add signage specific to HICP and other conditions explaining how exercise benefits the conditions.
Movement Therapy Outdoor Rooms				Clearly identified areas for movement classes. Well maintained surfaces for drainage and balance concerns.	No need for changes
Accessible Exercise Options and Variety		Fitness and movement classes are part of development. Minimal number of exercise equipment stations.			Increase focus on exercise equipment in specific areas to increase usage.
Sensory Engagement		Multiple types of plants provide color engagement. Minimal sound features or barriers are apparent.			Consider putting a line of trees between ballfields and movement areas for sound barriers.
Trails				Multiple trails of different posted lengths with different materials in place. Well-maintained with good signage.	No changes required at this time
Seasonality			Multiple shade structures in place. Variety of plantings indicate seasonality interest for users. Indoor facilities for winter use.		Increase variety of plantings across park for diversity of interest.