

# Green Paths to Mental Health: A Theoretical Framework

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The Influence of Green Space on Mental Health | Wellesley Junior Fellowship Report  
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## Introduction

Green space, as one component of the built environment, is essential for our mental health and well-being (Haluza, Schönbauer, & Cervinka, 2014; Maller, Townsend, Pryor, Brown, & St. Leger, 2006; Shanahan, Fuller, Bush, Lin, & Gaston, 2015). Studies have shown that green space may reduce stress and promote relaxation, contributing to improved mental health (Bratman, Hamilton, & Daily, 2012; Di Nardo, Saulle, & La Torre, 2010; Gascon, Triguero-Mas, Martinez, & Nieuwenhuijsen, 2015; Lachowycz & Jones, 2013).

Although there is evidence that green space influences mental health and well-being, there is little existing work delineating the specific characteristics or features of green space as it relates to mental health impacts. A starting point towards this goal is to uncover and better understand the mediating and moderating factors that influence the relationship between green space and mental health. The theoretical framework presented in this paper synthesizes information that was gathered through a scoping review of reviews designed to understand the aspects of green space that affect mental health and well-being. Furthermore, the identified connections between green space and mental health are elaborated by an examination of the various mediating and moderating factors influencing this relationship

## Background

In 2015, Toronto Public Health (TPH) published the Green City report, an evidence-based review on how nature and green spaces impact physical and mental health and well-being (TPH, 2015). They found that not only is frequent access to green space important for mental health, but nearby green space may provide additional benefits in the case of low-income neighbourhoods. Different neighbourhoods in a city like Toronto vary in positive neighbourhood assets such as parks and ravines. Low-income neighbourhoods have less access to available parks and green spaces of good, usable quality (Floyd, Taylor, & Whitt-Glover, 2009; Francis, Wood, Knuiman, & Giles-Corti, 2012).

Toronto's communities are currently shifting according to income inequality. The Three Cities report (Hulchanski, 2010) found that Toronto's neighbourhoods are increasingly polarized by income and that this increasing disparity between high and low-income neighbourhoods is increasingly racialized,<sup>1</sup> with lower-income households composed of more newcomers and visible minority populations (Hulchanski, 2010). In the City of Toronto, 18 percent of the population has been in Canada for ten years or less. About 49 percent of the population has a mother tongue that is not English or French (City of Toronto, 2013).

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1 Racialized populations are defined as “Non-dominant ethnoracial communities who, through the process of racialization, experience race as a key factor in their identity” (Galabuzi 2001).

This income trend is compounded by the fact that newcomers and racialized populations in Toronto often face barriers to income security (Khandor, E., & Koch, A., 2011).

In recognition of these shifting economic conditions in urban centres, health researchers have sought to better document health inequalities. In 2010 the World Health Organization (WHO) led an international initiative called the Urban Health Equity Assessment and Response Tool (Urban HEART) to address urban inequities. In response, the City of Toronto analyzed data on its 140 neighbourhoods using the same framework (Centre for Research on Inner City Health [CRICH], 2014). This information was then used to identify 31 Neighbourhood Improvement Areas (NIAs), which had the lowest Neighbourhood Equity Scores. The Neighbourhood Equity Score is a “single number designed to capture the total weight of unnecessary, unfair and unjust differences faced by neighbourhood residents in five key areas: economic opportunities, social development, healthy lives, participation and decision-making and physical surroundings” (City of Toronto, 2014, p.1).

Green space is a factor in determining the neighbourhood equity score. In Toronto, Urban HEART measures the quantity of green space as the average amount of green space per kilometre squared in a one-kilometer circular buffer from each residential block in the neighbourhood (CRICH, 2014). There is also a walk score that is used as a proxy measure for access at the neighbourhood level. There is currently no way to measure the quality of green space, which can determine mental health and well-being (Hassen, 2016).

The quantity of, access to, and quality of green space must be considered when assessing its impact on mental health and well-being, as well as the mediating and moderating factors (Hassen, 2016). Although there is limited causal evidence of the link between green space and mental health and well-being, some studies are demonstrating positive associations between quantity, access, and quality of green space and mental health and well-being (Hassen, 2016).

Building on this work, this paper presents a theoretical model that can help researchers, urban planners, health promoters, and community leaders to better understand how green spaces can influence mental health and well-being outcomes. Researchers can use this theoretical framework to identify areas for future investigation, such as understanding the causal pathway between green space and mental health and well-being. Urban planners can use the framework to identify factors to consider when planning neighbourhoods and green spaces. Finally, Health promoters and community leaders use this paper as a starting point to better understand what aspects of green space to focus on with the aim of promoting mental health for all.

## Methods

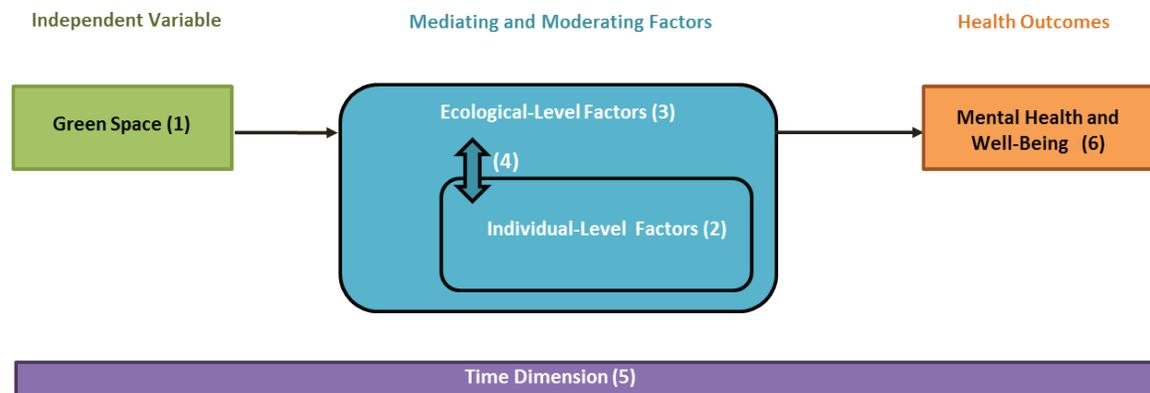
The methodological framework developed for this study is built on a review of the international academic literature from 2005 to 2015, collected through a scoping review of

reviews (Hassen, 2016). The scoping review synthesized information from 16 review articles to answer the following research questions:

- a) What are the aspects of green space that are associated with mental health and well-being?
- b) What are the mediating and moderating factors<sup>2</sup> influencing the relationship between aspects of green space and mental health and well-being?

The theoretical framework draws on the following components from the scoping review of reviews: aspects of green space, mediating and moderating factors, and health outcomes. The mediating and moderating factors were further categorized into four dimensions. Based on a model presented by Shah, Mizrahi, & McKenzie (2011), these four dimensions are i) individual-level factors, ii) ecological-level factors, iii) the interactions between individual and ecological-level factors, and iv) time. To fill any gaps and to develop a comprehensive model, evidence from additional studies that explored the mediating and moderating factors between green space and mental health were reviewed and included based on their fit within any of the four dimensions.

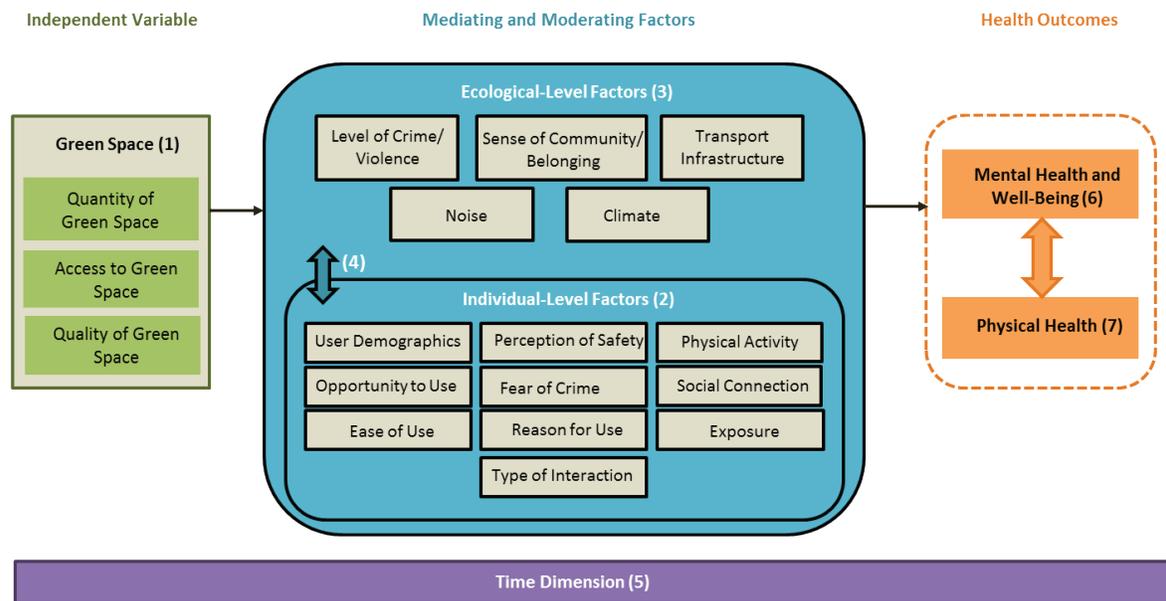
## Theoretical Framework



**Figure 1a.** Overview of the Theoretical Framework. This figure depicts the pathway and mediating and moderating variables involved in how green space influences mental health and well-being outcomes. The framework builds on the findings from a scoping review of reviews.

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2 Mediating factors are variables that are involved directly in the pathway of how green space influences mental health and well-being. These variables are important to consider, as they can increase or reduce the influence of green space on mental health and well-being (Baron & Kenny, 1986).



**Figure 1b.** Detailed Theoretical Framework. This figure depicts the sub-concepts involved in the pathway and explores how aspects of green space can result in either a positive or negative impact on mental health and well-being or have no impact at all. The sub-concepts included here are based on the current and available literature that was found and will continue to evolve and expand over time.

## Description of the Framework's Components

### 1. Green Space

Green space has three main aspects, quantity of green space, access to green space, and quality of green space.

#### a) Quantity of green space:

Quantity of green space refers to the amount of land dedicated to green space and is typically measured in units of area (Hassen, 2016). Studies have measured the quantity of green space based on the amount of green space, the number of green spaces, or the perception of the quantity of green space.

#### b) Access to green space:

Access to green space refers to the ease of proximity to a green space (whether by walking, cycling, or other means of transport), as well mobility once inside the green space for specific populations (e.g. seniors, those with disabilities, infants) (Hassen, 2016). Access to green space can be measured either objectively or subjectively.

#### c) Quality of green space:

Quality of green space refers to the condition of the green space ranging from aesthetics, safety, facilities, cultural context, and community need (Hassen, 2016). The quality of green space also includes the presence of water features, visual

stimuli (including design and landscape), noise levels, and biodiversity/species richness.

## 2. Individual-Level Factors

The scoping review of reviews identified a number of factors at the individual level that mediate and moderate the effect of green space on mental health and well-being (Hassen, 2016). These factors include user-demographics, opportunity to use green spaces, ease of use of green spaces, environmental concern, perception of safety, fear of crime, reason for use, type of interaction, physical activity, social connection, and the level of satisfaction after visiting.

### a) User demographics:

Each population has different needs and uses for green spaces and perceives these spaces in unique ways (Abraham, Sommerhalder, & Abel, 2010). For instance, gender can be a mediating/moderating factor: women may walk more purposefully than men, indicating that their use of green spaces might be with the purpose of reaching a different destination, rather than for leisure (Lee & Maheswaran, 2010). In contrast, young adults tend to spend more leisure time in green spaces, whereas seniors and teenagers do so less, suggesting that age is another mediating/moderating factor (Lee & Maheswaran, 2010). From a racial perspective, Lachowycz and Jones (2013) included studies that found stronger associations between exposure to green space and improved health for white groups compared to non-white groups. Ethnicity was also found to influence the relationship through preferences for types of activities in green spaces and perceptions of the environment (Lachowycz & Jones, 2013).

### b) Opportunity to use:

Access to transportation and free time availability (outside of work and other obligations) are both determinants of whether an individual can access green space. An individual's opportunities to use green space can moderate its effect on mental health (Lachowycz & Jones, 2013).

### c) Ease of use:

This factor refers to an individual's ability to overcome practical barriers (such as finding appropriate attire and footwear) to use a green space or staying safe from hazards (such as unsafe footpaths and heavy traffic) (Lachowycz & Jones, 2013).

### d) Perception of safety:

Different individuals may have varying perceptions of how safe a green space is and, consequently, this may impact their use of the space and its influence on mental health (Lee & Maheswaran, 2010). In particular, perceived safety is important for children, youth, and their parents (Lee & Maheswaran, 2010).

e) Fear of crime:

Fear of crime is associated with poorer mental health. In relation to green space, the fear of crime may cause an individual to limit time outside of the home and in green spaces. In turn, this perceived lack of safety may impact an individual's physical activity and social connection, in turn influencing mental health and well-being (Lorenc, Clayton, Neary, Whitehead, & Petticrew, 2012). Physical activity and social connection are mediators in the relationship between green space and mental health and well-being, as described below (2h and 2i).

f) Reason for use:

There are also various factors that influence whether or not someone may use a green space. For instance, someone who is experiencing a higher level of stress may actively seek out green space (Di Nardo et al., 2010), and this increased usage moderates the relationship outlined in the scoping review of reviews.

g) Type of interaction:

The type of interaction with nature was a moderating factor between green space and mental health and well-being (Keniger, Gaston, Irvine, & Fuller, 2013; Sandifer, Sutton-Grier, & Ward, 2015; Tzoulas, Korpela, Venn, & James, 2007). For instance, Russell et al. (2013) identified and explored four ways of interacting with green spaces that include knowing, perceiving, interacting with and living within, and identified studies that address each of these. There is plentiful research linking perceiving, interacting, and living within nature to mental health, while there is only limited research that connects the factor of knowing nature to mental health.

h) Physical activity:

An individual's level of physical activity influences whether or not green spaces will affect their mental health. Most studies and reviews focused on physical activity as an outcome of green spaces; however, to keep the review focused these were excluded from this review. The sub-components of physical activity includes "green exercise" which refers to exercising in nature or a green space; it was found that exercising in nature provided benefits over and above just exercising (Abraham et al., 2010; Bratman et al., 2012). Recreational activities such as soccer, yoga, or running in green spaces are another way by which green spaces influence mental health and well-being (Gascon et al., 2015; Lachowycz & Jones, 2013; Lee & Maheswaran, 2010). For instance, van den Berg (2015) included a study that found that active people (aged 45 and older) who were living in the greenest neighbourhoods were less mentally distressed.

i) Social connection:

Social connection is an important consideration when designing public, urban green spaces (Di Nardo et al., 2010; Lachowycz & Jones, 2013). Green spaces provide

venues for both formal and informal types of socializing. For example, a formal event can take place in a park or people may informally meet one another within this same multi-use green space.

j) Level of satisfaction:

The level of satisfaction experienced and reported by users of green space moderates the relationship with mental health and well-being (Lachowycz & Jones, 2013; van den Berg, Wendel-Vos, van Poppel, & Maas, 2015). The reasons that people use green spaces, whether it is to socialize with neighbours, exercise in, or something else, may be linked to how satisfied they are with the space (Hunter & Luck, 2015; Villanueva et al., 2015).

**3. Ecological-level Factors**

Ecological factors that moderate the relationship between green space and mental health include levels of crime and violence, sense of community or belonging, transportation infrastructure, noise, and climate (O'Campo et al., 2009; Lachowycz & Jones, 2013; Lorenc et al., 2012).

a) Level of crime and violence:

High levels of crime and violence in a neighbourhood may affect people's perceptions of safety and consequently influence their use of public green spaces (Lorenc et al., 2012).

b) Sense of community or belonging:

Green spaces were also found to provide a sense of community or belonging, which can positively contribute to mental health. Having a social support network and feeling included within a community are both beneficial factors for mental health and well-being (Hardyns, Vyncke, Pauwels, & Willems, 2015; Levasseur, Généreux, Bruneau, & Bedard, 2015; Litt, Schmiege, Hale, & Sancar, 2015). The feeling of belonging to something bigger than oneself can come from being within nature. Similarly, belonging to a community creates a sense of belonging and can promote mental health and well-being (O'Campo et al., 2009; Russell et al., 2013).

c) Transport infrastructure:

Reliable and comprehensive public transportation has been identified as essential for good mental health and well-being (O'Campo et al., 2009). Access to bike paths as well as regular maintenance of roads and sidewalks are also important at an ecological level (O'Campo et al., 2009).

d) Noise:

Noise is considered a negative ecological-level factor that can negatively impact mental health (Hunter & Luck, 2015; O'Campo et al., 2009).

e) Climate:

Climatic conditions such as light, rain, snow and temperature can moderate the relationship between green space and mental health by influencing how people use green spaces (Lachowycz & Jones, 2013).

**4. Interaction Between Individual-level Factors and Ecological-level Factors**

Individual-level factors take place within the context of ecological factors and, consequently, there is an interaction between the mediating and moderating effects occurring at these two levels (Shah et al., 2011). One example is climate: extreme weather conditions are an ecological-level factor, but individuals may not be able to easily use green spaces, particular if they do not have weather appropriate clothing and footwear (Lachowycz & Jones, 2013). Therefore, the influence of green space on mental health will be adversely affected to a greater extent for people who do not have the proper attire, than for people who can. Another example is that fear of crime at an individual-level may interact with social well-being, sense of community, and belonging at an ecological level (Lorenc et al., 2012). If individuals fear crime, they may be hesitant to engage with their neighbours or participate in community events and this may impact the sense of community in the neighbourhood to a greater extent.

**5. Time**

The relationship between green space and mental health varies over time in four possible ways and is fundamental to understanding the complexity of this issue (Shah et al., 2011):

- a) Enough exposure to either individual-level or ecological-level factors “may only occur over time” (p.13). For example, at the individual level the amount of exposure to green space (including frequency and duration of use) can influence the degree to which green space has an influence on mental health and well-being (Bratman et al., 2012; Lachowycz & Jones, 2013; Lee & Maheswaran, 2010; Lovell, Wheeler, Higgins, & Depledge, 2014).
- b) Time is necessary to magnify the interaction between individual-level and ecological-level factors. This point can be illustrated using the example of fear of crime at the individual level and sense of community at the ecological level, as described in point 4 above. If individuals are fearful of crime in their neighbourhood and consequently do not interact with others, over time the effect of this factor can be magnified to the extent that it negatively impacts the overall sense of community in the neighbourhood.
- c) The time of exposure to nature in one’s life (during critical periods) may be significant in determining perceptions, attitudes, and behaviours towards green space (Keniger et al., 2013). This exposure may influence the relationship between mental health and green space later in life. For example, there is initial evidence that

interacting with nature during childhood can affect attitudes towards nature later on in life (Keniger et al., 2013).

d) Shah et al. note that “There may be a delay in time between the exposure” (p.13) to a mediating or moderating factor and the mental health and well-being outcomes. For example, the time delay may be present in the case of social connection at the individual level and mental health and well-being of the individual.

## 6. Mental Health and Well-being

Mental health and well-being refers to self-reported and objectively recorded mental health that incorporates mental and emotional well-being and wellness. Clinically defined mental illnesses (such as a diagnosis of schizophrenia, Alzheimer’s, dementia, depression, anxiety, and mood disorders) were not included in the scoping review of reviews (Hassen, 2016). Consequently, this theoretical model focuses on emotional mental health and well-being and excludes cognitive, social, and behavioural processes. Depending on the quantity of, access to, and quality of green spaces, and the interaction of mediating and moderating factors, green spaces may either have a positive, negative, or no impact on mental health and well-being outcomes.

## 7. Physical Health

Green spaces can have both physical and mental health and well-being benefits. These benefits are interconnected (Abraham et al., 2010; Di Nardo et al., 2010; Keniger et al., 2013; Lee & Maheswaran, 2010; Lovell et al., 2014; Russell et al., 2013; Sandifer et al., 2015; Tzoulas et al., 2007; van den Berg et al., 2015; Villanueva et al., 2015). For instance, outdoor physical activity in green spaces (i.e. “green exercise”) promotes physical health as well as mental health and can have both a preventative and curative effect (Abraham et al., 2010; Bratman et al., 2012; Tzoulas et al., 2007).

# Implications and Use of the Framework

This theoretical framework is a description of how aspects of green spaces are believed to influence mental health and well-being, as well as the mediating and moderating factors that affect the relationship between green space and mental health. However, it is still not well understood how these different aspects of green space and mediating and moderating factors relate to each other to impact mental health and well-being for diverse population groups.

The mediating and moderating factors were categorized into i) individual-level factors, ii) ecological-level factors, iii) interaction between individual and ecological-level factors, and iv) time, to form a theoretical framework. Individual-level factors refer to the demographic profile of the user, including the circumstances and conditions relevant to their use (e.g. opportunity for use, ease of use, perception of safety, fear of crime), their reasons for using a green space, and how they are using the green space (e.g. type of interaction, physical

activity, social connection, level of satisfaction) (De Vries et al., 2013; Keniger et al., 2013; Lachowycz & Jones, 2013; Lee & Maheswaran, 2010; Sandifer et al., 2015; Tzoulas et al., 2007). At the ecological level, levels of crime and violence, sense of community or belonging, transportation infrastructure, noise and climate all affect how green spaces influence mental health and well-being.

The individual-level and ecological-level factors are drawn from the findings of the scoping review of reviews. As such, they reflect a restricted list that draws on a discrete body of evidence. It is likely that our understanding of what factors inform this theoretical framework would evolve and expand over time as new studies are conducted and more evidence is found.

The framework highlights that green spaces (quantity, access, and quality) need to be tailored for specific populations, depending on individual-level factors such as user demographics and reasons for use. The context of ecological factors within the neighbourhood should also be considered. Adapting green spaces for diverse populations can help ensure that users are satisfied that green spaces meet their needs, thereby facilitating improved mental health and well-being.

Toronto's neighbourhoods are diverse and to maximize the positive effects of green space on mental health and well-being at a population level, it is important to understand how green spaces can be adapted for different users. The effects of green space may vary across different population groups, and green spaces need to be tailored to communities based on these needs (Bowie, Beere, Griffin, & Kingham, 2013). To strive towards creating mental health-promoting green spaces, we need to ensure access to good quality green spaces that meet the needs of diverse populations. In urban settings, neighbourhoods with low-income, newcomer, and racialized populations tend to have lower access to available, good quality green spaces compared to other groups that are higher income or white (Floyd, Taylor, & Whitt-Glover, 2009; Francis et al., 2012; Powell, Slater, & Chaloupka, 2004; Powell, Slater, & Chaloupka, 2006; Wolch, Wilson, & Fehrenbach, 2005; Moore, Diez Roux, Evenson, McGinn, & Brines, 2008). Due to systemic issues regarding the social determinants of health, these populations also face differential mental health outcomes and health inequities compared to their counterparts. For instance, structural factors such as socioeconomic status and ethnicity are key factors affecting the mental health of Asian Americans (Kim, Chen, & Spencer, 2012). Shakya et al. (2010) found that newcomer youth were subject to a number of social determinants (including settlement stressors, language barriers, poverty, and lack of social support) that impacted their mental health. Groups that face social barriers to good mental health also face obstacles to mental health-promoting green spaces, thereby compounding the problem (Floyd, 2009; Powell et al., 2006).

Policies and programs like Toronto Strong Neighbourhoods Strategy (TSNS 2020) could apply this theoretical framework to make decisions about green spaces in Toronto to promote mental health and well-being and “support and strengthen healthy communities” (City of

Toronto, 2014). The 31 NIAs through TSNS 2020 presents an opportunity to influence the mental health and well-being of populations by improving the quality of green space.

Taking into consideration these previous models, the theoretical framework offered herein can be used to guide future research and planning work as well as mental health promotion efforts. Researchers, urban planners, health promoters, and community leaders can use this theoretical framework to better understand how green spaces can influence mental health and well-being outcomes, identify future areas of research, and plan neighbourhood green spaces with relevant factors and populations in mind. It is recommended that this theoretical framework is considered within the context of social determinants of health as outlined by the Public Health Agency of Canada (PHAC) (2016).

There are a number of potential mediating and moderating factors that have complex interconnections and can be challenging to research and understand without longitudinal studies. The majority of the studies included in the scoping review of reviews were cross-sectional, meaning that they explored the links between green space and mental health and well-being at one point in time. To account for variables that may confound our understanding, longitudinal studies that take place over a period of time are necessary. While there is a lack of research that can conclusively determine how the causal pathway of green spaces influence mental health (due to a lack of longitudinal studies), the theoretical framework presented herein can clarify the aspects of green space and the mediating and moderating factors potentially involved.

## Conclusion

This paper presents a theoretical framework that maps different aspects of green space and the various mediating and moderating factors that can influence mental health and well-being. Mediating and moderating factors were categorized into either individual-level or ecological-level factors, which do not exist independently of one another, but instead interact to influence mental health and well-being outcomes. Time, too, affects the relationship between green space and mental health and well-being. The proposed framework draws attention to the need for tailoring green spaces to meet the needs of diverse population groups. This framework can also be used by policymakers, health researchers, health promoters, and urban planners to understand this relationship and work towards creating mental health-promoting green spaces for all.

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