GENERAL, MENTAL, AND PHYSICAL HEALTH BENEFITS OF TREE CANOPY COVER AND RECREATIONAL PARK IN 77 COMMUNITIES OF CHICAGO, U.S.

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Abstract

There were three main interrelated areas of focus in this paper related to urban green spaces (UGS): the general well-being, mental, and physical health. In this paper they were analyzed separately. The data of the three health aspects were collected from the Healthy Chicago Survey, an annual telephone survey that interviewed adults in Chicago, U.S., based on randomly selected addresses. UGS have been associated with better health and well-being. They provide sites for physical activity, buffer air and noise pollution, and alleviate thermal discomfort. UGS also promotes social interaction and increased social cohesion. However, research was limited in the health benefits from different types of UGS provisions. This paper aimed to reveal the associations between the availability of two types of UGS — tree canopy cover and recreational park — and urban residents' general, mental, and physical health in Chicago, the third largest city in the U.S. The UGS spatial data were derived from the National Land Cover Database (NLCD) and the Chicago Data Portal (CDP). The percent tree canopy cover (TCC), the number of parks, park areas, and the percentage of park areas were analyzed through ArcGIS ESRI's ArcMap 10.7.1. Using hierarchical regression models that controlled for a range of confounding factors (age, gender, race, education level, employment status, and poverty level), this study assessed the variances of the general, mental, and physical health benefits from different UGS types. The results indicated that the increase of the park area was significantly associated with better general health perception. Higher percent TCC was significantly associated with lower levels of psychological distress. And an increase of the percentage of park area and the number of parks were associated with lower body mass index (BMI). The paper highlighted that different UGS types have various impacts on general, mental, and physical health to urban residents. By adding scientific evidence, this study may help policymakers, urban planners, landscape architects and designers, and other related professionals to make informed decisions on maximizing the health benefits of UGS and to achieve social equity.

Introduction

Today, more than half of the world's population lives in urban areas. This proportion will increase from one third in 1950 to two thirds in 2050 (United Nations Department of Economic and Social Affairs, 2018). This shift from rural to urban environments not only offers the opportunities of intellectual and cultural stimulation, but also economic growth and development (Marsella, 1998). People choose to live in urban areas for more concentrated services and better access to facilities (Pretty et al., 2005). However, urban environments challenge urban residents' life as well. Residents in urban areas may have more limited access to natural environments than those in rural areas (Escobedo et al., 2011). In most urban areas in the U.S., there exists insufficient supply of green spaces.

Being in urban environments results in increased risk of obesity and reduced mental well-being (Leon, 2008; Patil, 2014). Urban green spaces (UGS) have been considered to have the potential to cope with health problems (Mitchell & Popham, 2007). The influential impact of being in the presence of green spaces and the restorative power of green spaces were emphasized in the two explanatory theories: the Stress Recovery Theory (SRT) and the Attention Restoration Theory (ART). Due to the current urbanization challenges and the growing global health problems, it is important to understand what UGS factors promote health and mitigate the negative effects caused by high-density living in urban areas (Guite et al., 2006). This research aimed to reveal the associations between different types and characteristics of UGS and general, mental, and physical health of residents in the urban areas of Chicago, the third largest city in the U.S.

All people should enjoy the right of equal share of resources, such as green spaces. Equal access to UGS for all the communities and their community members is the key to achieve the equity of UGS. However, residents of lower socioeconomic status (SES) often have less access to UGS (Wen et al., 2013). Socioeconomic inequalities may contribute to inequalities in health. Study showed that the white-majority census tracts in Chicago generally enjoy better UGS accessibility than the minority-dominated census tracts (Liu et al., 2021). It is critical to know if there are any correlations between UGS and health in 77 Chicago communities and to figure out the mechanism behind it.

Methodology

This study used a de-identified pooled Healthy Chicago Survey (HCS) dataset (2016–2018) provided by the Chicago Department of Public Health (CDPH)[1] (Chicago Department of Public Health, n.d.). The HCS collected general, mental, and physical health data from 77 community areas of Chicago annually since 2014. The survey randomly selected addresses so that each neighborhood was fairly represented in the sample. The goal of the HCS was to help each community to identify their health concerns and help the CDPH ensure health equity across the city (Chicago Department of Public Health, n.d.).

In this study, general health perception was measured by the single item of the HCS: "Would you say that in general your health is …?" The answer had five categories: "1 = Excellent," "2 = Very Good," "3 = Good," "4 = Fair," and "5 = Poor." A lower score of an answer reflected better general health perception.

Mental health was measured by the six questions of the Kessler Psychological Distress Scale 6 (Kessler-6). The HCS used the Kessler-6 questionnaire to ask each participant: 1) "About how often during the past 30 days did you feel **NERVOUS** — would you say all of the time, most of the time, some of the time, a little of the time, or none of the time?"; 2) "During the past 30 days, about how often did you feel **HOPELESS** — all of the time, most of the time, some of the time, a little of the time, or none of the time?"; 3) "During the past 30 days, about how often did you feel **RESTLESS OR FIDGETY?** [If necessary: all, most, some, a little, or none of the time?]"; 4) "During the past 30 days, about how often did you feel **SO DEPRESSED THAT NOTHING COULD CHEER YOU UP?** [If necessary: all, most, some, a little, or none of the time?]"; 5) "During the past 30 days, about how often did you feel **EVERYTHING WAS AN EFFORT?** [If necessary: all, most, some, a little, or none of the time?]"; and 6) "During the past 30 days, about how often did you feel **WORTHLESS?** [If necessary: all, most, some, a little, or none of the time?]". The total scores ranged from 0 to 24. Sores 0–7 were considered as no psychological distress. Sores 8–12 and scores 13–24 represented mild/moderate psychological distress and serious psychological distress, respectively.
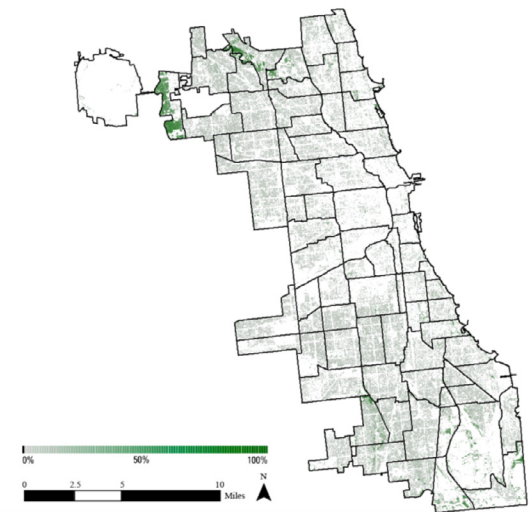

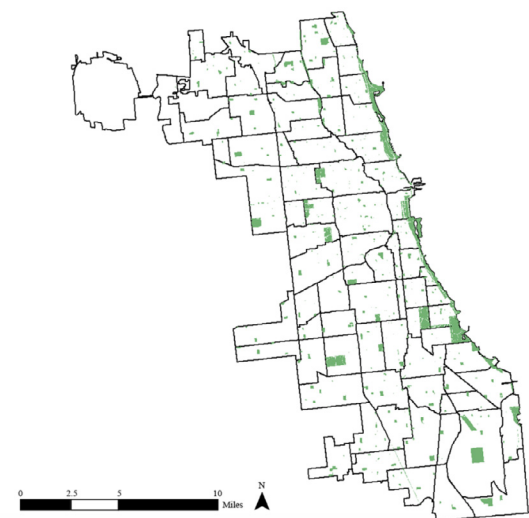Figure 1: Percent TCC of Chicago. (Graphed by Liwen Kang. Data source: NLCD.)

Figure 2: Distribution of the recreational parks in Chicago. (Graphed by Liwen Kang. Data source: CDP.)

This study used BMI to measure physical health. BMI is calculated by a person's weight in kilograms divided by the square of their height in meters (kg/m²). In the HCS, the BMI was determined by self-reported height and weight. The results were categorized into 3 levels: 1 = obese, 2 = overweight, and 3 = normal or underweight.

The percent TCC data was from the NLCD collected in 2016. The database contained percent TCC estimates of each 30 × 30 meter grid cell in the U.S. This dataset was built and maintained by the U.S. Forest Service (USFS) Geospatial Technology and Applications Center (GTAC) (Multi-Resolution Land Characteristics Consortium, 2016) (Figure 1). By using the percent values of TCC (ranging from 0 to 100) and the counts of each value obtained from the dataset, this paper calculated percent TCC for each community.

The data of the recreational parks of Chicago was derived from the CDP (Chicago Data Portal, 2022). This dataset provided current boundaries of the properties of Chicago Park District as of Nov. 4, 2016. It was last updated on May 18, 2022 (Figure 2). By combining this dataset and the boundaries of community areas of Chicago (Chicago Data Portal, 2018), this paper obtained the number of parks and the total park areas for each community. The percentage of park areas of each community was calculated by dividing the total park areas by the total community areas. All the geospatial data were processed through ArcGIS ESRI's ArcMap 10.7.1.

Using hierarchical regression models that controlled for a range of confounding factors (age, gender, race, education level, employment status, and poverty level), this study assessed: 1) whether or not TCC and recreational parks have positive impacts on urban resident's general, mental, and physical health, and 2) which factors of recreational parks have impacts on urban resident's general, mental, and physical health.

Results

There were 9,018 participants in the 2016–2018 pooled HCS dataset. Their ages ranged from 18 to 98. More than half of the respondents were over 45 years old. Female respondents (57 percent) were more than male respondents (43 percent). Most respondents were Black/African American (37.3 percent). Over 43 percent of the participants had a college or above education level. Nearly half of the respondents were employed. And over 42 percent of participants were categorized at the poverty level greater than 400 percent.

Most participants thought their health were good in general and second most participants thought their health was very good (Figure 3). The average Kessler-6 score of all the participants was 4, with a standard deviation of 4.186, out of a maximum of 24 (Figure 4). Participants who had mild or moderate psychological distress were 12.4 percent and those who had serious psychological distress were 4.8 percent. About 32.3 percent of respondents were obese and 33.2 percent were overweight based on their BMI (Figure 5).

The results of the statistical analyses showed that the park area was significantly associated with general health perception ($p < 0.05$). An increase of park area predicted better self-reported general health. However, the percent TCC was not found to be associated with general health in this study. In terms of mental health, a higher percent TCC predicted lower psychological distress score (or better

mental health) ($p < 0.05$), while none of the park factors were associated with the Kessler-6 score. For physical health, both the percentage of park areas and the number of parks were significantly associated with BMI. An increase of the percentage of park areas and the park number predicted lower BMI ($p < 0.001$).
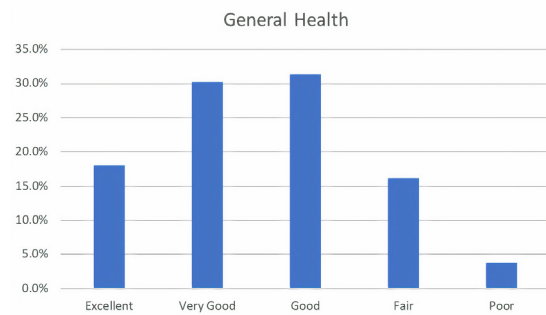
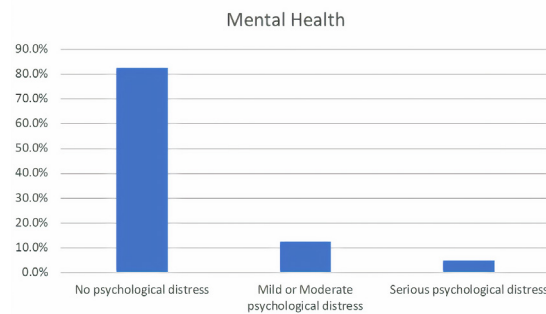Figure 3: The general health outcomes in the 2016-2018 pooled HCS dataset. (Graphed by Liwen Kang.)

Figure 4: The mental health outcomes (based on Kessler-6 scale) in the 2016-2018 pooled HCS dataset. (Graphed by Liwen Kang.)
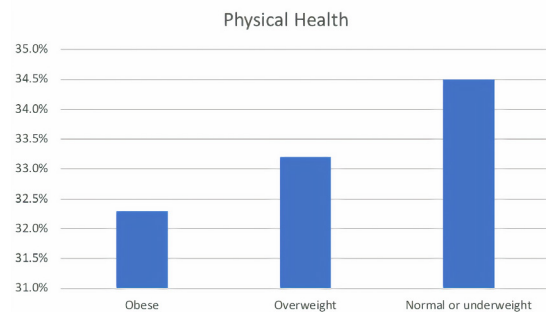
Figure 5: The physical health outcomes (based on BMI) in the 2016-2018 pooled HCS dataset. (Graphed by Liwen Kang.)

Conclusion

The study highlighted that different types and factors of UGS have various impacts on urban residents' general, mental, and physical health. Recreational parks had better impacts on general and physical health than mental health. And TCC had positive effects on mental health. Besides TCC and recreational park, other UGS types such as trees and grass could also be included into the analyses to reveal associations between other UGS types and the three health aspects. This study also suggested that other characteristics of UGS such as neatness, maintenance, and attractiveness that may influence urban residents' use of UGS need to be taken into consideration for future qualitative studies. This study may help policymakers, urban planners and designers, landscape architects and designers, and other related professionals to make informed decisions on maximizing the

health benefits of UGS, including but not limited to building new creational parks and planting more trees in the needed community areas. It is also very necessary to educate community members about the health benefits of UGS in order to promote the use of UGS. This study emphasized the importance of ensuring equitable planning on UGS in all the communities.

Acknowledgements

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