

**POPULATION DENSITY AND URBAN
DESIGN FEATURES' RELATIONSHIP
TO MENTAL HEALTH**

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Introduction

The idea for this option paper topic started from my visit to Seoul Korea after a year of graduate study in Atlanta. The physical forms of Seoul and Atlanta are extremely different. While Atlanta is more spread out in terms of development, Seoul is developed in a very dense manner. Furthermore, in terms of commute, Seoul has a very strong public transit system, whereas Atlanta is more automobile-commute-oriented than transit. Many planning professionals and activists have emphasized the importance of public transit oriented development and promotion of density in cities, because of the negative externalities that are produced from sprawled automobile-oriented cities. These negative externalities include an increase in public expenditure, traffic, health issues, and environmental issues. These negative externalities are the reasoning for planning professionals and activists for the promotion of density, but the writer's experience back in Seoul after a year stay in Atlanta gave the writer a different perspective of density. There are many benefits to cities that are densely developed like Seoul. These benefits include accessibility to different regions via public transit and energy efficiency which diminishes public expenses. Ultimately, the many different benefits of densely developed cities come to one conclusion, which is efficiency in utilizing natural resources. The earliest form of cities started from people living close to each other and after sanitary reform and industrialization, people started to move to suburbs where it caused sprawl. Now, the trend has shifted toward dense developments like a cycle between density and sprawl. My impression from this comparative experience between two cities is that people are not knowingly forced to live in denser cities because of this efficiency in utilizing natural resources and trading off the convenience and accessibility from living in dense cities with their own psychological stress. Therefore, this study believes that dense development is not the solution to problems or negative externalities caused by sprawled development. From this option paper, I will explore the possible relationship between density and mental health. Furthermore, I will explore the possible urban forms that can be implemented in dense cities that can help relieve

stress, since it is indisputable that there are benefits of dense cities over sprawled ones that cannot be neglected. I will be exploring the possibility of a relationship between density and stress.

Comparing the density values

To set an density baseline, an article from National Geographic, the author lists the following cities as the overall top 10 cities that are considered the most sustainable. The population density in Atlanta is 3392 per sq / mi. Comparing this value to the average population density of the top 10 most sustainable cities, Atlanta requires four times more population density to meet the qualification of a sustainable city. This average value might not be the best threshold to qualify sustainability since there are cities like London and Rotterdam in the top 10 list. However, all the cities listed in the top 10 list have a higher population density value than Atlanta.

Table 1. Showing the top 10 sustainable cities and their population density

City name	Population density (sq/ mi)
Frankfurt	7,600
London	3,900
Copenhagen	18,000
Amsterdam	9,200
Rotterdam	4,900
Berlin	10,400
Seoul	42,789
Hong Kong	16,431
Madrid	12,000
Singapore	18,000
Average	14,322

PART 1

COMPARING POPULATION DENSITY TO MENTAL HEALTH INDICATORS

Literature review

Relationship between urban density and mental health

- Winsborough, Halliman H. "The Social Consequences of High Population Density." *Law and Contemporary Problems* 30, no. 1 (1965): 120. doi:10.2307/1190689

Keywords: Density, High population, Calhoun, Death rate, Tuberculosis

The social consequences of high population density piece start by talking about the two groups of social scientists who poses different approaches when addressing social issue. These two groups of people are the behaviorists and the structuralists. The paper tries to address the issues of urban density by talking on behalf of both views. The structuralists try to promote density, yet the behaviorists discourage it. The paper also talks about the animal experiment that Calhoun did regarding density, which is the experiment of observing rat's behavior and population due to density. The results are the rats behaved in a more stressful way as they were put into a denser environment. The paper acknowledges that the experiment that Calhoun did might not be directly applicable since the experiments were done on rats and not humans. The author transitions the experiment to the investigation that they worked on by assessing five variables in terms of the density, which are infant death rate, overall death rate which has been adjusted for differences between areas in age composition, a tuberculosis rate, an overall public assistance rate adjusted for differences in age composition, and a measure of the rate of public assistance to persons under eighteen years old. The author judges the numbers to be more realistic, but their findings turned out to be mixed. Furthermore, the author concludes that optimum level of density varies with the thing optimized.

One of the interesting approaches about this reading is that the author does not talk about the gist of the topic at the beginning of the literature. Instead, the author introduces the different groups of social scientists, how they are different, and how this shapes the urban planning framework. At first, the beginning contents made me question the relevance of the paper the topic. However, the author manages to connect their thoughts into how people can approach the topic of the subject in many different ways. The style of the writing helped me to understand or take a step back and view the relationship of density and human health in a different perspective. The author also utilizes different literatures in an efficient manner that helps the reader to understand the material even better.

One thing that the literature can do better is in explaining their findings in comparing the results of density's relation to the five variables that they derived from Calhoun's experiment, which are the infant death rate, an overall death rate which has been adjusted for differences between areas in age composition, a tuberculosis rate, an overall public assistance rate adjusted for differences in age composition, and a measure of the rate of public assistance to persons under eighteen years old. The author explains how they measured the relationship of these variables to the density, but there was insufficient information for readers to follow along with the steps that the author takes to derive the results. Therefore, the paper could have done better in explaining their analysis process and methodology.

Overall, I believe that the author does a great job in capturing some of the preceding studies of the consequences of high population density, and also viewing this idea from different perspectives of social science. The paper can definitely be utilized for my option paper as a starting point of trying to measure the effect of high population density.

- Evans, G. W., S. Saegert, and R. Harris. "Residential Density and Psychological Health

among Children in Low-Income Families." *Environment and Behavior* 33, no. 2 (2001): 165-80. doi:10.1177/00139160121972936.

Keywords: Mental health, Density, Low income, Residential density

This article talks about a relationship between urban and rural children living in poverty. The author does not mention their reasoning for focusing on the low-income group of the cohort to discuss the residential density's behavior on psychological health. The author touches on Calhoun's research of density in rodents which is also discussed in many other research papers regarding density and mental health. The interesting factor that is incorporated in this article unlike other research is the incorporation of socioeconomic factors. They conduct their research based on the children in grades 3 through 5, and their setting takes place in East Harlem in New York city. Some interesting factors about their approach of density is the individuals' residential density. They analyzed how sizes of the apartments are related to the number of people who are living in those apartments. The dependent value for their analysis is the learned helplessness. This learned helplessness means a sense of powerlessness arising from a traumatic event. Their finding was that boys tend to suffer from stress caused by dense residential environment more than girls. The paper also finds that low-income household children tend to be more vulnerable to this learned helplessness than higher income household children.

The strength of this article is the incorporation of socioeconomic factor into their analyses, which is also recognized in their literature. Some of the interesting findings from their analyses are the fact that both children from both low-income households as well as children high-income household suffer from psychological stress from residential density. Furthermore, their findings of the intensity of the effect on stress depending on gender was also an interesting takeaway that overlapped with many previous types of research.

While the author presents several takeaways that are very interesting to researchers on the related subjects, there were some weaknesses in terms of their procedures of conducting the survey. As acknowledged in the article, the paper utilizes the same method to measure the low-income group and the non-low-income group of children with the same measure of psychological analysis. The author acknowledges the fact that the discrepancy in the result might be due to different stressor between the two socioeconomic groups rather than indicating the extremity of the stress the two groups might be having. It is true that psychological statuses are hard to quantify and some deal with stress better than others.

Considering the weaknesses and strengths in this paper, it seems to be difficult to quantify or come up with a global measure that can be applicable for everyone in terms of the level of density. Due to the fact that people in different socioeconomic groups and even with gender, children reacted differently from their environment. It will be interesting to note that there is a difference between different groups, and it will also be a great exercise to think about how to delineate these differences when writing the option paper.

- Asztalos, Melinda, Katrien Wijndaele, Ilse De Bourdeaudhuij, Renaat Philippaerts, Lynn Matton, Nathalie Duvigneaud, Martine Thomis, William Duquet, Johan Lefevre, and Greet Cardon. "Specific Associations between Types of Physical Activity and Components of Mental Health." *Journal of Science and Medicine in Sport* 12, no. 4 (2009): 468-74. doi:10.1016/j.jsams.2008.06.009.

Keywords: Physical activity, Different demographics

This is a paper that tries to find the relationship between physical activity and components of mental health. The author acknowledges that there are several preceding studies that research on related subjects that suggests that there is a relationship between the two

variables. The author introduces their research by explaining how they delineated the physical activity into five categories and measured the relationship to two mental health measures. The five physical activity includes housework, leisure active transportation, biking to/from work, walking to/from work, and sports participation and the two mental health measures include perceived stress and psychological distress. The author analyzed the results in a socioeconomic standard, which helps to define what type of groups prefer certain activities over another. The results show that the only physical activity that relieves both perceived stress and psychological distress is sports participation. The result also showed that housework associated with more mental stress and distress in women with blue-collar jobs. There was an inverse effect of housework in young adults with white-collar jobs. Biking to and from work was associated with more stress in men with blue-collar jobs.

The author does a great job of recognizing that there are many types of prior research that tell a similar overall picture. The author's research design of separating the physical activity into categories that are greatly associated with daily life is extremely noteworthy since the results tell a very interesting story about how some physical activity causes stress to one group while it relieves stress to another group. The paper also does a great job on explaining some of the methodologies that they went through that might help another researcher to recreate the conducted steps from this paper.

While the paper helps readers to understand the gist of the research, some of their results concerning variation between different social groups were not clear. The paper only discusses the results that were significantly different from one another and neglects some of the outcomes from individual socioeconomic attributes to each physical activity and mental health.

The paper deals with a subject that is commonly known by a lot of people; however, the author captures reader's attention by relating the paper to physical activities that people do on daily basis. The tells an interesting story about how different people from different socioeconomic criteria react to different physical activity in a different manner. The results seem like very important information that many planners might want to take into account when working on their comprehensive plan.

- Cohen, Sheldon, Tom Kamarck, and Robin Mermelstein. "A Global Measure of Perceived Stress." *Journal of Health and Social Behavior* 24, no. 4 (1983): 385. doi:10.2307/2136404.

Keywords: Global measure of stress, Accuracy

As the title of the paper denotes, this paper talks about the reliability and validity of a global stress measure called the Perceived Stress Scale(PSS). This PSS is designed to measure the degree to which situations in one's life are appraised as stressful. The author asserts that clear advantages to an objective measure of stressful events include the simplicity of measuring the intensity, the potential of estimating the risk of disease associated with the occurrence, and the reduction of chances of various subjective biases. One of the disadvantages of utilizing objective measures that the paper talks about is the biasedness of the response of the objective measure survey. To be more specific, some of the stress causing events are considered stressful not due to their inherent characteristics but rather dependent on personal and contextual factors, which can eventually question the objectiveness. The findings of the paper were that PSS showed adequate reliability and was correlated with life-event scores, utilization of health services, social anxiety and others.

The paper familiarize the readers of this stress measure methodology and explaining some of the strengths and potential weaknesses of this measure that can undermine the validity and the reliability of PSS. The author also references some of the studies that

were conducted that relate to the study they are conducting and distinguish how their study is different from others. Furthermore, the author thoroughly explains the data collection process as well as their reasoning of how they came up with the survey group in detail that helps the reader to follow along with the entire process.

One of the limitations of this study is that the paper lacks the explanation of the breakdown of the PSS. While the paper explains in depth of the characteristics of PSS in the paper, in the discussion of the reading, the author starts talks about the different sub-types of PSS and their relationship to validity. This may confuse the readers since none professionals might not have a full prior knowledge of the material in depth to understand how these sub-types of PSS is different among others.

In conclusion, this paper talks about how there are many components of stress measures that make their validity and reliability in question. However, unlike their presumed concern for validity, their analysis result shows that PSS is a reliable and valid measure of stress. The author could have done better if they further question their methodology of assessing the validity and reliability of PSS measure for researchers who are interested in further investigating on this issue.

Methodology

To determine the relationship between density and mental health, this paper compares 12 US cities per their population density level. As for the mental health aspect, this paper incorporates several markers of mental health, such as physical inactivity, excessive drinking, poor mental health days, and suicide rate. The aim of the analysis is to see the relationship between the population density to all these markers of mental health. Due to the lack of these data to a city

level, the mental health markers are all county level data. The 12 randomly selected cities are shown in table 1 below. ‘

Table 2. Showing the list of cities and the State they are in.

City	State
New York	New York
San Francisco	California
Boston	Massachusetts
Chicago	Illinois
Arlington	Virginia
Norfolk	Virginia
Atlanta	Georgia
Houston	Texas
Jacksonville	Florida
Birmingham	Alabama
Kansas City	Missouri
Peoria	Arizona



Figure 1. Showing the location of the cities that are focus of this study.

Data Description

As mentioned above the mental health information is challenging to acquire at the city level and therefore, this study uses the mental health information from the county level and assumes that this information best represents the mental health status of the city. The mental health assessment is separated into several markers Physical Inactivity, Excessive Drinking, Number of Depressed Days, and Suicide Rate. Physical Inactivity, Excessive Drinking, and Number of Depressed Days markers are acquired from County Health Rankings & Roadmaps (CHRR). This website is a collaborative effort between Robert Wood Johnson Foundation and the University of Wisconsin Population Health Institute. Their goal is to “build awareness of multiple factors that influence health, provide a reliable, sustainable source of local data and evidence to communities to help them identify opportunities to improve their health, engage and activate local leaders from many sectors in creating sustainable community change, and connect & empower community leaders working to improve health.” (County Health Rankings & Roadmaps, 2016)

Poor Mental Health Days:

According to CHRR, the poor mental health days' data is acquired through Behavioral Risk Factor Surveillance System (BRFSS). This is a state-based random digit dial telephone survey that is conducted annually in all states. “Data obtained from the BRFSS are representative of each state’s total non-institutionalized population over 18 years of age and has included more than 400,000 annual respondents with landline telephones or cell phones since 2011. Data are weighted using iterative proportional fitting (also called "raking") methods to reflect population distributions. For the County Health Rankings, data from the BRFSS are used to measure various health behaviors and health-related quality of life (HRQoL) indicators. HRQoL measures are age-adjusted to the 2000 U.S. standard population.” (County Health Rankings & Roadmaps, 2017)

Physical Inactivity:

“Physical Inactivity is the percentage of adults age 20 and over reporting no leisure-time physical activity. Examples of physical activities provided include running, calisthenics, golf, gardening, or walking for exercise.” (County Health Rankings & Roadmaps, 2017) The data for the physical inactivity is also acquired from the CDC’s Behavioral Risk Factor Surveillance System(BRFSS). The data provided on the County Health Ranking & Roadmap website is an estimate using Bayesian multilevel modeling techniques.

Excessive Drinking:

“Excessive drinking is a risk factor for several adverse health outcomes, such as alcohol poisoning, hypertension, acute myocardial infarction, sexually transmitted infections, unintended pregnancy, fetal alcohol syndrome, sudden infant death syndrome, suicide, interpersonal violence, and motor vehicle crashes. Approximately 80,000 deaths are attributed annually to excessive drinking. Excessive drinking is the third leading lifestyle-related cause of death in the United States.” (County Health Rankings & Roadmaps, 2017)

Suicide Rate:

Suicide rate data is acquired from the Center for Disease Control and Prevention (CDC) through their Web-based injury Statistics Query and Reporting interface. The unit for the result are per every 100,000 people

Results and Findings

As addressed above, this simple analysis compares the cities’ density value to the mental health indicators. Out of all the twelve study cities, the study ranked the cities based on their population area and categorized into three different population density level as shown in table 3.

Table 3. Showing the city and their population density category.

City	State	Population	Land area (sq. miles)	Density (/sq.mile)	Category
New York	New York	8,175,133	302.6	27,012.40	high
San Francisco	California	805,235	46.9	17,179.20	high
Boston	Massachusetts	617,594	48.3	12,792.70	high
Chicago	Illinois	2,695,598	227.6	11,841.80	high
Arlington	Virginia	207,627	26	7,993.50	medium
Norfolk	Virginia	242,803	54.1	4,486.30	medium
Atlanta	Georgia	420,003	133.2	3,154.30	medium
Houston	Texas	2,099,451	599.6	3,501.50	medium
Jacksonville	Florida	821,784	747	1,100.10	low
Birmingham	Alabama	212,237	146.1	1,453.00	low
Kansas City	Missouri	459,787	315	1,459.90	low
Peoria	Arizona	154,065	174.4	883.4	low

Utilizing the data addressed above, the county level mental health data was acquired and illustrated in the table below.

Table 4. Showing the mental health indicator values for the study areas.

City	County	Physical Inactivity	Excessive Drinking	Depressed Days	Suicide Rate
New York	Kings	26%	17%	3.9	5.06
San Francisco	San Francisco	14%	20%	3.1	10.50
Boston	Suffolk	20%	22%	3.8	6.25
Chicago	Cook	20%	21%	3.4	8.04
Arlington	Arlington	14%	21%	2.8	8.88
Norfolk	Norfolk	25%	19%	3.4	11.37
Atlanta	Fulton	19%	18%	3.5	10.64
Houston	Harris	21%	18%	3.2	10.13
Jacksonville	Duval	24%	19%	4.1	15.63
Birmingham	Jefferson	28%	15%	4.5	13.36
Kansas City	Jackson	24%	16%	3.8	15.97
Peoria	Maricopa	20%	17%	3.4	15.15

Physical Inactivity

Figure 2 shows the Physical Inactivity value the cities are labeled in terms of their population density level, where the highest population density on the left corner and the lowest population density on the right corner. Just by looking at the graph, there is no distinctive trend; however, figure 2 also shows the average percentage of the physical inactivity in a green dotted line. Comparing all the cities based on this threshold value, it is obvious that the cities on the right, which are lower population density cities, have a higher tendency to become physically inactive compared to cities on the left.



Figure 2. Legend for all the mental health graphs

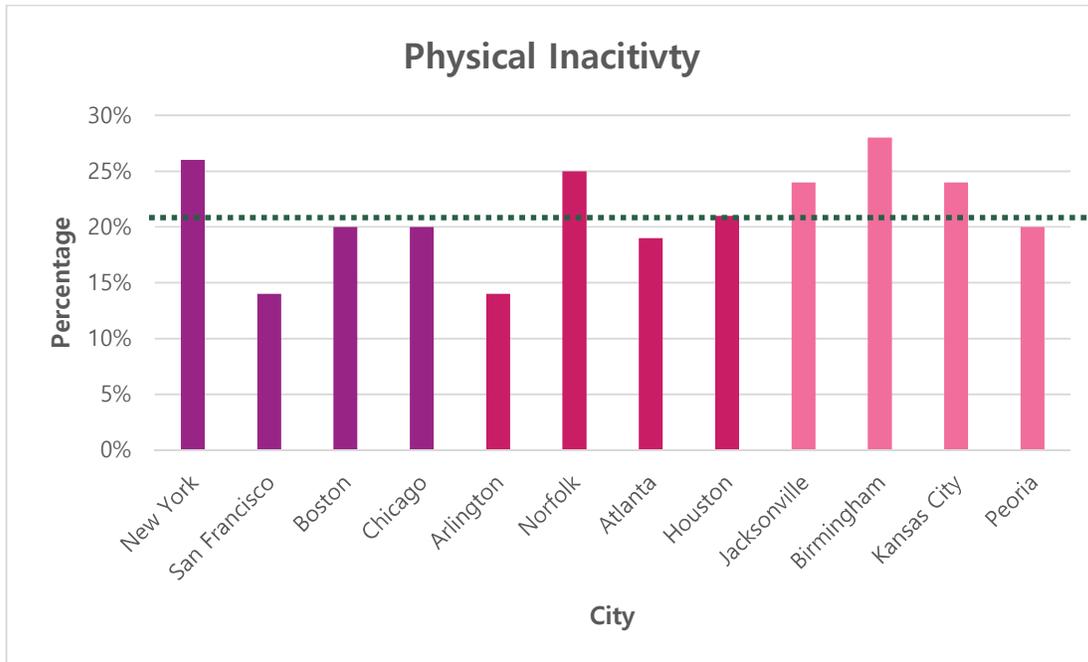


Figure 3. Graph showing the physical inactivity measure over different cities.

Excessive Drinking

Unlike the result from the physical inactivity percentage, the indicators of Excessive Drinking show a clear and distinctive trend. The average percentage of all the 12 cities was 19%. Figure 3 shows that there is the higher tendency of excessive drinking within higher population density cities than lower population density cities. Furthermore, the bar graph shows a descending trend of excessive drinking as the population density goes down.



Figure 4. Graph showing the percentage of excessive drinking in the city

Poor mental health days in a month

Figure 5 shows the result of poor mental health survey results according to city population density. While there is no specific trend based on the population density value, it is clear that the medium population density cities tend to have lower poor mental health days in a month.

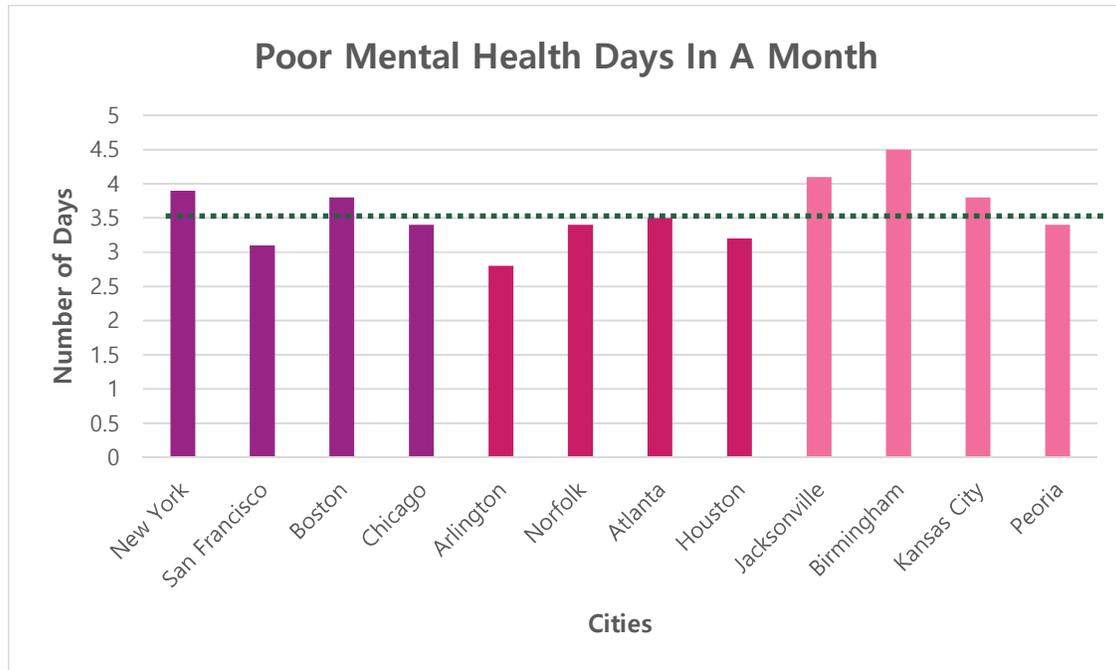


Figure 5. Graph showing poor mental health days in a month

Suicide Rate

Figure 6 shows the graph of suicide rate of all 12 cities. Among all the mental health indicators, the discrepancy between different population densities is the most extreme in suicide rate comparison. While most mental health indicators have been showing the tendency of riskier mental health values, the distinction had not been this extreme. From figure 6 it is possible to conclude that people in lower population density region has the tendency to suffer from suicide.

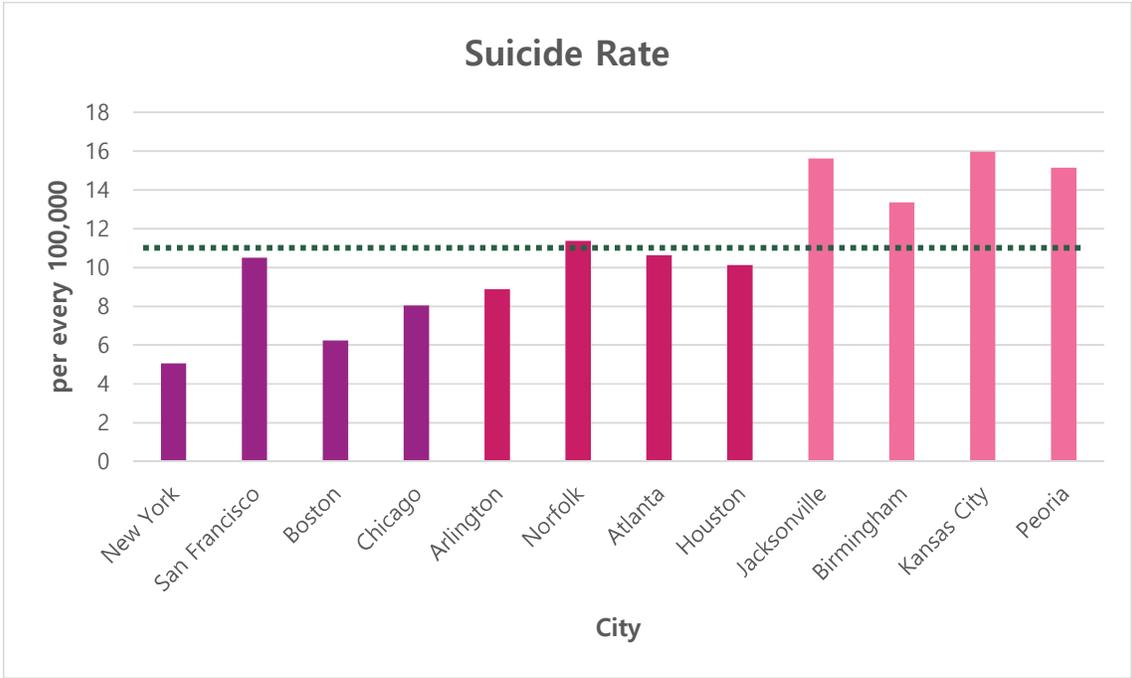


Figure 6. Graph showing suicide rate of all 12 cities

PART 2

COMPARING GREEN SPACE SERVICE

AREA COVERAGE TO MENTAL

HEALTH INDICATORS

Literature Review

- Beer, Anne R. December 1991. "Urban design: The growing influence of environmental psychology." University of Sheffield, Sheffield S10 2UJ, U.K. no. Volume 11 (Issue 4):359-371.

Keywords: Environmental Psychology, Land Planning, Urban Design

This article is a review essay of several articles related to urban design and its relationship to environmental psychology. The writer of this article is a professor of landscape architecture at the University of Sheffield. In her essay, she points out the importance of the consideration of the cultural, social and economic issues when designing a town or a city. She also points out the importance of environmental consideration that is often overlooked during the decision-making stage of city planning. The author of this essay believes that environmental psychologist can act as the informer of this environmental consideration. Environmental psychology is the expertise of researching on what constitute a satisfactory environment in the wide range of different circumstances. The study aims at providing an environment that can promote a satisfactory experience of urban life.

The essay captures the importance and the role of the environmental psychology. It also links the role of environmental psychology to the importance of well laid out physical site planning. The author acknowledges the difficulty that most urban designers might go through because of the budgetary limitation. Consequently, she suggests some potential reading material that might help promote the site planning framework for urban designers. Overall, the paper does a reasonable job of summarizing some of the articles in a related discipline to explain the idea behind how environmental psychology can benefit the workflow many designers.

While the essay has thoroughly explained the need for environmental psychology, it lacks some crucial explanation of this new field of environmental psychology. The author thoroughly explains the workflow of designing a town or a city, and continuously links the limitation that most designers have and acknowledges that this can be improved through integration of the understanding of environmental psychology. However, the reading only vaguely hints at what this field of study is, and lacks any information on what are some potential qualities that environmental psychologists should have. This vagueness of author's explanation is something that the author can improve on from this paper.

In general, this reading was helpful in a way to understand what most site planners or urban designers might face in terms of not understanding the environment in a holistic manner. The field of environmental psychology does seem like a crucial role in site planning, but the vagueness of who they are makes it difficult to understand the paper entirely.

- Vries, Sjerp De, Sonja M.e. Van Dillen, Peter P. Groenewegen, and Peter Spreeuwenberg. "Streetscape Greenery and Health: Stress, Social Cohesion and Physical Activity as Mediators." *Social Science & Medicine* 94 (2013): 26-33. doi:10.1016/j.socscimed.2013.06.030.

Keywords: Greenspace, Stress, Social Cohesion, Physical Activity, Green Survey

The article starts by talking about the need for greenspace's association with health improvement. There have been several studies that show the relationship between local green space availability and residents' health. While there are many forms of green space, the author focuses on analyzing the effectiveness of streetscape greenery for mediation of stress reduction, stimulating physical activity, and facilitating social cohesion. The authors of the paper conduct their research by assessing the quality of streetscape, and

they do a qualitative research on the residents using the streetscape. The result showed that the quality of green space is more associated with health than the quantity of green space. The result interestingly showed that stress reduction and social cohesion as mediators of promoting quality and abundance of green space in the community. The paper discusses how the physical activity was not an associative mediator of streetscape greenery.

This paper also discusses the preceding study that is related to the relationship between green space and human health. It explains how individual studies are different in terms of their findings as well as their individual characteristics of the preceding studies. By the discreet explanation of the preceding studies, the paper creates a flow of its hypothesis in a manner that reader can follow easily. The reading also thoroughly explains the methodology of how they conducted the analysis of their study and the methodology of their survey. Furthermore, the paper also does a great job of linking their findings to the discussion of answering the question they set in the hypothesis of the paper, and acknowledges the limitations they had that can be improved in the future.

The paper uses the term of mediator throughout the entire paper and explains how these mediators which are stress reduction, physical activity, and social cohesion, will mediate the relationship between quantity and quality of greenery in urban neighborhoods. While their methodology of analysis was clear the term mediator and its relationship with the urban neighborhood were slightly vague. Furthermore, their methodology of assessing greenness of streetscape was weak since they were assessing the streetscape on an ordinal scale based on the impression. The study could have been greater if they utilized a certain framework of assessing these values. The paper to discusses how they analyzed their data by an inter-rater consensus method and their values did range within a higher

percentage frame. A framework for assessing the greenness of streetscape could have increased the validity of their final output.

Overall, assesses the relationship between quality and quantity of greenness to the human mental health. It also creates a valuable framework for explaining the characteristics and takeaways of preceding studies regarding the related subject. The paper also thoroughly breaks down the methodology they used to assess or analyze this subject, which allows many professionals to recreate the analysis again for professionals interested in further exploring this subject.

- Bjork, J., M. Albin, P. Grahn, H. Jacobsson, J. Ardo, J. Wadbro, P-O Ostergren, and E. Skarback. "Recreational Values of the Natural Environment in Relation to Neighbourhood Satisfaction, Physical Activity, Obesity and Wellbeing." *Journal of Epidemiology & Community Health* 62, no. 4 (2008). doi:10.1136/jech.2007.062414.

Key words: Recreational values, Neighborhood satisfaction, Proximity measure using GIS

This paper discusses mainly the relationship between recreational values with a close natural environment, neighborhood satisfaction, physical activity, obesity, and wellbeing. The five recreational value that the paper mainly focuses are serenity, wildness, lushness, spaciousness, and cultural feeling. The author conducts their analysis utilizing an extensive public health survey distributed by a mailed questionnaire in the Scania region in southern Sweden. The study tries to validate their results even more by only utilizing the results from rural and suburban areas, and they also excluded recreational values of the natural environments in inner city areas. The survey answered questions regarding time spent on physical activity per week, body mass index (BMI), self-rated physical and

psychological health at present, and the 36-item short-form health survey item “vitality”. They utilized the survey result and the GIS locational measure of the survey results to their targeted recreational spaces to understand the relationship between the recreational values with a close natural environment, neighborhood satisfaction, physical activity, obesity, and wellbeing.

The writing asserts that one of the strongest suits of their paper is the use of GIS techniques to accurately measure the proximity of the surveyed results to the major recreational areas that they are targeting. The paper also asserts that other regions can recreate the analysis that they have in a different regional context using the framework they have used. In my personal opinion, the strongest aspect of this paper is the fact that they have collected such an abundant amount of information utilizing the survey questionnaire where they can exclude survey results that they believe that is unsuited for the purpose of this paper. Accessibility to such detailed survey answers is not common among all professionals in social studies.

While they have access to such detailed survey results, one thing that the study could have done better was to incorporate different statistical analysis for a different cohort of the target survey respondents rather than excluding some of the results that do not directly associate with their target analysis goal. Furthermore, the recreational values that they try to investigate are relatively vague with hard to measure aspects. Due to their hardship to measure recreational values, some of the major distinction between the five recreational values were not clear.

Considering that this study was conducted a decade ago, their somewhat intensive use of GIS techniques seems reasonable and noteworthy. The survey that they conduct for their research collects or answers a tremendous amount of information that can be greatly

utilized to come up with different findings for their research. However, they choose to exclude some of the data sets that do not directly associate with the findings they are interested, which in my perspective, could have done a better job.

- Grahn, P. "Landscape Planning and Stress." Urban Forestry & Urban Greening: 1-18.
Keywords: Landscape planning, stress, restorative environments, urban open green spaces.

This study talks about the importance of landscape and greenery in planning that can benefit the people greatly. The authors acknowledge the fact that there is a growing cost of medical services that deals with mental health related illness. The author talks about the background knowledge that can help readers to familiarize with the material and further explains their methodology of their study in depth, which helps the readers to easily understand the material. The survey was conducted over nine Swedish cities regarding their health and their use of urban open green spaces in the city. Their findings assert that there is a significant relationship between city landscape planning and the health of town dwellers regardless of their social category. The result showed that more often a person visits urban open green spaces, the less often these people suffer from mental related health issues. The same effect was shown on the amount of time spent on these urban green spaces. The author concludes that the proximity of these urban green spaces is a potentially decisive factor that relates to the time spent as well as the frequency of the visit to these urban green spaces. Furthermore, the paper discusses that people do not try to compensate for their lack of proximity to green environments with more visits to public parks or urban forests. Therefore, the study asserts the importance of smaller scale landscape planning within different neighborhoods.

The strength of this paper is the extensive breakdown analysis of their answers from their questionnaire. Most of the papers from this literature include the process of doing a qualitative survey regarding their health status. While many surveys include an extensive set of questionnaires, they only utilize only a few of the answers, when they analyze their answers from the survey. This paper, on the contrary, includes an extensive analysis of their survey results and explains in depth of their findings. Furthermore, the author breaks down their findings in the discussion in a bullet point format with a sentence summary of the findings in the beginning of each paragraph.

This paper can be greatly utilized for my option paper study in several ways. The breakdown of their research results would definitely help me to understand an optimal distance from the residential areas to these urban open green spaces. However, the author does lack other attributes that might have constituted in causing these stress related health issues like air quality.

- Hartig, Terry. "Green Space, Psychological Restoration, and Health Inequality." *The Lancet* 372, no. 9650 (2008): 1614-615. doi:10.1016/s0140-6736(08)61669-4.

Keywords: Health inequality, Restoration, Green Space

This paper talks about the health inequality and its association with the accessibility of parks and other green spaces from home. The author conducts their analysis by dividing their target group which is people younger than the retirement age into four income deprivation groups. Furthermore, they compared these people's accessibility to close parks and greenspaces within five groups. Before explaining the conclusion of their findings, the writer explains some of the commonly known understanding of how the natural environment affects human health through the provision of an ecosystem, and now many researchers acknowledge their positive effect on the mental health aspect.

Furthermore, the author explains how their study focuses more on the psychological restoration and stress reduction. They believe that experience of nature has the ability to reduce stress and promote psychological restoration. The author finds that there is a physical inequality between accessibility to green spaces, where people with close proximity to green spaces live longer while people with less close proximity with green space live shorter, and same applied to income. The author explains how greenspace is more than just pretty elements in the community and asserts that they do have health influences that many politicians overlook.

The author measures the health inequality associated with the accessibility to green spaces and thoroughly explains the flow of their idea in an organized manner that allows the readers to follow along easily. The author also explains the result of their paper and tries to explain the reasoning behind their outcome in a digestible manner.

While the author's reasoning for the mortality of the cohort they were chosen and the accessibility to the nearest greenspace is reasonable, they lacked explanation or exploration of the relationship between psychological restoration with the green space. Furthermore, their numbers might tell us that there is a great relationship between greenspace proximity and mortality of age group less than retirement, other variables were not associated in their analysis which makes the relationship questionable.

Overall, the author does illustrate the possible reasoning or idea behind their analysis and does a great job in explaining their thought process. The result of their comparison of health inequality and green space proximity is interesting but their lack of other variables when measuring the relationship makes their findings questionable. However, I believe that their thought process can greatly be associated with the option paper by utilizing their result of health inequality and green space proximity as a reference.

- Leslie, Eva, and Ester Cerin. "Are Perceptions of the Local Environment Related to Neighbourhood Satisfaction and Mental Health in Adults?" *Preventive Medicine* 47, no. 3 (2008): 273-78. doi:10.1016/j.ypmed.2008.01.014.

Keywords: Mental wellbeing, Causation of mental illness, Physical environment

This paper talks about the relationship between perceived environmental characteristics, neighborhood satisfaction, and self-rated mental health. The authors utilize the data from the Physical Activity in Localities and Community Environments (PLACE) study in Australia. This reported data includes social-demographics, perceived attributes of the environment, neighborhood satisfaction(NS), and mental health status. The paper discusses how in terms of neighborhood satisfaction, safety, and walkability, access to destinations, social network, travel network and traffic and noise are associated with mental health. Moreover, in terms of perceived environmental characteristics, greenery, land use mix, street connectivity, traffic safety, and walking infrastructure are positively associated with mental health.

Considering the number of factors that they put into understanding the relationship between each other and mental health, one of the strongest points about this paper was the access to the amount of information. There are many studies that try to link urban characteristics to the mental wellbeing, but most researchers encounter the difficulty of lack of data to validate their idea or hypothesis. However, the access to these data from the PALCE study makes this paper a very strong paper even though it is very short and concise. The author of the paper also notes its strength as the use of neighborhood factors derived from physical and social domains in the environment.

While I believe that this paper has a strong supporting data to support their findings of their neighborhood satisfaction factors and perceived environmental characteristics relationship to mental health, the author explains how their limitation is the lack of the size of the neighborhood when asking about satisfaction. Furthermore, they acknowledge the fact that they lack any other factors that might have contributed to the mental health factors which could be added for future studies of this topic.

Overall, the availability of the data to conduct the analysis is what makes their findings valuable. Many researchers try to examine the relationship between mental health and the physical environment, but they often encounter a lack of data to support their findings. I believe that their findings from the perceived attributes of the environment would greatly benefit my study regarding the option paper by giving an idea of what kind of environmental components associated with the mental health of the community.

Methodology

To compare the relationship of the urban design feature and its relationship to mental health. This study calculates the greenspace coverage of each city utilizing the green space layer that is available from the city website. Rather than just comparing the result from the area of coverage alone, this study does a buffer analysis around the green space of 0.25 mile assuming this is a reasonable walking distance to the nearest park. This walkable greenspace service area coverage value will be compared with the results from the mental health indicators. Due to lack of shapefile information for Peoria, Kansas City, and Birmingham, the greenspace service area analysis was only conducted for the other nine cities. All the shapefiles were acquired through the municipal GIS portal.

Results and Findings

New York City

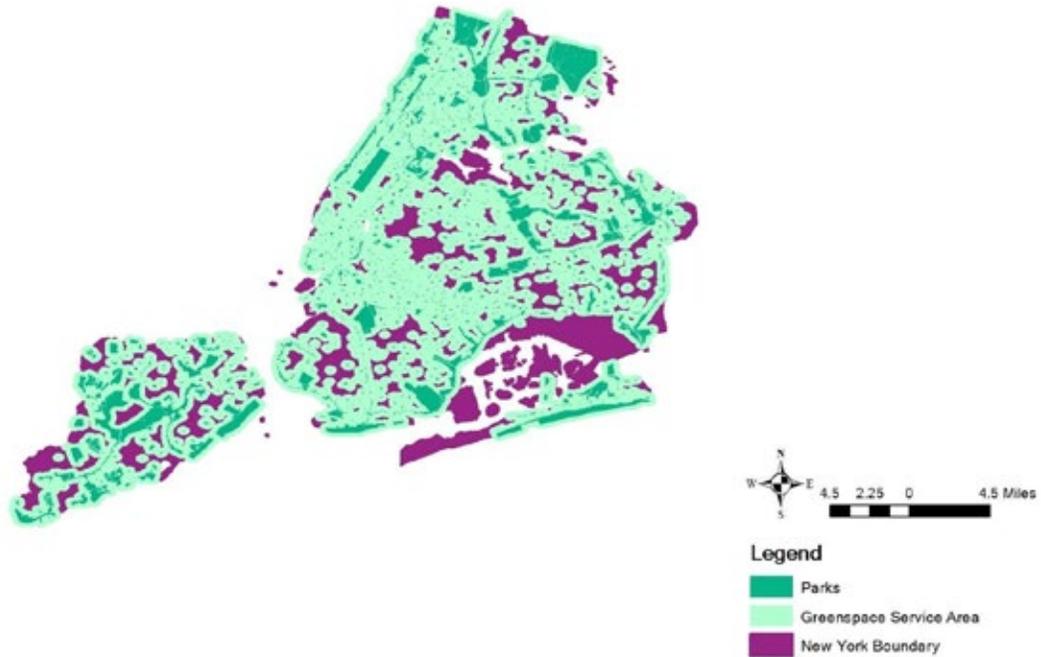


Figure 7. Map showing the green space service area of quarter mile buffer for New York City.

The output shows that the greenspace service area takes up 92% of the entire city which ranked second place from the nine cities.

Boston

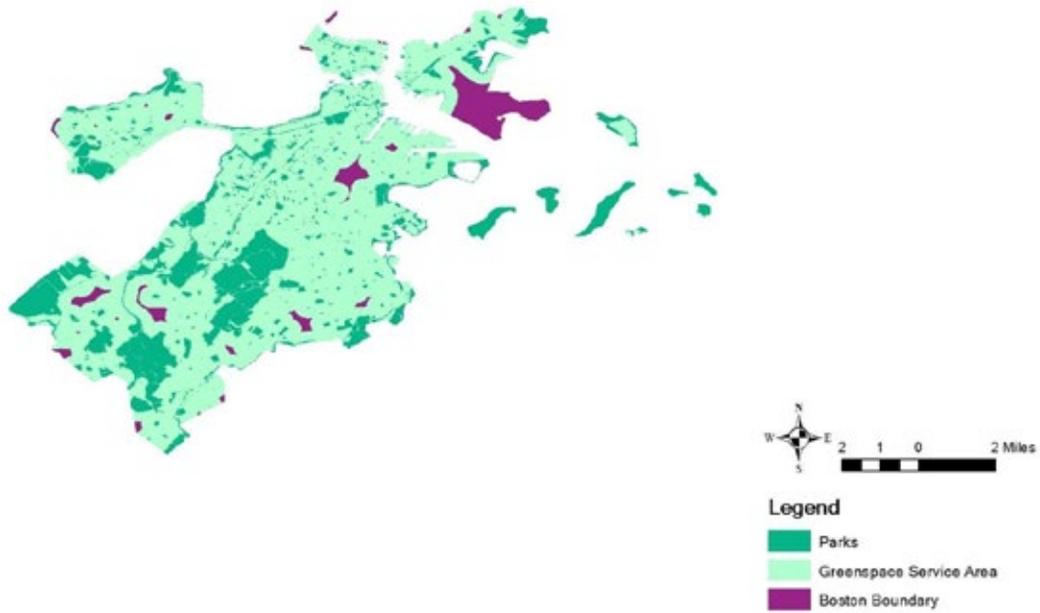


Figure 8. Map showing the green space service area of quarter mile buffer for Boston.

The output shows that the greenspace service area takes up almost 96% of the entire city boundary which ranked first place from the nine cities.

Chicago

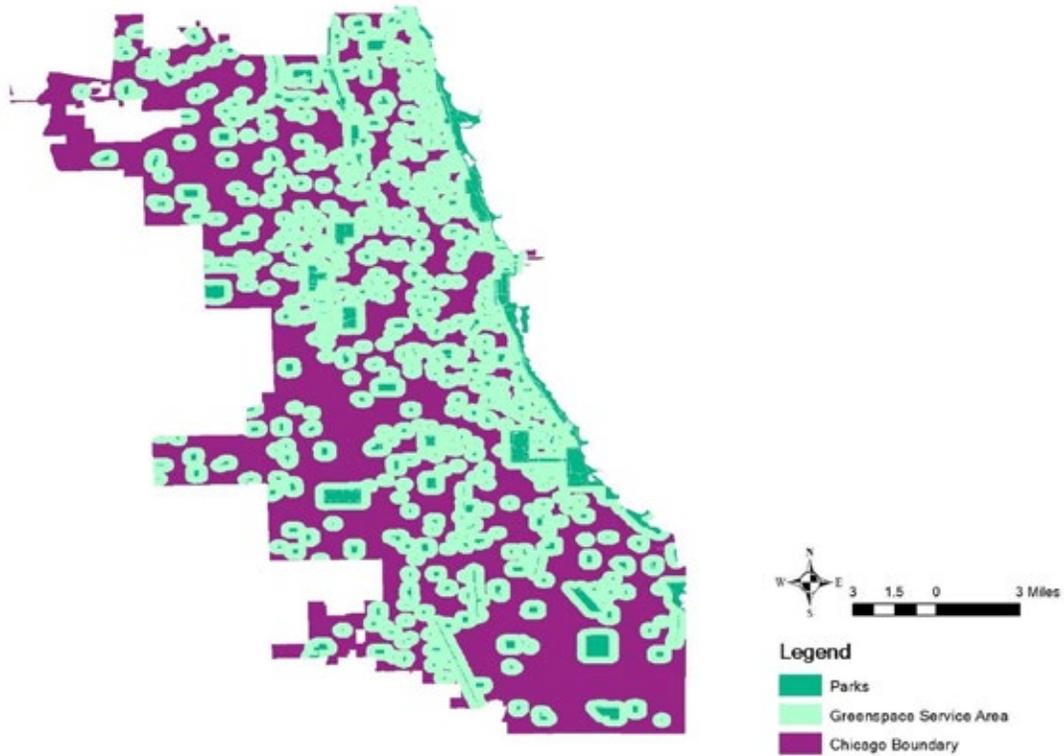


Figure 9. Map showing the green space service area of quarter mile buffer for Chicago.

The output shows that the greenspace service area only takes up 41% of the entire city which ranked at the seventh place from the nine cities.

Arlington

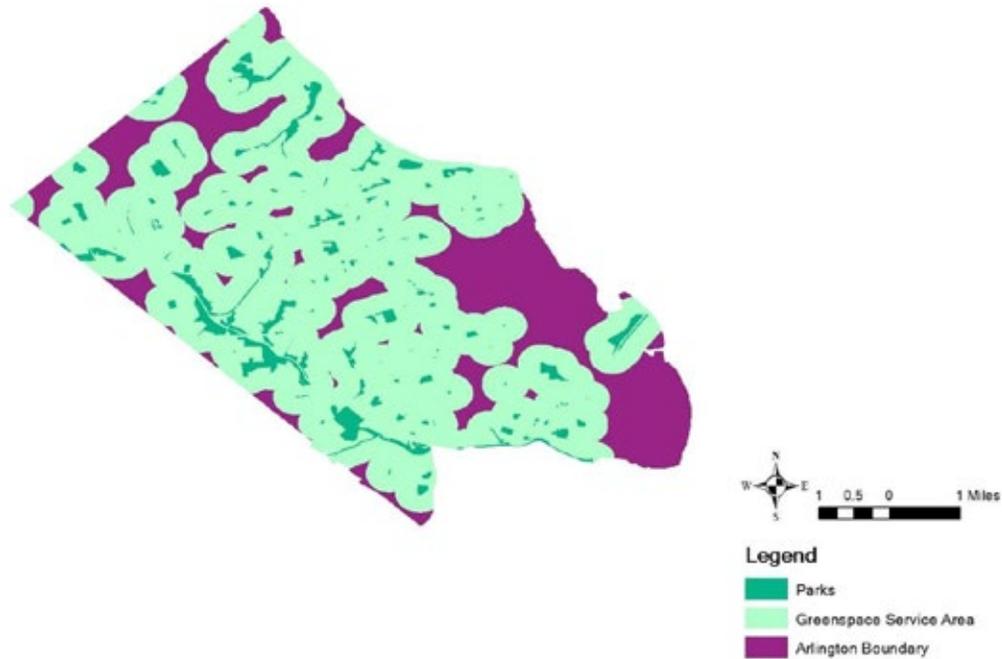


Figure 10. Map showing the green space service area of quarter mile buffer for Arlington.

The output shows that the greenspace service area takes up 85% of the entire city boundary which ranked at the fourth place from the nine cities.

Norfolk

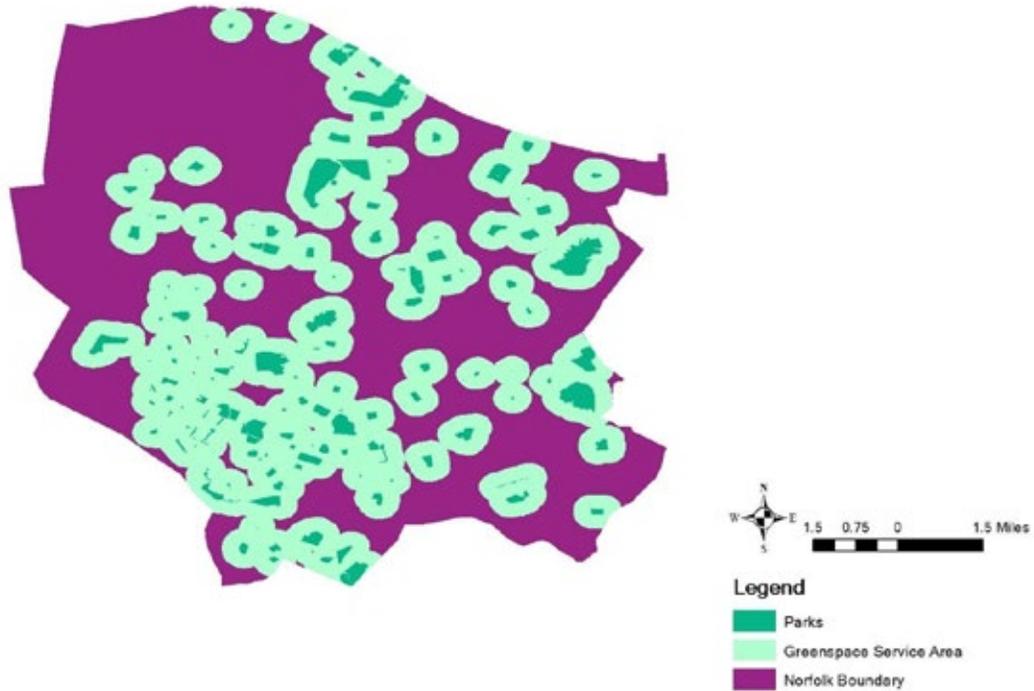


Figure 11. Map showing the green space service area of quarter mile buffer for Norfolk.

The output shows that the greenspace service area takes up 48% of the entire city boundary which ranked at the sixth place from the nine cities.

Atlanta

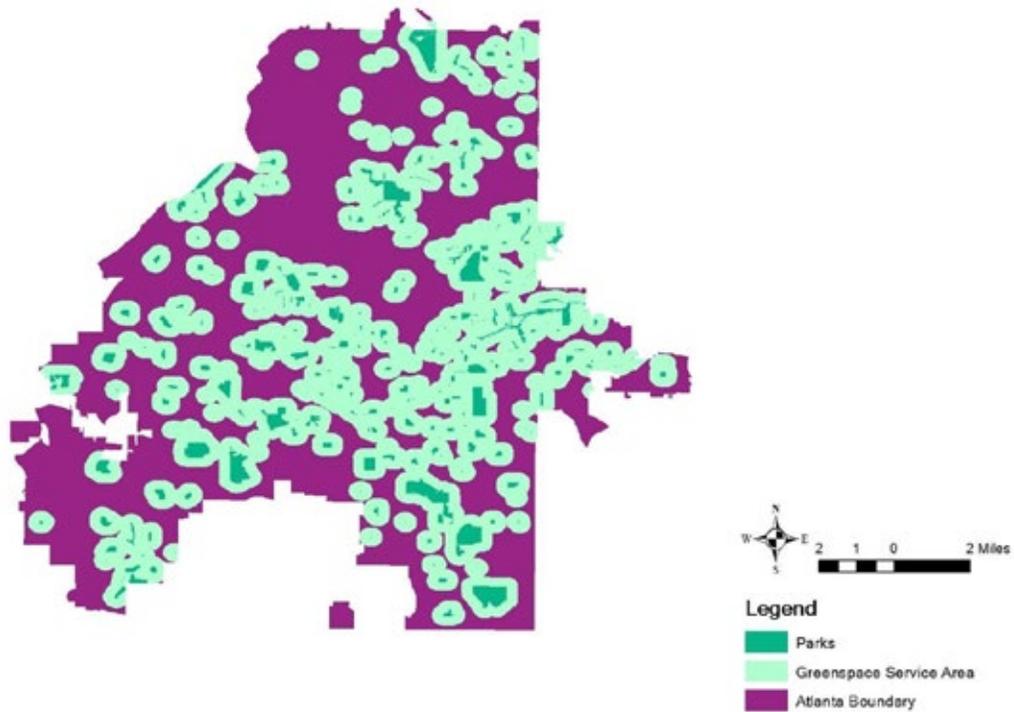


Figure 12. Map showing the green space service area of quarter mile buffer for Atlanta.

The output shows that the greenspace service area takes up 51% of the entire city boundary which ranked at the fifth place from the nine cities.

Houston

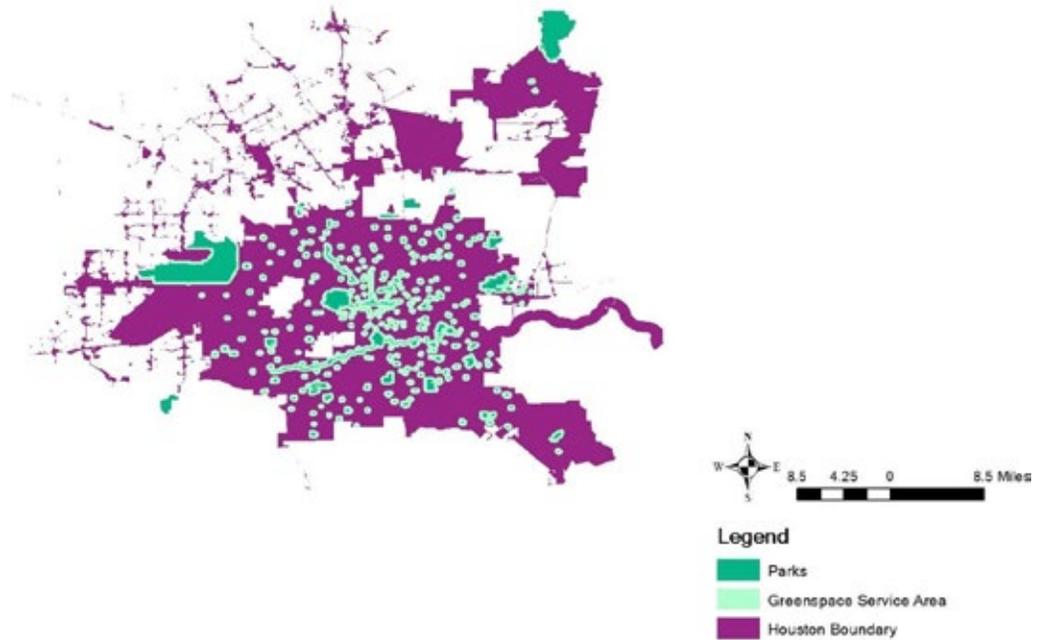


Figure 13. Map showing the green space service area of quarter mile buffer for Houston.

The output shows that the greenspace service area takes up 21% of the entire city boundary which ranked at the eighth place from the nine cities.

Jacksonville

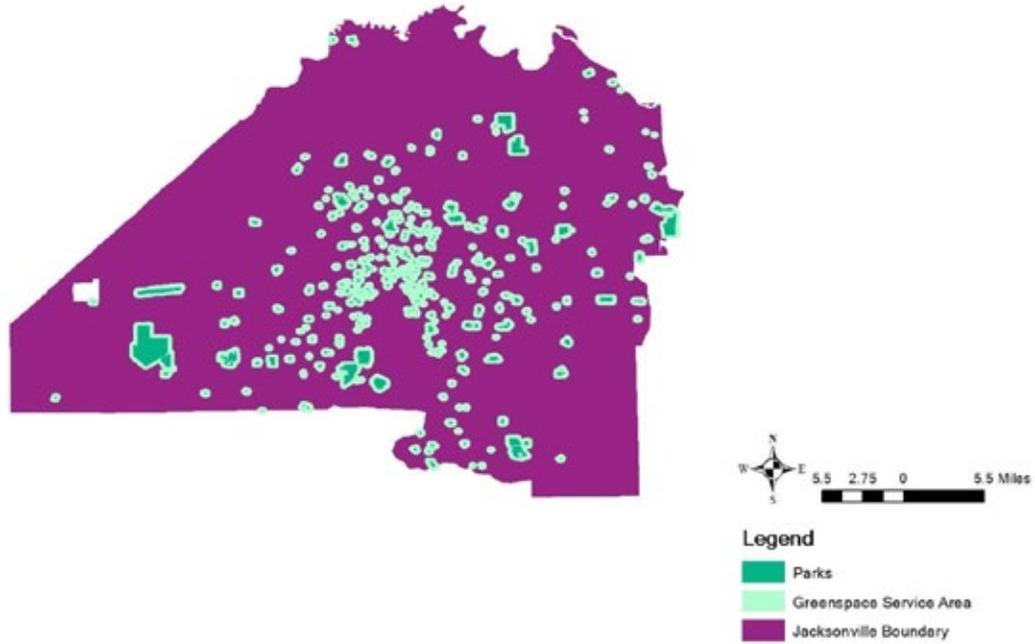


Figure 14. Map showing the green space service area of quarter mile buffer for Jacksonville.

The output shows that the greenspace service area takes up 85% of the entire city boundary which ranked at the ninth place from the nine cities.

Table 5. Showing the output of the greenspace service area compared with mental health indicators

Cities	Area	Greenspace Service Area	Service Area Percentage	Physical Inactivity	Excessive Drinking	Depressed Days	Suicide Rate
Boston	48	46	96%	20%	22%	3.8	6.2
New York	303	277	92%	26%	17%	3.9	5.1
San Francisco	47	42	89%	14%	20%	3.1	10.5
Arlington	26	22	85%	14%	21%	2.8	8.9
Atlanta	133	68	51%	19%	18%	3.5	10.6
Norfolk	54	26	48%	25%	19%	3.4	11.4
Chicago	228	94	41%	20%	21%	3.4	8.0
Houston	600	124	21%	21%	18%	3.2	10.1
Jacksonville	747	99	13%	24%	19%	4.1	15.6

From figures 15 and 16, showing both physical inactivity mental health indicators compared with greenspace service area coverage indicates that there is no strong relationship between greenspace service area coverage to physical inactivity.

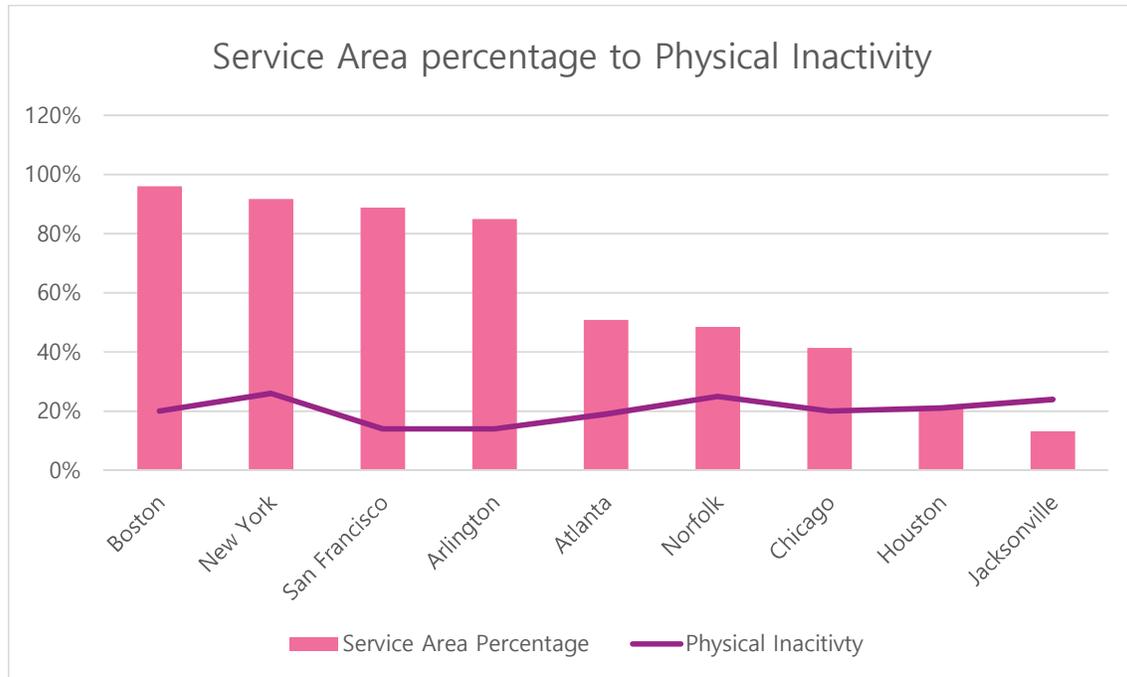


Figure 15. Graph showing Service Area percentage to Physical Inactivity

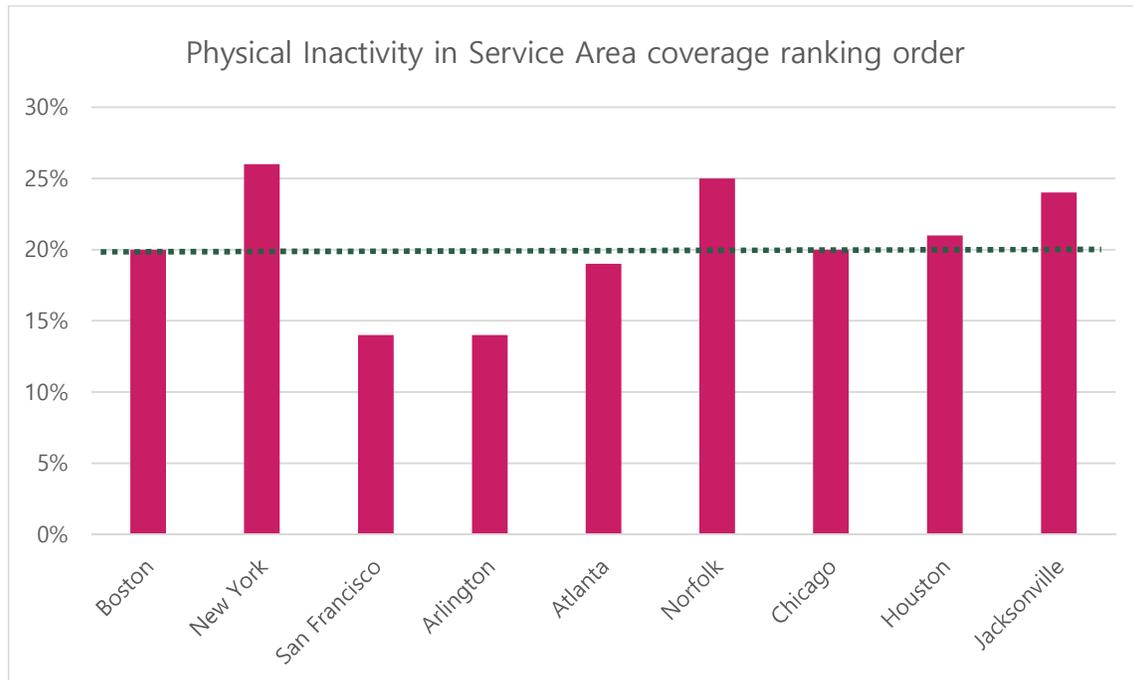


Figure 16. Graph showing Physical Inactivity in Service Area coverage ranking order

From figures 17 and 18, showing both excessive drinking mental health indicator compared with greenspace service area coverage indicates that there is no strong relationship between greenspace service area coverage to excessive drinking.

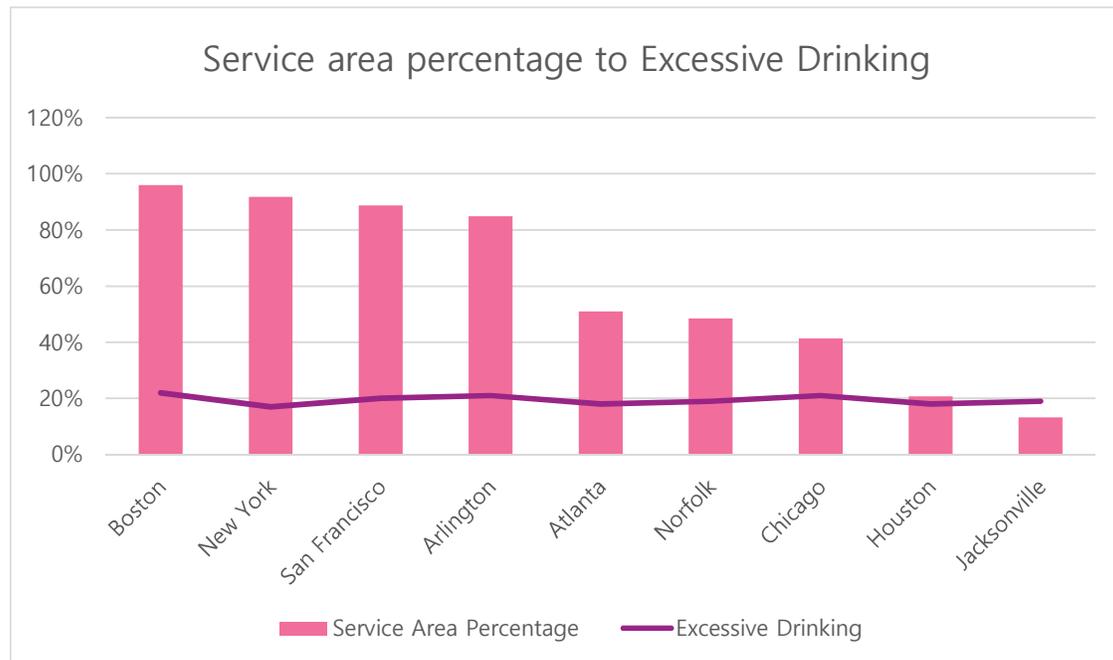


Figure 17. Graph showing Service area percentage to Excessive Drinking

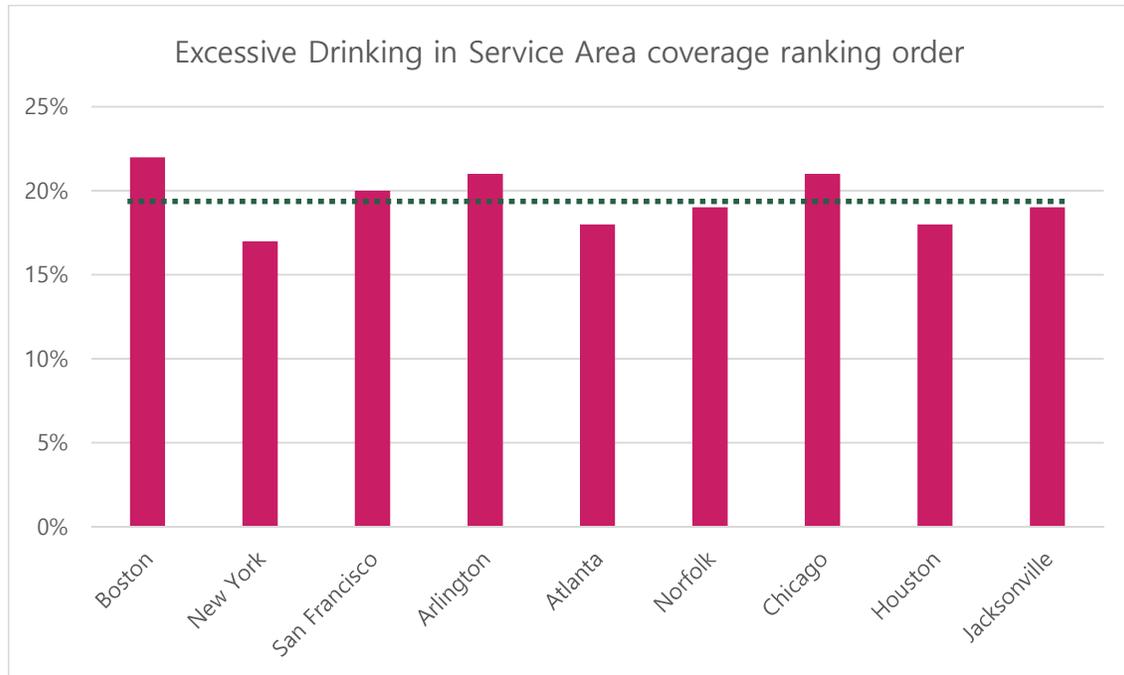


Figure 18. Graph showing Excessive Drinking in Service Area coverage ranking order

From figures 19 and 20, showing both depressed days mental health indicator compared with greenspace service area coverage indicates that there is no strong relationship between greenspace service area coverage to depressed days.

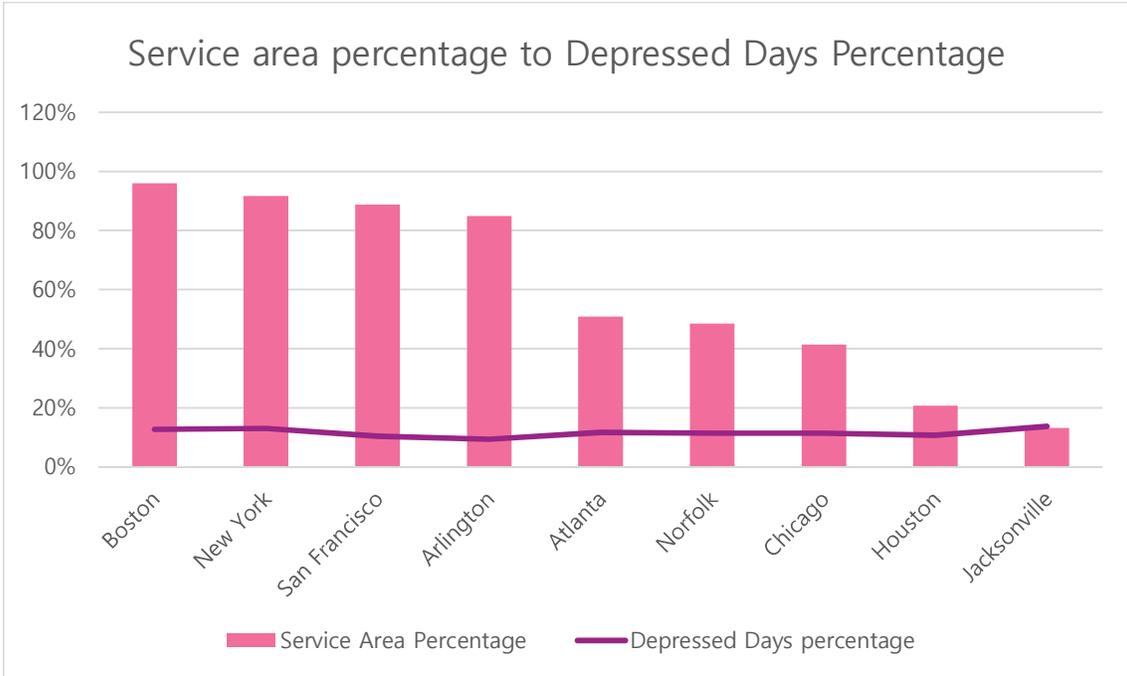


Figure 19. Graph showing Service area percentage to Depressed Days Percentage

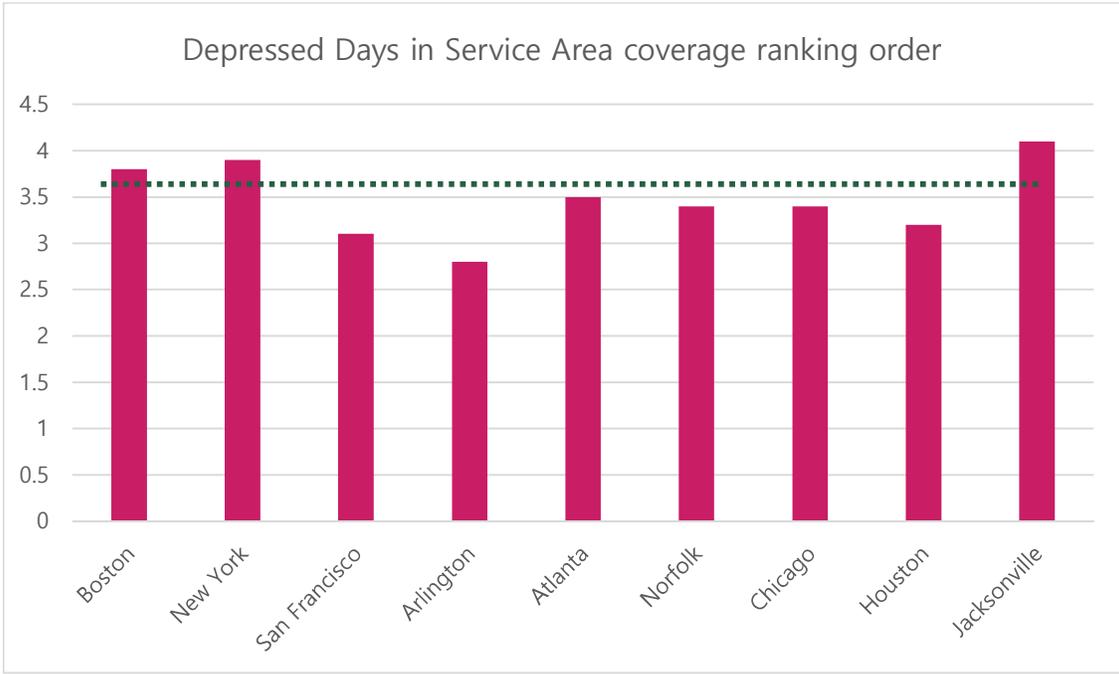


Figure 20. Graph showing Depressed Days in Service Area coverage ranking order

From figure 21 and 22, showing the suicide rate mental health indicator compared with greenspace service area coverage indicates that there is a small potential relationship

between greenspace service area coverage to suicide rate. However, the relationship seems minimal.

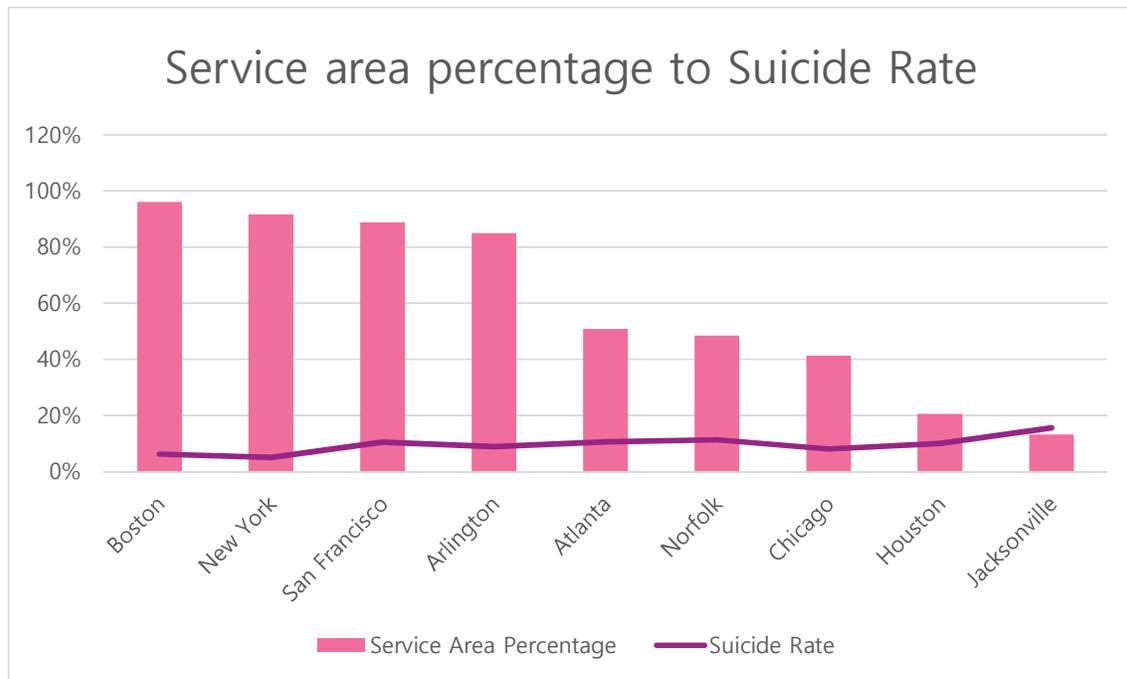


Figure 21. Graph showing Service area percentage to Suicide Rate

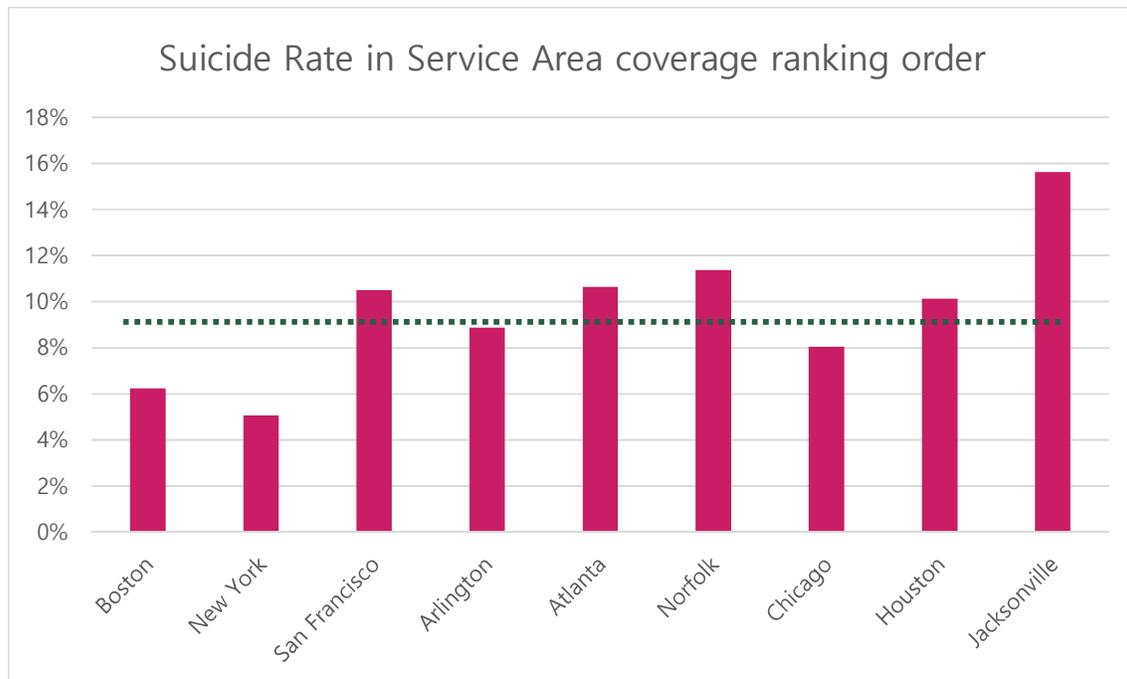


Figure 22. Graph showing Suicide Rate in Service Area coverage ranking order

Conclusion

The idea for this paper started from the stress I have gone through by staying in a denser environment after living in a less dense region. The hypothesis of this analysis is that people who are living in higher population density region will suffer from higher mental health risk. The first section of this paper divides 12 cities into three levels of population density and compares these cities to the major mental health indicators such as physical inactivity, excessive drinking, depressed days in a month, and suicide rate. Unlike how I hypothesized, the result showed that cities with lower population density show tendency of higher physical inactivity, depressed days, and suicide rate. The second part of this paper takes this analysis and compare population density to greenspace service area coverage and its relation to mental health. Per the literature reviews, many professional assert the psychological benefit of a greenspace. Unlike how many professionals predict, the analysis of this paper indicates the accessibility of a greenspace is not directly related to mental health. From this result, I

conclude that there are other factors such as the quality of a greenspace or the size of a greenspace is more likely to be associated with mental well-being.

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