Urban Green Space Accessibility and Seniors' Quality of Life in San Francisco

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In

Geography: Resource Management and Environmental Planning

by

Vincent Molina – ID No. 922251301

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Certification of Approval

I certify that I have read Urban Green Space Accessibility and Seniors' Quality of Life in San Francisco by Vincent Molina, and that in my opinion this work meets the criteria for approving a thesis submitted in partial fulfillment of the requirement for the degree Master of Arts in Geography: Resource Management and Environmental Planning at San Francisco State University.

Jason Henderson Ph.D.
Professor,
Thesis Committee Chair

Nancy Lee Wilkinson Ph.D.
Professor

XiaoHang Liu Ph.D.
Professor

Abstract

The impacts of urban green space accessibility on seniors' quality of life is the subject of a growing body of literature that underscores physical and mental health benefits. Building on theories of environmental justice, this thesis investigates the impacts of urban green space accessibility on seniors' quality of life, specifically physical and mental health, based in San Francisco's Richmond District. The thesis also focuses on seniors' preferences for green space safety and the surrounding built environment, as well as the influence of race/ethnicity and socioeconomic status. Results of this study show that pain, general health, emotional well-being, and energy/fatigue are some of the leading physical and mental health domains that influence seniors' health-related quality of life. Study participants reported that traffic, air quality, and distance to green space are their top three considerations of the surrounding built environment. Paths with clear lines of sight, good lighting, and security technology are their top three important green space safety features. Race and socioeconomic status were found statistically insignificant to urban green space accessibility and health. Future research should continue to explore how urban green spaces impact seniors' physical and mental health in combination with implementing measures of park proximity and park quality over a larger sample population representative of San Francisco's senior population to test if findings can be generalized.

Acknowledgements

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Introduction

In 1983, researcher Roger Ulrich introduced the Stress Reduction Theory, which suggests that spending time in nature promotes recovery from stress, and that time spent in the built environment does the opposite (The Science, n.d.). In 1989, environmental psychologists Rachel and Stephen Kaplan presented the Attention Restoration Theory, suggesting that attention or mental fatigue can be improved by spending time in nature (The Science, n.d.). And in 1993, social ecologist Stephen Kellert and biologist Edward O. Wilson introduced the biophilia hypothesis, suggesting that humans have an innate tendency to have connections with their natural environment (Scopelliti et al., 2019, p. 1). These three theories posit that humans are intrinsically connected to the natural world and that humans need nature to stabilize mental stresses. These theories are more important as a sizable portion of the global population resides in dense urban environments, areas where a high number of inhabitants are surrounded by built infrastructure. And according to the United Nations, by 2050, 68% of the world will live in urban areas (United Nations, 2018).

In response to current scientific research, this thesis aims to investigate how accessibility to urban green spaces impacts seniors' health-related quality of life in San Francisco's Richmond District. In the last three decades, the Richmond District has experienced a lack of infrastructure development relative to regional population, housing, and economic growth. Further, access to recreational spaces and facilities is hindered by the lack of transportation and pedestrian safety infrastructure, critical obstacles to sustainability and quality of life, especially since the area represents approximately 20% of the City's total park space (San Francisco Planning, 2015). And in the last two decades, geography, public health, and planning literature posit that the availability and accessibility to green spaces have physical and mental health benefits for seniors, particularly in dense urban environments. In this thesis, urban green spaces (UGS) refer to grassy or vegetated areas surrounded by the built environment. For example, parks, sports fields, and community gardens in cities. In this field of research, the denotation of accessibility varies. A textbook definition suggested by Merriam-Webster defines accessibility as “capable of being reached”, “capable of being used or seen”, or “easily used or accessed by people with disabilities” (“Accessible”, 2022). While these definitions offer some insight, there is much to be considered in terms of urban green space accessibility for seniors. This study will also investigate seniors’ preferences for green space characteristics and the surrounding environment (e.g., roads, traffic, and the number of intersections). Third, accessibility to urban green spaces addresses concepts of environmental justice, or the fair and equitable distribution, movement, and right of access to environmental goods and services (Sheller, 2018). Thus, this study also aims to investigate three different kinds of measurement strategies used by other researchers, notably park proximity, park quality, and park quantity; race/ethnicity and socioeconomic status are also considered.

This paper first presents a literature review of current research on the impacts of green space accessibility on seniors’ health-related quality of life, seniors’ preferences for the surrounding built environment and of green spaces, and green space accessibility in the scope of environmental justice. Then, the study objectives, framework, and methodology are descriptively outlined. The third section presents the statistical analyses used and the respective findings. Then the fourth and final section is a discussion that interprets findings and dovetails findings with other current research, including the significance of this study, limitations, and suggestions for future research.

Literature Review

Physical health benefits of urban green spaces

In this paper, physical activity refers to the action of mobilizing the body in a manner that exerts energy; this allows for a range of activities including walking, running, and/or cycling. With respect to what the World Health Organization refers to as ‘active aging’, researchers suggest that to reduce age-related health decline, seniors should retain a healthy level of physical activity to combat chronic diseases, prevent disabilities, and provide a plethora of other health benefits (Gong et al., 2014; Dalton et al., 2016; Vich et al., 2021). Research studies concur that physical activity is important for maintaining health and overall functionality; it is essential to engage in physical activity to ensure a good quality of life, and to avoid health-related complications that result from aging (Gong et al., 2014; Dalton et al., 2016; Duan et al., 2018; Hooper et al., 2020; Vich et al., 2021; Zhai et al., 2021).

Accessibility to urban green spaces also allows opportunities for seniors to foster their mental health and create meaningful connections through social encounters and interactions. Several public health, planning, and geography studies based in places like the United States, United Kingdom, Germany, and China concluded that physical activity, mental health, and social interaction are important aspects of ensuring a good quality of life and health for older adults (Astell-Burt et al., 2013; Gong et al., 2014; Gascon et al., 2015; Dalton et al., 2016; Duan et al., 2018; Lee & Lee, 2019; Schmidt et al., 2019; Hooper et al., 2020; Vich et al., 2021; Zhai et al., 2021). These life components carry more weight in communities where space may be configured in ways that hinder or impede the mobility of older adults.

In terms of physical activity, studies reveal that UGS encourages older adults to engage in various forms of physical activity, namely walking, that leads to better physical health amongst other benefits (Gong et al., 2014; Dalton et al., 2016; Duan et al., 2018; Hooper et al., 2020; Vich et al., 2021; Zhai et al., 2021). Second, UGS act as places of encounter where older adults have opportunities to create and/or cultivate relationships with others of all ages; consistent physical activity and social interaction make up the third benefit of UGS, a place to remedy and nurture mental health (Astell-Burt et al., 2013; Gascon et al., 2015; Lee & Lee, 2019; Schmidt et al., 2019). These three elements in conjunction with the availability *and* accessibility to UGS lead to a healthier and better quality of life for older adults. Figure 1 below depicts a high-level visualization of neighborhood park benefits from a study conducted by Loukaitou-Sideris et al. (2016) based in Los Angeles, California.

Figure 1. Neighborhood park benefits

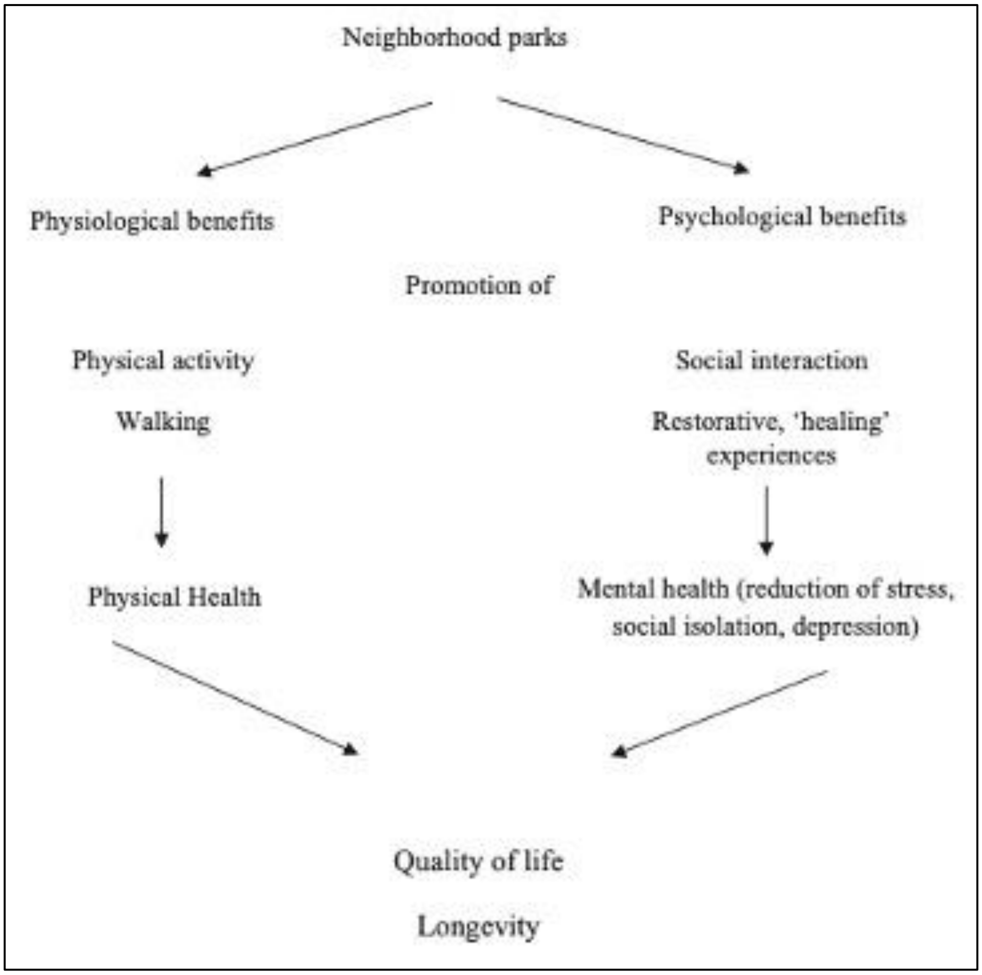

Figure 1. Adapted from Parks for an Aging Population: Needs and Preferences of Low-Income Seniors in Los Angeles, by Loukaitou-Sideris et al., 2016, Journal of the American Planning Association, 82:3, p. 237.

Studies of UGS and physical activity patterns of older adults take two leading approaches. The first is to examine whether and how UGS influences the physical activity patterns of older adults; the second is to investigate the physical activity patterns of older adults within UGS in relation to their health conditions (in other words, what kinds of physical activity do older adults engage in within UGS and are they generally healthier?). Both types of studies have found that physical activity is significantly associated with better health and good quality of life (Gong et al., 2014; Dalton et al., 2016; Duan et al., 2018; Hooper et al., 2020; Vich et al., 2021; Zhai et al., 2021).

In studies that investigated how UGS influences the physical activity patterns of older adults, researchers concluded that older adults that have access to UGS are more likely to participate in physical activity (Gong et al., 2014; Dalton et al., 2016; Vich et al., 2021). In studies that explored physical activity patterns of older adults for health, researchers discovered that older adults preferred walking as their primary form of exercise and that older adults who engage in physical activity within UGS were likely to consistently engage in physical activity for longer durations, and therefore, are more likely to meet physical activity recommendations (Duan et al., 2018; Hooper et al, 2020; Zhai et al., 2021). In Figure 2 below, the graph shows the predicted probabilities of study respondents performing regular physical activity, with those reporting poor lower extremity physical function less likely to participate in regular physical activity.

Figure 2. Predicted probability of regular participation in physical activities associated with variation in neighorhood vegetation by the levels of lower extremity physical function

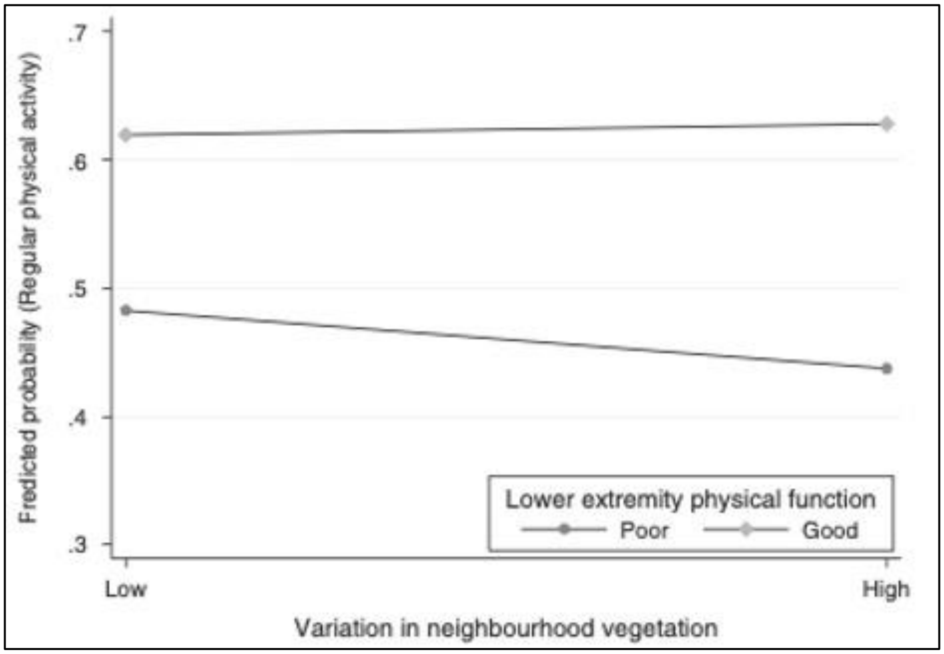

Figure 2. Adapted from Neighbourhood green space, physical function and participation in physical activity among elderly men: the Caerphilly Prospective study, by Gong et al., 2014, International Journal of Behavioral Nutrition and Physical Activity, 11:40, p. 8.

Research by Gong et al. (2014), Dalton et al. (2016), and Vich et al. (2021) on the impacts of UGS presence on older adults' physical patterns suggests that if older adults that have access to green spaces and can safely and comfortably get there, they develop better physical activity habits that may help prevent age-related health declines. Research by Duan et al. (2018), Hooper et al. (2020), and Zhai et al. (2021) on physical activity levels and the types of park facilities used by older adults within UGS suggest that ensuring the provision of UGS in older adults' neighborhoods not only help to develop better habits but also help to increase the quality and frequency of physical activity among older adults. Urban planners, decision-makers, city officials, and community stakeholders should be aware that both the internal *and* external spatial configuration of UGS in relation to the built environment impact older adults' park use.

On the other hand, significantly fewer studies have specifically examined the association between UGS and mental health for older adults. However, a growing body of research indicates that there is a synergy between UGS exposure and mental health for older adults (Astell-Burt et al., 2013; Lee & Lee, 2019; Schmidt et al., 2019; Pelegrini, 2021).

Mental health and urban green spaces

In a study based in Australia, Astell-Burt et al. (2013) examined the relationship between green space and physical and mental health for participants *45 years and older*. The Kessler Psychological Distress Scale was used to measure symptoms of psychological distress, and the authors used a derivative of the Active Australia Survey to measure physical activity (Astell-Burt et al., 2013, p. 602). The authors found that psychological distress and physical inactivity were less common among residents living in the greenest neighborhoods. Additionally, there were mental health benefits for participants that regularly engaged in physical activity in the same neighborhoods (Astell-Burt et al., 2013, p. 605). Figure 3 below presents the results from Astell-Burt et al.'s (2013) study, showing a negative association between the rate of psychological distress and percent of green space (in other words, participants that lived in the greenest neighborhoods reported less psychological distress). The authors proposed that "the link between mental health and greener surroundings as we get older may be increasingly dependent upon our ability to maintain regular active lifestyles" (Astell-Burt et al., 2013, p. 605).

Figure 3. Association between green space and psychological distress, by frequency of participation in physical activity

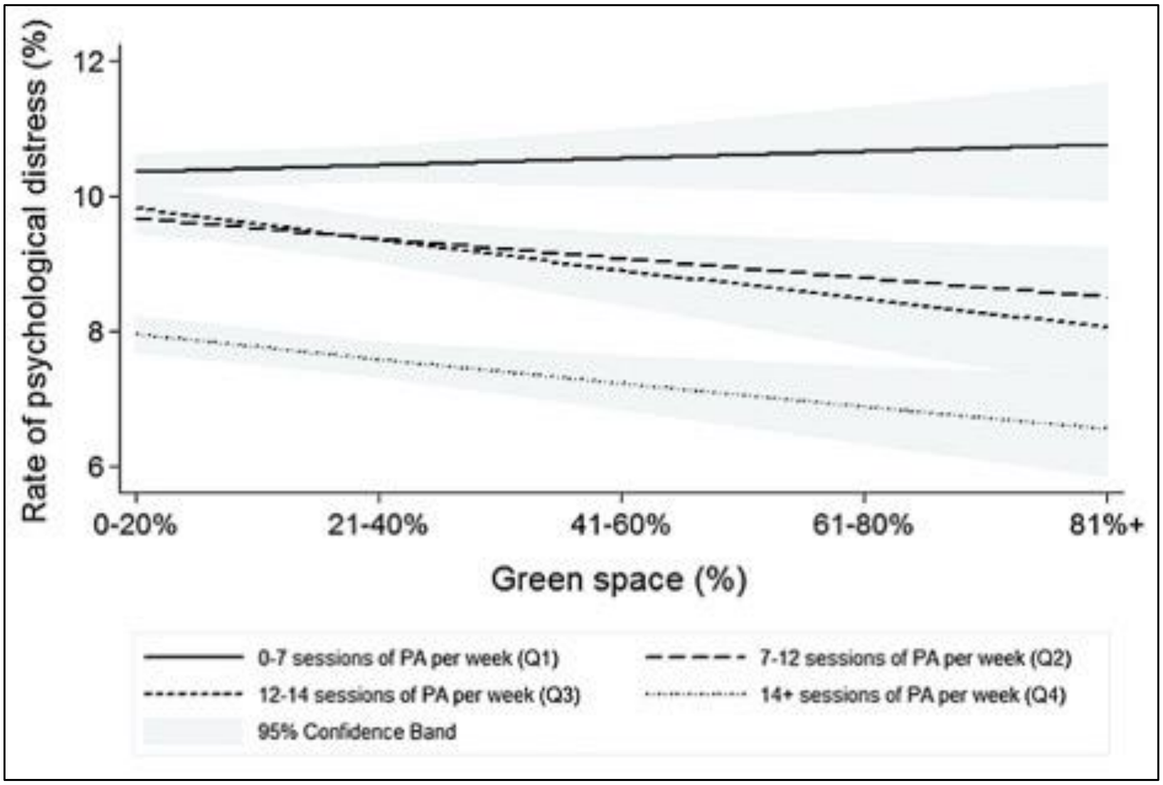

Figure 3. Adapted from Mental health benefits of neighbourhood green space are stronger among physically active adults in middle-to-older age: Evidence from 260,061 Australians, by Astell-Burt et al., 2013, Preventive Medicine, 57, p. 605.

In assessing the associations between older adults' socioeconomic status and mental health vulnerability, Lee & Lee (2019) investigated the prevalence of mental health problems in seven metropolitan areas in Korea. They used the 2015 Community Health Survey from the Korea Centers for Disease Control and Prevention to assess the health status, health behavior, and health determinants of participants. Lee & Lee (2019) found that "the higher the rate of greenery in a city, the less stress and fewer symptoms of depression" within the elderly population (p. 8). However, the same *could not* be said for areas in the city with the smallest urban green area ratio. Furthermore, in the same analysis, the authors did not find a statistically significant association between urban green space, regular physical activity, and social activities (Lee & Lee, 2019, p. 7-8).

Third, Schmidt et al. (2019) investigated the association between the built environment, social activity, and walking while socially interacting among older adults living in low socioeconomic neighborhoods in Copenhagen. Schmidt et al. (2019) discovered that social interaction was negatively associated with walking; of the older adults observed, approximately 80% walked alone, and approximately 53% walked while engaging in social interaction (Schmidt et al., 2019, pp. 10-11). When social interaction was occurring, walking was less likely to occur (Schmidt et al., 2019, p. 12). Nonetheless, the authors concluded that social areas in these spaces are important for the residents as they serve as places of social encounters and social interaction, suggesting an association in the reduction of loneliness and depression (Schmidt et al., 2019, p. 13). And as one interview participant expressed, "...well a lot of people are alone…but then they meet down there (by the benches and raised beds) and talk…" (Schmidt et al., 2019, p. 13).

Fourth, a 2021 study conducted in San Francisco explored the relationship between environmental factors and mental health during pregnancy. From 824 participants, Pelegrini (2021) discovered that green space was negatively correlated with depression and stress and that women with access to higher levels of green space, on average, reported low levels of perceived stress and depression. Although Pelgrini's (2021) study focused on pregnant women, the data is contextually relevant and previously justified the importance of UGS in the greater San Francisco Bay Area.

It is evident that the impacts of green spaces in relation to mental health vary, and with these studies in accordance with the critical role the built environment may have on green spaces, a question then arises — what aspects of the built environment *surrounding* UGS do seniors consider, and to what extent?

The surrounding built environment

Green spaces are important components of healthy and vibrant communities, especially in dense, built environments. Public health, land-use planning, and geography studies, as mentioned above, posit that access to green spaces encourages healthier lifestyles through the promotion of physical activity and social interaction. As the global elderly population (ages 65 and over) is expected to increase to about 20% by 2050, providing senior-accessible green spaces becomes increasingly important (Veitch et al., 2020, p. 1). To ensure the life longevity of seniors, UGS accessibility should consider the built environment surrounding these spaces (such as the presence of traffic and sidewalks) as well as safety.

First, and perhaps the most important park characteristic for older adults, is the psychological sense and physical presence of safety and security. Loukaitou-Sideris et al. (2016) conducted a study involving 39 low-income seniors in Los Angeles and found that safety and security from human threats and environmental hazards are essential and important for seniors (p. 242). Mahmood et al. (2012) and Veitch et al. (2020) similarly concluded that both the psychological and physical sense of safety and security influence park usage and visitation (p. 4, p. 1184). Without the psychological sense and physical presence of safety and security, a visit to the park becomes unlikely. This is parallel when associating safety with comfort in movement within and around parks for older adults, both in terms of traffic and crime risks (Mahmood et al., 2012, p. 1184).

Accessibility, in terms of *ease of access* to green spaces in dense, built environments is another critical feature for older adults (Parra et al., 2010; Mahmood et al., 2012; Loukaitou-Sideris et al., 2016). Older adults that live in dense or limited-space communities may not have the luxury of access to their own backyard or garden and therefore must depend on public green spaces to tend to their health-related needs. Assessing park accessibility becomes an important step in deciding whether to visit an urban park. For example, an older individual living in a dense and busy neighborhood may ask, “Which is the most accessible park from where I live?”. And while contemplating distance/proximity may be enough, a collection of studies reveals that proximity is merely one part of the decision-making process to determine if a park is accessible for older adults.

In a study conducted in Bogotà, Colombia by Parra et al. (2010), older adults residing in areas with a high number of intersections were less likely to report active park use (p. 1179). Parra et al. (2010) concluded that built environments (or *neighborhood-level characteristics)* like slope terrain, park density (i.e., number of parks in a neighborhood), and the mix of surrounding land uses have a positive association with active park use. Loukaitou-Sideris et al. (2016) reported from their study that seniors are intimidated by having to cross wide streets on their way to the park (p. 242). Mahmood et al. (2012) found that public transit factors such as bus shelters, bus route availability, and location of bus stops are important considerations for moving around the neighborhood (p. 1184). Mahmood et al. (2012) also noted that traffic hazards such as speeding cars, heavy traffic, blind spots, and traffic rule disobedience deter park visits (p. 1184). Through these findings, older adults must ultimately consider information like the number of intersections, the presence of high-traffic arterials, accessible parking, crosswalks, and available public transit.

Another part of considering park accessibility is determining a park’s accessibility relative to the landscape of the park. Moving around the park creates opportunities for physical activity and social interaction, but older adults must take additional, special considerations to avoid precarious regions of the park. Studies conclude that flat, paved pathways are essential for park accessibility (Mahmood et al., 2012; Loukaitou-Sideris et al., 2016; Veitch et al., 2020; Veitch et al., 2022). Ensuring that the pathways are clean (i.e., no trash, debris) and free of obstructions (i.e., barrier-free) as well as providing handrails on stairs and ramps are all important (Loukaitou-Sideris, 2016, p. 243). Parks with rugged terrains designed to replicate natural features may deter older visitors if the paths are too strenuous. Figure 4 shows the four primary features of perfect parks for seniors identified in a study based in Australia: aesthetics, amenities, convenience, and safety (Veitch et al., 2020).

Figure 4. An illustration of important features within a "perfect park"

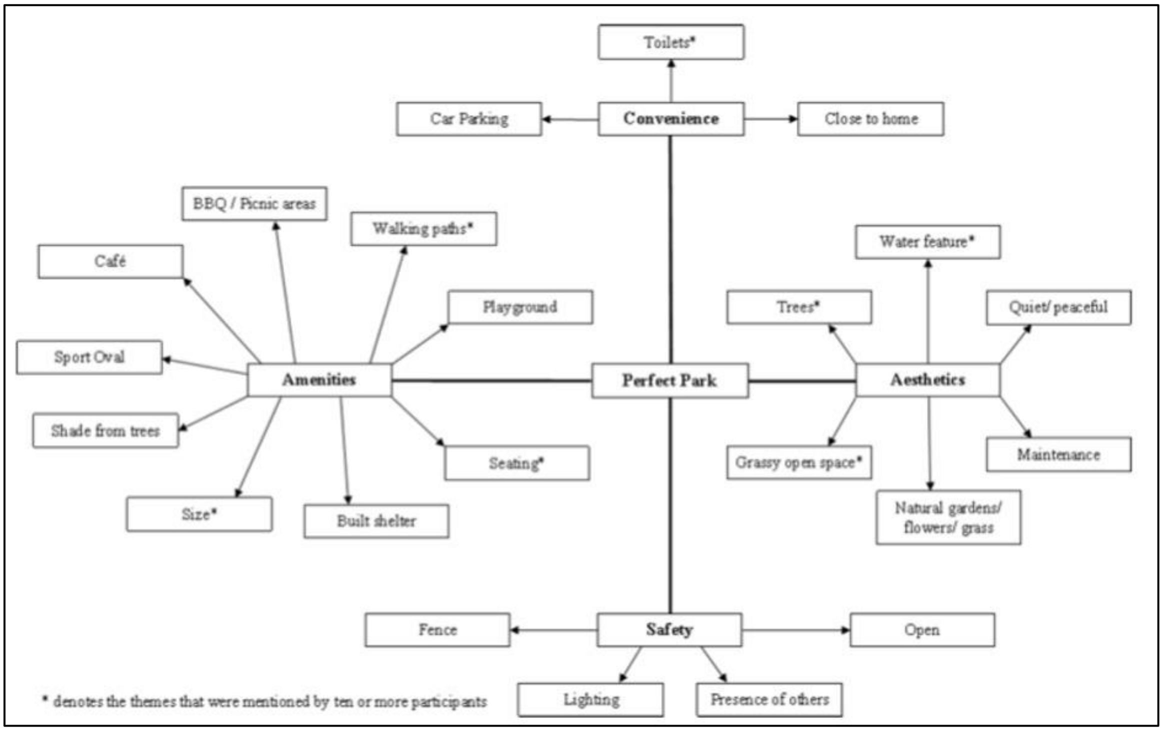

Figure 4. Adapted from Designing parks for older adults: A qualitative study using walk-along interviews, by Veitch et al., 2020, Urban Forestry & Urban Greening, 54, p. 6.

Environmental justice

The equitable distribution of goods, services, environments, and activities are signs of a diverse and inclusive community. However, diversity and inclusion of all races/ethnicities and socioeconomic groups are not consistent in communities throughout the world. Locally undesirable land and industrial areas saturated with environmental risks and hazards often occur in close vicinity to people of color, low-income groups, and minorities—an environmental issue that eventually spurred the rise of the environmental justice movement in the United States in the 1980s. The environmental justice movement first became publicized by protests over a toxic dump near a low-income Black community in Warren County, North Carolina in 1982. Subsequent events and legislation institutionalized attention to environmental justice in local, state, and federal policies and decision-making. In the California Government Code, environmental justice refers to the "fair treatment of people of all races, cultures, and incomes with respect to the development, adoption, implementation, and enforcement of environmental laws, regulations, and policies" ("*SB 1000"*, 2022).

The scope of environmental justice allows for a range of socio-cultural and racial considerations, but much of the focus has been on environmental risk and hazard exposure, like poor air quality, traffic impacts, pesticide use, groundwater threats, lead risk, and more (*Pollution Indicators*, n.d.). One expanding branch of environmental justice assesses the availability *and* accessibility of green spaces: do urban communities have equitable provision, distribution, and accessibility to green spaces for all races/ethnicities, ages, and socioeconomic classes? If so, what characteristics — physical and conceptual — make urban green spaces equitable and accessible?

Environmental justice literature that evaluates green space accessibility employs measures of park proximity, park acreage, and/or park quality — what researchers often refer to as measurement strategies. Park proximity refers to the geographical distance from a reference point such as someone's house to the closest park. Park acreage refers to the number and/or size of parks within a defined geographical boundary. And park quality refers to park amenities, maintenance levels, and crime rates, among other quality indicators (Rigolon, 2016, p. 162).

Current literature accentuates the nuanced conclusions of environmental justice-based literature on green space accessibility. If environmental justice calls for the equitable provision, distribution, and accessibility of green spaces to all people within communities, what measurement strategy should be used? Does a lack of high-quality parks equate with environmental injustice, or is a lack of parks or proximity to parks a better indicator? Some studies conclude that significant disparities in green space accessibility and availability are most distinct when using a combination of at least two measurement strategies.

Focusing on ten core counties in the Atlanta Metropolitan Statistical Area, Dajun Dai (2011) conducted a quantitative study to determine if neighborhoods with large proportions of racial/ethnic minorities and low socioeconomic status have poor green space access (p. 235). In a study based in Shanghai, China, Xiao et al. (2017) examined if and how the distribution of UGS is equitable for marginalized populations using socioeconomic data at the "juweihui" level, like the US census tract level (Xiao et al., 2017, p. 385). In a study conducted in Hannover, Germany, Wen et al. (2020) applied a mixed-methods approach to "assess the spatial disparity in access to [urban green and blue infrastructure], with a special focus on the elderly population" (p. 2). Dai (2011), Xiao et al. (2017), and Wen et al. (2020) designed their studies based on *park proximity* to determine how green space accessibility might differ with respect to race/ethnicity and socioeconomic variables. All three studies found that park proximity alone may be sensitive to study location and local contexts. Dai (2011) found that the unemployed population, populations below the poverty line, and the Black population had poor green space access, while Xiao et al. (2017) found no significant relationship between green space accessibility and working-class residents or those that live in affordable homes (p. 239; p. 390). Furthermore, Wen et al. (2020) discovered that the proportion of seniors in their study had a positive association with accessibility to urban green space and blue infrastructure, thus the senior population in their study did not experience disadvantages in the provision of accessible green spaces (Wen et al., 2020, pp. 8-9).

Further, in a study conducted in Philadelphia, when access is defined by the presence or absence of green space (i.e., a measure of proximity), green space accessibility in terms of race/ethnicity and SES are mixed (Heckert, 2013, p. 815). For example, a larger proportion of Black residents (88%) have green space access compared to Asians (80%) and Whites (85%) (Heckert, 2013, p. 815). In terms of SES, renting and female-headed households have higher green space access compared to owner-occupied and non-female-headed households (p. 816). Conversely, in a study conducted in Germany, Wüstemann et al. (2017) discovered no statistical significance when assessing the results of park proximity stating, "...the distance analysis identifies no inequalities…" (p. 127). The results of these two studies support the notion that solely using park proximity may not be sufficient as a proxy for green space accessibility.

Implementing all three measurement strategies, Hoffimann et al. (2017) conducted a study in Porto, Portugal to investigate "the presence of socioeconomic inequalities in geographic accessibility and quality of green spaces” (p. 1). They found that 80% of neighborhoods had green space accessibility, however, larger portions of green spaces were associated with the least-deprived neighborhoods. In other words, the number of green spaces and the area of green space were negatively associated with deprivation (see Figure 5 below). In terms of park quality, all quality scores were “negatively and significantly associated with neighbourhood deprivation” et al., 2017, p. 6). The least deprived neighborhoods also had better access to green spaces with active recreational facilities, notably walking trails, areas for sports, and playgrounds (Hoffiman et al., 2017, p. 6). And in a systematic literature review, Rigolon (2016) similarly found that the quality of parks including measures of park amenities, maintenance, and safety, were all considerably lower in low-SES neighborhoods populated by ethnic minorities (p. 165). For example, middle- and upper-class white people have more access to parks that have more playgrounds, a higher number of amenities, and trails and paths compared to underrepresented groups (Rigolon, 2016, p. 167).

Figure 5. Geographic distribution of public green spaces and neighborhood socioeconomic deprivation in Porto municipality.

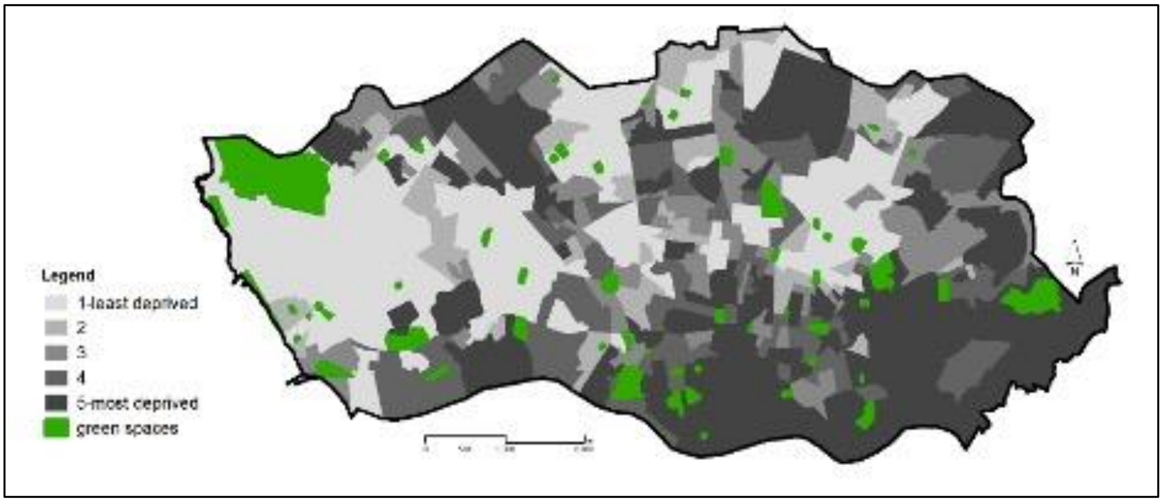

Figure 5. Adapted from Socioeconomic Inequalities in Green Spaces Quality and Accessibility---Evidence from a Southern European City, by Hoffiman, Barros, & Ribeiro, 2017, International Journal of Environmental Research and Public Health, 14, p. 3.

Employing findings and gaps identified in current scientific literature, the present study aims to investigate the impacts of urban green space accessibility in relation to seniors' health-related quality of life. It is well-established that UGS are physically and mentally beneficial for seniors, but associations regarding seniors' preferences are varied, and utilization of various measurement strategies yields mixed conclusions, as findings have been contextually dependent. To fill this research gap, the following questions are offered as research objectives for this case study:

(1) What are the impacts of urban green space accessibility on seniors' health-related quality of life in San Francisco's Richmond District?

    a. What are significant measures of accessibility particularly regarding park proximity, park quality, and/or park quantity?

(2) When visiting urban green spaces, what are seniors' preferences for the surrounding built environment, and in the matter of safety, within green spaces?

(3) What is the influence of race/ethnicity and socioeconomic status on urban green space accessibility and the health-related quality of life of seniors?

The present study measured participants' physical and mental health using the validated RAND-36 Measure of Health-Related Quality of Life questionnaire (RAND-36), and their park activity patterns, park preferences, and socio-demographic characteristics using a self-developed survey (Intake Survey). The data presented were obtained from 31 seniors during 12 collection days of 1.5 - 3 hours each, between February 2023 through March 2023, at two senior centers located in San Francisco's Richmond District. The results and analysis presented in this paper are four-fold. Firstly, it measures and presents physical and mental health data from RAND-36.

Secondly, it presents the variables considered in the Intake Survey, notably park visitation patterns, park preferences, and built environment variables. Third, it explores the associations between the RAND-36 and the Intake Survey using four types of statistical tests in relation to research objectives. Finally, a discussion is provided to interpret findings, dovetail with current literature, assert the significance of the study, briefly discuss limitations, and offer suggestions for future research.

Methodology

Study area

The geographical setting of this study is Supervisorial District 1, better known by San Franciscan residents as the "Richmond District" (used hereafter). Located in the northwestern corner of the City of San Francisco, the Richmond District is adjacent to the Pacific Ocean to the west, the Golden Gate Park to the south, the inner neighborhoods of San Francisco to the east, and the Golden Gate National Recreation Area (GGNRA) to the north (such as the Presidio and the Golden Gate Bridge).

In 2015, the San Francisco Planning Department published the *Existing Conditions Report* for the Richmond District in collaboration with then-District 1 Supervisor Gordon Mar to assess the neighborhood's slow population and housing growth relative to regional economic activity - an effort under the *Richmond District Strategy* which aims to ensure a sustainable and high quality of life for neighborhood residents. The report analyzed existing data on demographics, zoning and land use, housing, transportation, public space, and community facilities among other topics. With respect to the last three decades, notable findings in this report include a population growth of approximately half the rate of the City overall, a doubled Asian population, a disproportionately low share of the City's new housing development at 1%, and a transportation infrastructure that is only served by bus (the major arterial Geary Boulevard had the highest daily ridership at the time of publication) (San Francisco Planning, 2015). Further, Geary Boulevard boasts a street width six times more than most building heights along the arterial (San Francisco Planning, 2015). Specifically, regarding pedestrian access to parks, the report found that while the Richmond District represents about 20% of the City's total park space, pedestrian access to parks is often interrupted as 21 intersections have incomplete crosswalks and 15 have no crosswalks at all; small neighborhood parks are spread unevenly across the neighborhood, leaving the western parts with far less access (San Francisco Planning, 2015). With respect to transportation, green space access, and environmental justice concerns, the Richmond District is a prime example of a diverse residential neighborhood with an infrastructure capable of supporting green mobility and sustainable urban development. And with special consideration to seniors, the existing conditions and potential for the Richmond District can be accentuated, marking the importance of assessing the impacts of UGS accessibility on seniors' health-related quality of life in the area.

In the study area, there are 15 public green spaces of varying acreage managed by the San Francisco Recreation and Parks Department (San Francisco Recreation and Parks, 2019) – see Figure 6. Golden Gate National Recreation Area lands on the north side of the Richmond District give residents additional access to green space. In fact, it was announced in 2016 by then-Mayor Edwin M. Lee that the City of San Francisco is the first city in the nation where all residents have access to a park within a 10-minute walk ("San Francisco", 2022). Through this, it can be inferred that all Richmond District residents have "access" to at least one green space.

Figure 6. Map of green spaces in the Richmond District

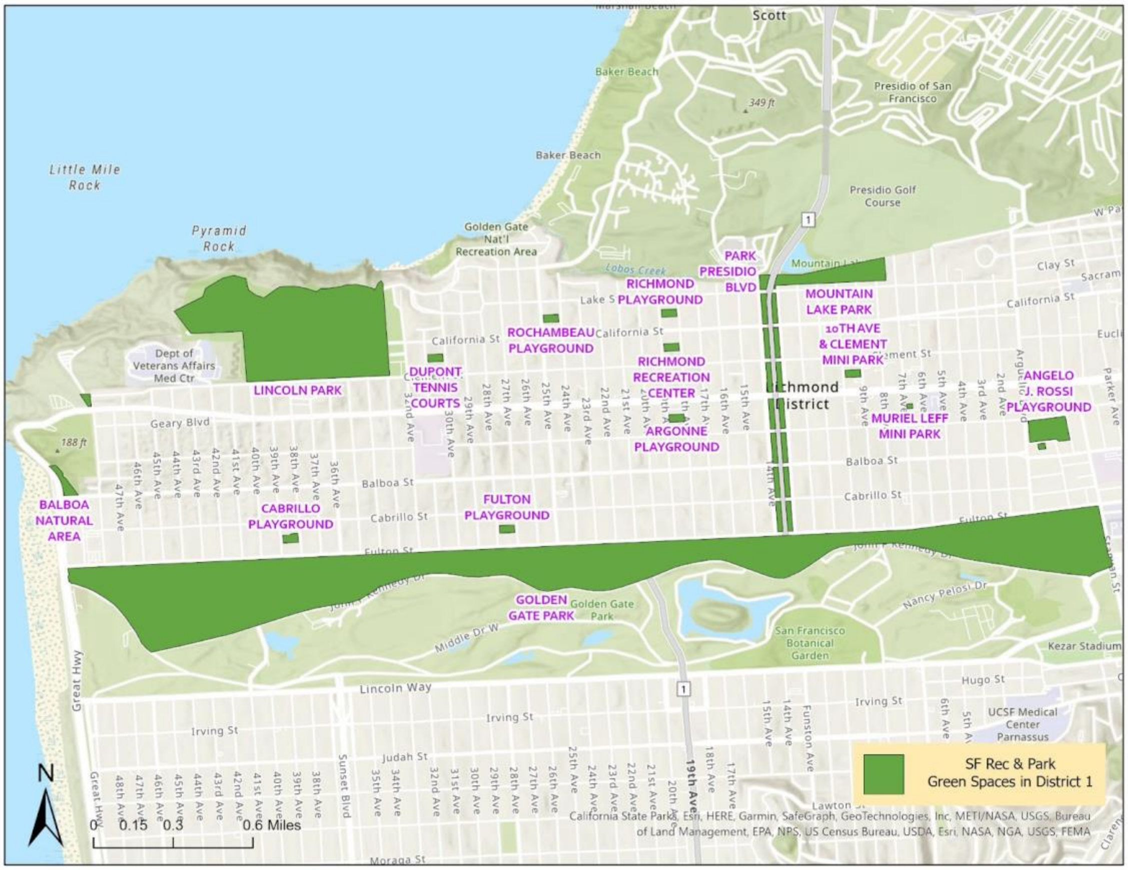

Figure 6. San Francisco Redistricting Task Force, 2023; San Francisco Recreation and Parks Department, 2019.

Table 1. San Francisco Recreation and Parks Managed Lands and the Presidio

Name	Size (acres)	Size (square feet)
Angelo J. Rossi Playground	6.5	281,884.5
Balboa Natural Area	1.8	80,279.6
Argonne Playground	0.8	35,710.6
Cabrillo Playground	0.9	38,919.9
Fulton Playground	0.8	35,717.8
Muriel Leff Mini Park	0.2	8,933.2
DuPont Tennis Courts	0.8	35,866.0
Rochambeau Playground	0.8	35,985.1
Richmond Playground	0.8	35,935.6
Lincoln Park	112.6	4,905,692.1
Richmond Recreation Center	0.8	35,935.8
Mountain Lake Park	12.8	556,991.8
Park Presidio Blvd	16.7	727,206.4
Golden Gate Park	1,026.7	44,722,773.3
10th Ave & Clement Mini Park	0.8	36,119.6
The Presidio	1,491	64,947,960.0
Total	**2,674.8**	**116,521,911.3**

Table 1.San Francisco Redistricting Task Force, 2022; San Francisco Recreation and Parks Department, 2019; Presidio, n.d..

As the study area is described, I note that the geographical setting is implicit in relation to the analysis of this research. Participants were told they must reside in the Richmond District, but address or proof of residence was not requested to avoid the collection of personally identifiable information, as guided by this study's research protocol. Moreover, characterizing the spatial distribution and aesthetics of green spaces helps to provide perspective into the types of green spaces within the study area, specifically the count, size, proximity, and quality of green spaces. With respect to Veitch et al.'s (2020) study, seniors identified four main green space preferences, notably aesthetics, amenities, convenience, and safety. Figures 7 – 9 depict the conditions of some of the green spaces in the Richmond District.

Figure 7. The green spaces of Richmond District - I

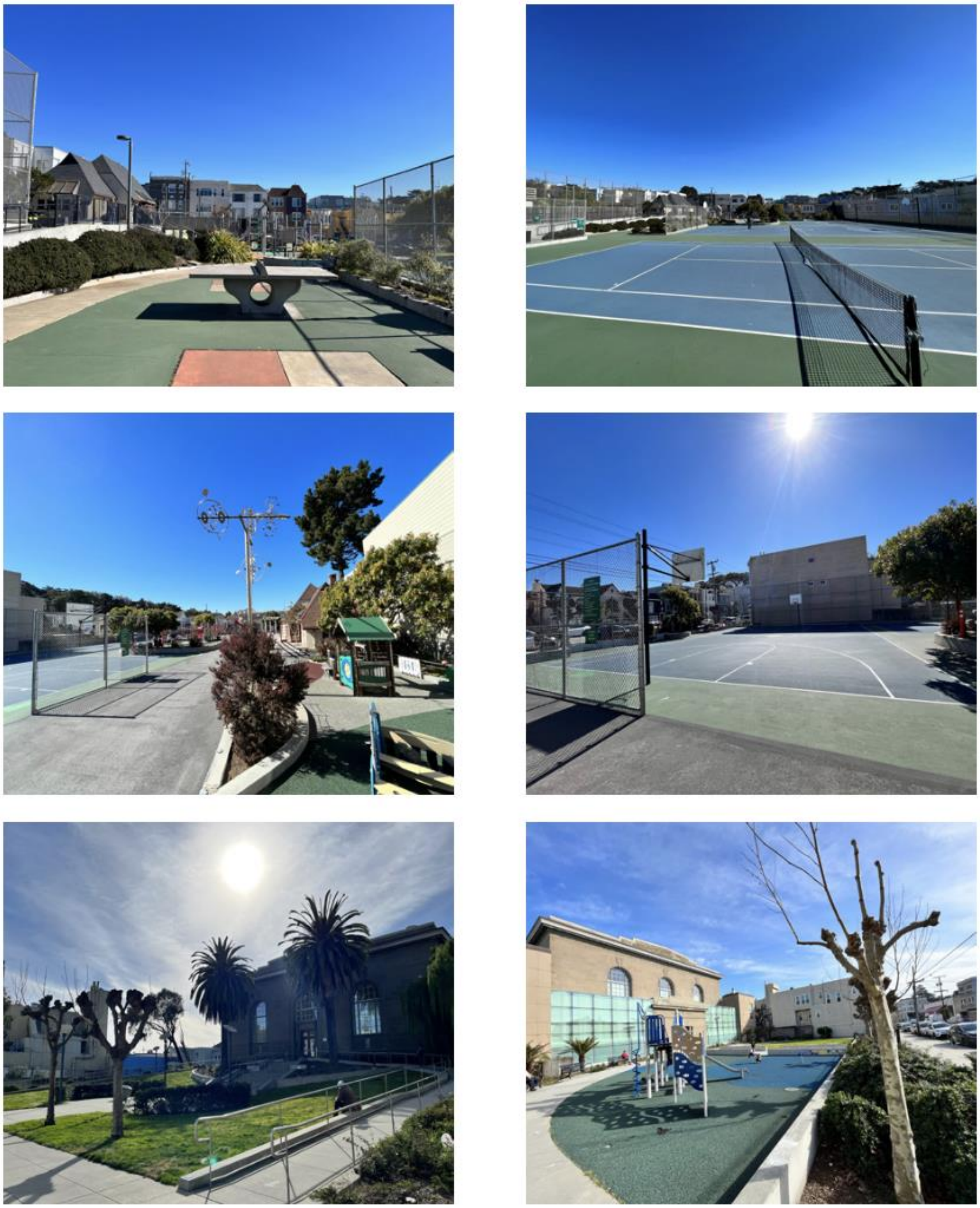

Figure 7. Top row - Cabrillo Playground; middle row - Fulton Playground; bottom row - 10th Ave and Clement Mini Park (April 2023).

Figure 8. The green spaces of Richmond District – II

Figure 8. Top row - Presidio/GGNRA; middle row - Mountain Lake Park; bottom row - Angelo J. Rossi Park (April 2023).

Figure 9. The green spaces of Richmond District – III

Figure 9. All four images are from Golden Gate Park. Top row - Polo field, LOVE art structure near JFK Drive; bottom row - Conservatory of Flowers, JFK Drive (April 2023).

In 2018, the total population of the Richmond District was approximately 80,000 with a population density of 15,360 persons per square mile or 24 persons per acre (San Francisco Planning, 2018). Adjacent districts, Supervisor Districts 2 (to the east), 4 (to the southeast), and 5 (to the south), had population densities of 21.1, 31, and 56 persons per acre, respectively. The City of San Francisco had a total population of about 842,000 with a population density of about 18,000 persons per square mile or 28.1 persons per acre. In terms of race/ethnicity, the Richmond District is quite diverse: 49% White, 40% Asian, 8% Latino (of Any Race), 8% Other/Two or More Races, 2% Black/African American, 0.4% Native Hawaiian/Pacific Islander, and 0.1% Native American Indian (San Francisco Planning, 2018). The neighborhood has a median age of 39 years, with residents aged 60 and older comprising 23% of the total population - approximately 3% higher relative to the City of San Francisco (San Francisco Planning, 2018). The Richmond District's population is also well-educated, with 34% of residents having earned a college degree, 23% a graduate/professional degree, and 21% reporting some college/associate degree; only 25% of residents reported having only a high school education or less (San Francisco Planning, 2018). Table 2 below shows socioeconomic profile comparisons between the Richmond District and the City of San Francisco.

Table 2. Socioeconomic profiles of the Richmond District and San Francisco

The Richmond District					
Race/Ethnicity (%)		**Age (%)**		**Educational Attainment (%)**	
Asian	40	0 to 4	4	Residents 25 years and older	
Black/African American	2	5 to 17	8	High School or Less	22
White	49	18 to 34	31	Some College/Associate Degree	21
Native American Indian	0.1	35 to 59	33	College Degree	34
Native Hawaiian/Pacific Islander	0.4	60 and older	23	Graduate/Professional Degree	23
Other/Two or More Races	8	Median Age	39.1		
% Latino (of Any Race)	8				
Language Spoken at Home (%)		**Linguistic Isolation (%)**		**Total Population: 79,970**	
English Only	58	% of All Households	13		
Spanish Only	4	% of Spanish-Speaking Households	13		
Asian/Pacific Islander	29	% of Asian Language Speaking Households	34		
Other European Languages	9	% of Other European-Speaking Households	26		
Other Languages	1	% of Households Speaking Other Languages	26		

City and County of San Francisco					
Race/Ethnicity (%)		**Age (%)**		**Educational Attainment (%)**	
Asian	34	0 to 4	5	Residents 25 years and older	
Black/African American	5	5 to 17	9	High School or Less	25
White	48	18 to 34	30	Some College/Associate Degree	20
Native American Indian	0.3	35 to 59	36	College Degree	33
Native Hawaiian/Pacific Islander	0.4	60 and older	20	Graduate/Professional Degree	22
Other/Two or More Races	12	Median Age	35		
% Latino (of Any Race)	15				
Language Spoken at Home (%)		**Linguistic Isolation (%)**		**Total Population: 841,820**	
English Only	56	% of All Households	12		
Spanish Only	11	% of Spanish-Speaking Households	21		
Asian/Pacific Islander	26	% of Asian Language Speaking Households	36		
Other European Languages	6	% of Other European-Speaking Households	17		
Other Languages	1	% of Households Speaking Other Languages	13		

Table 2. San Francisco Planning Department, 2018.

Study design and materials

This study's research procedure was designed in accordance with San Francisco State University's requirements guided by Human and Animal Protections in the Office of Research and Sponsored Projects. The research protocol and associated documents were reviewed and approved under the Determination of Exempt Category 2 as exempt from review by the Institutional Review Board (Protocol No. 2022-684-SFSU).

This study is framed as a descriptive case study using non-probability sampling, also known as convenience sampling. Convenience sampling is often used for *hypothesis-generating* research, or research that seeks to discover relationships and patterns to aid in informing subsequent *hypothesis-testing* studies. In this sense, a sub-purpose of this study is to provide foundational data for future research that can develop a design that provides more representative and generalizable results between urban green space accessibility and seniors' health-related quality of life in San Francisco. As mentioned, current literature expresses nuanced results concerning measurement strategies of accessibility to green spaces. Additionally, some studies have emphasized the impacts of geographical contexts such as local cultures, governments, economies, and more (Heckert, 2012; Gascon et al., 2015; Xiao et al., 2017; Veitch et al., 2020). Thus, to the extent identified in this paper, this study can serve as a preliminary glimpse into seniors' lived experiences in San Francisco's Richmond District. This study also provides an impetus for future, larger research to influence local decision- and policymaking through the identification of relevant and meaningful variables.

To recruit seniors to participate in the study, partnerships were established with the Richmond Senior Center (RSC) and Self-Help for the Elderly, also known as Jackie Chan Senior

Center (JSC), both located in the Richmond District. Tabling was conducted over 12 days at scheduled dates and times in February and March 2023; tabling occurred during peak visitation times at both senior centers. The daily duration of data collection spanned from 1.5 to 3 hours, depending on the type of events at the senior centers.

Inclusion criteria established for the study were that participants must be (1) 65 years or over, (2) a patron of RSC and/or JSC, and (3) reside in the Richmond District. Over the course of data collection, a total of 31 participants were eligible. This procedure is explained in depth in the following section.

To measure participants' health-related quality of life conditions, I employed the RAND-36. RAND-36 is a validated, widely used health-related quality of life (HRQL) survey instrument comprised of 36 questions that assess eight health domains: physical functioning, role limitations caused by physical health problems, role limitations, caused by emotional problems, social functioning, emotional well-being, energy/fatigue, pain, and general health (Hays, 2001). This health survey was developed in 1992 as part of the Medical Outcomes Survey (MOS) and is a variation of a health survey instrument called SF-36 and has been used in this field of research in the past (along with many other disciplines). For example, a German study conducted by Petersen et al. (2018) investigated the relationship between UGS, and self-reported physical and health-related quality of life of seniors and used a shorter variation of the survey titled "Short Form 12" (or SF-12) (p. 158). Another study, conducted in Norman, Oklahoma, used SF-36 to determine if physical activity was related to the HRQL of study participants aged 60 to 89 (Acree et al., 2006). The SF-12 is often used by researchers that anticipate survey length (time) restrictions; according to the RAND Corporation, it was designed to "reduce the respondent burden” while maintaining survey integrity and accuracy of results (“*12-Item Short Form*”, *n.d.*). The first versions of SF-36 and RAND-36 are verbatim, in terms of questions (e.g., semantics and order of questions), and notably differ in the scoring procedure. Figure 10 is the baseline data of the 1992 MOS (n=2,471) and presents the reliability (in alpha), central tendency (mean), and variability of the eight health domains measured in the RAND-36 survey. In this study, the full-length RAND-36 survey was chosen to maximize the preciseness of health outcomes, and in general, the comprehensiveness of survey results through the availability of more measured variables (i.e., 36 items instead of 12).

Figure 10. Reliability, Central Tendency, and Variability of Scales in the Medical Outcomes Study (1992)

Scale	Items	Alpha	Mean	SD
Physical functioning	10	0.93	70.61	27.42
Role functioning/physical	4	0.84	52.97	40.78
Role functioning/emotional	3	0.83	65.78	40.71
Energy/fatigue	4	0.86	52.15	22.39
Emotional well-being	5	0.90	70.38	21.97
Social functioning	2	0.85	78.77	25.43
Pain	2	0.78	70.77	25.46
General health	5	0.78	56.99	21.11
Health change	1	—	59.14	23.12

Figure 10. Adapted from RAND Corporation, n.d.

As Figure 10 illustrates, each of the eight health domains has several items that contribute to the scale score. For example, “Physical functioning” consists of 10 items, or 10 questions from the survey, “Role functioning/physical” with 4 items, and so on. In general, the scoring process for the RAND-36 is a straightforward procedure and consists of two main steps. The scoring is designed so that a higher score between a scale of 0 to 100 is a more favorable health state. The first step is changing the participants’ answers to each question to a predefined re-coded value. Figure 11 below illustrates this process where, for example, a participant’s answer for questions 1, 2, 20, 22, 34, and 36 are re-coded to a value of either 100, 75, 50, 25, or 0 depending on their answer. These scores represent the percentage of total possible scores that can be achieved, again with a higher score representing a more favorable health state.

Figure 11. Re-coding Item Values

Item numbers	Change original response category *	To recoded value of:
1, 2, 20, 22, 34, 36	1 →	100
	2 →	75
	3 →	50
	4 →	25
	5 →	0
3, 4, 5, 6, 7, 8, 9, 10, 11, 12	1 →	0
	2 →	50
	3 →	100
13, 14, 15, 16, 17, 18, 19	1 →	0
	2 →	100
21, 23, 26, 27, 30	1 →	100
	2 →	80
	3 →	60
	4 →	40
	5 →	20
	6 →	0
24, 25, 28, 29, 31	1 →	0
	2 →	20
	3 →	40
	4 →	60
	5 →	80
	6 →	100
32, 33, 35	1 →	0
	2 →	25
	3 →	50
	4 →	75
	5 →	100

* Precoded response choices as printed in the questionnaire.

Figure 11. *Adapted from RAND Corporation, n.d.*

The second step averages all re-coded items from the same scale, which represents the eight health domains. Figure 12 below shows the number of items that represent each scale, matching the number of items that are indicated in Figure 10 above. The RAND-36 used for this study is attached as Appendix E/F, offered both in English and simplified Chinese.

Figure 12. Averaging Items to Form Scales

Scale	Number of items	After recoding per Table 1, average the following items
Physical functioning	10	3 4 5 6 7 8 9 10 11 12
Role limitations due to physical health	4	13 14 15 16
Role limitations due to emotional problems	3	17 18 19
Energy/fatigue	4	23 27 29 31
Emotional well-being	5	24 25 26 28 30
Social functioning	2	20 32
Pain	2	21 22
General health	5	1 33 34 35 36

Figure 12. Adapted from RAND Corporation, n.d.

To measure the participants' input on variables like green space visitation patterns, safety preferences, and characteristics of the built environment, the self-developed 25-item Intake Survey was employed. In this survey, participants were asked for information such as race/ethnicity and educational attainment in addition to frequency and duration of green space visits, and green space accessibility measures like quantity, quality, and proximity of green spaces relative to their residence. Many items were single-choice questions with categorical answers. For example, a question asked, "What is your usual duration of green space visits" and possible answers included less than 30 minutes, 30 minutes to 1 hour, 1 to 2 hours, I do not regularly visit green spaces and prefer not to answer. A couple of questions about the surrounding built environment were multiple-choice questions, or "choose all that apply", with an option to provide additional open-ended feedback. This questionnaire was not pre-tested before dissemination. Unlike the RAND-36, a process for scoring items in the Intake Survey was not developed. As the next section explains, the items (or variables) from the Intake Survey are used as independent variables and are analyzed through various statistical techniques.

While the Intake Survey is self-developed, the items in the questionnaire are inspired by two studies conducted by geography and public health authors. The first, by Vich et al. (2021), measured the impacts of urban green spaces on physical activity in the Barcelona Metropolitan Region in a study that recruited 269 participants from senior centers between June 2016 to June 2017. The second, by Veitch et al. (2022) aimed to determine "the importance of park features that may be important for influencing older adults' decision to visit, be active and socially interact with others in park" (p. 2). Both studies included variables measuring the frequency and duration of green space visits and the intensity level of physical activity. Veitch et al. (2022) also included items such as mode of transport, frequency of meeting or talking to someone unknown/known, and frequency of participation in social events. Seven items (28%) in the Intake Survey were original, with the remainder adopted from Veitch et al. (2022) and Vich et al. (2021). The Intake Survey, attached as Appendix C/D, was offered both in English and Chinese (simplified).

Timeline and data collection

Project coordinators from the Richmond Senior Center and Self-Help for the Elderly were contacted via electronic mail in the Fall of 2022. After initial contact and in-depth discussions of the nature of this study, representatives agreed to sponsor this research. Between October 2022 and January 2023, meetings were held to discuss the timeline and day-to-day operations of data collection. An alternating weekly schedule between the senior centers was established; based on the availability of the primary investigator, research assistants, senior center events, and senior center hours, collection days were limited to Wednesdays, Thursdays, and Fridays, 11.5 hours per week. The first collection date was Wednesday, February 8th, and the last was Wednesday, March 15th. Table 3 shows the log over the collection period.

Before data collection, data collection dates and times for the RSC were modified due to construction (upgrading of the main facility). To maintain the expected weekly contribution to data collection and to increase the likelihood of participation, data was collected during Project Open Hand and other RSC-hosted recreational events (for example, mahjong). Founded in 1985, Project Open Hand is a non-profit organization that provides meals to critically ill neighbors and seniors (Project Open Hand, *n.d.*). RSC and Project Open Hand collaborate weekly every

Thursday morning to provide over 120 meals for local seniors. This program has been hosting many of the seniors who go to RSC, who have returned weekly for a couple of weeks to years.

Table 3. Data Collection Log

Date	Check In Time	Check Out Time	Location	Weather Conditions	Temperature (Fahrenheit)	Visitors encountered	Participants	Event
2/8/23	1:15:00 PM	3:30:00 PM	Jackie Chan	Sunny, clear skies	60	3	1	Post Lunch
2/9/0203	9:00:00 AM	12:30:00 PM	Richmond Senior Center	Sunny, clear skies	50	100+	6	Project OpenHand
2/10/23	12:30:00 PM	3:00:00 PM	Jackie Chan	Sunny, clear skies with some clouds	55	6	3	Post Lunch
2/15/23	12:30:00 PM	2:45:00 PM	Jackie Chan	Sunny, cold winds	54	4	1	Post Lunch
2/16/23	9:00:00 AM	12:00:00 PM	Richmond Senior Center	Mostly cloudy and cloud	50	60+	1	Project OpenHand
2/17/23	11:00:00 AM	1:00:00 AM	Jackie Chan	Sunny and cloudy	52	30	5	Lunch
2/23/23	9:30:00 AM	12:00:00 AM	Richmond Senior Center	Windy and cold	43	60+	2	Project OpenHand
2/24/23	10:00:00 AM	12:00:00 PM	Jackie Chan	Cold, wet, and rainy (rained the night before)	43	20+	2	Lunch
3/1/23	1:00:00 PM	2:30:00 PM	RSC Rochambeau	Sunny	41	6	5	Mahjong
3/3/23	11:00:00 AM	1:00:00 PM	Jackie Chan	Raining	45	20+	3	Lunch
3/9/23	11:00:00 AM	12:30:00 PM	Jackie Chan	Raining	45	20+	1	Lunch
3/15/23	11:00:00 AM	12:30:00 PM	Jackie Chan	Cloudy	45	20+	1	Lunch

Table 3. Dates, times, locations, weather conditions, participation counts, and event types between both senior centers during data collection period between February to March 2023.

Guided by the research protocol, and to prevent interrupting the workflow of Project Open Hand, tables were set up in the RSC lobby just behind the entrance to the building. As patrons stood by during Project Open Hand’s setup, this provided an opportunity for researchers and patrons to discuss the nature of the research project. Fliers were disseminated throughout lobbies, provided to those who were interested, and through program coordinators’ advertising platforms. Surveys at JSC were conducted during or after lunchtime. Like Project Open Hand, JSC provided free or low-cost meal service to patrons beginning at 11:30 AM every day during the week. Like the set-up at RSC, tables were arranged in what is considered JSC’s lobby, next to the receptionist’s desk. The primary difference in this senior center was that activities and lunch were held in one large multipurpose room. At both senior centers, fliers were provided to those who were interested, placed on researchers’ tables, and through the program coordinator’s advertising platforms (glass windows, receptionist’s desk, and online calendar). If participants were interested, they were escorted to a private setting or wherever they felt comfortable performing the survey at length and at their own pace, and further instructions were provided. Participants who were not available or interested at the time of initial contact were notified of planned tabling events over the duration of research - until mid-March 2023.

Survey protocol

If participants were interested, the first step was to determine their English language proficiency. There is a large Asian population in the study area, so it was crucial to determine if translators were needed during the surveys. To ensure research accuracy and reliability, it was important to ensure that participants were aware of the full scope of the research, the procedural nature of conducting the surveys, the expected outcomes, and their roles as research participants. I note that only interested participants that spoke English or Chinese (either Mandarin or Cantonese) were accepted as part of the study. Once this initial screening was completed, participants were asked if they matched the inclusion criteria, i.e., were 65 years or older, a resident of the Richmond District, and attending the Richmond Senior Center and/or Self-Help for the Elderly/Jackie Chan Senior Center.

Following the screening process, the participants reviewed and completed the Informed Consent Form (see Appendix A/B). It was emphasized that the participant would be able to ask questions at any time and could decide to stop the survey at any time without any consequences. Once all parties were ready, the participant completed the Intake Survey; on average, participants took less than 10 minutes to complete the Intake Survey, and most did not need any help interpreting the survey (English nor Chinese versions). The RAND-36 was employed immediately after; this longer health questionnaire, on average, took approximately 15 minutes to complete. Due to the semantics of the RAND-36, some participants requested clarifications (for example, what does it mean to be “full of pep” or “downhearted and blue”).

While participants were notified that there would be no compensation, they were given a third edition (2018) of a Nature in the City Map upon completion of both surveys. This doublesided map highlights trails, natural areas, local species, and in general, green spaces around the San Francisco Peninsula (see Figure 13 below).

Figure 13. Nature in the City Map

Figure 13. Adapted from Nature in the City, n.d

Data methodology

Data collected from both surveys were entered into IBM SPSS Statistics Version 29 and Microsoft Excel. Four types of analyses were performed depending on the questions to analyze the relationship between an Intake Survey item/question and a health domain.

Descriptive frequencies

The first statistical analysis conducted was descriptive frequencies, which show the number of occurrences of each response chosen by participants. This method was applied to questions 17 and 25, which are multiple-choice questions (choose all that apply) that investigated participants' preferences of the built environment surrounding green spaces and identification of important green space safety features. It is also applied to questions 21 and 23, which asked participants the importance of safety and physical quality of green spaces on a scale of 1 to 5; while these questions are technically ordinal data and can potentially be analyzed under other statistical methods, since most participants had the same answer it was more appropriate to simply use descriptive frequencies. This step provides basic measures of the dispersion of the participants' choices (for example, maximum and minimum).

Chi-squared test

For survey items that had nominal answers, for example, question 5 on participant's sex at birth (Male, Female, Prefer not to answer), a Chi-squared test was used. This test examines whether two nominal variables are independent of each other. By comparing the observed distribution of the data values with that expected under the assumption that there is *no relationship* between the two variables, the Chi-squared test answers whether one variable impacts the other variable. A significance level of 0.05 is used to determine whether the association is statistically significant. Table 8 lists the 6 items from the Intake Survey whose association with the eight health domains and measures of accessibility was examined using Chi-squared tests.

Spearman’s correlation

The third statistical analysis performed was Spearman’s rank-order correlation. This test measures the strength and direction of the monotonic relationship between two ranked variables, where a change in one variable is “generally associated” with a change in the other variable (Zach, 2022). Spearman’s correlation coefficient is a number between - 1 to +1 where the sign tells the direction of the correlation, and the absolute value tells the strength of the correlation. A positive Spearman’s correlation coefficient means that as one variable increases, the other variable also increases and vice versa. +1 indicates a perfect positive association. By the same token, a negative coefficient means that as one variable changes, the other variable changes in the opposite direction. -1 indicates a perfect negative association. 0 indicates no association between the two ranked variables. As for correlation strength, which is told by the absolute value of the coefficient, can be interpreted as follows: 0 - 0.19 means very weak association, 0.20 – 0.39, weak association, 0.40 – 0.59, moderate association, 0.60 – 0.79, strong association, 0.80 – 1, very strong association.

Spearman’s correlation was used for 13 questions where answers are ranked/ordinal. For example, question 2 asked the participants’ English fluency and answers included, in ranked order, needs translation followed by limited then fluent, respectively. Questions that were found to be significantly associated with a health outcome at the 0.05 or 0.01 significance level were followed up with linear regression. The analyses were based on all participants’ answers except those who chose “prefer not to answer”; the “prefer not to answer” entries were omitted from further analysis.

Linear regression

This fourth analysis assessed the power of an independent variable to explain the variation in a dependent variable. Its output R-Squared (R^2), whose value varies between 0 and 1, tells the proportion of variance in the dependent variable that can be explained by the independent variable(s). The 13 items that were found to be statistically significant at 0.05 and 0.01 levels in Spearman’s correlation analysis were followed up with linear regression. Because all 13 items have categorical answers, the independent variables were coded as dummy variables. The coding system used is explained in-depth on UCLA’s Statistical Methods and Data Analytics webpage (link).

There are various types of regression that can be used, notably binary regression and multivariate regression. The distinction between the two is that binary regression determines the statistical relationship between one or more explanatory (independent) variables to *one* dependent variable whereas multivariate regression tests against *multiple* dependent variables. Due to the small sample size, the variance of data, and the kinds of data gathered in this study (nominal and ordinal), the use of binary regression is more appropriate to develop and interpret results that are reliable and conclusive.

The combined use of the four statistical analyses outlined provides a multi-level analysis of the data gathered between variables of UGS accessibility and HRQL. Descriptive frequencies offer insights into the spread and choices of study participants, offering simple takeaways on popular preferences relative to questions asked. A Chi-squared test determines dependency between two variables, and similarly, Spearman's rank-order correlation determines associations between two variables. Both tests establish a baseline relationship, calculating if variables influence one another *and* to what degree. Finally, linear regression develops a representative *and* correlational relationship between dependent and independent variables. In other words, to what extent does having green space access explain a person's physical health (representative), and specifically, what aspect(s) of green space access predicts that person's physical health? A collective analysis of all four methods reveals both qualitative and quantitative insights that develop an in-depth understanding of how UGS accessibility impacts seniors' HRQL in San Francisco's Richmond District.

Results

Table 4. Participant demographic characteristics

Age groups	N	%	Educational attainment	N	%
65-69	6	19.4	Less than a high school diploma	6	19.4
70-74	14	45.2	High school degree or equivalent	5	16.1
75-79	5	16.1	Some college, no degree	7	22.6
80 and over	6	19.4	Bachelor's degree	8	25.8
			Master's degree	3	9.7
Sex	**N**	**%**	Doctorate	1	3.2
Male	12	38.7	Prefer not to answer	1	3.2
Female	19	61.3			
Sexual Orientation	**N**	**%**	**Primary (Main Language)**	**N**	**%**
Straight	29	93.5	English	6	19.4
Bisexual	1	3.2	Chinese	22	71
Prefer not to answer	1	3.2	Japanese	1	3.2
			Vietnamese	2	6.5
Ethnicity	**N**	**%**	**Race**	**N**	**%**
Hispanic/Latino	0	0	American Indian or Alaska Native	1	3.2
Non-Hispanic/Latino	26	83.9	Asian-Indian	2	6.5
Prefer not to answer	5	16.1	Chinese	23	74.2
			Japanese	1	3.2
English Fluency	**N**	**%**	Vietnamese	2	6.5
Needs translation	8	25.8	White	1	3.2
Limited	10	32.3	Other Asian	1	3.2
Fluent	13	41.9			

Table 4. Demographics of participants (n=31).

A total of 31 participants completed both surveys, including 14 participants from RSC and 17 from JSC. As shown in the table above, nearly half of the participants were aged between 70 to 74 years and about 60% were female. While about 84% of participants identified as non-Hispanic/Latino, and the remainder as “Prefer not to answer”, it can be assumed, from survey observations, that 100% of the latter were also non-Hispanic/Latino. Approximately half of the participants had attended college. Chinese was the primary language of 71% of the participants and 74% identified as Chinese (see Figures 14 through 16 below).

Figure 14. Socioeconomic variable - age

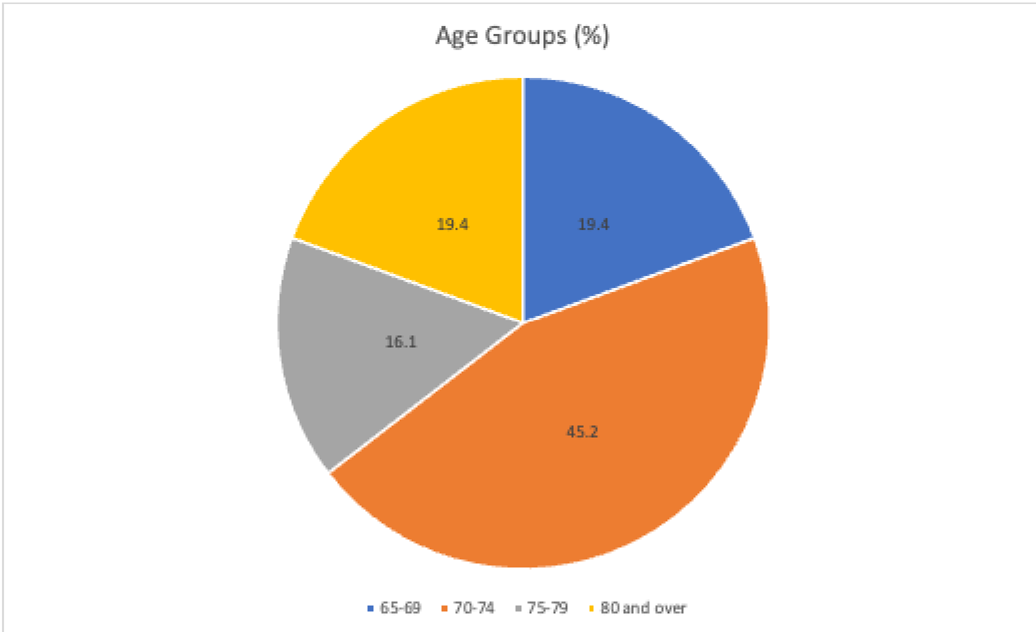

Figure 14. Participants' ages. 19.4% 65 - 69, 45.2% 70 - 74, 16.1% 75 - 79, 19.4% 80 and over.

Figure 15. Socioeconomic variable – educational attainment

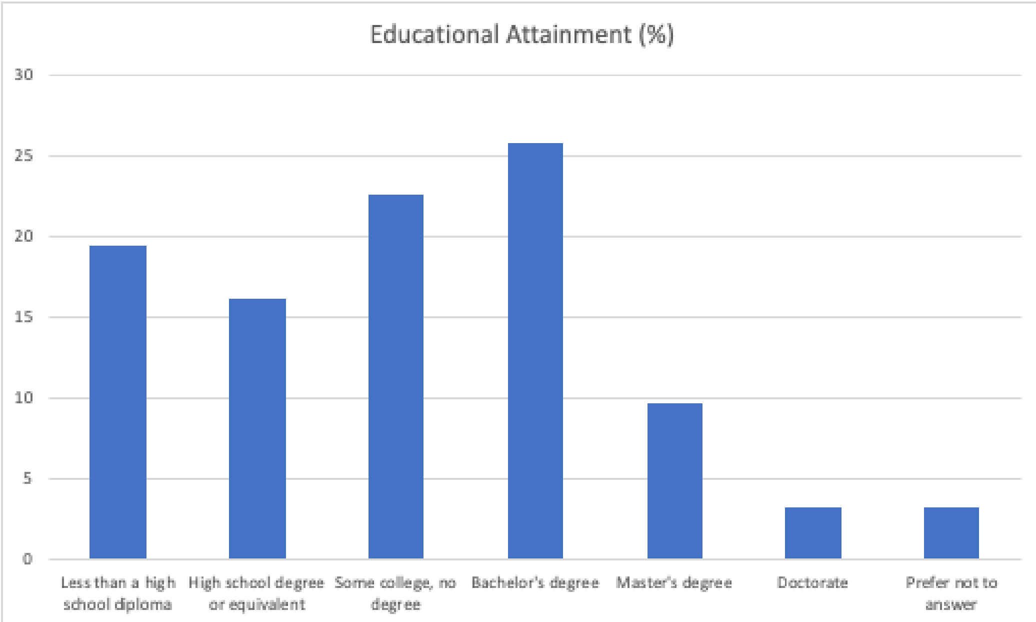

Figure 15. Bar graph showing the distribution of educational attainment among the sample population.

Figure 16. Socioeconomic variable – race

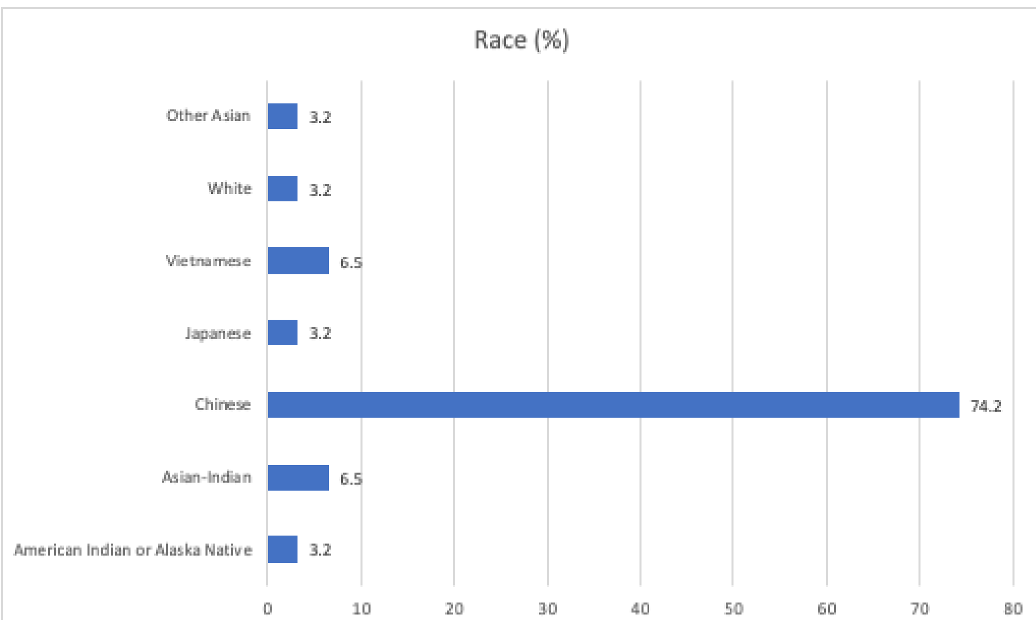

Figure 16. Horizontal bar graph showing many participants identified as Chinese.

The surrounding built environment and safety features

The participants were asked two multiple-choice questions regarding their preferences for the surrounding built environment and safety features they might consider when visiting green spaces. In terms of the surrounding built environment, there were 15 possible answers to choose from including an open-ended entry question (i.e., “other not listed”). The top three considerations of the surrounding built environment participants selected were traffic (n = 15), air quality (n = 11), and distance to green space (n = 10). Conversely, the considerations they indicated least important were intersections or the number of intersections (n = 2), roads or the number of roads (n = 2), and stairs (n = 3). The safety features they considered to be most important included paths with clear lines of sight (n = 17), good lighting (n = 16), and security technology (CCTV, emergency report systems) (n = 17); they ranked the presence of emergency phone boxes least important (n = 5).

Four of the 31 participants gave written feedback concerning important safety features, including clean toilets, not going out at night, nice people, and needing more cameras. Two participants gave written feedback for considerations about the surrounding built environment that we deemed irrelevant to the question (do not regularly visit, mostly stay at home). Tables 5 and 6 below show the participants’ answers in ranked order based on the number of responses in relation to the surrounding built environment and important green space safety features. Figures 17 and 18 represent some of the built environment and green space safety features that currently exist in the Richmond District the participants identified.

In addition to identifying considerations of the surrounding built environment and important green space safety features, participants were asked how important the physical quality of green spaces was as well as the importance of green space safety. As shown in Table 7, on a scale of 1 to 5, about 66% of participants gave a score of 5 for the importance of physical quality (for example, aesthetics and amenities), and about 86% of participants gave a score of 5 for the importance of green space safety - these responses corroborate the findings by Loukaitou-Sideris et al. (2016).

Table 5. Considerations of the surrounding built environment

Item	Number of respondents
Traffic	15
Air quality	11
Distance to green space	10
People	9
Sidewalks	6
Noise	5
Crosswalks	5
Buildings or number of buildings	5
Distance to public transport	4
Steep slopes	4
Trash	4
Stairs	3
Roads	2
Intersections	2

Table 5. In ranked order, participants' considerations of the surrounding built environment when deciding to visit a green space.

Table 6. Important green space safety features

Item	Number of respondents
Paths with clear lines of sight	17
Good lighting	16
Security technology	15
Community police officers	13
Wayfinding signage	13
Accessibility features	10
Emergency phone boxes	5

Table 6. In ranked order, important green space safety features identified by survey participants.

Table 7. Rated importance of safety and physical quality of green spaces

On a scale of 1-5, how important is the safety of green spaces to you?	
3 - Indifferent	7%
4 – Somewhat important	7%
5 – Important	86%
On a scale of 1-5, how important is the physical quality of green spaces to you?	
3 - Indifferent	10%
4 – Somewhat important	24%
5 - Important	66%

Table 7. Participants' feedback on the importance of green space physical quality (e.g., aesthetics, amenities) and safety.

Figure 17. Participants' considerations of the built environment

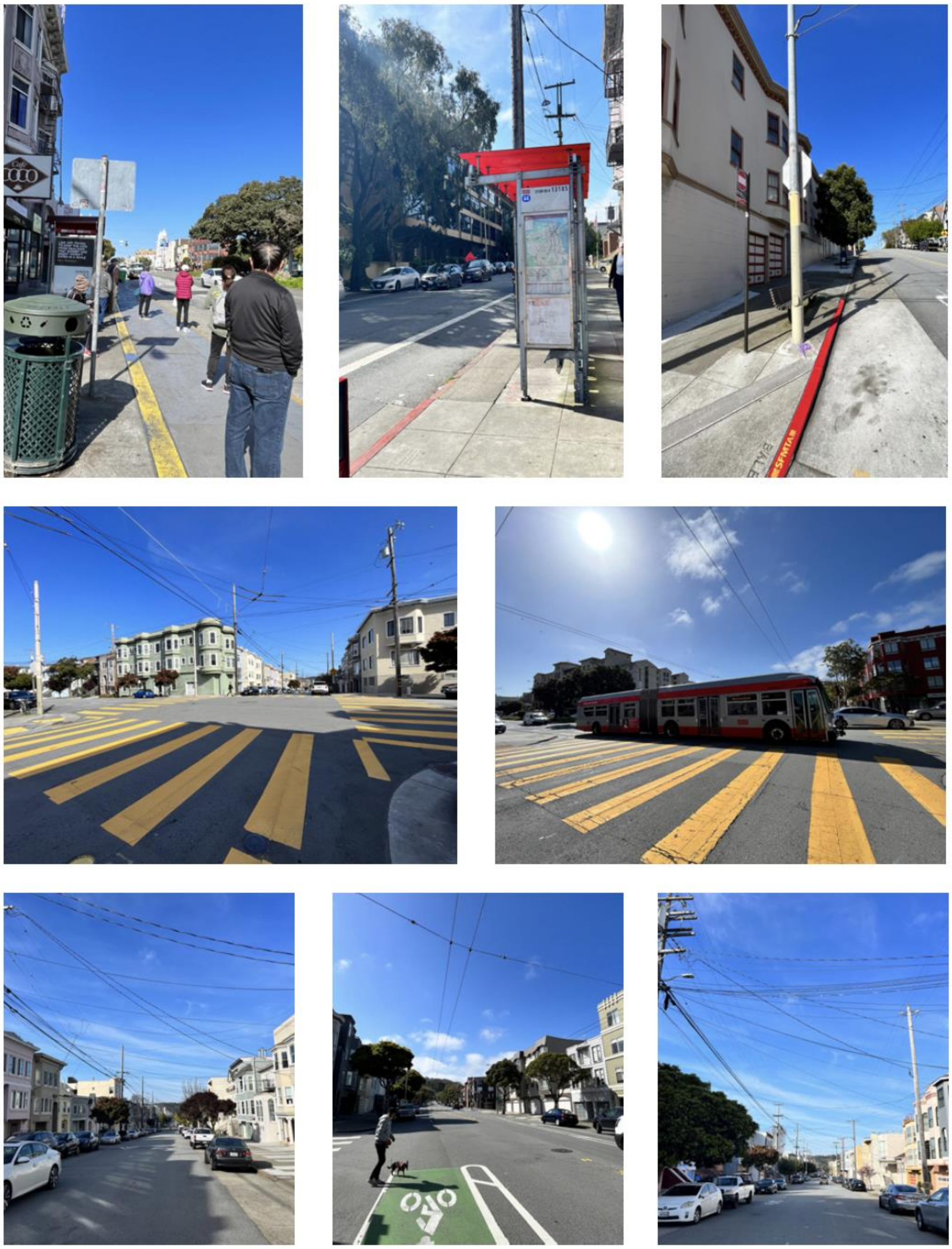

Figure 17. Top row - people waiting for a bus next to a major arterial, two types of bus stops; middle row - typical crosswalks and intersections; bottom row - residential streets (April 2023).

Figure 18. Participants' considerations on green space safety features

Figure 18. Top row - flat, paved wide paths with clear lines of sight; middle row - steep slope and damaged path next to a flat path, a path with shading and clear line of sight; bottom row - wayfinding signs (April 2023)

Chi-squared test

Table 8. Intake Survey items in the Chi-squared tests

No.	**Intake Survey Item**
1	What is your gender?
2	What was your sex at birth?
3	What is your sexual orientation?
4	How would you describe your race?
5	What is your usual mode of transport to green spaces?
6	Do you feel safe when you visit the green spaces you typically visit?

Table 8. The 6 questions analyzed by the Chi-squared test.

Chi-squared tests were employed for questions 4-8, 13, and 24 from the Intake Survey. These questions asked participants their gender, sex, sexual orientation, race, the usual mode of transport, and if they felt safe at the green space they typically visited (see Table 8 above). Results from this test showed no significant associations between any of the 6 items with any of the eight health domains nor with any of the measures of accessibility, that is park proximity, park quality, and park count (questions 14 – 16). These results suggest that none of these variables impacts seniors' HRQL or UGS accessibility in the study area, as informed by participants.

Table 9. Spearman's Correlation Coefficient

Question No.		Phys Func.	Role Phys Health	Role Emo Prob	Energy/ Fatigue	Emotional well-being	Social functioning	Pain	Gen Health
Q2. English fluency	Coeff.	0.308	0.249	0.465	0.137	0.198	-0.004	0.266	0.149
	Sig.	0.091	0.177	0.008	0.464	0.286	0.981	.149	0.425
	n	31	31	31	31	31	31	31	31
Q3. Age group	Coeff.	-0.201	0.001	-0.032	0.114	0.262	0.089	-0.124	-0.129
	Sig.	0.278	0.996	0.862	0.540	0.155	0.635	0.507	0.490
	n	31	31	31	31	31	31	31	31
Q9. Education	Coeff.	0.021	-0.134	-0.147	0.015	0.063	0.006	-0.155	0.121
	Sig.	0.920	0.523	0.484	0.945	0.764	0.978	0.459	0.565
	n	25	25	25	25	25	25	25	25
Q10. Visit frequency	Coeff.	0.111	0.373	0.227	0.151	0.169	0.371	0.112	-0.112
	Sig.	0.599	0.066	0.276	0.473	0.419	0.068	0.594	0.593
	n	25	25	25	25	25	25	25	25
Q11. Visit duration	Coeff.	0.226	0.237	0.124	0.210	0.279	0.384	0.171	0.154
	Sig.	0.256	0.234	0.536	0.292	0.158	0.048	0.395	0.443
	n	27	27	27	27	27	27	27	27
Q12. Usual activity level	Coeff.	0.345	0.172	0.065	0.249	0.230	0.026	0.471	0.451
	Sig.	0.084	0.401	0.752	0.219	0.257	0.899	0.015	0.021
	n	26	26	26	26	26	26	26	26
Q14. Number of green spaces	Coeff.	-0.003	0.238	0.123	0.281	0.260	0.354	0.106	0.073
	Sig.	0.988	0.197	0.510	0.126	0.159	0.051	0.572	0.697
	n	31	31	31	31	31	31	31	31
Q15. Distance to green space	Coeff.	-0.294	-0.466	-0.361	-0.48	-0.401	-0.347	-0.549	-0.340
	Sig.	0.109	0.008	0.046	0.006	0.025	0.056	0.001	0.061
	n	31	31	31	31	31	31	31	31
Q16. Time to green space	Coeff.	-0.208	-0.290	-0.343	-0.341	-0.433	-0.330	-0.359	-0.231
	Sig.	0.270	0.120	0.064	0.065	0.017	0.075	0.051	0.219

	n	30	30	30	30	30	30	30	30
Q18. Talking to unknown	Coeff.	-0.004	-0.048	0.068	0.289	0.208	0.106	0.272	0.075
	Sig.	0.985	0.804	0.724	0.129	0.279	0.586	0.154	0.701
	n	29	29	29	29	29	29	29	29
Q19. Talking to known	Coeff.	-0.129	0.014	0.004	0.192	0.061	0.055	0.028	-0.091
	Sig.	0.512	0.945	0.984	0.329	0.759	0.780	0.888	0.647
	n	28	28	28	28	28	28	28	28
Q20. Participate social events	Coeff.	0.003	0.003	-0.183	0.121	0.208	-0.033	0.153	0.370
	Sig.	0.987	0.988	0.352	0.540	0.288	0.869	0.437	0.052
	n	28	28	28	28	28	28	28	28
Q22. Physical quality	Coeff.	0.275	0.303	0.294	0.154	0.252	0.180	0.252	0.513
	Sig.	0.135	0.097	0.109	0.408	0.172	0.332	0.172	0.003
	n	31	31	31	31	31	31	31	31

Table 9. Spearman's coefficient analysis between RAND-36 and Intake Survey items. Questions and health measures that are significantly associated with each other at 0.01, 0.05, and 0.1 level are highlighted in green, orange, and yellow, respectively.

Table 10. Intake Survey in Spearman's correlation and linear regression

Question No.	**Intake Survey Item**
2	***English fluency:** (a) Needs translation, (b) Limited, (c) Fluent
3	**What is your age group?** (a) 65-69, (b) 70-74, (c) 75-79, (d) 80 and over
9	**What is your highest level of education?** (a) Less than high school, (b) High school, (c) Some college, (d) Associate, (e) Bachelor, (f) Master, (g) Professional, (h) Doctorate
10	**What your usual frequency of green space visits?** (a) Everyday, (b) 1 per week, (c) 2+ per week, (d) 1 per month, (e) 2+ per month, (f) Do not regularly visit
11	***What is your usual duration of green space visits?** (a) Less than 30 min., (b) 30 to 1 hour, (c) 1 to 2 hours, (d) Do not regularly visit
12	***What are your usual activity levels during green space visits?** (a) Mostly sitting/lying down, (b) Mostly light, (c) Mostly moderate, (d) Mostly vigorous, (e) Do not regularly visit
14	**How many green spaces are within a ¼-mile radius from your residence?** (a) 1, (b) 2-3, (c) 4+, (d) None
15	***How far is the nearest green space you usually visit?** (a) less than ¼-mile, (b) ¼ - ½, (c) ½ - 1, (d) 1-2, (e) 3-5, (f) 5+
16	***On average, how long does take to get to the green space you usually visit?** (a) less than 10 minutes, (b) 10 – 20, (c) 20 – 30, (d) over 30
18	**What is the frequency of yourself meeting or talking to someone unknown during green space visits?**
19	**What is the frequency of yourself meeting or talking to someone known during green space visits?** (a) 0 – 1 time, (b) 2 – 5 times, (c) 6+ times, (d) Do not regularly visit
20	**What is the frequency of participation in social events during green space visits?** (a) 0 – 1 time, (b) 2 – 5 times, (c) 6+ times, (d) Do not regularly visit
22	***Using the scale below, how would you rate the physical quality of the green space you typically visit?** (a) 1, (b) 2, (c) 3, (d) 4, (e) 5

*Table 10. The 13 Intake items analyzed using Spearman's correlation. *the independent variables for regression analyses.*

Table 9 shows the varying correlations between the eight health outcomes and 13 Intake Survey items. The significance levels and the number of samples used in each calculation (n) are listed. Table 10 shows the 13 items the participants answered as part of the Intake Survey; this table can be used to cross-reference items from Table 9 via “Question No.”. Pairs of highlighted green, orange, and yellow variables are significant at 0.01, 0.05, and 0.1, respectively. Also, Table 10 shows the independent variables that are significant under linear regression, marked by asterisks. It is observed that the eight health domains had a statistically significant association with at least 1 of 13 variables (at 0.1 significance level). Question 8 on the distance to the nearest green space typically visited is a leading item by being significantly correlated with 6 health outcomes. This is followed by question 16, the average time it takes to get to green space, then questions 12 and 22 on usual activity levels during green space visits and the physical quality of green spaces.

For pairs found statistically significant at 0.05 or 0.01 (color in green or orange in Table 9), a linear regression was performed. The dependent variable was the health domain, and the independent variable was the statistically significant answers from the Intake Survey items. For example, in the pair between “role limitations due to emotional problems” and question 1, English fluency, “role limitations due to emotional problems” is the dependent variable representing one of the health domains, and English Fluency is the independent variable representing an Intake Survey item. Because English Fluency has three outcomes: (a) Needs translation, (b) Limited, and (c) Fluent, it was coded as dummy variables. Regression analysis was conducted and found that “Needs translation” was statistically significant (at 0.05 significant level) but “Limited” and “Fluent” were not. The R^2 of 0.27 suggests that whether a participant

“Needs translation” in English explains 22% of the variation in role limitations due to emotional problems.

A linear regression was performed for the 11 significantly correlated pairs (orange or green highlights) in Table 9 following the method in the above example. The corresponding R^2 and the statistically significant independent variables are shown in Table 11. As shown, the dependent variables are from 5 health domains, and the independent variables are from 9 Intake Survey items. R^2 ranges from 0.22 to 0.33 suggesting that, in general, an Intake item explains 22-33% of the variation in a health outcome. In the following paragraphs, I discuss the results for each health outcome in sub-sections by first presenting the results from Spearman’s and then linear regression in the following paragraph, if necessary.

Table 11. Linear regression results

Health domain (dependent variable)	**Intake item**	R^2	**Accessibility item (independent variable)**
Role limitations due to emotional problems	English fluency	0.27	Needs translation
Energy/fatigue	Distance to nearest green space	0.31	Less than 1/4-mile; 1/4-1/2 mile
Emotional well-being	Time it takes to get to green space	0.24	Less than 10 minutes
Pain	Usual activity levels	0.22	Sitting or lying down
	Distance to nearest green space	0.33	Less than 1/4-mile
General health	Usual activity levels	0.27	Does not regularly visit; light activities
	Rating physical quality	0.32	3

Table 11. Linear regression between 5 health domains and 7 items from the intake survey (at 0.05 significance).

Physical functioning

Physical functioning (PF) consists of 10 items from RAND-36 which measured participants' health limitations in relation to performing vigorous and moderate activities, lifting/carrying groceries, "climbing stairs", and walking, among other scale items; a high value in PF indicates higher physical functionality. Statistical analysis found that PF was significantly correlated with "English fluency" ($r = 0.3$, $p = 0.06$) and "usual activity levels during green space visits" ($r = 0.4$, $p = 0.08$). The positive correlations, albeit weak or moderate, suggest that better PF is found in participants with better fluency in English and higher activity levels in green spaces. Because the correlations were only significant at 0.10 level, not at 0.05 or 0.01 level, no linear regression was conducted for this health domain.

Role limitations due to physical health

Role limitations due to physical health (RLPH) consists of four items that ask about problems with work or other regular daily activities due to physical health during the past 4 weeks. A high value in RLPH means fewer or no limitations in performing work or other regular activities due to physical health. RLPH was found to have a moderate positive correlation with the usual frequency of green space visits ($r = 0.4$, $p = 0.06$), and a moderate negative correlation with the distance to the nearest green space typically visited ($r = -0.5$, $p =0 .008$). This suggests that participants reported fewer RLPH as their frequency of green space visits increased and as the distance to the nearest green space typically visited decreased. Linear regression analysis was run as the correlations were significant at 0.05 level. However, none of the independent variables was statistically significant, and thus this health outcome does not appear in Table 11.

Role limitations due to emotional problems

This health domain asked participants about any problems with work or other regular daily activities because of any emotional problems during the past 4 weeks. A higher value in role limitations due to emotional problems (RLEP) means fewer or no limitations in performing work or other regular activities due to emotional problems. RLEP was found to be significantly correlated with three Intake Survey items: English fluency (r = 0.5, p = 0.008), distance to the nearest green space typically visited (r = -0.4, p = 0.05), and the average time it takes to arrive at a green space (r = -0.3, p = 0.06). These results suggest that participants who reported higher English fluency reported fewer RLEP. Conversely, participants that had less distance to green space and took less time to get there reported fewer RLEP.

Linear regression was performed to assess the impact of English fluency on RLEP. The dummy independent variable, “Needs translation”, was found statistically significant and the R^2 is 0.27. This means that 27% of the variation in RLEP can be explained by whether a participant needs English translation. The negative coefficient of “Needs translation” further suggests that needing translation results in higher RLEP.

Energy/fatigue

Energy/fatigue (EF) consists of 4 items that asked participants, over a 6-item Likert scale, questions like “Did you feel full of pep?” and “Did you have a lot of energy?”. Higher values in this domain mean a participant has more energy and experiences less fatigue with respect to physical health. EF was found to have a moderate negative correlation with distance to the nearest green space (r= -0.5, p = 0.006) and a weak negative correlation with the average time it takes to get to the green space (r = -0.3, p = 0.07). Thus, participants reported that less distance and less time traveled to a green space reported better EF levels.

Linear regression was conducted to assess the influence of the distances to the nearest green space on EF. Two independent variables, “less than ¼-mile” and “¼-½-mile” were found statistically significant. The R^2 of 0.31 means that distance to the nearest green space can explain 31% of the variation in EF, as informed by participants. Both independent variables have positive coefficients to EF, suggesting that close or walkable green spaces positively affect energy/fatigue levels.

Emotional well-being

Emotional well-being (EW) consists of 5 items from RAND-36 that asked participants, over a 6-item Likert scale, questions such as “Have you been a very nervous person?”, “Did you feel worn out?”, and “Did you feel tired?”. Higher values for EW mean a participant reports better emotional well-being. Distance to the nearest green space (r = -0.4, p = 0.03) and the average time it takes to get to a green space (r = -0.4, p = 0.02) had moderate negative correlations with EW. Like EF, participants who reported less distance to the nearest green space and took less time on average to get to green space reported better EW.

Regression analysis was run to assess how EW is impacted by the average time it takes to get to green space. The independent variable “less than 10 minutes” was found statistically significant. R^2 of 0.24 means that 24% of the variation in EW can be explained by the average time it takes to get to green space. The positive correlation coefficient of the independent variable suggests that taking less time, in this case, less than 10 minutes, to get a green space can significantly benefit EW.

Social functioning

Social functioning (SF) asked participants “During the past 4 weeks, to what extent have your physical health or emotional problems interfered with your normal social activities with family, friends, neighbors, or groups?” and “During the past 4 weeks, how much of the time has your physical health or emotional problems interfered with your social activities (like visiting with friends, relatives, etc.)?”. Five items from the Intake Survey were significantly correlated with SF: the usual duration of green space visits ($r = 0.4$, $p = 0.07$), the usual frequency of green space visits ($r = 0.4$, $p = 0.05$), the number of green spaces within a ¼-mile radius ($r = 0.4$, $p = 0.05$), the distance to the nearest green space ($r = -0.3$, $p = 0.06$), and the average time it takes to get to a green space ($r = -0.3$, $p = 0.08$). The correlation strength varied from weak to moderate. Variables with a positive correlation with SF mean that better SF is found in participants that spent more time in green spaces, frequently visit green spaces, and have green spaces within a ¼-mile radius from their residence. The negative correlations suggest that better SF is expected among participants who reported less distance to the nearest green space and less time, on average, it takes to get to green space.

A linear regression was performed to assess whether and how SF is impacted by the usual duration of green space visits, however, the statistically insignificant results suggest that the duration of green space is not useful to explain SF.

Pain

Two items represent pain in RAND-36; these questions asked, “How much bodily pain have you had during the past 4 weeks?” and “During the past 4 weeks, how much did pain interfere with your normal work?”. A higher value in this domain suggests less physical pain.

Pain was found to be positively correlated, with moderate strength, with two variables: usual activity levels during green space visits (r = 0.5, p = 0.02), and the distance to the nearest green space (r = -0.6, p = 0.001). Participants reported that performing some level of physical activity and less distance to the nearest green space is associated with less physical pain. The average time to get to the green space typically visited also had a moderate negative correlation (r = -0.4, p = 0.05), thus, participants reported that the less time it takes to get to a green space reported less physical pain.

Two linear regressions were performed to assess how pain is impacted by usual activity levels and distance to the nearest green space. The analysis based on usual activity levels during green space visits resulted in R^2 of 0.22, and the one based on the distance to the nearest green space typically visited resulted in R^2 of 0.33. Thus, 22% and 33% of the variation in pain can be explained by usual activity levels during green space visits and distance to the nearest green space typically visited, respectively. For usual activity levels, sitting or lying down is found statistically significant; its negative coefficient in regression means that limiting activity levels during green space visits results in less pain. This observation is contextually accurate as most seniors did not perform activities higher than “light activities” regardless of pain conditions. On the other hand, the positive coefficient of having a green space within a ¼-mile radius of a residence suggests that having a green space within a ¼-mile radius is favorable in relation to physical pain.

General health

General health (GH) consists of five items in the RAND-36, with 4 items deriving from a 5-item Likert scale design as true or false statements such as “I am as healthy as anybody I know” and “My health is excellent”. Again, a higher score in this health domain, as with the others, between the scale of 0 - 100 indicates better GH. GH is found to be significantly correlated with 3 Intake items. First, the rating of the physical quality of green space typically visited was particularly strong (r = 0.5, p = 0.003), meaning that participants in generally good health reported the physical quality of the green space they typically visited as “good”. Second, usual activity levels during green space visits (r = 0.5, p = 0.02) and participants in generally good health are positively associated, meaning participants that do some levels of activity are in generally good health. Third, the frequency of participation in social events during green space visits (r = 0.4, p = 0.05) had a moderate positive correlation. This result suggests that participants that participate in social events during green space visits are in generally good health.

Usual activity levels during green space visits (R^2 – 27%) and rating of the physical quality of green spaces typically visited (R^2 – 32%) were statistically significant under linear regression. 27% of the variation for GH can be explained by usual activity levels performed during green space visits, while 32% of the variation for GH can be explained by the rating of the physical quality of green spaces typically visited. Both independent variables for usual activity levels had negative correlation coefficients, meaning that not regularly visiting or limiting usual activities to “light” positively influences GH. As for rating the physical quality of green space typically visited, a negative correlation coefficient suggests that decent green spaces have a negative relationship with GH. Both results are unexpected, especially in relation to the GH domain, since it is expected that performing at least some level of activity and having good physical quality green spaces should result in better GH. But in assessing the meaning of these results and the distribution of the participants’ answers, it is likely that there was not enough variation in data in relation to the GH domain, especially since most participants did not perform activity level higher than "light" or evaluated the physical quality of green spaces typically visited less than a 4. For example, since most participants limit their usual activity levels to "light", the sample population established a relationship that supports light activities in relation to good health.

Table 12. Health domains ranked

Rank No.	**Health domains (overall)**
1	Pain*
1	General health*
2	Emotional well-being*
2	Role limitations due to emotional problems*
3	Energy/fatigue*
4	Social functioning
4	Role limitations due to physical health
5	Physical functioning
Rank No.	**Physical health domains**
1	Pain
2	Energy/fatigue
3	Role limitations due to physical health
4	Physical functioning
Rank No.	**Mental health domains**
1	General health
2	Emotional well-being
2	Role limitations due to emotional problems
3	Social functioning

*Table 12. Health domains ranked at 0.05. Top table - overall ranks; middle table - physical health domains; bottom table - mental health domains. *Health domains considered in linear regression.*

Table 12, *Health domains ranked*, is classified by the number of statistical significances each health domain has accrued against variables over Spearman's and linear regression (at 0.05). For example, pain and general health are tied as leading health domains as each gathered 4 total counts between Spearman's (2) and linear regression (2). Emotional well-being and role limitations due to emotional problems follow with each gathering 3 total (2 from Spearman's and 1 from linear regression), then energy/fatigue with 2 (1 from Spearman's and 1 from linear regression). The remaining 3 domains, social functioning, role limitations due to physical health, and physical functioning, are, by this method, the least influential health domains in relation to UGS accessibility.

Discussion

This study aimed to investigate the impacts of UGS accessibility on seniors' health-related quality of life over three primary objectives, notably the relationship between (1) health conditions to a range of accessibility measures and (2) seniors' preferences for the surrounding built environment and green space safety as well as (3) race/ethnicity and socioeconomic status to UGS accessibility and HRQL. This study finds that UGS access in San Francisco's Richmond District is predictive of seniors' HRQL; this is particularly the case for 5 out of 8 health domains in a predictive sense and for all 8 health domains in an associative sense. I posit that seniors who live in urban environments should be encouraged to visit and be accommodated to access green spaces as they markedly improve HRQL. This study also finds park proximity and park quality as relevant measures of UGS accessibility. Next, it is important to consider features of the built environment surrounding green spaces as well as the safety *within* these green spaces; from a holistic perspective, getting to green space, and feeling safe within the space are all part of (urban green space) accessibility for seniors. Specifically, data show that traffic, air quality, and distance to green space are Richmond District Seniors' top three considerations of the surrounding built environment. Paths with clear lines of sight, good lighting, and security technology are the top three important green space safety features. Finally, it is found in this study that race and SES do not impact Richmond District seniors' HRQL or their accessibility to UGS.

Impacts of urban green space accessibility

The findings suggest that the leading health domains influenced by seniors' accessibility to UGS in the Richmond District are pain, general health, emotional well-being, role limitations due to emotional problems, and energy/fatigue. However, I believe that all health domains are important. For example, it is proven that seniors that do some level of physical activity during green space visits, have less distance to the nearest green space typically visited, and take less time, on average, to get to the green space typically visited reported less pain – a sign of good physical health. In other words, these measures of UGS accessibility are the cause (to an extent) and the health domains are the health outcomes/effects. Similar conclusions about emotional well-being, role limitations due to emotional problems, and energy/fatigue can be reached.

Five out of 8 health domains can be statistically predicted to some extent by 9 intake survey items. For pain, the explanatory variables included "sitting or lying down", and "less than ¼-mile". For emotional well-being, the explanatory variable is "less than 10 minutes". For energy/fatigue, the explanatory variables are "less than ¼-mile" and "¼-½-mile. What do these 5 independent variables have in common? They point to the simple conclusion that having accessibility to UGS nearby is beneficial for seniors' physical and mental health (a nod to park proximity). And based on the current literature reviewed for this thesis, it is not surprising that participants reported that, to a certain extent, accessibility to UGS improved their physical and mental health by reducing the impacts of pain, improving emotional well-being, improving their energy/fatigue, and more.

Environmental justice-based literature also supports the conclusion that measures of park proximity and park quality should be considered in this field of study, in accordance with studies conducted by Dai (2011), Heckert (2013), and Rigolon (2013). Along with these authors, I conclude that measures of park proximity and park quality are relevant in assessing seniors' UGS accessibility. I point to the associations discovered in this study between both measures and seniors' HRQL.

Table 12, *Health domains ranked*, above presents all health domains in a ranked order, including sub-groups for physical health and mental health. Among others, there are several public health, land use, and policy decision-making implications that can be interpreted from these results. In coalescing the five leading health domains, which are pain, general health, emotional well-being, role limitations due to emotional problems, and energy/fatigue, it can be concluded that seniors that live in the Richmond District can significantly benefit from visiting green spaces, and in turn, will have better physical and mental health, as explained by these five domains. Conversely, the value of the bottom three health domains, which are social functioning, role limitations due to physical health, and physical function, still serve as important outcomes since those that reported less social functionality, less physical functionality, and more role limitations due to physical health most likely do not visit green spaces as they are physically and mentally discouraged and/or physically unable to. Through this logic, there is an inverse relationship between UGS accessibility and health to a significant extent - over 31 participants reported that regularly visiting and being closer to green spaces make them physically and mentally healthier. Simply put, this data suggests that if a senior is experiencing issues with, for example, pain or emotional well-being, visiting a green space, and having one nearby could help!

Several variables were not found significantly associated with any health outcome, particularly age, race, sex/sexual orientation, the usual mode of transport to green spaces, and frequency of social interactions. However, these results confirm findings from some current literature. In past research, age, as well as sex/sexual orientation, are often controlled in analysis, and in fact, it was observed in this study that several older seniors (80 and over) reported good physical and mental health conditions. Therefore, I argue that age (relative to seniors) and sex/sexual orientation (in this study 40% male and 60% female) are extraneous factors, and these variables serve a better purpose to describe population demographics.

As for the usual mode of transport, options included active (walking, jogging, cycling), public transport, car, transportation network companies (TNCs), and others not listed. An overwhelming portion of participants (71%) answered active followed by public transport (19%). A possible explanation may be that having “active” as an umbrella option negatively impacted the robustness of the variable, thus losing potential data insights. From my observations, most participants chose “active” as an option, and it is assumed that they walked, rather than jogged or cycled, due to the physical requirements of the latter active transportation choices. In terms of slope, the Richmond District is relatively flat, especially south of the major arterial Geary Blvd. (where both senior centers are adjacent). Regardless of whether a participant is physically or mentally healthy, the mode of transport to green spaces may not be a significant factor in health outcomes as the built environment may not be an obstacle in the local context (i.e., the Richmond District).

For the frequency of social interactions, the top two answers in relation to the frequency of participants meeting or talking to someone *unknown* were never/rarely (0-1 time) (48%) and rarely/sometimes (2-5 times) (32%). On the other hand, the top two answers in relation to the frequency of participants meeting or talking to someone *known* were never/rarely (26%) and rarely/sometimes (36%). To an extent, the Copenhagen study conducted by Schmidt et al. (2019) matches these nuanced results as social interaction was found to be negatively associated with walking in open spaces, however, they also found through participant feedback that these spaces are still important as they act as social interactions. And while there were no significant associations found against the eight health domains, it's worthwhile to acknowledge that social interactions are occurring during green space visits and the likelihood increases when seniors are with someone they know.

What are important considerations to the surrounding built environment?

Building on the studies conducted by Parra et al. (2010) (Colombia), Mahmood et al. (2012) (Vancouver and Oregon), Loukaitou-Sideris et al. (2016) (Los Angeles) and Veitch et al. (2020) (Australia), this paper asked participants' considerations of the surrounding built environment and important green space safety features. As Table 5, *Considerations to the surrounding built environment*, shows, participants identified traffic, air quality, distance to green space, people, and sidewalks to be the top 5 considerations when visiting green spaces. Interestingly, the least important considerations, in descending order, were steep slopes, trash, stairs, roads, and intersections. Parra et al. (2010) found that connectivity (a high number of intersections and roads) had a negative impact on older adults' park use and those areas with high slopes (greater than 5%) reduced the likelihood of active park use. Since the Richmond District is *relatively* flat and trash-free, these results do not necessarily detract from Parra et al.'s (2010) findings. The Richmond District, while a high-density neighborhood, is primarily residential and experiences lower volumes of vehicular traffic than other San Francisco neighborhoods. It also offers relatively wide sidewalks and wide crosswalks, and stoplights at major intersections (see Figure 17).

Featured in Table 6 and some shown in Figure 18, 6 out of 7 green space safety features garnered 10 responses or more; these include paths with clear lines of sight, good lighting, security technology, community police officers, wayfinding signage, and accessibility features. The only safety feature under 10 responses was emergency phone boxes ($n = 5$) and this makes sense as most people own a cellular device, rendering emergency phone boxes outmoded. The 6 significant safety features are also identified in the studies by Loukaitou-Sideris et al. (2016) and Veitch et al. (2020).

Also, a question in the Intake Survey asked participants "Do you feel safe when you visit the green spaces you typically visit?". While this question was found insignificant to other variables, approximately 93% of participants reported that they felt safe. The overwhelming answer does not mean that it is not a significant factor, but rather it *directly* and *clearly* states that green spaces in the Richmond District are safe as informed by participants. In other words, there is no statistical test or statistical significance needed since the answer is self-explained.

Race/ethnicity and socioeconomic status

This study investigated the influence of race/ethnicity and SES on UGS accessibility and HRQL. Race, gender, sex/sexual orientation, and educational attainment were not significant (ethnicity was not considered since 100% of participants identified as non-Hispanic) to seniors' HRQL; the same variables were tested against park proximity, park quantity, and park quality variables. In either analysis, no statistical significance was discovered. These results do not reject a predictive relationship, rather they suggest a lack of association between race and SES variables to UGS accessibility and/or seniors' HRQL as informed by participants. Studies by Xiao et al. (2017) and Wen et al. (2020) also found no significant relationships between green space accessibility and disadvantaged populations, but it should be noted that other studies conclude otherwise. Ultimately, these results underscore the nuanced impacts of local cultures, spatial and socioeconomic contexts, and more.

Furthermore, and with respect to the narrow sample population based on the inclusion criteria (participants must be a patron of at least one senior center), data show that 100% identified as non-Hispanic/Latino (ethnicity variable), nearly 75% identified as Chinese (race variable), and nearly 50% indicated a bachelor's degree or some college with no degree. This helps explain why there was no discovered significance against health domain variables in addition to measures of park quality, park proximity, and park quantity variables. As a matter of fact, the insignificance of these tests points to the conclusion that seniors in the Richmond District are not experiencing UGS (in)accessibility because of race/ethnicity, gender, sex/sexual orientation, or educational attainment. And this is a good thing!

Significance of study

Many studies that explore the relationship between green space accessibility and health outcomes are cross-sectional studies. Most of the cited articles in this paper are cross-sectional. The biggest disadvantage of a cross-sectional study is that it cannot establish causal relationships due to the lack of temporal observations (repeated observations over the same variables are needed). An ideal framework to establish reliable, generalizable, and correlational findings is a longitudinal study, a design that involves repeated observations over a statistically meaningful period. However, when assessing the relationships between urban green space accessibility and seniors' health-related quality of life through health and accessibility measures, as this research specifically investigates, there is a lack of cross-sectional data and even less longitudinal data. The primary and ultimate significance of this study is the local, contextual insights that are gained for seniors that live in San Francisco's Richmond District, particularly from study participants. I have not discovered any studies that investigate even the broader scope of the role of green spaces on seniors in San Francisco, therefore, this study serves as the first of its kind and fills a gap in the literature.

Second, on a broader scale, this study justifies the significance of health and green space variables as identified by other studies. It is well-documented that green spaces play a role in the health and well-being of people; findings presented in this paper confirm and illuminate the role green spaces play in the lives of San Francisco residents (specifically in relation to pain, emotional well-being, and general health). And with considerations of green space accessibility, this study is foundational for future research that may examine the interrelationships among green spaces, health, accessibility, and most importantly, the role of seniors in an increasingly urban world. This speaks to the interconnectedness of many disciplines and in this case public health, planning, and geography.

Third, the present study was conducted with no sponsorship funding and a total cost of no more than $300. This speaks to the recognition by organizations of the importance of green spaces and shows that communication with these organizations can facilitate future research endeavors without the need for large financial costs. If these results derive from a low-cost study through a relatively limited/narrow sample population, the potential insights gathered from future funded research are likely monumental in this field of study, especially studies that are scaled up.

Fourth, this paper empowers the presence and role of seniors in society. Often, seniors are overlooked during societal events like local decision-making and the development of community infrastructure. In retrospect, how many parks, goods, and services are truly accommodating of seniors' lifestyles? This study addresses only one out of several important aspects of society that seniors are often neglected, intentionally or not. Availability and accessibility to green spaces should *accommodate* all people.

Limitations

The primary limitation of this study, implicitly addressed throughout this paper, is the use of convenience sampling. The benefit (and disadvantage) of this sampling method is that access to the sample population is relatively easy and straightforward. In this case, collaborating with the two senior centers provided access to several hundred seniors. While efforts were made to reduce bias that stems from convenience sampling, this sampling method and the results thereof are not meant to be generalized; this can only be properly achieved through random sampling. Therefore, the findings of this study *are not* representative of the population of seniors that live in the Richmond District. Nonetheless, the findings hold statistical significance for the narrowed sample population and *are representative* of that population.

Under the sphere of convenience sampling in addition to the survey structure, this study is then prone to sampling bias, response bias, and recall bias. Sampling bias occurs when a sample is collected in a way that favors the response of one group over another, leading to statistically inaccurate and unrepresentative results. In this study, the fact that sampling occurred at senior centers meant that house-bound seniors were not included. Response bias occurs when participants answer questions falsely or inaccurately; response bias may occur during self-report surveys or interviews (for example, participants may not answer truthfully when asked about their health and park visitation patterns). Recall bias occurs when participants do not accurately remember past experiences or withhold certain information. Naturally, cross-sectional studies are subject to at least one of three biases in varying degrees, and the best course of action to prevent such biases is to follow survey protocol as outlined, adding variability only when necessary and valid. Best practices and efforts were implemented to the highest degree possible for all survey instances, therefore, findings in the study are useful given these sampling limitations.

From direct observations and feedback, while the average time to complete both surveys did not exceed over 20 to 25 minutes, and although participants were notified of the estimated time of completion, some stated that the time it took to complete both was too long. Participants were given as much time needed to complete both surveys, however, their perception of how long both surveys take to complete may have impacted the recollection of their thoughts and experiences in relation to green spaces (for example, providing answers as quickly as possible without thoughtful considerations to each question). As mentioned, there are other forms of the RAND-36 that are shorter in length (and perhaps duration), however, the variables considered under each health domain are shortened as well. With this in consideration, I argue that employing RAND-36 should still be employed, to maximize the depth of considerations for each health domain, in future research as these observations/feedback are only from a fraction of the sample population. Further, since participants completed both surveys, it can be concluded that length is a matter of personal preference and may not significantly influence participants' answers.

Conclusion

Over several health domains, urban green space accessibility is important for seniors that live in San Francisco's Richmond District. While there are a variety of other factors that can impact health conditions, such as genes, lifestyle choices, and physical functionality, the 31 participants represented in this study make a case for themselves – access to urban green spaces is associated with and positively influence physical and mental health. With a greater sample population beyond the two senior centers, and as data suggests, the presumption that the same can be said on a city or regional scale is not far-fetched. Regardless, I conclude that green spaces are important for seniors' physical and mental health by reducing the implications of aging, encouraging physical activity, and as places of social interactions and encounters, among other benefits.

But to obtain the full spectrum of the benefits green spaces offer, it is *essential* that they are held at a reasonable level of quality, provide safety and accommodating features, and are close spatially and temporally to where seniors live. Two measurement strategies, park quality and park proximity, presented in this study prove to be important factors in ensuring the equitable and fair distribution of environmental goods and services; park quantity was not found to be a significant predictor of health, so perhaps the Richmond District fulfills the need in terms of park quantity as well as safety.

For future research, especially those that plan to be based in San Francisco, I suggest employing the variables considered in this study through a longitudinal design. If not possible, I suggest employing a more appropriate sampling method that maximizes the robustness, reliability, and validity of data. If these results are from 31 individuals, it is curious to see what the other 160,000+ seniors in San Francisco might say!

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Appendices

Appendix A: Informed Consent (English)

San Francisco State University
Informed Consent to Participate in Research
Urban Green Space Accessibility and Seniors' Quality of Life in San Francisco

A. PURPOSE AND BACKGROUND

The purpose of this research is to learn about the impacts of urban green space accessibility on seniors' physical and mental health. Another purpose is to discover the roles of socioeconomic status and the surrounding environment in urban green space accessibility for seniors. The researcher, Vincent Molina, is a graduate student at San Francisco State University conducting research for a master's degree in the Department of Geography & Environment. You are being asked to participate in this study because you: (1) are 65 years or over; (2) live in San Francisco's Richmond District; and (3) attend at least one of the following senior centers: the Richmond Senior Center or the Jackie Chan Senior Center.

B. PROCEDURES

If you agree to participate in this research, the following will occur:

- the researcher will verbally provide a detailed description of the purpose of the study (about 3 minutes);
- you will be allowed to ask questions and the researcher will answer to the best extent possible;
- you will be asked complete a survey that will ask for your demographics, park visitation patterns, and park activity patterns (about 10 minutes);
- you will be asked to complete a health questionnaire to measure your current physical and mental health conditions (about 20 minutes); and
- the survey and questionnaire will take place consecutively in a private room in one of the three senior centers listed above only when the researcher is present and at a time convenient for you.
- The total time to complete the survey and questionnaire is estimated to take no more than 30 minutes.

C. RISKS

There is a risk of loss of privacy. However, no names or identities will be used in any published reports of the research. Only the researcher and faculty advisor will have access to the research data. Data will be kept in a university-provided Box account with two-factor authentication.

D. CONFIDENTIALITY

Participant identities will be replaced and assigned pseudonyms, and the code key will be kept separate from the data. The pseudonyms will be semi-randomly selected while ensuring that the pseudonym is distinct from the actual name. Data will be kept in a university-provided Box account with two-factor authentication. Only the researcher and faculty advisor will have access to research data for this project. Access information will not be provided to any other individual. The Box folder will not be shared with any other user besides the faculty advisor.

E. DIRECT BENEFITS

There will be no direct benefits to the participant.

F. COSTS

There will be no cost to you for participating in this research.

Appendix B: Informed Consent (Chinese)

旧金山州立大学

研究参与知情同意书

旧金山城市绿地可达性和老年人的生活质量

A. 目的和背景

本研究的目的是为了探讨城市绿地对老年人身心健康的影响，以及发现社会经济地位和周围环境在城市绿地对老年人的影响中的作用。 研究人员 Vincent Molina
是旧金山州立大学地理与环境系的研究生，正在攻读硕士学位。 您被邀请参加这项研究是因为您：(1) 65 岁或以上； (2) 居住在旧金山的列治文区； (3)
至少参加了下列其中一间长者中心：列治文长者中心或成龙长者中心。

B. 过程

如果您同意参与这项研究，将会：

- 研究者会向您口头详细描述研究目的（约3分钟）；
- 您可以向研究人员提问，研究人员会尽可能地回答；
- 您会完成一项调查，询问您的个人信息、公园参观模式和公园活动模式（大约 10 分钟）；
- 您会完成一份健康问卷，以衡量您目前的身心健康状况（约20分钟）；
- 调查和问卷会在老年中心的私人房间内进行，并且只会在有研究人员在场且在您方便的时间进行。
- 完成调查和问卷的总时间估计不超过 30 分钟。

C. 风险

参与者会面临失去隐私的风险。 但是，任何已发表的研究报告都不会使用姓名或身份。
只有研究人员和指导老师才能访问研究数据。同时， 数据将保存在大学提供的具有双因素身份验证的 Box 帐户中。

D. 保密

参与者身份将被替换并分配假名，代码密钥将与数据分开保存。
我们将半随机选择假名，同时确保假名与真实姓名的不同。
数据将保存在大学提供的具有双因素身份验证的 Box 帐户中。
只有研究人员和指导教师才能访问该项目的研究数据。 访问信息不会提供给任何其他个人和机构。 Box 文件夹也不会与除指导老师之外的任何其他用户共享。

E. 直接利益

这个研究项目不会有任何的既得利益提供给参与者。参与者不会收到任何的既得利益。

Appendix C: Intake Survey (English)

Intake Survey

1. Primary (Main) Language
   ____
2. English Fluency:
   a. Needs translation
   b. Limited
   c. Fluent
3. What is your age group?
   a. 65- 69
   b. 70 - 74
   c. 75 - 79
   d. 80 and over
   e. Prefer not to answer
4. What is your gender? (Check one that best describes your current gender identity)
   a. Male
   b. Female
   c. Transgender Male
   d. Transgender Female
   e. Genderqueer/Gender Non-binary
   f. Not listed, please specify:
      ____
   g. Prefer not to answer
5. What was your sex at birth? (Check one that indicates your sex at birth)
   a. Male
   b. Female
   c. Prefer not to answer
6. How do you describe your sexual orientation? (Check one that best describes your sexual orientation)
   a. Straight/Heterosexual
   b. Bisexual
   c. Gay/Lesbian/Same-Gender Loving
   d. Questioning/Unsure
   e. Not listed, please specify
      ____
   f. Prefer not to answer
7. How would you describe your ethnicity?
   a. Hispanic/Latino
   b. Non-Hispanic/Latino
   c. Prefer not to answer
8. How would you describe your race? (You may mark more than one)
   a. American Indian or Alaska Native
   b. Asian-Indian
   c. Black or African American
   d. Cambodian
   e. Chinese
   f. Filipino

g. Guamanian
h. Hawaiian
i. Japanese
j. Korean
k. Laotian
l. Latino/Latina
m. Other - Asian
n. Other - Pacific Islander
o. Samoan
p. Vietnamese
q. White
r. Other not listed: ____
s. Prefer not to answer

9. What is your highest level of education?
   a. Less than a high school diploma
   b. High school degree or equivalent (for example, GED)
   c. Some college, no degree
   d. Associate degree (for example, AA, AS)
   e. Bachelor’s degree (for example, BA, BS)
   f. Master’s degree (for example, MA, MS, MEd)
   g. Professional degree (for example, MD, DDS, DVM)
   h. Doctorate (for example, PhD, EdD)
   i. Prefer not to answer
10. What is your usual frequency of green space visits?
    a. Every day
    b. Once per week
    c. 2+ times per week
    d. Once a month
    e. 2+ times per month
    f. I do not visit regularly visit green spaces
    g. Prefer not to answer
11. What is your usual duration of green space visits?
    a. Less than 30 minutes
    b. 30 minutes to 1 hour
    c. 1 to 2 hours
    d. I do not visit regularly visit green spaces
    e. Prefer not to answer
12. What are your usual activity levels during green space visits?
    a. Mostly sitting or lying down
    b. Mostly light activities
    c. Mostly moderate activities
    d. Mostly vigorous activities
    e. I do not visit regularly visit green spaces
    f. Prefer not to answer
13. What is your usual mode of transport to green spaces?

a. Active (walk, jog, cycle)
b. Public transport
c. Car
d. Uber, Lyft, etc.
e. Other not listed: ____

14. How many green spaces (for example, parks, sports fields, community gardens etc.) are within a ¼-mile/400-m/1,200 feet radius from your residence?
    a. 1
    b. 2-3
    c. 4+
    d. No green space within a 400-m/1,200 feet radius.
15. How far is the nearest green space you usually visit?
    a. Less than ¼ mile
    b. ¼ - ½ mile
    c. ½ - 1 mile
    d. 1 - 2 miles
    e. 3 - 5 miles
    f. 5+ miles
16. On average, how long does it take to get to the green space you usually visit?
    a. Less than 10 minutes
    b. 10 - 20 minutes
    c. 20 - 30 minutes
    d. Over 30 minutes
17. What are some things about the surrounding environment you consider when deciding to visit a green space? Choose all that apply.
    a. Traffic (for example, cars, buses, etc.)
    b. Distance to green space
    c. Distance to public transportation
    d. People
    e. Intersections or number of intersections
    f. Crosswalks
    g. Roads or number of roads
    h. Sidewalks
    i. Trash
    j. Stairs
    k. Noise (for example, traffic noise)
    l. Air quality
    m. Steep slopes (for example, hills)
    n. Buildings or number of buildings around the park
    o. Other not listed: ____
18. What is the frequency of yourself meeting or talking to someone <u>unknown</u> during green space visits?
    a. Never/rarely (0-1 times)
    b. Rarely/sometimes (2-5 times)
    c. Most of the time/always (6+ times)

    d. I do not visit regularly visit green spaces
    e. Prefer not to answer

19. What is the frequency of yourself meeting or talking to someone known during green space visits?
    a. Never/rarely (0-1 times)
    b. Rarely/sometimes (2-5 times)
    c. Most of the time/always (6+ times)
    d. I do not visit regularly visit green spaces
    e. Prefer not to answer
20. What is your frequency of participation in social events during green space visits?
    a. Never/rarely (0-1 times)
    b. Rarely/sometimes (2-5 times)
    c. Most of the time/always (6+ times)
    d. I do not visit regularly visit green spaces
    e. Prefer not to answer
21. Using the scale below, how important is the physical quality of green spaces to you?
    a. 1 - Not important
    b. 2
    c. 3 - Indifferent
    d. 4
    e. 5 - Important
    f. Prefer not to answer
22. Using the scale below, how would you rate the physical quality (for example, presence of facilities or attractiveness) of the green space you typically visit?
    a. 1 - Bad
    b. 2
    c. 3 - Decent
    d. 4
    e. 5 - Good
23. Using the scale below, how important is the safety of green spaces to you?
    a. 1 - Not important
    b. 2
    c. 3 - Indifferent
    d. 4
    e. 5 - Important
    f. Prefer not to answer
24. Do you feel safe when you visit the green spaces you typically visit?
    a. Yes
    b. No
    c. Prefer not to answer
25. What are some important safety features you might consider when visiting green spaces?
    a. Paths with clear lines of sight
    b. Good lighting
    c. Emergency phone boxes
    d. Security technology (CCTV, emergency report systems)
    e. Community police officers/safety volunteers
    f. Wayfinding signage with visual graphics

g. Accessibility features (for example, ramps,
h. Other not listed: ____

Thank you for completing this survey!

Appendix D: Intake Survey (Chinese)

Intake Survey 调查表

1. 您的母语是：
   ____
2. 您的英语口语能力:
   a. 需要翻译
   b. 有限
   c. 流畅
3. 您的年龄分段是：
   a. 65岁- 69岁
   b. 70岁 - 74岁
   c. 75岁 - 79岁
   d. 80岁以上
   e. 选择不回答
4. 您的性别是 (请勾选最能描述您当前性别认同的一项)：
   a. 男
   b. 女
   c. 跨性别男性
   d. 跨性别女性
   e. 非二元性别（即不单纯属于男性或女性的自我性别认同）
   f. 如果未列出，请说明:
      ____
   g. 选择不回答
5. 您出生时的性别是 (请勾选一项表明您出生时的性别)：
   a. 男
   b. 女
   c. 选择不回答
6. 您的性取向是？（请选择您认为最符合的一项）
   a. 异性恋
   b. 双性恋
   c. 同性恋
   d. 非二元性别恋
   e. 如果未列出，请说明
      :____
   f. 选择不回答
7. 您如何描述您的种族渊源？
   a. 西班牙裔/拉丁裔

b. 非西班牙裔/拉丁裔
c. 选择不回答

8. 您如何描述您的种族？(可以多选择)
   a. 美国印第安纳人或者阿拉斯加原住民
   b. 亚洲印度人
   c. 黑人或者非裔美国人
   d. 柬埔寨人
   e. 中国人
   f. 菲律宾人
   g. 关岛人
   h. 夏威夷人
   i. 日本人
   j. 韩国人
   k. 寮国人
   l. 拉丁美洲人
   m. 其他亚裔
   n. 其他太平洋岛民
   o. 萨摩亚人
   p. 越南人
   q. 白人
   r. 其他未列: ____
   s. 选择不回答
9. 您最高的学历是：
   a. 低于高中文凭
   b. 高中学历或同等学力（例如GED）
   c. 有些大学，没有学位
   d. 副学士学位（例如AA, AS）
   e. 学士学位（例如BA, BS）
   f. 硕士学位（例如MA, MS, MEd）
   g. 专业学位（例如MD, DDS, DVM）
   h. 博士学位（例如 PhD, EdD）
   i. 选择不回答
10. 您通常访问绿地的频率是多少？
   a. 每天
   b. 每周一次
   c. 每周两次以上

d. 每月一次
e. 每月两次一双
f. 我不经常去绿地
g. 选择不回答

11. 您通常去绿地的时间是多久？
    a. 少于30分钟
    b. 30分钟到1小时
    c. 1小时到2小时
    d. 我不经常去绿地
    e. 选择不回答
12. 您通常去绿地的运动/活动水平是？
    a. 大多数是坐着或者躺着
    b. 大多数是轻度活动
    c. 大多数是适度的活动
    d. 大多数是剧烈活动
    e. 我不经常去绿地
    f. 选择不回答
13. 您去绿地的常用交通方式是什么？
    a. 步行，慢跑，自行车
    b. 公共交通
    c. 开车
    d. Uber, Lyft, 打车等
    e. 其他未列: ____
14. 在距您住所 1/4 英里，400米，或者 1,200英尺的半径范围内有多少个绿地？（例如 公园，运动场，社区花园等）
    a. 1
    b. 2-3
    c. 4+
    d. 1/4英里/400米/1200英尺半径范围内没有绿地
15. 你经常去的绿地有多远？
    a. 少于 ¼ 英里
    b. ¼ - ½ 英里
    c. ½ - 1 英里
    d. 1 - 2 英里
    e. 3 - 5 英里

f. 5英里以上

16. 你经常去的绿地平均需要花费多久？
    a. 少于10 分钟
    b. 10 - 20 分钟
    c. 20 - 30 分钟
    d. 大于 30 分钟
17. 在决定参观绿地时，您会考虑周围环境的哪些方面？（请选择所有适用的）
    a. 交通（例如 汽车，公共汽车等）
    b. 到绿地的距离
    c. 到公共交通的距离
    d. 人
    e. 交叉路口或者交叉路口的数量
    f. 人行横道
    g. 道路或者道路数量
    h. 人行道
    i. 垃圾
    j. 楼梯
    k. 噪音（例如，交通噪音）
    l. 空气质量
    m. 陡坡（例如，小山/山丘）
    n. 建筑物或者公园周围的建筑物数量
    o. 其他未列: ____
18. 在参观绿地期间，您与陌生人会面交流的频率是多少？
    a. 从不/很少（0-1次）
    b. 很少/有时（2-5次）
    c. 大多数时/通常（6次以上）
    d. 我不经常去绿地
    e. 选择不回答
19. 在参观绿地期间，您与认识的人会面交流的频率是多少？
    a. 从不/很少（0-1次）
    b. 很少/有时（2-5次）
    c. 大多数时/通常（6次以上）
    d. 我不经常去绿地
    e. 选择不回答
20. 您在参观绿地期间，您参加社交活动的频率是多少？

  a. 从不/很少（0-1次）
  b. 很少/有时（2-5次）
  c. 大多数时/通常（6次以上）
  d. 我不经常去绿地
  e. 选择不回答

21. 从1到5，您觉得绿地的环境质量有多重要？
  a. 1 - 不重要
  b. 2
  c. 3 - 一般
  d. 4
  e. 5 - 很重要
  f. 选择不回答

22. 从1到5，您如何评价您通常参观的绿地的环境质量？（例如，设施的存在或者吸引力）
  a. 1 - 差
  b. 2
  c. 3 - 适当
  d. 4
  e. 5 - 好

23. 从1到5，绿地的安全对您来说有多重要？
  a. 1 - 不重要
  b. 2
  c. 3 - 一般
  d. 4
  e. 5 - 重要
  f. 选择不回答

24. 您去绿地时平时是否感觉安全？
  a. 是
  b. 否
  c. 选择不回答

25. 在参观绿地时，您可能会考虑的重要安全措施有哪些？
  a. 视线清晰的路线
  b. 良好的灯光
  c. 紧急电话亭
  d. 安全技术 （例如 监控)
  e. 社区民警/安全志愿者
  f. 带有视觉图形的指路标志
  g. 辅助功能 （例如 坡道）

h. 其他未列:

____

感谢您完成本次调查表！

Appendix E: RAND-36 (English)

RAND 36 ITEM HEALTH SURVEY

Name:____

1. In general, would you say your health is:
   a. Excellent
   b. Very Good
   c. Good
   d. Fair
   e. Poor
2. **Compared to one year ago**, how would you rate your general health **now**?
   a. Much better than one year ago
   b. Somewhat better than one year ago
   c. About the same
   d. Somewhat worse now than one year ago
   e. Much worse now than one year ago

The following items are about activities you might do during a typical day: Does **your health now limit you** in these activities? If so, how much?

	Yes, limited a lot	Yes, limited a little	No, not limited at all
3. **Vigorous activities**, such as running, lifting heavy objects, participating in strenuous sports	●	●	●
4. **Moderate activities**, such as moving a table,pushing a vacuum cleaner, bowling, or playing golf	●	●	●
5. Lifting or carrying groceries	●	●	●
6. Climbing **several** flights of stairs	●	●	●
7. Climbing **one** flight of stairs	●	●	●
8. Bending, kneeling, or stooping	●	●	●

9.	Walking **more than a mile**	●	●	●
10.	Walking **several blocks**	●	●	●
11.	Walking **one block**	●	●	●
12.	Bathing of dressing yourself	●	●	●

During the **past 4 weeks**, have you had any of the following problems with your work or other regular daily activities **as a result of your physical health**?

		Yes	No
13.	Cut down the **amount of time** you spent on work or other activities	●	●
14.	**Accomplished less** than you would like	●	●
15.	Were limited in the **kind** of work or other activities	●	●
16.	Had **difficulty** performing the work or other activities	●	●

During the **past 4 weeks**, have you had any of the following problems with your work or other regular daily activities **as a result of any emotional problems** (such as feeling depressed or anxious)?

		Yes	No
17.	Cut down the **amount of time** you spent on work or other activities	●	●
18.	**Accomplished less** than you would like	●	●
19.	Didn't do work or other activities as **carefully** as usual	●	●

20. During the **past 4 weeks**, to what extent has your physical health or emotional problems interfered with your normal social activities with family, friends, neighbors, or groups?

   a. Not at all
   b. Slightly
   c. Moderately
   d. Quite a bit
   e. Extremely

21. How much bodily pain have you had during the past **4 weeks**?

   a. None
   b. Very mild
   c. Mild
   d. Moderate
   e. Severe
   f. Very severe

22. During the **past 4 weeks**, how much did **pain** interfere with your normal work (including both work outside the home and housework)?

   a. Not at all
   b. Slightly
   c. Moderately
   d. Quite a bit
   e. Extremely

These questions are about how you feel and how things have been with you **during the past 4 weeks**. For each question, please give the one answer that comes closest to the way you have been feeling. How much of the time during the **past 4 weeks**….

		All of the time	Most of the time	A good bit of the time	Some of the time	A little of the time	None of time
23.	Did you feel full of pep?	●	●	●	●	●	●
24.	Have you been a very a nervous person?	●	●	●	●	●	●
25.	Have you felt so down in the dumps that nothing could cheer you up?	●	●	●	●	●	●
26.	Have you felt calm and peaceful?	●	●	●	●	●	●
27.	Did you have a lot of energy?	●	●	●	●	●	●
28.	Have you felt downhearted and blue?	●	●	●	●	●	●
29.	Did you feel worn out?	●	●	●	●	●	●
30.	Have you been a happy person?	●	●	●	●	●	●
31.	Did you feel tired?	●	●	●	●	●	●

32. During the **past 4 weeks**, how much of the time has **your physical health or emotional problems** interfered with your social activities (like visiting with friends, relatives, etc.)?

a. All of the time
b. Most of the time
c. Some of the time
d. A little of the time
e. None of the time

How TRUE or FALSE is **each** of the following statements for you.

		Definitely true	Mostly true	Don't know	Mostly false	Definitely false
33.	I seem to get sick a little easier than other people	●	●	●	●	●
34.	I am as healthy as anybody I know	●	●	●	●	●
35.	I expect my health to get worse	●	●	●	●	●
36.	My health is excellent	●	●	●	●	●

Appendix F: RAND-36 (Chinese)

RAND 36 项健康调查

姓名:____

1. 一般来说，您认为您的健康状况是:
   a. 极好
   b. 非常好
   c. 好
   d. 一般
   e. 差
2. 与一年前相比，您现在整体上会如何评价自己的健康状况？
   a. 现在比一年前好多了
   b. 现在比一年前好一点
   c. 大致相同
   d. 现在比一年前差一点
   e. 现在比一年前差多了

以下项目是关于您在一天中可能进行的活动。 您现在的健康状况有没有限制您进行这些活动？如果有的话，有多大程度的影响

		有，很大限制	有，有点限制	没有，完全没有限制
3.	剧烈活动，例如跑步、举重物、参与剧烈运动	●	●	●
4.	适度的活动，例如移动桌子、推动吸尘器、打保龄球或打高尔夫球	●	●	●
5.	举起或拿着杂货	●	●	●
6.	爬几段楼梯	●	●	●
7.	爬一段楼梯	●	●	●
8.	弯腰、跪下或俯身	●	●	●

9.	步行超过一英里	●	●	●
10.	步行几个街区	●	●	●
11.	步行一个街区	●	●	●
12.	自己洗澡或穿衣	●	●	●

在过去的 **4** 周内，您的工作或其他日常活动有没有因身体健康问题而出现以下任何问题？

		有	没有
13.	减少花在工作或其他活动上的时间	●	●
14.	完成了比你想要完成的少	●	●
15.	在工作或其他活動的种类上受到限制	●	●
16.	難以執行工作或其他活動(例如，耗费额外的精神力气)	●	●

在过去的 **4** 周内，您的工作或其他日常活动有没有因任何情绪问题(例如感到沮丧或焦虑）而出现以下任何问题？

		有	没有
17.	减少花在工作或其他活动上的时间	●	●
18.	完成了比你想要完成的少	●	●
19.	没有像往常一样认真地做工作或其他活动	●	●

20.　在过去 **4** 周内，您的身体健康或情绪问题在多大程度上影响了您与家人、朋友、邻居或团体的正常社交活动？

a. 完全没有
b. 轻微
c. 中等
d. 相当大
e. 极度

21.　在过去的 **4** 周内，您有多大程度的身体疼痛？

a. 没有
b. 非常轻微
c. 轻微
d. 中等
e. 严重
f. 非常严重

22.　在过去的 **4** 周内，疼痛对您正常工作（包括外出工作和家务）有多大程度的影响？

a. 完全没有
b. 一点点
c. 中等
d. 相当大
e. 极度

T这些问题是关于您在过去 **4** 周内的感受和情况。请在每个问卷题上给出最接近您的感受的答案。过去 **4** 周有多少时间…

	无时无刻	大多数时候	很多时候	有些时候	少部分时候	从来没有
23. 你感到精神饱满吗？	●	●	●	●	●	●
24. 你是一个非常紧张的人吗？	●	●	●	●	●	●
25. 你有没有曾感到情绪低落，没有什么能让你振作起来？	●	●	●	●	●	●
26. 你感到心平气和吗？	●	●	●	●	●	●
27. 你感到精力充沛吗？	●	●	●	●	●	●
28. 你感到沮丧吗？	●	●	●	●	●	●
29. 你感到疲惫吗？	●	●	●	●	●	●
30. 你是一个快乐的人吗？	●	●	●	●	●	●
31. 你感到累吗？	●	●	●	●	●	●

32. 在过去 **4** 周内，您的身体健康或情绪问题有多少时间影响了您的社交活动（如拜访朋友、亲戚等）？

a. 无时无刻
b. 大多数时候
c. 有些时候
d. 少部分时候
e. 从来没有

以下每项陈述对您而言是正确还是错误。

		绝对正确	有点正确	不知道	有点错误	绝对错误
33.	我似乎比其他人更容易生病	●	●	●	●	●
34.	我和我认识的人一样健康	●	●	●	●	●
35.	我预计我的健康状况会变得更差	●	●	●	●	●
36.	我的健康状况非常好	●	●	●	●	●