The Levels of Availability and Access to Open Space and Its Outcomes on Health: The Case of Camden, London

Manasa Vinodkumar

Figure 1. Regent's Park, London. © Peter Lane / Alamy Stock Photo, 2019

Introduction

—

Today, urban green spaces, such as gardens, play areas, and suburban greenery, can promote physical and mental health, and reduce sickness and death in urban inhabitants by providing mental relaxation and motivating social unity, easing stress, supporting exercise, and reducing contact with air pollution, noise, and extreme heat (Takano et al., 2002). Urban green space can include publicly accessible areas with natural vegetation, such as grass, plants, or trees, and may include built environment features, such as urban parks while suburban, less managed areas, including woodland and nature reserves, tend to be found outside the city. Often social infrastructure is seen around urban green areas.

Green spaces comprise nearly half of London's surface area, equating to 31.69 sqm green space per person, of which parks (Figure 1) account for 16.13 sqm (Usborne, 2014). Green spaces are often used to provide controlled beneficial interventions for vulnerable groups such as young people at risk, persons living with depression, dementia or ill-health, and stressed workers. Interventions include creating pedestrian accessibility and creating or finding walkable areas in open, green spaces. For example, adolescents with behavioural or self-esteem issues spend weeks at a time in green spaces, which are then used as vehicles for reflection. Relevant psychological and behavioural improvements are frequently reported, such as enhanced self-esteem, self-efficacy, image, empowerment, control, self-confidence, and decision-making. For individuals living with dementia, interacting with green spaces can influence eating and sleeping rhythms, fitness and mobility, sense of comfort, self-confidence, and regulation related to enhanced social communication and a sense of fitting in.

London ranks a privileged 37th in the 2021 Cost-of-living Index rankings. Camden Borough, part of the city's centre, is an area that contains some of the most deprived wards and exhibits large health disparity gaps (MHCLG, 2019). These disparities are often influenced by socio-economic factors like housing, income, education, employment and so on that affects a healthy lifestyle. Camden's well-being measures go beyond access to medical facilities and include helping residents improve their social and physical health by giving them access to green and open spaces. The Camden Local Plan 2017 (SPI, 2017) refers to the availability of 4.3 sqm of green space per capita, which means 65.7 percent of homes in Camden deficient in access to local, small, or pocket parks. The Plan also outlines the intention of improving services and infrastructure.

As such, it is important to explore health impacts on the surrounding neighbourhoods and the measurable differences in access to green and/or open space within smaller neighbourhoods using spatial variables that account for local spatial configuration. This can be done through a series of tools and theories offered by space syntax analysis by identifying the impact of health values in regions of high social housing-residential density through metric step depth and catchment analysis to and from parks. This enhances the relevance of a study that can identify the multi-variables that influence usage of open and green spaces contributing to good health. Living in areas that offer mixed usage and easy connectivity, availability, and free access to all, can allow healthy networks. This study can be used to understand by certain areas within the same regions that have varying health levels. Thus, do people living in low deprivation areas have greater access to parks and streets with good walkability than those in low deprivation zones?

City Walkability: A Conceptual Overview

—

Walking is said to influence health. Based on studies interlinking urban morphology, land use location, and routes taken by users, good walkable areas are considered enablers of active neighbourhoods (Geddes & Vaughan, 2014). Street-level greenery can impact walkability, since, for example, people choose routes that are greener. Rapid urbanisation can deplete green coverage, which may have negative effects on residents' health and well-being (Yi et al., 2018). Studies on green space, urbanity, and health reveal show how these spaces in a 1 to 3 km radius or in local neighbourhoods can have positive impacts specifically in urban areas (Maas et al., 2006). Findings from Greater London boroughs reveal green spaces influence active travel (walking and cycling) and physical activity, and, therefore, health and mortality levels, which is studied against vehicular movement needs to encourage the creation of shared spaces (Sarkar et al., 2015).

The theory of cities as 'movement economies' (Hillier, 1996) derives from 'natural movement' (Hillier et al., 1993) that affects land use distribution across a city, which helps identify angular and metric attributes (Hannan & Freeman, 1977). The integration shows the sum of the shortest path between origin and destination. The higher its value, the likelier it is to become 'to-movement'. Choice shows the path overlap between origin and destination: the higher the value, the more likely it will be used as a through-movement path. These ideas are derived from graph theory describing the 'to and through movement potentials', i.e., configuration of streets and public spaces by users and how they transit within the streets of the city.

The physical attributes of a neighbourhood can affect the social 'behaviour' of its residents (Hickman, 2013). Therefore, as a result, not surprisingly, more of their social interactions occurred in open places (Sennett, 1992; Goodchild, 2008). The regions that are not centres have lower local and global choice at increasing radii values until they are consistent at global choice. This know-how can help decode the reasons for health level reports in different areas by understanding the position of activities within the community.

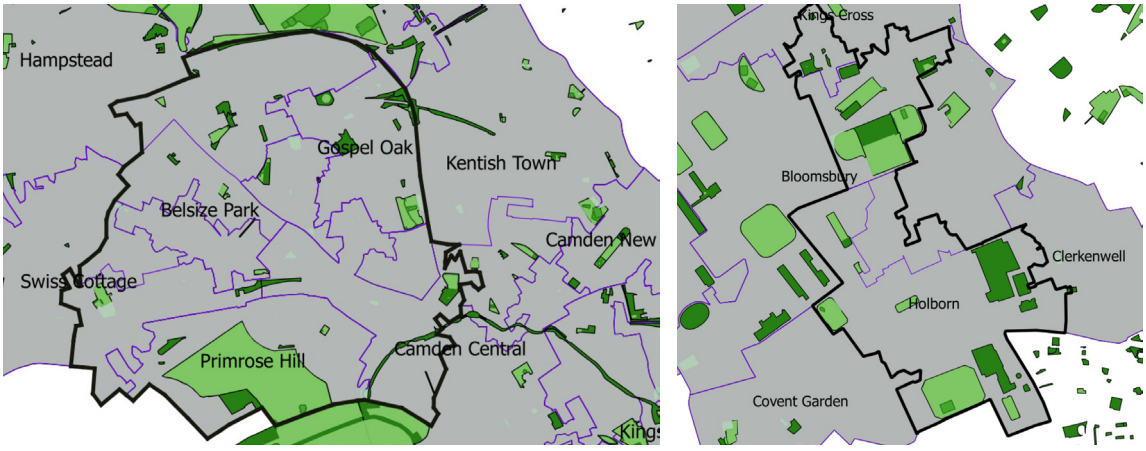


Figure 2. The boundaries of Study Areas 1 and 2 chosen for the study. Source: Author

Datasets and Methods

—

Study area and methodology

For the purpose of this study, two areas within Camden were selected (Figure 2). Study Area 1 is larger and bordered by metropolitan parks, whereas Study Area 2 has only pocket parks. These features were selected in order to exhibit the differences between the two zones in terms of availability and access. Hence, this research addresses the main question: What are the differences between Study Areas 1 and 2 in terms of their ratios of open to green spaces? However, access to social infrastructure (gyms, recreational spaces, shops, and activities for leisure) also plays a role in the reported health levels of a space. Therefore, the study will identify whether these facilities contribute to a measurable difference in health levels in areas 1 and 2 with the understanding that regions in study area 2 have more social infrastructure available.

The research follows a basic outline of using data within these areas mapped onto Geographical Information System (GIS) maps. Socio-economic data and Indices of Deprivation* are collected at the level of Lower Layer Super Output Areas (LSOAs) for both Study Area 1 and 2. In parallel, spatial models for these areas are prepared. The availability of open areas and green areas is measured against social infrastructure and social housing. This is done through angular segment analysis, metric step depth (from parks and social housing units) and catchment analysis of the areas around parks and social housing. Finally, the differences are noted and statistically tested, which is analysed with correlations and regression models.

Scope of study

The spatial accessibility and socio-economic parameters that are relevant to the impact study have been chosen by counts of social infrastructure, residential density of social housing, and number of green and open spaces available in the selected area. These are selected since they are important for comparing access and availability between areas of high and low health deprivation that can be traced back to areas of high or low residential density social housing units. Since health levels also suggest a significant connection to third places, the social infrastructure count of the region has been considered.

Mapping health

A question on self-assessed general health was included in both the 2001 and 2011 Censuses. In 2011, each member of a household was asked to rate their health in general. Unlike simple indicators based on the presence or absence of disease, an important property of the general health status indicator is that it includes the entire spectrum of health states ranging from ‘good’ to ‘not good’ health (Office for National Statistics, 2021). As a result, 81.2 percent of people reported their general health as either ‘very good’ or ‘good’ in London.

Angular segment analysis

An angular segment analysis was performed, the maps were stylised in QGIS. The spatial data were summarised to derive values of normalised angular integration (NAIN) and normalised angular choice (NACH) at selected radii for Study Areas 1 and 2 which are helpful for comparison. The distance measured is calculated through angular change due to movement from one segment to another, which

reflects people's actual movement patterns from space to space rather than intersections (Dhanani et al., 2017):

NACH = LOGCH+1/LOGTD+3
NAIN = NC^1.2/TD

Step depth and catchment analysis

Step depth shows the shortest angular path from a selected segment to all other segments within the system. The study aims to use the local centres identified as the selected segment to calculate step depth to all the segments in the system. Catchment analysis enables the examination of usage in a contained boundary to evaluate the walking accessibility of the chosen areas by the inhabitants. For both step depth and catchment analysis, a buffer zone is created depending on the intensity of the adjacent land use which helps define the buffer size through distance. The data is then merged with the segment, using a spatial join.

Availability ratios

To calculate availability ratios of each ward, social housing and social infrastructure in the region were mapped along with green and open spaces to compare the data for highly health deprived LSOAs and lesser deprived LSOAs. Each LSOA was given a number sequentially. The availability ratios for the following categories were observed:

- Ratio 1: social housing (residential density): open spaces
- Ratio 2: social housing (residential density): green spaces
- Ratio 3: open spaces: green spaces
- Ratio 4: green spaces: open space
- Ratio 5: social housing: social infrastructure

Results

The values of NACH and NAIN were taken for R400, R800, R1000, R2000, R3000, and R5000 to show variations in the local and global scale. These are normalised measures so that they can be compared on various scales in different cities of different sizes.

Normalised angular choice

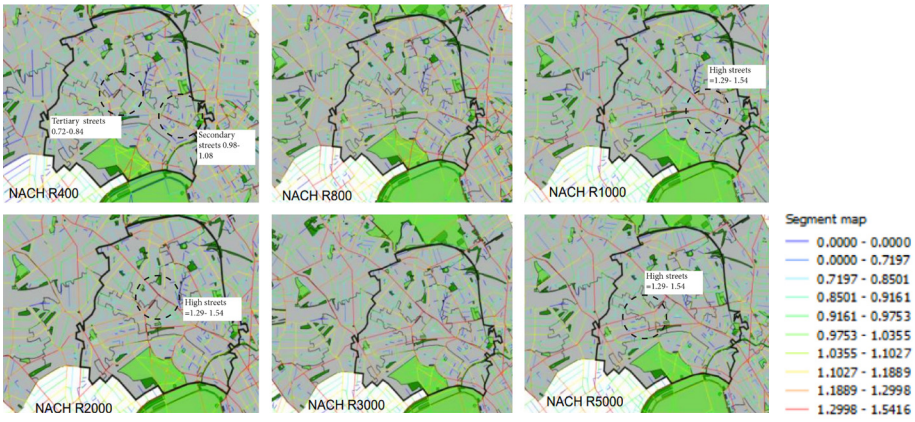


Figure 3a. Values for NACH R 400 to NACH R5000 for Study Area 1. Source: Author

Study Area 1: Normalised Choice value (Figure 3a) is higher on the high streets (Source-OSM) running across Camden and its perimeter at NACH R800, NACH R 1000, and NACH R 2000. There is high choice value on main streets (value = 1.29-1.54) and neighbourhood borders. However, at NACH R400 the value falls at the inner secondary (0.98-1.08) and tertiary street level (0.72-0.84).

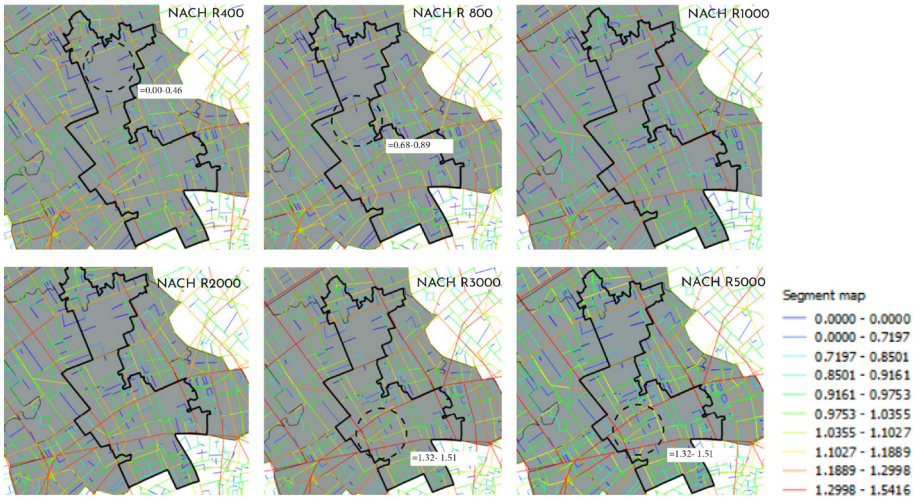


Figure 3b. Values for NACH R 400 to NACH R5000 for Study Area 2. Source: Author

Study Area 2: NACH R400 and NACH R800 indicated that the main roads cutting across the neighbourhoods have higher values and the inner tertiary routes have least choice, seen in blue (value = 0-0.89). NACH R3000 and NACH R5000 show high choice values of streets cutting through the centre of the neighbourhoods within the study area (1.10-1.46). The circled values indicate range of the region (Figure 3b).

Normalised angular integration

Study Area 1: NAIN R400 and NAIN R800 indicated that the main roads of the neighbourhood boundaries are highly integrated, and the inner routes are much less integrated (the value drops from 1.54 to 0.91). Near the neighbourhood boundaries

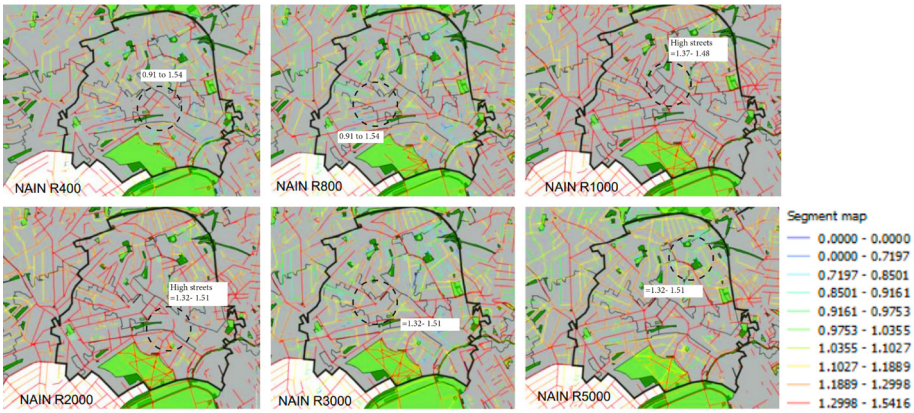


Figure 4a. Values for NAIN R 400 to NAIN R5000 for Study Area 1. Source: Author

at R1000 and R2000 the values are higher (between 1.32-1.51). NAIN R3000 and NAIN R5000 show a highly integrated street network in most neighbourhoods (slightly lower, 0.72-0.85 within the regions of a large park towards the north of Camden). Circled values indicate range of the region (Figure 4a).

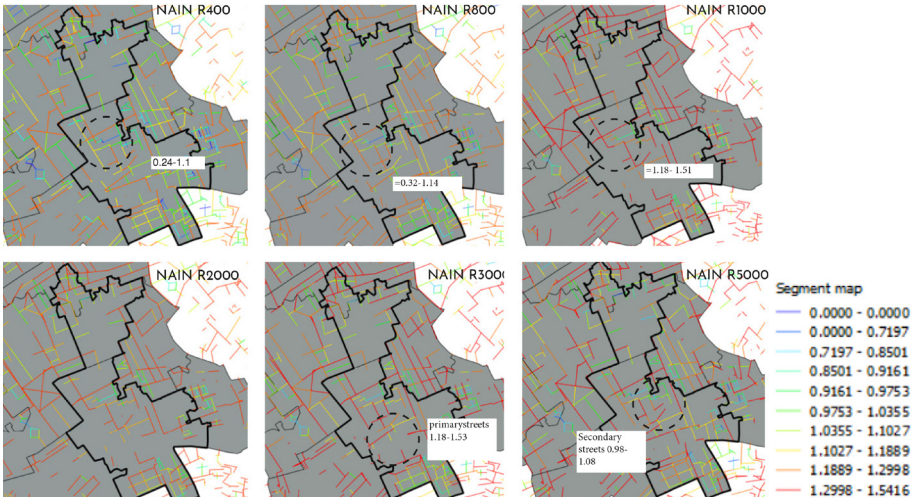


Figure 4b. Values for NAIN R 400 to NAIN R5000 for Study Area 2. Source: Author

Study Area 2: NAIN R400, NAIN R800 have very few streets with high integration (0.24-1.1) but in NAIN R1000, most streets are highly integrated within each LSOA. The values fall for tertiary street connections. NAIN R3000 and NAIN R5000 shows highly integrated primary and secondary streets. The circled values indicate range of the region (Figure 4b).

Catchment analysis

Study Area 1A: A spatial join was used to join the health deprivation data to the segment map (Figure 5a) and map it against Choice R1200. The centres of each LSOA have high choice (2-350) value, indicating the internal areas are well used. The areas near metropolitan open and green spaces have lower choice value (600-980).

Study Area 1B: A spatial join was used to join the park access points on the segment map and identify access to social infrastructure around them within a ten-minute walking distance (Figure 5b). This region has social infrastructure or third places centrally as opposed to near the boundary of the metropolitan park within each ward indicated by high values (82-194).

Study Area 2A: A spatial join between Health deprivation levels and Choice R1200 was made (Figure 5c). It is seen that less deprived areas lying in the northern region of the study area have higher choice values (3 -112) compared to the south, which has higher health deprivation rates and lower choice (846-972).

Study Area 2B: A spatial join was made between the access points of the parks in the study area on the segment map and the resulting data plotted against social infrastructure (4-91) available in the region (Figure 5d). All the wards have high access to social infrastructure towards the western ends of the study area from the parks.

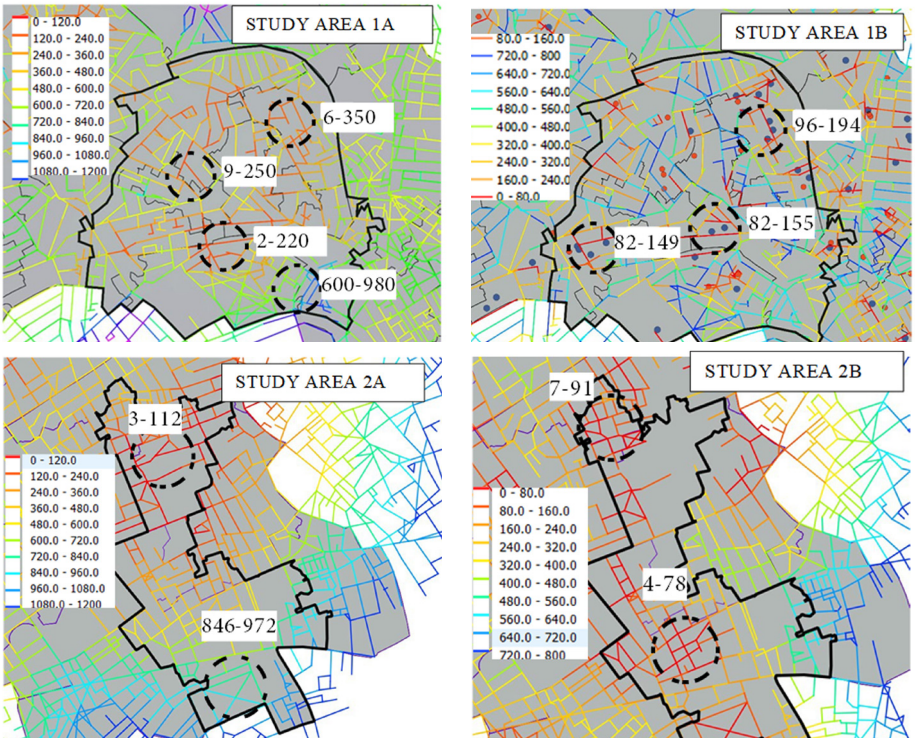


Figure 5a. Catchment analysis - Study Area 1A - Health deprivation and Choice R1200. Source: Author
Figure 5b. Catchment analysis - Study Area 1B - Parks to Social Infrastructure R800. Source: Author
Figure 5c. Catchment analysis - Study Area 2A - Health deprivation and Choice R1200. Source: Author
Figure 5d. Catchment analysis - Study Area 2B - Parks to Social Infrastructure R800. Source: Author

Step depth analysis

A metric step depth analysis was conducted to railway stations in study areas 1 and 2 to compare access to transport within a ward unit surrounded by green and open spaces (Figure 6). Study Area 1: Railway stations lie along the high streets or very close to major road junctions. The centre of the study area also has a few stations, allowing access to the railway both in the centre and on the periphery. Study Area 2: The study area has access to railway stations at its western end. The values are higher (5- 122) around the railway station but fall at its periphery. The main roads connecting to high streets have low values (1541-1801).

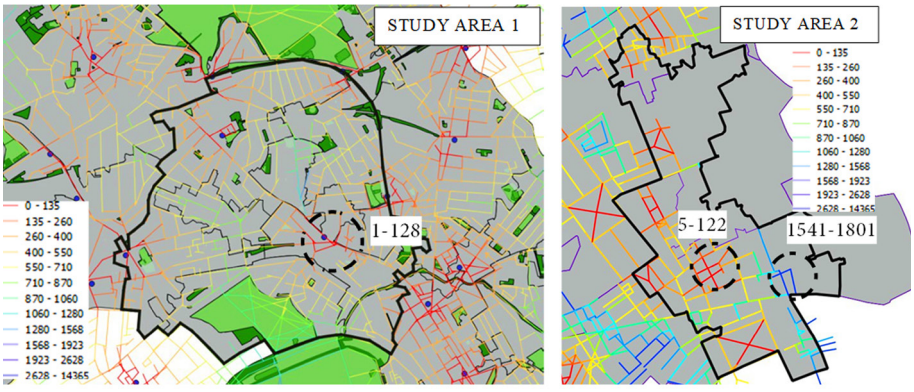


Figure 6. Metric step depth analysis: railway stations for Study Areas 1 and 2. Source: Author

Availability ratio

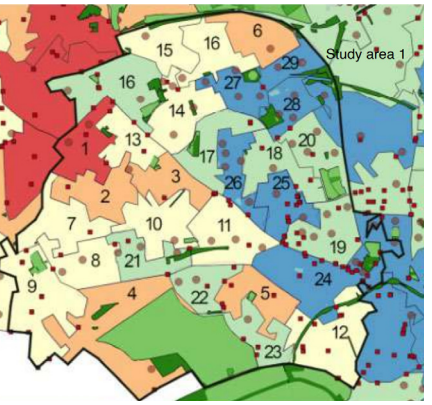
Study Areas 1 and 2 (Figure 7) were divided into their LSOA units and the values reported for health deprivation were plotted using Census data. The most deprived region lacks open and green spaces. The average value for each ratio was calculated based on the health deprivation colour for the region and shows the availability of open and green spaces and social infrastructure put side by side. Study Area 1 shows a higher overall ratio of open-green spaces because it is a larger area (Graph 1, Figure 7). However, the social infrastructure value is higher in Study Area 2 even though there are fewer parks, and it is not close to any large metropolitan area (Graph 2, Figure 8).

RATIO 1
social housing (residential density): open spaces

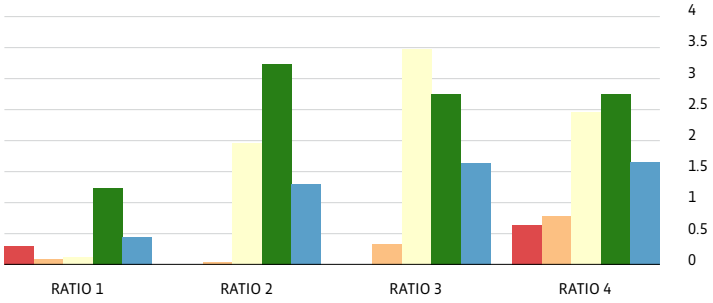
RATIO 2
social housing (residential density): green spaces

RATIO 3
green spaces: open space

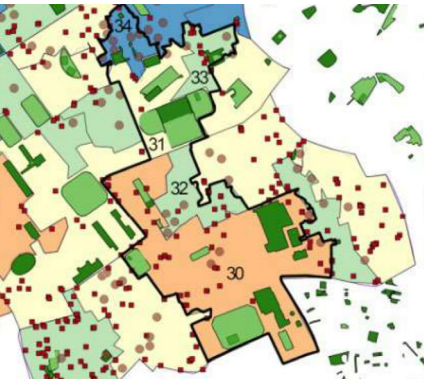
RATIO 4
social housing: social infrastructure



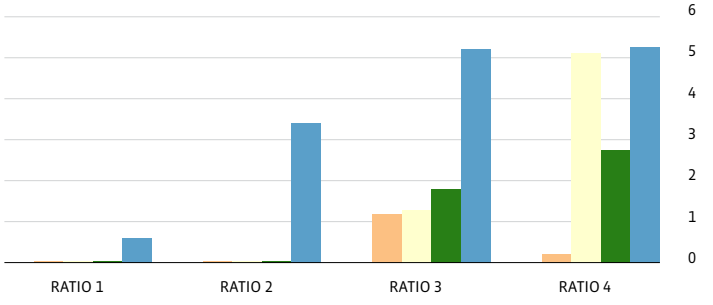
	RATIO 1	RATIO 2	RATIO 3	RATIO 4
RED	0,3	0	0	0,62
ORANGE	0,088833333	0,037166667	0,32	0,789333333
YELLOW	0,137646683	1,962578281	3,472453163	2,455555556
GREEN	1,24600887	3,213043684	2,733044357	2,733044357
BLUE	0,443122222	1,303197158	1,63137438	1,649483311



Graph 1. Availability ratio in Study Area 1. Source: Author
Figure 7. Availability ratio in Study Area 1. Source: Author



	RATIO 1	RATIO 2	RATIO 3	RATIO 4
ORANGE	0,017	0,02	1,18	0,2
YELLOW	0,03	0,04	1,26	5,1
GREEN	0,032	0,04	1,81	2,75
BLUE	0,59	3,4	5,19	5,25



Graph 2. Availability ratio in Study Area 2. Source: Author
Figure 8. Availability ratio in Study Area 2. Source: Author

Conclusions

—

From the segment map, catchment and metric step analysis, it is clear that the areas of high integration and choice have a local or pocket park within the neighbourhood they border. Highly integrated streets contain social infrastructure, lesser within the study area comparing to the centre. Access to social infrastructure along highly integrated streets within north and south wards is lacking compared to the central wards. As for the availability ratio, the regions in red (high deprivation) near the Belsize Park have almost no open and green spaces, while regions in blue (low deprivation) have higher values of open and green spaces, as well as social infrastructure values. Small deficiencies of access to open and green spaces are noticed along Haverstock Hill in Gospel Oak (east end) and the edge of Kentish Town's west end, with large deficiencies towards the southwest edge of Hampstead Town and Swiss Cottage. The results of linear regression indicate that out of the selected independent variables only residential density has a strong and positive Pearson's Correlation value (0.731) and the corresponding P value of .000 indicates that this correlation is also statistically significant.

Health depreciation is studied to identify direct impacts of the surrounding areas in Camden. It is understood that the extent of impact on health is limited to walking distance from parks, and the local communities lack extensive health benefits since no significant correlation was found. However, catering to people living in social housing units, particularly in deprived areas, by improving availability and accessibility of open green spaces and social infrastructure can improve health levels. For radii between 1,200 and 2,000 m from a park, it can be said with certainty that the health of residents increases closest to the park and decreases as one moves away. There are deficiencies in both study areas where not all residents have access to metropolitan parks within 3,200 m from home, district parks within 1,200 m, and pocket parks within 400 m from home. There is no significant advantage of living closer to a metropolitan park versus a local park. Study Area 1 has two major metropolitan parks around it and one inside it, while Study Area 2 has no metropolitan park nearby, but the health values of Study Area 2 show less deprived outcomes. Thus, it is advantageous to have any green or open space around. The limitation, however, is that the area chosen and the sample size for health deprivation values are lower in Study Area 1 than in Study Area 2, hence, no perfect comparison can be made. Though many people use open and green spaces for health benefits, access to a holistic combination of open-green and social infrastructure within a region could contribute to healthier, more inclusive communities.

Use of space cannot be attributed to just spatial variables, since many social and psychological factors, including motivation and personal tastes, and other local and global phenomena, such as bad weather and pandemics like Covid-19, constrain the use of green or open spaces. Even the time of day may be a factor. Also, only about 70 percent of the residents participated and reported health levels in the Census. Finally, for this study, only general health is considered, and other factors, such as various mental illnesses, provision of unpaid health care, and long-term disability were not considered.

—

Endnote

* The Index of Multiple Deprivation ranks every small area in England from 1 (most deprived area) to 32,844 (least deprived area) (Office for National Statistics, 2021). Deprivation 'deciles' are published alongside ranks. Deciles are calculated by ranking the 32,844 small areas in England from most deprived to least deprived and dividing them into 10 equal groups.W

References

Dhanani, A., Tarkhanyan, L., & Vaughan, L. (2017). Estimating pedestrian demand for active transport evaluation and planning. *Transportation Research Part A: Policy and Practice, 103*(C), 54– 69.

Geddes, I. & Vaughan, L. (2014). *Why Do People Walk in the Suburbs? An Analysis of How Spatial Configuration and Land Use Diversity Contribute to Walkability*. Working Paper 1/2014. London: University College London.

Goodchild, B. (2008). *Homes, Cities and Neighbourhoods: Planning the Residential Landscapes of Modern Britain*. Aldershot: Ashgate.

Hannan, M. & Freeman, J. (1977). The Population Ecology of Public Organizations. *American Journal of Sociology, 82*(5), 929–964.

Hickman, P. (2013). "Third places" and social interaction in deprived neighbourhoods in Great Britain. *Journal of Housing and the Built Environment, 28*(2), 221–236.

Hillier, B. (1996). *Space Is the Machine: A Configurational Theory of Architecture*. Cambridge: Cambridge University Press.

Hillier, B., Penn, A., Hanson, J., Grajewski, T., & Wu, J. (1993). Natural Movement: or, Configuration and Attraction in Urban Pedestrian Movement. *Environment and Planning B, 20*(1), 29–66.

Maas, J., Verheij, R.A., Groenewegen, P.P., Vries, S., & Spreeuwenberg, P. (2006). Green Space, Urbanity, and Health: How Strong Is the Relation? *Journal of Epidemiology and Community Health, 60,* 587–592.

MHCLG (Ministry of Housing, Communities and Local Government). (2019). *English Indices of Deprivation 2019 – Summaries at Local Authority Level*. https://opendatacommunities.org/data/societal-well-being/imd2019/indicesbyla. Accessed on June 22, 2022.

Office for National Statistics. (2021). *Calculating IMD*. https://assets.publishing.service.gov.uk. Accessed on June 22, 2022.

Sarkar, C., Webster, C., Pryor, M., Tang, D., Melbourne, S., Zhang, X., & Jianzheng, L. (2015). Exploring Associations between Urban Green, Street Design and Walking: Results from the Greater London Boroughs. *Landscape and Urban Planning, 143*, 112–125.

Sennett, R. (1992). *The Conscience of the Eye: The Design and Social Life of Cities*. London: Faber and Faber.