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Faculty of the Built Environment
The Bartlett School of Planning

Stepping into Elderly Londoners' Shoes: Exploring Walking Behaviours and Perceived Walkability in Various Neighbourhoods

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Being a dissertation submitted to the faculty of The Built Environment as part of the requirements for the award of ***MSc Transport and City Planning*** at University College London:

I declare that this dissertation is entirely my own work and that ideas, data, and images, as well as direct quotations, drawn from elsewhere are identified and referenced.

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Abstract

In the context of an aging population, there is an emerging imperative to design walkable communities catering to the elderly. Even in the cosmopolitan city of London, there is a conspicuous gap in investigations regarding how older citizens perceive walkability. It is worth noting that such perceptions critically shape their willingness to engage in walking activities.

The core research objective is to identify the determinants of walking behaviours and perceived walkability among seniors across various neighbourhoods in London, whilst also illuminating the relationship between them. A quantitative analysis was conducted on a sample size of 200 elderly individuals in Ealing, London. Utilizing a modified version of the Neighborhood Environment Walkability Scale for British Seniors, both linear and logistic regression models were employed to decode the data.

The research confirms that the adapted NEWS is apt for assessing perceived walkability among seniors in London. It further demonstrates that socio-demographic factors and neighbourhood type, informed by Socio-Economic Status and Walkability, are critical in shaping their perceptions. As a consequential finding, it is evident that certain perceptions significantly influence the walking patterns of the elderly in studying area.

1. Introduction

1.1 Background

According to the Office for National Statistics (2023), the proportion of the elderly population[1] residing in England and Wales has witnessed an increase from 16.4% in 2011 to the figure of 18.6% in 2021. Despite being a metropolitan area, London has also experienced continuous growth in the elderly population, with numbers increasing from 891,590 in 2001 to 904,749 in 2011 and further to 1,043,271 in 2021 (Census 2001, 2011, 2021). Accompanying this trend is a concern for their mobility and accessibility. As individuals age, their mobility tends to decrease, posing challenges in terms of travelling and navigation, even within their local communities. This can lead to a sense of isolation and a decline in overall well-being. As a senior participant expressed in Angele Storey's article (2022), 'I am blessed to be able to move about … Losing my independence would really bite into me'.

In addressing this challenge, it becomes particularly crucial to consider mobility from a walking perspective. This is attributed to the comprehensive nature of walking, which not only includes simple pedestrian activities but also serves as a key component in the integration of various transportation modes. Studies have shown that activities and services located within short distances will prompt a higher likelihood for the elderly to opt for walking (Shergold, Parkhurst and Musselwhite, 2012). Furthermore, as many cities prioritize senior-friendly development with a focus on public transport, the act of walking to public transit stops often experiences an increase (Coronini-Cronberg *et al.*, 2012). Therefore, improving walkability would substantially increase the age-friendliness of the city (Klicnik and Dogra, 2019).

Walkability refers to the degree to which an environment is intentionally designed to be pedestrian-friendly. It includes micro-scale elements like wide sidewalks and well-lit streets, as well as macro-scale aspects such as density and diversity that impact travel distances. However,

1 As provided by Public Health England (2019), older age is typically defined as 65 years and above in developed countries, with further subdivisions: young-old (65-74), old (75-84), and old-old (85+). This paper adopts these standards for referencing older individuals.

simply offering these facilities is insufficient. It is equally important for seniors to perceive the environment as walkable, as it fosters a sense of comfort and willingness to walk. Therefore, improving the walkability and perceptions of seniors in communities is a crucial step towards creating more liveable and equitable cities.

1.2 Research Questions

In light of the context provided, this dissertation aims to investigate the determinants of walking behaviours and perceived walkability among the elderly population in London, as well as identify strategies to improve their perceptions and encourage them to walk. This objective has several implications for urban planning, as it calls for an assessment of the current pedestrian environment and an emphasis on its improvement. It also raises broader questions about how to design communities that are inclusive and accessible for people of all ages and abilities.

To address this objective, this dissertation has formulated the following research questions:

- In London, what are the typical walking duration, distance, frequency, and objectives for the elderly, and how do they perceive the walkability of their surroundings?
- How is the questionnaire designed to evaluate the perceived walkability of neighbourhoods among elderly individuals in London?
- How do the neighbourhood type and socio-demographics influence walking behaviours and perceived walkability for London seniors?
- What is the relationship between walking behaviours and perceived walkability?

1.3 Outline Structure

Subsequently, Chapter 2 will conduct a comprehensive review of the existing literature on walking behaviours, walkability, perceived walkability and measuring methods. Following this, Chapter 3 will outline a detailed methodology for this study. Chapter 4 will present the results, while Chapter 5 will initiate a discussion based on in-depth analysis and major findings. Finally, Chapter 6 will offer conclusions and future considerations.

2. Literature Review

2.1 Walkability

Research on walkability can be classified into two distinct levels: macro and micro, which provide different perspectives for defining the concept of walkability and assessing it. At the macro level, walkability refers to the degree of support offered by urban environments for pedestrian activities, with the overall structure of cities serving as the main focus. This viewpoint is supported by Shields *et al.* (2021), who believe the broad concept of walkability can be considered as a quality that arises from the features of the urban form. In his view, the quality favours various elements, including the accessibility to various services, street connectivity, and population and building density. It covers a wide range of domains, such as transport and city planning, land use, and environmental characteristics.

On the micro scale, walkability refers to the specific design details experienced by pedestrians while walking. Previous literature has placed a greater emphasis on street designs, as well as their impact on the walking experience. Through qualitative research methods such as focus groups and interviews, these studies have identified prominent architectural and environmental features that are most conducive to walking in the local context. Key influencing factors may include lighting, pavement quality, safety measures, parking facilities, aesthetic features (Abastante *et al.,* 2020) and other unique factors such as stairs and slopes, as observed in a study conducted in Portugal (Alves *et al.,* 2021).

However, the existing literature on walkability has primarily centred on public health, accounting for approximately 70% of the research (Wang and Yang, 2019). For instance, studies have examined the relationship between walkability and residents' physical activity (Kolbe-Alexander *et al.,* 2015), obesity (Wen and Kowaleski-Jones, 2012), cardiovascular health (Müller-Riemenschneider *et al.,* 2013; Adhikari *et al.,* 2021), lower respiratory diseases (Simons *et al.,* 2018) and mental health (Li *et al.,* 2021). In addition, walkability can also be linked to various social issues, such as social equality. An illustrative instance can be found in the work written by Bartzokas-Tsiompras, Tampouraki and Photis (2020). They conducted a

pedestrian street scene assessment to examine the walkability in eight European cities, aiming to investigate the inequalities in social benefits within urban areas. Nonetheless, there has been limited attention paid to other factors that contribute to transport and urban studies.

Furthermore, as Ramakreshnan *et al.* (2021) stated, most of the existing research on walkability has been undertaken in the United States (389 studies), followed by Canada (136 studies) and Australia (133 studies). This could be attributed to the challenges faces by many cities there, such as a heavily car-dependent transportation system (Speck, 2012) and an increasingly ageing population. Given these challenges, local governments have placed significant emphasis on walking as an alternative green mode of transportation when formulating their policies. And this is a perspective that is often underestimated or overlooked in other countries (Mateo-Babiano, 2016). Another possible reason is that Canada and the US have a longstanding history of studying liveable cities, with ample researchers, funding, and facilities dedicated to this field. Consequently, the emphasis on the environment and liveability has motivated researchers to focus on improving pedestrian environments. In comparison, the United Kingdom, despite being positioned sixth along with Brazil in this ranking, has only produced only 31 studies in this field (Ramakreshnan *et al.*, 2021). Moreover, there is a notable lack of research specifically addressing walkability for older adults in England. One example from the few existing literature is authored by Zandieh *et al.* (2017), which focuses on the walkability and equity of older adults in Birmingham. However, this study primarily emphasizes macro-level factors, particularly the impact of land use.

2.2 Walking Behaviour and Walkability of Seniors

The ageing population in London is prompting an urgent need to address the mobility and accessibility challenges faced by elderly residents in the city. According to GLA City Intelligence (2022), the proportion of individuals aged 65 and above is expected to increase from 12.2% in 2020 to 18.0% in 2041 based on the housing-led population. In parallel, elderly individuals who have limited mobility often face feelings of isolation and social exclusion (Lamanna *et al.*, 2020; Sen and Prybutok, 2021). Consequently, this demographic shift highlights the importance of ensuring that the urban environment is conducive to elderly

mobility.

Currently, there exists a substantial body of literature focusing on the vehicular travel behaviour of older adults (Fisker, 2011; Fordham, Grisé and El-Geneidy, 2017). For instance, the research by Li *et al.*(2012) highlights the increasing reliance on motorised cars among the elderly, showing more frequent yet shorter trips. However, overreliance on automobiles can also contribute to sedentary lifestyles (Owen *et al.*, 2011) and thus pose risks to health (Musselwhite, Holland and Walker, 2015). On the other hand, walking offers a multitude of advantages, as discussed in Chapter 2.1 Therefore, studying the walking behavior of the elderly is of great importance.

The majority of research on walking behaviour among seniors has predominantly focused on travel frequency. For instance, Bempong and Asiamah examined the correlation between walkability, social activity, and the frequency of walking among the elderly in Ghana (2022). Similar studies on walking frequency can also be found in other countries worldwide, such as Spain (Romo, Schwingel and Chodzko, 2012), the US (Sawchuk *et al.*, 2011), China (Zhang *et al.*, 2014; Ma *et al.*, 2022) and Australia (Boakye-Dankwa *et al.*, 2019). Furthermore, walking distance, or trip length, has become the buzzword in this field. Research conducted by Moniruzzaman *et al.* (2013) has focused on exploring walking distances as a function of age in Montreal, Canada while Macioszek *et al.* (2022) studied the distance intervals' impact on walking probability based on data from Qazvin, Iran. However, the duration and purpose of the journey are not given much consideration.

In parallel, the walkability for seniors has received little attention even though walking is a necessity and the most realistic form of transport for them (Duncan *et al.*, 2021). According to Klicnik and Dogra (2019), Some of their walkability characteristics, such as slow paces and the need for rest benches, are not well considered in urban planning and street design. Furthermore, particular requirements like the availability of toilets, which Cerin *et al.*(2010) highlighted in a study done in Hong Kong, and the supply of shelters or shade during extreme weather

conditions as Loukaitou-Sideris *et al.* (2016) found in Los Angeles, are also overlooked. In addition to these infrastructure elements, Zandieh *et al.* emphasizes the significance of aesthetics and safety as other key aspects of 'the micro built environment' (2016, p. 2), noting the profound impact on seniors' walkability. One possible reason is that they desire to savour the process of travelling, beyond merely reaching the destination. It is also supported by Graham *et al.* (2020) based on interviews with elderly individuals. In light of it, when it comes to walkability, dense land use and well-connected streets ensure that people can reach their destinations. On the other hand, these micro things pay more attention to the individual's actual perception, as they directly influence the details of travel.

2.3 Perceived Walkability

Perceived walkability refers to the subjective perception of an individual regarding the extent to which their environment encourages walking (Oreskovic *et al.*, 2014). It highlights the subjectivity of the walking environment, whereas walkability can be regarded as the objective measurement of a place's pedestrian-friendliness. Therefore, whilst objective walkability does have a bearing on perceived walkability, the subjective essence of the latter makes it more susceptible to individual factors. For instance, Ma and Cao (2019) developed a structural equation model focused on shopping-related travel, and uncovered the direct influence that travel attitudes have on perceived walkability. Age is another significant factor to consider. Kent, Ma and Mulley (2017) conducted a quantitative analysis of households in Sydney. They identified a U-shaped relationship between age and life satisfaction, which in turn exhibited a positively correlated with perceived walkability. In parallel, it has been demonstrated that subjective perceptions are also influenced by their level of education and income. The research conducted by Gebel, Bauman and Owen (2009) indicates that those with lower incomes and less education are more likely to think the environment is less walking-friendly than it actually is. Moreover, van der Vlugt, Curl and Wittowsky (2019) identified the availability of alternative transportation modes, such as cars, as another influential factor based on the research conducted in Nottingham, UK. Interestingly, this factor did not demonstrate a significant influence in Hamburg, Germany (ibid). This suggests that, in addition to individual factors, perceived walkability also varies because of the social contexts.

There exist diverse viewpoints on the relationship between perceived walkability and physical activity. Some argue that the perception of walkability does not significantly influence physical activity, as demonstrated in the study of US college students by Bartshe, Coughenour and Pharr (2018). Chor *et al.* (2016), however, believe that perceived walkability has a favourable impact on physical activity after researching over 14,000 Brazilian servants. Consistent with this point of view are Hanibuchi *et al.* (2015), who further pointed out that objective walkability does not affect physical activity. But this notion is disproved by Marquet and Hipp (2019) in their study on American workers, asserting that both have a positive influence on physical activity. Supporting this viewpoint, Hinckson *et al.* (2017) further argue that subjective walkability matter more than objective ones after researching youngsters in New Zealand. In conclusion, the relationship between perceived walkability and physical activity is complex, affected by various factors like the target group and the unique research context.

The importance of perceived walkability has been demonstrated by a growing body of literature. For instance, similar to the positive correlation between objective walkability and weekly minutes of walking (Van Holle *et al.,* 2014), perceived walkability is also proven to positively influence walking duration by Yu *et al.* (2017). Furthermore, perceived walkability will affect the mode choice to transit nodes. The study in three different cities in South Korea by Ha *et al.* (2023) reveals that when people perceive the environment of the first/final last mile to be more walking-friendly, low-income commuters are more likely to walk instead of taking buses. In addition to its impact on transport, perceived walkability also influences the quantity and quality of social interactions and activities, thereby affecting community belongingness (van den Berg, Sharmeen and Weijs-Perrée, 2017). Another key advantage is that, since perceived walkability differs among individuals, research on vulnerable groups, such as the elderly, disabled and children, or those from diverse cultures can help shape inclusive walking spaces, thus creating a more equitable city.

2.4 Measuring Methods of Walkability and Perception

There are several approaches to measuring walkability. One popular method is Walk Score[2], which is based on the proximity of services and amenities in a city. With its website offering a quick reference indicator, Walk Score has the advantage of being straightforward to understand. But it does not consider factors such as safety, and only supports the cities in the US and Canada. A similar tool that applies to the UK is Opening Map GB[3] by Space Syntax, the 2km scale of which considers spatial accessibility and is suitable for measuring walkability. Furthermore, the studio developed a Walkability Heat Map based on buildings in 2020 and published a report (Tim Stonor, 2020). However, it is unfortunate that the entire database is not publicly accessible. Another approach is the Walkability Index (WI) proposed by L.D. Frank (2005), which has gained global application in countries like the Netherlands and China (Cowie *et al.*, 2016; Fan *et al.,* 2018; Lam *et al.,* 2022). In comparison to Walk Score, WI considers multiple variables such as density and land use. This comprehensive approach makes it complicated and requires substantial data support. In addition, there are other methods like Walk Opportunity (Kuzmyak, Baber and Savory, 2006) and Pedshed Connectivity (Porta and Renne, 2005). Detailed comparisons of these methods can be found in the study by Manaugh (2011).

However, there is evidence to suggest a disparity between perceived and actual walkability. For instance, Gebel *et al* (2011) tracked a group of people for four years and found that roughly one-third of the participants misperceived high-walkability neighbourhoods as being low whereas another third mistook low-walkable areas as high ones. In parallel, the former group showed a decline in walking duration and a trend for weight gain compared to people whose views align with objective levels. Therefore, there is a need for distinct measurements of perceived walkability.

The most commonly used method for measuring perceived walkability is the Neighborhood Environment Walkability Scale (NEWS), a self-report questionnaire assessing perceptions of

[2] https://www.walkscore.com/
[3] https://spacesyntax-openmapping.netlify.app/#13/51.4908/-0.1391

the neighbourhood environment. The scale was first developed by Saelens *et al.* in (2003). It comprises eight subscales, as shown in Figure 1(a), with a total of 67 items (ibid). Up to now, it has been validated worldwide, including in Australia, Brazil, India, Nigeria and more (Malavasi *et al.*, 2007; Cerin *et al.*, 2008; Oyeyemi *et al.*, 2013; Adlakha, Hipp and Brownson, 2016). In addition, several variants have been evolved to meet different research purposes, such as NEWS-A (Cerin *et al.*, 2006), the abbreviated form that captures the most salient aspects of walkability. Compared with NEWS, the number of items has been reduced to 54, and the subscales have been revised to include 6 multi-item subscales and 4 single items (ibid), as depicted in Figure 1(b). And it was proven effective after cross-validation (Cerin *et al.*, 2009). In parallel, it has been adapted based on the research groups. For instance, Rosenberg *et al.*(2009) proposed NEWS-Y, which is specifically designed for young individuals. Another example is NEWS-Chinese Seniors (Cerin *et al.*, 2010), which demonstrated how NEWS-A was applied to Asian cities and seniors. However, there is a limited application of the NEWS scale on perceived walkability for seniors, especially in the UK.

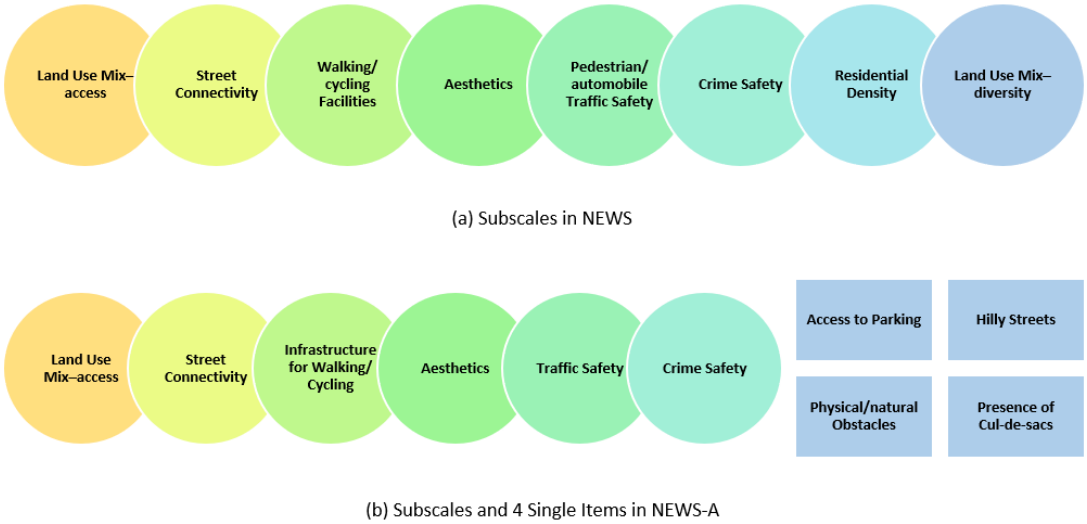


Figure 1 Factors across Different Versions of NEWS

2.5 Summary

The current state of knowledge on the research topic reveals a gap in the literature regarding walkability, particularly in the elderly population. While there have been several studies on walkability, most of these have focused on public health and physical activity. Few studies have explored walkability focusing on transportation, and even fewer have focused on elderly

individuals. In parallel, there is a lack of research analysing perceived walkability in the UK, particularly among the seniors. While some studies have examined objective measures of walkability, such as the built environment, few have focused on subjective perceptions of walkability.

In light of the gaps identified, this research aims to provide an in-depth understanding of the walking behaviour and perceived walkability of seniors in London based on NEWS. The findings will serve as valuable insights in guiding the development of targeted interventions to enhance walking-friendly urban environments, specifically focusing on the needs of older Londoners. Hence, the research will have significant implications for the creation of age-friendly and walkable cities.

3. Methodology

To achieve the research objective and address key questions, the study will employ a quantitative approach to analyse the data from collected questionnaires.

3.1 Site Selection

The study will focus on the built environment within one specific borough, specifically selecting four distinct neighbourhoods that represent different combinations of socioeconomic status (SES) and walkability. These neighbourhoods will be categorized as follows:

- Neighbourhood with low SES and high walkability.
- Neighbourhood with low SES and low walkability.
- Neighbourhood with high SES and low walkability.
- Neighbourhood with high SES and high walkability.

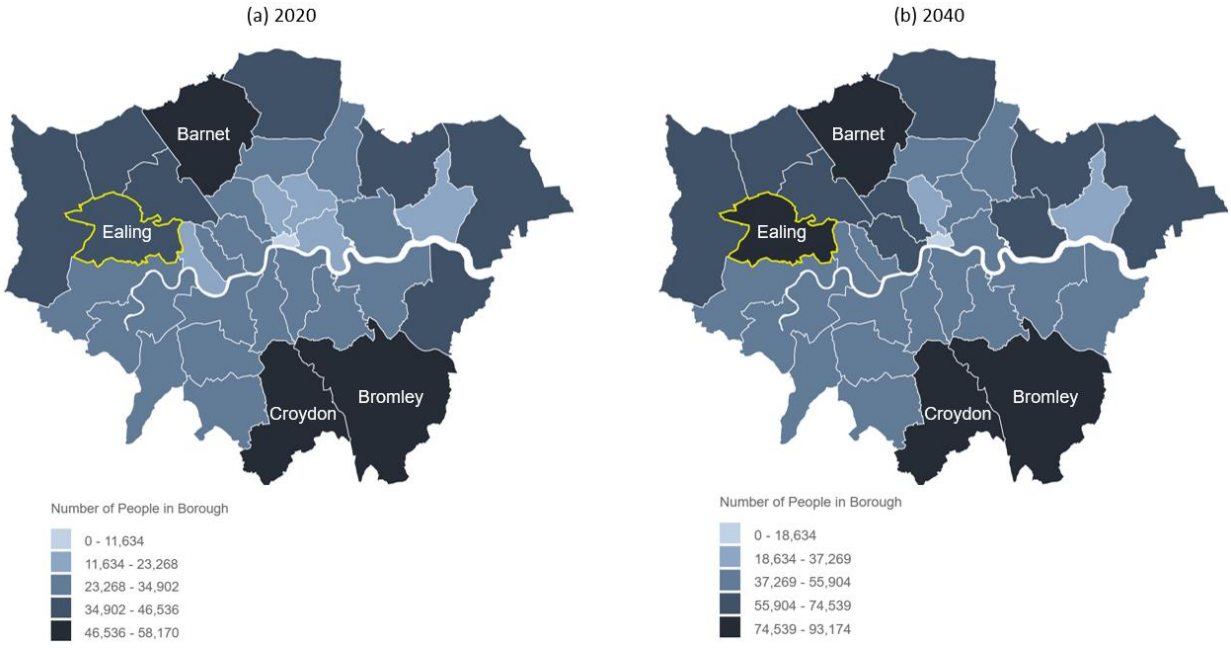


Figure 2 The Population (Aged 65-90) of 2020 and 2040 By Borough in London

To begin with, pinpointing the specific borough under discussion is essential. The London Population Projections Explorer[4] is used to categorise boroughs into five levels according to

[4] https://apps.london.gov.uk/population-projections/

its population aged 65 and above. As the aging trend, two heat maps are created to represent the years (a)2020 and (b)2040, as illustrated in Figure 2. Upon observation, four boroughs, namely Barnet, Croydon, Bromley, and Ealing, reached the top-tier category by 2040. However, only Ealing was positioned at the second-highest level in 2020. This distinction makes Ealing an ideal borough for further research, given its alignment with the study's context.

The second step is to determine the scale of the study. In most of the literature on perceived walkability, the number of participants ranges from 10 to 60 individuals per neighbourhood across different methods including interviews and questionnaires (Saelens *et al.,* 2003; Rosenberg *et al.,* 2009; Cerin *et al.,* 2010). Given it, this study seeks to collect 50 valid data sets from seniors within each unit. This ensures the reliability of the questionnaire results and subsequent analysis. In parallel, the majority of UK's population open data is usually summarized using three scales: Output Areas (OA), Lower Layer Super Output Areas (LSOA), and Middle Layer Super Output Areas (MSOA). Table 1 illustrates their attributes. Considering the proportion of the elderly population in Ealing, survey response rates, and other potential circumstances leading to participant withdrawal, LSOA has been selected as the scale for neighbourhood segmentation. There are 199 LSOAs in Ealing in total.

Levels	Number of Households	Number of Population	Total Number in England
OAs	40~250	100~625	
LSOAs	400~1,200	1,000~3,000	33,755
MSOAs	2,000~6,000	5,000~15,000	6856

Table 1 Characteristics of Levels of Census Geographies, data from (*Census 2021 geographies*, 2022)

The third phase is selecting four targeted neighbourhoods. Given the available open data in the UK, The Index of Multiple Deprivation (IMD) 2019 is selected as a metric for SES. It is composed of 7 different domains with details shown in Table 2. The index divides LSOA into a 10-level scale by combining weighted scores and ranks from sub-indicators. Level 1 represents the most deprived areas, while level 10 corresponds the least. The SES outcomes in Ealing are mapped in Figure 3.

Domains	Weights
Income	22.5%
Employment	22.5%
Health Deprivation and Disability	13.5%
Education, Skills Training	13.5%
Crime	9.3%
Barriers to Housing and Services	9.3%
Living Environment	9.3%

Table 2 IMD Domains, data from (Bowie Penney, 2019)

Figure 3 Ealing by SES Levels (LSOA Boundaries), author based on IMD (2019)

In line with WI, residential density and street connectivity are chosen as parameters of neighbourhood walkability. The steps in QGIS are outlined in Figure 4. Residential density (households/km²) is calculated based on Census 2021, with its visualization available in Figure 5. In parallel, street connectivity (intersections/km²) is assessed based on the road network data from OpenStreetMap[5]. A detailed breakdown of this process is provided in Figure 6: (a) displays the road network, (b) shows the identified road intersections, and (c) visualises the intersection density.

[5] http://download.geofabrik.de/europe/great-britain/england/greater-london.html

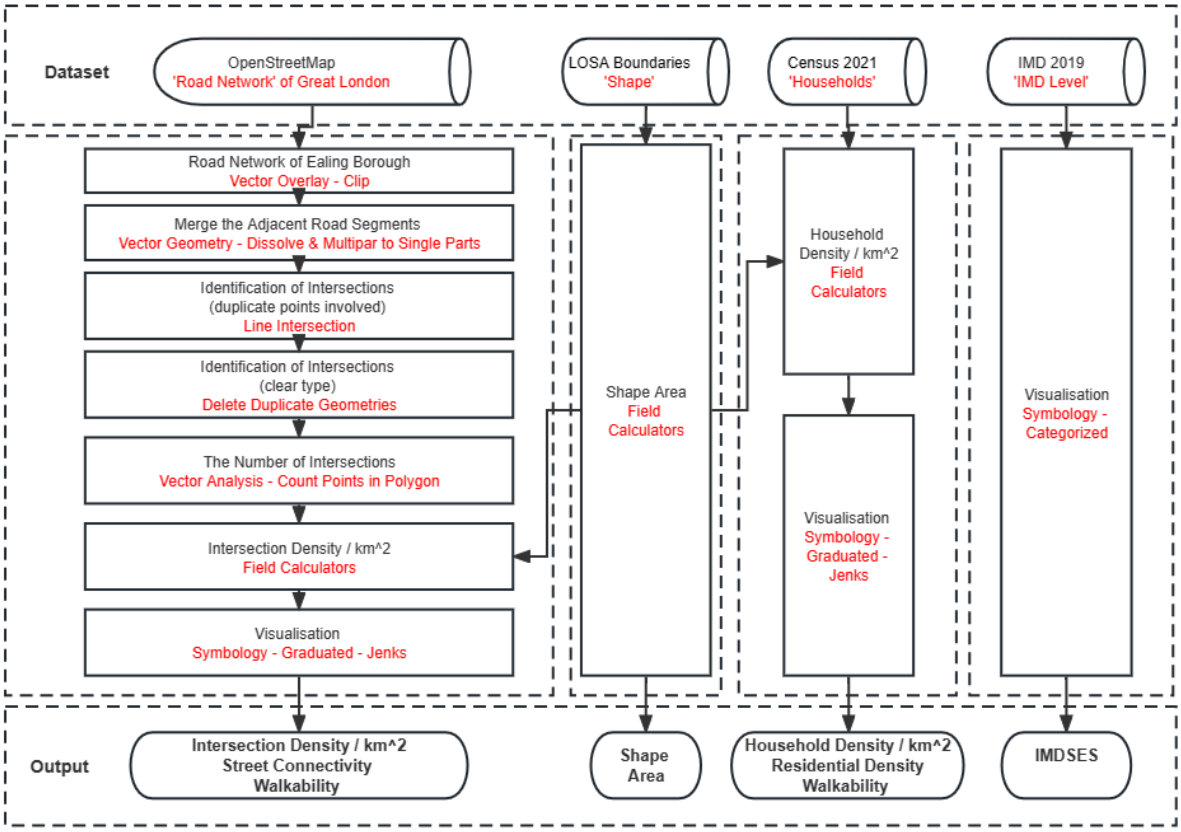


Figure 4 The Process of QGIS

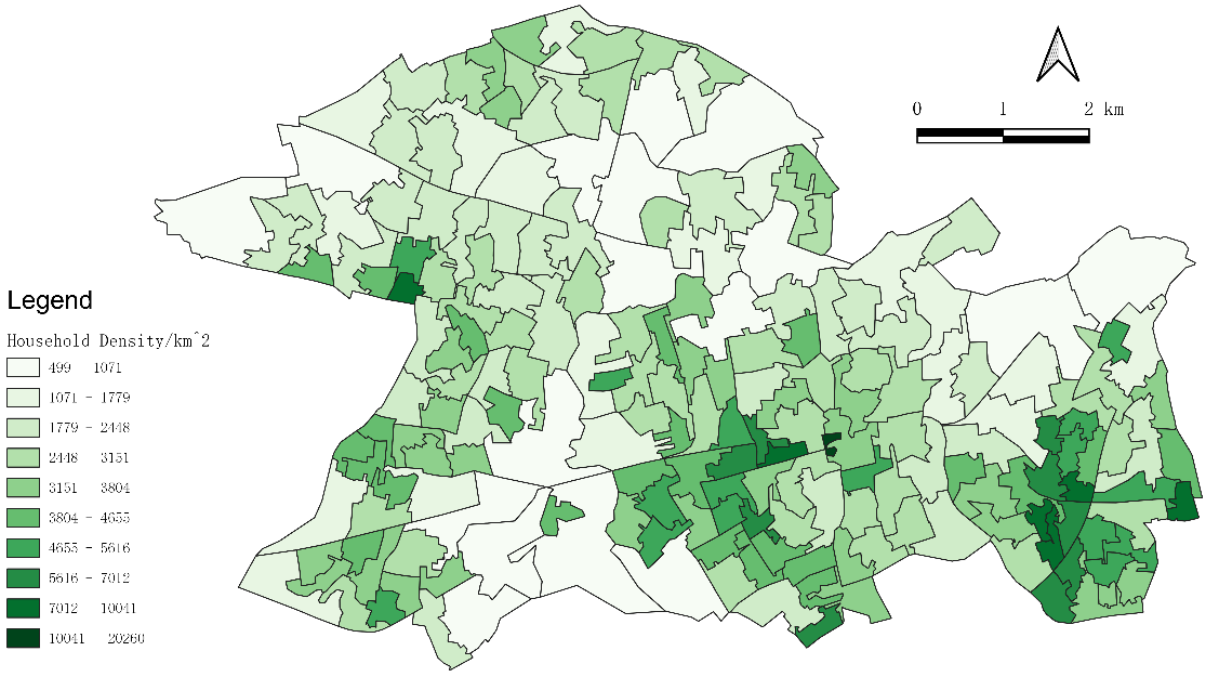


Figure 5 Ealing by Household Density Levels (LSOA Boundaries), author based on Census 2021[6]

[6] https://www.nomisweb.co.uk/sources/census_2021_bulk

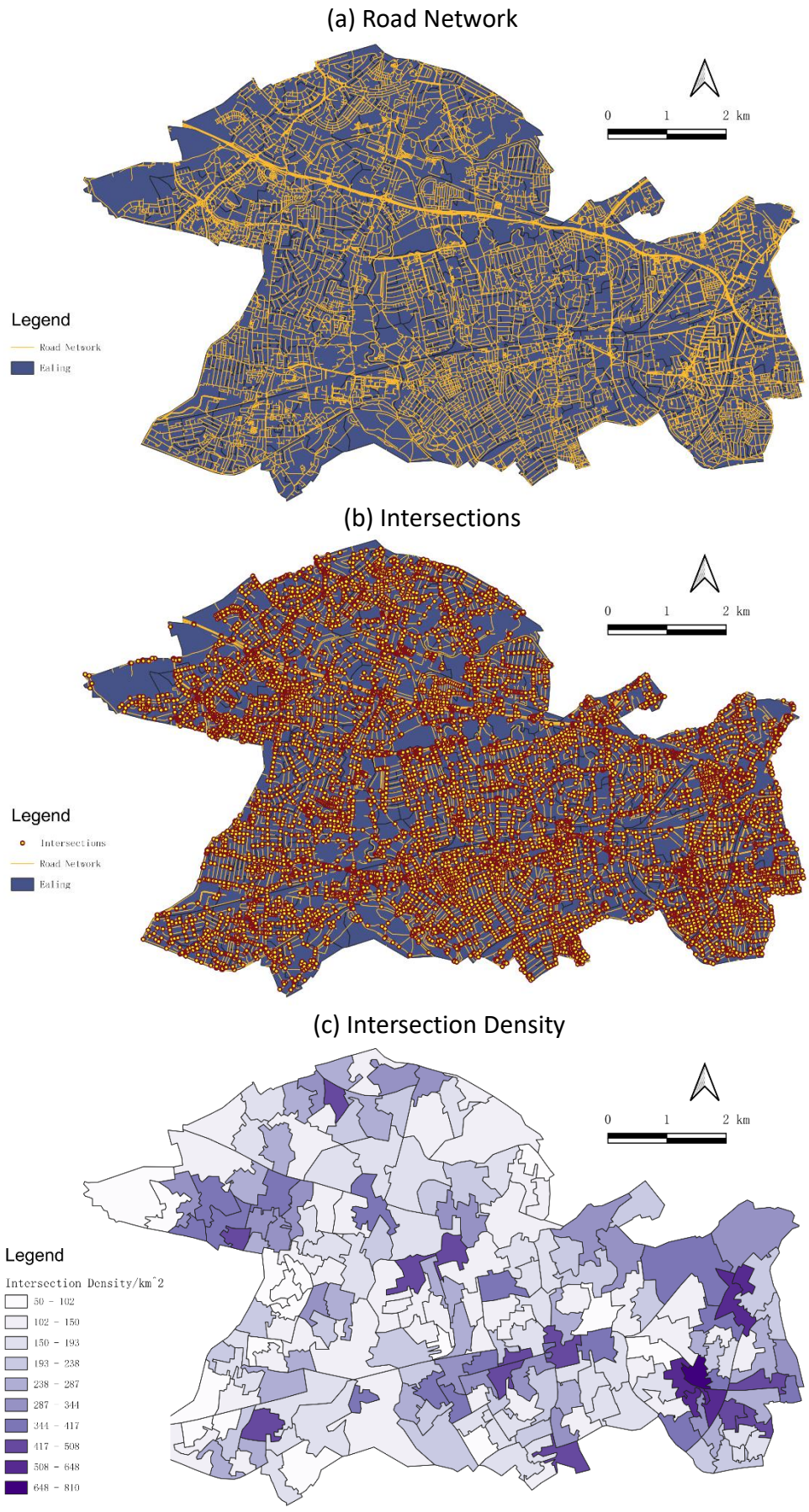


Figure 6 Ealing by Intersections Density Levels (LSOA Boundaries), author based on Open Street Map

To calculate the walkability, intersection density and residential density need to be normalized using the Z-score. The initial formula calculating walkability by Frank et al. (2010) is Formula 1. The intersection density is weighted twice in the scoring, highlighting its pronounced impact on active travel (ibid). However, this study calculates the neighbourhood walkability using Formula 2 because of limited datasets:

$$Walkability = 2 * z_{intersection\ density} + z_{net\ residential\ density} + z_{retail\ floor\ area\ ratio} + z_{land\ use\ mix} \quad (1)$$

$$Walkability = 2 * z_{intersection\ density} + z_{residential\ density} \quad (2)$$

As shown in Figure 7, a quadrant chart is generated with SES on the x-axis and walkability on the y-axis. Following a thorough consideration, four LSOAs are selected for detailed research: E01001202 (High Walkability, Low SES), E01001339(Low Walkability, Low SES), E01001299(Low Walkability, High SES), and E01001375(High Walkability, High SES). Their geographical locations are illustrated in Figure 8.

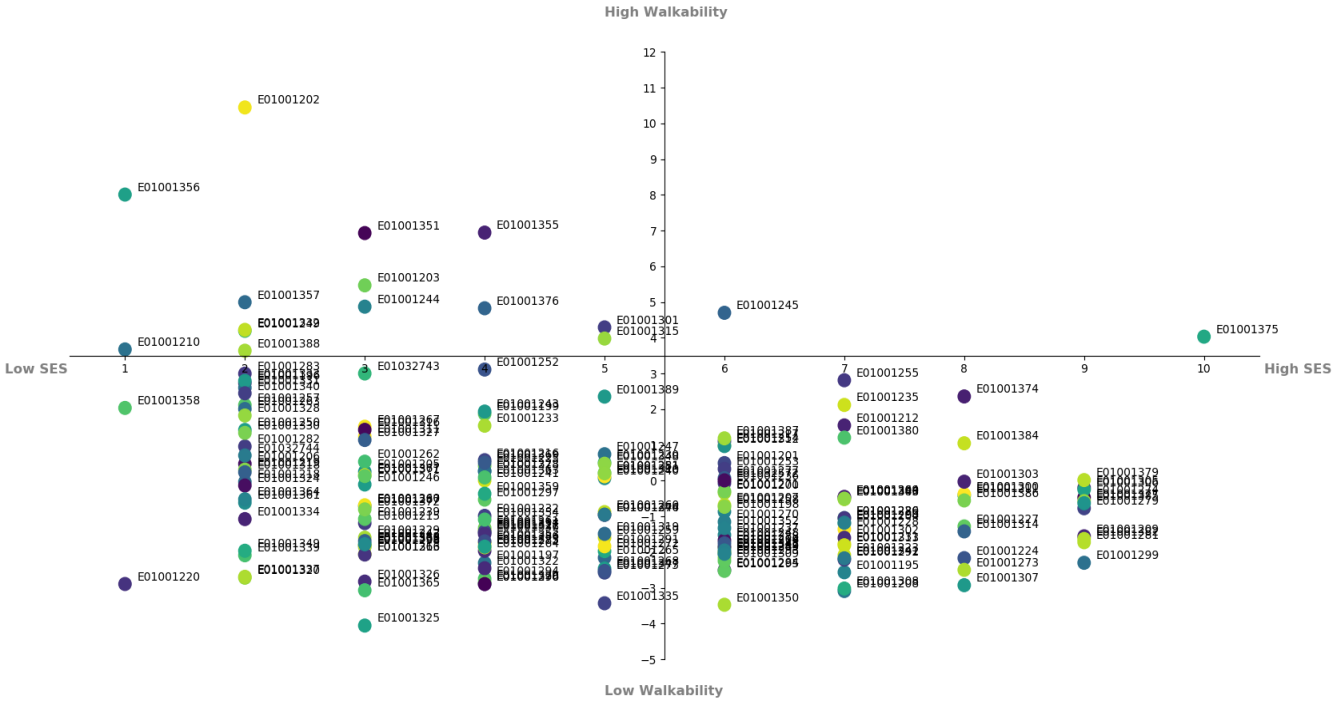


Figure 7 SES-Walkability of LSOAs in Ealing, drawn by author

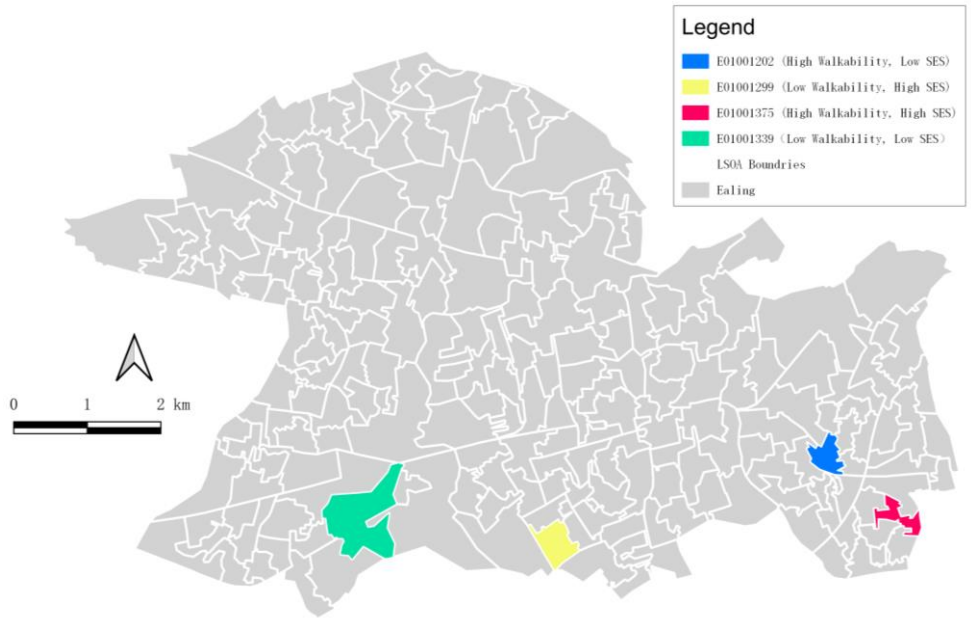


Figure 8 The Targeted Neighbourhoods

3.2 Target Group

To gather data, 50 seniors from each of the four selected neighbourhoods will be surveyed, leading to 200 respondents in total. Eligible respondents are those aged 65 or above and are capable of independent walking. Participants are recruited and provided with questionnaires through three main methods: offline distribution of leaflets, Internet email, and collaborating with local community centres.

3.3 Questionnaire

The questionnaire, NEWS-London Seniors (NEWS-LS), consists of three parts, and a copy of it can be accessed in Appendix A.

The first part primarily focuses on the socio-demographics, namely age and gender, of the elderly respondents. This section aims to provide an overview of the background characteristics of the surveyed population.

The second part seeks to gather information about how elderly people walk on a regular basis. Four questions make up this section: walking frequency, distances, duration and the types of activities they walk for. This information is crucial, as it will contribute to revealing the genuine

daily walking patterns of the seniors in London.

The third part is based on the standardized NEWS-A questionnaire. However, due to concerns regarding the negative impact of questionnaire length on response rates, only selected questions will be incorporated into the study. NEWS-LS retains the four-point Likert scale section from NEWS-A (Cerin et al., 2006). It not only facilitates quantification, statistical analysis, and evaluation of respondents' subjective attitudes but also omits the frequently 'neutrality' stance, which has been critiqued for its overuse in questionnaires (Kulas, Stachowski and Haynes, 2008). It will include topics related to Access to Services, Neighbourhood Safety, Street Connectivity, Walking Infrastructures, and Neighbourhood Surroundings (corresponding to Aesthetics), along with four individual items shown in Figure 1(b). Additionally, microelements such as benches, which have often been overlooked in past street designs, will be taken into account. Furthermore, to prevent respondents from developing a fixed mindset, the questionnaire also includes four reverse-worded items positioned at 8.1, 8.3, 12.2, and 12.4. Also, certain American English words used in the original questionnaire will be modified to British English words for regional appropriateness.

3.4 Analysis Method

Firstly, statistical analysis will be conducted for Questionnaire: Part 1 and Part 2. The analysis and distribution of the socio-demographic indicators will be covered in Part 1. Similarly, for Part 2, the walking behaviour of the participating seniors will be analysed and presented. It aims to address **Research Question 1 Part 1:** *In London, what are the typical walking duration, distance, frequency, and objectives for the elderly?*

The second stage is to explore the questionnaire, which helps to answer **Research Question 2:** *How is the questionnaire designed to evaluate the perceived walkability of neighbourhoods among elderly individuals in London?* In the research, the data will undergo Exploratory Factor Analysis (EFA) using the SPSS software. After that, the mean scores of different dimensions presenting their perceived walkability can be computed, assisting in addressing **Research Question 1 Part 2**: *How do London seniors perceive the walkability of their surroundings?*

The third step directs attention to **Research Question 3:** the influencing factors of neighbourhood type (SES, Walkability) and socio-demographics (age, gender) on Walking Behaviours and Perceived Walkability**.** For the examination of walking behaviours, the Chi-square test is employed due to its suitability for categorical variables, while the assessment of perceived walkability utilizes analysis of variance (ANOVA) owing to its applicability to continuous variables. Subsequently, Ordinal Logistic Regression (OLR) is used to explore the influence on walking behaviours of London seniors while multiple linear regression analyses their perceptions.

Finally, the study will discuss **Research Question 4:** What is the relationship between walking behaviours and perceived walkability? Firstly, the Spearman rank correlation coefficient is employed to analyse the correlation. This is because that there isn't a specific test method for analysing correlations between ordered categorical and continuous variables. Therefore, the approach treats the continuous variables as if they were ordered categorical variables. Following this, OLR will be utilized to examine perceptions' effects on walking frequency, time, and distance, with a binary logistic regression model being employed for investigating walking aims.

3.5 Statement of Ethics

Each of the elderly participants was fully informed about the research purpose, and they were made aware of their right to withdraw from the study at any time. In such circumstances, their consent was obtained. Additionally, to reduce ethical risks, all data collected was anonymized. Appendix B provides the thorough risk assessment.

4. Results

This chapter delves into the computation and interpretation of data. Section 4.1 provides the data collection procedure. Subsequently, Section 4.2.1 addresses the first part of Research Question 1, whereas Section 4.2.2 offers insights on the first part of Research Question 3. Section 4.3.1 is then tailored to Research Question 2. Sections 4.3.2 and 4.3.3 respectively attend to the secondary elements of Research Questions 1 and 3. Finally, Section 4.4 answers Research Question 4.

4.1 Procedure

4.1.1 Information on Neighbourhoods

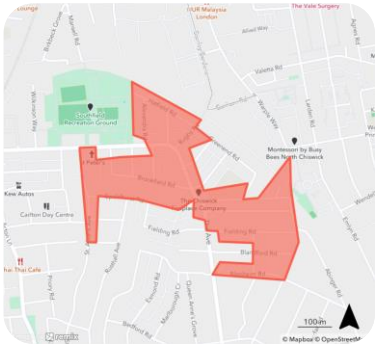
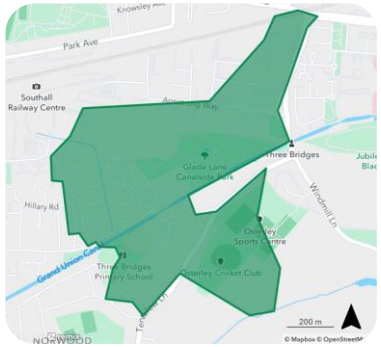
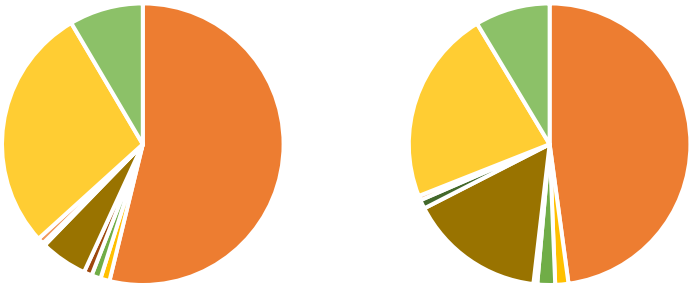
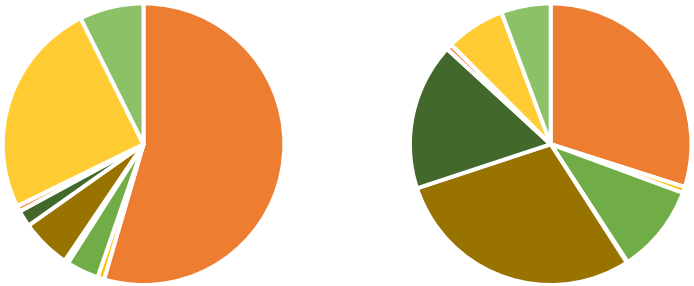
Area 1 (LSOA code: E01001202, Low SES) and Area 2 (LSOA code: E01001375, High SES), both representing zones with high walkability, are located in Acton Town. Specifically, Area 1 lies to the southeast corner of Acton, sharing its borders with North Chiswick. In parallel, Area 2 sits at Acton's heart and encompasses its main commercial area (high street). The Hanwell neighbourhood's Area 3 (LSOA code: E01001209, High SES) is adjacent to River Brent, a tributary of the Thames. As for Area 4 (LSOA code: E01001339, Low SES) in Southall Town, it is intersected by the Grand Union Canal. And this canal is connected to River Brent through the Hanwell flight of locks. Figure 9 offers the aerial view of the four neighbourhoods.

(a) Area 1 (b) Area 2

(c) Area 3 (d) Area 4

Figure 9 Aerial View of Four Selected Neighbourhoods, Google Earth

Table 3 provides further fundamental details regarding the four study areas. From the gathered data, it can be noticed that over half of the households in Area 2 do not possess cars. In contrast, Area 3 has only one-fifth of such households. Additionally, Area 1 has the lowest proportion of BAME residents, accounting for 16%, while the number for Area 4 is approximately 3/4. In terms of religious beliefs, both Area 1 and Area 3 demonstrate similar distributions, while Area 2 has a higher proportion of Muslim residents. It is noteworthy that Area 4 has a higher percentage of Hindu adherents, which can be attributed to the area's sizable Asian immigrant community (*Southall, Ealing,* no date).

LSOA Code	E01001375	E01001202	E01001299	E01001339
Name	Area 1	Area 2	Area 3	Area 4
Type	High Walkability, High SES	High Walkability, Low SES	Low Walkability, High SES	Low Walkability, Low SES
Map*				
% BAME community (2021) *	0.159	0.383	0.242	0.737
% No Car Household (2021)	0.273	0.568	0.195	0.262
Religion (2011) *				

* Map: Author by Remix

* BAME: Black, Asian and minority ethnic (BAME) communities

* (2021) / (2011): based on statistics from Census 2011 and 2021

Table 3 Overview of Selected Neighbourhood Characteristics

4.1.2 Actual Questionnaire Filling Status

Questionnaires were distributed across several locations, including Southfield Recreation Ground, St. Peter's Church Acton Green, Springfield Gardens, St. Mary's Church, Acton Centre, Elthorne Park, St. Thomas Church, and Glade Lane Canalside Park. Each of the four communities provided a total of 50 replies. However, due to time constraints, two questionnaires in Area 3 were incomplete in the perceived walkability section. Additionally, one questionnaire in Area 4 was left incomplete in the walking behaviour section for unknown reasons, resulting in a total of 197 valid questionnaires.

Table 4 presents the gender and age information of all valid data. Throughout the questionnaire collection process, measures were implemented to ensure a diverse sample of gender. Despite these efforts, there were still almost 10% more female respondents than male respondents, as shown in Figure 10. The traditional social roles where women take on caregiving responsibilities within their families, which may persist into their elder age, may be to blame for this imbalance. This observation was particularly evident when the questionnaires were distributed in the parks, with more elderly women caring for grandchildren.

Characteristic	Estimate		
Gender (%)	Male		Female
Area 1	0.440		0.560
Area 2	0.480		0.520
Area 3	0.375		0.625
Area 4	0.449		0.551
Age Group	65-74	75-84	85 and above
Area 1	42	7	1
Area 2	46	4	0
Area 3	46	2	0
Area 4	49	0	0

Table 4 Demographic Profile of Respondents by Study Area

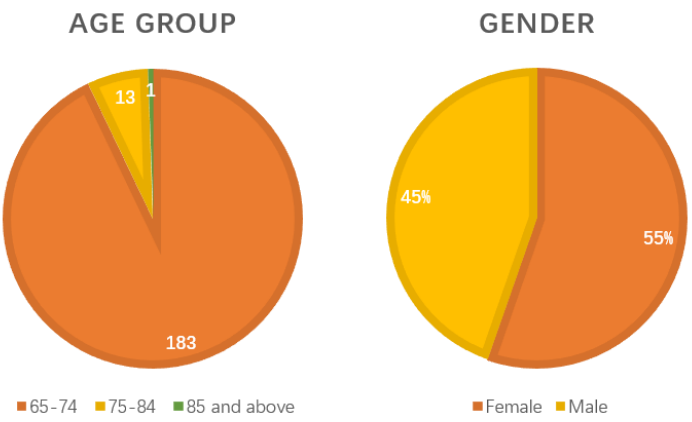


Figure 10 Demographics of All Respondents

4.2 Walking Behaviour

4.2.1 Basis Statistics

The present questionnaire focused on the walking behaviour of elderly individuals, including walking frequency, walking distance, walking duration, and types of activities engaged in while walking. Figure 11 illustrated their distributions.

The first observation is that walking is a fundamental component of daily routines for the elderly, with 3-4 times per week being the most common frequency. In contrast, only a very small percentage of seniors rarely or never walk. Secondly, the walking distance for them is primarily concentrated between 0.5 to 2 miles, with corresponding walking durations ranging from approximately 15 to 60 minutes. It is rare for elderly individuals to cover distances beyond 2 miles or extend their walking sessions exceeding 1 hour.

The results also suggest that leisurely walking dominates among the elderly population, as nearly three-quarters of respondents choosing this option. And only about one-fourth reported walking as a mode of commute. It is noteworthy that many respondents also cited engaging in other activities while walking, notably picking up children and walking their dogs.

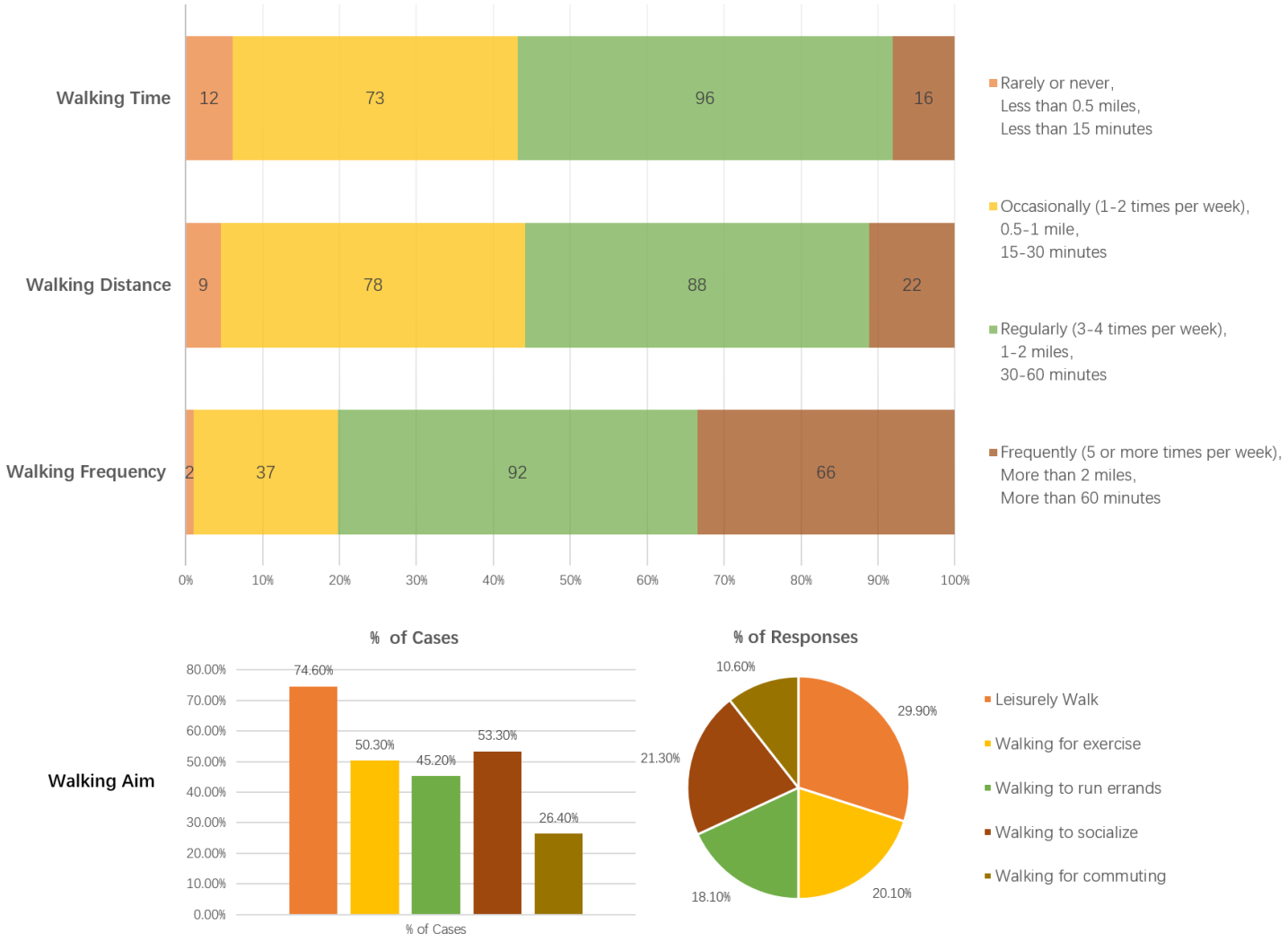


Figure 11 Descriptives of Walking Behaviours

4.2.2 Influencing Factors of Walking Behaviours

The first thing to investigate is the impact of covariates on walking behaviours. Considering the multi-select nature of 'activities while walking' (referred to as 'walking aims' hereafter), a multiple-response set is set in SPSS for further analysis.

Figure 12 presents the differences in walking aims among elderly males and females (% of Cases). It indicates that a gender-specific predilection in the motivations behind walking. Males tend to favour walking for exercise and commuting, while females are more likely to choose social events and errands. Additionally, the majority of senior people display an inclination for leisurely walks, with males showing a more pronounced preference.

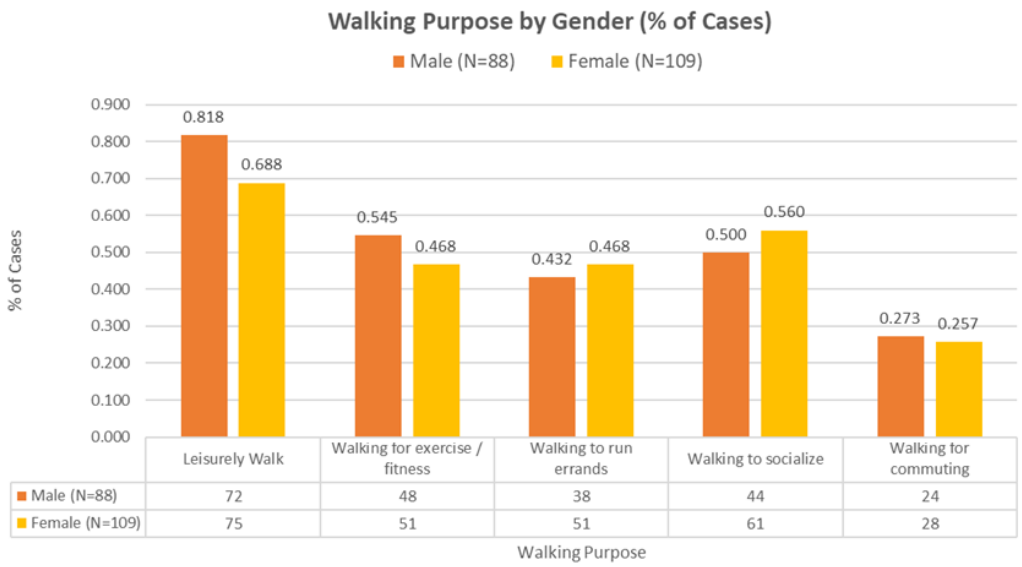


Figure 12 Walking Purpose by Gender

Chi-square tests, as shown in Table 5, suggest that there is no statistically significant correlation between those independent variables and Walking Aim within this sample. However, it unveils a significant association between studying area and metrics such as walking frequency, distance, and duration.

Items	Age	Gender	Area	SES	Walkability
Walking Frequency	8.163	2.151	25.232***	7.535*	9.477**
Walking Distance	4.497	3.179	39.852****	7.144*	22.806****
Walking Time	2.232	3.468	18.713**	2.813	13.022***
Walking Aim	6.514	1.871	14.638		

*p<0.1; **p<0.05; ***p<0.01; ****p<0.001

Table 5 Chi-Square Tests: Walking Behaviours & Demographics and Community Traits

Notably, the dummy variables for age exhibited tolerance values of 0.075 (for age 65-74) and 0.076 (for age 75-84) respectively, both falling below the threshold of 0.1. This suggests a multicollinearity issue. Given that age did not demonstrate significance in the chi-square test, it was deemed appropriate to exclude it from subsequent analyses. OLR (with the Logit link function) was conducted with the aforementioned three walking behaviours as dependent variables. The test of parallel lines for Frequency, Distance, and Time yielded results of 3.591 (p=0.732), 2.767 (p=0.837), and 1.821 (p=0.935), indicating the presence of the proportional odds assumption. Table 6 offers the results of OLR, with the reference groups being Males, Low SES, and Low walkability.

	B	Sig.	Exp(B)
Frequency			
Gender	0.063	0.817	1.065
SES	0.796	0.004	2.217
Walkability	0.884	0.001	2.421
Distance			
Gender	0.366	0.189	0.693
SES	-0.83	0.003	2.293
Walkability	-1.356	<0.001	3.881
Time			
Gender	0.45	0.107	0.638
SES	-0.488	0.078	1.629
Walkability	-0.976	<0.001	2.653

Table 6 Parameter Estimates on Walking Behaviours with Gender and Community Traits

4.3 Perceived Walkability

4.3.1 Validity

As stated in Section 3.3, the estimated model should include 21 interrelated items, which can be found in Appendix A.

Following the adaptation of the questionnaire, EFA was conducted to test its validity. Based on Figure 1(b), four single items are excluded, resulting in a total of 17 items for factor analysis. Before EFA, the value of the KMO test is 0.695 > 0.6, and the chi-square of Bartlett's Test of Sphericity is 534.887 with p-value < 0.001, indicating that the variables have a robust linkage and are suitable for factor analysis.

The EFA was conducted using Principal Component Analysis as the extraction method, and Varimax with Kaiser Normalization for rotation. After 15 rotation iterations, 6 distinct factors emerged, as shown in Table 7. The absolute values of the loading coefficients for each variable in each component surpassed 0.4, indicating a strong correlation between these variables and corresponding factors. Furthermore, when viewed longitudinally, *Separated Pavements by Grass* appeared as a separate dimension, and as such, it is deemed invalid and subsequently removed. At last, each factor was named to clearly reflect its content.

Factors and Items	Component					
	1	2	3	4	5	6
Mix-access to services (MS)						
MS1. Many places within walking distance	0.792					
MS2. Easy to walk to a transit stop	0.789					
MS3. Many alternative routes	0.731					
MS4. Shops within easy walking distance	0.730					
Traffic safety (TS)						
TS1. Speeding drivers		0.788				
TS2. Slow traffic speed		0.779				-0.341
TS3. Heavy traffic		0.673				0.473
Aesthetics (AE)						
AE1. Attractive natural sights			0.734			
AE2. Attractive buildings/homes			0.687			
AE3. Many trees			0.494			
Walking infrastructure (WI)						
WI1. Separated pavements by parked cars				0.840		
WI2. Pavement			0.300	0.708		
WI3. Short distance between intersections	0.314			0.573		
Elderly-friendly (EF)						
EF1. Crosswalks and pedestrian signals					0.718	
EF2. Resting places					0.662	
EF3. Streetlights at night					0.471	
SG. Separated pavements by grass						0.940

Table 7 Factor Loading (over 0.3) from EFA for NEWS-LS

4.3.2 Basis Statistics

A descriptive analysis was performed on the nine dimensions, including five sub-scales and four single items (*Few cul-de-sacs*, *Physical barriers to walking*, *Hilly Street* and *Access to Parking*). The scoring for each item ranged from 1 to 4, with higher scores representing higher levels of perceived walkability. Table 8 presents the mean value for each dimension in descending order. The scores of the five sub-scales were calculated as the mean of all items under each subscale. The sample size for *Access to Parking* is notably 120 as not everyone can drive, while the other eight dimensions have 197 respondents.

	Dimension	Mean	Std
1	Hilly Street	3.863	0.44
2	Walking infrastructure	3.768	0.35
3	Physical barriers to walking	3.640	0.72
4	Mix-access to services	3.485	0.58
5	Aesthetics	3.398	0.49
6	Elderly-friendly	3.241	0.59
7	Few cul-de-sacs	3.193	0.84
8	Traffic safety	2.787	0.58
9	Access to Parking	1.992	0.88

Table 8 Descriptive of Factors of NEWS-LS

Observations reveal that within the study area, elderly individuals scored above 3.4 out of 4 points (85% of the maximum score) in the first four dimensions. However, the scores for *Traffic Safety* and *Access to Parking* were relatively low, with the latter even rated below 2.

To be more specific, 73.3% (N=88) of the respondents disagreed with *'Parking is difficult in local shopping areas'*. As for the *Traffic Safety* dimension, the mean ratings for *Speeding drivers* and *Heavy traffic* among seniors were 2.82 and 2.42, respectively. Additionally, 52.3% (N=103) of respondents highlighted the prevalent issue of traffic congestion along nearby streets, while 32.5% (N=64) reported observing many drivers exceeding speed limits within the neighbourhood.

4.3.3 Influencing Factors of Perceived Walkability

Table 9 shows the results of One-Way ANOVA analysis, examining the impact of Age, Gender, SES, and Walkability on the perceived walkability scores across nine dimensions for London seniors. The results indicate that the four independent variables do not significantly affect *Hilly Street* and *Physical Barriers to Walking* at the 0.1 significance level. However, their influences differ across the remaining dimensions.

Dimension	Age	Gender	SES	Walkability
Mix-access to services	2.679*	0.111	49.834****	92.293****
Aesthetics	2.733*	0.771	0.157	0.883
Traffic safety	3.287**	6.483**	16.420****	0.828
Elderly-friendly	1.129	1.650	0.203	13.760****
Walking infrastructure	1.426	0.473	1.006	13.101****
Access to parking	0.194	0.514	8.302***	12.817****
Few cul-de-sacs	0.583	3.575*	3.580*	1.713
Hilly Street	0.059	1.787	3.580	0.780
Physical barriers to walking	0.428	0.292	2.241	1.955

*p<0.1; **p<0.05; ***p<0.01; ****p<0.001

Table 9 F-values from One-way ANOVA Assessing Factors of Perceived Walkability

The next step is conducting multiple linear regression analyses on the seven dimensions. The 'Age Group' variable had previously transformed into two dummy variables, namely 'Age 65-74' and 'Age 75-84'. However, all variables other than these two dummy variables related to age have successfully passed the collinearity check. Therefore, a strategic restructuring of the 'Age' variable was undertaken, splitting it into two distinct categories: 'Age 65-74' and 'Age 75 and above'. Following this alteration, 'Age' successfully cleared the collinearity check.

The results are presented in Table 10, displaying only significant independent variables' Beta (95% CI). Reference groups are Males, Low SES, and Low walkability. Each Durbin-Watson test value fall between 0 and 4, satisfying the data independence requirement. However, though one independent variable in each model has a statistically significant impact, the models for *Aesthetics* and *Few Cul-de-sacs* failed F tests. This occurrence could be attributed to insufficient variables selected in the model or the limited sample size.

Dimension	Durbin-Watson	F	Sig.	Beta (95% CI)			
				Age: 65-74	Gender: Male	SES: Low	Walkability: Low
Mix-access to services	0.91	52.58	<0.001			0.45 (0.40~0.63)	0.56 (0.53-0.76)
Traffic safety	1.62	5.99	<0.001		-0.17 (-0.35~-0.04)	-0.27 (-0.47~-0.16)	
Aesthetics	1.67	1.67	0.158	0.16 (0.03~0.58)			
Walking infrastructure	1.87	3.77	0.006				0.24 (0.06~0.22)
Elderly-friendly	1.93	4.85	<0.001				0.28 (0.17~0.49)
Few cul-de-sacs	1.69	2.38	0.053			0.14 (0.01~0.48)	
Access to parking	1.75	5.75	<0.001			0.23 (0.11~0.71)	-0.32 (-0.88~-0.26)

Table 10 Multiple Linear Regression of Perceived Walkability

In this analysis, the sign of the Beta value determines whether the influence of the independent variable is positive or negative. Females recorded lower scores in *Traffic Safety*, and similarly, participants from higher SES communities also rated *Traffic Safety* lower. Those from high walkable neighbourhood gave lower ratings to *Access to Parking*. All other significant results were positive, suggesting an increase in scores with shifts of the independent variables. The size of the absolute Beta value conveys the effect size: the larger its absolute value, the more pronounced the impact. Notably, SES and Walkability have the strongest impact on *Mix-access to Services*, with values surpassing 0.40. In contrast, age and gender show less influences, with values falling below 0.20.

4.4 Relationship Between Walking Behaviour and Perceived Walkability

First, the correlation analysis between perceived walkability and walking behaviours among London seniors was conducted using the Spearman rank correlation coefficient, with the results presented below.

	MS	TS	AE	WI	EF	HS	FC	BW	AP
Frequency	0.246**	-0.033	-0.061	0.169*	0.239**	0.018	0.076	0.069	0.084
Distance	0.258**	-0.047	-0.069	0.029	0.241**	0.047	-0.024	0.052	-0.089
Time	0.248**	-0.029	-0.060	0.009	0.152*	-0.008	0.022	0.007	-0.090
Walking Aim									
Leisurely	0.331**	-0.106	0.107	0.166*	0.008	0.028	0.136	0.112	0.098
For exercise	0.199**	0.060	0.058	-0.026	0.231**	-0.080	0.056	0.014	-0.051
To run errands	0.491**	-0.054	0.126	0.061	0.313**	-0.180*	0.151*	0.026	-0.039
To socialize	0.353**	0.073	0.039	0.120	0.193**	-0.152*	0.197**	-0.001	-0.164
For commuting	0.251**	0.081	0.032	0.134	0.173*	-0.129	0.100	0.094	0.026

*p<0.05; **p<0.01

Table 11 Correlation Coefficient between Perceived Walkability and Walking Behaviours

Then, regression analysis is used to delve deeper into effects of these factors on walking behaviours. Walking frequency, distance, and time were examined using OLR (link function: logit), while Walking aim was decomposed and analysed via five binary logistic regressions[7]. Additionally, *Access to Parking* was excluded from the regression due to its lower response

[7] Walking frequency, time, and distance are ordinal variables, scaled from 1 to 4; higher values indicate more frequent walks, longer durations, and extended distances. The five Walking Aim categories are binary: 1 denotes selection of a walking purpose, while 0 indicates its absence.

count of 120 compared to the 197 responses for other items, and given its absence of significant correlations with the variables mentioned above. Preliminary tests for multicollinearity and parallel lines were conducted. Figure 13 visually presents the results.

The independent variables represent the perceived walkability ratings of targeted group. Here, the OR implies that for each unit increment in the independent variable (rating), the dependent variable will rise by $(OR - 1) * 100\%$. Accordingly, the outcomes reveal that *Mix-access to Services* has a significant positive impact on all dependent variables, while *Walking Infrastructure* prominently influences frequency. Furthermore, *Elderly-friendly* positively affects frequency and distance, while *Aesthetics* bears a significant negative effect on these walking behaviours. Additionally, individuals with higher ratings for *Elderly-friendly* display a tendency to choose *Walking to Exercise* and *Walking to Run Errands*. In contrast, those giving *Traffic Safety* higher scours generally favour *Walking to Socialize*.

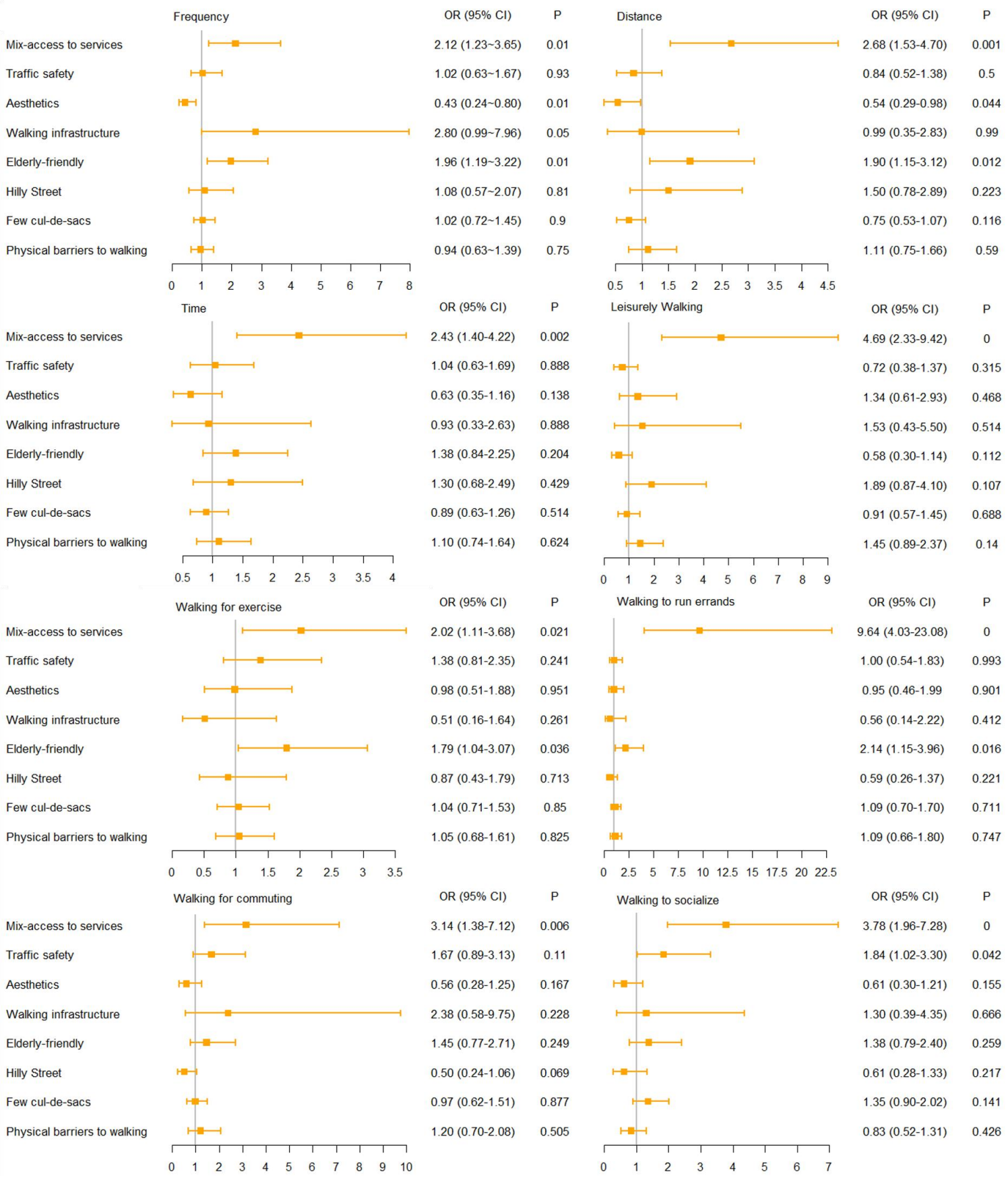


Figure 13 Forest Plots of Regression for Perceived Walkability and Walking Behaviours

5. Discussion and Reflection

5.1 Exploration into the Walking Patterns and Perceptions

The research suggests that most elderly Londoners prefer engaging in moderate-distance and moderate-duration walking. Considering their physical condition and interest in walking, this walking trend not only lowers the risk of overwork but also enhances their physical and mental health. This finding also aligns with statistics on England's annual per-person walking frequency in 2021. According to NTS0601 Statistical Data Set (Department for Transport Statistics, 2022), individuals aged 60 to 69 make an average of 222 walking trips per year covering a sum of 227 miles. Meanwhile, those aged 70 and above walk approximately 219 times per year covering a total distance of 188 miles. This consistency bolsters the reliability of the research and further highlights the prevalence of these walking behaviours among seniors.

The preference for leisurely strolls may be attributed to their desire to relax and enjoy life, especially after retirement. Leisurely walking, such as strolling in parks, natural sights or within the neighbourhood, usually focuses on relaxation and enjoyment. On the other hand, their commuting needs typically decrease after retirement. And they have plenty of time to participate in these activities. Additionally, the potential decline in physical capabilities with the long distances might make them to opt for more convenient transportation modes like cars. For instance, Alsnih and Hensher (2003) highlight their reliance on cars for their travel demand. They pointed out that individuals aged 65 and above favour cars as their primary mode of transportation, particularly in the global north.

Hilly streets, well-developed walking infrastructures, few barriers to walking and convenient access to services contribute to the walkability of the research area, thereby offering a positive walking experience for the elderly. The findings suggest the commendable efforts of the relevant stakeholders in these domains. It is recommended that they continue to sustain and further improve their outstanding performance in these four dimensions.

This research suggests that parking in shopping areas is not difficult for the majority of elderly

individuals. However, this convenience may lead them to drive rather than walk. Therefore, improvements can be undertaken to make the surroundings more pedestrian-friendly. Another potential strategy is encouraging supermarkets and community organizations to establish walking incentive programs, wherein frequent walkers are rewarded with discounts or incentives. It is believed to significantly boost their desire and enthusiasm for walking.

The findings also indicate that the elderly have certain concerns regarding traffic safety. The perceptions of insecurity and challenges stemming from these concerns might discourage them from walking. Thus, the following measures can be implemented to improve their experience. Firstly, pedestrian-only zones and traffic-calming initiatives may help tackle the issue of heavy traffic. Moreover, enhanced traffic management and stricter enforcement may reduce speeding behaviours. The result aligns with findings by Van Cauwenberg *et al.*(2012), which indicate concerns towards over-speeding cyclists, particularly those on electric bikes. When collecting questionnaires in Area 1, an elderly lady expressed her deep concern about the speeding electric bicycles and e-scooters in her neighbourhood. She mentioned that despite regulations against the use of unlicensed electric scooters on roads, several residents still use them. These vehicles are small enough to allow users to ride freely on pavements. The old lady expressed her worry about potential collisions with these fast-moving e-scooters, which may pose serious consequences. Her sentiments not only reflect the negative perception some elderly individuals hold towards these scooters but also highlight inadequacies of existing regulations on unregistered electric vehicles. This serves as a crucial reminder for city planners and traffic authorities about the need for more detailed regulations governing electric scooters' use, especially in urban and residential areas.

5.2 NEWS for Elderly Londoners

After reliability and validity testing, NEWS-LS consists of 20 items and can be further decomposed into 5 sub-scales and 4 single items, as illustrated in Figure 14. These factors enhance the appeal of walking for London seniors. *Traffic Safety* and *Aesthetics*, in line with the categories in NEWS-A (Cerin *et al.,* 2006), emphasize the emotional and experiential aspects of how built environments shape their perceptions. For instance, a visually appealing

and safe community can transform walking into a delightful activity (Humpel *et al.*, 2004). In contrast, *Mix Access to Services* and *Walking Infrastructure* focus on the functional and practical elements, affecting how efficiently a pedestrian can complete their tasks or reach their destinations. By ensuring that different services are accessible by foot, *Mixed Access* directly affects the utility value. Similarly, *Walking Infrastructure* like pavements plays a crucial role in facilitating and promoting walking by providing convenient access and direct routes.

The analysis also introduced a novel sub-scale *Elderly-friendly*, including lights, resting places, and pedestrian signals. Previous studies reveal that lighting was usually classified as Crime safety since street lighting standards rely heavily on official crime statistics (Cozens *et al.*, 2003). However, it is redistributed to *Elderly-friendly* because older adults tend to have visual impairments such as vision problems or reduced contrast sensitivity when they get older (Fujiyama *et al.*, 2007). However, UK street lighting standards, such as BS 5489-1, do not consider their specific lighting needs (ibid). Similarly, resting places, crossings and traffic signals matter a lot because of their potentially slower walking pace, diminished stamina, and potential visual/auditory disabilities.

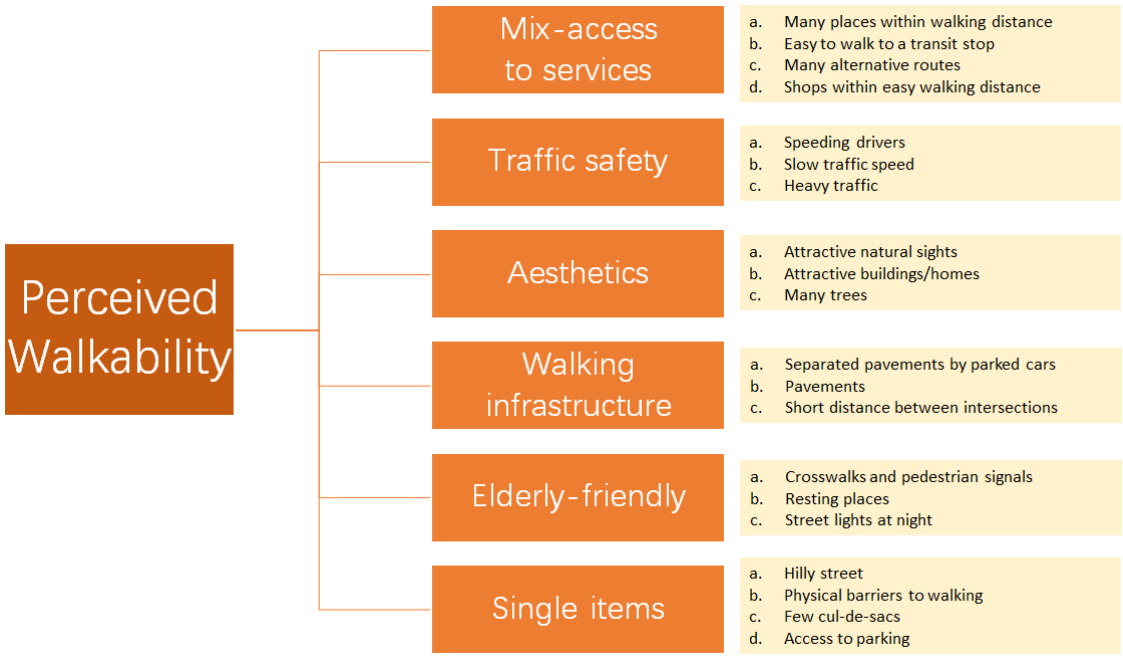


Figure 14 Structure of NEWS-LS

5.3 Dual Forces of Demographics and Neighbourhood Type

Males show a more pronounced preference for leisurely walking. It aligns with the analysis of 36 global studies by Pollard and Wagnild (2017), which indicates that elderly men engage in leisure walking more than elderly women, despite a higher proportion of women participating in leisure walking among younger age groups. However, despite the differences, gender was not statistically significant for the other three behaviours.

The research also indicate that walkability holds a significant correlation with all three pedestrian behaviours. Specifically, higher walkability may encourage longer walking distances, extended walking durations, and increased walking frequency. Based on the walkability calculation method, it can be attributed to the fact that a higher intersection density typically equates to shorter streets and provides multiple route options, thereby increasing the appeal of walking. Also, increased residential density often correlates with a dense concentration of commercial, recreational and other essential services, which benefits the elderly in terms of walking. These findings are consistent with the conclusions drawn by Cerin *et al.* (2020) concerning walking behaviours in older community dwellers. However, Broberg, Kyttä and Fagerholm (2013) argue that the extremely high densities might lead to a reduction in neighbourhood walking for children and seniors.

In parallel, SES significantly influences walking frequency and distance, although the effect was relatively weak compared to walkability. It suggests that higher SES may be associated with more frequent walking and longer walking distances. This tendency may stem from the fact that high SES groups potentially have more free time, more opportunity and motivation to walk, and better health. This conclusion is also supported by Cerin, Leslie and Owen (2009), who propose that SES affects walking behaviours by indirect factors like the sense of community, traffic burden, vehicular ownership, appreciation of environmental aesthetics, and participation in physical activities. It is these indirect influences that make walkability more dominant than SES in shaping walking behaviours.

Therefore, policymakers and town planners should seriously consider implementing the following measures. For instance, socioeconomically disadvantaged communities could organize more activities specifically targeted at elderly residents to promote their engagement in walking. Also, hosting regular health-focused walking events can improve their walking frequency. Furthermore, offering a diverse range of social and cultural activities might enhance their motivation and willingness to walk. Moreover, providing support and guidance on walking for the elderly in the neighbourhood, such as details on appropriate walking routes, safety guidelines, and the health benefits of walking, would be highly beneficial.

Research highlights that age and gender distinctly stand out as determinative factors in the perceptions of *Aesthetics* and *Traffic Safety*. Contrary to the findings by Shigematsu *et al.* (2009), the elderly rate street aesthetics more positively as age increases. One possible reason might be that they may have higher well-being in relation to urban green settings (Ode Sang *et al.,* 2016). When it comes to perceived traffic safety, females appear to express more concerns. However, seniors with high SES reflects a reduced perception of safety. A potential explanation is that perceived safety may not mirror actual safety (Loewen, Steel and Suedfeld, 1993). Those from a wealthier socio-economic tier may hold higher expectations, intensifying their alertness and judgment. Notably, they exhibit Beta values with an absolute significance of less than 0.2, suggesting a relatively minor influence of personal traits.

Evidence further highlights the significance of SES and neighbourhood walkability in shaping walking perceptions. Elderly residents in higher SES neighbourhoods not only display a notable positive influence on their perceptions of *Mix-access to Services* and *Difficulty of Parking*, but also show a positive correlation with the *Presence of Fewer Cul-de-sacs*. The former might result from the research area being closer to the town centre, echoing the findings by Cerin, Leslie and Owen (2009) in Australia. Meanwhile, fewer dead-end streets could be a reflection of a more optimized utilization of land.

Regarding walkability, the elderly in high-walkability neighbourhoods show a greater

appreciation for *Mixed-access to Services*, *Walking Infrastructure*, and *Elderly-friendly*. However, they assign lesser importance to *Parking Access*. This negative impact might result from high-walkability community offering convenient walking options, thereby diminishing the car dependence. This argument is supported by Table 3, where communities with high walkability exhibit approximately 8% to 20% higher proportions of households without cars compared to low walkability ones among similar SES levels. Thus, older adults perceive fewer parking difficulties in such areas. Corresponding it, observations from Area 3 (low walkability) offer insights into perceptions regarding *Walking Infrastructure* and *Elderly-Friendly*. Several elderly participants from Area 3 mentioned situations where nearby streets were blocked for extended periods due to construction, and vehicles parked on pavements hindered pedestrian movement. They also highlighted, as shown in Figure 15, that most road crossings lack traffic signals, with a handful only featuring yellow pedestrian caution lights. And only the intersections of Westlea Rd and Boston Rd, as well as the area in front of Boston Manor Station, are equipped with timed traffic signals. Since these kinds of crossings could potentially pose a challenge for elderly individuals with limited mobility or physical disabilities, it is advisable to consider installing enhanced crossing devices to ensure their safety.

Figure 15 Pedestrian Crossing Devices on Boston Manor Rd, taken by Author

5.4 Relationship of Walking Behaviours and Walkability Perceptions

Research findings indicate that the walking activity levels of London seniors are significantly correlated with their perceptions of *Mix-access to Services*, *Walking Infrastructure*, *Elderly-friendly*, and *Aesthetics*. Intriguingly, a negative correlation was identified between *Aesthetics* and both walking frequency and time, which runs counter to most previous studies

(McCormack *et al.*, 2004; Gong *et al.*, 2014; Moran *et al.*, 2014). However, this observation may align with the findings in Ghent and Seattle by Van Dyck *et al.*(2012), where a positive U-shaped curve relationship between walking time and perceived *Aesthetics* was identified. At first glance, it may suggest that an overly complex aesthetic might deter them walking. On the other hand, an alternative interpretation could be that individuals who walk more frequently might have a deeper appreciation and thus a sharper judgment of streetscape. The precise nature of this relationship needs further exploration.

All other variables displayed positive effects. A notable instance is the relation between *Mix-access to Services* and walking behaviours. This parallels Cerin's findings in the study on elderly individuals in Hong Kong, which focuses on the relationship between perceived environment and walking. While he emphasized frequency having a more significant effect than time (2014), this research identified comparable levels of significance for both. Another significant variable is the elderly-friendly environment, with abundant evidence supporting this relationship. For instance, 16% of Flemish older adults in the fourth group highly value the availability of benches (Van Cauwenberg *et al.*, 2016). Also, street lighting has been found to correlate positively with the total amount of walking (Barnett *et al.*, 2017). Both of these topics are sub-items under this variable. Moreover, the study indicates that the better the elderly perceive *Walking Infrastructure*, the more frequently they engage in walking. This finding is consistent with Gómez's research on the elderly's walking patterns in Bogotá (2010).

Research reveals that perceptions of *Mix-access to Services*, *Traffic Safety*, and *Elderly-friendly* environments matters in influencing their decisions to walk for particular purposes. In environments perceived as traffic-safe, London seniors are more inclined to walk outside for social interactions. This highlights the subtle social value associated with a sense of traffic safety (Sönmez and Graefe, 1998). Moreover, the daily walking activities of the elderly, including exercise and running errands, show a pronounced association with elderly-friendly environments. Hence, it would be prudent to install more elderly-friendly amenities in the community to encourage them to walk more.

6. Conclusion

6.1 Conclusive Summary

This research has been centred on understanding the walking behaviours among the elderly in London and their perceptions. Data analysis has revealed that they prefer moderate distances and durations of walking. And concerns have been highlighted regarding traffic safety, particularly related to speed drivers. Following this, NEWS-LS has been introduced to assess perceived walkability for London seniors. This structure includes 20 items, categorised into five sub-scales and four single items. Emotional and experiential aspects have been highlighted in *Traffic Safety* and *Aesthetics* sub-scales, while *Mixed-access to Services* and *Walking Infrastructure* prioritize functionality and utility. And *Elderly-friendly*, a novel sub-scale focusing on their specific needs, has been introduced.

In the next step, the investigation has delved into how neighbourhood type and socio-demographic characteristics influence walking behaviours and perceptions among elderly Londoners. Findings indicate that elderly males show a preference towards leisurely walking. Communities with high walkability are likely to encourage extended distance, duration, and frequency of walks. SES has been found to influence walking frequency and distance, though its impact is less pronounced than walkability. *Aesthetic* appreciation correlated positively with age, whereas safety perception was lower among elderly with high SES. The research underscores the significance of enhancing walkability and offering support for the elderly. At last, it examined the relationship between them. Factors such as service accessibility, pedestrian infrastructure, designs friendly to the elderly, and environmental aesthetics were brought to the fore. To review, a potential negative correlation might exist between *Aesthetics* and walking frequency, while other variables generally encourage walking. Furthermore, the study reveals the critical influence of these perceptions on their inclination to walk for various purposes, such as the role of perceived safety in social interaction.

In light of the 5C framework proposed by London Planning Advisory Committee, spaces conducive to walking should ideally integrate elements of connectivity, convenience, comfort,

conviviality, and conspicuousness (Gardner *et al.*, 1996; Moura, Cambra and Gonçalves, 2017). Therefore, establishing pedestrian-friendly communities for seniors necessitates stepping into their shoes - gaining authentic insights into the surroundings and evaluating its alignment with the aforementioned five Cs. This suggests the significance of this study, which not only fills the conspicuous gaps identified in literature review but also paves the way for fostering a more age-friendly London in terms of walking. Additionally, by delving into London's distinct context, this study serves as a reference for other global cities, assisting them in enhancing their urban walking environments to better meet the needs of senior inhabitants.

6.2 Limitations and Future Research

There are some limitations that should be further addressed. Firstly, it adopted a cross-sectional design, with all questionnaire data gathered in June and July of 2023. In comparison to many previous studies that spanned over six months and validated questionnaire reliability through retests (Cerin *et al.*, 2010), the findings of this research lack temporal robustness. Hence, a future research direction is extending the investigation period to delve deeper into the walking behaviours and perceived walkability, and even to explore the potential impacts brought about by changes over time.

Secondly, the selected sample for this study might introduce bias into the results. Given that a large proportion of the questionnaires were distributed in parks and community activity centres, there might be an overrepresentation of seniors who are keen on physical activities. To achieve a more representative sample, a potential approach would be to collaborate with the local council to obtain the email addresses of the target population for questionnaire distribution.

Another limitation stems from the constrained sub-items in personal information, leading our study to focus only on age and gender as personal influencing factors. However, other variables might also have a significant impact (Van Cauwenberg *et al.*, 2016). This narrowed scope was due to many respondents' unwillingness to share additional personal data such as occupation, marital status, health condition, and the number of children at home during the pilot questionnaire distribution process. Potential reasons might involve the lack of reliable backing

from credible organizations or governments, concerns over data privacy, and a shortage of incentives for survey completion. Therefore, more work could be done by exploring effective methods to encourage participants to provide various personal characteristics, thus broadening the dimensions of the research.

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Appendices

Appendix A Copy of Questionnaire

Neighborhood Environment Walkability Scale (NEWS)

ID # _____

We would like to find out more information about the way that you perceive or think about your neighborhood. Please answer the following questions about your neighborhood and yourself.

A. Background Information about Yourself

1. Age Group

☐ 65-74 ☐ 75-84 ☐ 85 and above

2. Gender

☐ Male ☐ Female ☐ Prefer not to say

B. Walking Behaviours

3. How often do you engage in walking?

☐ Rarely or never ☐ Occasionally 1-2 times p.w. ☐ Regularly 3-4 times p.w. ☐ Frequently 5 or more times p.w.

4. On average, how far do you walk in miles during each walking session?

☐ Less than 0.5 miles ☐ 0.5-1 mile ☐ 1-2 miles ☐ More than 2 miles

5. How long does each walking session typically last?

☐ Less than 15 mins ☐ 15-30 minutes ☐ 30-60 minutes ☐ More than 60 mins

6. What types of activities do you typically engage in while walking? (Select all that apply)

☐ Leisurely walk
☐ Walking for exercise/fitness
☐ Walking to run errands (e.g., grocery shopping, banking)
☐ Walking to socialize (e.g., meeting friends, attending events)
☐ Walking for commuting (e.g., going to appointments, local activities)

C. Perceived Walkability

Please circle the answer that best applies to you and your neighborhood.
Both local and within walking distance mean **within a 10-15 minutes' walk** from your home.

7. Access to Services

	Strongly disagree	Somewhat disagree	Somewhat agree	Strongly agree
Shops are within easy walking distance of my home.	○	○	○	○
There are many places to go within easy walking distance of my home.	○	○	○	○
It is easy to walk to a transit stop (bus, train) from my home.	○	○	○	○

8. Neighbourhood Safety

	Strongly disagree	Somewhat disagree	Somewhat agree	Strongly agree
There is so **much traffic** along nearby streets that it makes it **difficult or unpleasant to walk** in my neighborhood.	○	○	○	○
The speed of traffic on most nearby streets is usually **slow** (20 mph or less).	○	○	○	○
Most drivers **exceed the posted speed limits** while driving in my neighborhood.	○	○	○	○
My neighborhood streets are well lit **at night**.	○	○	○	○

9. Street Connectivity

	Strongly disagree	Somewhat disagree	Somewhat agree	Strongly agree
The distance between intersections in my neighborhood is usually short (100 yards or less; the length of a football field or less).	○	○	○	○
There are many alternative routes for getting from place to place in my neighborhood. (I don't have to go the same way every time.)	○	○	○	○

10. Walking Infrastructure

	Strongly disagree	Somewhat disagree	Somewhat agree	Strongly agree
There are sidewalks/pavements on most of the streets in my neighborhood.	○	○	○	○
Sidewalks are **separated** from the road/traffic in my neighborhood **by parked cars**.	○	○	○	○
There is a grass/dirt strip that separates the streets from the sidewalks in my neighborhood.	○	○	○	○
There are enough resting places such as benches when walking in my neighbourhood.	○	○	○	○
The crosswalks and pedestrian signals are elderly-friendly in my neighborhood.	○	○	○	○

11. Neighborhood Surroundings

	Strongly disagree	Somewhat disagree	Somewhat agree	Strongly agree
There are many trees along the streets in my neighborhood.	○	○	○	○
There are many attractive natural sights in my neighborhood (such as landscaping, views).	○	○	○	○
There are attractive buildings/homes in my neighborhood.	○	○	○	○

12. Other

	Strongly disagree	Somewhat disagree	Somewhat agree	Strongly agree
Parking is difficult in local shopping areas.	○	○	○	○
The streets in my neighborhood are hilly, making my neighborhood difficult to walk in.	○	○	○	○
The streets in my neighborhood **do not have** many cul-de-sacs (dead-end streets).	○	○	○	○
There are **major barriers** to walking in my local area that make it hard to get from place to place (for example, freeways, railway lines, rivers).	○	○	○	○

	Items	Question
1	Shops within easy walking distance	Shops are within easy walking distance of my home.
2	Many places within walking distance	There are many places to go within easy walking distance of my home.
3	Easy to walk to a transit stop	It is easy to walk to a transit stop (bus, train) from my home.
4	Short distance between intersections	The distance between intersections in my neighbourhood is usually short (100 yards or less; the length of a football field or less).
5	Many alternative routes	There are many alternative routes for getting from place to place in my neighbourhood. (I don't have to go the same way every time.)
6	Many trees	There are trees along the streets in my neighbourhood.
7	Attractive natural sights	There are many attractive natural sights in my neighbourhood (such as landscaping, views).
8	Attractive buildings/homes	There are attractive buildings/homes in my neighbourhood.
9	Heavy traffic	There is so much traffic along nearby streets that it makes it difficult or unpleasant to walk in my neighbourhood.
10	Slow traffic speed	The speed of traffic on most nearby streets is usually slow (20 mph or less).
11	Speeding drivers	Most drivers exceed the posted speed limits while driving in my neighbourhood.
12	Streetlights at night	My neighbourhood streets are well-lit at night.
13	Pavement	There are sidewalks/pavements on most of the streets in my neighbourhood.
14	Separated pavements by parked cars	Sidewalks/pavements are separated from the road/traffic in my neighbourhood by parked cars.
15	Separated pavements by grass	There is grass that separates the streets from the sidewalks/pavements in my neighbourhood.
16	Resting places	There are enough resting places such as benches when walking in my neighbourhood.
17	Crosswalks and pedestrian signals	The crosswalks and pedestrian signals are elderly-friendly in my neighbourhood.
18	Access to parking	Parking is difficult in local shopping areas.
19	Hilly streets	The streets in my neighbourhood are hilly, making my neighbourhood difficult to walk in.
20	Presence of cul-de-sacs	The streets in my neighbourhood do not have many cul-de-sacs (dead-end streets).
21	Physical walking barriers	There are major barriers to walking in my local area that make it hard to get from place to place.

Appendix B Copy of Approved Risk Assessment Form

RISK ASSESSMENT FORM
FIELD / LOCATION WORK

DEPARTMENT/SECTION: THE BARTLETT SCHOOL OF PLANNING

LOCATION(S): LONDON, UNITIED KINGDOM

PERSONS COVERED BY THE RISK ASSESSMENT: The elderly people who will participate in the study living in the selected communities in London, UK.

BRIEF DESCRIPTION OF FIELDWORK (including geographic location): COMPLETE HERE

The fieldwork for this research will involve conducting 20 semi-structured in-depth interviews with elderly residents in parks located in selected communities in London. The interviews aim to explore the importance of different indicators by factor analysis, specifically addressing research objective 3, which is to identify factors that are experienced as more important for elderly people in terms of their walking experience. The interviews will include questions about participants' background information, walking behaviour, evaluation and satisfaction with the walkability of their current community, and recommendations for improving the walkability of their neighbourhood. The semi-structured interviews will provide an opportunity for participants to express their views and experiences in their own words, allowing for a more nuanced understanding of the issues related to walkability for elderly residents in London. The geographic location for the fieldwork will be in selected communities in London, which will be determined based on the research criteria. The fieldwork will be conducted in compliance with ethical guidelines to ensure the safety and confidentiality of the participants.

COVID-19 RELATED GENERIC RISK ASSESSMENT STATEMENT:

Coronavirus disease (COVID-19) is an infectious disease caused by coronavirus SARS-CoV-2. The virus spreads primarily through droplets of saliva or discharge from the nose when an infected person coughs or sneezes. Droplets fall on people in the vicinity and can be directly inhaled or picked up on the hands and transferred when someone touches their face. This risk assessment documents key risks associated fieldwork during a pandemic, but it is not exhaustive and will not be able to cover all known risks, globally. This assessment outlines principles adopted by UCL at an institutional level and it is necessarily general. Please use the open text box 'Other' to indicate any contingent risk factors and control measures you might encounter during the course of your dissertation research and writing.

Please refer to the Dissertation in Planning Guidance Document (available on Moodle) to help you complete this form.

Hazard 1: Risk of Covid -19 infection during research related travel and research related interactions with others (when face-to-face is possible and/or unavoidable)

Risk Level - Medium /Moderate

Existing Advisable Control Measures: Do not travel if you are unwell, particularly if you have COVID-19 symptoms. Self-isolate in line with NHS (or country-specific) guidance.

Avoid travelling and face-to-face interactions; if you need to travel and meet with others:

- If possible, avoid using public transport and cycle or walk instead.
- If you need to use public transport travel in off-peak times and follow transport provider's and governmental guidelines.
- Maintain (2 metre) social distancing where possible and where 2 metre social distancing is not achievable, wear face covering.

- Wear face covering at all times in enclosed or indoor spaces.
- Use hand sanitiser prior to and after journey.
- Avoid consuming food or drinks, if possible, during journey.
- Avoid, if possible, interchanges when travelling - choose direct route.
- Face away from other persons. If you have to face a person ensure
that the duration is as short as possible.
- Do not share any items i.e. stationary, tablets, laptops etc. If items need to be shared use
disinfectant wipes to disinfect items prior to and after sharing.
- If meeting in a group for research purposes ensure you are following current country specific guidance on face-to-face meetings (i.e rule of 6 etc.)
- If and when possible meet outside and when not possible meet in venues with good ventilation (e.g. open a window)
- If you feel unwell during or after a meeting with others, inform others you have interacted with, self-isolate and get tested for Covid-19
- Avoid high noise areas as this mean the need to shout which increases risk of aerosol transmission
of the virus.
- Follow one way circulation systems, if in place. Make sure to check before you visit a building.
- Always read and follow the visitors policy for the organisation you will be visiting.
- Flush toilets with toilet lid closed.
-'Other' Control Measures you will take (specify):

NOTE: The hazards and existing control measures above pertain to Covid-19 infection risks only. More generalised health and safety risk may exist due to remote field work activities and these are outlined in your Dissertation in Planning Guidance document. Please consider these as possible 'risk' factors in completing the remainder of this standard form. For more information also see: Guidance Framework for Fieldwork in Taught and MRes Programmes, 2021-22

Consider, in turn, each hazard (white on black). If **NO** hazard exists select **NO** and move to next hazard section.
If a hazard does exist select **YES** and assess the risks that could arise from that hazard in the risk assessment box.
Where risks are identified that are not adequately controlled they must be brought to the attention of your Departmental Management who should put temporary control measures in place or stop the work. Detail such risks in the final section.

ENVIRONMENT	**The environment always represents a safety hazard. Use space below to identify and assess any risks associated with this hazard**
e.g. location, climate, terrain, neighbourhood, in outside organizations, pollution, animals.	Examples of risk: adverse weather, illness, hypothermia, assault, getting lost. Is the risk high / medium / low?
	Risks associated with this hazard: Adverse weather Risk assessment: Low

CONTROL MEASURES	**Indicate which procedures are in place to control the identified risk**
	work abroad incorporates Foreign Office advice
	only accredited centres are used for rural field work
X	participants will wear appropriate clothing and footwear for the specified environment
	refuge is available
	work in outside organisations is subject to their having satisfactory H&S procedures in place
	OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

EMERGENCIES	**Where emergencies may arise use space below to identify and assess any risks**
e.g. fire, accidents	Examples of risk: loss of property, loss of life
Risks associated with this hazard: Loss of property	

CONTROL MEASURES	**Indicate which procedures are in place to control the identified risk**
	participants have registered with LOCATE at http://www.fco.gov.uk/en/travel-and-living-abroad/
X	contact numbers for emergency services are known to all participants
X	participants have means of contacting emergency services
	a plan for rescue has been formulated, all parties understand the procedure
	the plan for rescue /emergency has a reciprocal element
	OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

EQUIPMENT	Is equipment used?	NO	If 'No' move to next hazard If 'Yes' use space below to identify and assess any risks
e.g. clothing, outboard motors.	Examples of risk: inappropriate, failure, insufficient training to use or repair, injury. Is the risk high / medium / low ?		

CONTROL MEASURES	Indicate which procedures are in place to control the identified risk
	the departmental written Arrangement for equipment is followed
	participants have been provided with any necessary equipment appropriate for the work
	all equipment has been inspected, before issue, by a competent person
	all users have been advised of correct use
	special equipment is only issued to persons trained in its use by a competent person
	OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

LONE WORKING	Is lone working a possibility?	YES	If 'No' move to next hazard If 'Yes' use space below to identify and assess any risks
e.g. alone or in isolation *lone interviews.*	Examples of risk: difficult to summon help. Is the risk high / medium / low?		

Risks associated with this hazard: difficult to summon help; risk of abuse/attack
Risk assessment: Low

CONTROL MEASURES	Indicate which procedures are in place to control the identified risk
	the departmental written Arrangement for lone/out of hours working for field work is followed
	lone or isolated working is not allowed
X	location, route and expected time of return of lone workers is logged daily before work commences
	all workers have the means of raising an alarm in the event of an emergency, e.g. phone, flare, whistle
	all workers are fully familiar with emergency procedures
X	OTHER CONTROL MEASURES: please specify any other control measures you have implemented: Where possible carry a radio or mobile phone; Specify dates and times of departure and return. If your plans change, inform someone as soon as possible; Do not carry valuables or large sums of money unless you need to; Instigate a "check-in" system with a colleague or supervisor - Phone in at regular intervals. If you do not phone or return at a certain time arrange for suitable action to be taken.

ILL HEALTH	The possibility of ill health always represents a safety hazard. Use space below to identify and assess any risks associated with this Hazard.
e.g. accident, illness, personal attack, special personal considerations or vulnerabilities.	Examples of risk: injury, asthma, allergies. Is the risk high / medium / low? Risks associated with this hazard: Fatigue leading to lack of concentration, accidents and risk of injury; Lack of Physical Fitness leading to risk of personal injury/illness Risk assessment: Low
CONTROL MEASURES	**Indicate which procedures are in place to control the identified risk**

	all participants have had the necessary inoculations/ carry appropriate prophylactics
X	participants have been advised of the physical demands of the research and are deemed to be physically suited
	participants have been adequate advice on harmful plants, animals and substances they may encounter
	participants who require medication should carry sufficient medication for their needs
X	OTHER CONTROL MEASURES: please specify any other control measures you have implemented: Do not try to do too much in one day, especially if the work is to be followed by a long drive home; Lack of sleep can lead to accidents - ensure sufficient rest is taken; Plan your work within your limits

TRANSPORT	Will transport be required	NO		Move to next hazard
		YES	X	Use space below to identify and assess any risks
e.g. hired vehicles	Examples of risk: accidents arising from lack of maintenance, suitability or training Is the risk high / medium / low? Risks associated with this hazard: accidents arising from lack of maintenance. Risk assessment: Low			
CONTROL MEASURES	**Indicate which procedures are in place to control the identified risk**			

X	only public transport will be used
	the vehicle will be hired from a reputable supplier
	transport must be properly maintained in compliance with relevant national regulations
	drivers comply with UCL Policy on Drivers http://www.ucl.ac.uk/hr/docs/college_drivers.php
	drivers have been trained and hold the appropriate licence
	there will be more than one driver to prevent driver/operator fatigue, and there will be adequate rest periods
	sufficient spare parts carried to meet foreseeable emergencies
	OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

DEALING WITH THE PUBLIC	Will people be dealing with public	YES	If 'No' move to next hazard If 'Yes' use space below to identify and assess any risks
e.g. interviews, observing	Examples of risk: personal attack, causing offence, being misinterpreted. Is the risk high / medium / low?		
	Risks associated with this hazard: risk of personal attack/abuse due to misunderstanding of nature of work, leading to abuse/attack; other people's "pets" - risk of injury; Causing offence, leading to abuse/attack. Risk assessment: Low		
CONTROL MEASURES	**Indicate which procedures are in place to control the identified risk**		

	all participants are trained in interviewing techniques
	advice and support from local groups has been sought
X	participants do not wear clothes that might cause offence or attract unwanted attention
X	interviews are conducted at neutral locations or where neither party could be at risk
X	OTHER CONTROL MEASURES: please specify any other control measures you have implemented: Do not spread your belongings around; Let them know how much of their time you will need; Be aware that not all pets are "friendly"; Be aware of any delicate issues involved with discussions or interviews e.g. before asking a farmer questions regarding his or her land management, explain why you need to know; Conduct interviews at neutral locations or public spaces or where neither party could be at risk; Where possible conduct any interviews with an observer

WORKING ON OR NEAR WATER	Will people work on or near water?	NO	If 'No' move to next hazard If 'Yes' use space below to identify and assess any risks
e.g. rivers, marshland, sea.	Examples of risk: drowning, malaria, hepatitis A, parasites. Is the risk high / medium / low?		
CONTROL MEASURES	**Indicate which procedures are in place to control the identified risk**		

	lone working on or near water will not be allowed
	coastguard information is understood; all work takes place outside those times when tides could prove a threat
	all participants are competent swimmers
	participants always wear adequate protective equipment, e.g. buoyancy aids, wellingtons
	boat is operated by a competent person

	all boats are equipped with an alternative means of propulsion e.g. oars
	participants have received any appropriate inoculations
	OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

MANUAL HANDLING (MH)	**Do MH activities take place?**	**NO**	**If 'No' move to next hazard** **If 'Yes' use space below to identify and assess any risks**
e.g. lifting, carrying, moving large or heavy equipment, physical unsuitability for the task.	Examples of risk: strain, cuts, broken bones. Is the risk high / medium / low?		

CONTROL MEASURES	**Indicate which procedures are in place to control the identified risk**

	the departmental written Arrangement for MH is followed
	the supervisor has attended a MH risk assessment course
	all tasks are within reasonable limits, persons physically unsuited to the MH task are prohibited from such activities
	all persons performing MH tasks are adequately trained
	equipment components will be assembled on site
	any MH task outside the competence of staff will be done by contractors
	OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

SUBSTANCES	Will participants work with substances	NO	If 'No' move to next hazard If 'Yes' use space below to identify and assess any risks
e.g. plants, chemical, biohazard, waste	Examples of risk: ill health - poisoning, infection, illness, burns, cuts. Is the risk high / medium / low?		
CONTROL MEASURES	**Indicate which procedures are in place to control the identified risk**		

	the departmental written Arrangements for dealing with hazardous substances and waste are followed
	all participants are given information, training and protective equipment for hazardous substances they may encounter
	participants who have allergies have advised the leader of this and carry sufficient medication for their needs
	waste is disposed of in a responsible manner
	suitable containers are provided for hazardous waste
	OTHER CONTROL MEASURES: please specify any other control measures you have implemented:

OTHER HAZARDS	Have you identified any other hazards?	YES	If 'No' move to next section If 'Yes' use space below to identify and assess any risks
i.e. any other hazards must be noted and assessed here.	Hazard: Health: Medical conditions resulting from extended display screen equipment use Risks associated with this hazard: Risk of injury or ill health, including postural problems, visual problems and fatigue and stress. Risk assessment: Low		
CONTROL MEASURES	**Give details of control measures in place to control the identified risks**		

To control for fatigue and stress, ensure postural and visual problems are dealt with and take sufficient breaks. Breaks should ensure the user varies their posture and changes visual demands.
Space must be sufficient for postural changes and to provide freedom of movement while seated and while moving between furniture and equipment.
Lighting levels must be sufficient for all tasks at the workstation e.g. reading or keyboard work. The light source can be natural or artificial or a combination of both. Measures must be taken to avoid reflections and glare

Have you identified any risks that are not adequately controlled?	**NO**	**X**	**Move to Declaration**
	YES		**Use space below to identify the risk and what action was taken**

DECLARATION	The work will be reassessed whenever there is a significant change and at least annually. Those participating in the work have read the assessment.

Select the appropriate statement:

X	I the undersigned have assessed the activity and associated risks and declare that there is no significant residual risk
X	I the undersigned have assessed the activity and associated risks and declare that the risk will be controlled by the method(s) listed above

NAME OF SUPERVISOR

Appendix C Copy of Ethical Clearance Questionnaire Responses

Ethical Clearance Pro Forma

It is important for you to include all relevant information about your research in this form, so that your supervisor can give you the best advice on how to proceed with your research.

You are advised to read though the relevant sections of UCL's Research Integrity guidance to learn more about your ethical obligations.

Submission Details

1. **Name of programme of study:**

   MSc Transport and City Planning

2. **Please indicate the type of research work you are doing**

   - Dissertation in Planning (MSc)

3. **Please provide the current working title of your research:**

   Exploring Perceived Walkability and its influencing factors for Elderly in London at community level

4. **Please indicate your supervisor's name:**

   De Vos, Jonas

Research Details

5. **Please indicate here which data collection methods you expect to use. (Tick all that apply/or delete those which do not apply.)**

   - Questionnaires (including oral questions)
   - Secondary data analysis

6. **Please indicate where your research will take place (delete that which does not apply):**

   - UK only

7. **Does your project involve the recruitment of participants?**
   'Participants' means human participants and their data (including sensor/locational data and observational notes/images.)

   Yes

Appropriate Safeguard, Data Storage and Security

8. Will your research involve the collection and/or use of personal data?

Personal data is data which relates to a living individual who can be identified from that data or from the data and other information that is either currently held, or will be held by the data controller (you, as the researcher).

This includes:

- Any expression of opinion about the individual and any intentions of the data controller or any other person toward the individual.
- Sensor, location or visual data which may reveal information that enables the identification of a face, address etc. (some post codes cover only one property).
- Combinations of data which may reveal identifiable data, such as names, email/postal addresses, date of birth, ethnicity, descriptions of health diagnosis or conditions, computer IP address (of relating to a device with a single user).

Yes

9. Is your research using or collecting:

- special category data as defined by the General Data Protection Regulation*, and/or
- data which might be considered sensitive in some countries, cultures or contexts?

*Examples of special category data are data:

- which reveals racial or ethnic origin, political opinions, religious or philosophical beliefs, trade union membership;
- concerning health (the physical or mental health of a person, including the provision of health care services);
- concerning sex life or sexual orientation;
- genetic or biometric data processed to uniquely identify a natural person.

No

10. Do you confirm that all personal data will be stored and processed in compliance with the General Data Protection Regulation (GDPR 2018)? (Choose one only, delete that which does not apply)

- Yes

11. I confirm that:

- The information in this form is accurate to the best of my knowledge.
- I will continue to reflect on and update these ethical considerations in consultation with my supervisor.

Yes

Supervisor sign-off for Ethical Clearance Forms and Risk Assessment Forms

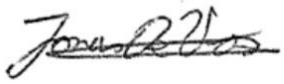
(For supervisor completion only BEFORE submission via Moodle)

Are you satisfied with the **ethical clearance form** (*yes/no*)?

Please provide any additional comments about the form that may help the student. ***(If the form is missing, the proposal must be given a mark of 0, and the student will have 48hours to resubmit the complete proposal. If the form is unsatisfactory, the student must amend their ethical questionnaire to your satisfaction before they can proceed with their research)*** ***Yes***

Are you satisfied with the **risk assessment form** (*yes/no*)?

Please provide any additional comments about the form that may help the student. ***(If the form is missing, the proposal must be given a mark of 0, and the student will have 48hours to resubmit the complete proposal. If the form is unsatisfactory, the student must amend their ethical questionnaire to your satisfaction before they can proceed with their research)*** ***Yes***



03/04/2023