DOCTORAL THESIS

SHIBAURA INSTITUTE OF TECHNOLOGY

THE RELATIONSHIP OF PHYSICAL AND SOCIAL ENVIRONMENTS WITH ACTIVE AGEING AMONG OLDER ADULTS: A CASE STUDY IN THE MALAYSIAN NEIGHBOURHOODS OF JOHOR BAHRU

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ABSTRACT

An ageing population poses a major challenge to low and middle-income countries such as Malaysia which is related to an increased prevalence of non-communicable diseases among older adults due to physical inactivity. Focusing on developing an active ageing living environment is the preferred solution to deal with this problem. The physical and social neighbourhood environments (PNE & SNE) can affect active ageing among older residents from the context of physical activity (PA) level. The objectives of this research are to examine the objective and subjective measures of PNE & SNE, and their direct and indirect relationship with (PA) levels of older residents. The PNE objective (PNEO): land use mix entropy, population density, traffic intersection density and distance to facilities; and PNE subjective (PNES): comprised of physical neighbourhood perception based on the NEWS-A questionnaire items: and their relationship with older adults' PA were analyzed. Concurrently, the SNE objective (SNEO): social networks and sociability; and SNE subjective (SNES): generalized trust, collective action and cooperation, and perception towards community groups: and their relationship with older adults' PA were also analyzed. The SNEO and SNES items were based on the SC-IQ questionnaire items and findings from the author's pilot survey. The PA was measured based on the IPAQ questionnaire items. The questionnaire were combined and survey was conducted on 280 older residents in four neighbourhoods of Johor Bahru city, Johor, Malaysia. Cross-tabulations and correlation analyses were conducted to analyse the significant relationships.

It was found that PNEO, PNES, SNEO and SNES items showed significant relationships. The most profound relationships with PA level were demonstrated in two or more neighbourhoods: distance to facilities such as mosques and recreation areas, and land use mix entropy for PNEO; perceived neighbourhood accessibility, perceived traffic safety, and lack of cul-de-sacs for PNES; sociability specifically on participation in community activities for SNEO; and lastly perceived generalized trust and perception towards community groups for SNES. Moreover, an observation of the four neighbourhoods showed similar physical characteristics which may greatly influence the significant results that were obtained in this study such as the existing traffic network condition, residential segregation, and functional neighbourhood centrality area. A conceptual framework was constructed to formulate the research hypotheses and to illustrate the relationship between the PNE and SNE. Furthermore, unrelated to the PNE and SNE, the socio-economic indicators especially gender, period of stay, and race might also be an important influence to the physical activity level of older adults.

This study has achieved the objectives of this study which were to analyse the relationship between the objective and subjective PNE and SNE measures with PA level of older adults. Hypotheses were validated to prove the relationships underlying the PNE, SNE and PA. The findings from this study can help to contribute to existing knowledge in the neighbourhood environment planning especially in highlighting the important objective measures of the PNE and SNE. This can help suggest and improve the urban planning housing policy guidelines in order to promote active ageing neighbourhood environment in Malaysia.

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1 INTRODUCTION

1.1 Research Background

Globally, nations are now encountering a state of increasing ageing population which is a major issue of social transformation, whereby all sectors of development are affected. Population ageing is a continuous phenomenon that are mainly caused by reduced fertility rates and an increased in life expectancy in the population. The global ageing population aged 60 years and above is expected to increase to 1.5 billion in 2050 from an estimated 524 million in 2010, in which most increased of ageing population occurred in developing countries (National Institute on Ageing. & Health., 2011). The United Nations defined an ageing society when 15% of the country's population consisted of elderly people who aged 60 years and above. Developed countries like Japan are experiencing a super-aged phenomena in which the percentage of its elderly population (aged 65 and older) increases from 19.8% in 2005 to 26.3% in 2015 (World Bank, 2016), and is projected to increase to 33.3% in 2036, which makes Japan as the country with the highest ageing ratio in the world (National Institute of Population and Social Security Research, 2017). This has become a major challenge for developed countries, and an even more formidable challenge for developing countries such as Malaysia.

Malaysia has seen a progressive development growth but rather a slow-paced ageing society in which the population will consist of about 7 percent elderly people according to the forecast in 2020, and in 2030, the percentage of the elderly population will increase to about 11 percent (Hedrich et al., 2016). An ageing population poses a major challenge to low and middle-income countries especially relating to an increased prevalence of non-communicable diseases (Kampfen, Wijemunige, & Evangelista Jr., 2018), usually related to diseases among the elderlies. Moreover, global health estimates projections by WHO (2018) shows that Malaysia as an upper-middle income country will experience a gradual increase of mortality caused by non-communicable diseases from 84.3% in 2016 to 89.9% in 2045.

Concurrently, the health and social care system of the living environment among the elderly population has become the subject of numerous discussions. However, using conventional measures for dealing with the increasing number of elderly people is no longer the main solution. Instead, the focus has been towards improving environmental spatial planning in order to cater to the elderly. In addition, preparation towards a social shift that is deemed fit for all age sectors among the population is vital in order to experience continual progress in sustainable development. Previous studies have shown that the neighbourhood environment is an important aspect regarding the well-being of the elderly, especially in terms of their physical and social needs. This is because such an environment serves as a daily setting that facilitates/assists the community members as well as acts as a support system to those experiencing decreasing health levels and social isolation. Cramm and Nieboer (2015) reported that a poor neighbourhood environment negatively affects elderly people who live alone, especially in obtaining support in their daily lives. Therefore, establishing and maintaining supportive relationships through a desirable neighbourhood environment can positively influence morbidity, mortality, and the elderly dependency ratio, all of which can strengthen the level of social capital among the community members (Cramm & Nieboer, 2015). Furthermore, strong evidence has shown that non-communicable diseases are caused by physical inactivity which is usually prevalent among older adults (Chan et al., 2019). As older adults increase with age and enters the retirement period, their level of physical activity will be reduced.

To deal with the problems associated with physical inactivity, the WHO developed an active ageing framework that empowers older people's physical, social and mental health through community engagement (WHO, 2002). Active ageing refers to active community engagement that promotes a healthy lifestyle in older people and retirees to improve their quality of life, increase their physical fitness, reduce health problems and prolong life. Active ageing promotes older people to sustain a healthy lifestyle which is fundamental especially among older people and retirees. It may help them to

experience higher life expectancies and improve their quality of life by becoming physically fit and by showing active engagement in the community.

Physical activity (PA) can be assessed from several active ageing indicators related to the economy, health and social services, behaviour, personal circumstances, social surroundings and the physical environment (WHO, 2002). It has been found that older adults who participate in social and physical activities have higher self-satisfaction and confidence, a lower level of hospitalisations and a decreased likelihood of early mortality (Gautam, Saito, & Kai, 2007). Risk of obesity can be reduced among older adults who regularly participate in physical activities such as physical transportation activities (walking or cycling to destinations), physical occupational activities, indoor and outdoor household chores and daily sports and recreation activities (WHO, 2011). On the other hand, social activities such as interaction with neighbours and participating in community activities were also known to influence elderlies extent of PA level (Rebecchi et al., 2019).

Thus, an extensive approach such as the promotion of active ageing lifestyle among older adults are currently sought upon as an alternative to cope with the trend of ageing society. Malaysia as a developing country should be outlining its future developments to meet the needs of a future ageing nation. In Malaysia, the issue of ageing society and how to cater the needs of increasing number of elderlies are mainly done by promoting through health awareness campaigns among the population in order to live a healthy lifestyle. It is insufficient to just promoting through awareness campaigns, thus, the physical environment in which the elderlies live should also be aware of. The built environment characteristics is of utmost important when it comes to elderlies, especially in terms of the spatial planning that affects the accessibility, mobility, safety, attractiveness to make elderlies want to spend time outdoors during their everyday life.

1.2 Problem Statement and Significance of the Study

As one of the developing countries in Southeast Asia, Malaysia's economic growth has increased gradually as well as the rate of the country's development. Prior to this, the population demographic in Malaysia is fast increasing into the middle aged working people and this indicates a starting process of population ageing where the number of elderlies will make up a larger share of proportion in the future total population. The proportion of elderly is projected to reach 16.3% of the total population in Malaysia by the year 2040 (Abd. Rashid S. et al., 2016). Estimates by Jacob (2016) also showed a gradual increase of the elderly share of the population from 7% in 2005 to 12% in 2020. The age structure has gradually changed over the past few years: the proportion of younger people is declining and the proportion of older adults showed a steady increase (Karim, 1997). As shown in Figure 1.1, Malaysia is expected to become an ageing society in 2030, when 15% of the population will comprised of elderly people (UM, 2012). Based on these statistics, it is forecasted that Malaysia will become an ageing nation in the near future.

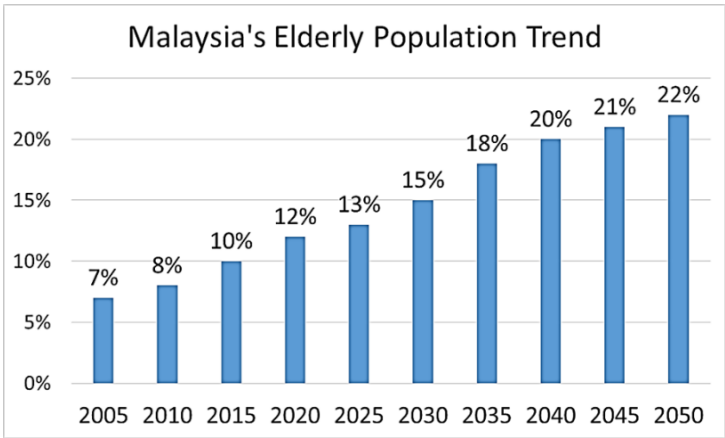


Figure 1.1: Malaysia's Elderly Population Trend

Source: Universiti Malaya: International Conference on Population Ageing (2012)

Generally, people's physical functions deteriorate with age, making older people less active and less mobile (Milanovic et al., 2013), which tends to lead to physical inactivity, as has been found in 48.8% of Malaysian men and women aged 60 years and above (Yy et al., 2019). An increase in physical inactivity will have major impacts on Malaysia such as an increase in dependency ratio and increasing needs of healthcare and medical facilities due to unhealthy dietary habits and sedentary lifestyle. In developed nation like Japan, this has become a major issue concerning the shift in demographic change. An increase of the elderlies percentage was shown to influence Japan's local and national economies which caused a huge surge on pension funds and greater reliance on health care systems (Rupavijetra, Chompikul, & Rupavijetra, 2016). Furthermore, a higher proportion of older people living in the urban area greatly affect the distribution of health care resources in Malaysia (Mafauzy, 2000). Thus, a preparation to cope with this demographic shift in all related sectors is deemed important since Malaysia is moving progressively to an ageing society in the future.

Figure 1.2 shows the current population pyramid of Malaysia, in which the majority are young and middle-aged adults between the ages of 20 and 39. The population in 2040 is expected to increase, which will change the pattern of the population pyramid. Figure 1.3 shows a majority age group from the population pyramid, which will be among young-old adults in the range of 45 to 59. This is a slowly progressing trend that shows the importance of a development shift towards prioritising the needs of older adults in Malaysia, especially in the neighbourhood environment, to help them live independently.

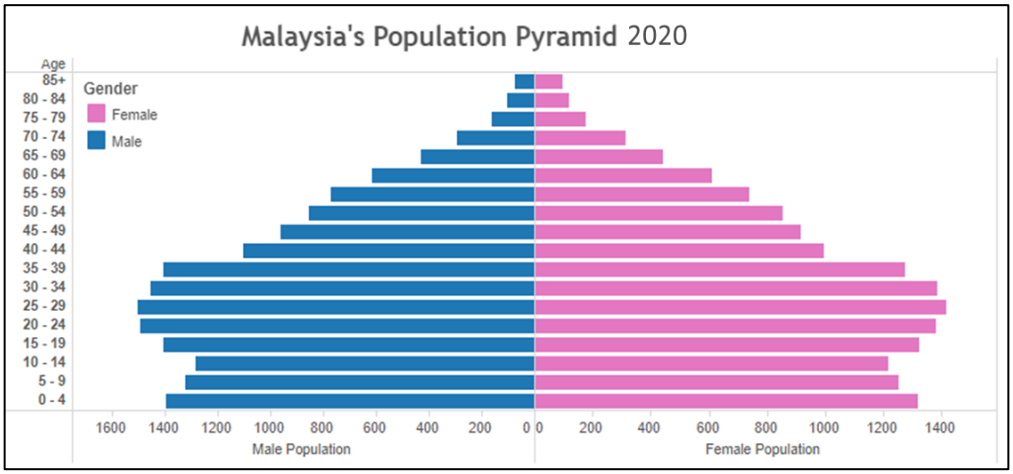


Figure 1.2: Population pyramid for Malaysia in 2020
Source: Department of Statistics Malaysia (2020)

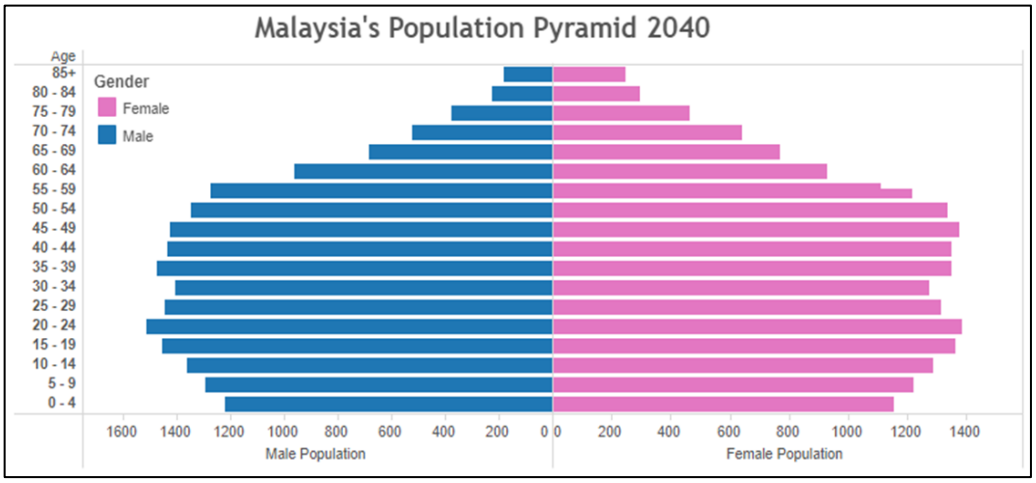


Figure 1.3: Population pyramid for Malaysia in 2040
Source: Department of Statistics Malaysia (2020)

Malaysia's current progress regarding the promotion of active ageing lifestyle is still underway, by promoting active ageing in its revised policy framework in the National Policy and Plan of Action for Older Persons in 2011 (Zawawi, 2013). Yet, the actions promoted remain rather general, which mostly focused on the health care provision and promotion of elderlies' well-being. This study is significant to highlight the importance of specific policies concerning the development of an active ageing lifestyle in Malaysia, as well as the importance of the physical neighbourhood environment (PNE) as a daily setting that facilitates an active ageing lifestyle among older people.

1.3 Research Objectives

This research aimed to investigate the physical and social characteristics of the neighbourhood environment that can facilitate an active ageing lifestyle among older adults in Malaysia. The objectives for this research were developed based on the general research background, which are:

Objective 1: To investigate the influence of the PNE on the physical activity level among older adults

Objective 2: To examine the impact of the social neighbourhood environment (SNE) on the physical activity level among older adults

Objective 3: To investigate the influence of the PNE on the physical activity level among older adults through SNE

1.4 Expected Outcomes

The results of this study are expected to facilitate the housing policy and planning guidelines for Malaysian neighbourhoods that can act as a benchmark, especially in Malaysia's housing sector. Significant relationships between the PNE and SNE with older adults' physical activity are expected to aid the formulation of specific policies.

1.5 Research Questions and Hypotheses

Several research challenges arise to achieve the research objectives. Several hypotheses were then formulated to answer the research questions from this study which are described below in Table 1.1.

Table 1.1: List of research questions and hypotheses statements of this study

Research Questions (RQ)	Hypotheses Statement
RQ1: Is there any relationship between each objective measure of the physical neighbourhood environment (PNEO) and the physical activity level of older adults?	H1: There is a statistically significant association between each PNEO measure and physical activity level of older adults
RQ2: Is there any relationship between each subjective measure of the physical neighbourhood environment (PNES) and the physical activity level of older adults?	H2: There is a statistically significant association between each PNES measure and physical activity level of older adults
RQ3: Is there any relationship between each objective measure of the social neighbourhood environment (SNEO) and the physical activity level of older adults?	H3: There is a statistically significant association between each SNEO measure and physical activity level of older adults

RQ4: Is there any relationship between each PNES measure with PA which is indirectly caused by PNEO?	H4: There is a statistically significant association between the PNES measure with PA which is indirectly caused by PNEO
RQ5: Is there any relationship between each SNEO measure with PA which is indirectly caused by PNEO?	H5: There is a statistically significant association between the SNEO measure with PA which is indirectly caused by PNEO
RQ6: Is there any relationship between each SNES measure with PA which is indirectly caused by PNEO?	H6: There is a statistically significant association between the SNES measure with PA which is indirectly caused by PNEO
RQ7: Is there any relationship between each demographic attribute with the physical activity level of older adults?	H7: There is a statistically significant association between each demographic attribute and physical activity level of older adults

1.6 Scope of the Study

This research This research highlights the influence of important physical and social neighbourhood environmental characteristics, primarily in terms of objective and perceptual measures on the degree of physical activity among older adults in the context of the Malaysian urban neighbourhood. There are currently limited studies focusing on this research area in Malaysia. Specific physical and social characteristics of the neighbourhood environment were hypothesised to influence the extent of physical activity among Malaysian older adults.

The study area was chosen based on the high proportion of older adults living in the urban neighbourhood of Johor Bahru City, Malaysia, based on the 2010 census data. The population census data of 2010 is the only data currently available from the Department of Statistics Malaysia. In Malaysia, the population census report is formulated every ten years. The physical characteristics of the neighbourhood areas are limited to the existing GIS data of the Iskandar Malaysia region in Johor Bahru, which was obtained in 2012. Further modifications were added to suit the current land-use status in the study area. Only three neighbourhoods were selected as the final study areas due to the difficulties of obtaining respondents with the age range of 50 and over. The neighbourhoods were selected based on the activeness of the neighbourhood associations that were managed by the community themselves.

To date, few studies have investigated active ageing (Ambigga et al., 2011; H. Elsawahli et al., 2017) and the impact of PNES on older adults active lifestyles (Ajit Singh et al., 2018; Azmi and Karim, 2012; H. Elsawahli, Ahmad, & Ali, 2016; Lai et al., 2016; Mohammad and Abbas, 2012; APUDG, 2000) in Malaysia. There are no studies on possible relationships between objective PNE measures (PNEO) and Physical activity (PA) levels in Malaysian older adults. Since investigations have also found relationships between PNES and PA in Malaysia, it was anticipated that these measures also affect the PA levels of older Malaysian adults. Therefore, this study hypothesised that PNEO characteristics directly affect the level of PA in older adults and that the PNES characteristics indirectly affect the PA level depending on the respondent's perception towards the distinctive physical characteristics of each neighbourhood. The unique physical attributes for each neighbourhood in this study were defined as small-scale physical features such as road medians, main roads with no pedestrian crossings, residential district boundaries and drainage barriers.

We also focus on the daily setting of the neighbourhood environment among elderlies living independently in their own house. By looking at a bigger context, the clusters of elderlies' current location of living must be determined first to understand the spatial location of elderlies further. Also, we need to realise in what neighbourhood conditions they currently live (whether ground properties or high-rise affordable housing).

Urban settings have been found to influence older people's daily activity levels (Rebecchi et al., 2019). In particular, the surrounding neighbourhood environment can affect the extent to which residents

engage in healthy and active ageing activities (Kerr, Rosenberg, & Frank, 2012; Rosso, Auchincloss, & Michael, 2011). PNE can be measured objectively and subjectively. The objectively-measured PNE (PNEO) is the observable and measurable real-time data related to the physical characteristics of the neighbourhood environment, which can be obtained and analysed from either direct observation or secondary GIS data. PA can also be measured objectively through questionnaire surveys on residents. However, subjectively-measured PNE (PNES) is the perceived and subjective opinions of the general population about their surrounding neighbourhood environment. While both measures are interdependent (Sayegh et al., 2016), it is also essential to explore the underlying assumptions that may influence the PA levels in older adults (Hawkesworth et al., 2018; Nyunt et al., 2015; Thornton et al., 2017).

1.7 Thesis Structure

The overall flow of the thesis structure is described in Figure 1.4. Chapter 1 discussed the construction of the overall research framework, including the research background, problem statement, study significance, research objectives, expected outcomes, research questions, hypotheses and the scope of the study. Chapter 2 highlights the discussion of the literature review to develop an appropriate conceptual framework for this research. The main topics of this research include active ageing concepts and PA as the primary indicators, various physical and social neighbourhood environmental measures, and the research pilot study findings regarding active ageing in the context of bridging social capital. Chapter 3 is related more to the overall research methodology, including the description of the study areas, research method design, respondents of this study, analytical methods of the PNE spatial data, questionnaire framework and analytical methods performed based on the characteristics of variables.

Chapters 4, 5, 6 and 7 provide further results and discussions on the four case study areas. These chapters will discuss the results of descriptive statistics and analysis of PNEO, and the results of the questionnaire survey related to the demographic attributes of the respondents, PNES, SNEO, SNES and PA. Next, significant relationships are shown to prove the expected hypotheses for this study. Chapter 8 highlights the summary of the overall findings based on the four models and the validation of various hypotheses developed based on the conceptual framework of this research. This chapter provides detailed cross-tabulations to prove the indirect relationship of other hypotheses that combine respondents in a total of four models. The concluding chapter also discusses how the findings of this study can help promote an active ageing lifestyle for older adults across physical and social neighbourhood environment settings.

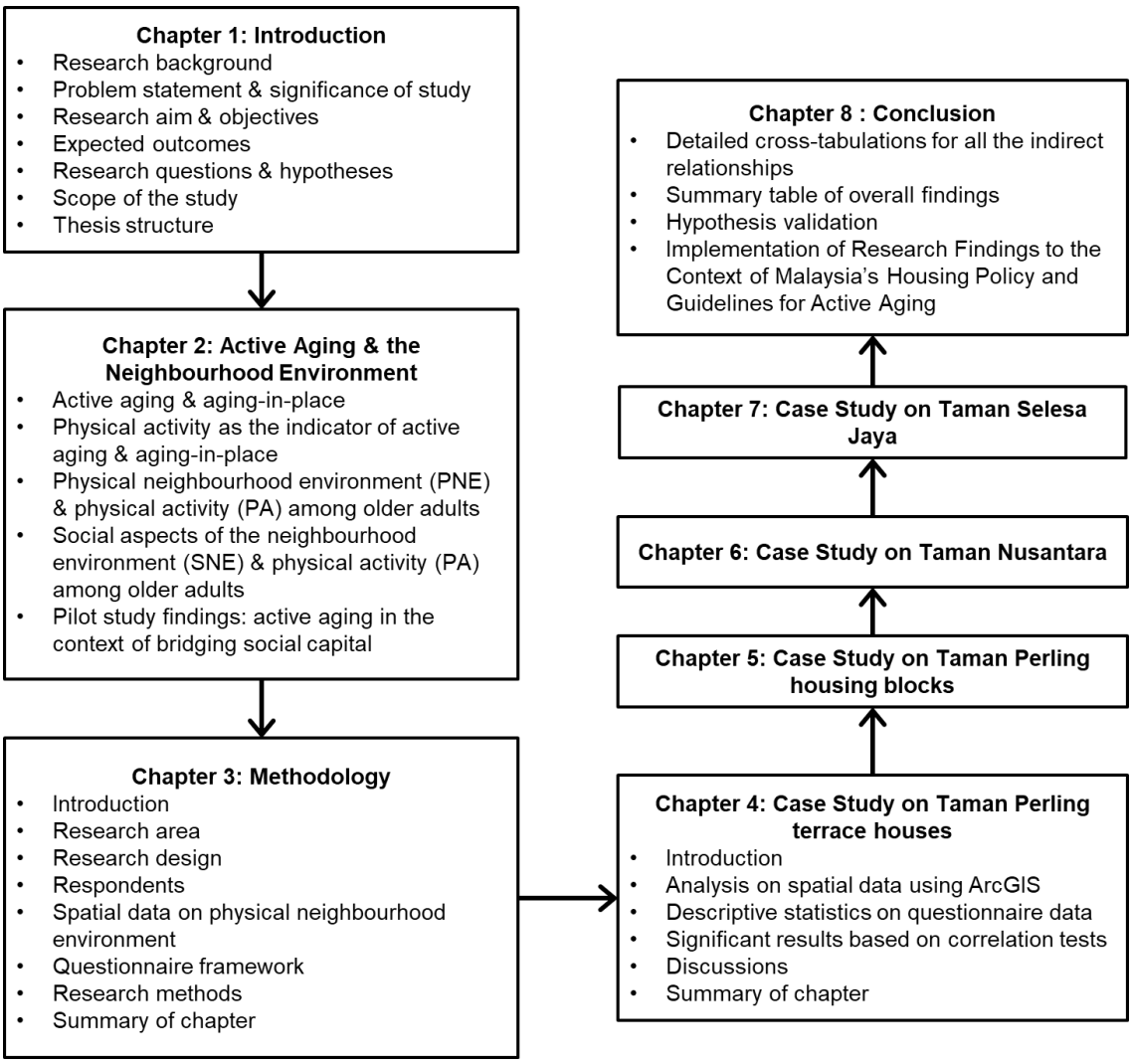


Figure 1.4: Overall flow of thesis structure

2 ACTIVE AGEING AND THE NEIGHBOURHOOD ENVIRONMENT

This chapter will discuss about the current literature review regarding the importance of active ageing and ageing-in-place, the present situation of Malaysia's housing policy and guidelines focusing on older people, and the importance of physical and social neighbourhood environment in terms of objective and subjective measures which greatly affect the extent of physical activity among older people especially in the neighbourhood setting.

2.1 Active Ageing and Ageing-in-Place

Active ageing can be generally understood as sustaining participation in all domains of life, such as the physical, social, economic, civic and spiritual aspects, to enhance the quality of life (WHO, 2007). This concept improves the life quality and well-being of older people by maximising the opportunities to be physically, socially and mentally healthy, as well as maintaining autonomy and living independently. Older retired adults, as well as unemployed older adults such as housewives, can remain active across the different domains of active ageing. It promotes behaviours that lead to higher life expectancies and better quality of life by becoming physically fit and active, nurturing each individual's well-being and continuous involvement in the community, as well as having a healthy mental state. Furthermore, active ageing captures the synonym of being engaged in life, which includes a healthy, emotional, environmental, physical, social and spiritual life despite age, demographic attributes and health status (International Council on Active Ageing, 2015). As theorised by WHO (2007), active ageing exists in different domains of an individual's life. It varies according to gender and various cultural backgrounds in a community (see Figure 2.1).

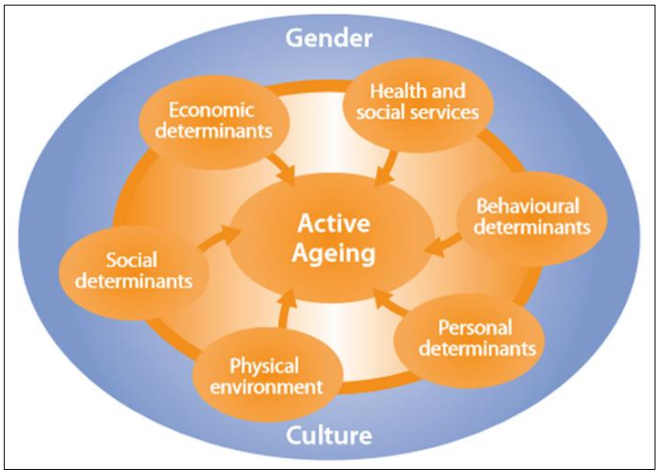


Figure 2.1: Active Ageing concept by WHO (2007)

Correspondingly, when viewing in a smaller context, adaptation strategies for the active ageing concept can be sought by looking to the ageing-in-place lifestyle, focusing on the design of physical environments for adaptation purposes, especially for older adults. Physical features in the neighbourhood environment must be barrier-free to encourage the elderly to engage in daily activities outdoors. Ageing-in-place can be understood as the ability of older people to remain in their residential neighbourhoods with informal and formal social support, accessibility to transportation, and a walkable neighbourhood design, encourageing them to stay active, independent, and socially engaged (Woolrych & Fang, 2016). Furthermore, several characteristics of an age-friendly city concept were formulated by WHO (2007) which is also closely related to the ageing-in-place theory. The characteristics can be divided into two main categories which are physical and social. Physical characteristics includes housing, outdoor spaces and buildings, and transportation whereas social characteristics includes having good community support and health services, adequate communication and information, engagement in social

participation, high levels of respect and social inclusion, and civic participation and employment. The planning for an age-friendly city focuses especially on the social and the physical built environment, whereby these settings have a profound significance to each other (Phillipson, 2011).

Ageing-in-place is regarded as a sensible concept for many since it allows older people to remain living independently rather than having to move out to live in institutional care facilities regardless of their health changing over time (Hagen, 2013). Past researches have also proven that most older adults tend to continue staying in their current homes compared to moving out to retirement homes (Hartje, 2004; Wiles et al., 2012). Malaysian middle adults aged 40 and above mostly preferred to stay in their homes when they get older, provided that they are surrounded by family and friends and have high mobility to access to facilities and services in their housing area (Aini, Aziz, & Hanif, 2015). This signifies the importance of ageing-in-place, since it empowers them to be independent and socially engaged in a secure and comfortable neighbourhood environment. Furthermore, this concept is referred extensively in both the internal housing environment as well as the neighbourhood environment setting that plays an important role for older adults to participate in various outdoor physical activities. Hence, it is sufficient to assume that ageing-in-place concept as a firm foundation to be a starting point in planning for an inclusive and sustainable neighbourhood environment in the future.

Currently, all issues regarding older persons are counselled by the Department of Social Welfare under the Ministry of Women, Family and Community Development. The ageing-in-place concept in Malaysia is still underway with the government formulating a few housing policies to address the needs of the older people. The National Policy and Plan of Actions for Older Persons was formulated in October 1995, focusing on older people right of access to obtain ample health care. In accordance to this, the Ministry of Health (MOH) Malaysia initiated the National Council on Health of the Elderly in 1997 with specific action plans for health care allocation for older people in Malaysia (Mohammad & Abbas, 2012).

A newer version of the National Policy and Plan of Actions for Older Persons was approved in January 2011. The modifications includes integrating the older persons in the society and to empower older persons with a high self-worth and integrity. This policy is expected to initiate a conducive environment for older people to help develop their sense of independence and realizing their self-potential for their own self-improvement (Zawawi, 2013). Furthermore, the government have also developed the National Health Policy for Older Person in 2008 which mainly focused on improving the healthcare services for older people as well promoting individual health. All of the current policies for elderly in Malaysia only focuses on providing sufficient and high quality health care services and none focusing on the neighbourhood built environment. Until now, there have been no specific housing policy or guidelines which aims towards promoting an active ageing and ageing-in-place lifestyle in the neighbourhood environment in Malaysia.

2.2 Physical Activity as the Indicator of Active Ageing and Ageing-in-Place

Physical activity is an important measure for active ageing among older adults. Active ageing stems from the elderly individuals' own desires and intentions to introduce physical activity into their everyday lives, simultaneously engageing in economic or social activities. This typically depends on the shift older adults experienced when entering the retirement phase. They tend to have more free time for leisure as well as focusing on their own self-improvement.

The majority of the elderly living independently normally participates in the physical, social, spiritual, and environmental dimensions of wellness. A survey by Williams & Keen (2009) in the U.S. showed that the elderly aged 65 and above tend to do gardening, participate in community activities, and volunteer their time for charity. Furthermore, much of the leisure time of older adults after retirement is spent indoors doing house chores and home improvement, whereas for outdoor activities this population

tends to spend time shopping, socializing, volunteering, and exercising (Brandon, 2013). In another region of Southeast Asia, a study based in Hong Kong deduced that the elderly subjects tended to spend their time in social centers and become followers of religious beliefs, because they considered religious activities to be a major pursuit in life (Chow & Chi, 1994). Participation in religious activity such as frequent church attendance among older adults in Western countries was associated with positive outcomes of active ageing (Gautam, Saito, & Kai, 2007). The act of praying and going to religious places are regarded as a form of physical activity specifically focusing on the dimension of religiosity among older adults.

A similar trend was observed in Malaysia, which has multiple ethnicities and religions among its population, showing that learning is integral for a seamless ageing process involving health, spiritual and community concerns (Muhamad & Merriam, 2000). In Malaysia, the process of learning among the elderly is firmly link with daily routines, regardless of differences in religions and ethnicities. Informal learning, especially among elderly Muslims, who constitute the majority is usually practiced through attending religious classes at a mosque, going to the mosque to pray during a certain time of the day, and spending one's free time reciting the Koran to improve their life's contentment (Muhamad & Merriam, 2000). Similarly, in the aforementioned study, Malaysian elderlies who follow other religions also incorporate learning into their daily lives, for example by walking daily, learning new farming techniques, helping others, and giving back to their society through learning and teaching. Most daily activities pursued by the elderly in Malaysia involve spending time outdoors, normally in the surrounding neighbourhood setting. For this reason, the outdoor neighbourhood environment can be expected to facilitate daily learning activities among the elderly in Malaysia.

Previous research has established several types of physical activities common among older people such as the transportation physical activity, the moderate-vigorous physical activity and the leisure-time physical activity. It is commonly depicted that participation in different types of physical activities occurs simultaneously across neighbourhood settings in which the physical and social environment might encourage or discourage physical activity among older adults. The main issue in promoting active ageing is whether older adults can maintain their physical and cognitive function during their free time across the outdoor neighbourhood environment settings, which is indirectly related to the objectives of this study by proving the relationship between the PNE, SNE and PA among older adults.

2.3 Physical Neighbourhood Environment (PNE) and Physical Activity among Older Adults

The role of the built environment greatly influences the extent of physical activity among older adults. Previous research by Michael, Green, & Farquhar (2006) shows that good neighbourhood design and outdoor environment promotes active ageing by providing access to daily activities that can eventually improve their quality of life through daily walking and physical activity. The surrounding physical neighbourhood environment tend to substantially influences residents' intentions of spending time outdoors. Previous studies have also examined what constitutes an age-friendly environment that promotes both active ageing and ageing-in-place. Physical features in the neighbourhood environment must be barrier-free in order to encourage the elderly to engage in daily activities outdoors (Anastasia, Lené, & Madeline, 2014).

Attributes of the neighbourhood environment significantly affect walkability among the elderly (Zhe Wang & Lee, 2010) and are usually associated with higher physical activity levels (Molina-García et al., 2017; Sallis et al., 2018, 2009). Highly walkable neighbourhoods tend to have a close distance to recreation areas and may promote physical activity especially leisure-time physical activity among older adults (Molina-García et al., 2018; Queralt & Molina-García, 2019). Activity among older adults is influenced by aspects of the surrounding environment, such as commercial activities (Nagel et al., 2008),

traffic, pedestrian or bicycle infrastructure (Sallis et al., 2013), neighbourhood attractiveness, and public transportation (Michael, Green, & Farquhar, 2006). Furthermore, a study done among older adults in Belgium, Brazil, Canada, Colombia, Hong Kong, Japan, Lithuania, New Zealand, Norway, Sweden, and the U.S has shown that having good accessibility to sidewalks is second-most-important factor in increasing the activity level of the elderly in a neighbourhood, following only that of neighbourhood amenities such as transit stops and low-cost recreational facilities (Sallis, Bowles, et al., 2009).

Contrarily, the PNES may also hinder PA among its dwellers. Adults living in automobile-dependent neighbourhoods tend to have lower levels of PA, particularly in low-walkable neighbourhoods that usually leads to increased sedentary time (Silfee et al., 2016). Physical neighbourhood barriers such as railway tracks and highways, heavy traffic and high crime rates were linked with physical inactivity and increased sedentary behaviours (Stappers et al., 2018). In addition, older adults may experience a reduced extent of PA in neighbourhoods with low qualities such as lack of access to public services, overpopulation, traffic jam, elevated and slippery slopes and low street lights (Barnett et al., 2016). This underscores the critical role of the PNES in promoting the increased likelihood of older people doing PA outside their homes.

Furthermore, one important feature of a physical daily setting for elderly residents is the presence of an elderly-friendly park that is within walking distance which offers recreation activities in a neighbourhood. Previous studies have shown that older people in South Korea tend to be more physically active when they live near public exercise areas, which greatly support elderly residents in being healthy and active (An, Lee, & Kim, 2012). Public parks are an important resource, especially in minority communities, as such communities are often underserved by their neighbourhoods, which are less accessible to resources (Cohen et al., 2007). Differences in socio-demographic and cultural characteristics also demonstrate the norms that determine the user patterns and preferences for parks of the elderly in a neighbourhood (King & King, 2010). It is likely that low-income people living in affordable housing will use the nearest public transportation, as they tend to have no private vehicles, meaning they spend more time outdoors than medium-and high-income people in the same neighbourhood (Nagel et al., 2008). A recent study of elderly in Malaysian neighbourhoods by Lai et al. (2016) showed that such needs of accessibility to public transportation, outdoor spaces, buildings that are elderly-friendly, and affordable healthcare services are among the highest priorities in the creation of an age-friendly environment and promotion of active ageing in Malaysia.

2.3.1 Objective and Subjective Measures of PNE

The physical neighbourhood environment can be measured objectively and subjectively. Objective physical neighbourhood environment concerns on the structural real-time ground data and the subjective measures concerns more on the cognitive aspects such as the perception of the community towards the neighbourhood physical environment. Objective measures of the physical neighbourhood environment (PNEO) is greatly related the design of the neighbourhood districts and how its land uses are planned.

Based on Jacob's concept of crucial urban living, these four conditions of mix residential and commercial land use to promote pedestrian activity, short street blocks and intersections, and reducing the traffic as well as having less walking distances for pedestrian needs to fulfil in order to achieve a livable neighbourhood living (Sung, Lee, & Cheon, 2015). Write more on this part.

Several studies have found that PNEO directly influences the PA level of older adults. A study conducted in Singapore found that the PNEO measured as an accessibility index and a walkability index significantly influenced the PA level as measured through health status and clinical measures (Nyunt et al., 2015). Similarly, a study in Japan found that the neighbourhood walkability index, which was defined using PNEO measures such as residential density, street connectivity, land use

mix and the availability of parks and green space, significantly influenced the PA level of older adults (Hanibuchi et al., 2012). Accessibility indices are usually measured by combining the values and weights from PNEO measures such as residential density, street connectivity and land use mix (Oliver et al., 2011; Nyunt et al., 2015) and walkability indices are usually measured by the proximity to community facilities (Nyunt et al., 2015). While most PNE studies have used the walkability and accessibility indices to determine the influence of PNEO on PA, this study specifically referred to each PNEO measure and did not rely on any PNEO index to determine which of these measures were significantly related to the PA level of the older adults. This is because based on the author's observation and pilot survey, walking for transportation is not a common trend among older people in Malaysia.

Numerous studies have shown that objective measures such as density, accessibility, proximity and connectivity greatly influence the extent of physical activity especially among older adults. PNEO measures such as land use mix entropy (Christian et al., 2011; Hajna et al., 2015; Wei et al., 2016), population density (Hajna et al., 2015; Zhiyong Wang et al., 2019; Wei et al., 2016), traffic intersection density (Berrigan, Pickle, & Dill, 2010; Kaczynski et al., 2014; Nyunt et al., 2015; Wu et al., 2019; Ying, Ning, & Xin, 2015) and proximity to recreation areas (Azmi & Karim, 2012; Ribeiro et al., 2015; Ying et al., 2015) influence the PA levels of older adults. While these types of PNEO measures are reliable in representing the objective physical characteristics of the neighbourhood environment that can strongly influence the PA level in older adults, in some cases local considerations are also needed. For example in this study, an additional PNEO measure: the proximity to the mosque: was added as it was hypothesised that this also was directly related to the PA of Malaysian older adults. This was because older Muslim Malaysian adults tend to spend their free time in leisure and spiritual activities, which is considered an important type of PA as they spend more time performing formal and informal spiritual learning activities, with many attending religious activities and social activities at the mosque (Merriam & Mohamad, 2000). Therefore, it was hypothesised that older adults living nearer to the mosque would have a higher PA.

The PNES measures were based on the Neighbourhood Environment Walkability Scale abbreviated version (NEWS-A), which includes the perceived measures of the neighbourhood environment. This scale was considered suitable as many past studies in diverse settings have established a connection between perceived PNE and PA in older adults (Azmi & Karim, 2012; Oyeyemi et al., 2012; Ribeiro et al., 2015; Salvo et al., 2018; Ying et al., 2015). Past studies have also found that perceived PNE (PNES) measures such as perceived residential density (Azmi & Karim, 2012; Nyunt et al., 2015; Saelens et al., 2003), land use diversity (Azmi & Karim, 2012; Cerin et al., 2013; Nyunt et al., 2015; Panter et al., 2011; Saelens et al., 2003), accessibility (Ajit Singh et al., 2018; Nyunt et al., 2015; Panter et al., 2011; Saelens et al., 2003), street connectivity (Nyunt et al., 2015; Saelens et al., 2003), infrastructure for walking and cycling (Panter et al., 2011; Van Holle et al., 2012), neighbourhood aesthetics (Jensen et al., 2017; Nyunt et al., 2015; Saelens et al., 2003), safety from traffic hazards (Jensen et al., 2017; Oyeyemi et al., 2012; Panter et al., 2011; Saelens et al., 2003) and safety from crime (Jensen et al., 2017; Oyeyemi et al., 2012; Panter et al., 2011; Rees-Punia, Hathaway, & Gay, 2018) were significantly associated with PA. In addition, single-question item PNES measures such as lack of parking (Dalton et al., 2013), lack of cul-de-sacs, hilliness and physical barriers have also been found to have a significant association with PA in older adults.

2.4 Social Neighbourhood Environments (SNE) and the Physical Activity of Older Adults

Physical neighbourhood environments significantly influence the physical activity of the older resident adults, with communities living in walkable, pedestrian-oriented, and mixed-use neighbourhoods being found to be more socially engaged than communities in car-oriented neighbourhoods (Leyden, 2003), and neighbourhoods with high walkability having been found to be correlated with social cohesion and social connections (Beenackers et al., 2013), reduced social seclusion (Leyden, 2003) and low crime levels (Edwards & Dulai, 2018; Foster et al., 2014). Older people who are more involved in outdoor activities have been found to experience a higher rate of community participation (Chudyk et al., 2017). Walking or simply spending time outdoors also facilitates social interactions, which in turn improve physical and mental health (Phillipson, 2011), and the presence of elderly-friendly parks have also been found to enhance social interactions between strangers (Aelbrecht, 2010), reduce social isolation, increase the possibility of intergenerational communication and produce a sense of attachment and belonging to the neighbourhood (Anastasia et al., 2014).

Therefore, neighbourhood environments shape daily resident social, community, health, mobility and safety activities, all of which are essential elements for a healthy lifestyle, which is especially important for the ageing and aged. Recent studies have found that older people living at home tend to rely heavily on supportive social environments to help them live an active ageing lifestyle. The daily social interactions that occur in neighbourhood settings can lead to the development of informal relationships that can assist the elderly develop healthy well-being (Gardner, 2011), and the establishment and maintenance of supportive relationships in desirable neighbourhood environments can positively influence morbidity, mortality, and the elderly dependency ratio, thereby strengthening community social capital (Cramm, Van Dijk, & Nieboer, 2013). Social interactions between family members, friends, neighbours (Iecovich, 2014) and the community are generally regarded as the social neighbourhood environment.

To sustain physical and cognitive functions, physical wellness activities should be mostly done outdoors (International Council on Active Ageing, 2011) and possibly in physical neighbourhood settings. Depledge, Stone, & Bird (2011) found that being exposed to the natural environment reduces stress and aids in mental recovery; therefore, being exposed to daily outdoor settings in neighbourhoods, such as parks, backyard spaces, and converted empty spaces, can reduce stress and mental fatigue (Kaplan, Kaplan, & Ryan, 1998). Further, water-features in outdoor natural environments have also been found to boost older people's self-esteem and moods (Barton & Pretty, 2010).

Gilleard, Hyde, & Higgs (2007) proved that older people tended to experience reduced residential mobility but an increased sense of belonging to their community, which indicated that the physical neighbourhood environment in terms of accessible facilities and services was significant, and that age-friendly environments that encourage daily social connectedness and engagement promote more active and healthy older people (Lai et al., 2016). Previous studies have shown that as physical environments provide support systems, they play an important role in the well-being and social connectedness of older people experiencing decreasing health and social isolation. Cramm et al. (2013) found that poor neighbourhood environments adversely affected the elderly living alone, especially in terms of daily support; therefore, neighbourhood environments in which there are open outdoor spaces can help encourage continuous community engagement and maintain social ties (Kweon, Sullivan, & Wiley, 1998).

An important domain in social neighbourhood environments is the extent of community social capital, which is an individual's willingness to sacrifice their own time, effort and consumption to co-operate with others (Cloete, 2014) and the networks, shared norms and social trust (Pretty & Ward, 2001) between the community members that assist in maintaining strong social bonds and facilitate collective

actions (Putnam, 2000). The social connectedness between certain groups in society plays an important role in maintaining a certain quality of life, which is especially important for older retired people who have a greater amount of spare time. Social capital for individuals involves a willingness to participate in community organisations, and being socially proactive in terms of trustworthiness, safety, neighbourhood connections, family and friend relationships, work connections, tolerance of diversity and the value of life (Bullen & Onyx, 2005).In this regard, it is important to create a strong social capital, which can be further understood by the three main domains in the neighbourhood environment; sense of community, place attachment, and citizen's participation (Twigger-Ross et al., 2016). Social connectedness is greatly influenced by social participation or civic engagement: the more engaged a person is, the stronger the social connectedness and bonds with other people in their groups within society. Because ageing is positively associated with volunteering (Cornwell, Laumann, & Schumm, 2008), and the act of volunteering is a form of social participation, social connectedness can be achieved through participating in volunteering and other activities that give mutual benefits to older and younger people (Emlet & Moceri, 2012).

Developing social capital and good life quality in ageing people can promote active ageing (Aminjafari, Aghajani, & Hashemianfar, 2016; Ueshima et al., 2010), as being socially engaged and connected affects physical and mental health and maintains cognitive function (Fratiglioni, Paillard-Borg, & Winblad, 2004; Glei, 2005). Zunzunegui et al. (2003) discovered that the number of older people living with experienced cognitive decline due to limited social connections, less social participation and a certain degree of social disengagement.

The degree of social connections in a society is usually implied by structural social capital, which means connections at the substantial levels, and cognitive social capital, which means relationships at the psychological levels (Nishide, 2006), making social connections the basis for social equity. Structural social capital is the density of the connections between community group members. It refers to 'what people do', while cognitive social capital is the sentiment values and norms that refers to 'what people think' (Campos et al., 2015). For example, networks and standards can be closely related to the structural and cognitive aspects of social capital (Keefer & Knack, 2005), but social trust is usually associated with cognitive aspects (Mitchell & Bossert, 2007). Therefore, structural social capital is related to the intensity of the activities and relationships, and cognitive social capital is associated with the recognition of support, reciprocity, sharing and trust (Harpham, 2002).

Structural and cognitive social capital can be evidenced by the degree of bonding, bridging and linking in a community. Putnam (2000) defined bonding social capital as the relationships between community members with the same demographic characteristics and socio-financial positions (Babaei et al., 2012), which has also been seen to be connected to family and friendship relationships (Twigger-Ross et al., 2016) and is a form of social connectedness. Bridging social capital, however, is defined as the community connections between people who do not necessarily share the same characteristics, such as age, socio-economic status, ethnicity or education (Szreter & Woolcock, 2004). Linking social capital was defined by Babaei et al. (2012) as the relationships that link community groups with the people who had the power, authority and access to key resources, such as NGOs, government agencies, politicians and the private sector. Bonding social capital can be categorized under cognitive whereas bridging and linking can be categorized under structural social capital. Figure 2.2 illustrates the social capital concept based on Putnam's theory.

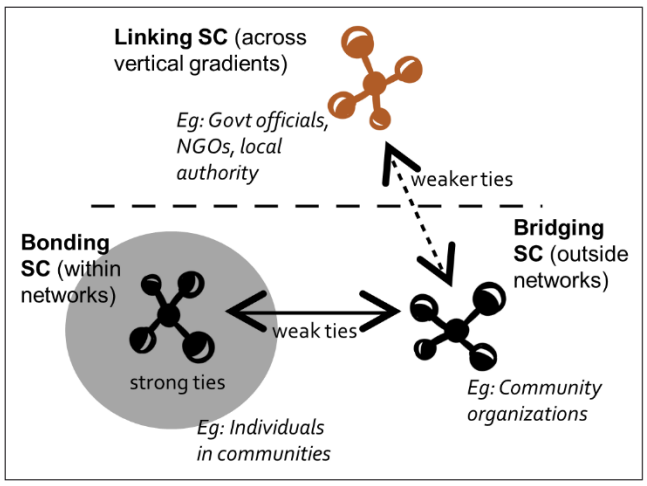


Figure 2.2: Social capital theory: bonding, bridging and linking (Ernstson, 2010)

There are two distinct interrelated components in neighbourhood social capital: trust and association (Larsen et al., 2004). Social trust is the extent of credence one community member has with another community member, including the trust for close companions and for strangers (Lim et al., 2017). Association, however, is related to socialising behaviours (Larsen et al., 2004), such as the informal companionship of family friends and neighbours, or the formal relationships of organisational members such as local government and authorities. Therefore, both social trust and social associations contribute to community social capital. Lim et al. (2017) found that social trust could lead to substantial collective actions and cooperation and was related to cognitive social capital, and Larsen et al. (2004) found that strong community social bonds led to members surpassing their own interests to engage in mutually collective actions. Collective and cooperative actions involve willing community members getting together to solve common issues or problems to achieve a shared community goal (Ireland & Thomalla, 2009; Meinzen-dick, Gregorio, & Mccarthy, 2004).

Good cognitive social capital (trust and association, and collective action and cooperation) can lead to greater membership density in community organisations, which is a type of structural social capital. The membership density in community organisations can simply be understood as the number of community groups a person becomes involved in. Belonging to a neighbourhood community organisation can increase social capital trust and interpersonal relationships (Ruef & Kwon, 2016), and different types of neighbourhood community organisations can be crucial sources of information for local residents. This is an important element of social capital as joining the various community groups leads to better well-being and health, especially in older adults (Yamakita et al., 2015; Zaitsu et al., 2018).

Neighbourhood community groups can take various organisational forms and have specific goals, such as formal residents' associations, neighbourhood watch groups, religious committee groups, traders' associations, women's groups, sports and hobby groups and recreational groups. Baum et al. (2000) found that older Australian adults were most often involved in church and social clubs, while older indigenous Malaysian adults were more likely involved in religious community groups (Kimm et al., 2014) such as mosque committees. The participation of older adults in neighbourhood community groups depends typically on their interests after their retirement. For instance, middle-aged adults are generally involved in parents and teachers associations, sports clubs or hobby clubs that are not commonly compulsory. However, older adults are typically engaged in formal organisations and voluntary clubs such as neighbourhood associations to help fill their free time after retirement and allow them to remain involved in societal decision-making processes in their neighbourhoods. Older adults also tend to join religious groups and spiritual activities, especially in Asia (H. M. H. Elsawahli, 2013). Therefore, trust and association, collective actions and cooperation, and membership density in

community organisations are essential components of social capital (Campos et al., 2015) and can significantly influence the PA of older adults in the social neighbourhood environment.

2.4.1 Objective and Subjective Measures of SNE

To clarify, structural and cognitive social capital are both bound within the social capital bonding, bridging and linking ties or relationships, and similar to the physical neighbourhood environment, the social capital structural and cognitive components can also be measured objectively and subjectively in the social neighbourhood environment by obtaining primary data. The objective structural social capital measures are tangible measures. Structural social capital can be assessed through various factors such as community organisation membership and the width of a person's social network (having many close friends, people willing to lend money and the frequency of interactions with neighbours), and the cognitive social capital can be assessed through more subjective or intangible measures by the individual's perception of the various social capital components in the community such as generalised trust, collective action and cooperation and their perceptions of the neighbourhood community groups.

2.5 Active Ageing from a Structural Social Capital perspective (Pilot Study Findings)

The Rukun Tetangga (RT), which are formal neighbourhood associations in Malaysia, were established with the aim of developing stronger community interdependence between residents and the committee members and between the residents and higher authorities. The RT committees act as mediators between the government and the neighbourhood on issues of local concern. Khairi (2016) concluded that developing a community that had strong social bonds and a peaceful living environment required the RT to take responsibility for implementing programmes and community activities focusing on ten main areas: sports, culture, social, recreation, welfare, education, security, health, economic and religion. The RT also develop their own project ventures to contribute to their neighbourhood's capital assets. Abdul Karim & Abdul Rashid (2012) found that the RTs were able to bring communities together and make collective actions. Therefore, it is important to examine the neighbourhood associations (RT) in Malaysia to determine the extent of their social capital and whether it might influence the PA level among the community members.

Any neighbourhood community that wishes to establish a neighbourhood association (RT) can attach a list of committee members and apply for consent from the Department of National Unity & Integration (Jabatan Perpaduan Negara dan Integrasi Nasional in Malay language (JPNIN). Once approved, the government provides an annual grant for community activities, with the number of successful community activities completed by the committee to determinine future financial assistance. The RT in Malaysia is similar to the 'jichikai' or 'chonaikai' in Japan. The Malaysian government established the Department of National Unity & Integration under the Prime Minister's Department of Malaysia to implement neighbourhood community policies in Malaysia. Therefore, the functions of the RT evolve from year to year depending on the country's modernisation objectives. Letchumanan (2013) found that the number of neighbourhood associations in Malaysia increased from 3,995 in January 2011 to 6,031 in October 2012, a growth of 51%. Figure 2.3 shows the number of neighbourhood associations (RTs) throughout Malaysia. Specifically, this research was focused on Johor Bahru in the state of Johor, which has the fourth highest number of RTs of all states in Malaysia and is the fourth most populated city in Malaysia (Department of Statistics, 2018). The idea of one neighbourhood areas for new RTs is generally around 80 houses, or at least 2,000 people and not more than 6,000 people (Mohd. Taib Dora, 2009).

No	STATES	YEAR							NO. OF RT UNTIL FEB 2018
		2011	2012	2013	2014	2015	2016	2017	
1	PERLIS	92	99	102	112	116	121	126	126
2	KEDAH	341	370	397	414	441	457	469	472
3	PULAU PINANG	352	406	439	461	472	484	504	508
4	PERAK	454	477	499	518	533	546	560	561
5	SELANGOR	721	764	821	861	916	975	1032	1033
6	W.P. KL	243	258	272	287	294	295	296	296
7	W.P. PUTRAJAYA	24	27	28	36	42	45	48	51
8	N. SEMBILAN	298	325	348	359	363	366	371	372
9	MELAKA	181	198	214	225	229	236	238	239
10	JOHOR	630	670	698	729	755	770	792	792
11	PAHANG	443	459	484	498	510	522	529	532
12	TERENGGANU	341	373	401	435	466	482	492	494
13	KELANTAN	424	436	452	445	449	452	455	456
14	SARAWAK	516	611	698	810	886	935	976	981
15	SABAH	512	555	597	835	952	987	1024	1028
16	W.P LABUAN	33	33	33	33	33	34	35	35
	TOTAL	5,605	6,061	6,483	7,058	7,457	7,707	7,947	7,976

Figure 2.3: Number of Neighbourhood Associations (RT) in Johor Bahru City

The RTs are important in mobilising community activities and strengthening community social unity. Ahmad Sabri & Mohd Rashidi (2016) reported that the RT functions were to: promote community solidarity and national integration, help prevent perpetrators or inter-racial issues, implement citizenship values for a united Malaysia, detect and assess racial and community relations from a national integrity perspective (Alias Mohamad, 2005), and coordinate programmes/activities that encourage unity in association with government agencies, private companies and other organisations. The RTs also play a role in controlling crime and other social problems (Then, 2018), act as mediators between the higher authorities and the local community to address local problems and issues, and work together with community members to help alleviate the problems. Formal neighbourhood associations are a form of structural social capital within which bridging and linking relationships occur. Bridging relationships usually occur in an RT in which the members have different demographic characteristics and linking relationships may occur as vertical relationships between the RT members and individuals or groups belonging to different neighbourhood communities, higher government authorities, or non-profit organisations.

Skim Rondaan Sukarela (SRS) is a voluntary neighbourhood patrol scheme with a minimum of 20 people above 18 years old managed by the residents within an RT neighbourhood area. After decisions were made in a cabinet meeting in 2004, the SRS was formally publicised and spread throughout the country. The main function of the SRS is to assist the higher authorities to control crime and safeguard the RT neighbourhood security. Any residents living in the RT area can volunteer and take turns with other community members in the patrol activity, regardless of whether they are RT committee members (Khairi, 2016). The SRS have made residents feel safe from burglary and theft, especially at night. Since its initial formation, SRS acts as one of the main driving forces in the National Key Result Areas initiatives. As part of the Global Transformation Program and in cooperation with the PDRM (Polis Diraja Malaysia/Royal Malaysian Police), the People's Volunteer Corps (Malay: Jabatan Sukarelawan Malaysia, abbreviated RELA), a paramilitary civil volunteer corps formed by the Malaysian government, and local authorities (JPNIN, 2018), the motivation behind the formation of the SRS was to enhance safety and assist in the control of misdemeanours in the society while helping to reduce the dependency on the police.

A pilot survey was conducted in three RT in three different neighbourhoods in Johor Bahru, which were Taman Nusantara, Bandar Selesa Jaya and Taman Johor. These neighbourhoods were chosen because the RT were considered very active in terms of conducting various types of community activities and programs. The leader and committee members were interviewed using a questionnaire, with the content and questions mainly focused on RT activities and the efforts made to encourage the residents to join the RT activities. While neighbourhood RT should have no more than 80 houses and populations of no more than 2,000 people, the RT in Johor Bahru at the time of the pilot study only involved a small community that was divided by roads; that is, the neighbourhood areas were only around 20 to 60 houses in Johor Bahru, with focused populations of around 90 to 270 people.

The leader and most of the higher RT members were pensioners, most of whom were in their 60s and above; however, the normal active RT members were working people aged from 40. The majority of the Johor Bahru RT members were Malays, with a small percentage being from Chinese and Indian cultural backgrounds. However, to ensure that the voices from the various cultural backgrounds were heard, a neighbourhood with a majority of people from Chinese cultural backgrounds was also chosen. RT leaders were usually chosen based on their good public relations, social networking and experience with political parties and government statutory bodies. Most of the RT leaders in Johor Bahru had been councillors at the nearest local authority or important committee members of their political parties. Their public involvement was found to be important for the activation of the RT activities and in improving neighbourhood conditions. Normally, the RT leaders, who are usually retired officials, are elected by the community based on a majority voting system.

The structural social capital and specifically the bridging capital was found to be strong among the RT members, possibly because of their importance in the neighbourhood. As all residents tended to know each other very well, all neighbourhood problems and complaints in the RT were directed to the leaders and the RT members for resolution. However, not all residents actively participated in the community activities organised by the RT, especially those from younger working families who had less time; therefore, a majority of the RT activity participants were older retired people and housewives.

As Malaysia is a multicultural country, it was found that Malaysians from different cultural backgrounds tended to participate in different types of activities. For example, Malays tended to join religious and spiritual activities and activities in the mosque. All RT organisations that had indigenous Malay majorities had a mosque bureau unit, and almost all RT members were also members of the mosque bureau, and had specific roles, such as organizing weekly Quran readings, weekly religious talks, celebrations during festive Muslim occasions, and activities during the month of Ramadhan. However, the Chinese Malaysian majority RTs tended to organise recreational and leisure activities to fill their free time, such as ‘karaoke’ and ‘tai chi’ clubs. It was found that Chinese Malays were actively involved in the RT activities if the leaders were also involved, which indicated that there were strong trust and social bonds with the RT leaders and that the role of the RT leader was important in encourageing the residents to become involved.

Another compulsory activity conducted by nearly every RT in Johor Bahru was ‘gotong-royong’, which is an annual, monthly or weekly event depending on the activeness of the RT. The activity involves residents in cleaning up their neighbourhood areas and their public facilities such as the mosques and community halls. The RT residents usually voluntarily participate to compete with other RT neighbourhoods to beautify their neighbourhoods and ensure their neighbourhood area are clean and rubbish-free. This event is also important in preventing dengue fever outbreaks. The ‘gotong-royong’, therefore, assists in social integration and unity (Abdullah, Ismail, & Mohd Noor, 2016) and allows residents to engage with other community members in their neighbourhood which eventually improved their relationship and broaden their social networks.

Figure 2.4 shows the normal RT organisational structure in all neighbourhoods, which was developed by the JPNIN to simplify the RT management. The RT chairman is responsible for organising the various activities, connecting members in the RT area, and establishing links with higher government officials and non-profit organisations to improve the neighbourhood condition. The chairman is assisted in these tasks by the vice chairman, secretary and treasurer, who also are responsible for activities associated with the smaller RT sub-units.

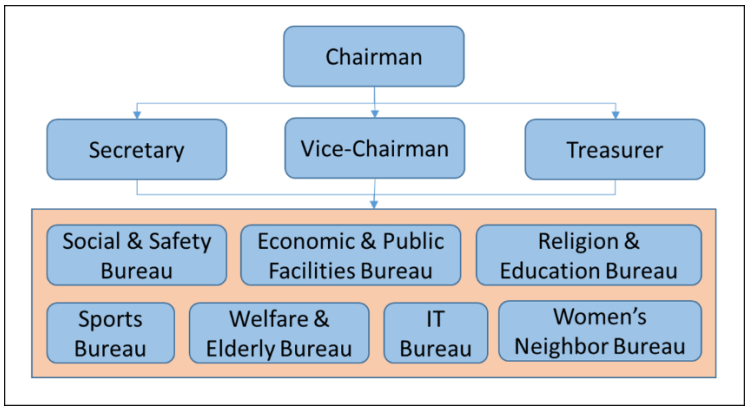


Figure 2.4: Normal RT organisational structure

At the beginning of this research, as it was difficult to find respondents, assistance was sought from the Ministry associated with the establishment of the RT. The government officer in charge of the JPNIN gave a briefing session regarding the history and management of the RT and provided a list of all active RT in the Johor Bahru area. Then, the RT leaders in Taman Perling, Taman Selesa Jaya, Taman Nusantara and Taman Johor were contacted. However, Taman Perling was not included due to time constraints. A pilot survey was conducted in 2017 by performing an interview session with the leader of the neighbourhood associations ('Rukun Tetangga') and several active members in the three neighbourhoods. It was performed in order to obtain the general information on the activities done by their neighbourhood association, as well as some insights on the leader's perspective towards their neighbourhood community. The outcomes from this pilot survey is explained in the next section.

2.5.1 'Rukun Tetangga' (RT) in Taman Selesa Jaya (SJ)

The leader of the RT in SJ is En. Mazalan, a 57-year old clerk currently working in a private company and also the owner of a livestock sales business. He is also a member of the Local Authority and is active in the UMNO political party. There are 23 committee members (20 Malays and 3 Chinese) in this RT, of which 14 males and 9 are females belonging to different sub-units in the RT, as shown in Figure 4 above.

This RT was involved in establishing a Koperasi RT (neighbourhood cooperative), which was an initiative introduced by the JPNIN to assist people, and especially those from low-income households, to start their own businesses and become involved in small and medium enterprises. The Koperasi was started with funds from the JPNIN and knowledge from the Malaysian National Co-operative Movement (ANGKASA). The management of the cooperative is funded by the annual fees collected from participating members who were also responsible for the Koperasi's long-term insurance investments.

While this RT manages around 400 households, only about 30% of households actively participate in the programmes and activities organised by the RT. This might be largely caused by the other types of housings in this neighbourhood. Most of the residents who participates were usually among the ones who are permanent residents compared to temporary residents which can be regarded as

renters. Based on the interview with the leader of this RT, the percentage of permanent residents and temporary residents were almost similar, due to the present of a high-rise condominium which makes up most of the temporary residents in this neighbourhood.

Table 2.1 shows the 2018 programmes and activities schedule done by the RT committee in Taman Selesa Jaya.

Table 2.1: Monthly and weekly activities and programmes run by the Rukun Tetangga in Taman Selesa Jaya in 2018

Monthly	Programs
January	Disaster Prevention Lecture and Demonstration Program in collaboration with this RT and the Fire and Rescue Department (e.g.: practice putting out fires using a fire extinguisher)
April	Community programme and lecture from the Police State Department on crime & safety in the SJ community (current collaboration from the SJ residents as the SRS together with the local police)
June (Ramadan)	Community work with UTM students to cook and distribute food to the needy during suhoor and iftar sessions every weekend
July (Eid Celebration month)	Eid prayer at the mosque with community food banquet
August	Eid Al-Adha Muslim Celebration (community work to perform livestock sacrifices and distribute the meat to the local community)
October	Annual General Meeting of the Koperasi Rukun Tetangga for this RT with a guide and collaboration with JPNIN & ANGKASA
Weekly	Activities
1 time	Quran recitation class & religious lecture
3 times	SRS patrol with the help of the local police

Source: Author's Pilot Survey Findings from Interview Sessions with the leader and members of Taman Selesa Jaya RT (2018)

2.5.2 The RT in Taman Nusantara

The leader of the RT is Mdm. Hjh. Rahmah, a 60-year old female who was active in organising the RT and had recently been appointed as the leader representing 'Jiran-jiran Wanita' (Women's Neighbour unit) among 25 RTs in Iskandar Puteri Zone in Iskandar Malaysia, Johor. 'Jiran-jiran Wanita' is a sub-unit of the RT organisation that represents the women group in each of the RT.

The Taman Nusantara Phase 4 RT committee has 15 females and 10 males: 23 indigenous Malays, 1 Chinese Malay and 1 Indian Malay. The neighbourhoods in Malaysia are usually divided into sections by the roads. In the Phase 4 Taman Nusantara, there are 11 road sections with about 40 houses; therefore, there are 411 houses under the RT Taman Nusantara Phase 4 administration. For every 2 road districts, a sub-leader is appointed by the RT leader to better manage the organisation. The Taman Nusantara RT administration was being expanded with the addition of four new road sections each with about 50 houses, adding around 200 houses to the RT administrative area. However, only around 160 households in these 4 road sections were actively participating in the RT activities and programmes. Table 2.2 shows the 2018 programmes and activities schedule.

Table 2.2: 2018 monthly and weekly activities and programmes by the Taman Nusantara Rukun Tetangga

Monthly	Programmes
January	'Gotong-royong Perdana' (extensive community programme to clean up the neighbourhood)
February	'Program Mencegah Denggi' (Dengue Prevention Program) in collaboration with the State Health Department of Johor Bahru
April	Bowling Competition & Family Day
May	'Gotong-royong' in each of the RT Taman Nusantara Phase 4 road sections
June (Ramadan)	Weekly suhoor and iftar in nearest surau
July (Eid Celebration month)	'Qiamullail' program during the last 10 days of Ramadhan
August	Quran Recitation Program under Biro Helwah (all female sub-unit under the RT Taman Nusantara Phase 4)
October	'Marhaban' visitation for a few selected houses in Taman Nusantara Phase 4 during the first 7 days of the Eid Celebration
December	Formal Program for the appointment of the Taman Nusantara Phase 4 RT leader as the Female Leader of RT Zon Iskandar Puteri with an invitation from the State Director of Unity, Johor
Weekly	Activities
1 time	Quran recitation class & religious lectures

Source: Author's Pilot Survey Findings from Interview Session with the leader and members of Taman Nusantara RT (2018)

2.5.3 RT in Taman Johor

The leader of the RT in Taman Johor is Mr. Chua, a 67 year old Chinese Malay who has lived in Taman Johor since its construction in the early 1990s. The RT committee has 23 Chinese Malays and 2 indigenous Malays, which includes a female representative, a youth representative and an elderly representative, each of whom function as the voice for their specific communities in Taman Johor. Around 60% of the committee members are retired, with the other 40% being late-middle aged and working. The Taman Johor RT area includes about 600 houses; however, only about 100 households actively participate in the RT programs and activities. Table 2.3 shows the 2018 program and activities schedule.

Table 2.3: 2018 monthly and weekly activities and programmes by Rukun Tetangga committee in Taman Johor

Monthly	Programmes
February	Chinese New Year Celebrations (Chinese lion dance performance)
March	Women's Day Celebration (banquet, karaoke session)
April	'Program Mesra Rakyat' (People's Outreach Program)
May	Labour Day Celebration
August	Independence Day Celebration (banquet, community cultural dance)
September	Celebrating the 30th Anniversary of community cultural dance - Formal invitation of Parliament Member Dato' Nur Jazlan, State Director of Unity, & Director of Local Authority Government
Weekly	Activities
3 times	Community cultural dance (mix of elderly & younger people)

2 times	'Tai chi' morning session (all elderly)
3 times	Mixed community dance and aerobic fitness (mix of elderly & younger people)
3 times	Chinese lion dance (all younger people)
2 times	Karaoke session for 2 groups (all elderly)

Source: Author's Pilot Survey Findings from Interview Session with the leader and members of the Taman Johor RT (2018)

2.5.4 Overview of the RT pilot survey findings

The RT activities conducted in the three surveyed neighbourhoods were found to increase the social capital between the residents, and especially between the older retired residents. The RTs were observed to be the main driving force for the neighbourhood community activities, which means that the funding was effectively empowering the community. The RT acts as a bridge between the community and the government, and the active and effective leadership of the RT leaders and committees has positively influenced the community's social capital.

The leadership and the majority ethnicities among the RT committees means that types of community activities are normally based on ethnic interests. For instance, RT committee with Malay majorities focused on organizing religious activities as well as some programmes involving other higher officials. Meanwhile, RT committee with Chinese majorities focused on organizing leisure and recreation activities such as karaoke session and 'tai chi' session. Programmes that include all types of ethnicities are usually collaboration programs with higher government officials or non-profit organization and celebration day programmes. Formal and informal community activities organized by the community organization are an important type of bridging social capital at the same time may impact the extent of informal social bonding between the members of the community. Considering the influence of physical neighbourhood environment towards the social neighbourhood environment that can help improve the physical activity level among older residents, the settings of these community activities and programmes needs to be taken into account. Community facilities such as community hall and small recreation areas, as well as religious facility such as mosque are important physical features of the physical neighbourhood environment. The accessibility to these community facilities in the neighbourhood environment is also an important physical measure that needs to be considered. Thus, future research needs to examine how the physical neighbourhood features affects the social neighbourhood environment and especially on the structural social capital domains.

2.6 Theoretical Frameworks and Conceptual Model

Two types of theoretical frameworks, namely PNE and SNE, were developed to demonstrate the different domains that can influence the PA of older adults in this study. These theoretical frameworks were formed through an extensive literature review in the previous chapters to identify significant relationships that might contribute positively to the active ageing lifestyle among older adults. The PNE domain, which consists of both objective (PNEO) and subjective (PNES) measures, was assumed to have a direct relationship with the PA level among older adults, as shown in Figure 2.5. However, it was also hypothesised that PNES has an indirect relationship with the PA level caused by PNEO, making PNEO as the independent variable, PNES as the dependent variable, and PA level as the outcome variable for the PNE domain.

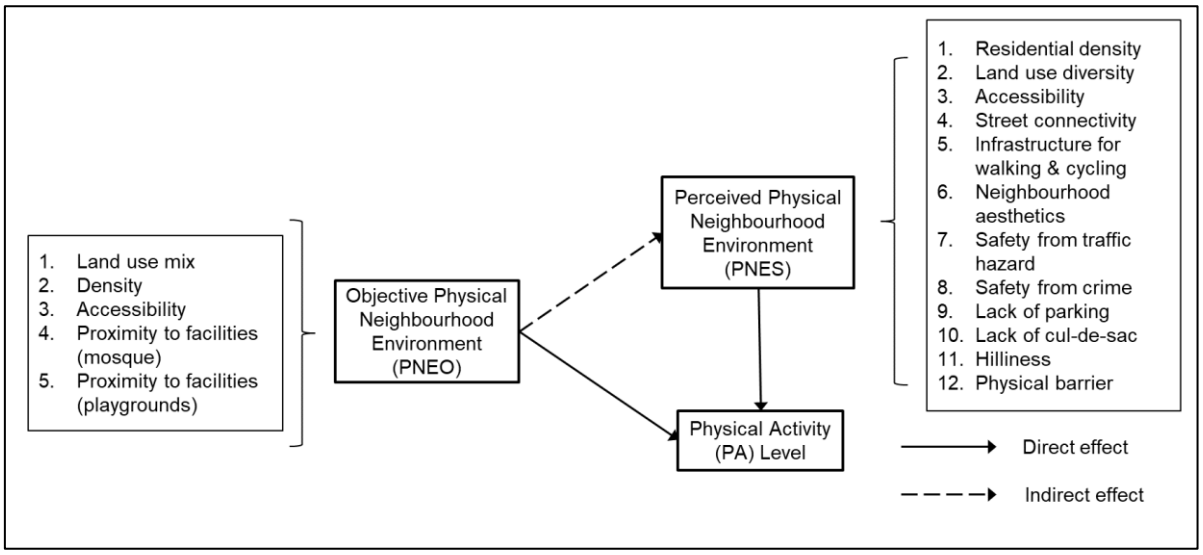


Figure 2.5: Theoretical framework illustrating the physical neighbourhood environment (PNE) domain which can influence the PA level among older adults

On the other hand, the SNE domain, which is composed of both objective (SNEO) and subjective (SNES) measures, was also assumed to have a direct relationship with PA levels among older adults, as shown in Figure 2.6. It was also hypothesised that SNES has an indirect relationship with the PA levels caused by SNEO, making SNEO as the independent variable, SNES as the dependent variable, and PA level as the outcome variable for the SNE domain. Moreover, it is logical to assume that SNEO and SNES have a direct or indirect relationship with each other. However, in this research context, since PNEO measures were supposed to be the major impact of both PNE and SNE domains, it was sufficient to assume a direct relationship between SNES-PA and SNEO-PA.

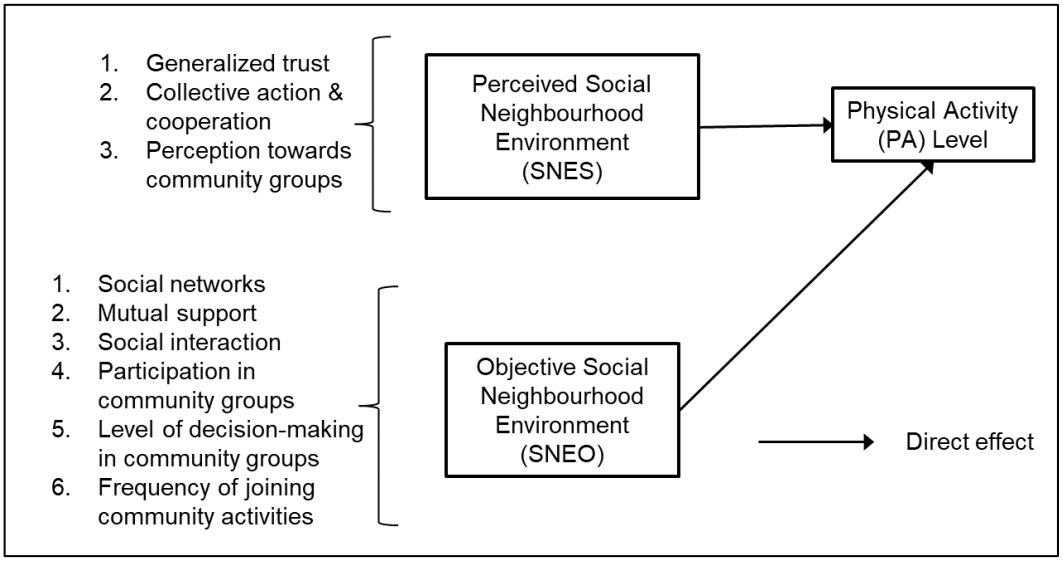


Figure 2.6: Theoretical framework illustrating the social neighbourhood environment (SNE) domain which can influence the PA level among older adults

Next, a final conceptual framework was created by combining the two PNE and SNE domains, as well as including the demographic attributes of the respondents as the external domain shown in Figure 2.7. The final conceptual framework was created to formulate the research hypotheses as well as to highlight the gaps in this study. A new relationship was assumed by merging the two PNE and SNE domains and associating physical and social neighbourhood environments. H1, H2 and H3 were the assumed relationships that directly influence the PA levels. Meanwhile, H4, H5 and H6 were the indirect relationships that were hypothesised to affect the PA levels. For H4 and H5, the independent variable was PNEO, which was assumed to have an indirect relationship with the PA levels (outcome variable) through PNES and SNES (the dependent variable). In contrast, for H6, the independent variable was SNEO, which was assumed to have an indirect relationship with PA levels (outcome variable) through SNES (dependent variable).

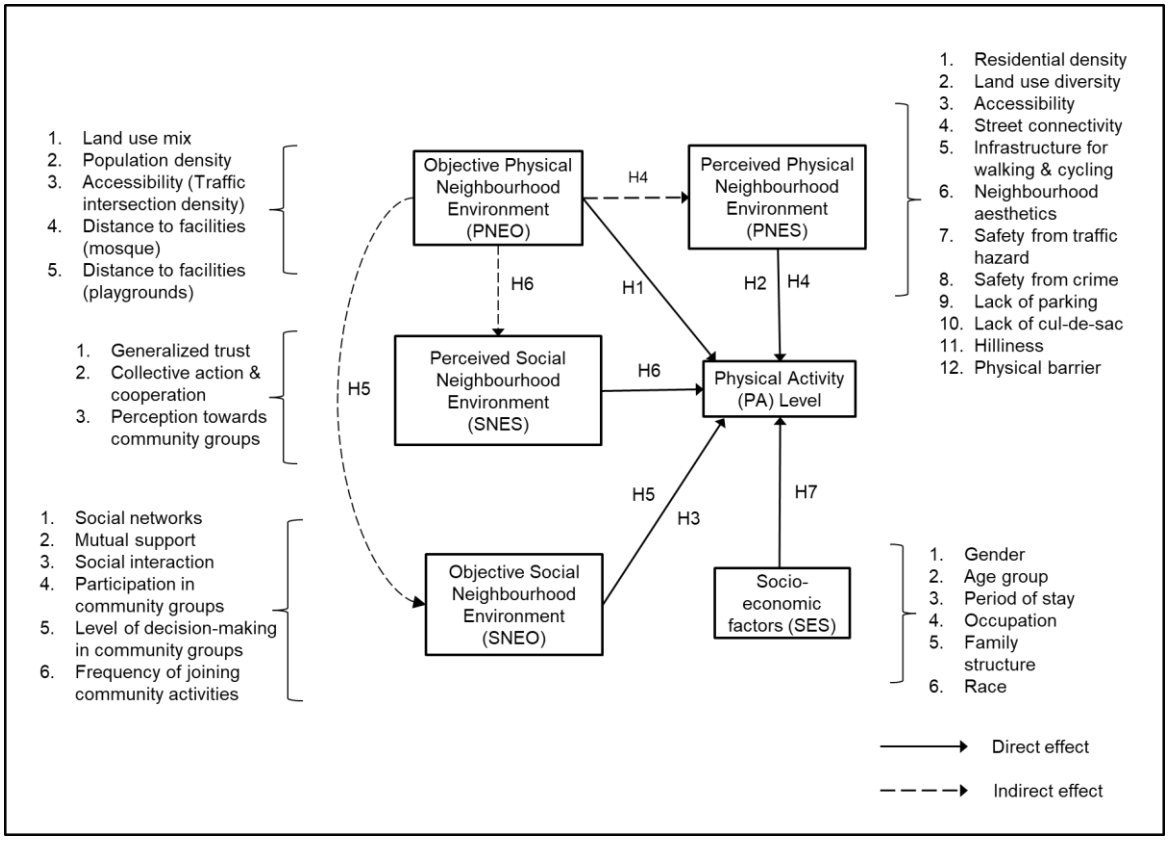


Figure 2.7: Overall conceptual framework for this study

2.7 Hypothesis Formulation

Based on the overall conceptual framework constructed from an extensive literature review, several hypotheses were developed for each domain of PNEO, PNES, SNEO, and SNES with PA level. Since each domain consists of several specific measures, detailed hypotheses were constructed from the general hypothesis statement for each domain, seen in Table 2.4.

Table 2.4: Specific hypotheses constructed from the general hypotheses statement for each domains

Hypotheses Statement	Specific Hypotheses
H1: There is a statistically significant association between PNEO and physical activity level of older adults	H1a: Land use mix is statistically significant with PA level among older adults
	H1b: Density is statistically significant with PA level among older adults
	H1c: Accessibility is statistically significant with PA level among older adults
	H1d: Proximity to facilities (mosque) is statistically significant with PA level among older adults
	H1e: Proximity to facilities (recreation areas) is statistically significant with PA level among older adults
H2: There is a statistically significant association between PNES and physical activity level of older adults	H2a: Perceived residential density is statistically significant with PA level among older adults
	H2b: Perceived land use diversity is statistically significant with PA level among older adults
	H2c: Perceived accessibility is statistically significant with PA level among older adults
	H2d: Perceived street connectivity is statistically significant with PA level among older adults
	H2e: Perceived infrastructure for walking and cycling is statistically significant with PA level among older adults
	H2f: Perceived neighbourhood aesthetics is statistically significant with PA level among older adults
	H2g: Perceived safety from traffic hazard is statistically significant with PA level among older adults
	H2h: Perceived safety from crime is statistically significant with PA level among older adults
	H2i: Perceived lack of parking is statistically significant with PA level among older adults
	H2j: Perceived lack of cul-de-sacs is statistically significant with PA level among older adults
	H2j: Perceived hilliness is statistically significant with PA level among older adults
	H2k: Perceived physical barrier is statistically significant with PA level among older adults
H3: There is a statistically significant association between SNEO and PA level of older adults	H3a: Participation in community groups is statistically significant with PA level among older adults
	H3b: Frequency of joining community activities is statistically significant with PA level among older adults
	H3c: Mutual support is statistically significant with PA level among older adults
	H3d: Social network is statistically significant with PA level among older adults
H4: There is an indirect association between PNES and PA level caused by PNEO	PNES is hypothesized to be indirectly caused by PNEO and will only be analysed based on H1 (PNEO< >PA) and H2 (PNES< >PA) results that are significant.

H5: There is an indirect association between SNEO and PA level caused by PNEO	SNEO is hypothesized to be indirectly caused by PNEO and will only be analysed based on H1 (PNEO< >PA) results that are significant with all SNEO items
H6: There is an indirect association between SNES and PA level caused by PNEO	SNES is hypothesized to be indirectly caused by SNEO and will only be analysed based on H1 (PNEO< >PA) results that are significant with all SNES items
H7: There is a statistically significant association between SES attributes and physical activity level of older adults	H7a: Gender is statistically significant with PA level among older adults
	H7b: Age group is statistically significant with PA level among older adults
	H7c: Period of stay is statistically significant with PA level among older adults
	H7d: Family structure is statistically significant with PA level among older adults
	H7e: Occupation is statistically significant with PA level among older adults
	H7f: Race is statistically significant with PA level among older adults

3 METHODOLOGY

3.1 Introduction

The general workflow of this research consists of several parts. The first part focused on the acquisition of information through an extensive literature review from past investigations to further understand the research background and to identify the scope and relevant issues related to active ageing among older people. Relevant research objectives and hypotheses were developed during the first stage based on an extensive literature review. A pilot study was executed to highlight the research gaps, which are essential for community activities organised by different community organisations across the Malaysian neighbourhood settings. The second part focused on formulating a questionnaire survey for the various domains related to this study. Different results were expected, depending on the neighbourhood settings.

3.2 Study Area

The city of Johor Bahru city was chosen as thea study area, whereby an abundance of with abundant residential old ground properties land and high-rise affordable housings are situated high-rise housing located near the urban core area.city centre. Johor Bahru has a population of aboutapproximately 500,000 people, and is a smaller part of the Iskandar Malaysia region. The research area for this study involvesarea included three neighbourhoods located in the city of Johor Bahru, Johor, Malaysia which are, including Taman Perling, Taman Nusantara and and Taman Selesa Jaya. Both Taman Perling and Taman Selesa Jaya are located in the centre of Johor Bahru, whereaswhile Taman Nusantara is located at the fringe of Johor Bahru city which is in the Gelang Patah district.District of the Johor Bahru City. Figure 3.1 shows the locations of the three neighbourhoods locatedsituated in the bigger part of the region, namely the Iskandar Malaysia region.

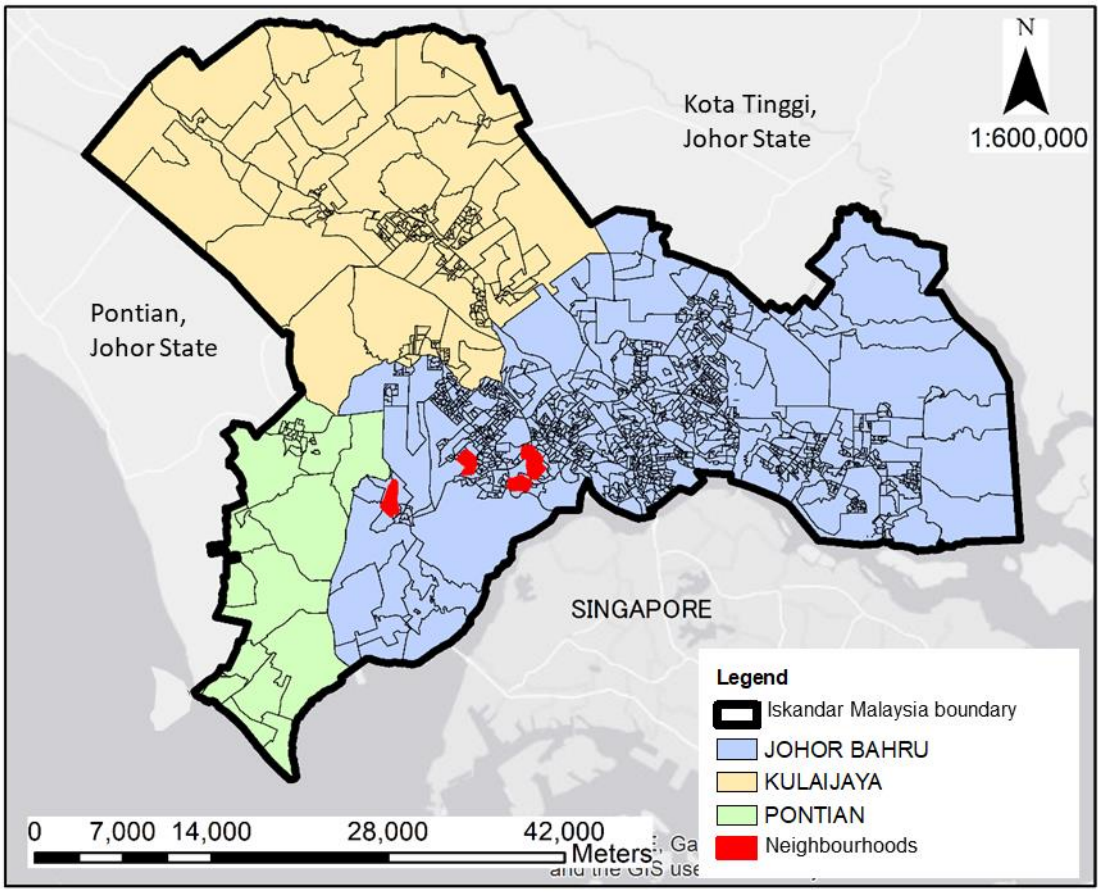


Figure 3.1: The location of the three neighbourhoods in Johor Bahru city in the Iskandar Malaysia region

Pilot and formal questionnaire surveys were executed in orderconducted to obtain the primarykey data for PNES, SNEO and SNES items. Normally, neighbourhoods would beNeighbourhoods were typically chosen based on their high rate of ageinging population. But to facilitate this study,rate. Since the previous pilot survey found it challenging to obtain respondents for safety reasons, we selected respondents from neighbourhoods districts with active neighbourhood associations among their community was chosen since the previous pilot survey has proven difficult to acquire respondents due to safety purposes.communities to facilitate this study. The three chosen neighbourhoods can bewere further divided into four study areas since Taman Perling areis divided into two types of housing environments. The four study areas awere mainly compriosed of 2two types of housings which are the, including terraced houses and housing blocks. The neighbourhoods consisted of a similar housing environment;, mainly of 2 storeystwo-storey terraced houses and 4four to 5 storeysfive-storey housing blocks. Figures 3.2 and 3.3 shows the typical types of housing exist housings in the four study areas.

Figure 3.2: Housing blocks in Taman Perling

Figure 3.3: Terrace houses in Taman Nusantara

Table 3.1 shows the details of housing environment in all neighbourhoods, representing the number of respondents who participated in the questionnaire survey. Only Taman Perling consisted of terraced and housing blocks while the other two neighbourhoods only consisted of terraced houses. In this study, only respondents living in the terraced houses and four to five storey housing blocks were chosen, as it represented a majority of respondents in the area.

Table 3.1: Descriptive statistics of the number of respondents represented in the three neighbourhoods

Physical Characteristics	Taman Perling (N, %)	Taman Selesa Jaya (N, %)	Taman Nusantara (N, %)
Housing types			
-High-rise apartment	0	2, 3.51	0
-4 to 5 storey housing blocks	58, 41.72	0	0
-6 storey housing blocks	1, 0.72	0	0
-1 storey terraced house	1, 0.72	0	0
-2 storeys terraced houses	79, 56.83	55, 96.49	84, 100

Source: Nordin & Nakamura (2019) and Author's Findings

Figure 3.4 shows two study areas in Taman Perling composed of housing blocks and terraced houses. As shown in Figure 4, compared to the other study areas, Taman Perling was the largest (888.27 acres or 3.58 km2), and its boundaries consisted of two separate areas. Taman Perling is connected to the Malaysia-Singapore Second Link Highway. This neighbourhood has seven main entrances and exits which connect the adjacent neighbourhoods and display a traditional gridiron pattern. Each terraced block usually consists of no more than 14 units of terraced houses, separated by pedestrian and traffic side lanes. The commercial areas are mainly located along the main highway and the main arterial road

of this neighbourhood. Only four low-cost housing complexes were considered in this study since there are six housing blocks in this neighbourhood, and the other two medium-priced housing blocks are gated community areas. The physical environment inside the Taman Perling housing complexes can be described as having several grocery stores, food stalls, small community halls and a small mosque, usually used by the community living in the housing blocks. Figures 3.5 to 3.16 show the surrounding neighbourhoods of both the terraced houses and housing blocks areas in Taman Perling.

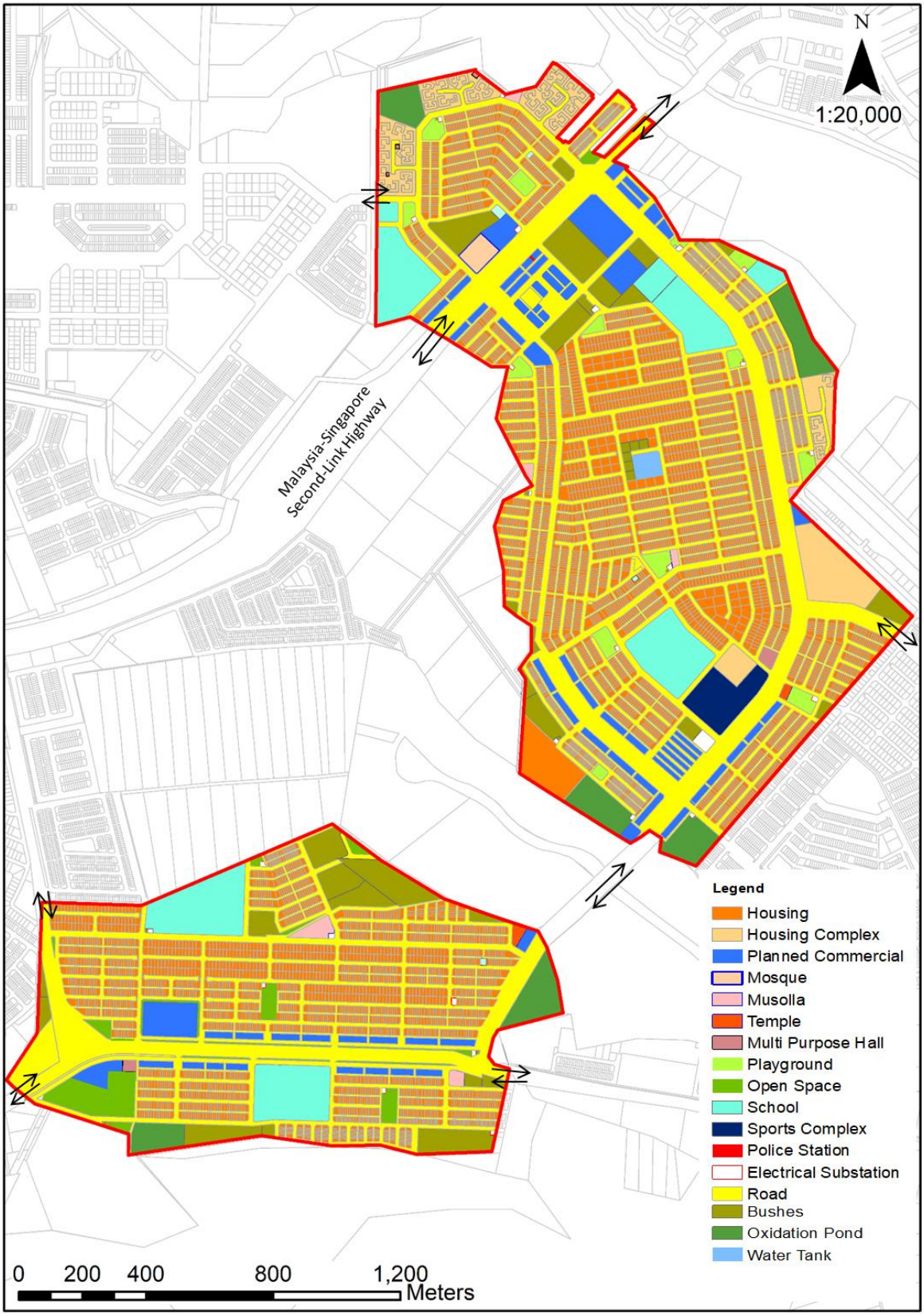


Figure 3.4: Land use map of Taman Perling for both terrace housing and housing blocks study areas

Figure 3.5: Commercial area in Taman Perling

Figure 3.6: 2- storeys terrace houses in Taman Perling

Figure 3.7: Traffic side lanes separating rows of terrace houses in Taman Perling

Figure 3.8: Pedestrian side lanes separating rows of terrace houses in Taman Perling

Figure 3.9: Pedestrian sidewalk connecting a bus stop and terrace houses in Taman Perling

Figure 3.10: Example of playground area in Taman Perling terrace housing area

Figure 3.11: Housing blocks surrounding consisting of 4 – 5 floors

Figure 3.12: Pedestrian lanes outside the housing blocks area

Figure 3.13: Coffee shop commercial spaces on the ground floor of Taman Perling housing blocks

Figure 3.14: A futsal court, the only open space area in one of the housing blocks in Taman Perling

Figure 3.15: Food stalls in the housing blocks area which is usually open at night

Figure 3.16: The only pedestrian sidewalk present in one of the housing blocks

Figure 3.17 shows the land-use distribution for the third study area, which is Taman Nusantara. Taman Nusantara has a total area of about 453.25 acres or 1.83 km2, consisting of two-storey terraced houses. This neighbourhood has been constructed after the other neighbourhoods. Hence, it is a newer surrounding neighbourhood. There are three main entrances and exits which connect the neighbourhood to the adjacent areas. The housing layout of this neighbourhood is a traditional gridiron pattern bounded by the main roads and small grass strips. As shown in Figures 3.18 to 3.23, the iron-road medians separating the main roads and the drainage network system were observed.

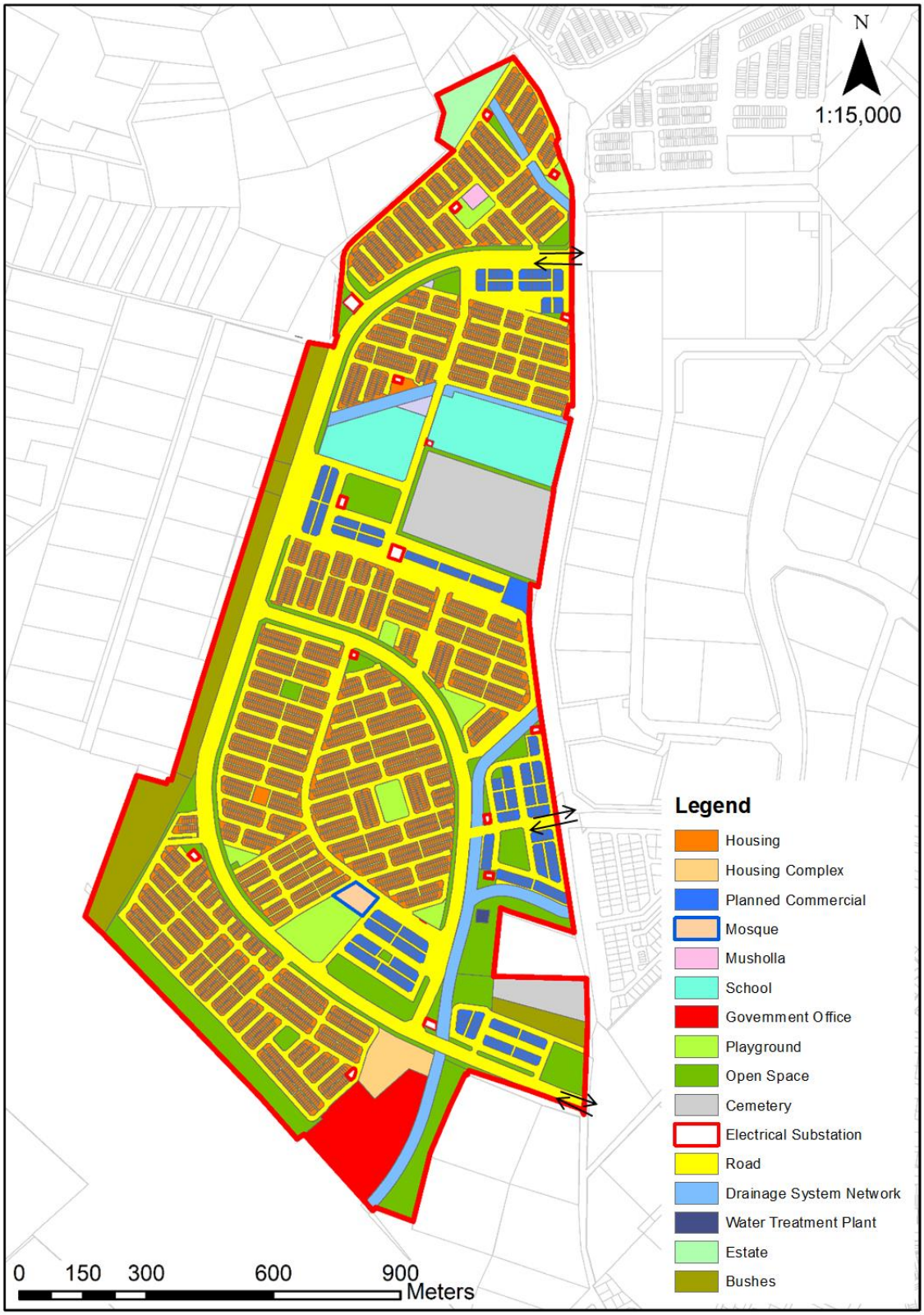


Figure 3.17: Land use map of Taman Nusantara

Figure 3.18: A pedestrian lane connecting a cul-de-sac road to the main road

Figure 3.19: A small SRS (safety patrol unit) guard house in Taman Nusantara

Figure 3.20: Pedestrian side walk and iron-road median in Taman Nusantara

Figure 3.21: The drainage system network in Taman Nusantara

Figure 3.22: Recreational open space area consisting of an indoor futsal court and a playground

Figure 3.23: A network of pedestrian lane in a recreational open space area

The last study area is Taman Selesa Jaya has an area of 322.88 acres or 1.31 km2. This neighbourhood has a typical gridiron layout pattern and is the smallest study area compared to the other communities. There are several types of housings in this neighbourhood such as two-storey terraced houses, several gated housing blocks and a gated high-rise condominium. A total of there main entrances and exits connect this neighbourhood to the adjacent areas. Figures 3.24 to 3.30 show the surrounding environment of Taman Selesa Jaya.

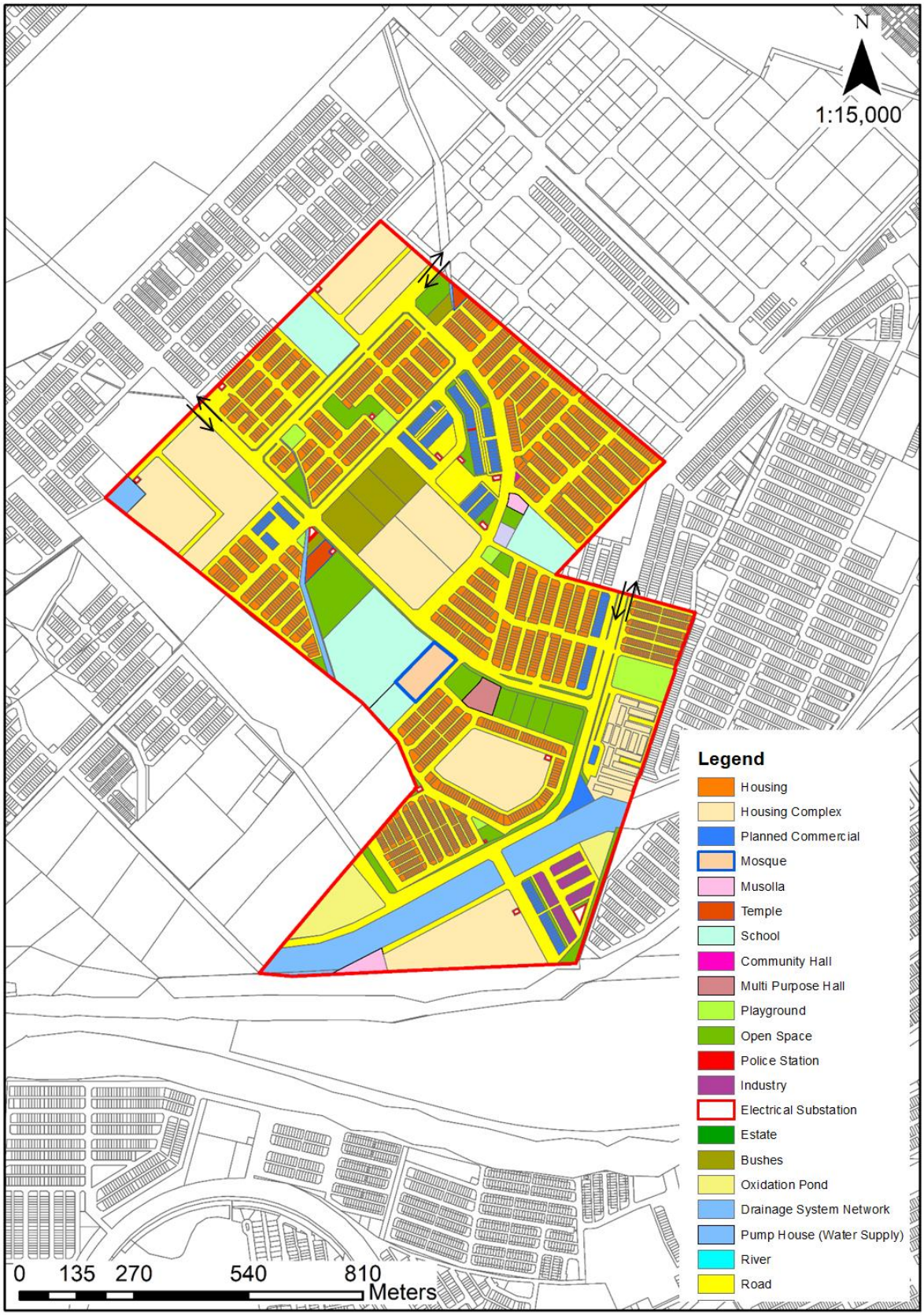


Figure 3.24: Land use map of Taman Selesa Jaya

Figure 3.25: 2-storeys commercial shopping lots located in front of the main road

Figure 3.26: Mosque located within walking distance in Taman Selesa Jaya

Figure 3.27: Playground located in small recreation area

Figure 3.28: Football field as a recreational area in Taman Selesa Jaya

Figure 3.29: Pedestrian sidewalks with barrier

Figure 3.30: Drainage network system separating terrace houses and commercial area in Taman Selesa Jaya

3.3 Research Design

The PNE for both objective and subjective (PNEO & PNES) and the SNE for objective (SNEO) were measured directly with PA level. On the other hand, several indirect relationships were hypothesized based on the conceptual framework discussed in the earlier chapter. PNEO were hypothesized as an independent variable that influences the indirect relationships between PNEO – PA, SNEO – PA, and SNES – PA. The subsequent methodology section focuses on the detailed analytical processes in the study. A comprehensive flow chart of the analytical process is illustrated in Figure 3.31.

A questionnaire survey was conducted in the three neighbourhoods which consists of four case study areas to obtain the associated demographic attributes and the respondents' types of houses, and to

identify the PNES, SNEO and SNES measures that influences the PA levels of the respondents. A total of 280 respondents were individually interviewed using a questionnaire over a period of 3 months from August 2018 to October 2018. For PNEO measures, the spatial data were obtained directly from the GIS land use data for Johor Bahru city. The spatial analysis covered items such as the land use entropy index, population density, the proximity of neighbourhood facilities and traffic intersection density. All direct relationships of PNEO, PNES, SNEO and PA relationships were analysed using SPSS version 24.0 by using a correlation test of Goodman-Kruskal Gamma analysis. Simple cross-tabulations between the variables were conducted to explore the underlying trends in the significant relationships. In addition, the indirect relationships were measured in detailed by cross-tabulating the significant results from PNES – PA and SNEO – PA with the significant results of PNEO – PA, wherein PNEO was treated as independent variables. For SNES – PA, all of the SNES items were cross tabulated with the significant results of PNEO.

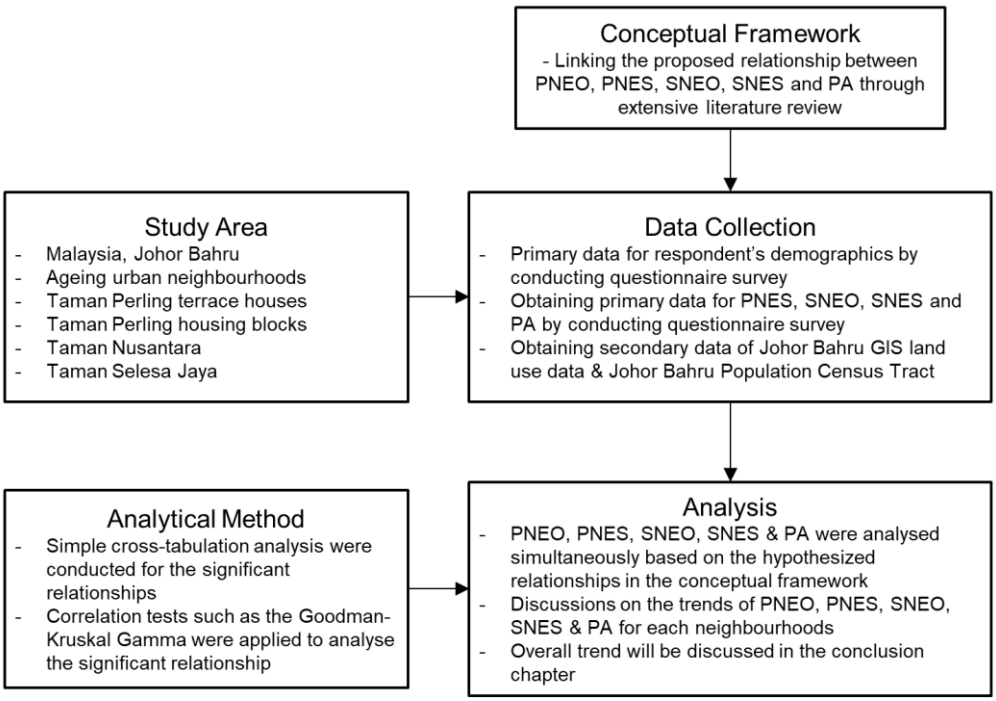


Figure 3.31: Flow chart of the analytical method

3.4 Spatial Data on Physical Neighbourhood Environment

GIS spatial data was obtained from Iskandar Malaysia Development Authority and is based on the 2012 land use data since the latest land use plan is yet to be made public by the local authority of Johor Bahru city. Geographic Information System (GIS) datasets such as land use, road networks, and public facilities were combined and analysed to assess the objective physical measures of the neighbourhood environment. The analysis covered items such as land use entropy index, population density, the proximity of neighbourhood facilities and accessibility of traffic networks. The last step of the GIS analysis is locating and establishing a spatial reference for each respondent based on their home's road address to correlate with the PNEO indicators and PA levels obtained from the questionnaire interview.

3.4.1 Land Use Mix

Land use mix entropy is commonly used in previous research related to measuring the objective neighbourhood environment and is generally used to measure the land-use mix diversity in an area based on Bordoloi et al. (2013). The formula of the land use mix entropy is as shown below.

$$\text{Land use mix entropy} = \frac{\sum_j P_j \times \ln(P_j)}{\ln(J)}$$

where,

P_j = the percentage of total land area of jth land use class

J = the number of total land use class considered in the study area

Usually, the value of the land use mix entropy is between 0 and 1 where 0 is regarded as areas with homogenous land use, and 1 is assumed as equally distributed across all land-use types in an area (Bordoloi et al., 2013). The land use distribution in each neighbourhood can be seen in the previous figures (Figure 3.4, 3.17, 3.24).

3.4.2 Density

Population data in the study areas are obtained from the Johor Census Data provided by the Department of Statistics, Johor (2010). The population data consist of the total population, the population for each age group, the population based on gender for each administrative districts. Population density were then calculated based on the total population of each small districts divided by the total area of the each small districts in square km. The range of population density in Johor Bahru city was referred to an existing project done by Bell (2017) ranging from the relatively high to the highest (30,000 – 150,000 people per square km), moderately high (7000 people per square km), slightly high (5200 people per square km), medium (3330 people per square km), and low population density (1500 people per square km).

3.4.3 Accessibility

In order to measure connectivity, intersection density is analysed using ArcGIS. The density of intersections is computed as the total number of crossings excluding cul-de-sacs per unit of the area from the centre of the location (Dill, 2003). A buffer of 200 meters from respondents' homes was assigned for this study as the preferred walking distance, especially for Malaysian older people (APUDG, 2000; Azmi & Karim, 2012). Higher intersection density denotes higher connectivity in the specified area (Dill, 2003). Distance from each respondent's road address to two types of common facilities usually used by the older adults in Malaysia was analysed using ArcGIS to measure accessibility.

3.4.4 Proximity

Lastly, distance to facilities measures the proximity of various amenities and is obtained from the distance of the facility to the respondent’s homes (Xia, Li, & Chen, 2018) which is analysed using ArcGIS. The facilities include recreational open space and mosque, which is considered as basic amenities for older people in Malaysia. The mosque and playground facilities were chosen as the proximity measures that might influence PA level since older people in Malaysian neighbourhood tend to spend more time performing religious activities and recreation activities (Merriam & Mohamad, 2000). The distance of facilities was categorised into three categories which are low, medium and high based on interval cut points of mean and +1/-1 standard deviation using SPSS.

The distance scale are assumed to show variability in the relationship between the objective and perceived measures of the PNE.

3.5 Questionnaire Framework

A questionnaire survey was administered to 280 older respondents (aged 45 and above) in the three neighbourhoods to measure their level of physical activities performed and how the physical and social neighbourhood environment influences the PA. The first part comprises of respondent's demographic characteristics which can be referred in Table 2, the second part relates to PNES consisting of 5-likert scales agreement items adapted from NEWS-A scale (Saelens & Sallis, 2002), the third part relates to SNE which consist of both SNEO and SNES concerning mostly to social capital measures. SNEO items are consist of multiple answer questions whereas SNES items are consist of 5-likert scales agreement measures, both adapted from SC-IQ and the author's previous pilot survey findings. The last part relates to the types of PA performed which is adapted from the IPAQ based on the Self-Administered Long Version Format for use among population aged 15 – 64 years (IPAQ, 2002). Although it is noted that some respondents in the study areas were aged 65 years and above, the IPAQ version for 15 – 64 years old adults were deemed suitable to be used in this research context. The only difference between the IPAQ version for 15 – 64 years old adults and IPAQ version for older adults aged 65 years and above was the sitting question. This part can be disregarded from this research context since the questions on spending time on sitting among older adults aged 65 years old and above were mostly spent indoors, whereas the objective of this research was to explore the relationship caused by PNE, SNE measures and the physical characteristics in the study areas. All of the parts were then combined to introduce a new restructured questionnaire.

3.5.1 Study samples (SES items)

A total of 280 respondents were interviewed individually through a questionnaire survey done in a period of 3 months. The study sample was controlled in which older adults including young-old adults aged from 45 years old and above are chosen as respondents in this study. Respondents starting from the age of 45 until 59 are included in this study and assumed to be in the young-old age group since they will soon enter the retirement age at 60 years old. Moreover, respondents who were 60 years old and above were categorized as older adults who constitutes the majority of the respondents.

In order to facilitate the interview, the help of the neighbourhood associations were sought to gain respondent's trust. Most of the respondents who cooperate were from the low to middle income older residents since most neighbourhood associations are usually formed and managed by low to middle income community in different small districts of the neighbourhoods. Table 3.2 below shows the descriptive statistic of the study sample which includes the basic demographic attributes. The basic demographic attributes of the respondents consists of gender, age, period of stay in the neighbourhood, race, family structure and occupation. Among the respondents aged from 45 years old to 75 and above, the average age for the three neighbourhoods are about 60 years old, where the highest portion represents residents from the age group of 60 – 64. Most of the respondents have lived in the neighbourhoods from more than 16 years and can be assumed as permanent residents, but varies according to the neighbourhoods. Respondents living in Taman Perling and Taman Selesa Jaya stayed longer in the neighbourhoods which is more than 16 years but respondents living in Taman Nusantara have stayed from 6 to 15 years in their neighbourhood. This is due to the fact that Taman Nusantara was developed later than Taman Perling and Taman Selesa Jaya, which explains this trend. Moreover, a majority of the respondents were among the Malay in the three neighbourhoods and only a small number of Chinese and Indian participated in this questionnaire survey. In addition, most respondents in the three neighbourhoods were mostly retired persons and unemployed, living with either their couple and children or both.

Table 3.2: Descriptive statistics of the respondent's demographic attributes

Part A: Demographic Attributes	Taman Perling, N = 139 (n, %)	Taman Nusantara, N = 84 (n, %)	Taman Selesa Jaya, N = 57 (n, %)	Total respondents, N = 280 (n, %)
Gender				
Male	80, 57.55	54, 64.29	40, 70.18	174, 62.14
Female	59, 42.45	30, 35.71	17, 29.82	106, 37.86
Age (years)	*Mean = 59.62*	*Mean = 59.71*	*Mean = 62.16*	*Mean = 60.16*
45 – 49	8, 5.76	1, 1.19	0	9, 3.21
50 – 54	21, 15.11	18, 21.43	4, 7.02	43, 15.36
55 - 59	38, 27.34	18, 21.43	15, 26.32	71, 25.36
60 – 64	42, 30.22	31, 36.9	20, 35.09	93, 33.21
65 – 69	18, 12.95	10, 11.9	11, 19.3	39, 13.93
70 – 74	9, 6.47	4, 4.76	6, 10.53	19, 6.79
75+	3, 2.16	2, 2.38	1, 1.75	6, 2.14
Period of stay (years)	*Mean = 22.59*	*Mean = 9.27*	*Mean = 18.51*	*Mean = 17.76*
< 5	2, 1.44	16, 19.05	3, 5.26	21, 7.50
6 – 10	12, 8.63	36, 42.86	3, 5.26	51, 18.21
> 11 years	125, 89.93	32, 38.09	51, 89.47	208, 74.28
Race				
Malay	129, 92.81	78, 92.86	55, 96.49	262
Chinese	4, 2.88	5, 5.95	2, 3.51	11
India	5, 3.60	1, 1.19	0	6
Others	1, 0.72	0	0	1
Family structure				
Single	6, 4.32	4, 4.76	0	10, 3.57
Couple	66, 47.48	47, 55.95	32, 56.14	145, 51.79
Couple with children	67, 48.20	33, 39.29	25, 43.86	125, 44.64
Occupation				
Government staff	11, 7.91	12, 14.29	3, 5.26	26, 9.29
Private staff	17, 12.23	3, 3.57	6, 10.53	26, 9.29
Self-employed	29, 20.86	9, 10.71	3, 5.26	41, 14.64
Retired	49, 35.25	29, 34.52	21, 36.84	99, 35.36
Unemployed	33, 23.74	31, 36.90	24, 42.11	88, 31.43

Source: Author's Findings (2020)

3.5.2 Social Capital Integrated Questionnaire (SC-IQ)

The Social Capital Integrated Questionnaire (SC-IQ) established by the World Bank was referred to include the social aspects of the neighbourhood environment. As discussed previously, the SC-IQ items were divided into objective and subjective measures in which objective means observable and measureable data whereas subjective measures means the perception of the respondents.

The objective measures (SNEO) can be categorised into four items which are social networks, participation in community groups, participation in community activities, and collective action and cooperation. The perceptive measures (SNES) which explore the perception of respondents towards their social neighbourhood environment can be categorised into three items mainly trust and solidarity, collective action and cooperation, and the extent of a neighbourhood association, based on the level of agreement of the 5-point Likert scale.

The first and second items in the combined questionnaire are based on the SC-IQ, whereas the third part is based on the author's findings in the pilot survey previously. The third item which measures the respondent's perception towards the extent of the neighbourhood association is mainly a critical aspect to be included since the social neighbourhood environment can be commonly influenced by the extent of the neighbourhood association in Malaysia's neighbourhood. A question item under the SNES domain which is S8 (M) was treated as reverse scoring. A detailed explanation of the SNE items, its sub items, measurements, and each items references are illustrated in Table 3.3.

Table 3.3: Social neighbourhood environment measures for both objective and subjective (SNEO & SNES)

SNEO Items	**Sub-items**	**Measurement**	**Source**
S1- Social network 1	Number of close friends	• Open ended answers • Treated as a continuous scale variables	SC-IQ questionnaire items
S2 - Social network 2	Number of people willing to lend money		
S3 - Social network 3	Frequency of interaction with immediate neighbours	• Answers are based on frequency scales (Never, Rarely, Sometimes, Often)	Findings based on the previous pilot survey done by the author in 2018
S4- Sociability 1 (Participation in community groups)	'Rukun Tetangga' / Neighbourhood association	• Answers are based on 'Yes' or 'No' • Treated as a dichotomous categorical variable	SC-IQ questionnaire items
	'Skim Rondaan Sukarela' / Neighbourhood patrol group		
	'Jawatankuasa Penduduk' / Neighbourhood political committee		
	Mosque committee		
	Recreation club		
S5- Sociability 2 (Level of decision-making in community groups)	'Rukun Tetangga' / Neighbourhood association	• Answers are based on scales of decision-making level (Leader, Very active, Less active, Did not take part in decision-making)	
	Skim Rondaan Sukarela' / Neighbourhood patrol group		
	'Jawatankuasa Penduduk' / Neighbourhood political committee		
	Members of mosque committee		
	Members of recreation club		
S6- Sociability 3 (Frequency of participation in community activities)	'Gotong – royong' (community cleaning activities in the neighbourhood)	• Answers are based on frequency scales (Never, Rarely, Sometimes, Often)	Findings based on the previous pilot survey done by the author in 2018
	Recreation activities (eg: Aerobic, 'tai chi', family day)		
	Religious celebration and spiritual activities in the		

	mosque or musholla (eg: 'Tadarus Quran', 'Yassin readings')	• Treated as a categorical variable	
	Formal programs with collaboration from government agencies (Eg: Police, Fire Brigade)		
SNES Items	**Sub-items**	**Measurement**	**Source**
S7- Generalized trust	A) Most people can be trusted	• Measurements are based on a 5-point likert-scale items 1= Strongly disagree 2= Disagree 3= Neutral 4= Agree 5= Strongly agree	SC-IQ questionnaire items
	B) One must be alert or else someone will take advantage		
	C) People do not trust each other to lend and borrow money		
	D) Trust people from same race		
	E) Trust people from different race		
	F) Trust local shopkeepers		
	G) Trust local authorities representatives		
	H) Trust neighbourhood patrol group		
	I) Trust strangers strolling around in the neighbourhood		
	J) Count on neighbors to report to you if there is suspicious activity around the house		
	K) Count on neighbors to watch over your pets by lending your house key		
S8 - Collective action and cooperation	L) Community groups will help the poor in the neighbourhood	• Measurements are based on a 5-point likert-scale items 1= Strongly disagree 2= Disagree 3= Neutral 4= Agree 5= Strongly agree	
	M) Residents who did not take part in community activities will be criticize		
	N) Many residents will get together and help solve problems in the neighbourhood		
	O) Willingness to contribute time to a community project that may or may not benefit respondents	• Answers are based on 'Yes' or 'No' • Treated as a dichotomous categorical variable	
	P) Willingness to contribute money to a community project that may or may not benefit respondents		
S9 – Perception	Q) Neighbourhood 'Rukun Tetangga' is active		Findings based on the pilot

towards community groups		• Measurements are based on a 5-point likert-scale items 1= Strongly disagree 2= Disagree 3= Neutral 4= Agree 5= Strongly agree	survey done during this research
	R) Neighbourhood patrol group (SRS) makes you feel safer		
	S) Community groups are important to establish community relations between residents		
	T) Role of RT leader as connection to higher authority		
	U) Political representatives can help improve neighbourhood		

3.5.3 Neighbourhood Environment Walkability Scale – Abbreviated (NEWS-A)

The Neighbourhood Environment Walkability Scale (NEWS) is a 98-items questionnaire to measure the perception of the neighbourhood physical characteristics that can influence the physical activity among residents. It was constructed by the International Physical Activity and the Environment Network (IPEN) in 2002 and can be categorized as the normal version of NEWS and a shorter version which is the NEWS-A (abbreviated version). The Neighbourhood Environment Walkability Scale - Abbreviated (NEWS-A) is considered suitable to be used for this study to reduce the time consumption of the questionnaire survey. Moreover, walkability was also indirectly related to the extent of physical activity based on a review by Mena et al., (2017). A summary of the NEWS-A items and its sub-items which will be used are illustrated in Table 3.4.

Table 3.4: NEWS-A items measuring the resident's perceptions towards the physical neighbourhood environment

Subjective measures from NEWS-A	Sub-items
A) Residential density	Types of residence: Bungalow, terrace, semi-detached, Apartment 1-3 stories, apartment 4-6 stories, apartment 7-12 stories, apartment more than 13 stories
B) Diversity of land use mix	Distance to each destinations (minutes): Grocery store, supermarket, worship place, bus stop, coffee and restaurant, clinic, food stall, park and playground, community hall, night market, wet market
C) Accessibility	'Stores are within walking distance from home', 'Many places to go within walking distance from home', 'Walking to bus stop from home is easy'
D) Street connectivity	'Distance between traffic intersections are 100m or less', There are many alternative routes to get from place to place'
E) Infrastructure for walking and cycling	'Presence of sidewalks on most of the streets', 'Presence of grass strips that separates the streets from the side', 'Neighbourhood streets are well lit at night', 'Residents can easily observe pedestrians and bikers on the streets', 'Presence of crosswalks and pedestrian signals'
F) Aesthetics	'Presence of trees along the streets', 'Many interesting things to look at while walking', 'Many attractive natural sights and good landscaping', 'Many attractive buildings and homes'

G) Safety from traffic hazards (reverse scoring)	'Heavy traffic makes it difficult to walk in the streets', 'Traffic speed on the street near home is slow about 25km/h', 'Most drivers exceed the posted speed limits while driving in the neighbourhoods'
H) Safety from crime (reverse scoring)	'High crime rate in the neighbourhood', 'Crime in the neighbourhood makes it unsafe to walk in the day', 'Crime in the neighbourhood makes it unsafe to walk in the night'

Source: Neighbourhood Environment Walkability Questionnaire (NEWS-A) developed by Saelens & Sallis (2002)

The objective of item A is to measure resident's perception of residential density, based on the scoring weight of NEWS-A (J. Sallis, Black, & Chen, 2002). Higher numbers of residential density constitute higher walkability. For the other items, the scale range consists of 'Strongly Disagree, Disagree, Not Sure, Agree, and Strongly Agree'. Several additions are included in the questionnaire item B to adapt to the Malaysian neighbourhood environment such as places of worship, night markets, wet markets and clinics (M & Lee, 2018). Furthermore, food stalls in the neighbourhood area are also included since it is logical to regard this as a component supporting social liveability in a Malaysian neighbourhood based on the pilot survey performed by the author previously. The scores for PNES are categorised into low, medium and high scores based on the 25th, 50th and 75th percentiles. Each score of PNE was divided based on the 1st, 2nd and 3rd quartiles since there is no protocol to measure precisely the categorisation of low to high walkability based on the PNE scores. Higher scores of NEWS-A items means higher walkability but for safety from traffic hazards and safety from crime, lower scores means higher walkability (Saelens et al., 2007) due to reverse scoring items. Table 4 shows the descriptive statistics of the NEWS-A items as a result of the questionnaire survey.

3.5.4 International Physical Activity Questionnaire (IPAQ)

The International Physical Activity Questionnaire (IPAQ) was deployed to be used in this study. It is regarded as an international measure for physical activity since extensive reliability and validity was done in 12 countries (Australia, Canada, Finland, Guatemala, The Netherlands, Japan, Portugal, South Africa, Sweden, United States, United Kingdom, Brazil) which was deemed suitable and acceptable across different settings (Craig et al., 2003). The IPAQ Malaysian version (15 – 64 years old) was referred for the Malay language, but questions on sitting was excluded since the context of this study only deals with the external neighbourhood environment.

In the context of this study, the International PA Questionnaire (IPAQ) for adults aged 15-64 was considered suitable for deployment in this study. Although an existing IPAQ version specially focused on adults aged 65 years old and above, it could not be favourably adapted to the context of this research. The reason was that most of the respondents who voluntarily took part in this survey were adults in their late-middle age, who were approaching their retirement age. Moreover, the respondents had a starting age of 50 years, and the mean age of respondents was 60 years old. This was further supported by the results from a reliability and validity study conducted by Tomioka et al. (2011). They proved that IPAQ for ages 18-64 applies to adults over 65, showing adequate validity but insufficient reliability.

Different types of PAs occur in all domains of daily life, including work domain, active transportation, domestic and garden works and leisure-time activities. For all domains, three types of physical activities are specifically described based on IPAQ (2004), including walking activities (PA1), moderate-intensity activities (PA2), and vigorous-intensity activities (PA3). In the questionnaire survey, respondents were required to provide details of the duration (in minutes) and frequency (in days) during a week spent on different domains. PA1 was intended for walking purposes. It can be considered a mode of transport for most people who have less

mobility. Walking for recreation means spending time on brisk walking to exercise and maintain health.

Next, PA2 usually consisted of recreation and sports activities or leisure activities such as gardening and doing housing chores. PA3 can also be used for recreation and sports activities, similar to moderate activities. The significant differences that divide PA into several categories are because of the total time spend on each type of activity in a week. Besides, PA3 can also include work-related activities that typically cover older adults who are self-employed, such as selling food, in the case of retired older adults in Malaysia. Cycling activities can also be regarded as vigorous-intensity activities that were excluded from this study since it is not usually the norm among the respondents in the neighbourhoods. Table 5 shows a summary of five classes of PAs.

PA was measured using a subjective (indirect) instrument through a questionnaire survey. Respondents were interviewed on how many minutes per day in a week they spend time doing PA1, PA2 and PA3. Based on the scoring protocol of IPAQ (Forde, 2005), physical activities can be scored using continuous or categorical scores. Continuous scores are based on the IPAQ short form scoring protocol (2005). MET scores can be defined as the Metabolic Equivalent of Task, which is the ratio of a person's working metabolic rate relative to resting metabolic rate (WHO, 2020). An average MET score or weightage was derived for each type of PA, including 3.3 METs for walking activities (PA1), 4.0 METs for moderate-intensity activities (PA2), and 8.0 METs for vigorous-intensity activities (PA3). Each MET average score for PA1, PA2 and PA3 was then multiplied by minutes and days in a week. Total scores can also be obtained by calculating the summation of MET scores for PA1, PA2 and PA3. Based on this, new cutpoints were proposed, including the total PA running in all types of domains, the inactive (C1) category, the minimally active (C2) category, and the most active health-promoting physically-active or HEPA-active (C3) category. The criteria for these three levels can be defined as scores with less than 600 MET minutes per day per week below (C1), scores with a minimum of 600 and above per week (C2), and scores with a minimum of 3000 and above per week were the most active group (C3) (Forde, 2005).

3.5.5 Final Questionnaire Structure

The final questionnaire structure combining the demographic attributes, the social neighbourhood environment (SNEO & SNES), the extent of physical activity (PA), and the physical neighbourhood environment (PNES) were used in the questionnaire survey. The combined questionnaire consist of a total of 92 items. The questionnaire is shown in the Appendix section.

3.6 Research Measurements for the Hypotheses

Several hypotheses which were developed in the formulation of conceptual framework were then evaluated based on the expected direct and indirect relationships. The suitability of the correlation tests were chosen based on the nature of the variables. Table 3.5 below illustrated the usage of various types of correlation tests and its assumptions.

Table 3.5: The correlation tests used based on the types of variables

Variables	Type of variables	Correlation tests	Assumptions	Source
H1: PNEO – PA H2: PNES – PA H4: PNEO – PNES H5: PNEO – SNEO	Ordinal => Ordinal	Goodman & Kruskal Gamma (γ)	i. Values range from -1 to 1 ii. Positive values means both variables increased iii. Negative values means 1 variable increases and another decreases iv. P-value significance at > 0.05 v. Strength of association: 0.00 < 0.10: Negligible, 0.10 < 0.20: Weak, 0.20 < 0.40: Moderate, 0.40 < 0.60: Relatively strong, 0.60 < 0.80: Strong 0.80 < 1.00: Very strong	(Rea & Parker, 2014)
H3: SNEO – PA	Scale => Scale	Pearson's correlation	Absolute value of r: 0 < 0.3: None or very weak, 0.3 < 0.5: Weak, 0.5 < 0.7: Moderate, > 0.7: Strong	(Moore, Notz, & Fligner, 2018)
	Nominal => Ordinal	Chi-square test	P-value significance at > 0.05	(Mchugh, 2013)
H6: PNEO – SNES	Scale => Ordinal	Pearson's / Spearman's	Absolute value of r: 0 < 0.3: None or very weak, 0.3 < 0.5: Weak, 0.5 < 0.7: Moderate, > 0.7: Strong	(Moore et al., 2018)
	Nominal => Ordinal	Chi-square test	P-value significance at > 0.05	(Mchugh, 2013)
H7: SES – PA	Nominal => Ordinal	Chi-square test	P-value significance at > 0.05	(Mchugh, 2013)
	Scale => Ordinal	Pearson's / Spearman's	Absolute value of r: 0 < 0.3: None or very weak, 0.3 < 0.5: Weak, 0.5 < 0.7: Moderate, > 0.7: Strong	(Moore et al., 2018)

In this study, variables for SNEO such as social networks (number of close friends) and mutual support (number of people willing to lend money) were specifically treated as a continuous data when performing the correlation tests in order to reduce a high data variability related to different categorization of variables (Lovasi et al., 2012; Yip, Sarma, & Wilk, 2016).

3.7 Summary of Chapter

This chapter summarizes the overall methodology of obtaining data for this research starting from the details of the study area, the research design, and description of the study samples, various measures to obtain the PNEO data, constructing a new combined questionnaire framework based on the established questionnaires, and lastly identifying the research measurements based on the different nature of the hypotheses.

4 CASE STUDY ON TAMAN PERLING TERRACE

Taman Perling environment was observed as a large neighbourhood consisting of two separate boundary areas, with a large commercial area easily accessible via the highway access that cuts through the first boundary area of Taman Perling. The large commercial area consisted of a shopping mall, commercial shop lot buildings, a free-standing hotel building, a wet market and a dry market. Several rows of shop lots were also observed in some parts of the main arterial road in this neighbourhood. The layout design of this neighbourhood is a traditional gridiron pattern with several different types of houses, such as terraced houses, housing blocks, semi-detached houses and a few bungalow units. Based on the author's observation, some areas of the neighbourhood were away from access to a variety of facilities where most residents had to rely on their private vehicles. Pedestrian lanes were constructed only along the main road and some areas that were disconnected.

This chapter is divided into several parts: PNEO results, questionnaire survey results, and the results of correlation tests performed on each hypothesis.

4.1 Analysis on Spatial Data using ArcGIS

Respondents' locations were identified based on their road address information obtained from the questionnaire survey. Table 4.1 shows the five PNEO measures of Taman Perling terraced houses. The terraced houses of Taman Perling have an average population density of about 7,600 km2, which is moderately high for the city of Johor Bahru (Bell, 2017). The population density was calculated per neighbourhood and population data based on each smaller district was obtained from the 2010 Johor Bahru Census Data. Simultaneously, data attributes of the questionnaire survey results such as PNES, PA, SNEO and SNES were spatially combined with the respondents' location layer using ArcGIS.

Table 4.1: Summary of PNEO measures based on average values.

Objective measures (PNEO)	**Average values (mean)**
A) Population density (population / km^2)	7,600.10
B) Distance to facilities (m) - Recreational open space - Mosque	 354.17 317.91
C) Intersection Density (No. of real nodes/area)	491.85
D) Land Use Mix value (highest is 1)	0.49

The second PNEO measure was the distance to facilities, in which most respondents live within an average distance of 350 m from the recreational open space and about 300 m from the mosque, as shown in Table 1. The distance of the respondent's location was calculated using the network analysis, specifically the closest facility analysis. Road networks were created to facilitate the analysis. The facilities were supposed to be recreational open spaces and mosques in this neighbourhood, while the incidents were supposed to be the respondent's point of location. The third PNEO measure was the intersection density where this neighbourhood showed an average of 490 nodes per 200 m of buffer within the respondent's location. This was presumed to be a high intersection density value for this neighbourhood. The last PNEO measure was the land-use mix value of about 0.49, which was considered a moderate-mix land-use. Figures 4.1 to 4.8 shows the process of obtaining the data for each of these measures.

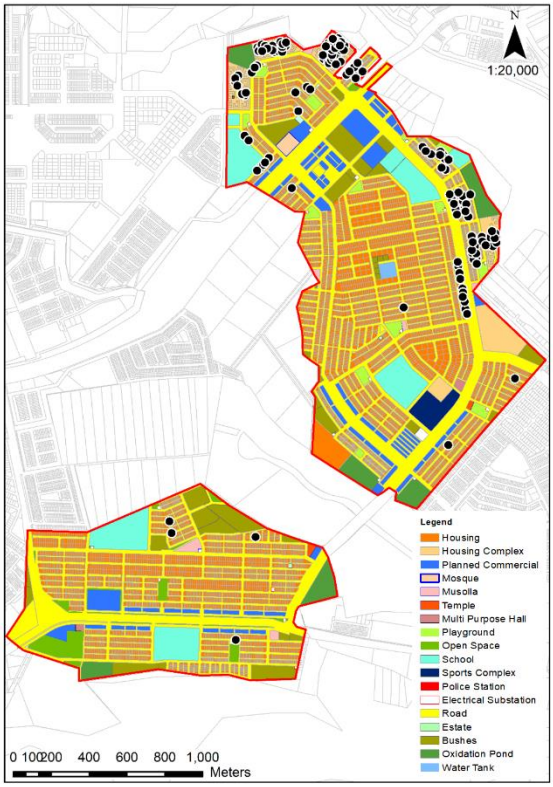


Figure 4.1: Respondent's location in both Taman Perling terrace houses and housing blocks

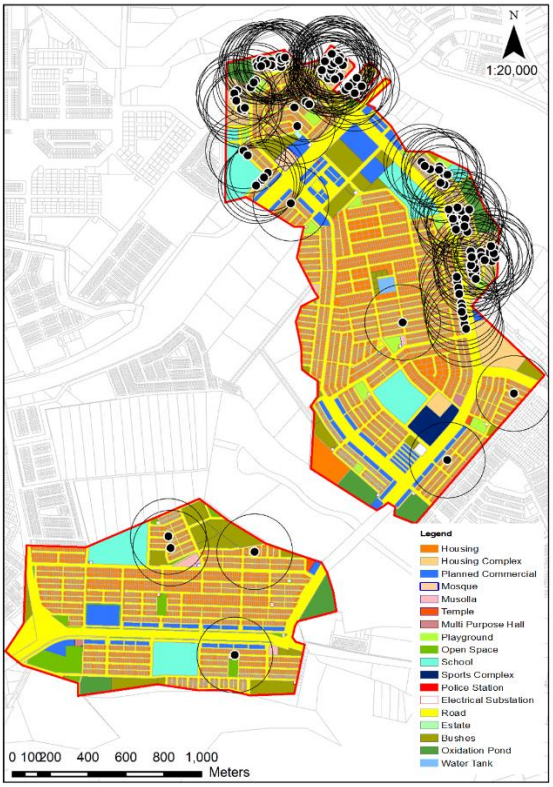


Figure 4.2: A buffer of 200 m were assigned for each respondent

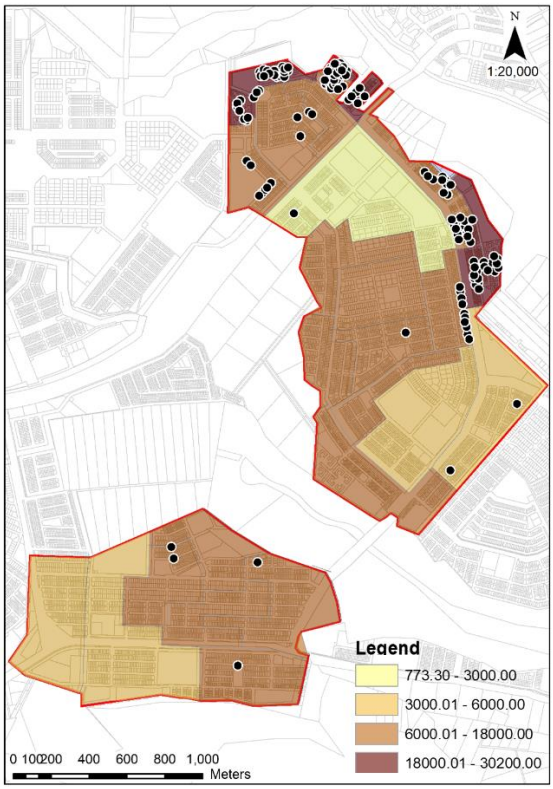


Figure 4.3: Population density based on the administrative districts from the Department of Statistics, Johor

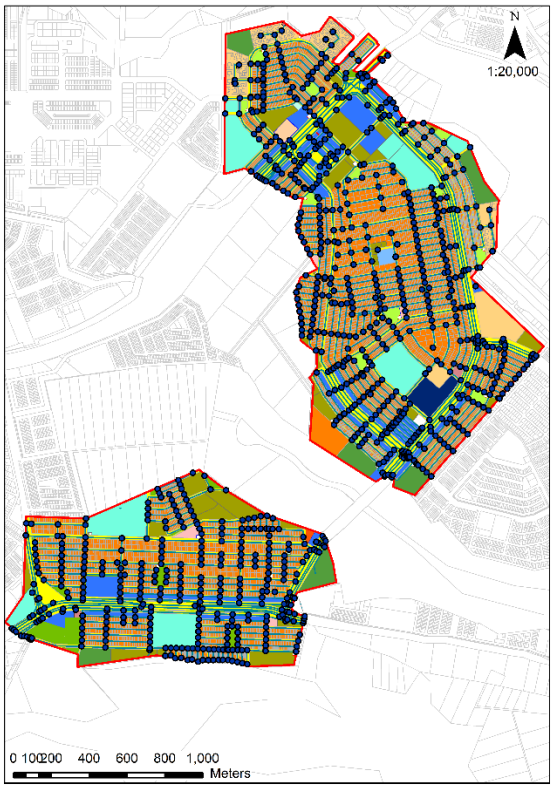


Figure 4.4: Road network and traffic intersection nodes of Taman Perling

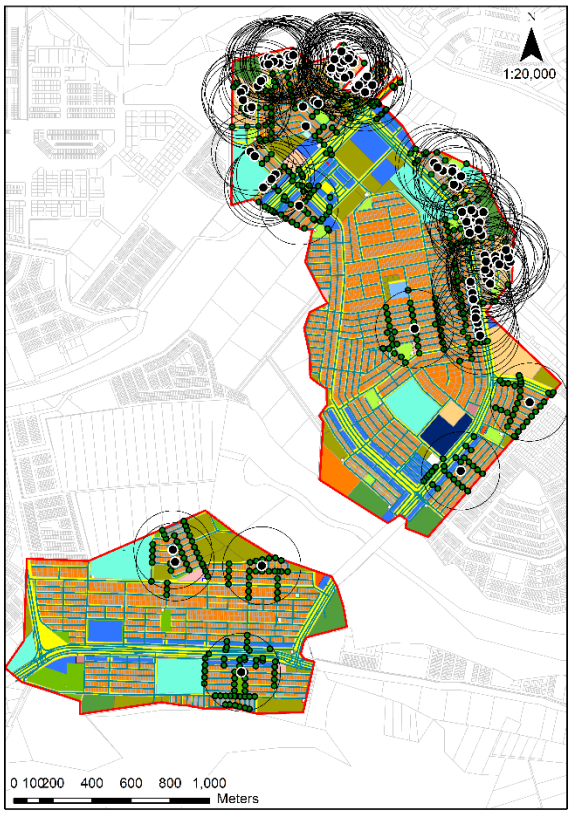


Figure 4.5: Nodes at road intersections were clipped with the respondent's location buffer

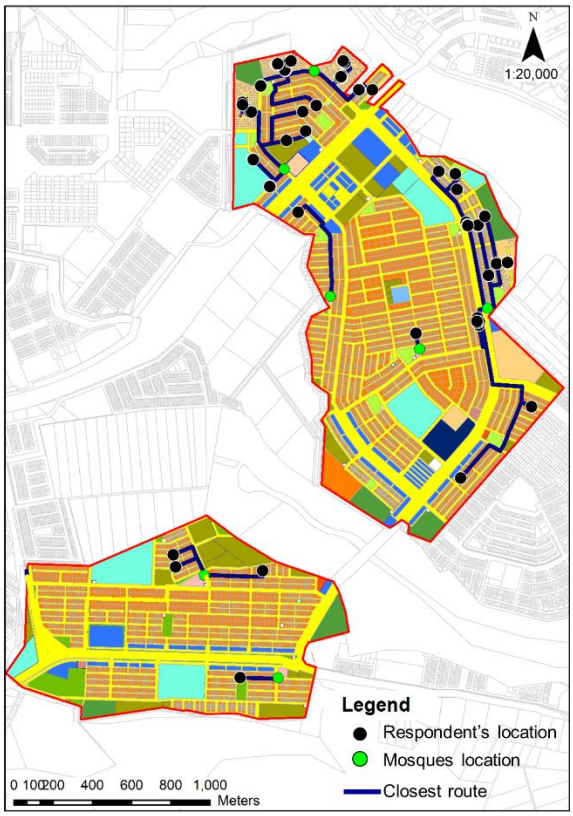
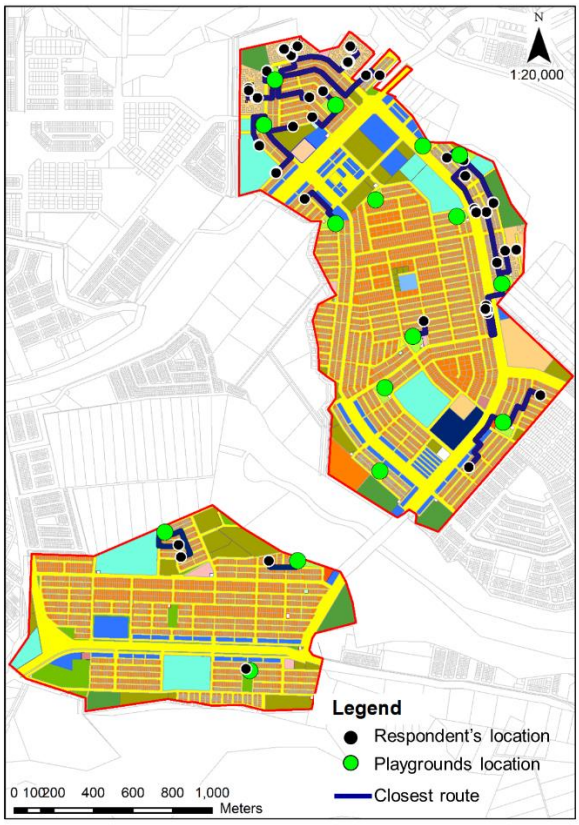


Figure 4.6: Each respondent's distance to facility (mosques) were analysed using the network analysis in ArcGIS



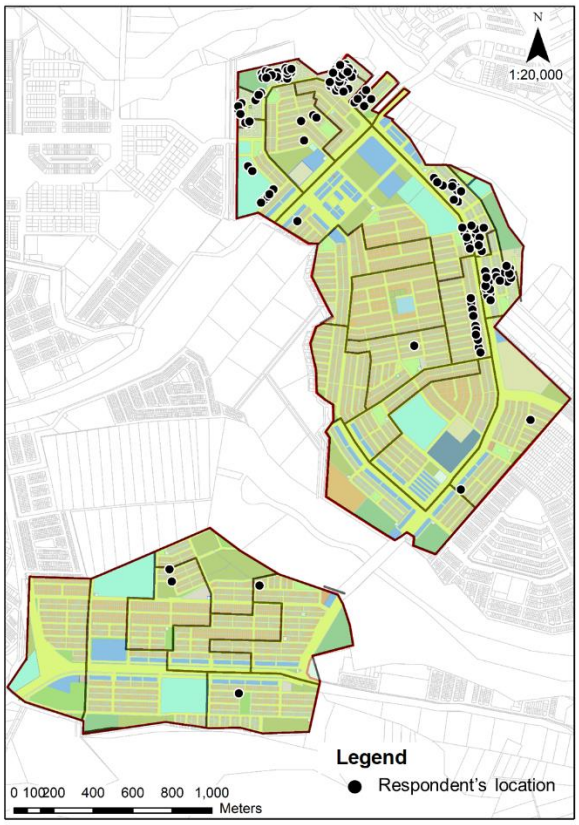


Figure 4.7: Each respondent's distance to facility (playgrounds) were analysed using the network analysis in ArcGIS

Figure 4.8: Land use mix entropy for each respondent were calculated based on the administrative boundaries of population census

4.2 Descriptive Statistics on Questionnaire Data

The first section of this part discusses the questionnaire survey results by explaining the descriptive statistics, specifically for SNEO, SNES, PNES and PA. Part A describes the demographic attributes defined in the previous chapter. The next section of this part discusses the results of significant relationships between each hypothesis and the relevant discussions.

4.2.1 Part 2: Social Capital Theme (SNEO & SNES)

This part describes the results of both objective (SNEO) and subjective (SNES) social capital themes. Based on the conceptual framework discussed in the previous chapter, five SNEO measures consisted of social network 1 (number of close friends), social network 2 (number of people willing to lend money), social network 3 (frequency of interactions with immediate neighbours), sociability 1 (frequency of joining community activities), sociability 2 (participation in community groups), and sociability 3 (level of decision making in community groups). Figure 4.9 shows descriptive statistics for social network 1, measured by the number of close friends among respondents. The majority of the respondents had more than 14 close friends, which was a common observation among older people in all neighbourhoods.

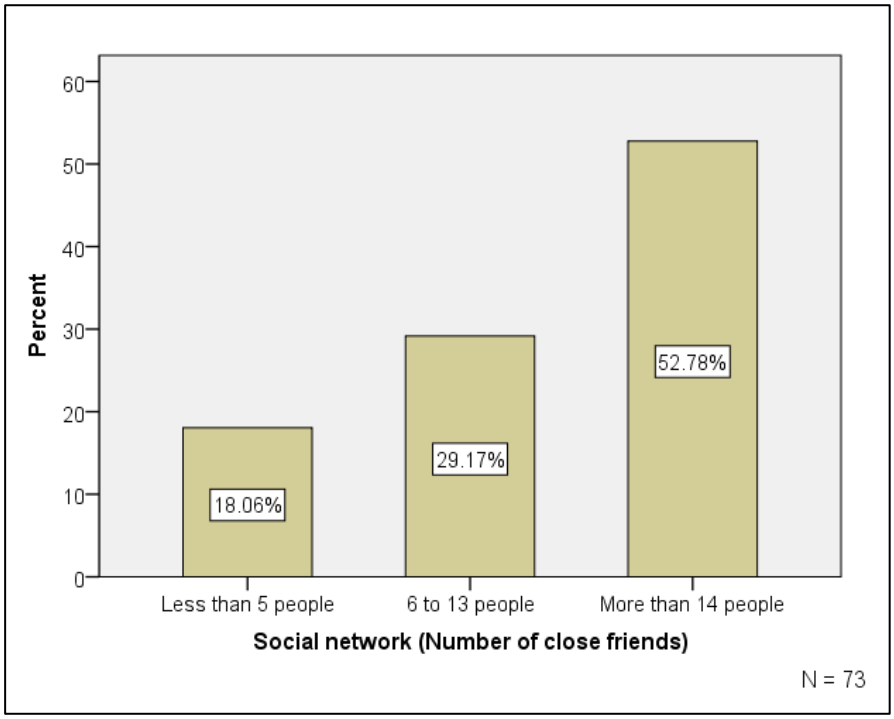


Figure 4.9: Descriptive statistics for social network 1 measuring number of close friends

Figure 4.10 shows social network 2 in terms of the number of people willing to lend money. The number of people willing to lend money is a measure that defines a closer relationship and stronger trust between community members. It was expected that the number of people

willing to lend money was less, but most of the respondents in terraced houses had two or more people who could rely on when they needed to borrow money. The third measure was the frequency of interaction with immediate neighbours, as shown in Figure 4.11. Most of the respondents often had social interactions with their neighbours, and the same trend was observed in the other neighbourhoods.

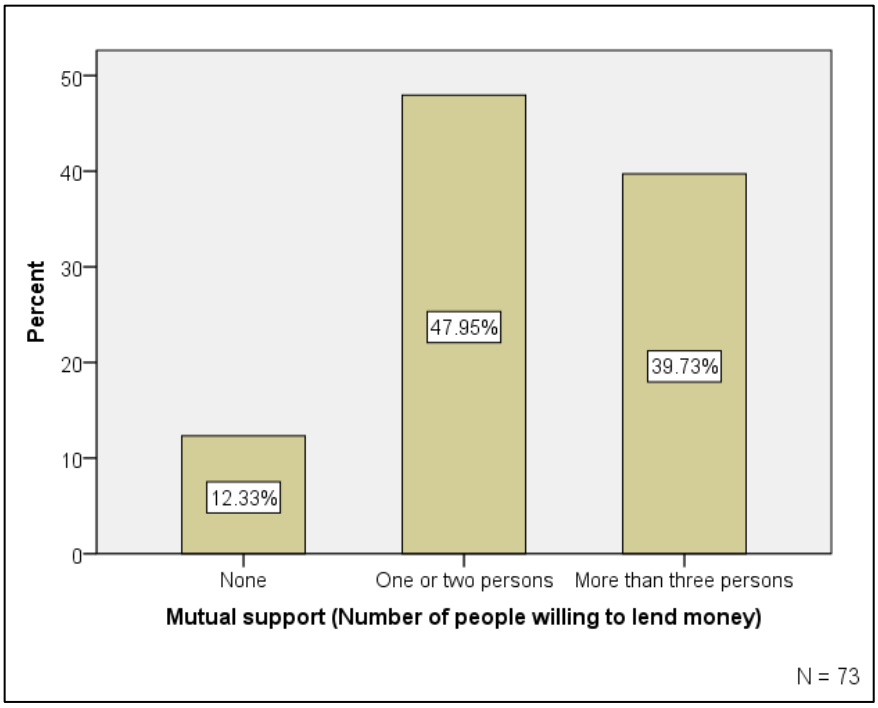


Figure 4.10: Descriptive statistics for social network 2 measuring number of people willing to lend money

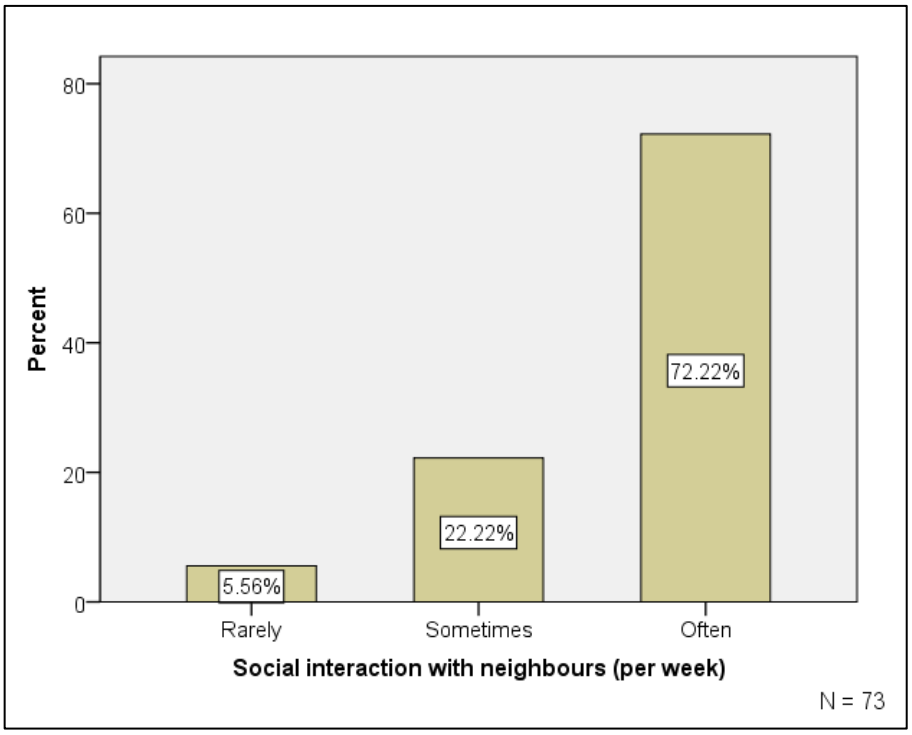


Figure 4.11: Descriptive statistics for social network 3 measuring social interaction with immediate neighbours in a week

Table 4.2 shows the frequency of joining various types of community activities among the respondents in this neighbourhood. As expected, most of them participated in religious activities, with about 60% of older adults participating in religious activities in mosques or 'musholla'. For the other activities, most of them never joined or rarely joined in the community activities.

Table 4.2: Descriptive statistics of Sociability 1 measuring types of community activities

Sociability 1 items	Frequency of participating in community activities (%)			
Types of community activities	Never	Rarely	Occasionally	Frequently
'Gotong – royong' (cleaning up the neighbourhood together)	50.00	30.56	18.06	1.39
Recreation activities	72.22	9.72	11.11	6.94
Religious activities	33.33	4.17	29.17	33.33
Collaboration programs	81.94	16.67	-	1.39

Descriptive statistics for SNEO items, such as measuring sociability, are discussed below. Figure 4.12 shows the frequency of respondents joining community groups in this region. Most of them belonged to the mosque committee and neighbourhood association group, with about 47 and 42%, respectively. The recreation clubs had the least members among the respondents, about 11%. On the other hand, among the respondents, there was no participation in the neighbourhood safety patrol groups (SRS) political party (JKP).

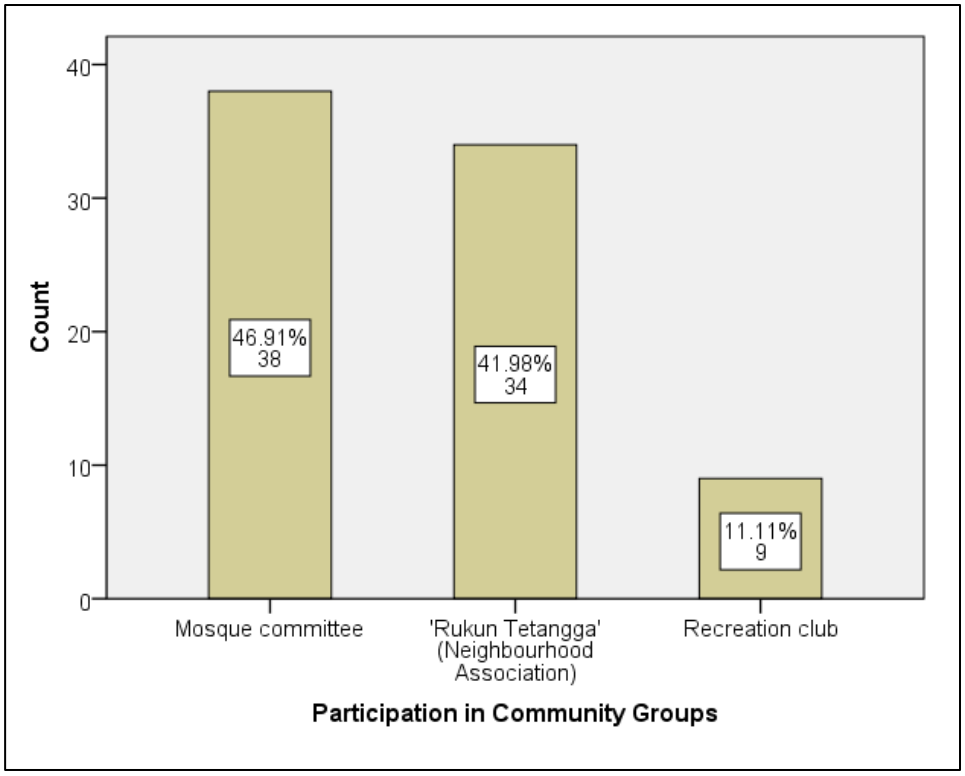


Figure 4.12: Descriptive statistics for participation in community groups (Sociability 2)

Table 4.3 shows the descriptive statistics for the level of decision making in the community groups. Most of the respondents who participated in neighbourhood associations and mosque committees were very active in making group decisions, but followed by less active respondents. Due to the small number of members, an equal proportion of respondents who participated in the recreation clubs was observed at all levels of decision making. It was also found that the recreation clubs had two leaders. This was a common trend for community groups to have a leader and a sub-leader.

Table 4.3: Descriptive statistics of level of decision-making in community groups (Sociability 3)

Level of decision-making in community groups (Sociability 3)	**Leader (N, %)**	**Very Active (N, %)**	**Less Active (N, %)**	**Does not take part in decision-making (N, %)**
i. 'Rukun Tetangga' / Neighbourhood association	-	21, 63.60	10, 30.30	2, 6.10
ii. Members of mosque committee	1, 2.70	26, 70.30	8, 21.60	2, 5.40
iii. Members of recreation club	2, 22.20	3, 33.30	2, 22.20	2, 22.20

For SNES, there are three measures: generalised trust, collective action and cooperation and perception towards the community groups in the neighbourhood. Table 4.4 shows the descriptive statistics for all the SNES measures. Most of the respondents tended to agree with all generalised trust items, but some respondents tended to disagree with the item 'Trust strangers strolling in the neighbourhood'. Regarding collective action and cooperation, respondents also tended to agree with the items, but some respondents tended to disagree with the item 'Residents who did not take part in community activities will be criticised' because this item was coded in reverse. For perception towards community groups, respondents also tended to agree with all items.

Table 4.4: Descriptive statistics of the SNES items

Subjective measures (SNES)	**Strongly Disagree (N, %)**	**Disagree (N, %)**	**Not sure (N, %)**	**Agree (N, %)**	**Strongly Agree (N, %)**
A) Generalized trust					
i. Most people can be trusted	-	3, 4.10	3, 4.10	50, 68.50	17, 23.30
ii. One must be alert or else someone will take advantage	1, 1.40	10, 13.70	1, 1.40	45, 61.60	16, 21.90
iii. People do not trust each other to lend and borrow money	3, 4.10	25, 34.20	8, 11.00	25, 34.20	12, 16.40
iv. Trust people from same race	1, 1.40	2, 2.70	-	53, 72.60	17, 23.30
v. Trust people from different race	-	-	2, 2.70	54, 74.00	17, 23.30

vi. Trust local shopkeepers	-	-	3, 4.10	56, 76.70	14, 19.20
vii. Trust local authorities representatives	-	-	4, 5.50	52, 71.20	17, 23.30
viii. Trust neighbourhood patrol group	-	-	6, 8.20	53, 72.60	14, 19.20
ix. Trust strangers strolling around in the neighbourhood	5, 6.80	27, 37.00	9, 12.30	21, 28.80	11, 15.10
x. Count on neighbors to report to you if there is suspicious activity around the house	-	-	-	50, 68.50	23, 31.50
xi. Count on neighbors to watch over your pets by lending your house key	-	7, 9.60	10, 13.70	39, 53.40	17, 23.30
B) Collective action and cooperation					
i. Community groups will help the poor in the neighbourhood	-	3, 4.10	16, 21.90	48, 65.80	6, 8.20
ii. Residents who did not take part in community activities will be criticize *reverse-coding	11, 15.10	34, 46.60	19, 26.00	7, 9.60	2, 2.70
iii. Many residents will get together and help solve problems in the neighbourhood	-	3, 4.1	18, 24.70	36, 49.30	16, 21.90
C) Perception towards community groups					
i. Neighbourhood 'Rukun Tetangga' is active	-	-	5, 6.80	54, 74.0	14, 19.20
ii. Neighbourhood patrol group (SRS) makes you feel safer	-	1, 1.40	2, 2.70	57, 78.10	13, 17.80
iii. Community groups are important to establish community relations between residents	-	1, 1.40	6, 8.20	47, 64.40	19, 26.00
iv. Role of neighbourhood association (RT) leader as connection to higher authority	-	-	6, 8.20	48, 65.80	19, 26.00
v) Political reps can help improve neighbourhood	-	-	13, 17.80	48, 65.80	12, 16.40

Another measure under collective action and cooperation is illustrated in Figure 4.13 next page. Most respondents tend to contribute time instead of money for a community project that can bring benefit to the community, which is more than 80% of the total respondents.

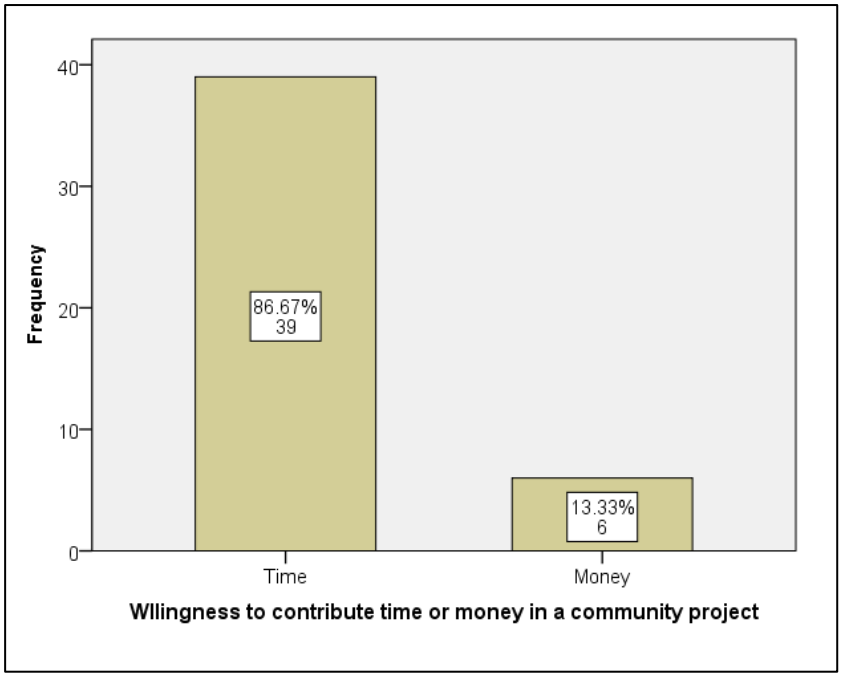


Figure 4.13: Descriptive statistics for willingness to contribute in time or money for a community project (Collective action and cooperation)

4.2.2 Part 3: Physical Activity (PA)

Physical activity data was obtained from the questionnaire survey based on different types of physical activities. Table 4.5 shows descriptive statistics for different types of physical activities among respondents in Taman Perling terraced houses. Then, different types of physical activities were aggregated based on the MET scores categorisation of walking activities, moderate-intensity activities and vigorous-intensity activities. Walking to a destination was considered a walking activity. Walking for recreation, doing recreation and sports activities, and doing leisure activities were deemed to be moderate-vigorous-intensity types of PA. Daily activities, such as doing part-time jobs, were regarded as vigorous-intensity activities. Based on Forde (2005), a specific weightage was assigned to a particular category of MET. The results are shown in Table 4.6 in terms of a new categorisation based on MET-min per week.

Table 4.5: The descriptive statistics of the types of physical activities performed by the respondents of Taman Perling terrace houses

Types of physical activities	**N, total minutes spent, mean of total minutes spent**
A) Walking to a destination other than walking for recreation (eg: walking to grocery store, mosque, market, bus stop)	59, 1995 mins, 33.81 mins
B) Walking for recreation (including walking your pets, jogging, brisk walking)	28, 733 mins, 26.18 mins
C) Recreation and sports activities (eg: soccer, aerobic, 'tai chi')	29, 1308 mins, 45.1 mins
D) Leisure activities outside your home (eg: gardening, cleaning home exterior, karaoke)	53, 6014 mins, 113.47
E) Daily activities such as part-time jobs (eg: retired person doing self-business)	5, 1455 mins, 291 mins

Table 4.6: Descriptive statistics for the categorization of PA level based on MET-minutes per week

Categories of PA level based on MET-minutes per week	**Mean of total minutes spent, S.D. (N= 73)**
C1: Inactive	136.75, 174.50
C2: Minimally active	214.25, 240.27
C3: Health-enhancing PA (HEPA-active)	395.07, 1060.67

4.2.3 Part 4: Physical Neighbourhood Environment Subjective (PNES)

Table 4.7 shows the descriptive data for the 12 PNES items. Respondents agreed that all types of houses in their living area were terraced houses. Most of the respondents tended not to recognise large neighbourhoods, but only within a certain area around their houses. This was because the neighbourhood also consisted of other types of houses, such as bungalow and semi-detached houses, as well as housing blocks with several floors and apartments somewhere nearby. Next, most of the respondents in Taman Perling found themselves within 1-5 mins and 6-10 mins from various destinations, within walking distance from their homes. The only clinic was more than 30 mins away from most of the respondents.

Interestingly, respondents tended to be almost against the accessibility of the neighbourhood where stores were not within walking distance, there were not many places to go near their homes, and walking from their home to the bus stop was relatively inconvenient. However, in terms of perceived road connectivity, most respondents agreed that the distance between intersections was less than 100 m, and there were many alternative routes. Next, most respondents agreed that infrastructure for walking was sufficient. Most of them tended to agree that sidewalks are present along with grass strips that separate the streets from sidewalks, crosswalks and pedestrian signals. Moreover, most respondents tended to admit that the aesthetics of their neighbourhood was at a satisfactory level.

Because of perceived traffic safety, respondents generally agreed that heavy traffic makes walking in the streets unpleasant. Besides, while most drivers tended to exceed the posted speed limit when driving on the roads, some agreed that roads near their home usually have slow traffic. This is because some respondents lived right in front of the main roads with traffic jam, while others lived in other streets. In contrast, respondents mostly perceived their houses were safe from crimes that tended to oppose by reverse score items. For individual measures, respondents agreed that parking lots are not enough in the commercial areas. Also, there were many blind alleys in this area, as most respondents tended to oppose the reverse score items for the lack of blind alleys. In the other three individual measures, a nearly even distribution of respondents agreed/disagreed with the hilly and physical barriers in their neighbourhood. This means that some respondents lived in hilly or flat areas, or near physical barriers.

Table 4.7: The questionnaire outcomes for the descriptive data of PNES items

Subjective measures (PNES)	**None (N, %)**	**A few (N, %)**	**Several (N, %)**	**Mostly (N, %)**	**All (N, %)**
A) Perceived Residential Density					
i. Bungalow / Semi-detached	68, 93.2	3, 4.10	1, 1.40	1, 1.40	-
ii. Terraced houses	9, 12.30	-	1, 1.40	11, 15.10	52, 71.20
iii. Apartment 1 – 3 floors	71, 97.30	1, 1.40	-	1, 1.40	-
iv. Apartment 4 – 6 floors	57, 78.10	4, 5.50	1, 1.40	6, 8.20	5, 6.80
v. Apartment 7 – 11 floors	69, 94.50	2, 2.70	-	2, 2.70	-
vi. Apartment more than 12 floors	71, 97.30	2, 2.70	-	-	-
B) Perceived land use diversity	**1 – 5 mins**	**6 – 10 mins**	**11 – 20 mins**	**21 – 30 mins**	**> 31 mins**
i. Grocery shop	33, 45.20	34, 46.60	4, 5.50	1, 1.40	1, 1.40
ii. Supermarket	19, 26.0	29, 39.70	17, 23.30	4, 5.50	4, 5.50
iii. Worship place	51, 69.90	18, 24.70	3, 4.10	1, 1.40	-
iv. Bus stop	25, 34.20	36, 49.30	4, 5.50	1, 1.4 0	7, 9.5
v. Coffee restaurant	25, 34.20	29, 39.70	10, 13.70	7, 9.60	2, 2.70
vi. Clinic	14, 19.20	8, 11.0	11, 15.10	7, 9.60	33, 45.2
vii. Food stall	23, 31.50	43, 58.90	4, 5.50	3, 4.10	-
viii. Park / Playground	46, 63.0	19, 26.0	3, 4.10	1, 1.40	4, 5.40
ix. Community hall	16, 21.90	39, 53.40	4, 5.50	3, 4.10	11, 15.10
x. Night market	11, 15.10	27, 37.0	18, 24.70	5, 6.80	12, 16.50
xi. Wet market	10, 13.70	28, 38.40	9, 12.30	11, 15.10	15, 20.50
C) Perceived neighbourhood accessibility	**Strongly Disagree (N, %)**	**Disagree (N, %)**	**Agree (N, %)**	**Strongly Agree (N, %)**	
i. Stores within walking distance	1, 1.40	66, 90.40	5, 6.80	1, 1.40	
ii. Many places to go within walking distance	-	67, 91.80	5, 6.80	1, 1.40	
iii. Walking to bus stop from home is easy	6, 8.20	60, 82.20	6, 8.20	1, 1.40	
D) Perceived street connectivity					
i. Distance between intersection is 100 metre or less	7, 9.60	16, 21.90	47, 64.40	3, 4.10	-
ii. There are many alternative routes	1, 1.40	5, 6.80	56, 76.70	11, 15.10	-

E) Perceived infrastructure for walking					
i. Present of sidewalks on most of the streets	5, 6.80	30, 41.10	37, 50.70	1, 1.40	-
ii. Sidewalks are separated from the road/traffic in my neighbourhood by parked cars	5, 6.80	22, 30.10	44, 60.30	2, 2.70	-
iii. Present of grass strips that separates the streets from the sidewalks	4, 5.50	18, 24.70	49, 67.10	2, 2.70	-
iv. Present of crosswalks & pedestrian signals to help pedestrian cross the streets	3, 4.10	17, 23.30	46, 63.0	7, 9.60	-
v. Neighbourhood streets are well lit at night	-	2, 2.70	64, 87.70	7, 9.60	-
vi. Residents can easily observe pedestrians and bikers on the streets in front of their homes	-	13, 17.80	48, 65.80	12, 16.40	-
F) Perceived neighbourhood aesthetics					
i. Many interesting things to look at while walking	6, 8.20	28, 38.40	31, 42.50	8, 11.0	-
ii. Present of trees along the streets	-	13, 17.80	50, 68.50	10, 13.70	-
iii. Many attractive natural sights/ good landscaping	-	18, 24.70	47, 64.40	8, 11.0	-
iv. Many attractive building/ homes	3, 4.10	12, 16.40	51, 69.90	7, 9.6	-
G) Perceived traffic safety					
i. Heavy traffic that makes it difficult/ unpleasant to walk in the streets	4, 5.50	19, 26.0	46, 63.0	4, 5.50	-
ii. Traffic speed on the street near home is slow (25km/h)	2, 2.70	30, 41.10	33, 45.20	8, 11.0	-
iii. Most drivers exceed the posted speed limits while driving in the streets	8, 11.0	16, 21.9	44, 60.30	5, 6.80	-

H) Perceived crime safety					
i. High crime rate in the neighbourhood	32, 43.80	36, 49.30	5, 6.80	-	-
ii. The presence of crime in the neighbourhood makes it unsafe to go for walks during the day	28, 38.40	37, 50.70	8, 11.0	-	-
iii. The presence of crime in the neighbourhood makes it unsafe to go for walks during the night	18, 24.70	34, 46.60	20, 27.40	1, 1.40	-
I) Perceived lack of parking – Parking is difficult in local commercial store	3, 4.10	23, 31.50	41, 56.20	6, 8.20	-
J) Perceived lack of cul-de-sac – The streets do not have many/ any cul-de-sacs	11, 15.10	58, 79.50	3, 4.10	1, 1.40	
K) Perceived hilliness – Walking is difficult due to hilly streets in the neighbourhood	8, 11.0	30, 41.10	33, 45.20	2, 2.80	
L) Perceived physical barriers – Main barriers like stairs, drainage & untrimmed sidewalks limits the num. of walking routes	2, 2.70	37, 50.70	32, 43.80	2, 2.80	

Table 4.8 below shows the descriptive summary for the 12-PNES items based on the average values and standard deviations.

Table 4.8: Descriptive summary of each PNES items based on mean and standard deviations

Subjective measures (PNES)	**Average values (mean, S.D.)**
A) Residential density	236.37, 42.59
B) Diversity of land use mix	2.28, 0.82
C) Accessibility	3.07, 0.33
D) Street connectivity	2.84, 0.34

E) Infrastructure for walking and cycling	2.76, 0.32
F) Aesthetics	2.81, 0.47
G) Safety from traffic hazards*	2.56, 0.55
H) Safety from crime*	1.80, 0.56
I) Lack of parking	2.68, 0.68
J) Lack of cul de sac	2.92, 0.49
K) Hilliness	2.41, 0.76
L) Physical barriers	2.48, 0.65

4.3 Significant Results based on Correlation Tests

This part will discuss about the significant results for each hypothesis of the direct and indirect relationships across the difference domains for Taman Perling terrace houses based on the conceptual framework in the earlier chapter.

4.3.1 Direct relationship for PNEO – PA (H1) & PNES – PA (H2)

Table 4.9 below illustrated the significant results analyzed for the relationship between PNEO – PA and PNES – PA based on the Kruskal – Gamma analysis. The underlying assumptions to these results are discussed below.

Table 4.9: Significant results for PNEO – PA (H1) and PNES – PA (H2)

PNEO measures => PA	**Significant results**
Land use mix entropy *Low: <0.5 *Medium: 0.51 – 0.74 *High: >0.75	$\gamma = 0.413$, $p < 0.081$ (High, C1-)
PNES measures => PA	**Significant results**
Land use mix access	$\gamma = -0.644$, $p < 0.011$ (Low, C1+)
Street connectivity	$\gamma = 0.482$, $p < 0.027$ (High, C3+ / Low, C1+)
Safety from crime	$\gamma = 0.526$, $p < 0.006$ (Low, C1+ / Medium, C2+)
Hilliness	$\gamma = -0.484$, $p < 0.031$ (Low, C2+)
Physical barrier	$\gamma = -0.543$, $p < 0.012$ (Medium, C1+ / Low, C2+)

For PNEO measures with PA, older people living in terraced housings of Taman Perling was shown to have a relatively strong relationship between land use mix entropy and PA level despite some study showing land use mix as insignificant to PA (Wei et al., 2016). The high land use mix value indicated that the respondents were C1, which was unlikely to happen as older adults would usually show high level of PA in high mixed land use neighbourhoods (Christian et al., 2011). The distribution of different types of land uses in the surrounding home vicinity can influence their likelihood to perform physical activities outside their home vicinity. High land use mix typically mean more destinations that they could go to within walking distance from their houses and vice versa (Christian et al., 2011).

One possible reason to this result was older adults might feel demotivated to walk due to the present condition of accessibility in their housing vicinity. Even though they were living in a high land use mix area, it could possibly consist of land uses that were not walkable such as industry, commercial areas with road barriers, drainage systems and oxidation ponds that are categorized under sewerage land use. The main road or highway in this neighbourhood might also be one possible reason whereby highways were often perceived as physical barriers in this context. Since most respondents of Taman Perling terrace houses were living near the main road, and it was highly likely that their extent of PA was reduced because of the fast-speed vehicles passing through the street which might endanger the safety of the older adults. These possible assumptions for high land use mix entropy and low PA level based on the respondent's location is shown in Figure 4.14 below.

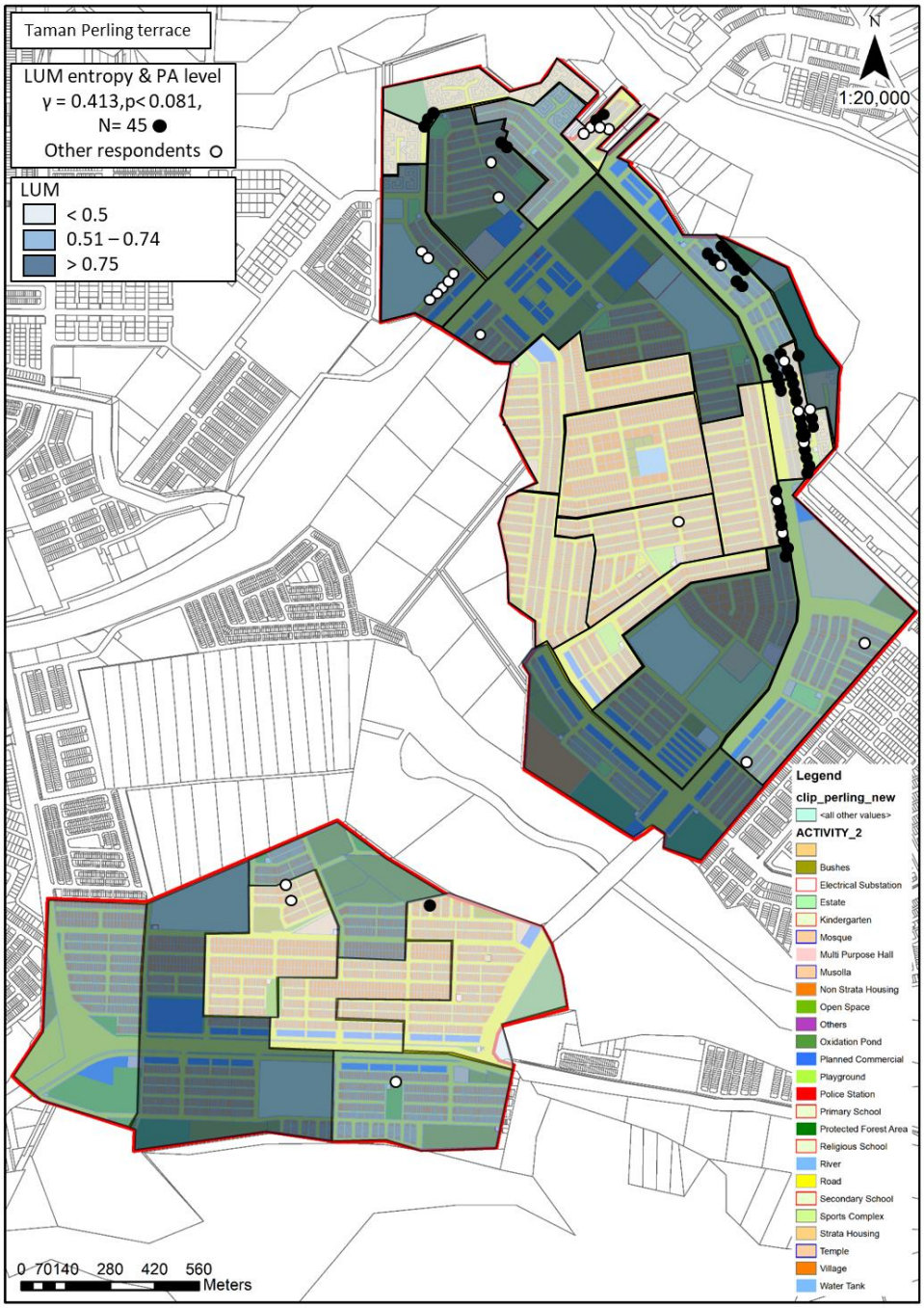


Figure 4.14: Land use mix entropy and respondent's location who had low PA level (C1)

For PNES, five measures were shown to have strong relationships with PA, which are land use mix access, street connectivity, safety from crime, hilliness and physical barrier. For low land use mix access areas, respondents tend to show a low level of PA (C1). By referring to Table 4.7 (PNES descriptive statistics) previously, it is proven that they perceived a low accessibility since a majority of them tend to disagree on all three measures of perceived accessibility. A low accessibility in their housing area shows that they perceive not many stores, not many places to go within walking distance from home as well as having some difficulties to walk to bus stop from their home (shown in Figure 4.15). Since they perceived less accessibility in their neighbourhood, it is logical to assume the reason they have a low PA level since they would have no purpose to walk to various destinations within their home vicinity. This can also strengthen the assumption made previously regarding respondents living in high land use mix areas that were showing a low PA level of C1.

Next, perception towards street connectivity is associated with PA of older adults. By referring to Table 4.7 (PNES descriptive statistics) in the previous section, it is proven that they perceived higher street connectivity since a majority of them agreed to the two measures of connectivity. People who perceive their neighbourhood having a higher street connectivity tend to show a high PA level and vice versa. This can be clearly understood since perception towards street connectivity measures the short distance between traffic intersections and many alternative routes in their neighbourhood area (shown in Figure 4.16), which is a strong reason for older adults to have C3. A higher perception of this characteristics can mean higher extent of physical activity spent in recreation areas (Kaczynski et al., 2014). They also might choose to walk to interact with their friends in the neighbourhood, shown by the significant relationship between number of close friends and PA level, which is explained in the SNEO part. Moreover, respondents who perceive a low street connectivity tend to show C1. This seems to be a logical reason because based on Berrigan et al. (2010), low street connectivity area are usually consist of longer rows of housing, less number of traffic intersections and high number of dead-end roads which are less conducive for walking and would hinder physical activity level. The results of this study further adds to the existing knowledge whereby Sa & Ardern (2014) and Wu et al. (2019) suggested that perceived street connectivity were usually positively associated with a substantial amount of PA among older adults.

Figure 4.15: An example of a bus stop by the main road which is only accessible using stairs

Figure 4.16: Small pedestrian lane that cuts through a row of terrace houses

Interestingly, a low perception towards the safety from crime is observed with PA of C1. Since safety from crime is measured by a reverse scoring procedure based on NEWS-A, this means that a low perception of safety from crime means low level of crime and would logically increase the tendency of walking in their neighbourhood. Thus, a higher PA level which typically mean having a low level of crime rate and is safe to walk anytime. But regardless of this, older adults tend to show C1. An underlying assumption from this is because of the respondent's location in which most of the respondents who answered a low perception towards crime mostly live near the main road of Taman Perling which has a designated speed limit of 70 km per hour and the local roads in this area also has a designated speed limit of 35 km per hour (shown in Figure 4.17). This might impede the respondents to walk around their home vicinity which explains C1.

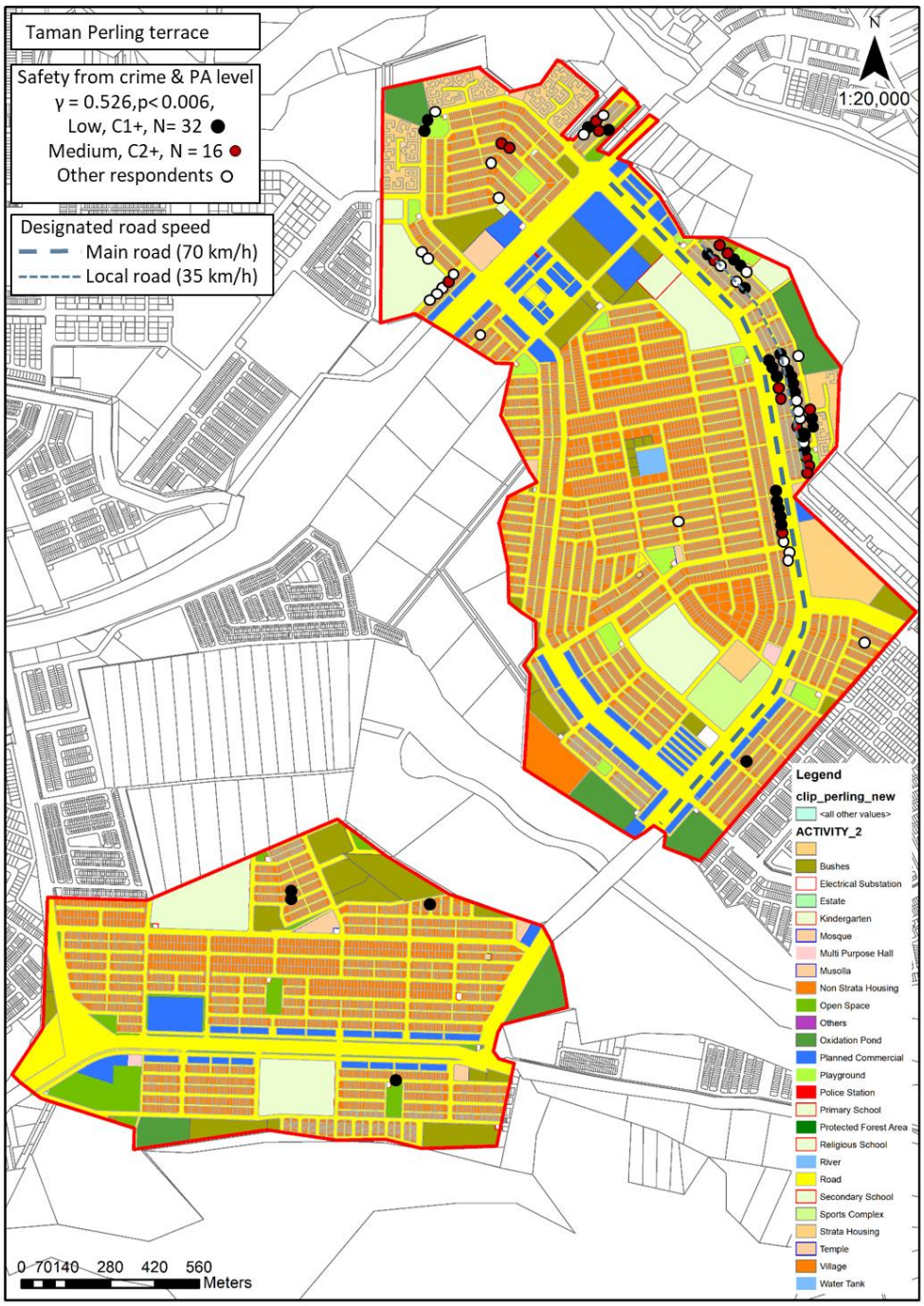


Figure 4.17: Respondent's location for perception towards safety from crime and their PA level.

Perception towards hilliness and physical barriers are strongly but negatively associated with PA. It is shown that respondents who answered low to these two measures tend to have C2. This is rational since this neighbourhood does not have hilly topography but it does have a major physical barrier such as the main road and the highway that divides this neighbourhood. However, looking at the micro-scale context focusing on the location of respondents who answered this question, there are no physical barriers such as drainage or hilly streets within their home vicinity. This can influence a higher likelihood to walk around their neighbourhood.

4.3.2 Direct relationship for SNEO – PA (H3)

Table 4.10 below illustrated the significant results done for the relationship between SNEO – PA and SNES – PA. The correlation tests yielded several significant results for SNEO and the respondent's PA level.

Table 4.10: Significant results for SNEO – PA (H3)

SNEO measures => PA (H3)	**Significant results**
Social network (Number of close friends)	$r = 0.776$, $N= 72$, $p < 0.015$
Sociability 3 (Frequency of joining community activities: 'Gotong-royong')	$\gamma = 0.470$, $p < 0.05$ (Never, C1+)
Sociability 3 (Frequency of joining community activities: Recreation)	$\gamma = 0.640$, $p < 0.006$ (Never, C1+) (Frequently, C2+ C3+)
Sociability 3 (Frequency of joining community activities: Collaboration programs with outside groups)	$\gamma = 0.753$, $p < 0.0018$ (Never, C1+) (Rarely, C2+)
Collective action and cooperation (Willingness to contribute time/ money in a community project that will benefit the community in the neighbourhood	$\chi^2 = 26.13$, $p < 0.0001$ (Contribute time, C1)

For SNEO, social network is significant with PA level, which was measured by a number of close friends and PA level. This means that the more friends they had, the higher the likelihood of the respondents to engage in physical activities. Having many close friends in the neighbourhood increases their likelihood of spending time outside their houses to interact with neighbours and friends which can be classified under informal bonding social capital. This result supports the findings from Smith, L. et al. (2017) in which older adults globally who tend to receive social support from family and friends were associated with higher leisure time physical activities.

Next, a similar trend were observed for sociability 3, in which respondents who never joined community activities such as the 'gotong-royong', recreation activities, and formal collaboration programs were in the C1 category. In contrast, respondents who frequently or rarely joined recreation activities and formal collaboration programs were in the C2 and C3 category. A strong assumption can be deduced from this trend in which older adults who frequently joined community activities tend to be more active compared to older adults who never joined any. However, an interesting trend in terms of collective action and cooperation was observed whereby older adults who were in the C1 category tend to contribute time in a community project that will benefit the community. Since the trends were contradictory, it might be sufficient to assume that most respondents who belong to the middle and low income group might tend to choose spending their time rather than contributing their money since their choices of answers were limited.

4.3.3 Indirect relationship for PNEO => PNES – PA (H4)

As mentioned previously in the earlier chapter, the indirect relationships based on the conceptual framework were examined by only referring to the significant relationships in H1 (PNEO – PA) which was the land use mix entropy and H2 (PNES – PA) which were the perceived land use mix accessibility, perceived street connectivity, safety from crime, hilliness and physical barriers. Cross-tabulations and further correlation tests were performed in SPSS for the PNEO, PNES and PA levels; illustrated in Table 4.11 below.

Table 4.11: Summary of significant results for the cross-tabulation of PNEO, PNES, and PA level

PNEO items	**PNES items**	**Significant results correlated with PA level**
Land use mix entropy (A)	Perceived land use mix accessibility (B)	$\gamma = -0.751$, $p < 0.011$ (Low A, Low B, C2)
	Perceived street connectivity (C)	$\gamma = 0.545$, $p < 0.049$ (Low A, High C, C3+)
	Perceived safety from crime (D)	$\gamma = 0.754$, $p < 0.003$ (Low A, Low D, C1)

The indirect relationship between PNES and PA which was hypothesized to be caused by PNEO yielded some significant results. The cross-tabulation and correlation tests showed that perceived land use accessibility, perceived street connectivity and perceived safety from crime were significant with the respondent's PA level. Respondents who stayed in low land use mix area tend to perceive a low accessibility and show C2. Since the measures for perceived accessibility in this context mostly deals with the accessibility to commercial areas, it is logical to assume that respondents living in housing areas with less mix of land uses tend to perceived less destinations to go within the housing vicinity.

However, the respondents tend to show C2 which might be related to a high perception of street connectivity. Although the respondents were living in low land use mix area with low accessibility, but high street connectivity might be the main reason for the respondents to be active which was proven by the significant results. Connected street networks with shorter traffic intersection and pedestrian side lanes that were observed in the terrace housing areas of Taman Perling may increase the likelihood of respondents to walk to various destinations. But in this case, since the respondents were living in a low mixed-land use area with less destinations to walk to, it can be deduced that they might walk to meet their friends or neighbours around their housing area. This assumption was strengthen when significant relationship was found between social network and PA level among the respondents, which was proven in the previous section under SNEO – PA (H3).

Furthermore, respondents living in low land use mix area tend to perceive a low perceived crime safety. Based on the sub-items under the perceived safety from crime, it can be deduced that crime rate in this housing area was low due to the reverse scoring procedure. Less types of land use in residential area can be a possible reason for less crime occurrence since less outsiders were present in the streets. A variety of land use in an area such as commercial and industry provides opportunity for outsiders to stroll around the area, which might make residents feel unsafe.

4.3.4 Indirect relationship for PNEO => SNEO – PA (H5)

The indirect relationship of SNEO and PA which was hypothesized to be caused by PNEO was based on the conceptual framework discussed earlier. Table 4.12 shows the results of the significant relationships for these domains. An interesting trend was observed where respondents who lived in high land use mix areas did not participate in community activities such as 'gotong-royong', recreation activities or formal collaboration programs, but were showing an inactive level of PA (C1). Yet, some respondents who frequently participated in religious activities at the mosque and joined formal collaboration programs at least several times a year showed a moderate level of PA (C2). This shows that respondents who went to participate in community activities tend to show higher levels of PA compared to respondents who never participated in any.

Based on this result, respondents living in high land use mix area can be assumed to be located close to housings, mosque and community facility where formal collaboration programs usually took place. They were most likely to walk to these facilities or spending their time in these activities performing moderate to vigorous type of PA such as helping to prepare food and venue place before the program starts as well as helping to clean out the venue after the program ended (shown in Figure 4.18 and 4.19). This shows that the community in this area is cooperative when it comes to volunteering activities especially for religious activities and formal collaboration programs. This was also proven through their willingness to contribute time to community projects which indicated their extent of collective action and cooperation in the community. In contrast, some respondents who refused to contribute time for community projects in low land use mix area might be influence by their housings locations where there might only be one type of land use within walking distance which was residential. While exhibiting a C2 PA level, these respondents might be involved in other types of PA.

Table 4.12: Summary of significant results for the cross-tabulation of PNEO, SNEO and PA level

PNEO items	**SNEO items**	**Significant results correlated with PA level (C1, C2, C3)**
Land use mix entropy (A)	Sociability 3 – Frequency of participating in community activities 'Gotong – royong' (B)	$\gamma = 0.691$, $p < 0.042$ (High A, Never join B, C1)
	Sociability 3 – Frequency of participating in community activities: Recreation (C)	$\gamma = 0.975$, $p < 0.00001$ (High A, Never join C, C1)
	Sociability 3 – Frequency of participating in community activities: Religious (D)	$\gamma = 0.643$, $p < 0.053$ (High A, Frequently join D, C2)
	Sociability 3 – Frequency of participating in community activities: Formal collaboration programs (E)	$\gamma = 1.000$, $p < 0.008$ (High A, Never join E, C1) (High A, Rarely join E, C2)
	Collective action and cooperation: Willingness to contribute time to community projects (F)	$\gamma = -0.784$, $p < 0.050$ (High A, Yes F, C2) (Low A, No F, C2)

Figure 4.18: Older and young women preparing food for a religious program at a mosque in Taman Perling

Figure 4.19: Older men preparing food to be distributed freely during Ramadhan month at a mosque in Taman Perling

4.3.5 Indirect relationship for PNEO => SNES – PA (H6)

Referring back to the conceptual framework in the earlier chapter, SNES items were hypothesized to be caused by PNEO, and showed an indirect relationship with PA. Based on Table 4.13, respondents living in low land use mix area tend to show high generalized trust and high perception towards the community groups in the neighbourhood. Respondents living in low land use mix area means that they are living in only residential land use. Informal social interaction which usually exists among the community living in a housing vicinity can be the reason underlying this relationship. Informal social bonding and formal bridging among neighbours and the members of community groups living within the respondent's housing vicinity were assumed since they tend to perceive a high generalized trust and high extent towards community groups. Older adults as members of a close-knit community tend to have more social interaction with their friends living within their home surrounding since they tend to have more free time which explains their extent of C2. Involvement in the formal activities organized by the community groups in their neighbourhood area can be the main reason they were showing C2.

Although there was no significant relationship found for social interaction with immediate neighbours and the extent of PA level in the previous section (H5), this does not necessarily show that there were no social interactions involved. The question regarding the frequency of social interaction with immediate neighbour was directed only to immediate neighbours in which social interaction might occur with residents beyond their immediate neighbours. In addition, significant relationship for social network measuring the respondent's number of close friends and PA level discussed previously can also support this justification. Furthermore, the present of community groups such as the neighbourhood association and neighbourhood patrol group within their housing vicinity might also give a perception of social security among the respondents which explains the high generalized trust, and was strengthen with the significant relationship found in perceived safety from crime discussed previously.

Table 4.13: Summary of significant results for the cross-tabulation of PNEO, SNES and PA level

PNEO items	**SNES items**	**Significant results correlated with PA level (C1, C2, C3)**
Land use mix entropy (A)	Generalized trust (B)	$\gamma = -0.770$, $p < 0.0001$ (Low A, High B, C2)
	Perception towards community groups in the neighbourhood (C)	$\gamma = -0.636$, $p < 0.012$ (Low A, High C, C2)

4.3.6 Direct relationship for SES => PA (H7)

Chi-square tests are implied to the measures of gender, occupation, family structure and race due to the nature of the variables which is categorical variable. Table 4.14 shows that only race was significant to PA level, in which most Malays showed a level of low PA. For the measures of age and period of stay, since the categories in age and period of stay were originally scale variables with a non-normal distribution, Spearman's rank correlation tests were deemed to be more suitable to be implied. However, there were no significant results for both age and period of stay for this neighbourhood.

Table 4.14: Significant relationship for SES items with PA level in this neighbourhood

SES items (Demographic attributes)	**Significant results correlated with PA level (C1, C2, C3)**
Race	$\chi^2 = 15.893$, $p < .009$ (Malay, C1+ / Indian. C3 +)

4.4 Summary of Chapter

- A general trend based on the important relationships discussed previously can be observed in this neighbourhood, which are pointed out below:
- The types of non-walkable land use that make up the overall land-use mix entropy calculation can impact PA levels for older people, as older people living across land-use mix did not exhibit PA.
- Perceived accessibility influences PA levels for older adults.
- Elderly adults living in nearby houses with higher street connectivity had higher PA levels. This is because areas with low street connectivity usually consist of long rows of houses, fewer traffic intersections and numerous dead-end roads, making them unsuitable for walking or physical activities.
- Physical barriers, such as drainage or hilly roads, nearby houses, can adversely influence the likelihood of walking around.
- Having many close friends in their neighbourhood increases the likelihood of spending time outside their houses to interact with neighbours and friends. This can be classified as an informal social capital relationship.
- Older adults who frequently participated in community activities tend to be more active than older adults who have never participated.
- Respondents living in low land-use mix areas with only residential land use showed a high level of generalised trust and awareness towards the community groups in their neighbourhood.
- The presence of community groups, such as neighbourhood associations and neighbourhood patrol groups, within their residential area leads to the recognition of social security among the respondents. This can imply high generalised trust and strengthen the important relationships found in perceived safety from crime.
- Involvement in formal activities organised by neighbourhood community groups can be the main reason for higher PAs in older adults.

5 CASE STUDY ON TAMAN PERLING HOUSING BLOCKS

5.1 Analysis on Spatial Data using ArcGIS

This section will discuss on the descriptive statistics of the objective measures of the physical neighbourhood environment (PNEO) and the steps of analysis performed in ArcGIS for each of the five PNEO measures. Table 5.1 shows the summary for the five PNEO measures in mean values. It is illustrated that Taman Perling housing blocks has a population density of about 22,800 sq km, which is considered relatively high for the city of Johor Bahru (Bell, 2017). This is because this study area consists of four housing blocks area which usually has high population density compared to terrace housings area. Population density were calculated and population data were obtained from the Johor Bahru Population Census Data 2010. Simultaneously, data attributes of the outcomes from the questionnaire survey such as PNES, PA, SNEO and SNES were spatially joined using ArcGIS with the respondent's location layer.

Table 5.1: Summary of PNEO measures based on average values.

Objective measures (PNEO)	**Average values (mean)**
A) Population density (population / sqkm)	22,804.64
B) Distance to facilities (metre) - Recreational open space - Mosque	 274.29 272.01
C) Intersection Density (No. of real nodes/area)	428.81
D) Land Use Mix value (highest is 1)	0.43

The second PNEO measure is distance to facilities, in which most respondents live within an average of 270 metres from the recreational open space and the mosque, shown in Table 5.1 above. The distance of respondent's locations were calculated using the network analysis specifically the closest facility analysis. Road networks were created in order to facilitate the analysis. The facilities were assumed as the recreational open spaces and mosques in this neighbourhood whereas the incidents were assumed as the respondent's point of location. The third PNEO measure is the intersection density in which this neighbourhood shows an average of 430 nodes per 200 meter buffer within a respondent's location. This is presumed as a high value of intersection density for this neighbourhood when compared to the other neighourhoods. The last PNEO measure is the land use mix value of about 0.43 which is considered a moderate-mixed land use. Figure 5.1 to 5.8 shows the process of obtaining the data for each of these measures.

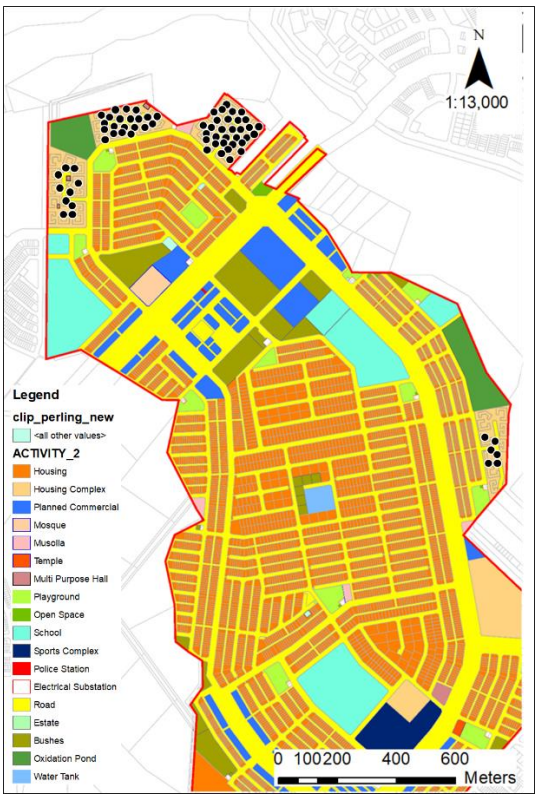


Figure 5.1: Respondent's location in both Taman Perling terrace houses and housing blocks

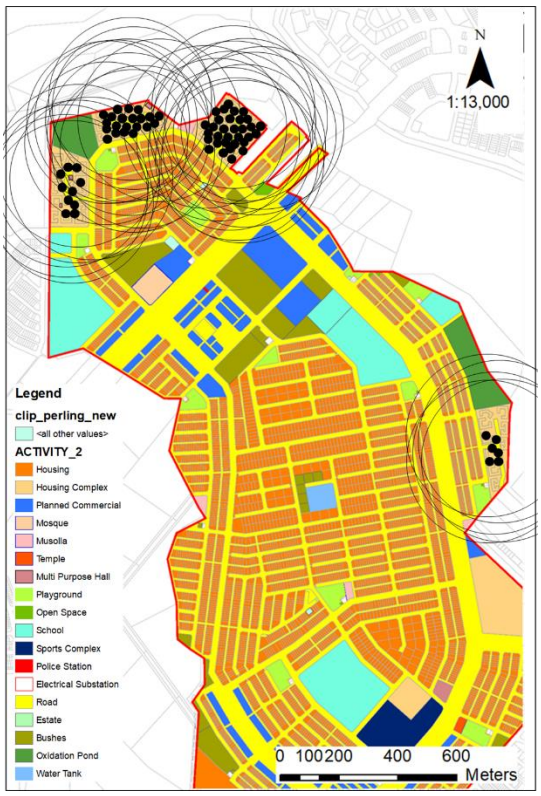


Figure 5.2: A buffer of 200 m were assigned for each respondent

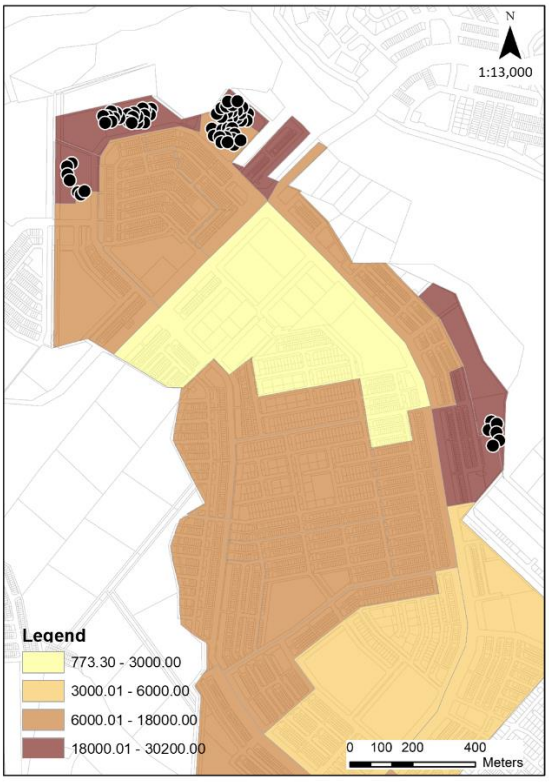


Figure 5.3: Population density based on the administrative districts from the Department of Statistics, Johor

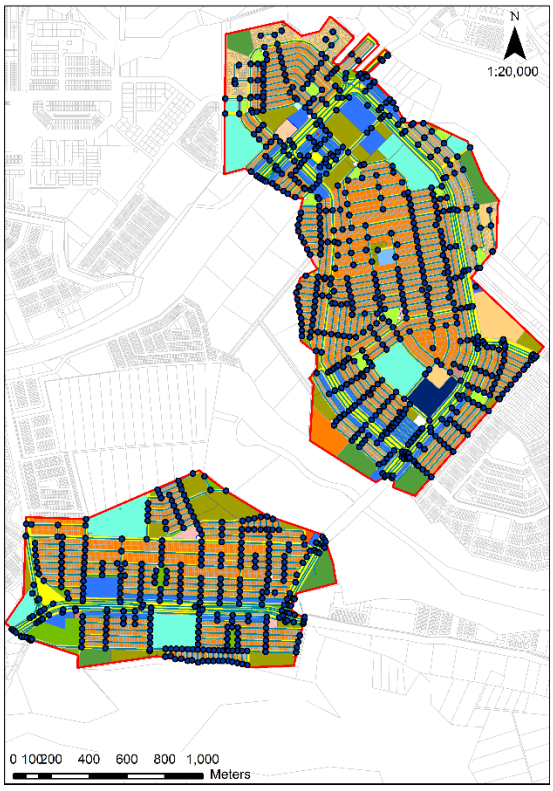


Figure 5.4: Road network and traffic intersection nodes of Taman Perling

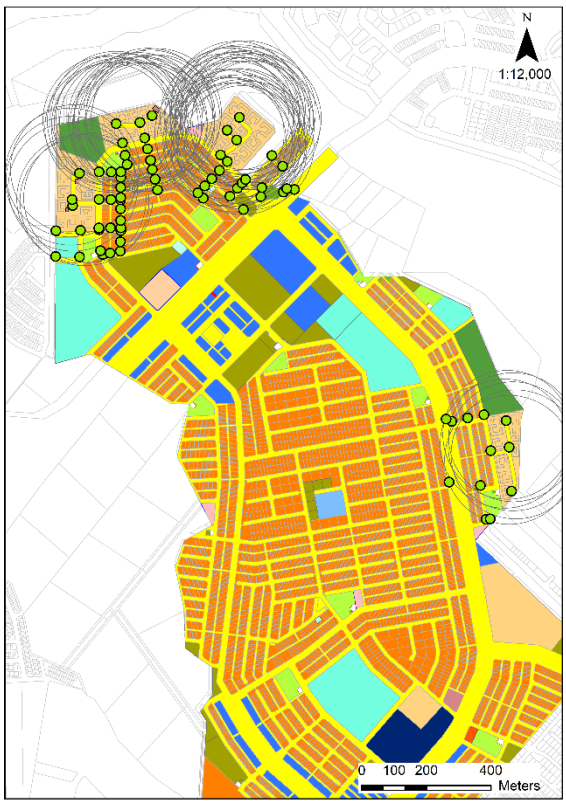


Figure 5.5: Nodes at road intersections were clipped with the respondent's location buffer

Figure 5.6: Each respondent's distance to facility (mosques) were analysed using the network analysis in ArcGIS

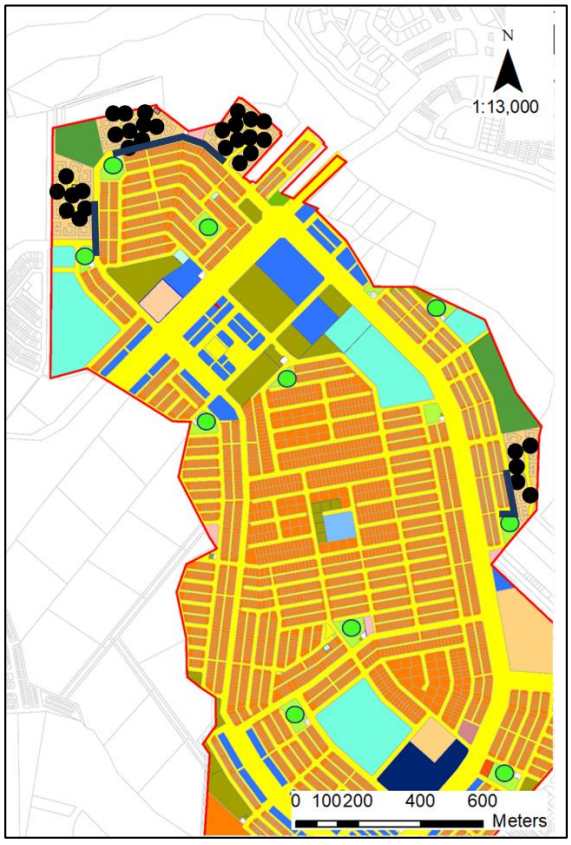


Figure 5.7: Each respondent's distance to facility (playgrounds) were analysed using the network analysis in ArcGIS

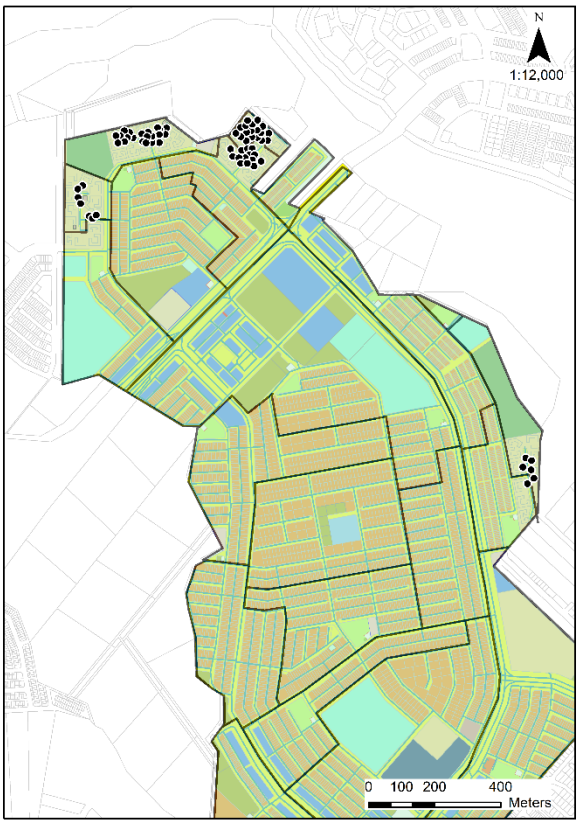


Figure 5.8: Land use mix entropy for each respondent were calculated based on the administrative boundaries of population census

5.2 Descriptive Statistics on Questionnaire Data

This first section in this part will discuss about the outcomes from the questionnaire survey by describing the descriptive statistics specifically for SNEO, SNES, PNES and PA. Part A is the demographic attributes and was explained in the previous chapter. The next section in this part will discuss about the results of the significant relationships for each hypothesis and the discussions.

5.2.1 Part 2: Social Capital Theme (SNEO & SNES)

This part will discuss about the outcomes of social capital theme for both objective (SNEO) and subjective (SNES). Based on the conceptual framework discussed in the earlier chapter, there were five SNEO measures which were consist social network 1 (number of close friends), social network 2 (number of people willing to lend money), social network 3 (frequency of interactions with immediate neighbours), sociability 1 (frequency of joining community activities), sociability 2 (participation in community groups) and lastly sociability 3 (level of decision-making in community groups). Figure 5.9 showed the descriptive statistics for social network 1 measured by the number of close friends among the respondents. A majority of the respondents had more than 14 close friends which was actually a common observation among older people in all the neighbourhoods.

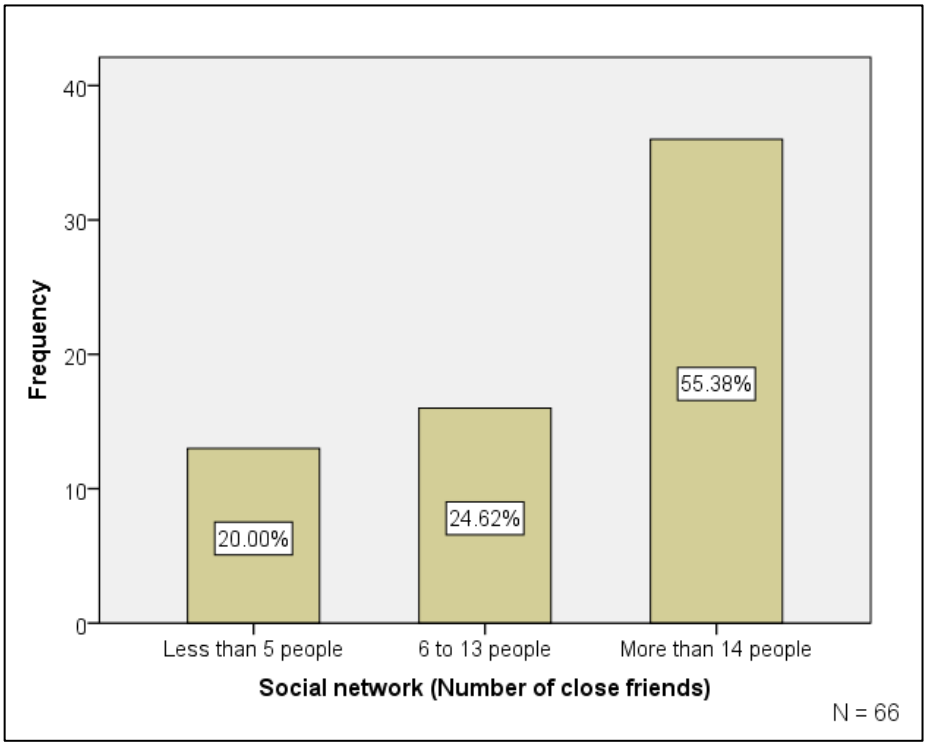


Figure 5.9: SNEO item of social network 1 measuring number of close friends

Figure 5.10 illustrated the second SNEO item which is measuring social network 2 in terms of number of people willing to lend money. Number of people willing to lend money is a measure that defines a closer bonding relationship and stronger trust between community members. It was expected that number of people willing to lend money would be less but respondents in this housing blocks mostly had 2 or more people who they could turn to in case they needed to borrow money. Next, the third measure is frequency of interaction with immediate neighbours, seen in Figure 5.11.

Most of the respondents often have social interaction with their neighbours, whereby the same trend was observed in the other neighbourhoods as well.

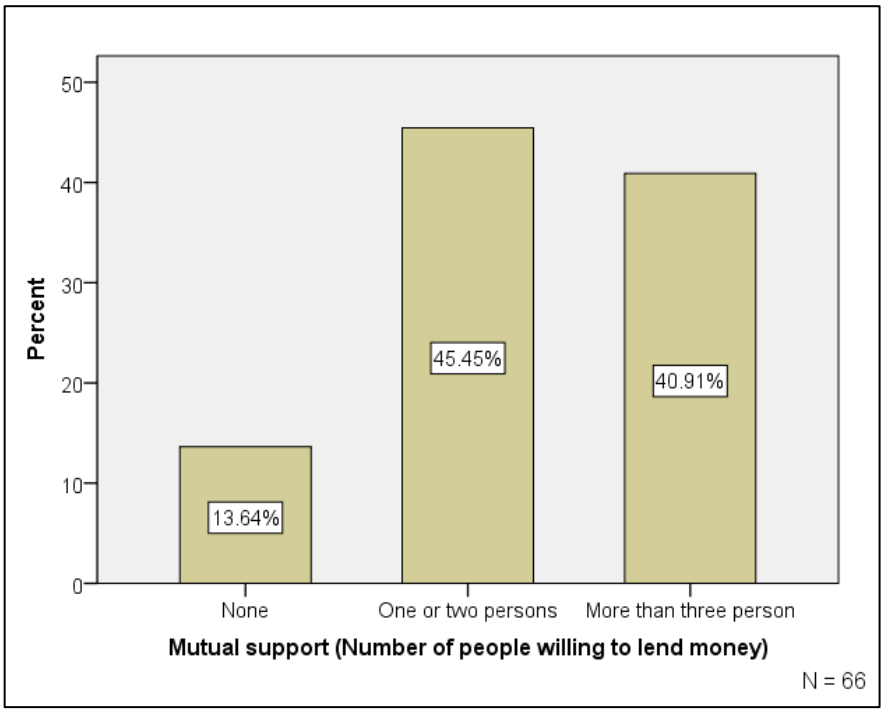


Figure 5.10: SNEO item of social network 2 measuring number of people willing to lend money

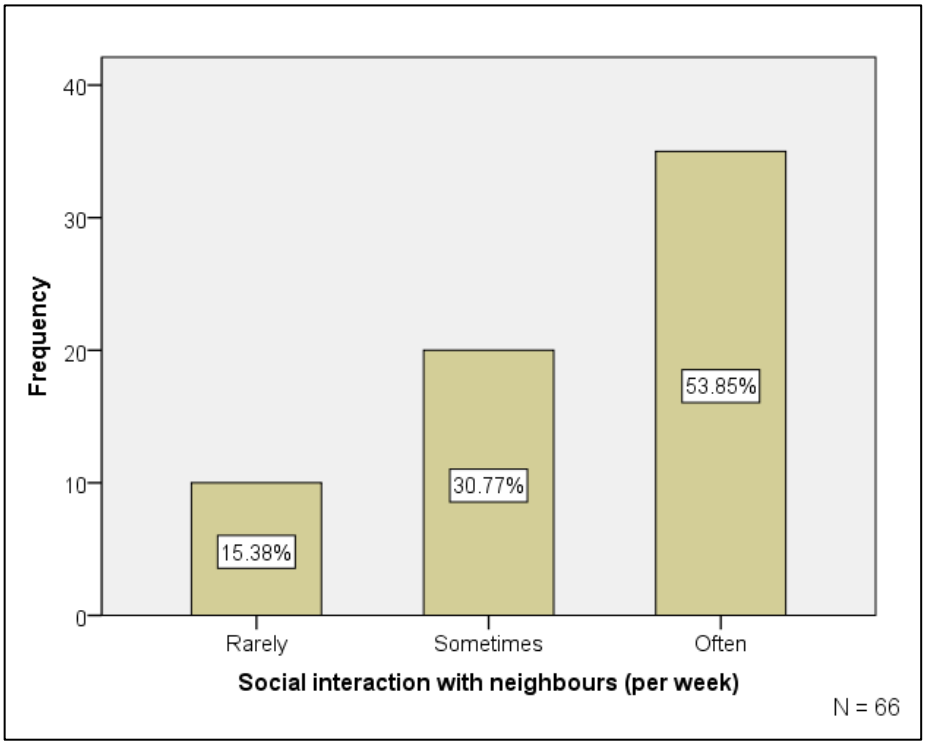


Figure 5.11: SNEO item of social network 3 measuring frequency of social interaction with immediate neighbours

Table 5.2 illustrated the frequency of joining various types of community activities among the respondents in this neighbourhood. As expected, a majority of them mostly participated in religious activities whereby about 70% of the older adults took part in religious activities in the mosque or 'musholla'. For the other activities, most of them never joined or rarely joined in the types of community activities.

Table 5.2: SNEO item of sociability 1 measuring frequency of respondents participating in community activities: 'Gotong – royong'

Sociability 1 items	Frequency of participating in community activities (%)			
Types of community activities	Never	Rarely	Occasionally	Frequently
'Gotong – royong' (cleaning up the neighbourhood together)	48.48	25.76	12.12	13.64
Recreation activities	66.67	22.73	7.58	3.03
Religious activities	19.70	9.09	37.88	33.93
Collaboration programs	72.73	21.21	3.03	3.03

Next, descriptive statistics for SNEO items such as measuring sociability are shown below. Figure 5.12 illustrated the frequency of respondents who participated in community groups in this neighbourhood. A majority of them were among the mosque committee, followed by the neighbourhood association group, about 52% and 37% respectively. Meanwhile, participation in neighbourhood political party (JKP), recreation club, and neighbourhood safety patrol group (SRS) were about 7%, 3% and 2% respectively.

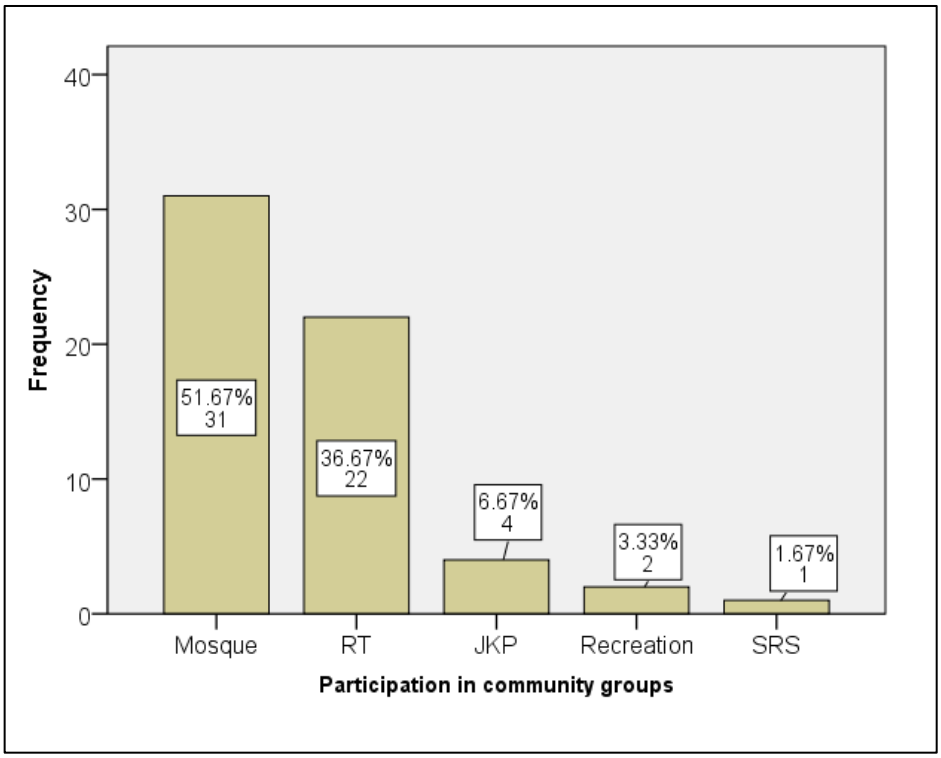


Figure 5.12: Descriptive statistics for participation in community groups (Sociability 2)

Table 5.3 shows the descriptive statistics for the level of decision-making in community groups. Most of the respondents who joined the neighbourhood association and the mosque committee were very active in making decisions in the groups, followed by respondents who were less active. An equal percentage among respondents who joined the recreation club were observed in all levels of decision-making due to the low number of members. It was also observed that recreation club has 2 leaders and this is a common trend where community groups usually has a leader and sub-leader.

Table 5.3: Descriptive statistics of SNEO item for sociability 2 measuring the participation in community groups

Level of decision-making in community groups (Sociability 3)	**Leader (N, %)**	**Very Active (N, %)**	**Less Active (N, %)**	**Does not take part in decision-making (N, %)**
i. 'Rukun Tetangga' / Neighbourhood association	2, 9.10	13, 59.10	6, 27.30	1, 4.50
ii. 'Skim Rondaan Sukarela'/ Neighbourhood patrol group	-	1, 100.0	-	-
iii. 'Jawatankuasa Penduduk / Residence Committee	-	3, 75.0	1, 25.0	-
iv. Members of mosque committee	-	21, 67.70	8, 25.80	2, 6.50
v. Members of recreation club	-	2, 100.0	-	-

For SNES, there are three measures which are generalized trust, collective action and cooperation, and perception towards the community groups in the neighbourhood. Table 5.4 illustrated the descriptive statistics of all the SNES measures. A majority of respondents tend to agree to all items of generalized trust but some tend to disagree for item 'trust strangers strolling in the neighbourhood'. For collective action and cooperation, respondents also tend to agree on the items but tend to disagree with item 'Residents who did not take part in community activities will be criticize' because this item is reverse-coded. For perception towards community groups, the respondents also tend to agree to all items.

Table 5.4: Descriptive statistics of the SNES items

Subjective measures (SNES)	**Strongly Disagree (N, %)**	**Disagree (N, %)**	**Not sure (N, %)**	**Agree (N, %)**	**Strongly Agree (N, %)**
A) Generalized trust					
i. Most people can be trusted	-	3, 4.50	2, 3.00	49, 74.20	12, 18.20
ii. One must be alert or else someone will take advantage	1, 1.50	2, 3.00	2, 3.00	42, 63.60	19, 28.80

iii.	People do not trust each other to lend and borrow money	1, 1.50	13, 19.70	14, 21.20	24, 36.40	14, 21.20
iv.	Trust people from same race	-	-	3, 4.50	48, 72.70	15, 22.70
v.	Trust people from different race	-	1, 1.50	4, 6.10	50, 75.80	11, 16.70
vi.	Trust local shopkeepers	-	1, 1.50	6, 9.10	52, 78.80	7, 10.60
vii.	Trust local authorities representatives	-	-	7, 10.60	46, 69.70	13, 19.70
viii.	Trust neighbourhood patrol group	-	-	13, 19.70	42, 63.60	11, 16.70
ix.	Trust strangers strolling around in the neighbourhood	5, 7.60	21, 31.80	13, 19.70	15, 22.70	12, 18.20
x.	Count on neighbors to report to you if there is suspicious activity around the house	1, 1.50	2, 3.0	6, 9.10	41, 62.10	16, 24.20
xi.	Count on neighbors to watch over your pets by lending your house key	-	5, 7.60	13, 19.70	32, 48.50	16, 24.20
B)	***Collective action and cooperation***					
i.	Community groups will help the poor in the neighbourhood	-	3, 4.50	9, 13.60	52, 78.80	2, 3.0
ii.	Residents who did not take part in community activities will be criticize	9, 13.60	29, 43.90	16, 24.20	9, 13.60	3, 4.50
iii.	Many residents will get together and help solve problems in the neighbourhood	1, 1.50	4, 6.10	15, 22.70	45, 68.20	1, 1.50
C)	***Perception towards community groups***					
i.	Neighbourhood 'Rukun Tetangga' is active	-	-	2, 3.0	56, 84.80	8, 12.10
ii.	Neighbourhood patrol group (SRS) makes you feel safer	4, 6.10	10, 15.20	11, 16.70	36, 54.50	5, 7.60
iii.	Community groups are important to establish	3, 4.50	10, 15.20	5, 7.60	40, 60.60	8, 12.10

	community relations between residents					
iv.	Role of neighbourhood association (RT) leader as connection to higher authority	-	-	3, 4.50	51, 77.30	12, 18.20
v)	Political representatives can help improve neighbourhood	-	1, 1.50	6, 9.10	50, 75.80	9, 13.60

Another measure under collective action and cooperation is illustrated in Figure 5.13 below. Most respondents tend to contribute time instead of money for a community project that can bring benefit to the community, which is more than 80% of the total respondents.

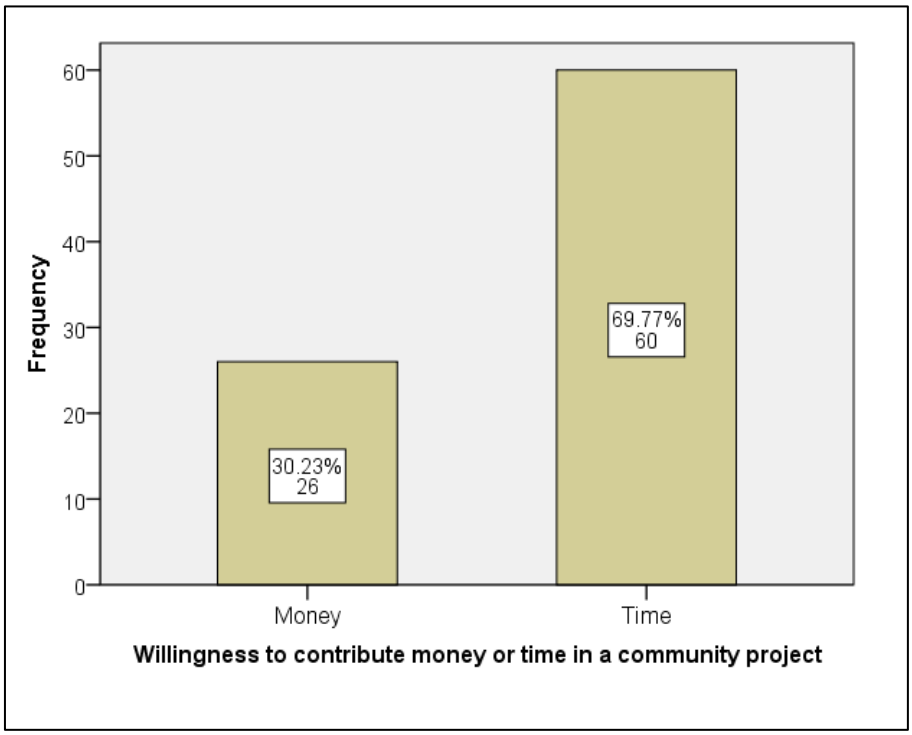


Figure 5.13: Descriptive statistics for willingness to contribute in time or money for a community project (Collective action and cooperation)

5.2.2 Part 3: Physical Activity

Physical activities data were obtained based on the different types of physical activities from the questionnaire survey. Table 5.5 below illustrated the descriptive statistics for the different types of physical activities among respondents in Taman Perling terrace houses. The different types of physical activities were then aggregated based on the MET scores categorization of walking activities, moderate-intensity activities and vigorous intensity activities. Walking to a destination was considered as walking activities. Walking for recreation, doing recreation and sports activities, and doing leisure activities were considered as moderate-vigorous intensity types of PA. Daily activities such as doing part-time jobs was considered as vigorous intensity activities. Specific weightages were assigned to the specific MET categories based on Forde (2005). The outcomes are shown in Table 5.6 below in terms of the new categorization based on MET-minutes per week.

Table 5.5: The descriptive statistics of the types of physical activities performed by the respondents of Taman Perling terrace houses

Types of physical activities	**N, total minutes spent, mean of total minutes spent**
A) Walking to a destination other than walking for recreation (eg: walking to grocery store, mosque, market, bus stop)	56, 1778 mins, 31.75 mins
B) Walking for recreation (including walking your pets, jogging, brisk walking)	29, 809 mins, 27.90 mins
C) Recreation and sports activities (eg: soccer, aerobic, 'tai chi')	26, 1034 mins, 39.77 mins
D) Leisure activities outside your home (eg: gardening, cleaning home exterior, karaoke)	40, 2617 mins, 64.43 mins
E) Daily activities such as part-time jobs (eg: retired person doing self-business)	9, 4838 mins, 537.56 mins

Table 5.6: Descriptive statistics for the categorization of PA level based on MET-minutes per week

Categories of PA level based on MET-minutes per week	**Mean of total minutes spent, S.D. (N= 66)**
C1: Inactive	97.0, 120.89
C2: Minimally active	275.15, 330.2
C3: Health-enhancing PA (HEPA-active)	953.33, 3616.7

5.2.3 Part 4: Physical Neighbourhood Environment Subjective (PNES)

The descriptive data for the 12-items of PNES are shown in Table 5.7 and 5.8 below. Respondents in the housing blocks mostly perceived their housing area having a high percentage of apartments with 4 - 6 floors. This is because the housing blocks are also categorized as apartments with 4 – 6 floors. Since the housing blocks are located just adjacent to terrace houses, a high percentage of respondents chose terrace houses but also half of them did not, in which these respondents were most probably living further inside the housing blocks vicinity. Next, most respondents perceived the land use diversity destinations closed to their housing vicinity. However, clinic, night market and wet market were perceived further within the walking distance. When looking at the land use map, these three destinations tend

to be located in the central commercial area of Taman Perling, whereby the respondents living in the housing blocks need to cross the highway to get to the other side of Taman Perling. This explains the further walking distance to these 3 destinations. Moreover, respondents were mostly not sure with items of perceived neighbourhood accessibility. This shows that the questions might not be applicable to them and were highly likely not within or near the housing blocks.

As expected, most respondents answered perceived street connectivity as not sure since there were not many inner roads in the housing blocks. For perceived infrastructure for walking, most of them tend to disagree with the items. This means that pedestrian facilities might not be present within the housing blocks vicinity. Next, neighbourhood aesthetics were rated as both disagree and not sure by most respondents. A different trend was observed when compared to Taman Perling terrace houses whereby respondents tend to disagree with slow traffic. This means the traffic in the inner road of the housing blocks is highly likely to make them feel unsafe from traffic hazard. At the same time, safety from crime were also rated as unsafe since most respondents tend to disagree being safe in the housing blocks. This is a common trend in most low-cost housing blocks in Malaysia when compared to terrace houses. For the individual measures, respondents tend to disagree that there were lack of parking in commercial areas, disagree to the present of cul-de-sac streets, disagree to the hilliness topography and disagree to the physical barriers in the housing complex.

Table 5.7: The questionnaire outcomes for the descriptive data of PNES items

Subjective measures (PNES)	**None (N, %)**	**A few (N, %)**	**Several (N, %)**	**Mostly (N, %)**	**All (N, %)**
A) Perceived Residential Density					
i. Bungalow	52, 78.80	-	14, 21.20	-	-
ii. Terraced houses	29, 43.90	1, 1.50	15, 22.70	15, 22.70	6, 9.10
iii. Apartment 1 – 3 floors	51, 77.30	-	1, 1.50	14, 21.20	-
iv. Apartment 4 – 6 floors	-	7, 10.60	11, 16.70	28, 42.40	20, 30.30
v. Apartment 7 – 11 floors	55, 83.30	5, 7.60	-	6, 9.10	-
vi. Apartment more than 12 floors	63, 95.50	2, 3.0	-	1, 1.50	-
B) Perceived land use diversity	**1 – 5 mins**	**6 – 10 mins**	**11 – 20 mins**	**21 – 30 mins**	**> 31 mins**
i. Grocery shop	57, 86.40	7, 10.60	1, 1.50	1, 1.50	-
ii. Supermarket	32, 48.50	7, 10.60	11, 16.70	11, 16.70	5, 7.50
iii. Worship place	43, 65.20	21, 31.80	-	-	2, 3.0
iv. Bus stop	39, 59.10	11, 16.70	6, 9.10	7, 10.60	3, 4.50
v. Coffee restaurant	33, 50.0	13, 19.70	12, 18.20	3, 4.50	5, 7.50
vi. Clinic	10, 15.20	3, 4.50	29, 43.90	10, 15.20	14, 21.20
vii. Food stall	22, 33.30	39, 59.10	1, 1.50	1, 1.50	3, 4.50
viii. Park / Playground	23, 34.80	37, 56.10	1, 1.50	-	5, 7.60
ix. Community hall	34, 51.50	10, 15.20	9, 13.60	6, 9.10	7, 10.60

x. Night market	10, 15.20	8, 12.10	28, 42.40	10, 15.20	10, 15.20
xi. Wet market	8, 12.10	24, 36.40	5, 7.60	4, 6.10	25, 37.90
C) ***Perceived neighbourhood accessibility***	**Strongly Disagree (N, %)**	**Disagree (N, %)**	**Not sure (N, %)**	**Agree (N, %)**	**Strongly Agree (N, %)**
i. Stores within walking distance	-	-	57, 86.40	9, 13.60	-
ii. Many places to go within walking distance	-	-	60, 90.90	6, 9.10	-
iii. Walking to bus stop from home is easy	-	20, 30.30	42, 63.60	4, 6.10	-
D) ***Perceived street connectivity***					
i. Distance between intersection is 100 metre or less	-	10, 15.20	44, 66.70	12, 18.20	-
ii. There are many alternative routes	7, 10.60	-	46, 69.70	13, 19.70	-
E) ***Perceived infrastructure for walking***					
i. Present of sidewalks on most of the streets	3, 4.50	26, 39.40	32, 48.50	5, 7.60	-
ii. Sidewalks are separated from the road/traffic in my neighbourhood by parked cars	3, 4.50	12, 18.20	46, 69.70	5, 7.60	-
iii. Present of grass strips that separates the streets from the sidewalks	1, 1.50	21, 31.80	33, 50.0	11, 16.70	-
iv. Present of crosswalks & pedestrian signals to help pedestrian cross the streets	-	14, 21.20	46, 69.70	6, 9.10	-
v. Neighbourhood streets are well lit at night	-	-	57, 86.40	9, 13.60	-
vi. Residents can easily observe pedestrians and bikers on the streets in front of their homes	-	3, 4.50	54, 081.8	9, 13.60	-
F) ***Perceived neighbourhood aesthetics***					
i. Many interesting things to look at while walking	2, 3.0	23, 34.80	32, 48.50	9, 13.60	-
ii. Present of trees along the streets	-	24, 36.40	37, 56.0	5, 7.60	-
iii. Many attractive natural sights/ good landscaping	-	19, 28.80	38, 57.60	9, 13.60	-
iv. Many attractive building/ homes	2, 3.0	8, 12.10	49, 74.20	7, 10.60	-

G)	***Perceived traffic safety***				
i.	Heavy traffic that makes it difficult/ unpleasant to walk in the streets	2, 3.0	3, 4.50	56, 84.80	5, 7.60	-
ii.	Traffic speed on the street near home is slow (25km/h)	2, 3.0	34, 51.50	25, 37.90	5, 7.60	-
iii.	Most drivers exceed the posted speed limits while driving in the streets	2, 3.0	1, 1.50	59, 89.40	4, 6.10	-
H)	***Perceived crime safety***					
i.	High crime rate in the neighbourhood	23, 34.80	38, 57.60	5, 7.60	-	-
ii.	The presence of crime in the neighbourhood makes it unsafe to go for walks during the day	22, 33.30	36, 54.50	8, 12.10	-	-
iii.	The presence of crime in the neighbourhood makes it unsafe to go for walks during the night	16, 24.20	31, 47.0	19, 28.80	-	-
I)	***Perceived lack of parking –*** Parking is difficult in local commercial store	1, 1.50	8, 12.10	48, 72.70	9, 13.60	-
J)	***Perceived lack of cul-de-sac –*** The streets do not have many/ any cul-de-sacs	-	4, 6.10	55, 83.30	7, 10.60	-
K)	***Perceived hilliness –*** Walking is difficult due to hilly streets in the neighbourhood	9, 13.60	35, 53.0	17, 25.8	5, 7.60	-
L)	***Perceived physical barriers –*** Main barriers like stairs, drainage & untrimmed sidewalks limits the num. of walking routes	2, 3.0	9, 13.60	46, 69.70	9, 13.60	-

Table 5.8: The descriptive summary for the 12-PNES items based on the average values and standard deviations.

Subjective measures (PNES)	**Average values (mean, S.D.)**
A) Residential density	280.47, 75.69
B) Diversity of land use mix	2.26, 0.89
C) Accessibility	2.99, 0.33
D) Street connectivity	3.01, 0.64
E) Infrastructure for walking and cycling	2.88, 0.46
F) Aesthetics	2.76, 0.50
G) Safety from traffic hazards*	2.78, 0.50
H) Safety from crime*	1.85, 0.54
I) Lack of parking	2.98, 0.57
J) Lack of cul de sac	3.05, 0.41
K) Hilliness	2.27, 0.80
L) Physical barriers	2.94, 0.63

5.3 Significant Results based on Correlation Tests

5.3.1 Direct relationship for PNEO – PA (H1)

Based on the conceptual framework constructed in the earlier chapter, the hypothesized relationships were analysed using a correlation test. This part will discuss on the direct relationship for PNEO and PA shown in Table 5.9.

Table 5.9: Significant results for PNEO – PA (H1)

PNEO measures => PA	**Significant results correlated with PA levels (C1, C2, C3)**
Population density *High: 7001 – 30,000 people/ sq km *Highest: 30,001 – 150,000 people/ sq km	$\gamma = 0.755$, $p < 0.033$ High, C1+ Highest, C2+
Distance to mosque *Short distance: <200m *Medium: 200.1m – 300m *Long: >300.1m	$\gamma = 0.723$, $p < 0.008$ Short, C1+
Distance to playground *Short distance: <200m *Medium distance: 200.1m – 300m *Long distance: >300.1m	$\gamma = -0.451$, $p < 0.027$ Long, C1+ Medium, C2

Several important relationships with PA were found for PNEO which are population density, distance to mosque and distance to playground. Housing blocks in this neighbourhood usually tend to have higher population density due to the medium rise residential blocks. Interestingly, respondents living in high population density area within the housing blocks tend to show C1. This is mainly because of the inner housing blocks environment in which respondents can sustain their everyday lives without having to go beyond the housing blocks boundaries. Respondents could walk to the nearest grocery stores within the housing blocks area which mostly accommodates the ground floor level of the residential blocks (shown in Figure 5.14). Furthermore, distance to mosque also showed significant relationship with PA. It is shown that respondents who lived in shorter distance of the mosque (less than 200m) tend to be C1. This

is because even though mosque facility are located very near and adjacent to the housing blocks area, there are no direct access from the housing blocks to the mosque. Older adults have to walk outside of the housing blocks boundary in order to go to the mosque, which may reduce their possibility to walk to the mosque due to concerns on traffic and crime safety (shown in Figure 5.15).

On the other hand, distance to playground is negatively associated with PA. People living in longer distance (more than 300m) with playground tend to be C1 whereas people living in medium distance (200m – 300m) to the playground tend to be C2. Since there is no existing open space area inside the housing blocks vicinity, older adults have to use the open space and playground areas outside of the housing blocks. It is understandable that the further the distance of playground facility, the lower the likelihood of older adults to actually walk and spend their time at the open space playground area. From this trend, it is reasonable to assume that the facilities such as playground or mosque should be located not more than 300m in order to encourage older adults to stay active.

Figure 5.14: Example of ground floor lot converted into stalls eatery

Figure 5.15: Pedestrian walkway for people to get to the adjacent mosque which acts as a barrier

5.3.2 Direct relationship for PNES – PA (H2)

There were no significant results for all PNES items when correlated with PA.

5.3.3 Direct relationship for SNEO – PA (H3)

Next, the direct relationship between SNEO and PA which was hypothesized based on the conceptual framework discussed in the earlier chapter showed several significant results. Table 5.10 illustrated that respondents who occasionally and frequently participated in community activities such as 'gotong-royong', recreation activities and collaboration programs organized by the neighbourhood association in this housing area showed at least a medium level of PA (C2). These findings can be assumed as a normal trend which also occurs in various cities in Malaysia (Ministry of Health Malaysia, 2003). Although not specifically proven among older adults, the large-scale study reported that adults aged 15 – 59 years old normally tend to spend their time on recreation, house chores, praying, and joining community activities such as 'gotong-royong' and social gatherings (kenduri). This results adds to the existing knowledge in Malaysia where community activities such as the 'gotong-royong' activities, recreation activities and collaboration programs were proven to show a higher extent of PA among Malaysian older adults.

Table 5.10: Significant results for SNEO – PA (H3)

SNEO measures => PA	**Significant results**
Frequency of joining community activities ('Gotong-royong')	$\gamma = 0.413$, $p < 0.025$ (Occasionally, C2+)
Frequency of joining community activities (Recreation)	$\gamma = 0.513$, $p < 0.020$ (Never, C1+ / Frequently, C2+)
Frequency of joining community activities (Religious)	$\gamma = 0.427$, $p < 0.021$ (Frequently, C1-)
Frequency of joining community activities (Collaboration program with outside groups)	$\gamma = 0.579$, $p < 0.017$ (Never, C1+ / Rarely, C2+)

5.3.4 Indirect relationship for PNEO => PNES – PA (H4)

Correlation tests were not performed for this indirect relationship since PNES – PA (H2) showed no direct significant relationships in the previous section.

5.3.5 Indirect relationship for PNEO => SNEO – PA (H5)

As mentioned previously in the earlier chapter, the indirect relationship that occurs between SNEO and PA which was caused by PNEO were examined by only referring to the significant relationships in H1 (PNEO – PA) and in H3 (SNEO – PA). The significant relationships in H1 were population density, distance to mosque and distance to playground whereas the significant relationships in H3 were frequency of joining community activities such as 'gotong-royong', recreation activities, religious and collaboration programs handled by the neighbourhood association. It was hypothesized that SNEO – PA might show an indirect relationship when cross-tabulated with PNEO items that were significant with PA. The significant correlation tests were performed in SPSS for the PNEO, SNEO and PA levels; illustrated in Table 5.11.

Table 5.11: Significant results for the indirect relationship of

SNEO – PA caused by PNEO (H5)

PNEO items	**SNEO items**	**Significant results correlated with PA level (C1, C2, C3)**
Population density (A) • 7001 – 30,000 people per sq km (moderately high) • 30,001 – 150,000 people per sq km (relatively high)	Frequency of joining community activities: 'Gotong-royong' (B) • Never • Rarely • Occassionally • Frequently	$\gamma = 0.4813$, $p < 0.049$ (Moderately high A, Occassionally B, C2)
	Frequency of joining community activities: Recreation	$\gamma = 0.534$, $p < 0.031$ (Moderately high A, Never B, C1) (Moderately high A, Rarely B, C2)
	Frequency of joining community activities: Collaboration program with outside groups	$\gamma = 0.606$, $p < 0.039$ (Moderately high A, Never B, C1) (Moderately high A, Rarely B, C2)
Distance to mosque (A) • Less than 200 metres (short) • 200.01 – 300 metres (medium) • More than 300 metres (long)	Frequency of joining community activities: Recreation activities (B) • Never • Rarely • Occassionally • Frequently	$\gamma = 0.667$, $p < 0.013$ (Medium A, Never B, C1) (Medium A, Rarely B, C2)
	Frequency of joining community activities: Religious activities (C)	$\gamma = 0.525$, $p < 0.044$ (Medium A, Frequently C, C2)
	Frequency of joining community activities: Collaboration program with outside groups (D)	$\gamma = 0.692$, $p < 0.022$ (Medium A, Never D, C1) (Medium A, Rarely D, C2)
Distance to playground (A) • Less than 200 metres (short) • 200.01 – 300 metres (medium) • More than 300 metres (long)	Frequency of joining community activities: 'Gotong-royong' (B) • Never • Rarely • Occassionally • Frequently	$\gamma = 0.653$, $p < 0.058$ (Medium A, Occassionally B, C2) (Medium A, Frequently B, C2)
	Frequency of joining community activities: Collaboration program with outside groups (B)	$\gamma = 0.874$, $p < 0.029$ (Long A, Never B, C1) (Long A, Rarely B, C2)

Table 5.11 above showed that there were several indirect relationships between SNEO and PA which were caused by PNEO. A general trend can be observed among older adults living in the housing blocks in which respondents living in moderately high population density and showing a moderate level of PA (C2) tend to at least participated in community activities such as 'gotong-royong', recreation activities and collaboration programs organized by their neighbourhood association. This result is in line with the previous neighbourhood of Taman Perling terrace houses whereby respondents showed the same trend caused by the PNEO measure of land use

mix entropy. However, since the population density boundary in this study area lies within the boundary of the housing complex, all of the 4 housing blocks were calculated as only one category of population density level which was moderately high population density. Further assumptions were insufficient to compare the 4 housing blocks since all of the housing blocks exhibits the same population density.

Next, respondents who were living within 200 to 300 metres to the mosque in the housing blocks area tend to show a moderate PA level and at the same time participated rarely in recreation and collaboration programs organized by their neighbourhood association. But an interesting relationship were found where respondents living within a medium distance (200 to 300 metres) to the mosque tend to show C1. As discussed previously in PNEO – PA (H1), respondents living in one of the housing blocks does not have direct access to the mosque even though the housing blocks are adjacent to the mosque which resulted in C1 PA level among the respondents.

But the assumption to this result differs with the fourth housing block in which respondents tend to show C3, even though the mosque are located within the same distance (200 – 300 metres) as the respondents in the first housing blocks. It can be deduced that for respondents' in the fourth housing blocks, the road access to the mosque was considered safe since the fourth housing block was located in the inner local road compared to the first, second and third housing blocks which were located in front of the main road (shown in Figure 5.16).

Moreover, respondents who were living within a medium distance (200 to 300 metres) to the playground areas tend to frequently join 'gotong-royong' activities and showed at least a moderate level of PA (C2). This is logical since 'gotong-royong' activities which means cleaning some parts of the neighbourhood together with other residents usually took place in the playground areas to avoid unnecessary litter and prevent the occurrence of dengue cases. Furthermore, a minor significant trend were observed among respondents living within a longer distance to the playground area (more than 300 metres). The respondents participated in collaboration programs rarely at least several times a year and still showed a moderate level of PA (C2) whereas respondents who never participated in community activities tend to show C1.

Figure 5.16: Types of existing road and its designated speed which might influence the significant relationship

5.3.6 Indirect relationship for PNEO => SNES – PA (H6)

Referring back to the conceptual framework in the earlier chapter, SNES items were hypothesized to be caused by PNEO, and show an indirect relationship with PA level. Several indirect significant relationships were shown when SNES items and PA level were cross-tabulated with PNEO items, as shown in Table 5.12 below. Respondents living within a medium distance from both mosque and playgrounds (200 to 300 metres) displayed high collective action and cooperation, but low PA level (C1).

Table 5.12: Significant results for the indirect relationship of

SNES – PA caused by PNEO (H6)

PNEO items	**SNES items**	**Significant results correlated with PA level (C1, C2, C3)**
Distance to mosque (A) • Less than 200 metres (short) • 200.01 – 300 metres (medium) • More than 300 metres (long)	Collective action and cooperation (B)	$\gamma = -0.587$, $p < 0.025$ (Medium A, High B, C1)
Distance to playground (A) • Less than 200 metres (short) • 200.01 – 300 metres (medium) • More than 300 metres (long)	Collective action and cooperation (B)	$\gamma = -0.709$, $p < 0.009$ (Medium A, High B, C1)

5.3.7 Direct relationship for SES => PA

Chi-square tests are implied to the measures of gender, occupation, family structure and race due to the nature of the variables which is categorical variable whereas Spearman's rank correlation tests were implied to the measures of age and period of stay since the categories for these variables were originally scale variables. The correlation tests showed that there were no significant relationships for these variables. However, there was a significant relationship for period of stay and PA whereby a positive Spearman's rank means physical activity among older adults were higher based on longer period of stay in the housing blocks, shown in Table 5.13 below.

Table 5.13: Significant results for the direct relationship of SES – PA (H7)

SES measures => PA	**Significant results**
Period of stay (years) 1= Less than 5; 2= 6 – 10; 3= More than 11	$r = 0.314$, $N = 66$, $p < 0.01$

5.4 Summary of Chapter

- A general trend based on the significant relationships discussed previously can be observed for this neighbourhood which were pointed out below:
- All four housing blocks exhibited only one level of population density, which was a moderately high-population density. This is because the population density boundary was the same as the population census boundary.
- Respondents living in densely populated housing blocks tended to be less active due to the internal environment of their housing blocks, especially those with grocery stores and food stalls on the ground floor of housing blocks. (H1)
- The first, second and third housing blocks did not have direct access to the mosque facility, even if they were located adjacent to the mosque. This can reduce the possibility of walking to the mosque for older adults, as they need to go outside the boundaries of housing blocks. (H1)
- There was no existing open space area inside the housing blocks No. 1, 2 and 3. So, the farther the playground facility from the housing blocks boundaries, the less likely for older adults to go to the playground. (H1)
- Only housing block No. 4 had a futsal court recreational space inside its boundaries, but it was not suitable for use by the elderly. (H1)
- Community activities such as 'gotong-royong' activities, recreational activities and collaboration programmes were proven to have a greater degree of PA among the elderly in Malaysia. (H3)
- Elderly people with a high population had moderate PAs (C2) and tended to participate in community activities such as 'gotong-royong', recreational activities and collaboration programmes organised by neighbourhood associations. This result parallels the findings of the Taman Perling terraced houses caused by the PNEO measure of mixed land-use entropy. (H5)
- Respondents in the fourth housing block tended to show C3, as access to the internal local mosque was considered safer compared to the first, second and third housing blocks. (H5)

6 CASE STUDY ON TAMAN NUSANTARA

6.1 Analysis on Spatial Data using ArcGIS

This section will discuss on the descriptive statistics of the physical neighbourhood environment objective (PNEO) and the steps of analysis performed in ArcGIS for each of the five PNEO measures. Table 6.1 shows the summary for the five PNEO measures in mean values. It is illustrated that Taman Nusantara has a population density of about 5157.21 sq km, which shows a slightly high population density when referring to the population density scale for Johor Bahru (Bell, 2017).

Table 6.1: Summary of PNEO measures based on average values.

Objective measures (PNEO)	**Average values (mean)**
A) Population density (population / sqkm)	5157.21
B) Distance to facilities (metre) - Recreational open space - Mosque	 329.89 803.28
C) Intersection Density (No. of real nodes/area)	151.77
D) Land Use Mix value (highest is 1)	0.74

The second PNEO measure is distance to facilities, in which respondents live within an average of 330 metres from the recreational open space and about 800 metres from the mosque, shown in Table 6.1 above. Compared to the other neighbourhoods, the respondents in Taman Nusantara were not located within walking distance to both recreational open space and mosque facility due to the form of this neighbourhood's layout. The distance of respondent's locations were calculated using the network analysis specifically the closest facility analysis. Road networks were created in order to facilitate the analysis. The facilities were assumed as the recreational open spaces and mosques in this neighbourhood whereas the incidents were assumed as the respondent's point of location. The third PNEO measure is the intersection density in which Taman Nusantara showed an average of 150 nodes per 200 meter buffer within a respondent's location. This is presumed as a low value of intersection density for this neighbourhood when compared to the other neighbourhoods. The last PNEO measure is the land use mix value of about 0.74 which is considered a high-mixed land use. Figures 6.1 to 6.8 shows the process of obtaining the data for each of these measures.

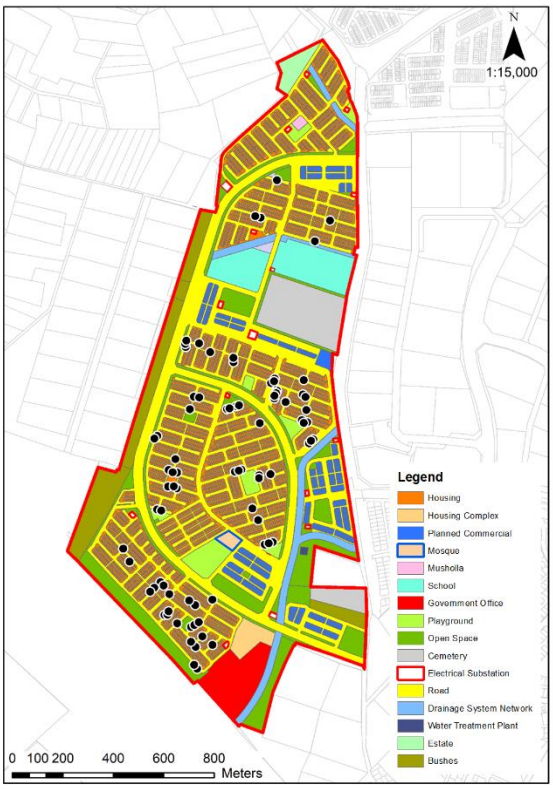


Figure 6.1: Respondent's location in Taman Nusantara

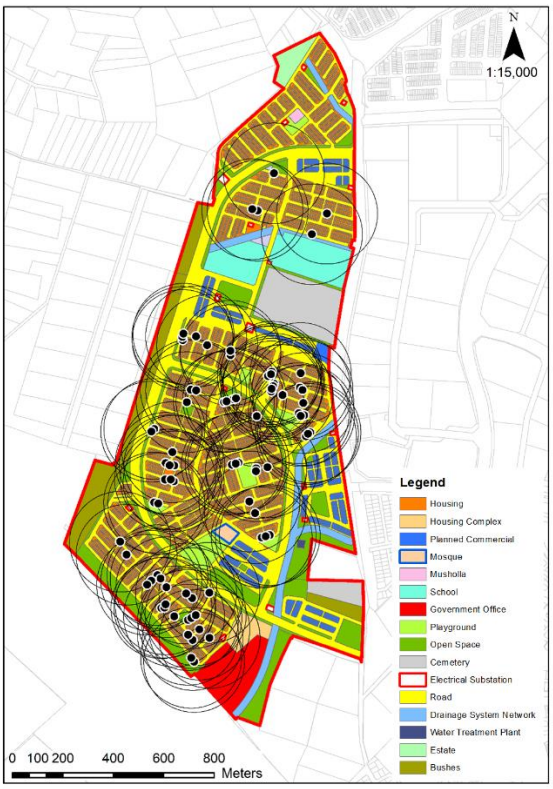


Figure 6.2: A buffer of 200 m were assigned for each respondent

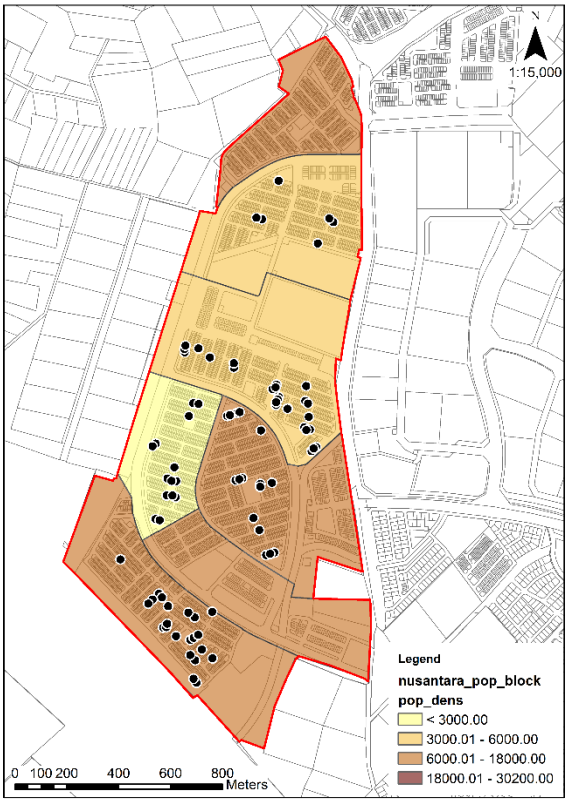


Figure 6.3: Population density based on the administrative districts from the Department of Statistics, Johor

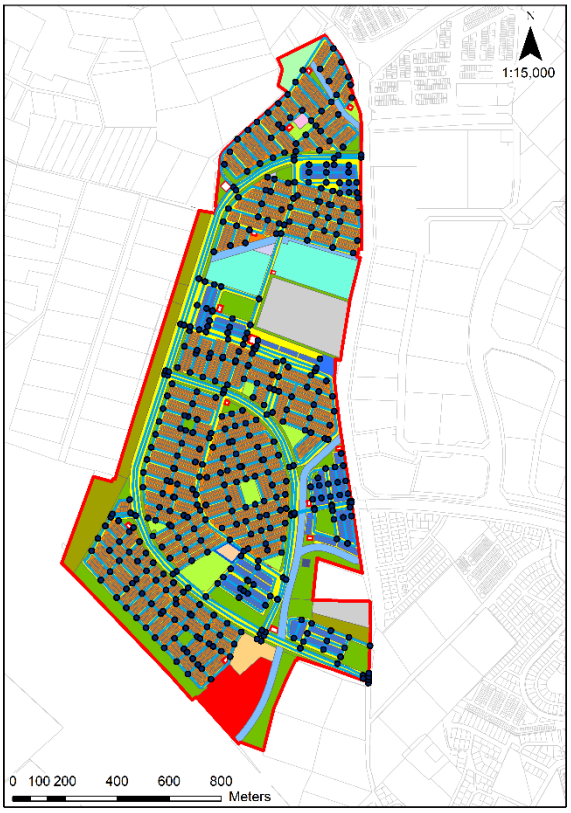


Figure 6.4: Road network and traffic intersection nodes of Taman Nusantara

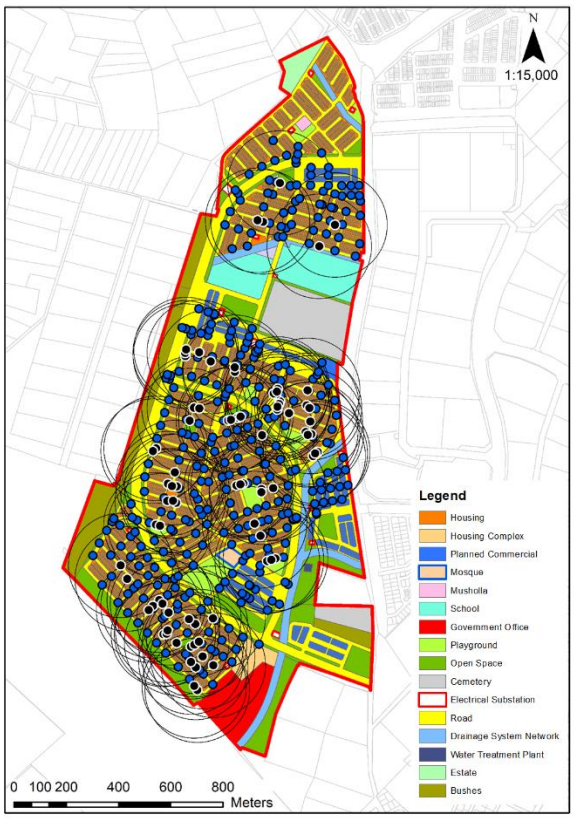


Figure 6.5: Nodes at road intersections were clipped with the respondent's location buffer

Figure 6.6: Each respondent's distance to facility (mosques) were analysed using the network analysis in ArcGIS

Figure 6.7: Each respondent's distance to facility (playgrounds) were analysed using the network analysis in ArcGIS

Figure 6.8: Land use mix entropy for each respondent were calculated based on the administrative boundaries of population census

6.2 Descriptive Statistics on Questionnaire Data

This section will discuss on the descriptive statistics of the combined questionnaire obtained from the survey. It consist of three parts which are the social capital theme, the physical activity theme and the subjective physical neighbourhood environment (PNES) for Taman Nusantara.

6.2.1 Part 2: Social Capital Theme (SNEO & SNES)

This part will discuss about the outcomes of social capital theme for both objective (SNEO) and subjective (SNES). Based on the conceptual framework discussed in the earlier chapter, there were six SNEO measures which were consist social network 1 (number of close friends), social network 2 (number of people willing to lend money), social network 3 (frequency of interactions with immediate neighbours), sociability 1 (frequency of joining community activities), sociability 2 (participation in community groups) and lastly sociability 3 (level of decision-making in community groups). Figure 6.9 showed the descriptive statistics for social network 1 measured by the number of close friends among the respondents. Unlike the other two previous neighbourhoods, a majority of the respondents tend to have less than 5 people as their close friends which was about 56% from the number of respondents who participated in the survey.

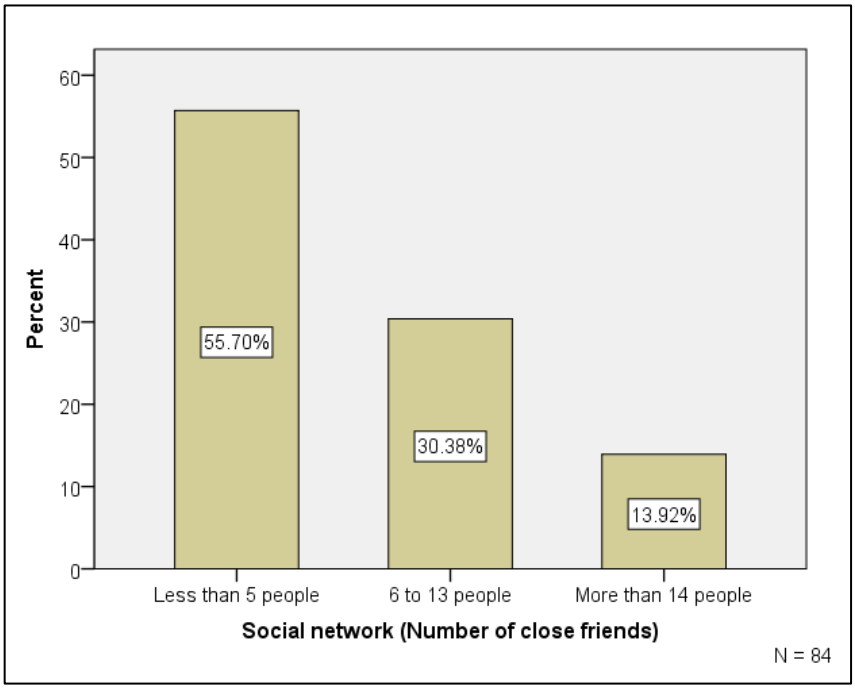


Figure 6.9: Social network defined by the number of close friends among respondents in Taman Nusantara

Figure 6.10 illustrated social network 2 in terms of number of people willing to lend money. Number of people willing to lend money is a measure that defines a closer bonding relationship and stronger trust between community members. It was expected that the number of people willing to lend money would be lesser than the number of close friends. About half of the respondents in Taman Nusantara have nobody to rely to in case they need to borrow or lend money to someone, which was a different trend than in Taman Perling terrace and housing blocks. Next, the third measure is frequency of interaction with immediate neighbours, seen in Figure 6.11. Most of the respondents often have social interaction with their neighbours, whereby the same trend was observed in the other neighbourhoods as well.

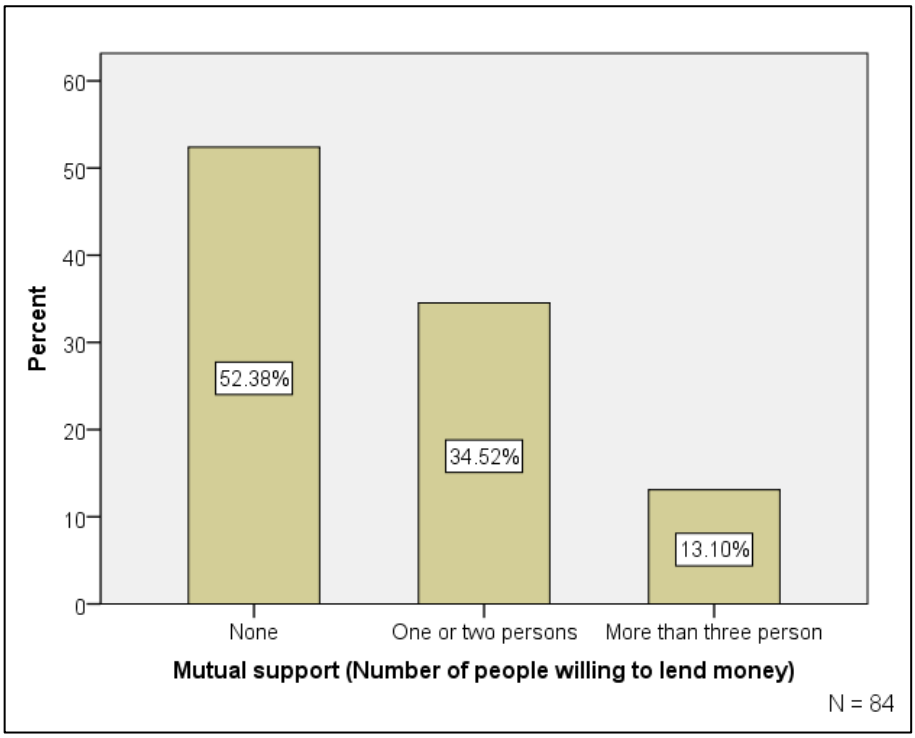


Figure 6.10: Mutual support defined by the number of people willing to lend money in Taman Nusantara

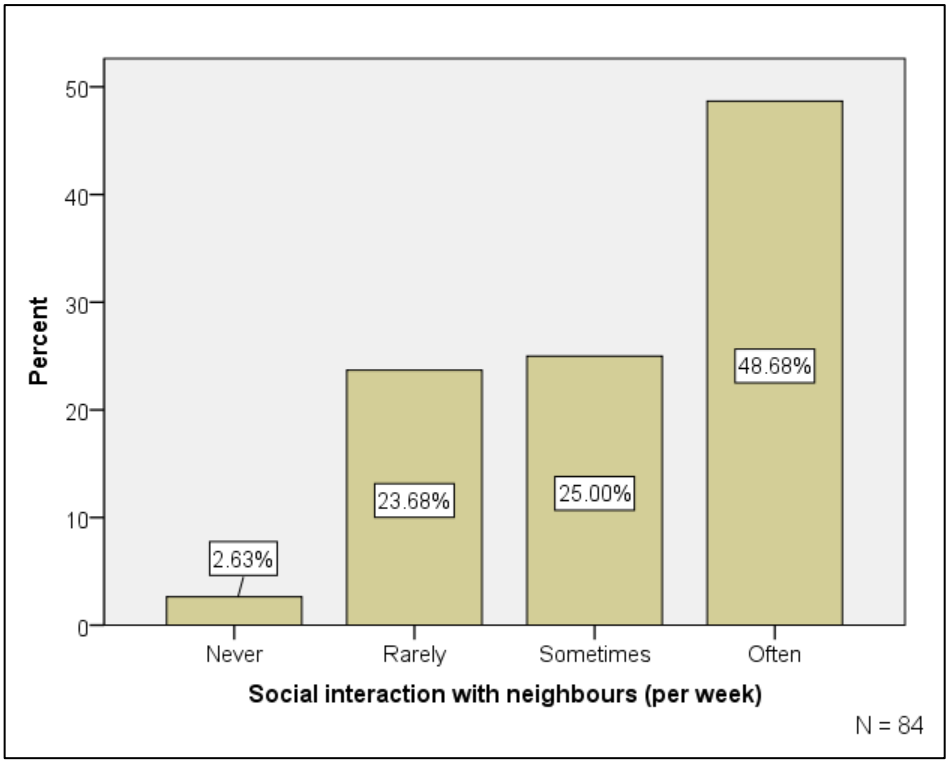


Figure 6.11: Descriptive statistics for social network 3 measuring social interaction with immediate neighbours in a week

Table 6.2 illustrated the frequency of joining various types of community activities among the respondents in this neighbourhood. Unlike the previous neighbourhoods, a majority of them never participated in any types of community activities. Roughly about 20% to 50% respondents has participated in 'gotong-royong' activities, recreation activities and collaboration programs.

Table 6.2: Descriptive statistics of Sociability 1 measuring types of community activities

Sociability 1 items	Frequency of participating in community activities (%)			
Types of community activities	Never	Rarely	Occasionally	Frequently
'Gotong – royong' (cleaning up the neighbourhood together)	42.86	34.52	22.62	-
Recreation activities	63.10	21.43	13.10	2.38
Religious activities	60.71	4.76	28.57	5.95
Collaboration programs	75.00	23.81	1.19	-

Next, descriptive statistics for SNEO items such as measuring sociability are shown below. Figure 6.12 illustrated the frequency of respondents who participated in community groups in this neighbourhood. A majority of them were among the mosque committee followed by the JKP, RT and SRS, which makes up about 40%, 29%, 14% and 13% respectively. Recreation club has the least members among the respondents, only about 3%.

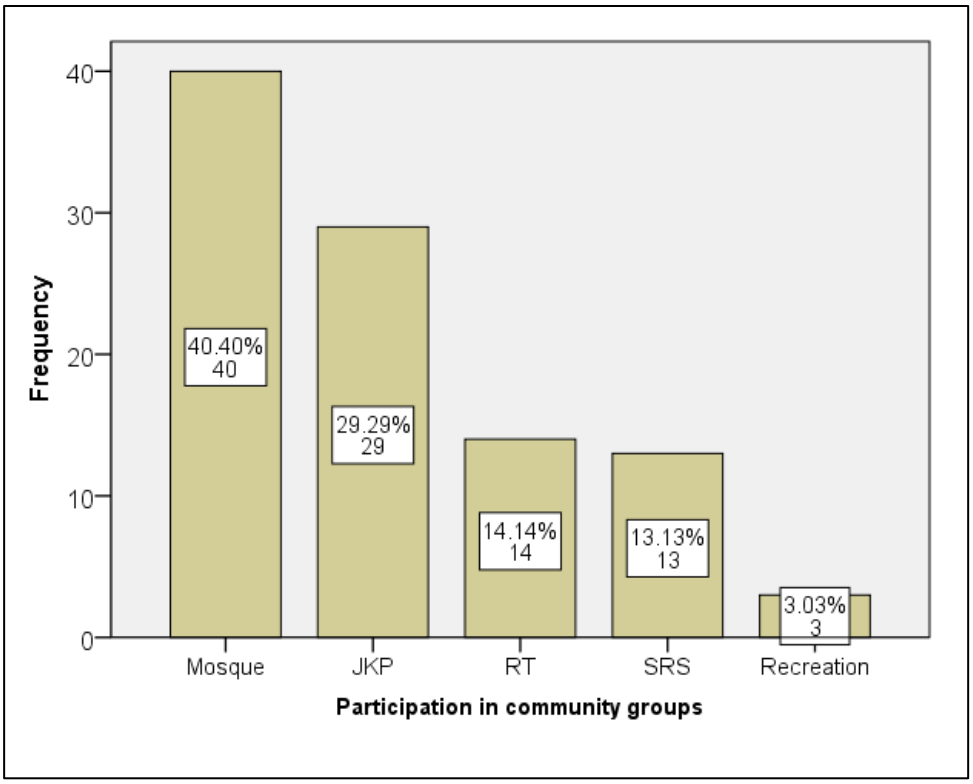


Figure 6.12: Descriptive statistics for participation in community groups (Sociability 2)

Table 6.3 shows the descriptive statistics for the level of decision-making in community groups. Most of the respondents who joined the neighbourhood association and SRS were less active in making decisions in the groups, followed by respondents who does not take part in any decision-making. For JKP and mosque committee, an equal percentage among respondents were very active in making decisions in the groups. It was also observed that members of the recreation club does not take part in the group's decision-making.

Table 6.3: Descriptive statistics of level of decision-making in community groups (Sociability 3)

Level of decision-making in community groups (Sociability 3)	Leader (N, %)	Very Active (N, %)	Less Active (N, %)	Does not take part in decision-making (N, %)
i. 'Rukun Tetangga' / Neighbourhood association	-	3, 20.00	9, 60.00	3, 20.00
ii. 'Skim Rondaan Sukarela' (Neighbourhood patrol)	-	2, 15.40	7, 53.80	4, 30.80
iii. 'Jawatankuasa Penduduk' (Residence social committee)	-	13, 44.80	8, 27.60	8, 27.60
iv. Members of mosque committee	-	18, 46.20	17, 43.60	4, 10.30
v. Members of recreation club	-	-	-	3, 100.0

For SNES, there are three measures which are generalized trust, collective action and cooperation, and perception towards the community groups in the neighbourhood. Table 6.4 illustrated the descriptive statistics of all the SNES measures. A majority of respondents tend to agree to all items of generalized trust but some tend to disagree for item 'trust strangers strolling in the neighbourhood'. For collective action and cooperation, respondents also tend to agree on the items but tend to disagree with item 'Residents who did not take part in community activities will be criticize' because this item is reverse-coded. For perception towards community groups, the respondents also tend to agree to all items.

Table 6.4: Descriptive statistics of the SNES items

Subjective measures (SNES)	Strongly Disagree (N, %)	Disagree (N, %)	Not sure (N, %)	Agree (N, %)	Strongly Agree (N, %)
A) Generalized trust					
i. Most people can be trusted	1, 1.20	1, 1.20	23, 27.40	47, 56.0	12, 14.30
ii. One must be alert or else someone will take advantage	10, 11.90	7, 8.30	19, 22.60	26, 31.0	22, 26.20
iii. People do not trust each other to lend and borrow money	13, 15.50	23, 27.40	34, 40.50	10, 11.90	4, 4.80
iv. Trust people from same race	5, 6.0	8, 9.50	21, 25.0	46, 54.80	4, 4.80
v. Trust people from different race	7, 8.30	11, 13.10	22, 26.20	38, 45.20	6, 7.10
vi. Trust local shopkeepers	7, 8.3	8, 9.50	22, 26.20	42, 50.0	5, 6.0
vii. Trust local authorities representatives	1, 1.2	5, 6.0	20, 23.80	52, 61.90	6, 7.10
viii. Trust neighbourhood patrol group	2, 2.40	2, 2.40	18, 21.40	52, 61.90	10, 11.90

ix. Trust strangers strolling around in the neighbourhood	42, 50.0	15, 17.90	6, 7.10	13, 15.50	8, 9.50
x. Count on neighbors to report to you if there is suspicious activity around the house xi.	7, 8.30	5, 6.0	11, 13.10	28, 33.30	33, 39.30
xii. Count on neighbors to watch over your house while you are away by lending your house key	39, 46.40	17, 20.20	18, 21.40	4, 4.80	6, 7.10
B) Collective action and cooperation					
i. Community groups will help the poor in the neighbourhood	3, 3.60	7, 8.30	28, 33.30	33, 39.30	13, 15.50
ii. Residents who did not take part in community activities will be criticize	15, 17.90	34, 40.50	27, 32.10	8, 9.50	-
iii. Many residents will get together and help solve problems in the neighbourhood	4, 4.80	8, 9.50	25, 29.80	44, 52.40	3, 3.60
C) Perception towards community groups					
i. Neighbourhood 'Rukun Tetangga' is active ii.	-	9, 10.70	15, 17.90	38, 45.20	22, 26.20
iii. Neighbourhood patrol group (SRS) makes you feel safer	-	-	10, 11.90	56, 66.70	18, 21.40
iv. Community groups are important to establish community relations between residents	1, 1.20	7, 8.30	22, 26.20	40, 47.60	14, 16.70
v. Role of neighbourhood association (RT) leader as connection to higher authority	1, 1.20	6, 7.10	22, 26.20	33, 39.30	22, 26.20
vi. Political reps can help improve neighbourhood	-	6, 7.10	16, 19.0	59, 70.20	3, 3.60

Another measure under collective action and cooperation is illustrated in Figure 6.13 next page. Most respondents tend to contribute time instead of money for a community project that can bring benefit to the community.

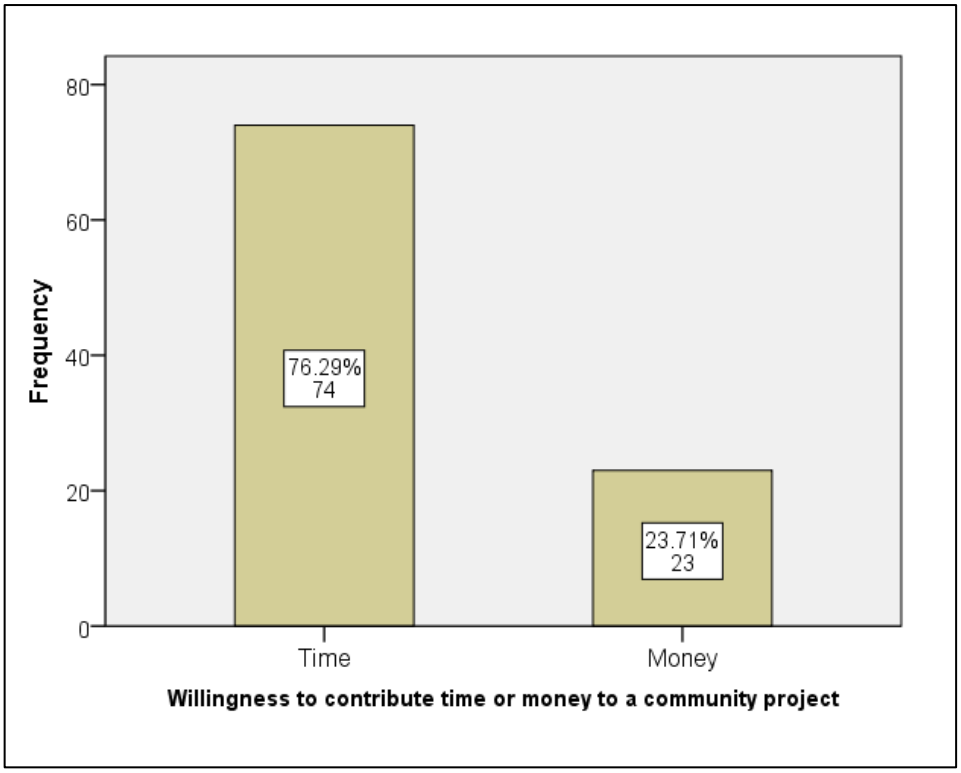


Figure 6.13: Descriptive statistics for willingness to contribute in time or money for a community project (Collective action and cooperation)

6.2.2 Part 3: Physical Activity (PA)

A majority of respondents in Taman Nusantara performed leisure activities with an average time of 170 minutes per week followed by walking for purpose to various destinations. Table 6.5 below illustrated the descriptive statistics for the different types of physical activities among respondents in Taman Nusantara. The different types of physical activities were then aggregated based on the MET scores categorization of walking activities, moderate-intensity activities and vigorous intensity activities. Walking to a destination was considered as walking activities. Walking for recreation, doing recreation and sports activities, and doing leisure activities were considered as moderate-vigorous intensity types of PA. Daily activities such as doing part-time jobs was considered as vigorous intensity activities. Specific weightages were assigned to the specific MET categories based on Forde (2005). The outcomes are shown in Table 6.6 below in terms of the new categorization based on MET-minutes per week.

Table 6.5: The descriptive statistics of the types of physical activities performed by the respondents of Taman Nusantara terrace houses

Types of physical activities	**N, total minutes spent, mean of total minutes spent**
A. Walking to a destination other than walking for recreation (eg: walking to grocery store, mosque, market, bus stop)	63, 7240 mins, 114.92 mins
B. Walking for recreation (including walking your pets, jogging, brisk walking)	54, 3815 mins, 70.65 mins
C. Recreation and sports activities (eg: soccer, aerobic, ‘tai chi’)	40, 2785 mins, 69.63 mins

D. Leisure activities outside your home (eg: gardening, cleaning home exterior, karaoke)	49, 8540 mins, 170.8 mins
E. Daily activities such as part-time jobs (eg: retired person doing self-business)	6, 410 mins, 68.33 mins

Table 6.6: Descriptive statistics for the categorization of PA level based on MET-minutes per week

Categories of PA level based on MET-minutes per week	**Mean of total minutes spent, S.D. (N= 84)**
C1: Inactive	282.66, 295.55
C2: Minimally active	502.62, 745.32
C3: Health-enhancing PA (HEPA-active)	675.24, 1442.05

6.2.3 Part 4: Physical Neighbourhood Environment Subjective (PNES)

The descriptive statistics for the PNES items are shown in Table 6.7 below. Almost all of the respondents in Taman Nusantara perceived their housing area having all terraced houses which seems to be correct even though there were some housing blocks in another part of the neighbourhood. They might not perceived the housing blocks within their vicinity since there were boundaries separating the housing blocks from the rest of the neighbourhood area. Next, respondents perceived most destinations within their housing vicinity within walking distance such as grocery shop, worship place, coffee restaurant, food stall, and park / playground. Only the supermarket, clinic, community hall, night market, and wet market were located further away. Most respondent tend to agree with the items of perceived neighbourhood accessibility, but disagree to the convenience of walking to a bus stop.

For perceived street connectivity, most of them tend to disagree with their house streets having shorter distance between intersections as well as having many alternative routes. But another half of the respondents perceived their housing area as having many alternative routes. Present of sidewalks on most of the streets under perceived infrastructure for walking showed the same trend, half of the respondents tend to agree as well as disagree. These respondents might be located in two different areas in the neighbourhood. Furthermore, respondents tend to disagree for all the other items under perceived infrastructure for walking. Although observation prior to the questionnaire survey showed that Taman Nusantara have pedestrian sidewalk facility with enhance safety railings, the respondents still tend to disagree to this in which they highly likely might not use the pedestrian sidewalks located mostly beside the main road of this neighbourhood, and was meant to perceive only the areas within their housing vicinity.

Perceived neighbourhood aesthetics items further showed that there were not sufficient extent in terms of aesthetics in this neighbourhood since most of them tend to disagree to most items but agree to only the present of trees besides the road. Moreover, mixed answers were observed among respondents where half of them tend to agree as well as disagree to the three items of safety from traffic. Some respondents might be living in inner parts of the neighbourhood where the inner streets were safe from fast-moving vehicles while others might be living in locations nearer to the main road and main entrance of each residential districts in the neighbourhood. Furthermore, respondents showed a good extent of perceived safety from crime which means crime was not a huge issue in this neighbourhood.

For the individual measures, respondents tend to disagree that there were lack of parking in commercial areas, disagree to hilliness and disagree to physical barriers in their neighbourhood which means the neighbourhood vicinity are consist of flat areas, and physical barriers were not a

main problem for them. However, an interesting perception among respondents were observed for lack of cul-de-sac in which the respondents tend to agree with. Prior to the observations made in Taman Nusantara, most of the streets in this neighbourhood were consist of cul-de-sac streets with pedestrian walkways connecting to the other areas. This illustrated that the respondents might perceived a cul-de-sac street as a truly dead-end street with no pedestrian access.

Table 6.7: Descriptive statistics of PNES items

Subjective measures (PNES)	**None (N, %)**	**A few (N, %)**	**Several (N, %)**	**Mostly (N, %)**	**All (N, %)**
A) Perceived Residential Density					
i. Bungalow	-	-	-	-	-
ii. Terraced houses	-	-	-	1, 1.2	83, 98.80
iii. Apartment 1 – 3 floors	-	-	-	-	-
iv. Apartment 4 – 6 floors	-	-	-	-	-
v. Apartment 7 – 11 floors	-	-	-	-	-
vi. Apartment more than 12 floors	-	-	-	-	-
B) Perceived land use diversity	**1 – 5 mins**	**6 – 10 mins**	**11 – 20 mins**	**21 – 30 mins**	**> 31 mins**
i. Grocery shop	24, 28.60	38, 45.20	11, 13.1	-	11, 13.10
ii. Supermarket	3, 3.60	24, 28.60	15, 17.90	17, 20.20	25, 29.80
iii. Worship place	41, 48.80	22, 26.20	10, 11.90	-	11, 13.10
iv. Bus stop	5, 6.0	19, 22.60	18, 21.40	4, 4.80	38, 45.20
v. Coffee restaurant	31, 36.90	37, 44.0	5, 6.0	-	11, 13.10
vi. Clinic	11, 13.10	27, 32.10	30, 35.7	-	16, 19.0
vii. Food stall	36, 42.90	29, 34.50	5, 6.0	-	14, 16.70
viii. Park / Playground	43, 51.20	24, 28.60	1, 1.20	-	16, 19.0
ix. Community hall	7, 8.30	28, 33.30	7, 8.30	1, 1.20	41, 48.80
x. Night market	9, 10.70	34, 40.50	9, 10.70	4, 4.80	28, 33.30
xi. Wet market	1, 1.20	17, 20.20	22, 26.20	9, 10.70	35, 41.70
C) Perceived neighbourhood accessibility	**Strongly Disagree (N, %)**	**Disagree (N, %)**	**Agree (N, %)**	**Strongly Agree (N, %)**	**-**
i. Stores within walking distance	5, 6.0	22, 26.20	32, 38.10	25, 29.80	-
ii. Many places to go within walking distance	4, 4.80	23, 27.40	51, 60.70	6, 7.10	-
iii. Walking to bus stop from home is easy	38, 45.20	24, 28.60	21, 25.0	1, 1.20	-
D) Perceived street connectivity					
i. Distance between intersection is 100 metre or less	21, 25.0	25, 29.80	25, 29.80	13, 15.50	-
ii. There are many alternative routes	38, 45.20	7, 8.30	29, 34.50	10, 11.90	-
E) Perceived infrastructure for walking					
i. Present of sidewalks on most of the streets	31, 36.90	16, 19.0	34, 40.50	3, 3.60	-

ii. Sidewalks are separated from the road/traffic in my neighbourhood by parked cars	30, 35.70	21, 25.0	33, 39.30	-	-
iii. Present of grass strips that separates the streets from the sidewalks	22, 26.20	43, 51.20	18, 21.40	1, 1.20	-
iv. Present of crosswalks & pedestrian signals to help pedestrian cross the streets	27, 32.10	31, 36.90	26, 31.0	-	-
v. Neighbourhood streets are well lit at night	2, 2.40	10, 11.90	47, 56.0	25, 29.80	-
vi. Residents can easily observe pedestrians and bikers on the streets in front of their homes	6, 7.10	13, 15.50	49, 58.30	16, 19.0	-
F) ***Perceived neighbourhood aesthetics***					
i. Many interesting things to look at while walking	19, 22.60	40, 47.60	24, 28.60	1, 1.20	-
ii. Present of trees along the streets	16, 19.0	9, 10.70	48, 57.10	11, 13.10	-
iii. Many attractive natural sights/ good landscaping	13, 15.50	38, 45.20	28, 33.30	5, 6.0	-
iv. Many attractive building/ homes	21, 25.0	40, 47.60	21, 25.0	2, 2.40	-
G) ***Perceived traffic safety***					
i. Heavy traffic that makes it difficult/ unpleasant to walk in the streets	7, 8.30	31, 36.90	30, 35.70	16, 19.0	-
ii. Traffic speed on the street near home is slow (25km/h)	2, 2.40	28, 33.30	37, 44.0	17, 20.20	-
iii. Most drivers exceed the posted speed limits while driving in the streets	18, 21.40	25, 29.80	37, 44.0	4, 4.80	-
H) ***Perceived crime safety***					
i. High crime rate in the neighbourhood	19, 22.60	49, 58.30	14, 16.70	2, 2.40	-
ii. The presence of crime in the neighbourhood makes it unsafe to go for walks during the day	19, 22.60	51, 60.70	14, 16.70	-	-
iii. The presence of crime in the neighbourhood makes it unsafe to go for walks during the night	19, 22.60	51, 60.70	14, 16.70	-	-
I) ***Perceived lack of parking*** – Parking is difficult in local commercial store	2, 2.40	53, 63.10	29, 34.50	-	-
J) ***Perceived lack of cul-de-sac*** – The streets do not have many/ any cul-de-sacs	26, 31.0	8, 9.50	19, 22.60	31, 36.90	-

K) Perceived hilliness – Walking is difficult due to hilly streets in the neighbourhood	39, 46.40	22, 26.20	16, 19.0	7, 8.30	-
L) Perceived physical barriers – Main barriers like stairs, drainage & untrimmed sidewalks limits the num. of walking routes	33, 39.30	29, 34.50	19, 22.60	3, 3.60	-

Table 6.8 below shows the descriptive summary for the 12-PNES items based on the average values and standard deviations.

Table 6.8: Descriptive statistics for the average values of specific PNES items

Subjective measures (PNES)	**Average values (mean, S.D.)**
A. Residential density	220.86, 1.31
B. Diversity of land use mix	3.05, 1.31
C. Accessibility	2.48, 0.63
D. Street connectivity	2.24, 0.95
E. Infrastructure for walking and cycling	2.36, 0.49
F. Aesthetics	2.27, 0.49
G. Safety from traffic hazards*	2.38, 0.52
H. Safety from crime*	1.96, 0.57
I. Lack of parking	2.32, 0.52
J. Lack of cul de sac	2.65, 1.27
K. Hilliness	1.89, 0.99
L. Physical barriers	1.90, 0.87

6.3 Significant Results based on Correlation Tests

6.3.1 Direct relationship for PNEO => PA (H1) and PNES => PA (H2)

Table 6.9 below illustrated the significant results done for the relationship between PNEO – PA and PNES – PA. The underlying assumptions to these results are discussed below.

Table 6.9: Significant results for PNEO – PA (H1) and PNES – PA (H2)

PNEO measures => PA	**Significant results**
Distance to recreational area *Short distance: <200m *Medium distance: 200.1m – 300m *Long distance: >300.1m	$\gamma = 0.458$, $p < 0.003$ (short, C1+) (Long, C2+)
Land use mix entropy	$\gamma = -0.393$, $p < 0.083$ (high, C1+)
PNES measures => PA	**Significant results**
Land use mix diversity	$\gamma = -0.684$, $p < 0.0001$ (High, C1+) (Medium, C2+) (Low, C3+)
Safety from traffic hazard	$\gamma = 0.680$, $p < 0.0001$ (Low, C1+)

Lack of parking	$\gamma = -0.515$, $p < 0.007$ (Medium, C1+) (Low, C2+)
Lack of cul-de-sac	$\gamma = -0.662$, $p < 0.0001$ (Medium, C1) (Low, C3+)

Several PNEO shows significant association with PA. Conversely to Perling housing blocks, distance to recreational area is positively associated with PA. It is shown that people living within short distance (less than 200m) tend to be C1. By investigating the location of the respondents, most of the respondents are living within a short distance to the only main and fully functional community facilities such as the open space playground and mosque. However, they are divided by a main road and the distinct feature of this neighbourhood is that the residential area are divided into several districts based on the main road positioning. Moreover, the main road has an iron median and the open space playground cannot be access directly because the nearest point that people could access it has a drainage line that is impossible to cross by without a small bridge or road (shown in Figure 6.14, 6.15 and 6.16). The land use mix entropy also showed the same trend in which respondents living in high land use mix area tend to be C1. It is reasonable to assume that these results were caused by the physical features in this neighbourhood which may affect the odds of older adults walking to the facilities, especially also concerning with the safety from traffic hazard which is shown to have a relationship with PA in PNES.

For PNES, four measures are shown to have significant relationship with PA. Firstly, land use mix diversity is negatively associated with PA. Respondents who answered high diversity of land use mix tend to be C1, which is the opposite from the results reported by (Zhao et al., 2020). High diversity of land use mix in this context refers to a short distance of various land use within the respondent's location. Based on the respondent's location, it is safe to assume that most respondents who answered this are displaced from using the main facilities such as open space playground and mosque due to the main road and residential segregation based on different districts. Secondly, a low perception on safety from traffic hazard typically means would lead to higher walkability thus higher physical activity (Oyeyemi et al., 2012). But contrariwise to the general assumption, respondents who perceived a low safety from traffic hazard tend to show C1. Due to the respondent's location across the neighbourhood, most respondents are living within each residential districts and not located near the main road of this neighbourhood which can be seen in Figure 14. Respondents in the upper part of the neighbourhood tend be located further from the main facilities which explains the possibility that they will choose not to walk to the facilities. Moreover, respondents in the lower part are located nearer to the main facilities, but divided by the main road and has grass-strips boundaries which explains why they will also choose not to walk to the facility.

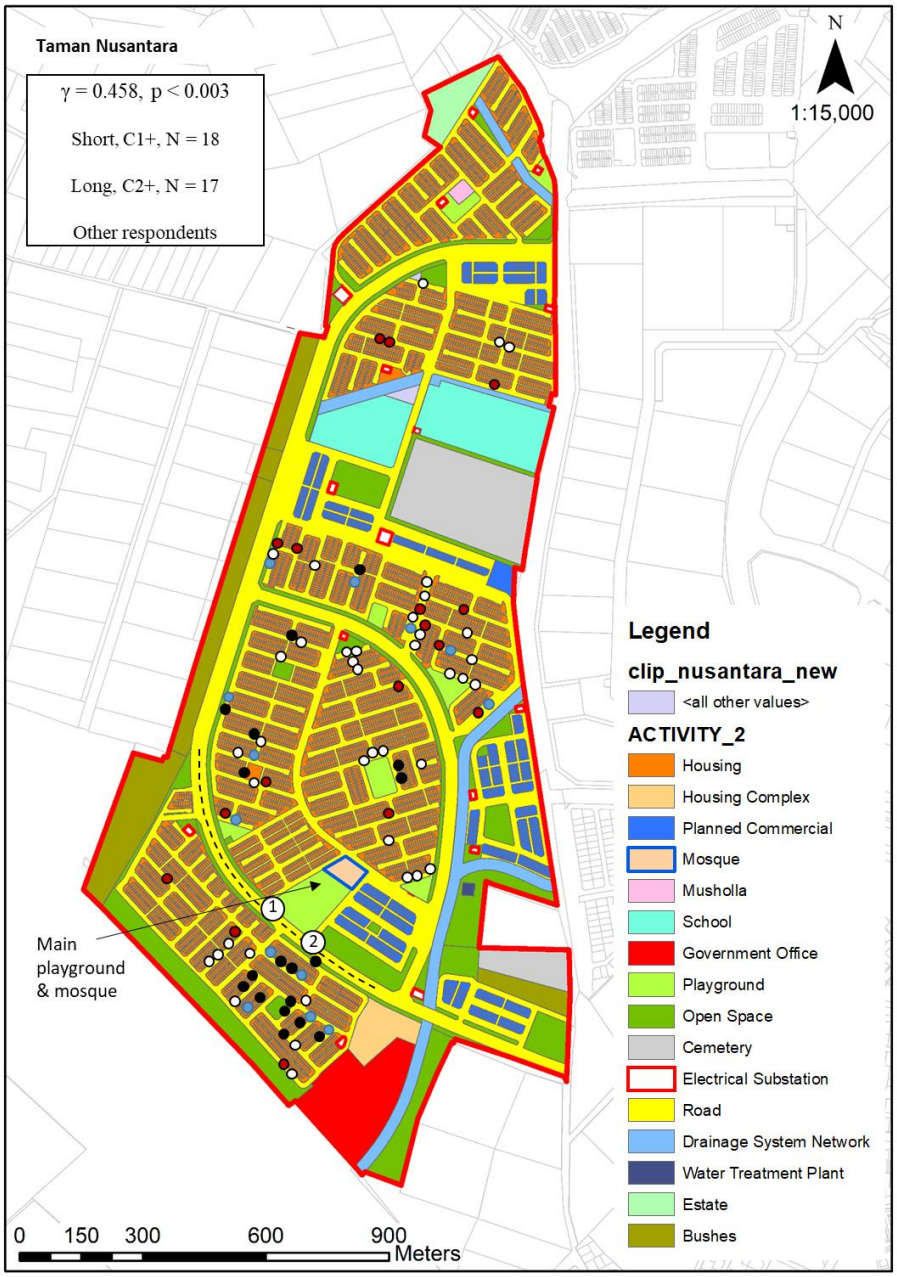


Figure 6.14: Respondent's location from the distance to mosque and their PA level

Figure 6.15: Road median barrier at the main road

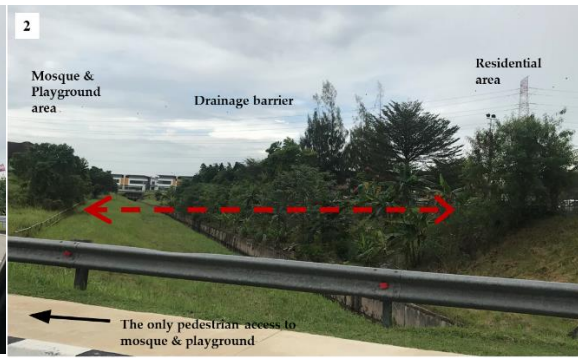


Figure 6.16: Drainage barrier separating the mosque and playground facility with residential area

Thirdly, both lack of parking and lack of cul-de-sac are negatively associated with PA. People who perceived a low lack of parking tend to be at least minimally active (C2) whereas people who perceived a low lack of cul-de-sac tend to be very active (C3). Higher scores of lack of parking indicated the lack of parking in local commercial area which helps to promote walking to the local commercial area (Dalton et al., 2013), thus higher physical activity. However, low scores for lack of parking in commercial areas means that there are many parking and it should show C1, but the respondents tend to show C2. This might be because of the types of PA the respondents did in Nusantara whereby respondents in Nusantara tend to spend more time doing recreation and leisure activities within their home vicinity without involving walking activities as can be seen in Table 6.5 in the previous section.

In addition, low scores of lack of cul-de-sac means a higher number of cul-de-sac streets. More cul-de-sac streets is significantly associated with an increase walking PA. (Bartshe, Coughenour, & Pharr, 2018). The results showed that respondents who perceive lower scores of lack of cul-de-sac tend to show C3. Contrary to the results by Bartshe, Coughenour, & Pharr (2018), this study finds out that more cul-de-sacs leads to C3. This is because every cul-de-sac streets in Nusantara usually has a small lane for pedestrian to get to the other street, which may differ from other neighbourhoods in other countries (Figure 6.17). This might influence the likelihood that respondents in Nusantara can walk around easily in their home vicinity but only within their residential district boundaries due to the present of main road dividing the neighbourhood into several parts.

Figure 6.17: Small pedestrian lane which cuts through the cul-de-sac street

6.3.2 Direct relationship for SNEO => PA (H3)

Table 6.10 below illustrated the significant results done for the relationship between SNEO – PA (H3). The underlying assumptions to these results are discussed below.

Table 6.10: Significant results for SNEO – PA (H3)

SNEO measures => PA	**Significant results**
Member of community group	χ^2 (2, N = 84) = 22.40, p = 0.004 (Mosque, C2) (SRS, C2)

Frequency of joining community activities (Religious)	$\gamma = 0.615$, $p < 0.0001$ (Never, C1) (Often, C3)
Frequency of joining community activities (Collaboration programs with outside groups)	$\gamma = 0.431$, $p < 0.045$ (Sometimes, C3)

Chi-square analysis shows there is a significant association between members of community group specifically the mosque committee and SRS committee with PA level. Older adults who joined the mosque and SRS committee tend to be adequately active and exhibit a moderate PA level. This can be explained based on a variety of activities done in both mosque and SRS (neighbourhood patrol group). Members of the mosque were usually involved with organizing religious and spiritual activities while not excluding the possibilities that they might walk to the mosque which explains the moderate level of PA (C2). Religious talks and classes were conducted weekly at the mosque and religious programs which were conducted based on the Muslims calendar (Figure 6.18). Extra effort is needed to prepare as well as to clean up after the program. Meanwhile, members of the neighbourhood patrol group (SRS) were usually involved in monitoring their neighbourhood area and usually perform several rounds to keep watch especially during the night. The types of activities done in these community groups explains their level of moderate PA (C2).

Figure 6.18: Older women participating in weekly religious activity

This can be strengthen with the significant relationship between the PA level and the frequency of joining religious activities and joining collaboration programs organized by the neighbourhood association. Respondents who often participated in religious activities and collaboration programs tend to be the most active (C3) whereas respondents who never participate in religious activities tend to be inactive (C1). This proves that physical activity were higher among older adults who frequently join religious activities and participate in collaboration programs.

6.3.3 Indirect relationship for PNEO => PNES – PA (H4)

As mentioned previously in the earlier chapter, the indirect relationships based on the conceptual framework were examined by only referring to the significant relationships in H1 (PNEO – PA) which were distance to recreational area. For PNES – PA (H2), perceived land use mix diversity,

perceived safety from traffic hazard, perceived lack of parking and lack of cul-de-sacs were shown to have direct significant relationships with PA. Hence, it is hypothesized that PNES – PA might show an indirect relationship which was influence by PNEO. Cross-tabulations were done for the PNEO – PA and PNES – PA items that were significant. The correlation tests were performed in SPSS; illustrated in Table 6.11.

Table 6.11: Summary of significant results for the cross-tabulation of PNEO, PNES, and PA level

PNEO items	**PNES items**	**Significant results correlated with PA level**
Distance to recreational area (A) • Less than 200 metres (short) • 200.01 – 300 metres (medium) • More than 300 metres (long)	Perceived land use diversity (B)	$\gamma = -0.918$, $p < 0.003$ (Short A, Low B, C3)
	Perceived safety from traffic hazard (C)	$\gamma = 0.774$, $p < 0.008$ (Long A, Low C, C1)
	Perceived lack of parking (D)	$\gamma = -0.774$, $p < 0.017$ (Long A, Medium D, C1)
	Perceived lack of cul-de-sac (E)	$\gamma = -0.892$, $p < 0.001$ (Long A, Medium E, C1)

Based on the results of the significant relationships, respondents living within a short distance to the recreational area tend to display an active PA level of C3 but low perception on land use diversity. It was expected that respondents living near to recreational area and playground will show a higher PA level because the short distance increases the likelihood for older adults to spend their time outdoors. However, even though the respondents live near to recreational areas and playgrounds, they tend to perceived a low level of land use diversity which might be because of the absent of other land uses such as commercial areas. They might be located far from the other land uses but near to recreational areas and playgrounds.

In addition, respondents living farther from recreational areas tend to perceive a low safety from traffic hazard and displayed a low level of PA. This trend was expected when respondents were located far from recreational areas since the likelihood of spending time in recreational areas was reduced even though traffic hazard was low. Furthermore, respondents who were living further than 300 metres to recreational areas tend to show a low level of PA and perceived a medium level of lack of parking and lack of cul-de-sacs streets. This showed that respondents who were displaced from recreational areas were also displaced from commercial areas which was shown through the lack of parking measure. This further strengthen the previous point whereby respondents who perceive a low level of safety from traffic hazard might be located near the inside roads and not near the main road, as well as far from recreational areas and commercial land uses. Furthermore, these respondents were also perceiving a medium level of lack of cul-de-sac which typically means that there were cul-de-sac streets present in some areas of the neighbourhood especially in the inside roads and not near the main road. However, as discussed previously based on observation, the cul-de-sac streets in this neighbourhood were not truly dead end roads since there were pedestrian lanes present to connect to the other area.

6.3.4 Indirect relationship for PNEO => SNEO – PA (H5)

Next, the indirect relationship of H5 based on the conceptual framework were examined by referring to the significant relationship in H1 (PNEO – PA) which was distance to recreational area and the significant relationships in H3 (SNEO – PA) which were members of community groups

(mosque and SRS neighbourhood patrol) and frequency of joining community activities (religious and collaboration programs).

As seen in Table 6.12, the PNEO item of distance to recreational area showed significant correlations with frequency of joining collaboration programs because some of the collaboration programs might be done in the recreational area. The recreational facility are consist of an indoor courts for futsal and basketball, outdoor courts for badminton and 'sepak takraw', a large open space area with jogging trails and playgrounds. Based on the outcomes of the pilot survey discussed in the earlier chapter, collaboration programs such as the "Dengue Prevention Program" and "Gotong-Royong Perdana" were usually done in outdoor settings (Figure 6.19).

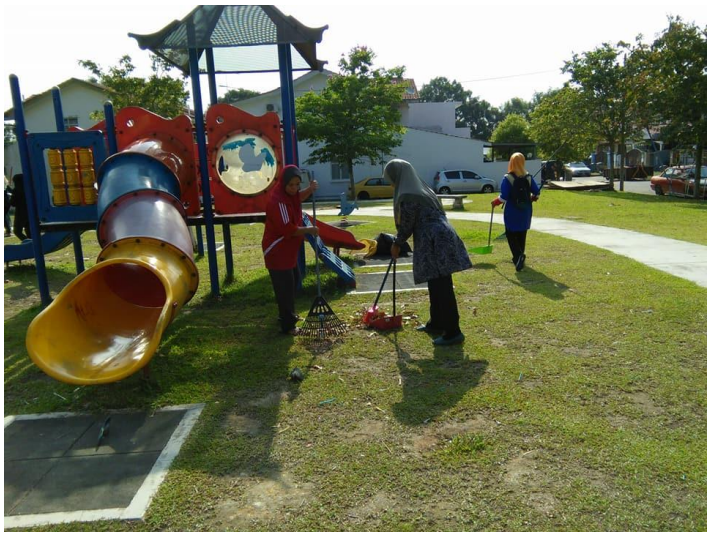


Figure 6.19: Residents participating in "Gotong-royong Perdana"

Respondents living within a medium distance to the recreational area tend to display a higher level of PA (C3) and at least joined the collaboration programs on an occasional basis. This is logical since most respondents were living within walking distance and not more than 300 metres. Even so, previous studies showed the preferred walking distance of Malaysian adults was less than 200 metres (Azmi & Karim, 2012). Hence, this outcome extends the existing knowledge where Malaysian older adults can show a higher level of PA when living not more than 300 metres from the recreational area. This was expected for this neighbourhood since the main recreational area of this neighbourhood consists of several facilities suitable to be used by all age groups while only small playgrounds existed in the other neighbourhoods.

Table 6.12: Summary of significant results for the cross-tabulation of PNEO, SNEO, and PA level

PNEO items	**SNEO items**	**Significant results correlated with PA level (C1, C2, C3)**
Distance to recreational area (A) • Less than 200 metres (short) • 200.01 – 300 metres (medium) • More than 300 metres (long)	Frequency of joining community activities: 'Collaboration programs (B) • Never • Rarely • Occasionally • Frequently	$\gamma = 0.69$, $p < 0.027$ (Medium A, Occasionally B, C3) (Long A, Never B, C1)

6.3.5 Indirect relationship for PNEO => SNES – PA (H6)

Referring back to the conceptual framework in the earlier chapter, SNES items were hypothesized to be caused by PNEO, and show an indirect relationship with PA. Correlation tests were done and positive results were obtained for several SNES measures associated with PA level. Table 6.13 below illustrated the significant results for the cross-tabulation of PNEO, SNEO, and PA level.

Older adults who were living farther from the recreational area tend to exhibit a low PA level (C1) and perceive low generalized trust, low collective action and cooperation as well as low perception towards community groups within their housing vicinity. It was proven that distance to recreational areas and playgrounds influences the PA level indirectly through perceptions towards the social neighbourhood environment. Living farther from the recreational area can reduce the likelihood of spending time outside and the chance to interact with people, which can be considered to influence the extent of generalized trust. Generalized trust is an important element of civic engagement which can also affect the extent of collective action and cooperation towards the community as well as the expectations towards community groups.

Table 6.13: Summary of significant results for the cross-tabulation of PNEO, SNEO, and PA level

PNEO items	**SNES items**	**Significant results correlated with PA level (C1, C2, C3)**
Distance to recreational area (A) • Less than 200 metres (short) • 200.01 – 300 metres (medium) • More than 300 metres (long)	Generalized trust (B)	$\gamma = 0.650$, $p < 0.029$ (Long A, Low B, C1)
	Collective action and cooperation (B)	$\gamma = 0.963$, $p < 0.00001$ (Long A, Low B, C1)
	Perception towards community groups in the neighbourhood (C)	$\gamma = 0.681$, $p < 0.003$ (Long A, Low C, C1) (Long A, Medium C, C2)

6.3.6 Direct relationship for SES => PA

Chi-square tests are implied to the measures of gender, occupation, family structure and race due to the nature of the variables which is categorical variable. It shows that only race is significant to PA level, in which most Malays showed a level of low PA. For the measures of age and period of stay, since the categories in age and period of stay were originally scale variables and had a non-normal distribution, Spearman's rank correlation tests were deemed to be more suitable to be implied. Based on Table 6.14 below, respondents who lived in this neighbourhood for more than 11 years tend to show a higher level of PA (C3). This showed that these respondents who were usually permanent residents and not renting, have a considerable level of PA. It was assumed that this result was influenced by both items from the PNE and SNE. Based on the significant results in H3, these permanent residents might be among the actively participated in the community activities that were held in this neighbourhood.

Table 6.14: Significant results for SES – PA (H7)

SES measures => PA	**Significant results**
Period of stay Less than 5 years; 6 – 10 years; More than 11 years	$\gamma = 0.387$, N= 84, $p < .013$ (More than 11 years, C3)
Gender	χ^2 (2, N = 84) = 7.519, p = 0.024 (Male, C2 / Female, C1)

6.4 Summary of Chapter

A general trend based on the significant relationships discussed previously can be observed for this neighbourhood which were pointed out below:

- Different locations of respondents who were inside the traffic volume, rather than near the main road, and far away from the main facilities in the upper part of this neighbourhood, affect their safety perception from traffic hazards, tending to be C1. (H1)
- Residents living in high land-use mix entropy did not always show high PA levels due to the present physical features of this neighbourhood.
- The likelihood of walking to a facility can be reduced beyond the residential boundaries of their housing vicinity divided by grass strips and main roads. (H1)
- Every dead-end alley in Nusantara usually had small lanes for pedestrians to go to other streets. This means that respondents in Nusantara can walk comfortably around their homes, but only within their residential district boundaries due to the presence of main road dividing their neighbourhood into several parts. (H2)
- The types of activities done in different community groups explain their level of moderate PAs because the older adults frequently participated in religious activities and collaboration programmes. (H3)
- Even though respondents living near recreational areas and playgrounds show higher PA levels, they perceived a low level of land-use diversity due to the absence of other land uses such as commercial areas. (H4)
- Respondents who perceive a low level of safety due to traffic hazards tend to be C1 and may be near inner roads rather than near main roads away from recreational areas, and commercial land uses. Normal traffic speeds can also cause this in most roads in this neighbourhood. Based on the comments made by the respondents during this questionnaire survey, they mostly exceed the posted speed limits. (H4)
- Inactive respondents displaced from the main recreational area were also displaced from commercial areas. (H4)
- The main recreational facility, consisting of different types of sports facilities for all ages, was next to the mosque, and in most residential areas, there was a small playground. However, some respondents may have low PA levels due to inappropriate use of senior playgrounds in other residential areas of this neighbourhood.
- Collaboration programmes usually take place in outdoor facilities and therefore have an essential relationship with distance to the recreational area. (H5)
- The older adults may show higher PA levels when living less than 300 m from the recreational area. (H5)
- Living away from recreational areas may reduce the likelihood of spending time outside and the chance to interact with people and influence the extent of generalised trust that is an essential element in citizens' engagement. This can affect the degree of collective action and cooperation with the community and low expectations of community groups. (H6)
- Respondents who were permanent residents and not renters had a considerable level of PA affected by both PNE and SNE items. (H7)

7 CASE STUDY ON TAMAN SELESA JAYA

7.1 Analysis on Spatial Data using ArcGIS

This section will discuss on the descriptive statistics of the objective measures of the physical neighbourhood environment (PNEO) and the steps of analysis performed in ArcGIS for each of the five PNEO measures. Table 7.1 shows the summary for the five PNEO measures in mean values. It is illustrated that Taman Selesa Jaya has a population density of about 11,700 sq km, which is considered relatively high for the city of Johor Bahru (Bell, 2017). This is because this neighbourhood consists of four housing blocks area which usually has high population density compared to terrace housings area. Population density were calculated and population data were obtained from the Johor Bahru Population Census Data 2010. Simultaneously, data attributes of the outcomes from the questionnaire survey such as PNES, PA, SNEO and SNES were spatially joined using ArcGIS with the respondent's location layer.

Table 7.1: Descriptive statistics for PNEO measures

Objective measures (PNEO)	**Average values (mean)**
A) Population density (population / sqkm)	11,706.84
B) Distance to facilities (metre) - Recreational open space - Mosque	 317.68 438.06
C) Intersection Density (No. of real nodes/area)	164.98
D) Land Use Mix value (highest is 1)	0.76

The second PNEO measure is distance to facilities, in which most respondents live within an average of 317 metres from the recreational open space and about 430 metres from the mosque, shown in Table 7.1 above. The third PNEO measure is the intersection density in which this neighbourhood shows an average of 165 nodes per 200 meter buffer within a respondent's location which considerably low when compared to the other neighbourhoods. The last PNEO measure is the land use mix value of about 0.76 which is considered a moderate-mixed land use. Figure 7.1 to 7.8 shows the process of obtaining the data for each of these measures.

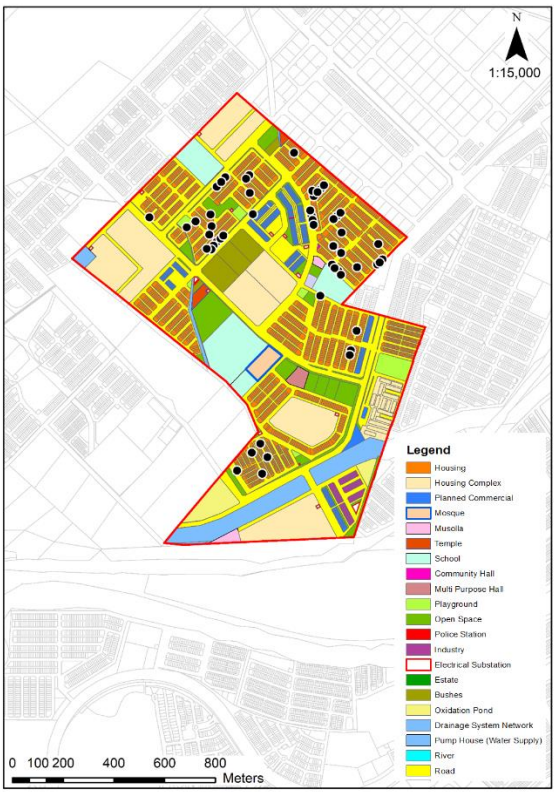


Figure 7.1: Respondent's location in Taman Selesa Jaya

Figure 7.2: A buffer of 200 m were assigned for each respondent

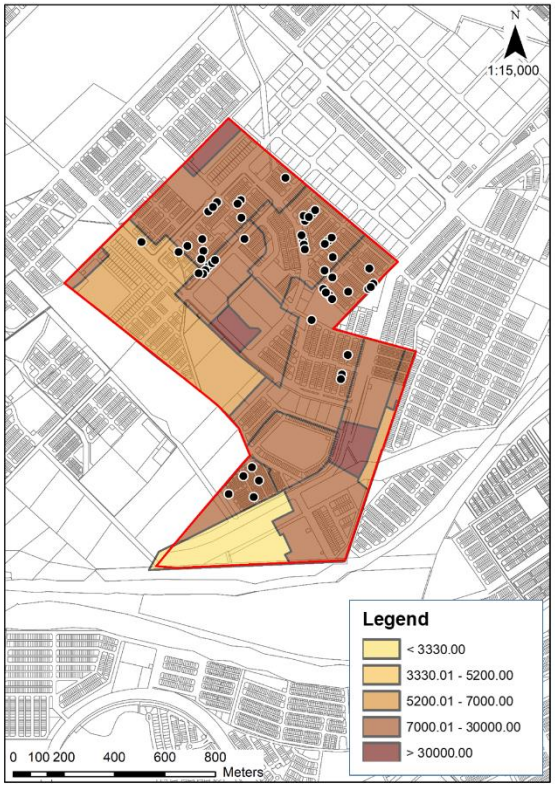


Figure 7.3: Population density based on the administrative districts from the Department of Statistics, Johor

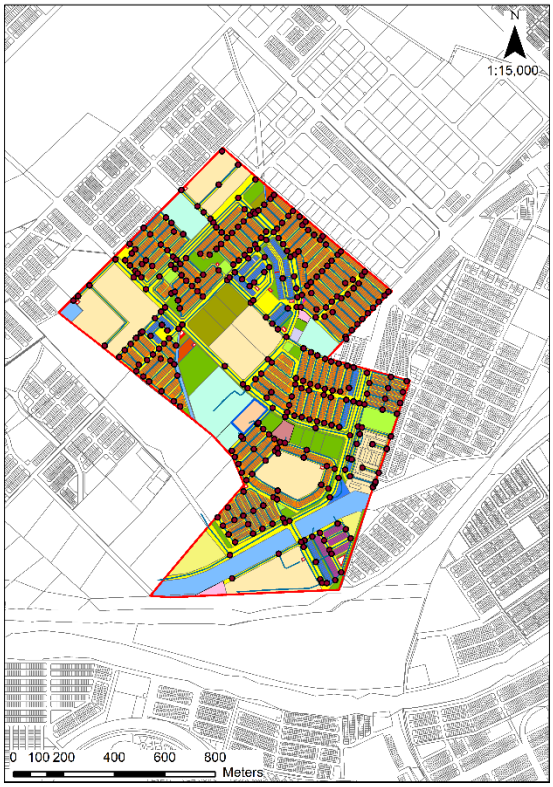


Figure 7.4: Road network and traffic intersection nodes of Taman Selesa Jaya

Figure 7.5: Nodes at road intersections were clipped with the respondent's location buffer

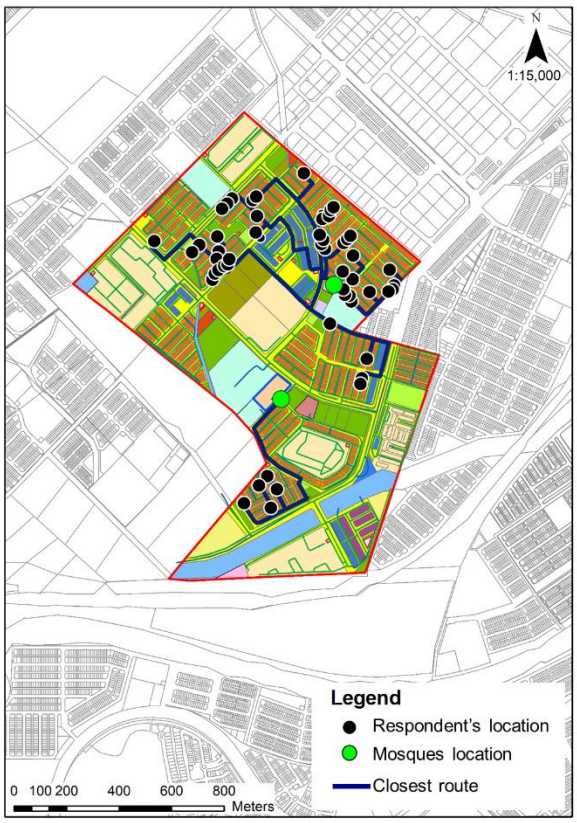


Figure 7.6: Each respondent's distance to facility (mosques) were analysed using the network analysis in ArcGIS

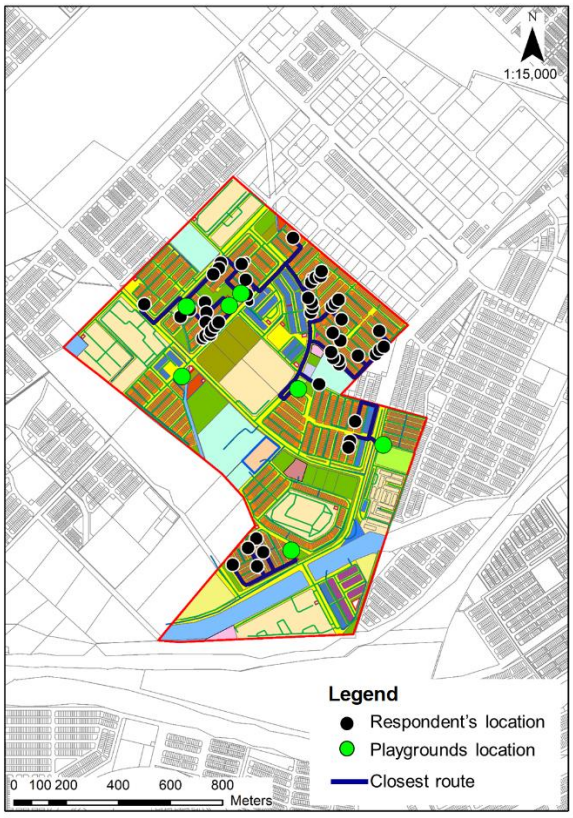


Figure 7.7: Each respondent's distance to facility (playgrounds) were analysed using the network analysis in ArcGIS

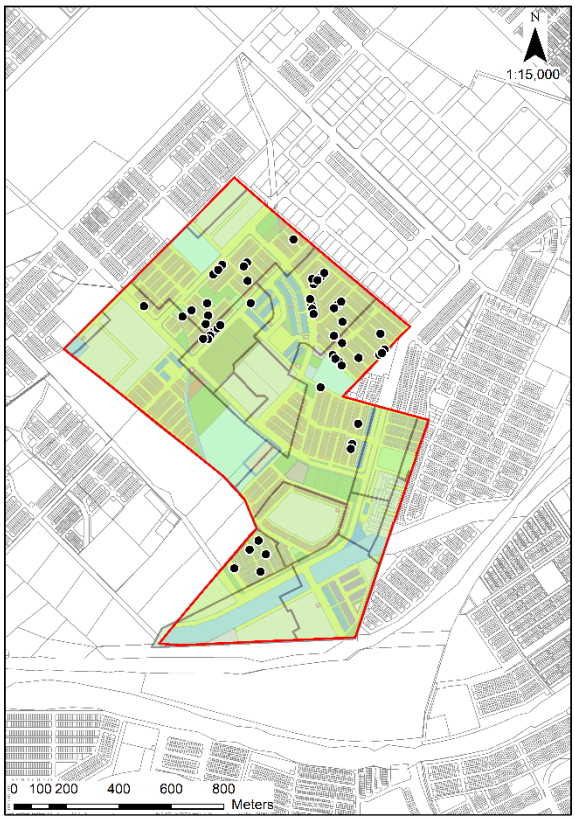


Figure 7.8: Land use mix entropy for each respondent were calculated based on the administrative boundaries of population census

7.2 Descriptive Statistics on Questionnaire Data

This first section in this part will discuss about the outcomes from the questionnaire survey by describing the descriptive statistics specifically for SNEO, SNES, PNES and PA. Part A is the demographic attributes and was explained in Chapter 3. The next section in this part will discuss about the results of the significant relationships for each hypothesis and the discussions.

7.2.1 Part 2: Social Capital Theme (SNEO & SNES)

This part will discuss about the outcomes of social capital theme for both objective (SNEO) and subjective (SNES). Based on the conceptual framework discussed in the earlier chapter, there were five SNEO measures which were consist social network 1 (number of close friends), social network 2 (number of people willing to lend money), social network 3 (frequency of interactions with immediate neighbours), sociability 1 (frequency of joining community activities), sociability 2 (participation in community groups) and lastly sociability 3 (level of decision-making in community groups). Figure 7.9 showed the descriptive statistics for social network 1 measured by the number of close friends among the respondents. A majority of the respondents in this neighbourhood had about 6 to 13 close friends, followed by 40% of respondents having less than 5 close friends.

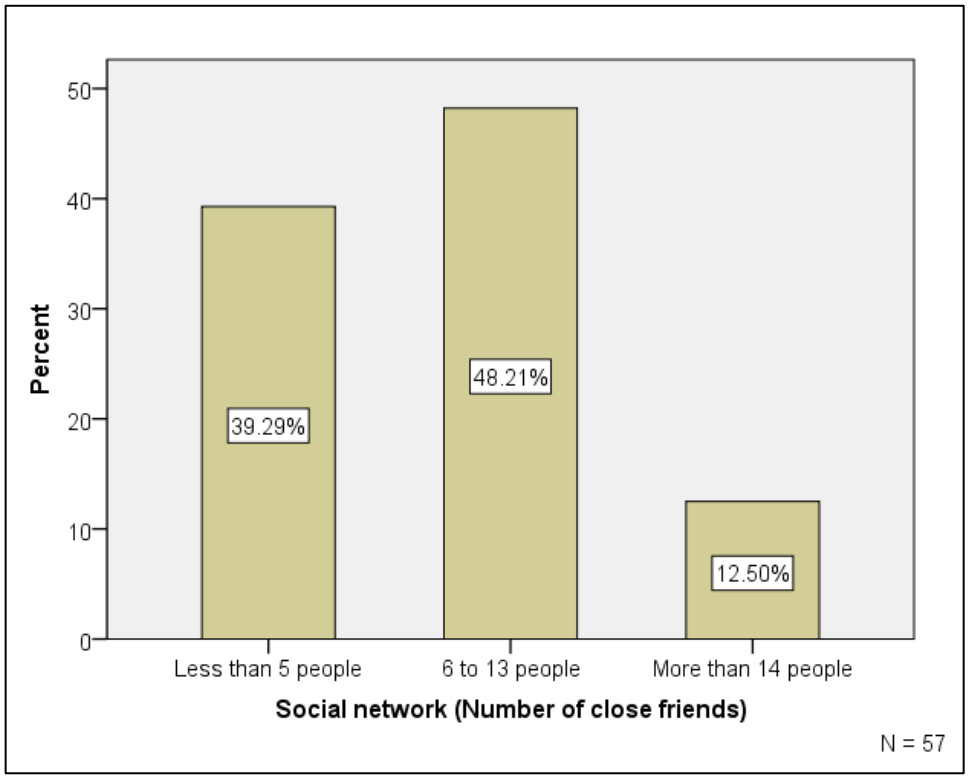


Figure 7.9: Descriptive statistics for social network 1
measuring number of close friend

Figure 7.10 illustrated social network 2 in terms of number of people willing to lend money. Number of people willing to lend money is a measure that defines a closer bonding relationship and stronger trust between community members. It was expected that number of people willing to lend money would be less but respondents in this terrace houses mostly had 2 or more people who they could turn to in case they needed to borrow money. Next, the third measure is frequency of

interaction with immediate neighbours, seen in Figure 7.11. Most of the respondents often have social interaction with their neighbours, whereby the same trend was observed in the other neighbourhoods as well.

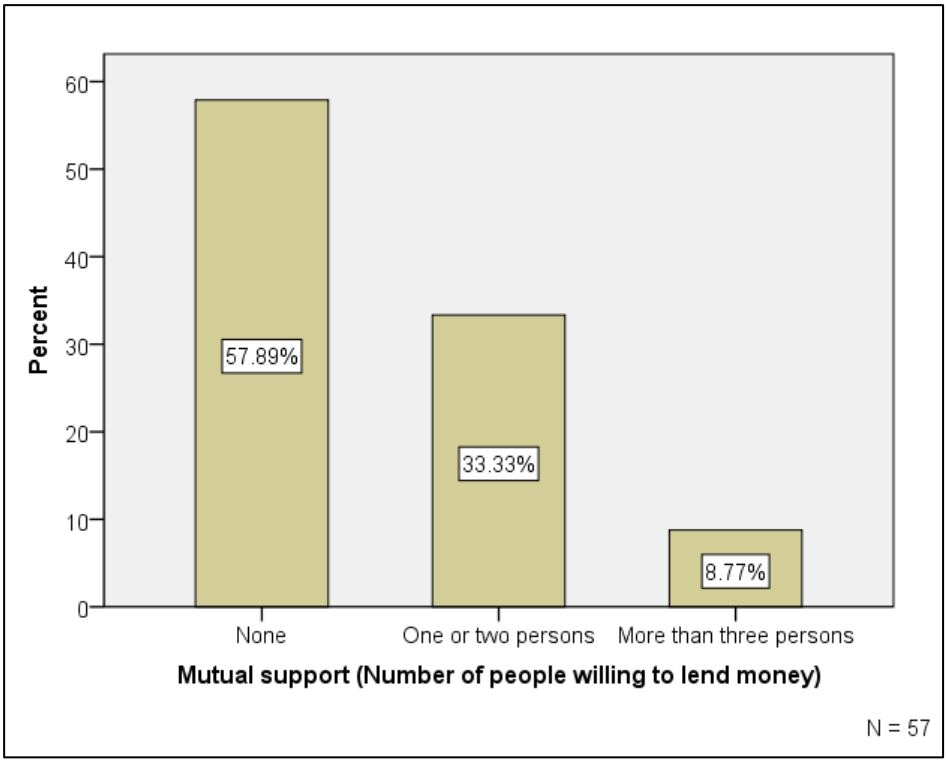


Figure 7.10: Descriptive statistics for social network 2 measuring number of people willing to lend money

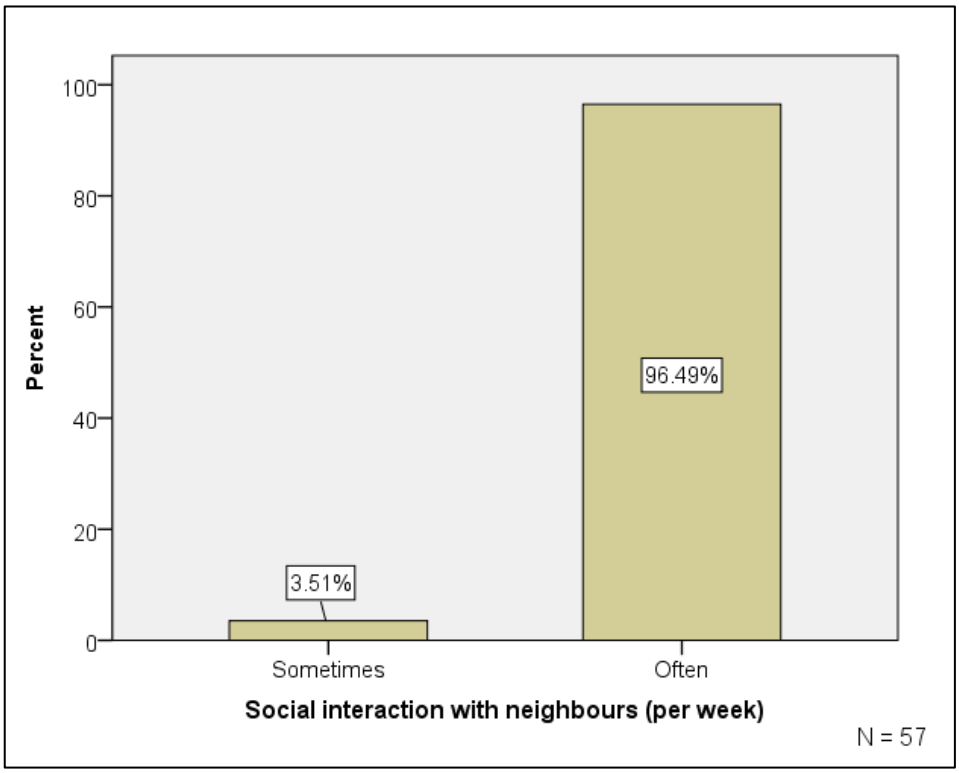


Figure 7.11: Descriptive statistics for social network 3 measuring social interaction with immediate neighbours in a week

Table 7.2 illustrated the frequency of joining various types of community activities among the respondents in this neighbourhood. As expected, a majority of them mostly participated in religious activities whereby about 60% of the older adults took part in religious activities in the mosque or 'musholla', followed by collaboration programs, 'gotong-royong' and recreation activities.

Table 7.2: Descriptive statistics of Sociability 1 measuring types of community activities

Sociability 1 items	Frequency of participating in community activities (%)			
Types of community activities	Never	Rarely	Occasionally	Frequently
'Gotong – royong' (cleaning up the neighbourhood together)	7.02	66.67	26.32	-
Recreation activities	47.37	26.32	26.32	-
Religious activities	12.28	3.51	78.95	5.26
Collaboration programs	29.82	26.32	43.86	-

Next, descriptive statistics for SNEO items such as measuring sociability 2 are shown below. Figure 7.12 illustrated the frequency of respondents who participated in community groups in this neighbourhood. A majority of them were among the neighbourhood association group (RT) followed by mosque committee, about 42% and 34% respectively. As seen in other neighbourhoods, recreation club has the least number of members, about 4%.

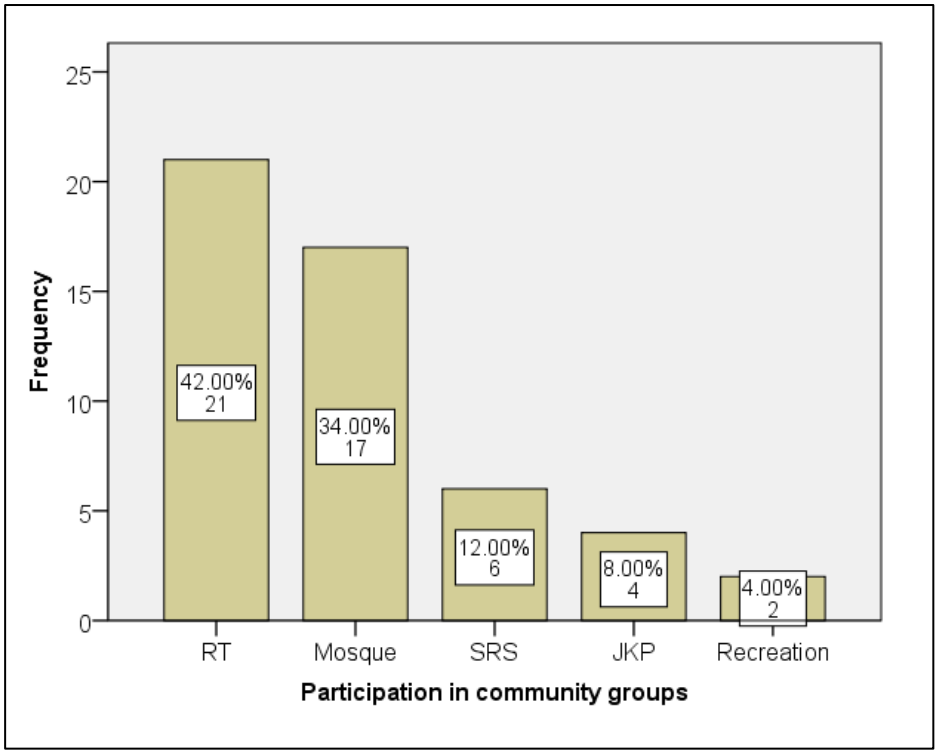


Figure 7.12: Descriptive statistics for participation in community groups (Sociability 2)

Table 7.3 shows the descriptive statistics for the level of decision-making in community groups. Most of the respondents who joined the neighbourhood association (RT), neighbourhood patrol group (SRS) and the mosque committee were either very active or less active in decision-makings of their groups. A small percentage of respondents joined the JKP and recreation club which were less significant.

Table 7.3: Descriptive statistics of level of decision-making in community groups (Sociability 3)

Level of decision-making in community groups (Sociability 3)	**Leader (N, %)**	**Very Active (N, %)**	**Less Active (N, %)**	**Does not take part in decision-making (N, %)**
i. 'Rukun Tetangga' / Neighbourhood association	1, 4.80	4, 19.00	12, 57.10	4, 19.00
ii. 'SRS' / Neighbourhood patrol group	-	2, 33.30	3, 50.0	1, 16.70
iii. 'JKP' / Neighbourhood political group	-	-	3, 75.0	1, 25.0
iv. Members of mosque committee	-	6, 35.30	9, 52.90	2, 11.80
v. Members of recreation club	-	-	-	2, 100.0

For SNES, there are three measures which are generalized trust, collective action and cooperation, and perception towards the community groups in the neighbourhood illustrated in Table 7.4 below. A majority of respondents tend to agree to all items of generalized trust but some tend to disagree to trusting people of the same race as well as different race. This might happen due to the various types of residents living in this neighbourhood which consist of terrace houses and several high-rise apartments. Besides that, the respondents tend to have trusting issues in borrowing or lending money to people, which also explains a high percentage of people who were not willing to lend money in the previous sections. The respondents also tend to show a general trust to their neighbours by agreeing to Item J, but tend to disagree when it comes to a more specific trust of lending their own house key to their neighbours (Item K). For collective action and cooperation, respondents tend to agree on the items but tend to disagree with item M because this item is reverse-coded. For perception towards community groups, the respondents also tend to agree to all items.

Table 7.4: Descriptive statistics of SNES items

Subjective measures (SNES)	**Strongly Disagree (N, %)**	**Disagree (N, %)**	**Not sure (N, %)**	**Agree (N, %)**	**Strongly Agree (N, %)**
Generalized trust					
A) Most people can be trusted	-	-	3, 5.30	40, 70.20	14, 24.60
B) One must be alert or else someone will take advantage	5, 8.80	1, 1.80	18, 31.60	10, 17.50	23, 40.40

C) People do not trust each other to lend and borrow money	3, 5.30	30, 52.60	7, 12.30	3, 5.30	14, 24.60
D) Trust people from same race	-	17, 29.80	11, 19.30	29, 50.90	-
E) Trust people from different race	-	22, 38.60	26, 45.60	9, 15.80	-
F) Trust local shopkeepers	-	3, 5.30	28, 49.10	12, 21.10	14, 24.60
G) Trust local authorities representatives	-	3, 5.30	8, 14.0	32, 56.10	14, 24.60
H) Trust neighbourhood patrol group	-	3, 5.30		31, 54.40	23, 40.40
I) Trust strangers strolling around in the neighbourhood	4, 7.0	10, 17.50	31, 54.40	4, 7.0	8, 14.0
J) Count on neighbors to report to you if there is suspicious activity around the house	-	-	1, 1.80	19, 33.30	37, 64.90
K) Count on neighbors to watch over your house while you are away by lending your house key	6, 10.50	16, 28.10	19, 33.30	3, 5.30	13, 22.80
Collective action and cooperation					
L) Community groups will help the poor in the neighbourhood	-	-	3, 5.30	44, 77.20	10, 17.50
M) Residents who did not take part in community activities will be criticize	12, 21.10	18, 31.60	19, 33.30	8, 14.0	-
N) Many residents will get together and help solve problems in the neighbourhood	-	-	14, 24.60	39, 68.40	4, 7.0
Perception towards community groups					
O) Neighbourhood 'Rukun Tetangga' is active	-	-	-	7, 12.30	50, 87.70
P) Neighbourhood patrol group (SRS) makes you feel safer	-	-	-	19, 33.30	38, 66.70
Q) Community groups are important to establish community relations between residents	-	-	-	26, 45.60	31, 54.40
R) Role of neighbourhood association (RT)	-	-	-	16, 28.10	41, 71.90

leader as connection to higher authority					
S) Political representatives can help improve neighbourhood	-	-	-	56, 98.20	1, 1.80

Another measure under the subjective collective action and cooperation is illustrated in Figure 7.13 below. Similar to the other neighbourhoods, most respondents tend to contribute time instead of money for a community project that can bring benefit to the community, which is about 90% and 11% response respectively.

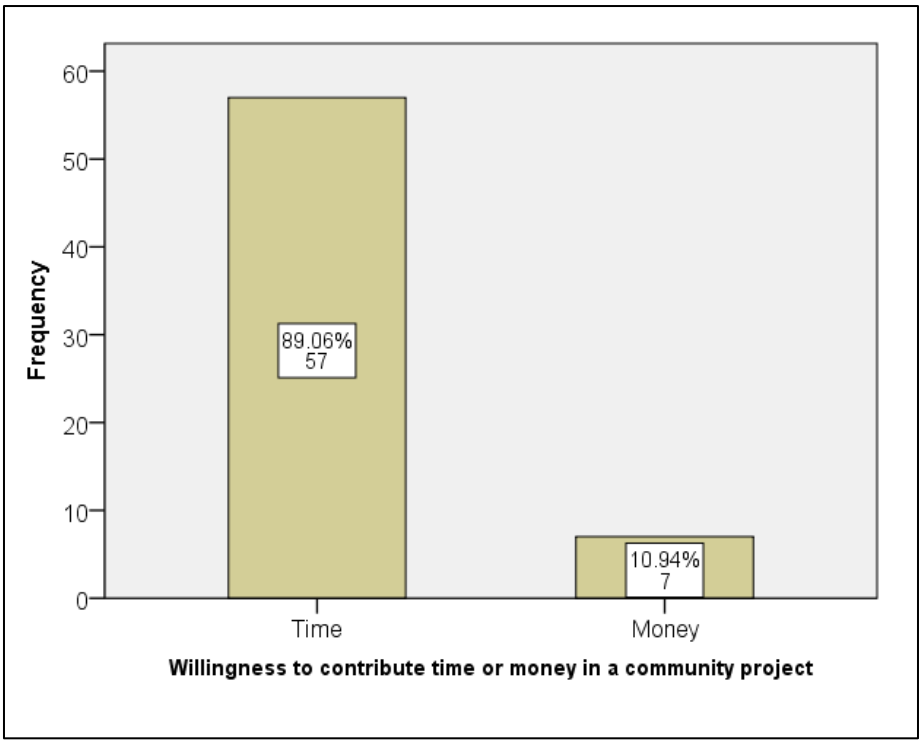


Figure 7.13: Descriptive statistics for willingness to contribute time or money for a community project (Collective action and cooperation)

7.2.2 Part 3: Physical Activity (PA)

Physical activities data were obtained based on the different types of physical activities from the questionnaire survey. Table 7.5 below illustrated the descriptive statistics for the different types of physical activities among respondents in Taman Perling terrace houses. A majority of respondents tend to perform leisure activities as well as recreations and sports activities, about an average of 122 minutes per week and 100 minutes per week for both types of PA respectively. For the last type of PA (doing part-time jobs after retirement period), although it shows the highest average of about 1065 total minutes spent in a week, it was less significant since there are only a few of them who performed this PA.

The different types of physical activities were then aggregated based on the MET scores categorization of walking activities, moderate-intensity activities and vigorous intensity activities. Walking to a destination was considered as walking activities. Walking for recreation, doing recreation and sports activities, and doing leisure activities were considered as moderate-vigorous intensity types of PA. Daily activities such as doing part-time jobs was considered as vigorous

intensity activities. Specific weightages were assigned to the specific MET categories based on Forde (2005). The outcomes are shown in Table 7.6 below in terms of the new categorization based on MET-minutes per week.

Table 7.5: Descriptive statistics of the types of physical activities among older adults in this neighbourhood

Types of physical activities	**N, total minutes spent, mean of total minutes spent**
A) Walking to a destination other than walking for recreation (eg: walking to grocery store, mosque, market, bus stop)	41, 1980 mins, 48.29 mins
B) Walking for recreation (including walking your pets, jogging, brisk walking)	22, 1955 mins, 88.86 mins
C) Recreation and sports activities (eg: soccer, aerobic, 'tai chi')	19, 1160 mins, 101.58 mins
D) Leisure activities outside your home (eg: gardening, cleaning home exterior, karaoke)	29, 3540 mins, 122.07 mins
E) Daily activities such as part-time jobs (eg: retired person doing self-business)	2, 2130 mins, 1065 mins

Table 7.6: Descriptive statistics for the categorization of PA level based on MET-minutes per week

Categories of PA level based on MET-minutes per week	**Mean of total minutes spent, S.D. (N= 57)**
C1: Inactive	146.76, 202.68
C2: Minimally active	392.28, 408.48
C3: Health-enhancing PA (HEPA-active)	519.3, 2320.45

7.2.3 Part 4: Physical Neighbourhood Environment System (PNES)

Table 7.7 below illustrated the descriptive statistics for the PNES items obtained from the questionnaire survey. The respondents in Taman Selesa Jaya perceived several types of housings that exists in their neighbourhood. The majority were terraced houses followed by high-rise apartments. Most of them were also living within walking distance to land uses such as commercial places, worship place, recreation areas and community facility except for clinic which is more than the preferred walking distance. This neighbourhood can be described as having a small area compared to the other neighbourhoods, consisting of a diverse types of land uses. Based on the trends of all the other PNES items, it seems that respondents were divided into two areas in which half of the respondents tend to disagree and half of them tend to agree with the items.

Table 7.7: Summary of the descriptive statistics for PNES items obtained from the questionnaire survey

Subjective measures (PNES)	**None (N, %)**	**A few (N, %)**	**Several (N, %)**	**Mostly (N, %)**	**All (N, %)**
A) Perceived Residential Density					
i. Bungalow	50, 87.70	7, 12.30	-	-	-
ii. Terraced houses	-	-	-	35, 61.40	22, 38.60
iii. Apartment 1 – 3 floors	55, 96.50	2, 3.50	-	-	-
iv. Apartment 4 – 6 floors	15, 26.30	4, 7.0	27, 47.40	10, 17.50	1, 1.80
v. Apartment 7 – 11 floors	12, 21.10	2, 3.50	33, 57.90	10, 17.50	-
vi. Apartment more than 12 floors	16, 28.10	11, 19.30	24, 42.10	6, 10.50	-
B) Perceived land use diversity	**1 – 5 mins**	**6 – 10 mins**	**11 – 20 mins**	**21 – 30 mins**	**> 31 mins**
i. Grocery shop	45, 78.90	12, 21.10	-	-	-
ii. Supermarket	1, 1.80	37, 64.90	11, 19.30	8, 14.0	-
iii. Worship place	50, 87.70	6, 10.50	1, 1.80	-	
iv. Bus stop	42, 73.70	4, 7.0	10, 17.50	-	1, 1.80
v. Coffee restaurant	44, 77.20	12, 21.10	1, 1.80	-	-
vi. Clinic	4, 7.0	12, 21.10	35, 61.40	4, 7.0	2, 3.50
vii. Food stall	14, 24.60	40, 70.20	2, 3.50		1, 1.80
viii. Park / Playground	36, 63.20	18, 31.60	2, 3.50	1, 1.80	
ix. Community hall	35, 61.40	15, 26.30	2, 3.50	3, 5.30	2, 3.50
x. Night market	7, 12.30	41, 71.90	7, 12.30	2, 3.50	
xi. Wet market	1, 1.80	32, 56.10	19, 33.30	2, 3.50	3, 5.30
C) Perceived neighbourhood accessibility	**Strongly Disagree (N, %)**	**Disagree (N, %)**	**Agree (N, %)**	**Strongly Agree (N, %)**	**-**
i. Stores within walking distance	-	20, 35.10	26, 45.60	11, 19.30	-
ii. Many places to go within walking distance	-	20, 35.10	32, 56.10	5, 8.80	-
iii. Walking to bus stop from home is easy	-	27, 47.40	24, 42.10	6, 10.50	-
D) Perceived street connectivity-					
i. Distance between intersection is 100 metre or less	-	27, 47.40	23, 40.40	7, 12.30	-
ii. There are many alternative routes	-	9, 15.80	43, 75.40	5, 8.80	-
E) Perceived infrastructure for walking					
i. Present of sidewalks on most of the streets	-	20, 35.10	37, 64.90	-	-

ii. Sidewalks are separated from the road/traffic in my neighbourhood by parked cars	-	25, 43.90	31, 54.40	1, 1.80	-
iii. Present of grass strips that separates the streets from the sidewalks	-	6, 10.50	51, 89.50	-	-
iv. Present of crosswalks & pedestrian signals to help pedestrian cross the streets	10, 17.50	19, 33.30	22, 38.60	6, 10.50	-
v. Neighbourhood streets are well lit at night	-	4, 7.0	28, 49.10	25, 43.90	-
vi. Residents can easily observe pedestrians and bikers on the streets in front of their homes	-	-	56, 98.20	1, 1.80	-
F) ***Perceived neighbourhood aesthetics***					
i. Many interesting things to look at while walking	-	35, 61.40	22, 38.60	-	-
ii. Present of trees along the streets	2, 3.50	28, 49.10	21, 36.80	6, 10.50	-
iii. Many attractive natural sights/ good landscaping	-	23, 40.40	29, 50.90	5, 8.80	-
iv. Many attractive building/ homes	-	17, 29.8	35, 61.4	5, 8.80	-
G) ***Perceived traffic safety***					
i. Heavy traffic that makes it difficult/ unpleasant to walk in the streets	-	31, 54.40	26, 45.60	-	-
ii. Traffic speed on the street near home is slow (25km/h)	-	11, 19.30	46, 80.70	-	-
iii. Most drivers exceed the posted speed limits while driving in the streets	-	40, 70.20	9, 15.80	8, 14.0	-
H) ***Perceived crime safety***					
i. High crime rate in the neighbourhood	10, 17.50	32, 56.10	14, 24.60	1, 1.80	-
ii. The presence of crime in the neighbourhood makes it unsafe to go for walks during the day	11, 19.30	26, 45.60	20, 35.10	-	-
iii. The presence of crime in the neighbourhood makes it unsafe to go	10, 17.50	23, 40.40	24, 42.10	-	-

for walks during the night					
I) Perceived lack of parking – Parking is difficult in local commercial store	4, 7.0	40, 70.20	13, 22.80	-	-
J) Perceived lack of cul-de-sac – The streets do not have many/ any cul-de-sacs	-	11, 19.30	41, 71.90	5, 8.80	-
K) Perceived hilliness – Walking is difficult due to hilly streets in the neighbourhood	1, 1.80	31, 54.40	19, 33.30	6, 10.50	-
L) Perceived physical barriers – Main barriers like stairs, drainage & untrimmed sidewalks limits the num. of walking routes	1, 1.80	18, 31.60	38, 66.70	-	-

Table 7.8 below shows the descriptive summary for the 12-PNES items based on the average values and standard deviations.

Table 7.8: Summary of descriptive statistics for the average values of PNES items

Subjective measures (PNES)	**Average values (mean, S.D.)**
A) Residential density	441.74, 92.28
B) Diversity of land use mix	1.82, 0.32
C) Accessibility	2.74, 0.58
D) Street connectivity	2.79, 0.38
E) Infrastructure for walking and cycling	2.82, 0.18
F) Aesthetics	2.60, 0.37
G) Safety from traffic hazards*	2.36, 0.35
H) Safety from crime*	2.17, 0.66
I) Lack of parking	2.16, 0.53
J) Lack of cul-de-sac	2.89, 0.52
K) Hilliness	2.53, 0.71
L) Physical barriers	2.65, 0.52

7.3 Significant Results based on Correlation Tests

This part will discuss about the significant results for each hypothesis of the direct and indirect relationships across the difference domains for Taman Selesa Jaya terrace houses based on the conceptual framework discussed in the earlier chapter.

7.3.1 Direct relationship for PNEO – PA (H1) and PNES – PA (H2)

The results of the direct relationships for PNEO – PA (H1) and PNES – PA (H2) are illustrated in Table 7.9 below. For this neighbourhood, two measures of PNEO and three measures of PNES showed good associations with PA. The PNEO measures are the distance to mosque and land use mix entropy while the PNES measures are the perceived residential density, perceived accessibility, and perceived safety from traffic hazard.

Table 7.9: Significant results of PNEO – PA (H1) and PNES – PA (H2)

PNEO measures => PA	**Significant results**
Distance to mosque *Short distance: <200m *Medium: 200.1m – 300m *Long: >300.1m	$\gamma = 0.423$, $p < 0.058$ Short, C3 +
Land use mix entropy *Low: <0.5 *Medium: 0.51 – 0.74 *High: >0.75	$\gamma = 0.621$, $p < 0.013$ Low, C2 +
PNES measures => PA	**Significant results**
Perceived residential density	$\gamma = 0.897$, $p < 0.632$ High, C1+
Perceived accessibility	$\gamma = 0.543$, $p < 0.006$ High, C3+, C2+
Perceived safety from traffic hazard	$\gamma = 0.421$, $p < 0.021$ Low, C1+
Perceived lack of cul-de-sacs	$\gamma = 0.472$, $p < 0.030$ High, C2+

For PNEO, respondent who lives within a short distance less than 200m from the mosque tend to show C3. Older adults who lives nearby to the mosque are logically assumed to be more active because they are more likely to walk and spend their time participating in religious activities at the mosque. This strongly supports the existing study done by Azmi & Karim (2012) whereby adults prefer to walk less than 200 meters to a community facility before choosing to drive (Azmi & Karim, 2012). APUDG (2000) also proves that the suitable maximum walking distance of older adults in Malaysia is usually 190 meters. Moreover, respondents living in lower land use mix entropy tend to show C2 in this neighbourhood. This is an interesting observation since most studies proves that people living in low mixed-land use area tend to be inactive. Since this neighbourhood has the smallest area compared to the other neighbourhood, the respondents were assumed to be located within a neighbourhood centrality that comprised of functional and walkable land uses such as residential and commercial. Due to the short walking distance to most of the commercial area in this neighbourhood, respondents were assumed to walk to their desired destinations within the neighbourhood (Figure 7.14), hence, the significant result low land use mix entropy and C2 PA level.

For PNES, respondents who perceive a high residential density tend to show C1. This is contrary to most Western countries studies in which residential density is usually positively associated with PA (Hajna et al., 2015; Van Holle et al., 2012). However, this result is in line with a study done in Asia where residential density is negatively associated with PA (Zhiyong Wang et al., 2019). Since high perception of residential density indicates the various types of residential, respondent's location showed that most of them were living near high-rise apartment (Figure 7.14). However, they tend to show a low PA. A logical reason to this is that older adults might felt intimidated and

uncomfortable to spend their time outside especially in recreation areas due to the high number of people in high-rise property who might also use the same facility. They might want to avoid unnecessary social interaction with residents living in the high-rise property since most of the high-rise residents were among the people who rents the place and not permanent residents in the neighbourhood, unlike all respondents living in the terrace housings in this neighbourhood. This is a common conception in this neighbourhood area based on the previous pilot interview. Some of the neighbourhood association members showed an extent of dissatisfaction and uneasiness to the new-comers or renters in the high-rise property by addressing their loudness, a huge number of vehicles that caused parking problems in the main road area, and younger people loitering around in the recreation area.

Next, a high perceived accessibility is associated with C2 and C3. Accessibility in this context indicate that there are many places to go, grocery stores are within walking distance and walking to bus stop is easy. Respondent's location clearly show that they actually walk to the nearest commercial area since their location is very near to a commercial lots located in the neighbourhood centrality area (Figure 7.14). Furthermore, low perception on safety from traffic hazard denotes a higher score of walkability (Saelens et al., 2003). The results showed that respondents who showed C1 tend to perceive a low perception towards traffic hazard safety which means their home vicinity has a good extent of traffic safety. This makes sense when considering the respondent's location in which most of the respondents are not located near the main road, but also located within walking distance to grocery stores which is reflected through the measure of accessibility.

Lastly, respondents who are C2 tend to perceive a high lack of cul-de-sac within their neighbourhood which typically means that the lack of cul-de-sac in this neighbourhood are positively associated with a higher level of PA among older adults. Older adults are at least moderately active regardless of the less number of cul-de-sac which normally would increase the walking distance within a residential block. When looking at the layout of this neighbourhood, most of the streets and residential property were laid out similarly to a traditional grid-iron pattern, with some areas are disconnected with cul-de-sac streets but are highly accessible for pedestrians through small walkways. Respondents perceived their houses to be located in streets that are still accessible for pedestrians to pass through because the cul-de-sac features are not truly a dead-end road, similar to the physical characteristics found in Taman Nusantara. This is highly supported by the previous significant relationship with perceived accessibility in which respondent who are C2 and C3 perceived a high level of accessibility in their housing vicinity. Thus, this explains the moderately active PA level of older adults in this neighbourhood which has a number of cul-de-sacs streets with accessible pedestrian lanes. Typically, the layout for Western neighbourhoods are either conventional cul-de-sac patterns or conventional grid irons, which does not have accessible pedestrian lanes, unlike the normal grid-iron pattern for most Malaysian neighbourhoods. This can be regarded as an intrinsic feature that supports an active ageing lifestyle among older adults in Johor Bahru city.

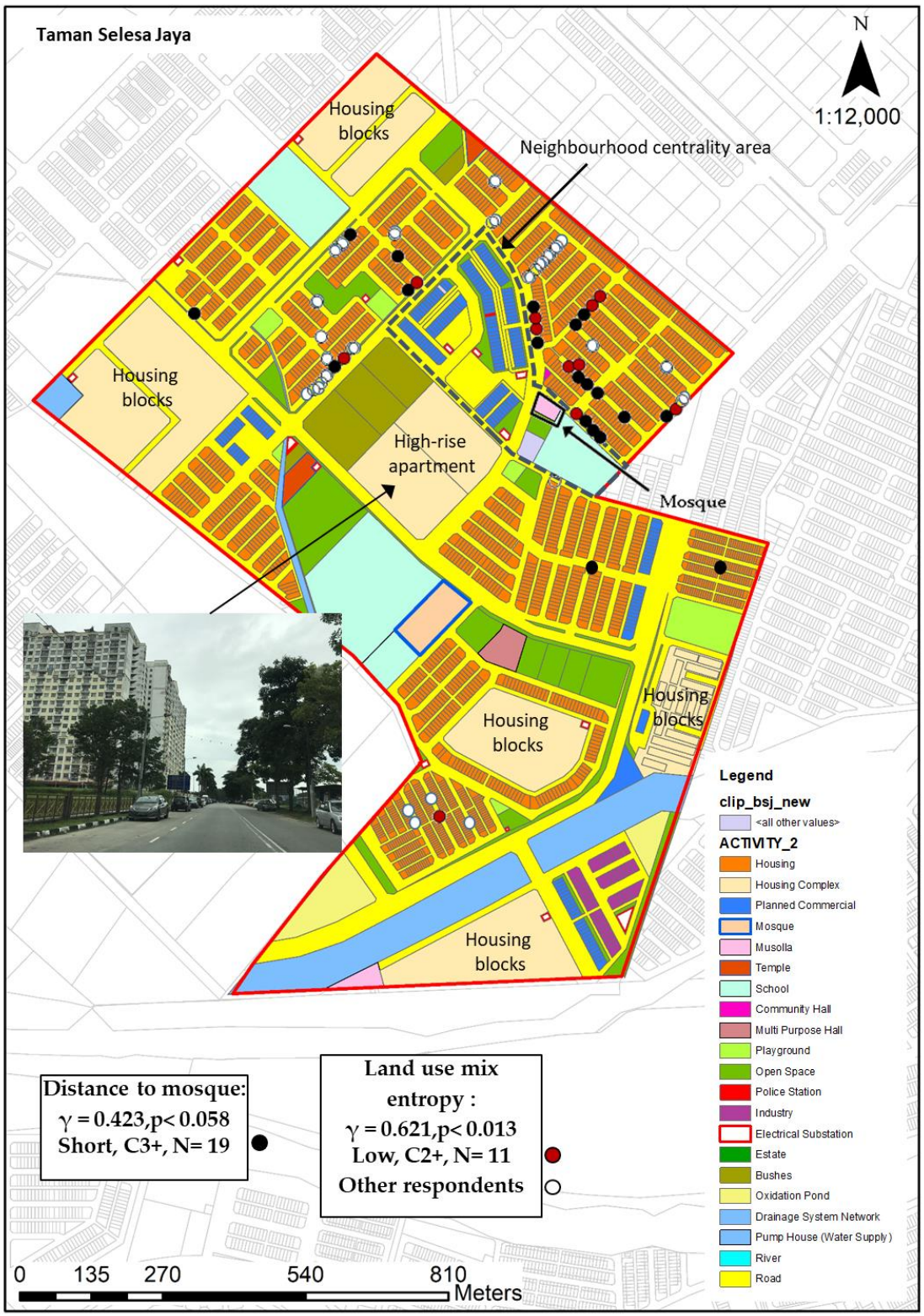


Figure 7.14: Land use map of Taman Selesa Jaya showing the neighbourhood centrality area and location of the high-rise apartment

7.3.2 Direct relationship for SNEO – PA (H3)

The correlation test was performed for SNEO items with PA level and the result was shown in Table 7.10 below. The SNEO item for frequency of joining religious community activities showed a direct relationship when correlated with older adults' PA level. Respondents who showed a high level of PA (C3) occasionally participated in religious community activities whereas respondents who showed inactivity (C1) never participated in any activities. Similar to the respondents in the other neighbourhoods that showed the same trend as this, participating in religious activities may increase the PA level of respondents by helping out for the preparation and closing time of the activities. Older adults who lived within a short distance to the mosque were also proven to show a significant level of PA discussed in the previous section.

Table 7.10: Significant result for SNEO – PA (H3)

SNEO measures => PA	**Significant results**
Sociability 3: Frequency of joining religious community activities • Never • Rarely • Occasionally • Frequently	$\gamma = 0.602$, $p < 0.057$ (Occasionally, C3) (Never, C1)

7.3.3 Indirect relationship for PNEO => PNES – PA (H4)

There were no significant results for this indirect relationship in this neighbourhood.

7.3.4 Indirect relationship for PNEO => SNEO – PA (H5)

As mentioned previously in the earlier chapter, the indirect relationships based on the conceptual framework were examined by only referring to the significant relationships in H1 (PNEO – PA) and H3 (SNEO – PA). Table 7.11 showed the indirect significant results obtained from the hypothesized relationship. It was proven that the high PA level shown by the respondents were influenced by their house locations that were within a short distance to the mosque (shown in Figure 7.14 previously), in which the respondents occasionally participated in religious activities. This means that the PNEO for the distance to mosque was proven to influence the PA level of older adults indirectly through their participation in religious activities (Figure 7.15).

Figure 7.15: Majority of older men participating in weekly religious activities held at the mosque in Taman Selesa Jaya

Table 7.11: Significant result for indirect relationship caused by SNEO – PA (H5)

PNEO items	**SNEO items**	**Significant results correlated with PA level (C1, C2, C3)**
Distance to mosque (A) • Less than 200 metres (short) • 200.01 – 300 metres (medium) • More than 300 metres (long)	Sociability 3: Frequency of joining religious activities (B) • Never • Rarely • Occasionally • Frequently	$\gamma = 0.673$, $p < 0.031$ (Long A, Never B, C1) (Short A, Occasionally, C3)

7.3.5 Indirect relationship for PNEO => SNES – PA (H6)

Referring back to the conceptual framework in the earlier chapter, SNES items were hypothesized to be caused by PNEO, and show an indirect relationship with PA. The significant PNEO items which was the land use mix entropy were cross-tabulated with all three SNES items and PA level of respondents. Only generalized trust showed significant results when correlated with PA level, shown in Table 7.12.

Table 7.12: Significant result for PNEO => SNES – PA (H6)

PNEO items	**SNES items**	**Significant results correlated with PA level (C1, C2, C3)**
Land use mix entropy (A) • Less than 0.5 (low) • 0.51 – 0.74 (medium) • More than 0.75 (high)	Generalized trust (B)	$\gamma = 0.797$, $p < 0.031$ (High A, High B, C3)

Respondents living in high land use mix entropy area showed a high generalized trust and high PA level of C3. In line with the results from Nabil & Eldayem (2015) which proves the influence of mixed land use to social capital measures, generalized trust tend to be stronger in communities with frequent social interactions. A high land use mix areas can be define as having a heterogeneity of various land uses which are residential, commercial, recreation or open space areas, religious and institutional land uses. For this neighbourhood context, respondents are located mostly near residential, commercial, recreation or open space areas, mosque and school facilities which explains a high land use mix entropy (as shown in Figure 7.14 previously). As expected, people who are living within high land use mix areas tend to perceive a high generalized trust to the surrounding community in their neighbourhood. This findings supports previous studies in which people living in diverse land uses tend to have higher social capital (Yoo & Lee, 2016). One possible explanation to this was explained by Jacob (1961) and supported by the New Urbanism concept (2000) wherein mixed land use areas increases the likelihood of social interaction in the diverse settings. Various types of land uses within the housing vicinity such as walkable destinations might influence the extent of social interaction among the community members and may help facilitate the creation of a close-knit community in the housing area.

7.3.6 Direct relationship for SES => PA (H7)

Chi-square tests are implied to the measures of gender, occupation, family structure and race due to the nature of the variables which is categorical variable. For the measures of age and period of stay, since the categories in age and period of stay were originally scale variables and had a non-normal distribution, Spearman's rank correlation tests were deemed to be more suitable. However, only period of stay showed significant correlation with the respondent's PA level in this neighbourhood, as seen in Table 7.13 below.

The results showed that older adults who stayed longer than 11 years tend to show C3. Similar to the same trend in the previous neighbourhoods, it was assumed that these respondents were permanent residents and usually has stronger informal bonding relationships among people who actively joined community activities. Similarly in the Malaysian context, Malay older adults especially retirees and unemployed housewives normally would have more free time and tend to be more active in religious and spiritual activities.

Table 7.13: Demographic attributes (SES items) that was significant with PA level of older adults

SES measures => PA	**Significant results**
Period of stay (years) 1= Less than 5; 2= 6 – 10; 3= More than 11	$\gamma = 0.491$, N= 57, $p < 0.023$ (More than 11 years, C3)

7.4 Summary of Chapter

- Older adults who live near the mosque become more active as they are more likely to walk and spend their time participating in religious activities in the mosque. (H1, H3 and H5)
- Respondents were assumed to be in the centre of functional, walkable neighbourhoods, such as residential and commercial areas. Since this neighbourhood is the smallest area compared to the other neighbourhoods, most commercial areas in this neighbourhood were within walking distance, and the respondents were expected to be walking to their desired destinations within the neighbourhood. (H1)
- Most respondents were living near high-rise residential property and showed low PA levels. Older adults might felt intimidated to spend their time in recreation areas due to the high number of people in high-rise property who also used the same facility. (H2)
- Most respondents were located very close to a commercial area, rather than the main road. This was also proven when respondents with C2 tend to recognise a low perception of traffic hazards safety. (H2)
- Similar to the other neighbourhoods, most streets and residential properties are laid out according to a traditional gridiron pattern, with some areas divided by dead-end alleys, but highly accessible for pedestrians through small walkways. (H2)
- Most respondents were near residential, commercial, recreational or open space areas, mosques and school facilities that explains a high land-use mix entropy. Various types of land uses within the housing vicinity, such as walkable destinations, may influence the extent of social interactions among the community members and may help facilitate the creation of a close-knit community, especially among respondents living in terraced houses. (H6)
- Respondents were permanent residents who were expected to have stronger informal bonding relationships, especially among people who actively joined community activities. (H7)

8 CONCLUSION

8.1 Overall Findings

To discuss the overall findings of this research, a simplified summary of the direct and indirect meaningful relationships combining all four neighbourhoods in this study is shown in Table 8.1 and Table 8.2. Some results can be generally summarised, while others were unique for each region due to the neighbourhood's physical characteristics. All objective physical neighbourhood elements (PNEO) except for traffic intersection density were found to have direct relationships with older respondents' PA levels, as well as all subjective physical neighbourhood elements (PNES) except for perceived infrastructure for walking and perceived neighbourhood aesthetics. The third direct hypothesis is SNEO-PA. It was the most significant element explaining the frequency of joining community activities (Sociability 1) in all four neighbourhoods. Besides, other SNEO items were also shown to have strong relationships with PA, specifically for the number of close friends (social network), participation in community groups, and willingness to spend time (collective action and cooperation) in separate neighbourhoods.

Generally, according to Table 8.1, at least three neighbourhoods showed significant relationships for the PNEO items when correlated with PA levels. The PNEO items were the distance to the mosques, distance to recreational areas or playgrounds, and land-use mix entropy. Key findings were closely associated with the recommended distance from facilities, including mosques, playgrounds or recreational areas. Therefore, it is recommended that these facilities be less than 300 m from residential land use to encourage a higher PA potential in older adults in Malaysia. As most respondents had less access to the mosques and open recreational facilities, the PA levels tend to decrease. Another important finding was that high-population density is not always positively correlated with higher PA values; therefore, it may not be a suitable residential environment to encourage active ageing in the Malaysian context. Another important finding was the classification of walkable land-use types in land-use mix entropy. This can affect the PA levels of the elderly documented across the neighbourhoods. The recreation area types are also crucial in promoting PA. For example, as most open recreational areas in this study were designed specifically for the younger generation, older adults were less likely to spend time on outdoor recreational activities.

Furthermore, land-use mix entropy was proven to be one of the critical findings that affect the PA levels of older adults across the three neighbourhoods. However, it was positively and negatively correlated with the PA levels concurrently. This is due to the unique physical characteristics of each region. For example, Taman Nusantara, which shows a robust negative association between land-use mix entropy and PA levels, was assumed to be due to residential segregation boundaries separated by main roads throughout the neighbourhood. On the other hand, Taman Selesa Jaya showed a positive association between land-use mix entropy and PA levels. This was assumed to be due to the centrality of the functional and walkable neighbourhood since the boundaries of this neighbourhood were smaller compared to other regions.

Meanwhile, the relationship between PNES and PA is also crucial in highlighting the similarities and differences of the perceived physical characteristics in each neighbourhood that may prevent or affect physical activities, as shown in Table 1. The PNES items that are important with PA levels were observed in at least two of four neighbourhoods, including perceived accessibility, perceived traffic safety and perceived lack of dead-end paths. According to this, it is apparent that these are essential PNES items that can directly affect the PA levels of older adults indirectly related to traffic road infrastructure across the neighbourhoods. This leads to the identification of similar small physical characteristics such as the presence of iron-road medians, drainage network line that separates potential walkable land uses, and the presence of dead-end alleys with pedestrian walkways connecting to the other side of the street. Besides, the existing traffic speed limit may also have a significant impact on the PA levels of older adults, since most respondents seem to be living near the main roads throughout the neighbourhoods. The existing traffic speed limit designated for local roads in front of the terraced houses was about 35 km/h. However, based on previous observations during the survey, most drivers

were driving faster than the speed limit even though road humps were available on all local roads in front of the terraced houses in all neighbourhoods except for the internal traffic network of the housing blocks in Taman Perling. This assumption was entirely based on the author's direct observation, but some respondents also complained about this issue. Due to the lack of sufficient data related to this issue, future investigations must consider this critical factor more specifically.

In addition, several critical physical characteristics of each neighbourhood were identified that help strengthen the assumption of significant relationships in the results section. Taman Perling has the largest area primarily composed of terraced houses and several housing blocks. The selected respondents living in terraced houses beside the main road and the inner roads somewhat influenced that obtained results. The types of roads and the designated road speeds may affect the likelihood of walking around their houses. Figure 8.1 shows more detailed information on this issue.

Moreover, the internal environment of the housing blocks was found appropriate to serve the residents due to the presence of a few grocery stores and a small eatery managed by the residents. The only active and walkable components within the housing blocks were grocery stores, restaurants, and mosques, indicating that most residents have low PA levels due to the lack of open space at the boundaries of the housing blocks. Pedestrian walkways that connect the housing blocks to the nearby mosque also exist. Still, the condition of walking to the mosque makes it dangerous, especially for older people, because pedestrians may be subjected to crime when walking beside the main road.

Furthermore, the three housing blocks were located near the main commercial area of Taman Perling. Still, the existence of the highway makes it difficult for pedestrians to cross even though there was a pedestrian crossing. Older adults living in the housing blocks in Taman Perling usually prefer not to use the pedestrian crossing to go to the other side of the neighbourhood since the internal environment of the housing blocks is considered sufficient for them. In addition, the location of the pedestrian crossing that is located at the entrance and exit point of the road network makes it unsafe to cross the road to go to the pedestrian crossing, especially for older adults. Figure 8.2 shows the main physical characteristics of the Taman Perling housing blocks environment.

On the other hand, the main physical characteristics of Taman Nusantara is residential segregation. This means that the different areas of the terraced houses are separated by grass strip boundaries and the main roads lined with iron medians. This condition makes it impossible for pedestrians to cross, especially for older people. The smaller areas of the terraced houses resulted in different smaller communities, which were managed by several neighbourhood associations. Here, the mosque was observed as the main venue for these communities to gather for more prominent programmes and activities. However, the vertical shape of the borders of the Tamannu Santara neighbourhood makes it difficult to create a functional, walkable neighbourhood central area. In this area, residents were obliged to travel by vehicles instead of walking and crossing a highway with grass boundaries and iron medians. Furthermore, the presence of the drainage network that separates the main commercial area from the rest of the residential sector in this neighbourhood makes it difficult for residents to walk. Figure 8.3 shows the main physical characteristics of Taman Nusantara.

Taman Selesa Jaya has an essential physical characteristic as a functional and walkable neighbourhood due to its smaller area boundary. The gridiron layout resulted in shorter rows of terraced houses, more traffic and pedestrian intersections, as well as the presence of a proper pedestrian walkway beside the main road similar to Taman Nusantara. Furthermore, the diversity of land uses in this neighbourhood may affect significant relationships obtained. Still, the older adults who were the permanent residents in terraced houses tend to be threatened by temporary residents in the apartments. Therefore, having diverse types of land use or different types of residential properties in the neighbourhood may not be the preferred choice to promote an active ageing environment. Figure 8.4 shows the main physical characteristics of Taman Selesa Jaya.

Figure 8.1: Types of roads in Taman Perling in which most respondents living in terrace houses were living near the main road and local road.

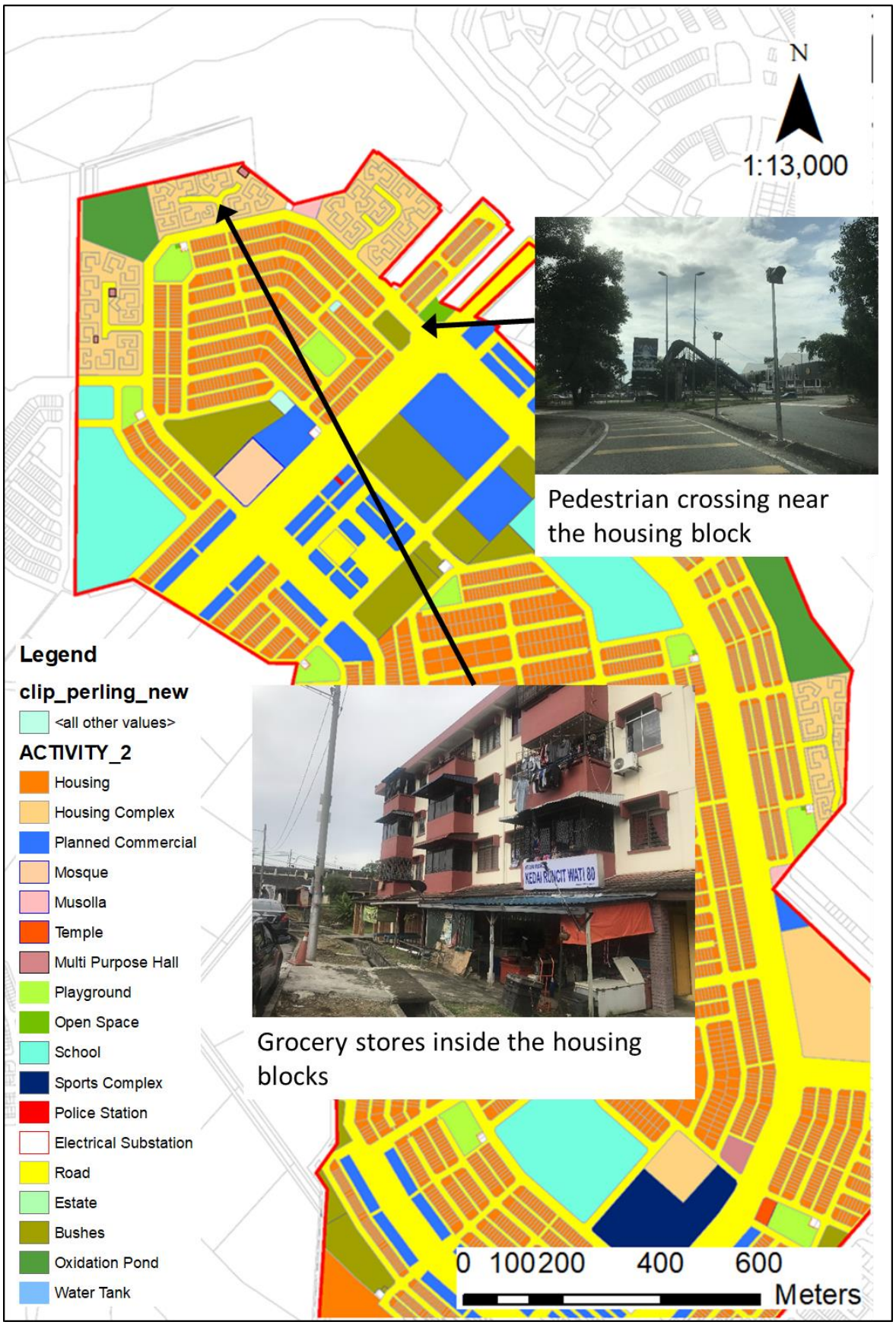


Figure 8.2: Housing blocks environment in Taman Perling

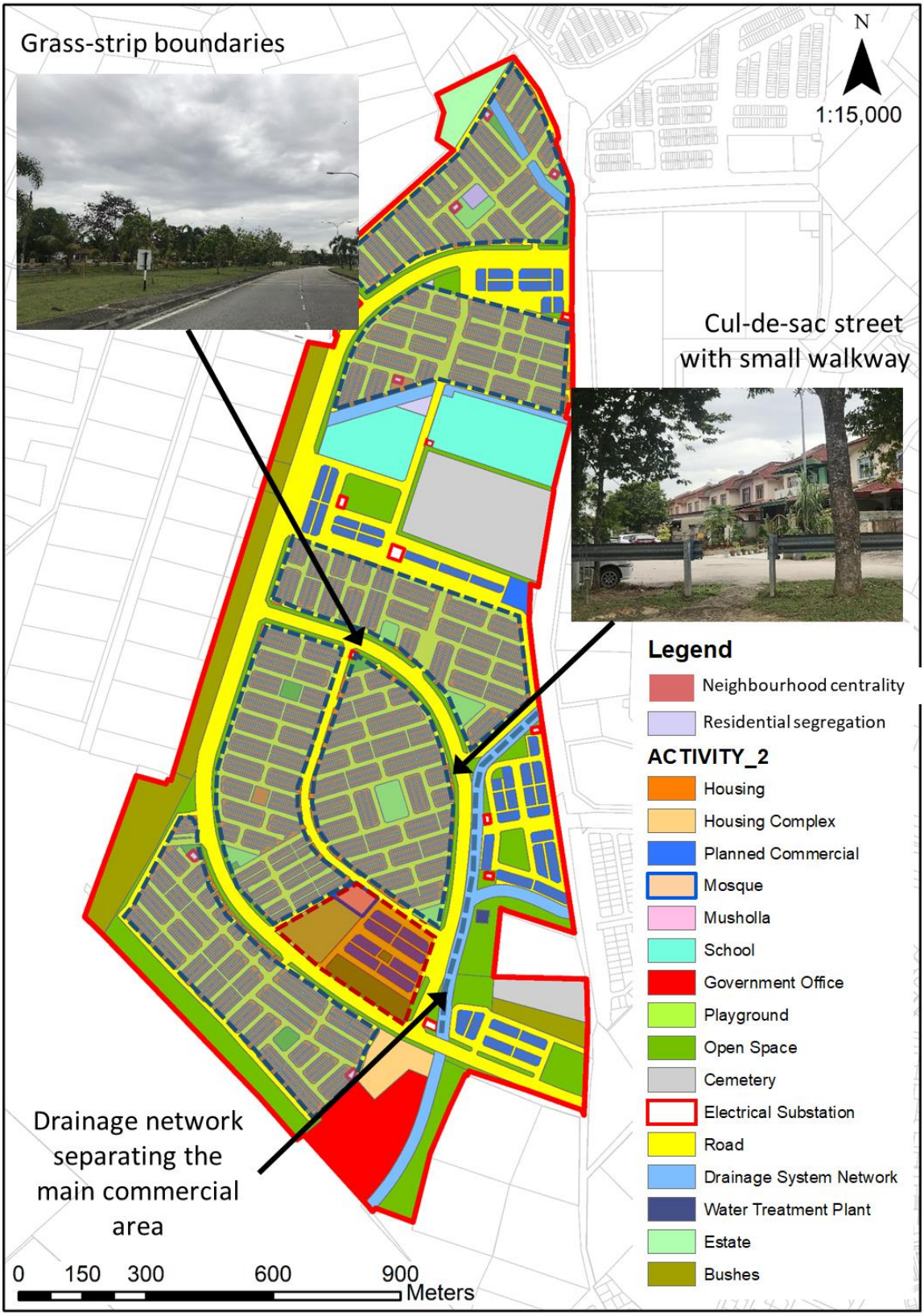


Figure 8.3: Residential segregation and neighbourhood centrality area in Taman Nusantara

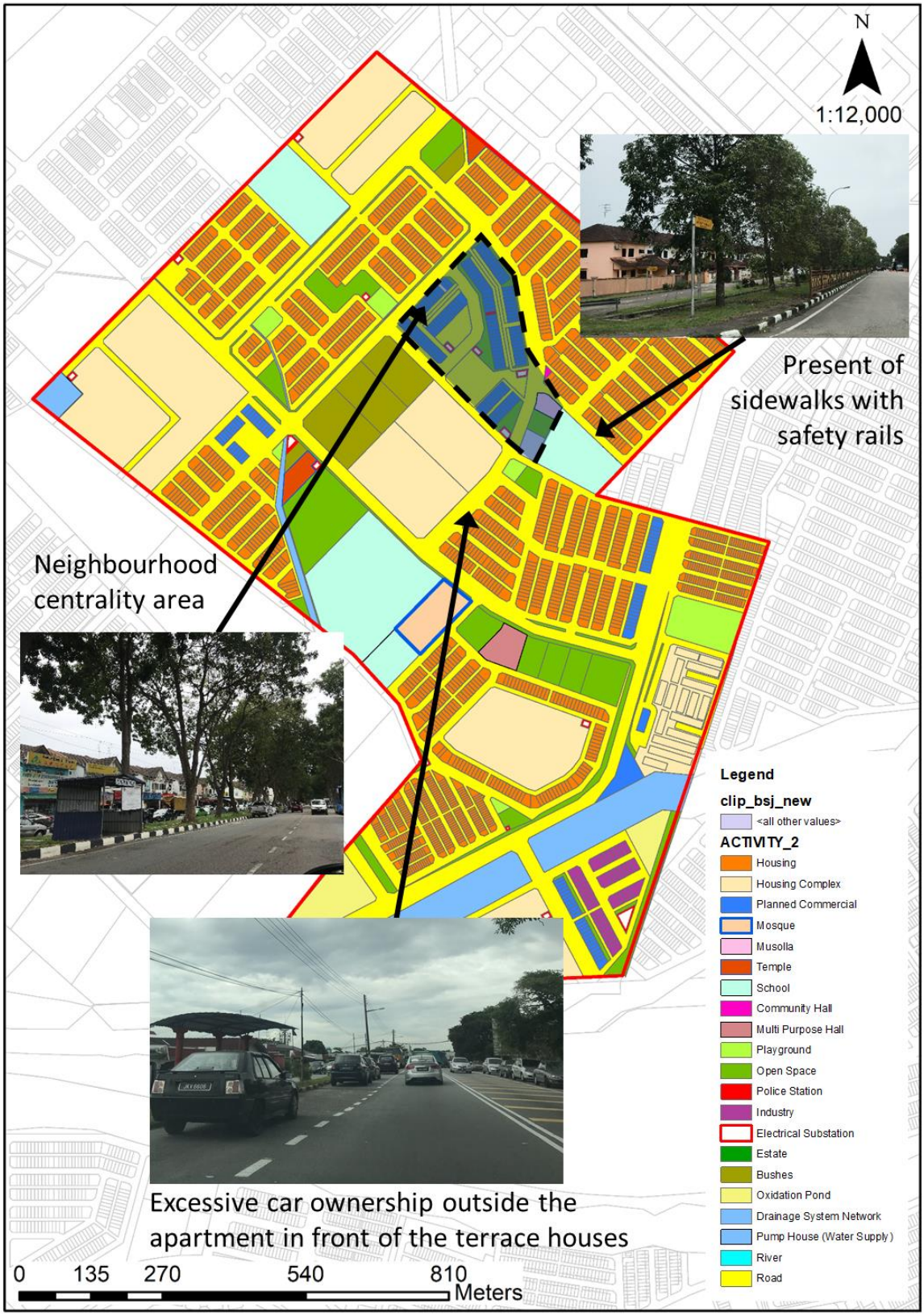


Figure 8.4: Existing condition in Taman Selesa Jaya

While focusing on PNE that can affect the PA levels in older adults, it is notable taking note of the direct relationships between SNEO and PA. According to Table 8.1, we can generalise the key findings of SNEO-PA based on the positive association between the frequency of participating in community activities and the PA levels. All neighbourhoods seem to show the same trend in which the 'gotong-royong' activities, recreation, religious and collaboration programmes were shown to affect PA level of older adults positively. A study has shown that older adults who frequently participated in community activities tend to have increased motivations to maintain regular attendance and receive benefits for their mental health, including stress relief, entertainment, and coping with their current life conditions (Lindsay Smith et al., 2017).

Some results between the members of community groups with PA level (Sociability 1 and 3) were also proven with increasing PA levels. The distinction between the members of community groups and the frequency of participation in community activities lies within the types of social relationships that exist in these two items. Under the social capital theory, becoming a member of the community groups means that members of the society have a formal bridging relationship involving other members. Contrarily, participating in community activities was much easier. Members of society must deal with informal social relationships while enjoying the benefits of well-informed and healthy activities. This represents the rationale of significant relationships.

The role of the neighbourhood association is an outstanding feature of the social neighbourhood environment, and a medium for binding community's tendency to strengthen the scope of collective action and cooperation. Although informal daily social interactions can occur among respondents, the presence of formal community organisations represents the voice of people living in a specific area. Furthermore, poor accessibility, which accounts for low intersection density, may be a feature of the potential PNES that may enhance the sense of security, especially among older people.

Furthermore, this study conforms to the importance of having dead-end alleys with small walkways for pedestrians to go across the street. Respondents seem to understand the nature of dead ends in the questionnaire survey, as a dead-end road has no pedestrian access. However, most local roads in front of the terraced houses in the neighbourhood tend to have limited pedestrian access. Critical results also showed that most people who perceived the scarcity of blind alleys, which means a small number of blind alleys in their residential area, were among the active elderly. Respondents tend to assume that the existing dead-end roads in their vicinity are not genuinely dead ends since most of them have narrow pedestrian walkways to pass through. This can reduce the accessibility of motorised vehicles, but at the same time, can create road intersections for pedestrians. Such situations positively affect daily causal interactions among residents. In the long run, this can be a salient feature that can help older people achieve ageing-in-place lifestyle.

Table 8.1: Summary table for all direct relationships

Measures	Taman Perling terrace	Taman Perling housing blocks	Taman Nusantara	Taman Selesa Jaya
H1 : PNEO < > PA				
Population density		✓		
Distance to facilities (mosque)		✓		✓
Distance to facilities (recreational area)		✓	✓	
Traffic intersection density				
Land use mix entropy	✓		✓	✓
H2: PNES < > PA				
Perceived residential density				✓

Perceived land use diversity			✓	
Perceived neighbourhood accessibility	✓			✓
Perceived street connectivity	✓			
Perceived infrastructure for walking				
Perceived neighbourhood aesthetics				
Perceived traffic safety			✓	✓
Perceived crime safety	✓			
Perceived lack of parking			✓	
Perceived lack of cul-de-sacs			✓	✓
Perceived hilliness	✓			
Perceived physical barriers	✓			
H3: SNEO < > PA				
Social network (number of close friends)	✓			
Mutual support (number of people willing to lend money)				
Social interaction (frequency of interaction with neighbours)				
Sociability 1 (Participation in neighbourhood association/ 'Rukun Tetangga')				
Sociability 1 (Participation in neighbourhood patrol/ 'SRS')			✓	
Sociability 1 (Participation in mosque committee			✓	
Sociability 1 (Participation in recreation club)				
Sociability 2 (Level of decision-making in neighbourhood association/ 'Rukun Tetangga')				
Sociability 2 (Level of decision-making in neighbourhood patrol/ 'Skim Rondaan Sukarela')				
Sociability 2 (Level of decision-making community in mosque committee)				
Sociability 2 (Level of decision-making in recreation club)				
Sociability 3 (Frequency of joining 'gotong-royong' activities)	✓	✓		
Sociability 3 (Frequency of joining recreation activities)	✓	✓		
Sociability 3 (Frequency of joining religious activities)		✓	✓	✓

Sociability 3 (Frequency of joining collaboration program with outside groups)	✓	✓	✓	
Collective action and cooperation (Willingness to contribute time to community project)	✓			
Collective action and cooperation (Willingness to contribute money to community project)				

On the other hand, apart from having direct relationships with PA levels, it was hypothesised that there were significant indirect relationships between PNES, SNEO and SNES with PA level that was caused by PNEO. However, meaningful indirect relationships mostly occurred in specific neighbourhoods that are not suitable to be generalised. This is due to the physical characteristics represented by each neighbourhood that can also result in these indirect relationships. Table 8.2 presents the summary of all indirect relationships. For the Taman Perling terraced houses, only land-use mix entropy (PNEO) indirectly affects the PA level of respondents through the PNES items of perceived accessibility, street connectivity and perceived safety from crime. The items in this area include the SNEO items of frequency participating in various types of community activities and willingness to spend time for a community project, and the SNES items of perceived generalised trust, perceived collective action and cooperation, and perception towards community groups in the neighbourhood.

The findings of the indirect relationships suggest that the PNES has an essential influence on the social neighbourhood environment among older people. In this study, living in a densely populated area shows that people perceived less crime. Therefore, they are expected to live in a secure environment and, at the same time, experience strong social trust, which may be the cause of informal daily social interactions with their neighbours. Respondents tend to be negatively correlated with collective action and cooperation items. Therefore, densely populated neighbourhoods may not be the optimal environment for older people to develop ageing-in-place lifestyle.

Table 8.2: Summary table for all indirect relationships

Measures	**Taman Perling terrace**	**Taman Perling housing blocks**	**Taman Nusantara**	**Taman Selesa Jaya**
H4: PNEO – PNES				
Land use mix entropy > Perceived accessibility	✓			
Land use mix entropy > Perceived street connectivity	✓			
Land use mix entropy > Perceived safety from crime	✓			
Distance to playground > Perceived land use mix diversity			✓	
Distance to playground > Perceived safety from traffic hazard			✓	

Distance to playground > Perceived lack of parking			✓	
Distance to playground > Perceived lack of cul-de-sac			✓	
H5: PNEO – SNEO				
Land use mix entropy > Frequency of joining 'gotong-royong' activities	✓			
Land use mix entropy > Frequency of joining recreation activities	✓			
Land use mix entropy > Frequency of joining religious activities	✓			
Land use mix entropy > Frequency of joining collaboration programs	✓			
Land use mix entropy > Contribute time	✓			
Population density > Frequency of joining 'gotong-royong' activities		✓		
Population density > Frequency of joining recreation activities		✓		
Population density > Frequency of joining collaboration programs		✓		
Distance to mosque > Frequency of joining recreation activities		✓		
Distance to mosque > Frequency of joining religious activities		✓		✓
Distance to mosque > Frequency of joining collaboration programs		✓		
Distance to mosque > Frequency of joining 'gotong-royong' activities		✓		
Distance to playground > Frequency of joining 'gotong-royong' activities		✓		
Distance to playground > Frequency of joining collaboration programs		✓	✓	
H6: PNEO – SNES				
Land use mix entropy > Perceived generalized trust	✓			✓
Land use mix entropy > Perceived collective action and cooperation	✓			

Land use mix entropy > Perception towards community groups	✓			
Distance to mosque > Perceived collective action and cooperation		✓		
Distance to playground > Perceived generalized trust		✓	✓	
Distance to playground > Perceived collective action and cooperation			✓	
Distance to playground > Perception towards community groups			✓	
H7: SES < > PA				
Gender			✓	
Age group				
Period of stay		✓	✓	✓
Race	✓			
Occupation				
Family structure				

Another domain, unrelated to PNE and SNE, included socio-economic indicators as one of the study results, which may also have a substantial impact on PA levels of older adults in these neighbourhoods. The extended period of stay showed significant results with PA levels across most neighbourhoods. This trend usually occurred among permanent residents when compared to temporary residents who rented a house. Permanent residents were generally older adults who lived longer in the neighbourhood. In contrast, the temporary residents were among the younger adults who had moved to the neighbourhood for less than five years. Logically, permanent residents tend to build stronger social relationships, ultimately affecting their tendency to engage in social affairs and participate in formal community groups and activities. They tend to develop a higher sense of responsibility when they experience productive social relationships in their neighbourhood.

Conversely, the nature of social relationships and networks is time consuming and challenging to build quickly. Residents can maintain good communication with their immediate neighbours while staying in communication over time. This is believed to be less common, especially among young adults who may be working before retirement at age 60. Newcomers in the neighbourhood could not usually adapt to their new life and experienced a lack of awareness of social affairs in their neighbourhood community (Zhong and Kou, 2017). Furthermore, it was commonly observed among permanent residents over the age of 60 to spend more free time after retirement. This can considerably affect their extent of PA levels through the PNE and SNE domains.

Furthermore, the status of permanent residents and temporary residents can also indicate the financial status of respondents. Permanent residents, usually residents among retired seniors, tend to own their property and, therefore, show a stable level of economic condition. The type of house they lived in, such as terraced houses or housing blocks, can also reveal the level of income of the residents. Based on the results presented above, the significant relationship between PNEO, PNES, SNEO, and SNES and PA levels varied in the Taman Perling housing blocks and the other three study areas. The level of financial status has not been directly analysed at the PA level, but this is an important feature to be investigated, especially in the field of social sciences.

This study highlighted the importance of both objective and subjective PNE and SNE measures that affect the degree of PA in older adults in smaller neighbourhoods. Apart from the outstanding results

obtained in this study, some similar physical characteristics in each neighbourhood were also assumed to affect the prominent achievements of this study. The results of this study are deemed to be generalised to most ageing neighbourhoods in the Malaysian cities by considering similar specific physical characteristics of the neighbourhood environment of terraced houses and housing blocks. Nonetheless, further research is needed to explore the distinctive outputs of other types of housing environments in Malaysia that can affect PA levels in the elderly.

8.2 Implementation of Research Outcomes to the context of Malaysia's Housing Policy and Guidelines for Active Ageing Promotion

Active ageing is well established in most policy frameworks in developed countries but less recognised in developing countries such as Malaysia. However, although Malaysia has promoted active ageing in its 2011 revised National Policy and Plan of Action for Older Persons (Zawawi, 2013), the context is general and few concrete actions have been proposed. Little attention has been given to the influence of the PNE on PA levels in the elderly. It is essential to foster an active ageing concept in the Malaysian housing sector by promoting physical neighbourhood characteristics.

Concerns about the welfare of the elderly were emphasised under Malaysia's Economic Transformation Plan (Chapter 16), which actively support the elderly and to provide sustainable lifestyles. The importance of caring for the elderly was also highlighted as one of the National Key Result Areas. In parallel, the Eleventh Malaysia Plan (RMK-11) focused on improving nursing facilities that give back to society, particularly for the elderly. Hence, the National Policy for Elderly (2011) was created at the time and improved to help older people become more independent and increase self-value through optimising well-being, leading to healthy, positive, active, productive, and supportive ageing lifestyles (Fazari & Salleh, 2017).

8.2.1 Significance of Malaysia's Elderly Policy in the Social Neighbourhood Environment

The Ministry of Women, Family, and Community Development is leading the National Policy for Elderly (2011), helping older people to live independently and providing alternative homes with suitable services such as retirement villages, mobile homecare, modern huts ('Pondok' system), and granny flat (Strategy 3, Programme 3) (Jumadi et al., 2017). The implementation of this policy has been successful so far, and 22 activity centres for older people have been constructed (PAWE/ 'Pusat Aktiviti Warga Emas') nationwide. The PAWE concept is focused on developing well-being and reaching out to the elderly. The activity centre offers a variety of activities such as religious programmes, recreational activities, rehabilitation therapies, medical examinations, health awareness seminars, and other types of life skill courses (Ismail et al., 2017).

As much as can be expected, the social awareness of the Malaysian elderly community is limited. Various government agencies must work together to make this programme successful. Although this was an excellent initiative to help Malaysian seniors, it is still somewhat troublesome for older people to participate in activity centres enthusiastically. The majority of seniors in society may have gone to these activity centres simply because private transport is unavailable or simply unable to move outside the neighbourhood. At present, there is only one activity centre (PAWE) in Johor Bahru. Concerning the importance of this study, most older people tend to be active through the daily activities they perform in the neighbourhood. Not all people free up their time to go to the activity centre for the purpose of productivity. Therefore, the importance of community groups and community activities organised in the neighbourhoods continues to be important and influential in improving PA levels in the elderly.

The importance of more localised community groups, whether formal or informal, is essential to enable older people to live independently within their environment. The types of activities organised by the community groups may serve different groups in society, depending on their interests. Malay Muslims tend to participate in religious activities in mosques. At the same time,

people of other races and religions may wish to participate in leisure and recreation activities held in recreational areas and playgrounds. Hence, these are some of the critical findings that can be improved by government and ministries, especially in the immediate environment.

8.2.2 Spatial Planning of the Physical Neighbourhood Environment

Improvements and initiatives provided by the government to support Malaysian seniors are more focused on social components, while still insufficient in terms of physical neighbourhood. Malaysia housings for the elderly is usually governed by the Department of Social Welfare (DSW), which is responsible for providing homes and healthcare service facilities for the elderly. NGOs that are more profit-oriented offer services to those who can afford it (Aini et al., 2015; Jumadi et al., 2017; Sulaiman et al., 2005). To date, the management of new homes for the elderly by DSW (as a government sector) has stopped. However, as noted by the Minister of Women, Family, and Community Development, existing facilities are still managed by the government (Malay Mail, 2016).

From a physical neighbourhood perspective, the solution is a senior co-housing similar to retirement homes. The basic concept of senior co-housing is to be socially active, fit physically, and aim to live independently while at the same time seeking to receive the support of neighbours while protecting each other's privacy (Brenton, 2017). The system is very similar to an actual example called 'Kampung Admiralty Mixed-Use Development Project' in Singapore. A preliminary study conducted in the city of Johor Bahru showed that older adults agree with the concept of co-housing and can be implemented to some extent (Jumadi et al., 2017). This is the right solution, but it does not apply to the majority of older adults who choose to still live in their current neighbourhood. Some local studies in the city of Kuala Lumpur reported that Malaysian older adults in the urban regions were mostly satisfied with their current accommodation and were not considering moving to a new location in the future (Aini et al., 2015; Ainoriza et al., 2016). This strongly supports that ageing in place is the preferred lifestyle among Malaysian seniors. Older adults in Malaysia also preferred an independent life with nearby amenities and facilities (Yusnani, 2006).

Furthermore, the existing Safe City Programme (Program Bandar Selamat) managed by local governments must focus on improving the well-being and health of potential older adults. Currently, this programme focuses on the concept of Universal Design by separating pedestrian walkways with motorised roads and installing bollards, as a safety measure against road and traffic crimes, to create a safe and secure environment. The programme also emphasises that pedestrian walkways must not be hidden from the public sighting, and streetlights must enhance the safety of the area. Regarding the critical findings of this study, this programme is suitable to be implemented by providing an improved pedestrian infrastructure that connects residential areas to various walkable land uses such as recreational spaces, mosque and commercial sectors. Physical barriers such as road medians should have a cut-off point. Also, narrow pedestrian bridges must be built every 200 m for pedestrians to cross. This will increase PA in the neighbourhood, and the likelihood for older adults to participate in community activities and become members of community groups.

Besides, active neighbourhoods can be encouraged through the process of creating neighbourhood layout. This is a work scope for urban planners. Current practice in designing neighbourhoods in Malaysia involves creating a neighbourhood masterplan and giving brief attention to developing pedestrian master plans in the neighbourhood. Before that, recreation networks must be created. This measure can increase neighbourhood-based physical activities. The type of recreational space is also important in supporting older people to spend their time outside by replicating adults' recreation spaces and outdoor gyms in the neighbourhood. Retrofitting existing spaces in the neighbourhood like sloap areas (space left after planning) into rest areas by connecting more extensive pedestrian networks surrounding the neighbourhood can also be the right solution to add to the pedestrian master plan.

8.3 Research Limitations

This study has some limitations. First, the concept and measurement of social capital are controversial. Though there are many ways to measure social capital, each method and measuring instrument may have limitations, and there is no concept that covers all areas of social capital. Furthermore, the methodology of this research may be sophisticated if structural equation modelling is applied. Due to time limitations, correlation tests were run for each hypothesised relationship. The assumptions were strengthened through indirect relationships.

The main limitation of this study was related to the study areas, as the distribution of respondents' locations was concentrated only in certain parts of the neighbourhood within the boundaries of various neighbourhood associations. First, in Malaysia, neighbourhood associations are developed by communities as needed. Therefore, members voluntarily participated in this survey. However, not all regions have neighbourhood associations. In other words, our survey was restricted to respondents associated with neighbourhood associations. Second, the findings of this study apply only to older adults between the ages of 45 to 75, not those older than 75 years old. Respondents in this study were not good at representing the total population of each neighbourhood. This was because only a small percentage of the residents volunteered, and due to time limitations, only adequate sampling was considered.

Third, this study mainly examined older Malay and Muslim adults, as only a small number of people from other backgrounds and religions were included in this study. It was not enough to judge differences in race, ethnicity and degree of daily physical activities. Fourth, the respective data distributions of the objective and subjective PNE indicators can limit the results of the study. The low, medium, and high range scales were based on normal data distribution and their indicators that the non-normal distribution is adjusted to be normal. Several comparisons were conducted to examine how the data distribution affects the study results, but the PNE objective and subjective range scales were considered reasonable. Fifth, missing values in some of the questions could not be avoided even though eligible enumerators took part in the questionnaire survey. This negatively impacted the likelihood of cooperation among the respondents due to the complexity of the survey, which took about 20-30 minutes to complete for each respondent.

Finally, some outstanding results of this study indirectly influence the PA levels of the elderly via a traffic road infrastructure based on the PNES items. As mentioned earlier, based on previous observations during the survey, most drivers were driving faster than the speed limit, and some respondents complained about this issue. However, this assumption was entirely made through the author's observation. Due to the lack of specific data on this, future research is needed to investigate this essential factor more specifically.

8.4 Conclusion

In conclusion, to encourage active ageing, physical neighbourhood characteristics must focus on fostering the social neighbourhood environment and improve PA for all generations. Therefore, objective and subjective PNE and SNE indicators should be highlighted when planning a future ageing society. In this study, we achieved the goal of assessing the relationship between objective and subjective PNE and SNE measures and PA levels in the elderly. The hypothesis was validated to prove the underlying relationships of PNE, SNE and PA. Figure 8.5 shows the PNE and SNE measures that affect PA levels in the elderly based on the key findings of this study.

The first objective, which was to investigate the effect of the PNE on PA levels in the elderly, was achieved from the important direct results of this study, as shown in Figure 8.5 (H1 and H2). We also obtained some indirect and significant results that correlate the effects of PNEO with PA via PNES, shown as H4 in Figure 8.5. The second objective, which was to investigate the impact of the SNE on PA levels in the elderly, was achieved through the important direct results of the study, shown as H3 in

Figure 8.5. The third objective was achieved through significant indirect results that correlate the effects of PNEO with PA through SNEO and SNES, shown as H5 and H6 in Figure 8.5. In another unrelated domain, H7, socio-economic factors (SES) were found to affect PA levels of the elderly, especially gender, length of stay and race.

The final conceptual model, including the significant results of this study, provides ideal PNEO measures for planning future neighbourhoods. It was found that PNEO, PNES, SNEO and SNES items show important relationships. The most profound relationships with PA levels were demonstrated in more than one neighbourhoods. The factors included distance to facilities such as mosques and recreational areas, land-use mix entropy (PNEO), perceived neighbourhood accessibility, perceived traffic safety, lack of dead ends (PNES), participation in community activities (SNEO), especially 'gotong-royong' activities, recreational, religious, and collaboration programmes, and finally perceived generalised trust and perception towards community groups (SNES). Moreover, the observations of the four neighbourhoods showed similar physical characteristics, which may significantly affect the key findings of this study, such as the status of existing traffic networks, residential segregation and central areas of the functional neighbourhood. Apart from this conceptual model, the previously discussed physical characteristics of the neighbourhood were also observed as an essential influence on important findings that should also be considered.

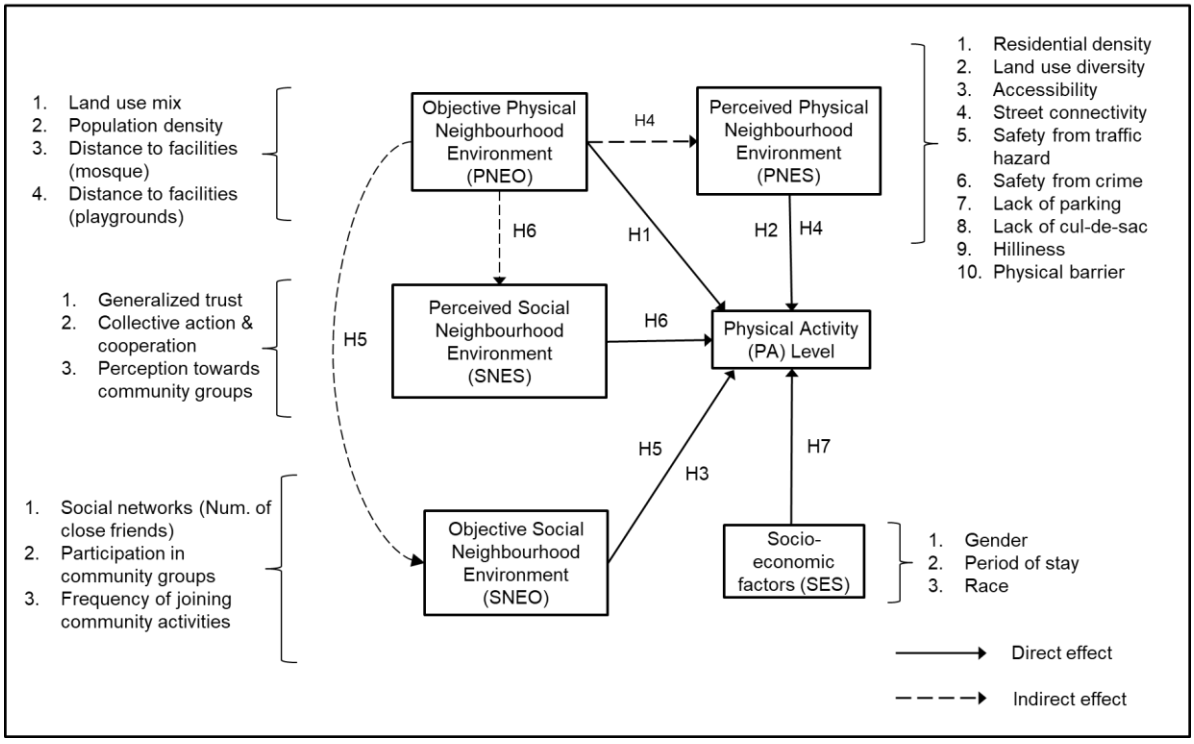


Figure 8.5: Final conceptual framework based on the significant results of this study

8.5 Future Study

The results of this study are expected to improve Malaysia's housing policy and guidelines in the future through a comprehensive spatial neighbourhood plan that considers physical and social neighbourhood measures. Despite the need for appropriate treatment when considering the intrinsic features of the neighbourhood, future research using another method of analysis is encouraged, such as structural equation modelling to obtain a more accurate relationship between PNE, SNE and PA among Malaysian older people. Apart from important PNE measures, the results of this study showed that bonding, bridging and linking social capital activities also contribute significantly to PA levels in the

elderly. Hence, future research should primarily focus on the successful implementation of appropriate social, religious and spiritual activities based on Malaysian elderly preferences.

Besides, it is necessary to consider concrete measures based on the current situation in the study area. New question items should be added to the questionnaire survey to assess the relationship between PNE and SNE. For example, more specific question items about existing traffic conditions in the study area are an important measure that can affect PA levels among the residents. Furthermore, future studies of all populations need to be performed in order to understand the trends that may exist between different ethnic groups of the elderly in Malaysia. Socio-economic indicators, such as income status, can also have a significant impact on determining the level of PA of older adults' access to mobility. The findings of this study will help contribute to the existing knowledge of neighbourhood environment planning, especially in highlighting critical objective measures of the PNES (PNEO) and social neighbourhood environment (SNEO). This also helps to propose and improve urban planning housing policy and guidelines to promote active ageing neighbourhood environment in Malaysia.

APPENDIX

Questionnaire Survey

Questionnaire Form

Neighbourhood: _____ Road Name: _____ House type/ floor: _____

A. Respondent's Information

Please fill in and tick (/) the answers for the questions below.

1. Gender	2. Age	3. Period of stay in the neighbourhood:	4. Occupation	5. Family structure in the household	6. Race
Male	_____	_____	Govt. worker	Single	Malay
Female			Private worker	Couple	Chinese
			Self-employed	Couple living together with working children	Indian
			Retired		
			Unemployed		Others

B. Social Capital Theme

Generalized Trust

In every community, some people get along with others and trust each other, while other people do not. I would like to ask you about the extent of generalized trust in your community.

7. Please tick the following statements based on the 1 – 5 scales.	Strongly disagree (1)	Disagree (2)	Not sure (3)	Agree (4)	Strongly agree (5)
a) Most people who live in this neighborhood can be trusted.					
b) In this neighborhood, one has to be alert or someone is likely to take advantage of you.					
c) In this neighborhood, people generally do not trust each other in matters of lending & borrowing money.					
d) People in this neighbourhood trusted: i) People from the same race					
ii) People from different races					
iii) Shopkeepers in the neighbourhood					
iv) Local authority representatives					
v) Neighbourhood patrol group					
vi) People who are strolling around and does not belong to the neighbourhood					
e) If you suddenly have to go away for a day or two, could you count on your neighbours to: i) Report to you if there is any suspicious activities within your house vicinity					
ii) Ask for help to watch over/give food to your pets by lending your extra house key					

Collective Action and Cooperation

8. If a community project does not directly benefit from you, but has benefits many others in the neighbourhood, would you contribute:

   Time ☐ Money ☐ Others: _____

The next part contains questions regarding the extent of making decisions as an act of togetherness in one society and the cooperation between residents in this neighborhood.

9. Please tick the statements below based on the following scale.	Strongly disagree (1)	Disagree (2)	Not sure (3)	Agree (4)	Strongly agree (5)
a) Do you agree that the political representatives can help improve your neighborhood's environment?					
b) Do you agree that the community groups in your neighborhood will help the poor and the needy living in your neighborhood?					
c) Do you agree that people who did not take part in community activities will be criticize?					
d) Do you agree that many people in your neighborhood will cooperate and get together to solve problems in your neighborhood?					

Social Networks

10. How many close friends do you have in the neighbourhood? These are the people you feel at ease with, can talk to about private matters or call on for help.
    _____ people
11. If you suddenly need a small amount of money (equal to about one week's wage), how many people beyond your immediate household could you turn to who would be willing to provide this money?
    _____people
12. Please state the frequency of interacting with your immediate neighbors within 1 week.
    _____ time(s)

Sociability

13. How frequent do you join these types of activities per week, per month and per year? Please state whether your participation is a voluntary action or mandatory.

Community activities	Frequency/ week	Frequency/ month	Frequency/ year
a) 'Gotong-royong'			
b) Healthy activities & recreation (Eg: Aerobic, 'tai chi', family day)			
c) Religious celebration & spiritual activities in mosques & 'musholla' in your neighborhood (Eg: Tadarus Quran, Yassin readings)			
d) Formal programs with collaboration from government agencies (Eg: Police, Fire Brigade)			

Participation in Community Groups and Level of Decision-making

Next, I would like to ask you about the community organizations to which you belong and the frequency of joining community activities. The community organizations could be formally organized groups or just informal groups of people who get together regularly to do an activity or talk about things. (Formal groups: Rukun Tetangga (RT), Sistem Rondaan Sukarela (SRS), Jawatankuasa Penduduk (JKP); Informal groups: Mosque/ surau committee, recreation club like 'tai chi'/ aerobic)

14. In this neighborhood, which organization or clubs that you are currently joining? If you did not join any club, please state your reason.

    ☐ RT ☐ SRS ☐ JKP Others:_____
    ☐ Mosque committee ☐ Recreation club ☐ Did not join any Reason:_____

15. Based on Q15, please state your level of activity in giving contribution and decision-making in the organization that you are joining in this neighbourhood. (Scale: 1 = Leader; 2 = Very active; 3 = Less active; 4 = Did not take part in decision-making)

☐ RT	☐ SRS	☐ JKP
☐ Mosque committee	☐ Recreation club	☐ Others:_____

Skip to Q17 if your neighborhood does not have any types of community groups.

Extent of Community Groups in the Neighbourhood

16. Please tick the statements below based on the following scale.	Strongly disagree (1)	Disagree (2)	Not sure (3)	Agree (4)	Strongly agree (5)
a) Do you agree that the RT in your neighbourhood is active and always doing community activities?					
b) Do you agree that (SRS) makes you feel safe living in this neighborhood?					
c) Do you agree that the community groups in this neighborhood is important in establishing community relations between residents?					
d) Do you agree with the RT leader's role as a medium linking the higher local authority to improve the neighborhood environment?					

C. Individuals Physical Activity In and Outside the Neighbourhood

The next part contains questions about your walking activity and destinations you did in and outside your neighbourhood. If your purpose of walking activity you do is the same as walking for recreation, please state it just once.

17. In a WEEK, please state the frequency and minutes during any activities including walking in or outside your neighbourhood.	Inside the neighbourhood		Outside the neighbourhood	
	times	mins	times	mins
a) Walking to a destination other than walking for recreation (eg: walking to grocery store, mosque/'musholla', market, bus stop)				
b) Walking for recreation (including walking your pets, jogging, brisk walking)				
c) Recreation & sports activities (eg: soccer, aerobic, 'taichi')				
d) Leisure activities outside your home (eg: gardening, cleaning interior/ exterior of your home, karaoke)				
e) Daily activities such as part-time jobs (eg: Retired person doing self-business)				

D. Perception towards the Physical Characteristics in the Neighbourhood

Next, we would like to know more about the way you perceive or think about your neighbourhood. If you seldom walk in your neighbourhood, please answer based on how you feel. Answer the following questions by providing only ONE answer for each item.

18. Please choose the types of residences that are present in your neighbourhood.

TYPES OF RESIDENCES IN YOUR NEIGHBORHOOD	None	A few	Several	Mostly	All
a) Bungalow					
b) Terrace houses					
c) Semi-detached houses 1 – 3 floors					
d) Apartment/ condominiums ___ floors					
e) Apartment/ condominiums ___ floors					

19. Please tick the duration of walking to the destinations in your neighborhood below:

STORES, FACILITIES, & OTHER THINGS IN YOUR NEIGHBORHOOD	1 – 5 min	6 – 10 min	11 – 20 min	21 – 30 min	31+ min	Not sure
a) Grocery store						
b) Supermarket/shopping store						
c) Worship places (eg: mosque, church)						
d) Bus stop						
e) Coffee shop/ restaurant						
f) Clinic						
g) Food stall (eg: burger stall)						
h) Playground/ recreation parks						
i) Community hall						
j) Night market						
k) Wet market						

20. Please tick the statements below based on the following scale. All statements are for areas within 10 – 15 minutes walking in your neighbourhood.	Strongly disagree (1)	Disagree (2)	Agree (3)	Strongly agree (4)
A) ACCESS TO SERVICES				
i) I can do most of my shopping at local stores.				
ii) Parking is difficult in local shopping areas.				
iii) Stores are within easy walking distance of my home.				
iv) There are many places to go within easy walking distance of my home.				
v) It is easy to walk to a transit stop (bus, train) from my home.				
vi) The streets in my neighbourhood are hilly, making my neighbourhood difficult to walk in.				
vii) Main barriers such as stairs, drainage or untrimmed sidewalks limit the number of routes for getting from place to place.				
B) STREETS IN MY NEIGHBORHOOD				
i) The streets in my neighbourhood do not have many, or any, cul-de-sacs (dead-end streets).				
ii) There are walkways in my neighbourhood that connect cul-de-sacs to streets, trails, or other cul-de-sacs.				
iii) The distance between intersections in my neighbourhood is usually short (100m or less; length of a football field or less)				
iv) There are many four-way intersections in my neighbourhood.				
v) There are many alternative routes for getting from place to place in my neighbourhood. (I do not have to go the same way every time.)				
C) PLACES FOR WALKING AND CYCLING				
i) There are sidewalks on most of the streets in my neighbourhood.				
ii) The sidewalks in my neighbourhood are well maintained (paved, even, and not a lot of cracks).				
iii) There are bicycle or pedestrian trails in or near my neighbourhood that are easy to get to.				

iv) Sidewalks are separated from the road/traffic in my neighbourhood by parked cars.				
v) There is a grass/dirt strip that separates the streets from the sidewalks in my neighbourhood.				
D) NEIGHBORHOOD SURROUNDINGS				
i) There are trees along the streets in my neighbourhood.				
ii) Trees give shade for the sidewalks in my neighbourhood.				
iii) There are many interesting things to look at while walking in my neighbourhood.				
iv) My neighbourhood is generally free from litter.				
v) There are many attractive natural sights in my neighbourhood (such as landscaping, views).				
vi) There are attractive buildings/homes in my neighbourhood.				
E) SAFETY FROM TRAFFIC				
i) There is so much traffic along the street I live on that it makes it difficult or unpleasant to walk in my neighbourhood.				
ii) The speed of traffic on the street I live on is usually slow (25 km/h or less).				
iii) Most drivers exceed the posted speed limits while driving in my neighbourhood.				
iv) There are crosswalks and pedestrian signals to help walkers cross busy streets in my neighbourhood.				
v) The crosswalks in my neighbourhood help walkers feel safe crossing busy streets.				
vi) When walking in my neighbourhood, there are a lot of exhaust fumes (such as from cars, buses).				
F) SAFETY FROM CRIME				
i) My neighbourhood streets are well lit at night.				
ii) Walkers and bikers on the streets in my neighbourhood can be easily seen by people in their homes.				
iii) I see and speak to other people when I am walking in my neighbourhood.				
iv) There is a high crime rate in my neighbourhood.				
v) The crime rate in my neighbourhood makes it unsafe to go on walks during the day.				
vi) The crime rate in my neighbourhood makes it unsafe to go on walks at night.				

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