

GREEN INFRASTRUCTURE AS GREEN HEALTH PROMOTION AGENDA FOR URBAN COMMUNITY

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Abstract

The study investigates how the presence of green infrastructure network enhances urban residents' physical health. The study reviews the literature related to green infrastructure benefits to physical health of urban individuals. In addition, it investigates the relationships of green infrastructure experience to physical health and well-being via a case study exploration on residents in Taiping, a small town in Central Peninsular Malaysia. Green infrastructure network is a composite of open space and greenery that is linked by walkways, streets and waterways around and between urban areas at all spatial scales. It is found that an accumulated literature review especially from the western world has produced a considerable amount of evidences on benefits of greenery and nature to health. Hence, this paper discusses the findings from various researches on the benefits of green infrastructure to physical health of urban residents. The paper also elaborates the results on green infrastructure experience and interaction derived from a survey (n=335) of residents in Taiping. Findings show that, regardless of ages, residents frequently visited the green infrastructure in the town. Effects from the existence of various types of green infrastructure in the town promote frequent visitation and participation in active recreation. The relationship suggests that the green spaces allow residents to experience active and leisure activities, which in turn afforded healthy feeling and wellness for residents. The findings implicates that the existence of green infrastructure network are essential in an urban fabric that may foster active living. Thus, as aspired by the Malaysian government, green infrastructure is a significant health promotion agenda that is seen as a way to improve healthy living in a community.

Key Words: green infrastructure, benefits, physical health, Taiping, health promotion

1. INTRODUCTION

The current urbanisation trends may have significant adverse effects on the health and well-being of urban communities. Studies in environmental psychology suggest that the physical benefits of contact with nature are vanishing in towns and cities due to humans' disengagement from the natural environment (Katcher and Beck, 1987; Axelrod and Suedfeld, 1995). It is claimed that the modern society and way of living especially in urban areas has insulated people from outdoor environmental stimuli and regular contact with nature (Katcher and Beck, 1987; Stilgoe, 2001). For example, high domination of build-up structures, buildings and paved over land more than the non-built areas (greenery and open spaces) resulted in urban residents being in less contact with the natural environment. Katcher and

Beck (1987) argue that the effects of too much artificial stimulation and an existence spent in purely human environments may cause exhaustion and produce a loss of vitality and health.

Physical inactivity is said to be most prevalent among residents who live in towns and cities. The inactivity due to sedentary living causes low agility and dexterity. This is affecting physical and social lifestyle of urban residents. Survey in Scotland showed that only 4 in 10 young people in the country were physically active (HEBS, 2001). It is suggested that sedentary lifestyle is a key factors on risk of morbidity and mortality of people living in urban areas (Takano et al., 2002). According to Ward Thompson (2007), a sedentary lifestyle is even greater risk in older adults because it reduces their physical function. In Malaysia, according to Ministry of Health Malaysia (2007), the second from ten principal cause of death among Malaysian populations are heart disease and disease of pulmonary circulation. One of the reasons is being that urban residents spend little time on recreational activities such as in gardens and parks. Hence, lack of kinetic engagements in urban greens decrease residents' experience of the outdoor spaces that affect their physical wellness. As a result, they are less agile and their dexterity is low because much of their time is spent indoors performing sedentary activities.

On the other hand, together with diet, physical and social outdoor activities are known to be an important determinant of health and well-being (Bird, 2004; Pretty *et al.*, 2005). For example, walking and outdoor sports in open space and environment filled with greenery are increasingly being recognised as some of the best ways to improve general health (Pretty et al., 2005, 2007). In other words, the activities are the prescription and an effective intervention for sedentary living that nowadays become prevalent in urban areas. Studies have shown that improved exercise habits are associated with improvement of cardio-vascular heart disease (Hardman and Hudson, 1989). The physical activity does not need to be strenuous to have a significant effect on people's health, general well-being and productivity (PATF, 2002). Improvements to health can be achieved by regular physical activity, for example, a recommended target of thirty minutes of moderate exercise such as walking every day. The most appropriate place to engage in the activities is the outdoor environment, in particularly, in the green infrastructure whereby residents may benefits more than just physical wellness, but also to their psychological and social health and well-being.

Green infrastructure networks are an attempt to overcome the negative effects of the built environment of towns and cities to residents. This study defines urban green infrastructure as various types of greenery and open spaces linked by streets, waterways and drainages encircling and connecting urban areas, at all spatial scales. Parks, home gardens, pocket spaces, courtyards, playing fields, bodies of water, incidental spaces, loose-fit places, other residual spaces, and streets, are some of the major green infrastructures in which human interaction with nature takes place. A green infrastructure network is a composite of these spaces linked by walkways, streets and trails, which enable urban residents to experience the outdoors both visually and kinetically. It stresses on the holistic relationship of outdoor open space with a range of human experiences in unbroken continuity. It facilitates residents'

ability to recreate, socialise and perform other regular transactional activities. Thus, the provision of green infrastructure network in urban areas focuses at fulfilling urban resident's nature needs and their interaction needs. The effect from the experiences (by viewing and actively participating in physical activities) may induce physical wellness to residents.

But, what kinds of green infrastructure and how much should it be provided to urban residents? How do urban residents benefit from their contact and experience in the green infrastructure? How does green infrastructure network affect physical health of residents? Do the existing green infrastructure's attributes are meaningful for urban residents' health and positive lifestyle behaviour? These questions are increasingly important for decision makers in urban land-use planning, landscape architecture and design disciplines in order to promote and increase healthy lifestyle of urban residents. It is recognised that green infrastructure provides many benefits to urban residents. However, despite this realisation, little is known on how urban residents use and value the green spaces. Much less is known about people's needs of the urban green infrastructure especially in developing Asian region such as in Malaysia even though some studies were found in the aspects of guidelines and framework for sustainable urban green infrastructure, urban planning and conservation and urban residents' uses of green infrastructure.

The aim of the paper is to review and explore the significance of green infrastructure to physical health of urban residents. In this study, physical activities and health are associated with active, kinetic and recreational activities such as jogging, walking, exercising, playing and strolling in various types of green infrastructure, which contribute to vitality and active living, and hence to a feeling of bodily healthy.

2. MATERIALS AND METHODS

2.1 Data collection and analysis

First, the study reviews the benefits of green infrastructure to urban residents' health. Then, Taiping, a town in northern Peninsular Malaysia was chosen as a case study exploration on the effects of town residents' participation in various types of green infrastructure in the town. For the case study, the study employed questionnaire surveys to capture experiences of town residents with the green infrastructure network. The field survey measured frequent visits of residents (n=335), their familiarity of green infrastructure and the relationship of the residents' contact and experience in the green spaces to physical health. The questionnaires mainly consisted of closed choice questions with a few of open-ended questions. Closed-ended response using multiple response scale, categorical and ordinal scale elicited most of the responses of residents. Open-ended questions were included to obtain more information about residents' visits to the green infrastructures, to expand on the responses made in the closed-

ended questions. The unit of analysis in the surveys consisted of 335 residents living in Taiping town and in some parts of Kamunting, Tupai and Assam Kumbang districts. Administration of survey using a variation of the drop-off method (Kamarul Zaman, 2007) was carried out in two ways: dropping off survey door-to-door in the neighborhoods and government offices, and intercepting passers-by in public spaces in town centre and green spaces.

The analyses of the questionnaires applied Statistical Product and Services Solutions (SPSS) vXIII. It applied descriptive statistics such as percentage and mean of score that described and compared the experience of residents in different types of green infrastructure. The completed questionnaires consist of 57% female and 43% male respondents. The Malays represented the ethnic majority of the respondents. The largest percentage of respondents (86%) was adults between the ages of 19 to 55 years old. Majority of the respondents (68%) have resided in Taiping between 11 to 50 years.

2.2 Study site

The study site consists of low-rise residential area, low-density commercial area and numerous green spaces. Green infrastructure network and recreational development in Taiping cover a total of 90 hectares of land (Figure 1).

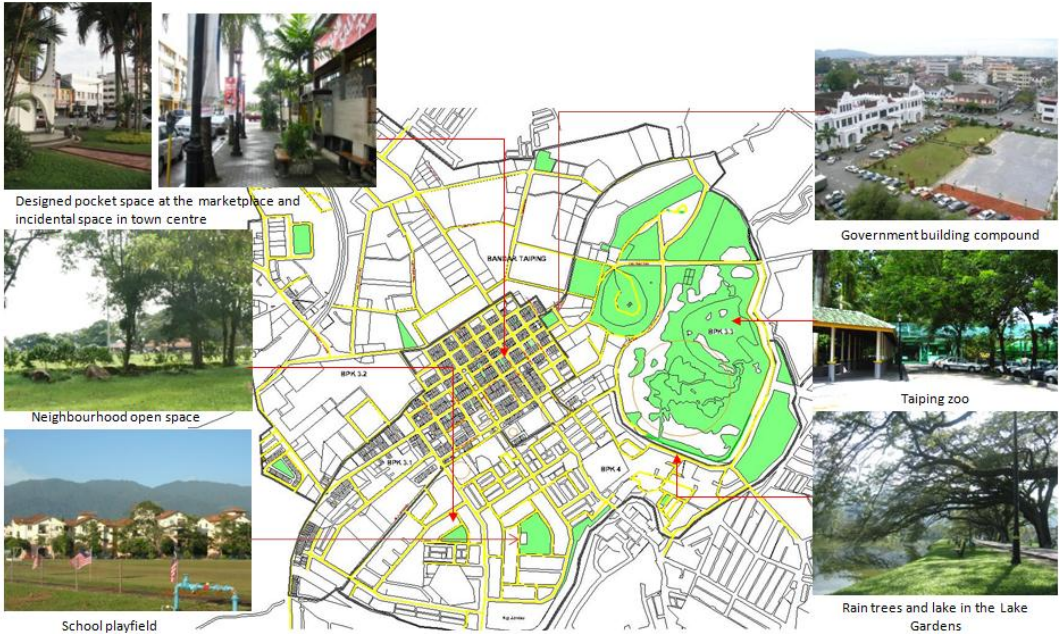


Figure 1: Distribution of green infrastructure network in Taiping

Its green area consists of, a town park i.e. the Lake Gardens, hill landscapes, river corridors, small green spaces in the town centre, such as courtyards within and among institutional and

government buildings, pocket spaces and street landscapes. The residential neighborhoods consist of open spaces with playgrounds, open fields and home gardens. The Lake Gardens is an 84-acre town park near the town centre, with glorious large rain trees, lakes and small ponds, recreational amenities and a zoo. Small incidental and pocket spaces between shop houses is scattered within the town centre and along the shophouses. Street landscapes consisting of trees and shrubs connect places within commercial areas to recreational spaces and neighbourhoods. Major roads lie in a rectangular gridiron form which includes Taming Sari Street and Kota Street, which connect the town centre with the Lake Gardens and the neighborhoods. The green infrastructure in the neighborhoods, including playgrounds, open playfields and home gardens. The green environment in Taiping is placed in a harmonious arrangement among a variety of buildings such as old public, institutional and commercial with Larut Hill as a backdrop.

3. FINDINGS AND DISCUSSION

3.1 Research on Green Benefits to Physical Health

An accumulating body of theoretical and empirical provides evidences on the importance of urban greenery and open spaces that influence outdoor activities such as walking and playing. The studies have shown that physical environmental attributes of the green spaces allow mobility, vitality and active living of urban residents (e.g. studies by Handy et al., 2002; Bird, 2004; Pretty et al., 2005, 2007). Various types of green spaces in proximity with urban residency such as parks, home gardens, small pocket spaces, playing fields and tree-link streets allow urban residents to experience the outdoor environment visually and kinetically, thus encourage active living and conducive behaviour that promote general well-being. The connection of these green spaces provides residents' interaction and close contact with nature in urban places. As such, provision for such green space network for health promotion is an important aspect of urban design and planning.

A considerable body of literatures in various disciplines especially from the western world identified the symbiotic human-green infrastructure relationships; among others include the fields of urban ecosystem, landscape architecture, urban and environmental planning, arboriculture and forestry, environmental behaviour and psychology, and preventive medicine and health promotion. Table 1 summarises the findings from various disciplines that contributed to the studies on green infrastructure and the effects to physical health especially to the urban community. The studies addressed that contact with the green environments give opportunities for urban residents to improve everyday well-being. Experience in the green infrastructure such as passive viewing or active participation gives direct physical exposure and induces psychological processes that benefit physical, psychological and social health

(Maller et al., 2005; Groenewegen et al., 2006). For example, Payne et al. (1998) found that parks users reported better general perceived health, higher level of activity and the ability to relax faster. Tzoulas et al. (2007) posited that the amount of green spaces might lead to people spending a greater amount of time outdoors, thus being more physically active.

Table 1: Summary of studies on green infrastructure experience and physical health

Urban ecosystem Landscape architecture, urban and environmental planning	
Authors	Concern of Research
Herrington & Studtmann (1998) Grahn et al. (1997) Tanaka et al. (1996); O'Sullivan (2001) de Vries et al. (2003) Guralnik (1994); Booth et al. (2000) Tzoulas et al. (2007)	<ul style="list-style-type: none"> • Active outdoor play environment for children in the school playfields • Fewer sick days, fewer attentional problems & concentration problems and improved motor functions • Greater longevity in older adults from green space • Effects of urban green space to cardiovascular and circulatory disease. • Urban green space users had better self reported health • Availability of space for walking increased the amount of senior citizen's activity, more active older people gain a higher functional status and live longer • Greater time in the outdoors and being more physically active with more green space
Arboriculture and forestry	
Authors	Concern of Research
Katcher and Beck (1983); Beck et al.(1986); Lewis (1996); Crisp and O'Donnell (1998); Russell et al.(1999); Fawcett & Gullone (2001); Pryor (2003) Payne et al. (1998)	<ul style="list-style-type: none"> • Nature-based therapy (including wilderness, horticulture) heal patients who previously had not responded to treatment • Urban park users reported better general perceived health, more physical activities and relaxation
Environmental psychology and behaviour	
Authors	Concern of Research
Hartig et al. (2003) Laumann et al. (2003) Kaplan et al. (1988; 1993) Kaplan & Kaplan (1989) Lohr & Pearson-Mims (2006) Kuo & Sullivan (2001)	<ul style="list-style-type: none"> • Lower blood pressure, increase positive affect and decrease aggression. • Lower heart rate that give restoration • Fewer ailments, overall health effects. • People with access to nearby natural settings have been found to be healthier overall than other individuals. • Lower blood pressure • Less aggressive behaviour
Preventive medicine and health promotion	
Authors	Concern of Research
Takano et al. (2002); Handy et al. (2002) Ulrich (1984); Ulrich et al. (1991); Parson (1991) Rohde & Kendle (1994) Maas et al. (2006) Groenewegen et al. (2006)	<ul style="list-style-type: none"> • Urban green space users have greater longevity • Effects of green space on respiratory • Natural views increase recovery from post-operative, lower score for minor post surgical complications, higher positive affects and faster and more complete recovery • Viewing nature reduces anger and anxiety, sustains attention and interest and enhances feelings of pleasure. • Better perceived general health

There is a reason to believe that the attributes in the physical green environment plays a special role in physical activity (Tzoulas et al., 2007). Among the parameters explored by western researchers such as Kaplan and Kaplan (1989) and Humpel et al. (2004) found that accessibility to recreational facilities, diversity, facilities and aesthetic attributes are consistently related to physical activities. Pretty et al. (2005) found that high connectivity of the street network is also associated with more walking and cycling. An association between levels of physical activity and proximity of green areas in the neighbourhood and buildings'

compounds has also been provided in various studies (e.g. Humpel et al., 2004, Pretty et al., 2005). On the effects of these attributes to urban residents, it is found that people who have access to nearby natural settings have been found to be healthier overall than other individuals (Kaplan and Kaplan, 1989). Studies by Takano et al. (2002), De Vries et al. (2003), Groenewegen et al. (2006) and Maas et al. (2006) also suggest that people who live in areas with more green space experience better general health. The availability of spaces near home of urban residents is also believed to increase the chances of walking outside of the residence which helps to maintain a high physical functional status (Pretty et al., 2007). Hence, distance to a green space is important for urban residents to attain health. As such, these western studies are significant in making explicit links between urban green infrastructure and health. Therefore, nearby greenery-filled public areas and easy-to-walk places should be emphasised in urban planning for the development and redevelopment of towns and cities. These studies are particularly important in the context of Malaysian cities as suggested that our community has lead a poor lifestyle.

3.2 Findings from the Case Study Site

The case study site has also provided information and evidences on how residents use the green infrastructure, their level of familiarity and the effects from their experience and interaction with the green infrastructure in Taiping. The results are presented and discussed under three sub-sections as follow:

3.2.1 Level of visitation to green infrastructure

What are the levels of visits to green infrastructure network? The level of visits to green infrastructure either for recreational and leisure determines whether the existing green spaces have been fully utilised by the town residents. This can also predict the types, significant and meaning of the infrastructure to the residents' everyday lives. Table 2 shows the results on residents' level of visit to the green infrastructure in their town.

Overall, 79 per cent of respondents agreed that they frequently visited the green infrastructures in the town. The survey results suggest that the largest percentage (77%) of residents visited various green spaces in Taiping at least once in two weeks. Therefore, the intensity of use of the green infrastructures in the town is high. It appears as well that residents of all ages recognised the presence of the green spaces. This is shown in the high agreement on visits to the spaces by three age group of residents (78%- 96%). Consequently, this result offers insights into the utilisation of the infrastructure by various groups of residents. It means that green infrastructures in Taiping are important amenity for outdoor activities of the residents in the town.

Table 2: Visits to the green infrastructure network

Measure	Scale	Agreement		N	
		%	No. of case		
Surveys :					
1) Do you frequently visit the green infrastructure?	1=Yes	79%	266	335	
	2=No	21%	69		
2) Frequency of visits	1=At least once/month	23%	76	334	
	2=Once/fortnightly	22%	73		
	3=Once or more/week	55%	185		
3) Frequent visit by age group*	Adolescent	Yes – 27; No - 1	96%	28	334/335
	Adult and older adult	Yes – 227; No - 64	78%	288	
Elderly	Yes – 15; No - 4	79%	19		

3.2.2 Types of green infrastructure visited

Table 3 shows the familiarity of residents towards the green infrastructure in Taiping. Residents indicated that eight types of green infrastructure are important for their outdoor activities. They are the Lake Gardens, hill forests, the zoo, river corridor, open space in town, open spaces between buildings, pocket spaces and street landscapes. The results suggest that in Taiping, the residents recognised the spaces that range from large recreational green infrastructure that include the Lake Gardens and the Esplanade, semi-natural areas in the hill forests to smaller spaces that include neighbourhood open spaces and home gardens, pocket and incidental spaces in the town centre and street landscapes (green network). Closed-ended survey results suggest that 91% of respondents frequently visited the Lake Gardens and 68% visited the hill forests. On the other hand, the green open playfield i.e. the Esplanade was barely visited by the residents (19%). The green compound of buildings (16%), the pocket spaces and the streets were also seldom visited (11%). It appears that the residents are familiar with the town park (the Lake Gardens) and the hill forests over the small incidental spaces that are distributed within the town centre. In other words, all large types of green infrastructure in Taiping are highly utilised for outdoor activities, meanwhile the environment of pocket spaces and other small spaces need to be improved in order to increase their utilisation.

In reference to open-ended answers in the surveys, there were also eight places identified by the respondents. The green infrastructures consist of the Lake Gardens, hill forests, the Esplanade and neighbourhood green open spaces, and the non-green infrastructures consist of shopping areas, streets, buildings and eating places that are located mostly in the town centre. The results show that the green infrastructures were more visited (90%) than places that have no green space especially in the town centre such as the shopping areas, buildings, restaurant and café (10%). The Lake Gardens is the place that was most frequently mentioned by the

residents (79%) and the results are consistent to the closed-ended responses of the survey. The hill forests however, were low in percentage of response in the open-ended question (4%) as compared to the closed-choice question. In addition, in the open-ended question, the respondents also referred to the neighbourhood green open space (6%) even though it is not included in the closed-choice question.

Table 3: Familiarity of green infrastructure

Types of data	Measures	Type of place				Respondents/ participants (n)
		No. of case (%)				
		Green infrastructure	Non-green Infrastructure			
1) Survey questionnaire (closed ended)	1 = The Lake Gardens	304	91%	-	-	335
	2 = Hill forests	227	68%	-	-	
	3 = Zoo	174	52%	-	-	
	4 = River corridor	75	22%	-	-	
	5 = Open playfield (Esplanade)	64	19%	-	-	
	6 = Green space of buildings in town	53	16%	-	-	
	7 = Streets in town	37	11%	-	-	
	8 = Pocket space in town	37	11%	-	-	
2) Survey questionnaire (open-ended question)	1 = The Lake Gardens	204	79%	-	-	257
	2 = Hill forests and vicinity (Burmese pool, Tmn Suria)	10	4%	-	-	
	3 = Neighbourhood & home garden	16	6%	-	-	
	4 = Esplanade	3	1.25%	-	-	
	5 = Shopping areas- Giant, Tesco, Fajar	-	-	10	4%	
	6 = Town centre - Kota road	-	-	9	3.5%	
	7 = Building – museum, library	-	-	3	1.25%	
	8 = Eating places	-	-	2	1%	

The findings show that green infrastructure in Taiping is valued and meaningful to the residents. This can be seen from the results that the residents spent their outdoor time visiting the green spaces more than other types of place of leisure. In particular, the residents frequently visit the Lake Gardens and hill forests. This is because the Lake Gardens is the largest recreational green infrastructure in the town (17% of land-uses. The hill forests including Larut Hill and nearby lowland forests are prominent green infrastructure for active activities such as walking and hiking. because These places are abundant with natural lowland vegetations that induce the feeling of being secluded from the rest of the world. At the foot of the hill, the Burmese Pool, a waterfall area, provides the residents a space for leisure activities with family and friends. The District Officers Residence Hill is a parcel of land in the Lake Gardens which the residents utilised for physical-kinetic activities such as jogging and walking. In the town centre, the residents do walk along the streets of the town to go to places such as shopping areas, food stalls and cafés. The neighbourhood open spaces and home gardens are also important to the residents. Adolescents used playfields, adults used playground to observe their small children and socialise with neighbours, and children used residential streets to play badminton and explore nature in their neighbourhood.

3.2.3 Physical benefits from green infrastructure experience

How do residents benefit from experience in the green infrastructure? Figure 2 shows the effects of residents' participation in physical activities in the green infrastructure.

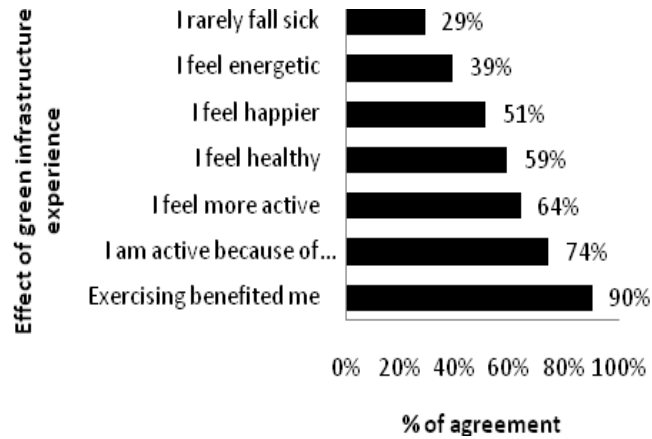


Figure 2: Physical effects of experiencing the green infrastructure network

Ninety per cent (90%) of respondents felt that exercising in the green space afforded beneficial effects to their body. They felt active because of the availability of green infrastructure in the town (74%). Multiple-choice questions revealed that participating in physical activities such as jogging, walking and playing enabled more than half of respondents to feel more active (64%), healthier (59%) and happier (51%). As such, the results suggest that residents did agree that activities in the green infrastructures contributing to some parameters of their physical health (i.e. feel active, healthy and happy) as products from their active and kinetic engagements such as exercising, jogging, walking and playing. However, the participation in the spaces did not make them feel more energetic (39%) or rarely fall sick (29%). Nonetheless, with frequent visits and participation in the green infrastructure, the activities may even boost their physical fitness.

Table 4 shows the mean of score for response on the affordance of various green infrastructures to physical well-being based from analysis of five-point Likert-scale items in the survey questionnaire. In terms of types of green infrastructure that caused active living to the residents, Table 4 shows the level of agreement on the effects of green infrastructure experience to physical well-being. It shows that the Lake Gardens obtained the highest mean score of rating (mean of score—4.65) and the lowest score was the pocket space in town (3.14). Therefore, results indicate that residents perceived large places that include the Lake Gardens, hill forest sites, the Esplanade (large playfield adjacent to town centre) and neighbourhood open spaces as places that affected their physical well-being, whereby they may perform active and kinetic activities with comfort. Thus, findings suggest that all types of green infrastructure are important for residents' active participation in the green environment.

Table 4: Mean of score on active living due to green infrastructure

Types of green infrastructure	%-agreement	Mean of score
1) The Lake Gardens	93%	4.65
2) Hill forest sites (Larut Hill, Burmese pool)	80%	4.22
3) Neighbourhood open space and home garden	60%	3.72
4) Open space (i.e. the Esplanade)	56.50%	3.65
3) Zoo	56%	3.65
9) Greenery along river corridor	45%	3.40
7) Green spaces of buildings/compound	40%	3.28
5) Street landscape in town	39.50%	3.31
8) Pocket spaces in town	35%	3.14

4. CONCLUSION

Provision and maintenance of green infrastructure network at all spatial scales, from home garden to large town park, afford town residents place for active engagements that trigger active living and vitality. Larger open spaces such as the town park offer various engagements that become urban residents' favourite place for visits. Results from the reviews of research and from the case study site suggest that urban residents perceived the green infrastructure network as space where they have contact with nature and fulfill their active lifestyle from physical activities. Much of the engagement happened in large green infrastructure as suggested by survey results in Taiping. The plurality of characteristics of spaces in a town park such as Taiping Lake Gardens enabled variety of choice for residents to engage in kinetic activities, which afford them physical well-being. In addition, the naturalness quality offered residents physical activities that are in close contact with nature and in a peaceful environment that may trigger psychological well-being. In summary, it shows that the green infrastructure network is a crucial part of urban fabrics that contributed to residents' outdoor experience and physical well-being. Thus, an ample array of green infrastructure in towns and cities are vital for health promotion of urban community which can afford their physical wellness.

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