The consequences of the physical-environmental factors on encouraging pedestrian and cycling activities in UPM campus

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KEYWORDS	A B S T R A C T
Physical-environmental factors, Users' perceptions, Encouragement factors, Walking and cycling, UPM campus, Tropical weather, Sustainable transportation	New urban life puts emphasis on developing environmental-friendly transportation which promotes walking and cycling as a broadly accessible mode of sustainable transportation. Recently, policy makers in University Putra Malaysia (UPM) have been attempting to provide cycling and walking facility and mobility without destroying campus qualities. In order to create more pedestrian and bicycle friendly campus, efforts need to focus on the user behavior and preferences. This paper presents the influential physical-environmental determinants on encouraging walking and cycling based on the users' perceptions. Users' perceptions data was obtained through a questionnaire survey results which have been completed by pedestrians and cyclists using the study site. The results indicated that respectively 6% and 32% of the user sample do cycling and walking in the campus. Both groups stated that accessibility and connectivity of the cycling and walking paths are the main problems; as well as inadequate traffic safety added by cyclists. Meanwhile, about 40% of both groups were willing to begin physically active commuting because of health, fitness and environmental benefits. Identifying the physical-environmental factors that influence on walking and cycling contributes with policy makers and transportation planners of university campus as well as inclusion of public health perspective.

Introduction

The interest in the field of causal relationship between built environment and active commuting has been grown in the last decade. Walking and cycling are widely admitted as the main modes of sustainable transportation (Mendoza *et al.,* 2010), and more it is important to understand how to encourage people to do walking and cycling activities (Foltête and Piombini, 2007). Physical and environmental factors highly influence people on choosing their mode of transportation (Guo, 2009). It is extensively accepted that the main aim of encouraging people to do pedestrian and cycling

activities is to improve quality of the associated environment.

Nowadays many publications focused how to create a walking and cycling friendly environments. But most of the studies in this field focused on the urban scale, and it is practically difficult to find documented literatures about sustainable transportation in an educational campus. Balas in 2003 studies on eight pre-selected environmental-friendly campuses in the U.S. and argued how a university campus environment can encourage people to do active commuting, and influence on reshaping societies (Balsas, 2003). Key founding in his study was university campuses are trying to decrease automobile usage (Balsas, 2003). In 2011 Kelly and her colleagues conducted a survey in UK to indicate the influential factors on active transportation. Subsequently their results showed well-connected paths are significantly influential, as well as people are more willing to walk when they have sense of safety (Kelly *et al.,* 2011). However, most of the studies have done in western countries. Although universal design is recommended for pedestrian and cycling environment plan, climate as an environmental factor is an inevitable factor. Practically, conducted researches in tropical condition are still meager compared to other climate conditions. In the other words, the question of what people are looking forward to walk and cycle in a tropical climate is still remaining. In this research, the influential factors for active commuting in a tropical climate studied and results shows people perceptions are not significantly different from what we know from other literature, except specific facilities such as canopy was mentioned by users.

University Putra Malaysia (UPM) is the leading organization in sustainable development among Malaysian universities.

UPM started creating bikeway network when the Road Safety Research Centre (RSRC) was established in 1992 at the Faculty of Engineering. Promoting pedestrian and cycling activities is one of the current plans of UPM in developing sustainable master plan and green campus. Due to the large number of travels in UPM campus, improving walking and cycling paths are a key factor to develop sustainable transportation.

Self-administered questionnaire has designed to indicate users' perceptions. The results showed that mostly users are looking for the facilities to protect them from the harsh weather condition. Findings in this study contributes with campus planners and policy makers to consider pedestrian planning and that more could be done for future studies related to sustainable transportation in tropical climate. In order to create more pedestrian friendly campuses, efforts need to focus on the pedestrian behavior and preferences. Research benefits could encompass wide range people who are engaged with the UPM campus, where walking consider as the basic mode of transportation. Furthermore, according to Balas university campus could be a place to promote sustainability in societies (Balsas, 2003).

Methodology

Probability sampling has been approved as the primary method of selecting large, representative sample for social science research (Creswell, 2002). The sample size was based on the accuracy required for the sample as well as the extent of the variation that existed in the selected population. The unit of analysis for this study is individual and the sample group was randomly selected based on the number of students from different faculties of UPM. Consequently,

387 number of sample group was required based on the Krejcie & Morgan table (Krejcie and Morgan, 1970). Sampling has done through a time interval sampling method in order to achieve a representative sample size, which increases the external validity of the results.

The study was adapted into a cross-sectional survey method, whereby quantitative methods were used as research methodology strategy. The survey was considered as self-administered structure, and respondents were asked to complete the questionnaire by themselves. The questionnaire was sub-divided into 3 components; the first part was asked respondent demographic, in the second part respondents were asked to answer questions about impacts of current bicycle route and pedestrian sides in the campus, potential factors for improving the routes and whether they have experienced of cycling or walking as transportation mode to reach their destinations. The third part of the questionnaire was designed to ask about respondents' perception of physical-environmental attributes and the factors might encourage them to do cycling and walking, as well as to express their opinions about the exciting challenges of bicycle riding and walking in the campus.

The selected group of the study consisted of the undergraduates and graduates students of University Putra Malaysia (UPM). UPM is located in Selangor state with the approximately 20 minutes of driving from the heart of the capital city of Malaysia, Kuala Lumpur. UPM has good developed sustainable transportation system and the highest number of travelling by walk or bicycle among universities in Malaysia. Due to the wide area of UPM campus and different quality and facilities of pedestrian and bicycle rout environment, different locations in the campus were selected for

distributing questionnaire. Furthermore, the questionnaire was in English and distributed in cross-sectional mode, which was during working hours (9am to 5pm) week days to incorporate the highest percentage of random respondents.

After data collection process, data analysis was done to indicate the students' perceptions and influential physical-environmental determinants. The analysis of data was carried out by means of content analysis (to analyze the students' evaluations of the effectiveness of physical-environmental factors on cycling and walking) and the Person analysis (to identify the relationship between evaluations of different physical- environmental factors on encouraging students to do walking and cycling). Computer analysis data were used for data analyzing and IBM SPSS was assisted as assistance software to analyze data and categorize outputs.

Levels of importance of physical-environmental factors on encouraging students to cycling and walking were tabulated based on the number of response for each physical-environmental attribute. Based on the frequency analyses, the average index was calculated to determine the ranking of each factor being considered. The average index is calculated as follow (Al-Hammad and Assaf, 1996)

$$AverageIndex = \frac{\sum a_i x_i}{\sum x_i}$$

In order to determine the level of importance of the constructability principles considered in this study the classification of the rating scales proposed by Abd. Majid in 1997 was used. The classifications of the rating scales are given in Table 1 (Muhd Zaimi, 1997):

In this study Likert's scale was used to investigate respondents' perceptions (Rensis Likert, 1932). By using Likert-type scales, it is essential to calculate and report Cronbach's Alpha coefficient for internal consistency reliability for any scales or subscales. The reliability test was done by using Cronbach's Alpha coefficient as a measurement tools. If Cronbach's Alpha is less than 0.3, reliability is in low level and it is not acceptable. If Cronbach's Alpha is bigger than 0.7, this reveals that consistency is in high level and is acceptable. Based on the data analysis by SPSS, the overall Cronbach's Alpha reliability coefficient was 0.803, which is the supportable value for this study.

Due to the large area of UPM campus it was difficult and costly to travel to the different locations of campus to distribute the questionnaire. On the other hand, during the data collection some of the students did not respond to the questionnaire. Although this might be considered as a common limitation of the present study, to more extend it provides an advantage to lead the future studies in this field.

Analysis

In total, 387 respondents from the age of 18 participated in this study. The responds rate was 85%, which means students were willing to participate in this study. There was no genre difference in this study and 63% of respondents were undergraduate students, 20% were master students and 17% were studying PhD.

In total only 6% of the respondents answered they do cycling in UPM campus and for walking this percentage was 32%. Analysis on education showed significant difference in doing active commuting. 46% of the sample users who were doing cycling

and walking were undergraduate students, and 33% percent were Master students and only 21% of the Ph.D. students were experienced in doing active transportation (Fig. 1).

In the first section of the questionnaire, respondents are asked to state their reasons of doing or willing to do cycling and walking activities. The reasons for doing active commuting we dived into four groups: a) time saving and flexibility b) car owner ship and public transport are expensive c) health and fitness d) environmental benefits e) recreation. Table 2 represents the reasons for doing walking and cycling among UPM students. Most chose reasons were because of health and fitness and environmental benefit with 25% and 23% respectively. Other effective reason was not having a car, which 16% of the respondents pinpointed out to this item. The lowest influential reason for doing walking and cycling was economics reasons with only 6%, which reflected as public transport is an expensive mode of transportation. Most of the percentages in this section were similar for both biker and walker groups perspectives, except for the reason of walking for recreation was higher than for cycling (Table 2).

In the second section respondents asked to state their opinion about weather and time for travelling by walk or bicycle in the campus. 33% responded that weather is a factor, which prevents to do active commuting, while this percent was 7% about time.

Table 3 shows the physical factors that users are looking forward as encouragement factors to do walking and cycling. The encouragement factors were based on four main physical design factors: a) functionality b) safety c) facility d)

aesthetics. Each of the sections detailed into their items (Table 3). 38% of the respondents chose functionality as the most encouraging factor for active commuting. After functionality, safety (25%) was the second influential factor, and facility and aesthetics chosen in 26% and 11% respectively.

Discussion

This study found that almost half of the students who do cycling and walking are undergraduate students. And this frequency is caused due to the significant difference of the number between undergraduate and post graduate students of the UPM. The results showed the economic reason has the lowest influence on doing walking or cycling, and only 16% of the students responded that not having a car is the reason to walk or cycle. However, health and fitness is the most popular aspect of doing pedestrian and cycling activities. In this study almost a quarter of the sample users pointed that they do active commuting because of their health and fitness, which means students consider walking or cycling as health promotion mean. Giles and Donavan in 2002 supported in their study that health and fitness is the most considered side benefit of walking and cycling by people (Giles-Corti and Donovan, 2002).

The second reason for active commuting among the students is environmental benefits. 17% of walkers and 23% of cyclists were concern about the environment. It showed that developing sustainable culture in UPM is going in right direction. However, there is not so many publications found on cycling or walking in a university campus, except (Tolley, 1996) who examined cycling in a university campus in UK. Tolley found that cycling in educational communities could be a reason

to reduce environmental impacts but he didn't point out about students' perspective of cycling and environmental benefits. Findings showed that walking for recreation reasons is more popular that the same reason for cycling. Walking as the most common and popular physical activity has seen in other literatures (Leslie *et al.,* 2005).

In the sections of the encouragement factors assessment, results represent that accessibility and barrier-free sidewalk are the most influential factors in terms of pedestrian environment functionality. It means students were highly concerned about availability of sidewalks. This reflects UPM is planned based on motorized transportation specially cars. Handy and Clifton stated that accessibility refers to how ease is to access to the places where the activities are going on, as well as availability (Handy and Clifton, 2001). Mobility mostly refers to the barrier-free way regardless of the possibility of the users (Handy and Clifton, 2001). For walkers there should be a barrier-free way especially for the people who are using wheelchair and other disability facilities, and for the cyclists flat and continues way should be provided. High concerned about mobility factors reflects UPM pedestrian environment is not in a good condition in terms of free walking and movement. The other encouragement factors which are pinpointed by the respondents are canopy and landscaping which are respectively in facility and aesthetics categories. Facilities and specifically canopy could protect the cyclists and walkers from the heavy rain and sunny days in tropical weather. By providing canopy, students feel more comfortable in outdoor spaces. Canopies could be installed in high density area of the campus. Furthermore, in urban pedestrian design it is recommended to provide covered sidewalk for pedestrians to protect them from rain and sun especially in harsh

weather (Department of Transportation, Columbia, 2007). Table 3 shows that landscaping is an influential factor to increase the frequency of walking and cycling. Overall, the walkways and bicycle routes with built-in aesthetics are preferable for the pedestrians and cyclists, who can take in the view more easily and be attracted toward them (Morris and Zisman, 1962). UPM campus is a green campus in terms of vegetation, but landscape design was not professionally planned. Landscape, in its entirety, plays a role in encouraging pedestrian movements (Foltête and Piombini, 2007). In addition, landscaping can create an attractive visual environment (Hales *et al.,* 1998).

At the end we asked about the weather as an environmental factor, and 33% answered that because of the hot and humid weather walking or cycling is not possible. As a result providing facilities and creating comfortable walkways and bicycle path could attract more number of people to do active commuting in tropical climate.

Conclusion

This paper has assessed physical-environmental determinants that encourage students to cycle or walk in UPM campus. Three different kinds of analyses have been undertaken. The first analysis examined relationship between educational levels and doing active commuting, the second analysis studied the reasons for cycling and walking, and the third analysis assessed physical-environmental determinants that users are looking forward as encouragement factors to do walking or cycling.

Results from these analyses provide several important insights. First, educational level has important effects on the propensity to active commuting and physical activity. The propensity to cycle or walk in the campus is lowest for the PhD students and as expected, undergraduate students have highest percentage of commuting in campus by bicycle. Second, the primary reasons for commuting by bicycle or walking among sample users were health and fitness benefits, the perceived contribution toward alleviating environmental problems and not having a car. The dominant deterrent to bicycle commuting is unpleasant weather. Third, this study found that the important physical characteristic such as functionality, safety, facility, aesthetics are highly influential on walking and cycling, but in tropical climate functionality and facility are more considered by the respondents. This can reflects that in tropical climate facilities plays more significant role to provide comfortable environment for the users. Consequently, improving the facilities options for students and making it safer for users to cycle and walk around the campus, as well as, making improvements on the streets will help to increase the number of students for cycling and walking in campus.

Non-motorized transport is the ideal modes of transportation for university campuses, it is quiet clean, inexpensive, sustainable and space efficient. Universities which are interested in becoming more environmental friendly can do so at fairly low cost by prioritizing cycling and walking as a main mode of transportation for campus transportation. Moreover, the benefits from using bicycle are clearly perceived by users that look for a healthier life. To enlarge the number of beneficiaries it is necessary to disseminate the benefits of cycling and walking for a better life and environment.

Table.1 Classifications of the rating scales

Very familiar/Agree	1.00 ≤ Average Index ≤ 1.50
Familiar/Agree	1.50 < Average Index ≤ 2.50
Moderately familiar/Agree	2.50 < Average Index ≤ 3.50
Less familiar/Agree	3.50 < Average Index ≤ 4.50
Not familiar/Agree	4.50 < Average Index ≤ 5.00

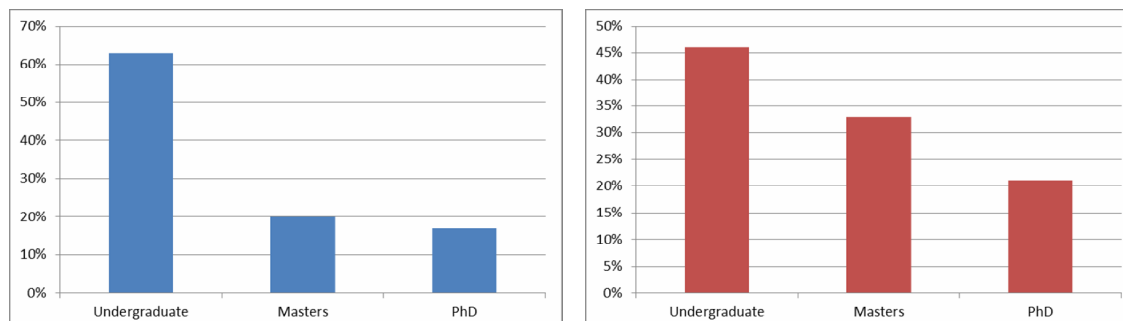**Table.2** Percentage of reasons for walking and cycling in UPM campus

Reasons	Walking %	Cycling %
Save time and offer flexibility	10	12
Car ownership is expensive	6	6
For fun and recreation	16	10
Dislike diving a car	2	2
Encouragement from friends	5	3
Public transport is too expensive	3	3
Health and fitness	26	25
Do not have car	16	16
Environmental benefits	17	23

Table.3 Influential factors on encouraging students to do pedestrian and cycling activities in UPM campus

Encouragement Factors	Items	5	4	3	2	1	Average Index	rank
Functionality	Accessibility	242	104	27	1	7	4.50	5
	Connectivity	120	194	49	13	2	3.84	4
	Mobility	210	140	25	4	2	4.44	4
Safety	Lighting	120	190	60	9	2	3.85	4
	Traffic	207	141	25	3	5	4.39	4
	Robbery	103	184	76	15	3	3.96	4
Facility	Bicycle parking	107	170	82	19	3	3.94	4
	Canopy	147	179	44	9	2	4.25	4
Aesthetics	Landscape	154	140	25	4	2	4.44	4
	Art works	188	131	51	7	4	4.29	4

Scale used: 1=Unimportant, 2=of little Important, 3=Moderately Important, 4=Important, 5 =Very Important

Fig.1 Educational level of respondents (left), educational level of students who does active commuting (right)

References

Al-Hammad, A., Assaf, S. 1996. Assessment of work performance of maintenance contractors in Saudi Arabia. *J. Manag. Eng.*, 12(2): 44–49.

Balsas, C.J.L. 2003. Sustainable transportation planning on college campuses. 10: 35–49.

Creswell, J.W. 2002. Research design: qualitative, quantitative, and mixed methods approaches, 2nd edn. SAGE Publications, London. 246 Pp.

Department of Transportation, 2007. Pedestrian safety and work zone stanards, District of Columbia.

Foltête, J.-C., Piombini, A. 2007. Urban layout, landscape features and pedestrian usage. *Landsc. Urban Plan.*, 81(3): 225–234.

Guo, Z. 2009. Does the pedestrian environment affect the utility of walking□? A case of path choice in downtown Boston. *Transp. Res. Part D*, 14(5): 343–352.

Giles-Corti, B., Donovan, R.J. 2002. The relative influence of individual, social and physical environment determinants of physical activity. *Soc. Sci. Med.*, 54(12): 1793–812.

Hales, C., Rhodes, V., Williams, B., Gardner, D.W., Hoffman, W.S., Vanderslice, E., Brown, M., Senechal, J. 1998. Pedestrian design guide, Portland.

Handy, S.L., Clifton, K.J. 2001. Evaluating neighborhood accessibility□:

Possibilities and practicalities. *Transp. Statisics*, 78: 67–78.

Kelly, C.E., Tight, M.R., Hodgson, F.C., Page, M.W. 2011. A comparison of three methods for assessing the walkability of the pedestrian environment. *J. Transp. Geogr.,* 19(6): 1500–1508.

Krejcie, R.V., Morgan, D.W. 1970. Determining sample size for research activities. *Educ. Phychol. Meas.*, 30: 607–610.

Leslie, E., Saelens, B., Frank, L., Owen, N., Bauman, A., Coffee, N., Hugo, G. 2005. Residents' perceptions of walkability attributes in objectively different neighbourhoods: a pilot study. *Health Place*, 11(3): 227–36.

Mendoza, J.A., Watson, K., Baranowski, T., Nicklas, T.A., Uscanga, D.K., Hanfling, M.J. 2010. Validity of instruments to assess students' travel and pedestrian safety. *BMC Public Health*,.

Morris, R.L., Zisman, S.B. 1962. The Pedestrian, Downtown, and the Planner. *Am. Inst. Planners*, 28: 37–41.

Muhd Zaimi, A.M. 1997. Non-excusable delays in construction. Loughborough University, England.

Rensis Likert, 1932. A Technique for the measurement of attitudes. *Arch. Psychol.*, 140: 1–55.

Tolley, R. 1996. Green campuses: cutting the environmental cost of commuting. *J. Transp. Geogr.*, 4(3): 213–217.