



University of HUDDERSFIELD

University of Huddersfield Repository

Shokoohi, Roya and Nikitas, Alexandros

Urban Growth and Transportation in Kuala Lumpur: Can Cycling Be Incorporated into Kuala Lumpur's Transportation System?

Original Citation

Shokoohi, Roya and Nikitas, Alexandros (2017) Urban Growth and Transportation in Kuala Lumpur: Can Cycling Be Incorporated into Kuala Lumpur's Transportation System? *Case Studies on Transport Policy*, 5 (4). pp. 615-626. ISSN 2213-624X

This version is available at <http://eprints.hud.ac.uk/id/eprint/33777/>

The University Repository is a digital collection of the research output of the University, available on Open Access. Copyright and Moral Rights for the items on this site are retained by the individual author and/or other copyright owners. Users may access full items free of charge; copies of full text items generally can be reproduced, displayed or performed and given to third parties in any format or medium for personal research or study, educational or not-for-profit purposes without prior permission or charge, provided:

- The authors, title and full bibliographic details is credited in any copy;
- A hyperlink and/or URL is included for the original metadata page; and
- The content is not changed in any way.

For more information, including our policy and submission procedure, please contact the Repository Team at: E.mailbox@hud.ac.uk.

<http://eprints.hud.ac.uk/>

Urban Growth and Transportation in Kuala Lumpur: Can Cycling Be Incorporated into Kuala Lumpur's Transportation System?

Roya Shokoohi¹ and Alexandros Nikitas²

¹ School of Sport Studies, Hanze University of Applied Sciences, Zernikeplein 17, Groningen, 9747AS, The Netherlands

² Department of Logistics, Operations, Hospitality and Marketing, The Business School, University of Huddersfield, Queensgate, Huddersfield HD1 3DH, United Kingdom

Abstract

In recent years, cycling has emerged as an increasingly important consideration for national and local authorities around the world, primarily because of the public's growing awareness about its health benefits and greenhouse emissions reduction. In the last decade, transport related policies in Malaysia and particularly in Kuala Lumpur have been seeking to support cycling as a travel mode, yet, cycling levels in Kuala Lumpur remain low and evidence about interventions are mixed. Data from an exploratory case study is used here to understand the transportation system planning and urban growth of Kuala Lumpur and their impact on cycling uptake, examining current status of cycling facilities in KL, evaluating effectiveness of the cycling interventions, and the attitudes of participants of cycling events towards using bicycle. Using a combination of evidences from existing literature, observation referring to the quality and use of the first bicycle pathway in Kuala Lumpur, interviews with city officials and a survey of people's attitudes towards using bicycle, this exploratory research highlights the challenges that a car dependent city faces in its urban transformation and in promoting cycling, as well as the residents' motivations and deterrents to use bicycle for commuting.

Keywords: cycling, sustainable mobility, changing travel behavior, commuting

1. Introduction

Cycling is being promoted as a travel mode with the capacity to increase sustainable transportation, mitigate environmental problems and support healthier lifestyles. Studies repeatedly showed that land use, presence of reliable public transportation; existing infrastructure, personal and traffic safety, weather condition and socio-demographic factors have an impact on the willingness to cycle (Böcker, et al., 2013; Buehler and Pucher, 2017; Handy, et al., 2010; Heinen et al. 2010; Heesch et al., 2014; Pucher and Buehler, 2016; Nielsen, et al., 2013;). However, most of these studies have been conducted in cycling-friendly, western and developed countries like the Netherlands, Denmark and Germany or in other western and developed countries that at least have an adequate standard of cycling infrastructure or they are improving fast (e.g. UK, Australia or US). With the exception of increasing number of bicycling related research in China (as described by Yang et al., 2015) that nonetheless has a clear focus in the distinctive areas of e-bikes (Cherry et al., 2016; Fishman and Cherry, 2016) and bike sharing (Yang and Long, 2016; Zhang et al., 2015), there is very limited literature discussing the opportunities and challenges for embracing cycling in Asia and in particular Southeast Asia, where rate of cycling is low and there is almost no cycling infrastructure in their cities .

Moreover, although the impact of weather condition on cycling is well documented, they have covered countries with mainly moderate climates or with relatively cold and snowy winters that does not include Malaysia with its tropical climate (Böcker, et al., 2013; Flynn et al., 2012; Helbich et al, 2014; Koetse and Rietveld, 2009; Saneinejad, et al., 2012; Wadud, 2014). There is only a single paper (Meng et al., 2016) that discusses systematically the impact that tropical weather conditions and weather forecast have on cycling travel behavior in Singapore; however, that was a study looking at established cyclists.

Although cycling is not a common mode of travel in Kuala Lumpur yet, there is some moderate leisure cycling activity in KL, and in theory a vast potential for cycling uptake (Oke

et al., 2015). However, it is not the only reason that makes Kuala Lumpur, Malaysia's capital city, an interesting region to study. Since 2009, the problems associated with the growth in car ownership, traffic, reducing car emissions and increasing the quality of life, is the subject of continual debate in national media across Malaysia (Bunnel et al., 2002).

In 2009, during the United Nations Climate Change Conference in Copenhagen, the Malaysian government along with many around the world, made a commitment to reduce by as much as 40% its greenhouse gases by 2020. In recent years, a number of policy initiatives have been launched to promote sustainable mobility, because of its economic benefits. Recently, particular attention paid to cycling because of some cycling advocacy groups and its well-documented health and environmental benefits when replacing short motorized trips (De Nazelle et al., 2011; Buekers et al., 2015). Mäkinen et al. (2015) argues that in the short term, the implementation and effectiveness of transport policies depend on urban form and, in the longer term, urban planning is influencing transport demands and its greenhouse gas emissions. Simultaneously, transport policies affect urban form as transport infrastructure investments change the relative accessibility of locations in urban areas, as they changed the accessibility in Kuala Lumpur during the past decades.

In this paper we review the urban growth of Kuala Lumpur and the development of its transportation system in relation to the local government's growing commitment to promote commuting cycling as well as people's perceptions of cycling. It can add to existing literature about cycling, as KL is a car-oriented city with no established cycling facilities and/or culture and it is interesting to see whether Malaysians will choose cycling as a means of travel. Specifically, this paper presents in its first part a desk-based review looking into Kuala Lumpur's urban growth and transportation system. Attention then turns to policies and the programs/interventions targeted at promoting cycling. Through an exploratory case study research including: interviews with city officials, observations of the first cycling pathway in Kuala Lumpur and also a survey of resident who are participating cycling events, this paper highlights the tensions and conflicts of a city transformation, and identifies some of the factors that could hinder and others that could promote cycling to be a legitimate travel option in the future development of the city. The findings of this study contribute to a deeper insight of challenges in a city with very low rate of cycling to stimulate commuting cycling culture from people's perspective as well local authorities

2. Case Study: Greater Kuala Lumpur

2.1. Development Pattern

During the past three decades, Malaysia has experienced considerable economic and social transformations that have triggered massive and rapid urbanization; 75% of the population lives in urban areas (World Bank, 2015; Teriman et al., 2009).

Since the early 1990s KL has undergone a reorientation process from being a federal capital to becoming one of South-East Asia's most prominent, modern and sophisticated cities (Bunnel et al., 2002). Its current identity however is dictated not only by economic growth and significant social and physical transformations but also by some of the highest levels of urbanization and motorization. These changes have led to the sprawl of KL's population towards the southern part of KL, leaving most parts of the city center for businesses. The city center has witnessed therefore an unprecedented reduction in its population due to out-migration to the more affordable residential districts (Barter, 2004; Shuid, 2004). Literature showed urban density, distribution of centers of activity, and the degree of mixed land-use, influence the choice of transport modes (Cervero, 2002; McIntosh et al., 2014). The urban growth of KL has been based substantially on planned townships that have been developed in the British post-war new towns model style. As such the neighborhoods are car-oriented in their layout and their centers of activity rarely coincide with public transport nodes. In 2010, KL had one of the lowest densities among East Asia capital cities that increased commuting distance and support driving private cars (Kamba et al., 2007; Morikawa et al., 2003;

Aditjandra et al., 2013). This trend provides evidence to Teriman et al. (2009) suggestion that compact urbanization and transit-oriented development has been less successful in Malaysian cities when compared to other cities in Asia.

2.2. Car ownership, Streets' Network and Transportation System

Economic growth has been accompanied by a rapid rise in private car ownership (361 cars per 1,000 people in 2010) according to Mat Yazid et al. (2011). In contrast, the share of public transport in cities has continuously declined from 34% in 1985 to 20% in 1997 and is now closer to 10–12% (Kuala Lumpur Structure Plan, 2020). This is partly influenced by a national strategy, promoting the two domestic automobile manufacturing industries - established in 1981 and 1993- and the idea that owning a car gives freedom, prestige and demonstrates a superior socio-economic status (Lim & Lee, 2012; Mohd Shariff, 2012). The increasing domination of the car in Malaysia is responsible for the significantly high Malaysian levels of carbon dioxide emissions per capita that according to United Nations Development Program, in 2007, were 114% higher than the average for countries in East Asia and Pacific and 88% higher than the global average for all middle-income countries(Senbil et al., 2009). However, there were no major government policies focusing on the promotion of active and clean transportation within the country until recently (Kari & Rasiah, 2008). Furthermore, the lack of interest to control car usage and inability to widen existing arterial roads, especially in Kuala Lumpur, led to increase demands for the existing infrastructure, and construction of more highways, which is an act ultimately promoting higher speeds and bigger volumes of cars (Almselati et al., 2011). Fig. 1 provides modal split figures for the current traffic versus the targeted modal split for year 2020 for a scenario where Kuala Lumpur will be a sustainable city. There is official statistical available for cycling and walking trips.

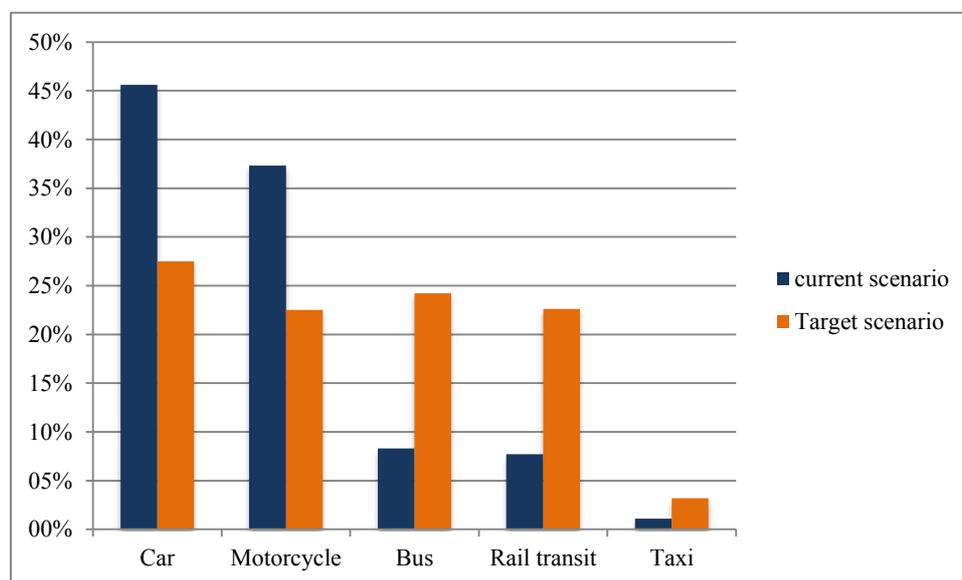


Fig. 1. Current modal split versus targeted modal split for 2020 (adapted by Chien Chen et al., 2014)

The preoccupation with the car as a precondition of modernity has generally resulted in the omission of walking and cycling in urban planning (Jones, 2012; Kamba et al., 2007). Transport solutions to respond to this problem led to large-scale road projects, and to the construction of expressways that were promoting high-speed and high-capacity vehicle flow. The Klang Valley stands out among Asian urban areas for having the highest level of expressway length per person (68 meters per 1,000 people), much higher than any other city in Southeast Asia, and similar to many Canadian and western European cities (Ong et al.,

2012). However, the rail network is only 15 km per 1 million populations while most large global cities have over 40 km per one million (Kuala Lumpur Structure Plan, 2020; Lim and Lee, 2012). This extra road capacity combined with the subsidized price of energy that increased the affordability of conventional fuel made private cars the main travel mode in Malaysia (Indati & Bekhet, 2014). Figs 2 and 3 provide transport network maps for Klang Valley and KL respectively.

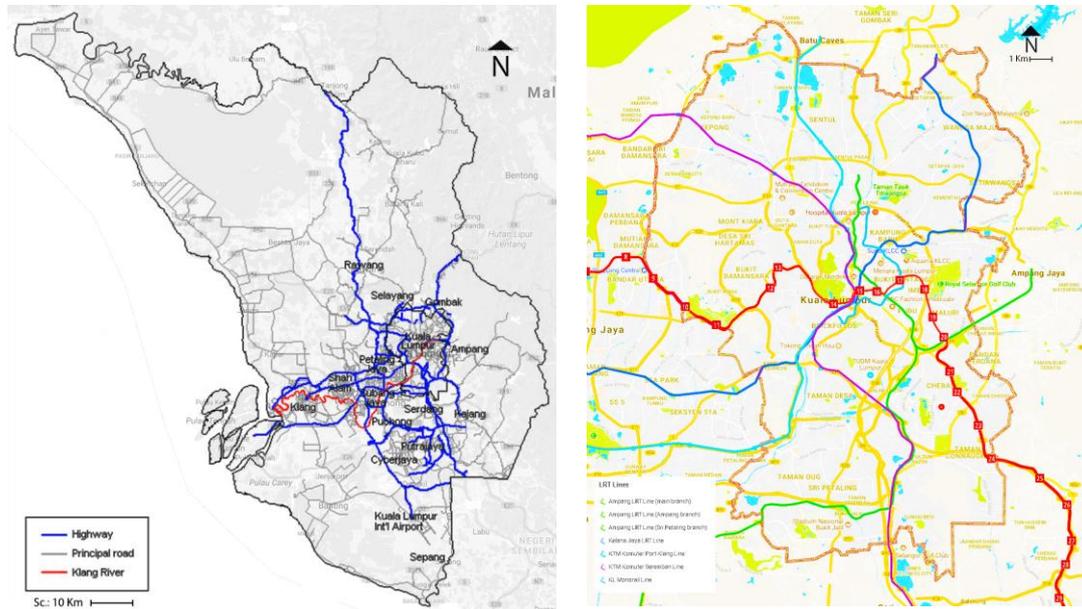


Fig. 2. (Left side) Klang Valley’s arterial road map; **Fig. 3.** (Right side) Kuala Lumpur LRT network map

Mass transit systems are often seen as playing a key role in helping a city to move away from car-oriented trends, and motivate people to walk and cycle at least for short trips. The Malaysian government provides a public transportation system including buses and a Light Rapid Transit system, which is modern and covers over 200 km of electrified double-tracked service connecting major districts of the city-region and many locations in between. In addition to these, KL has a monorail system of 8.6 km built over an elevated track in the city center area (Bunnell et al., 2002). However it is not sufficient alone to transform the overall trend in KL because it came late in the motorization process (has expanded in 1990s after the establishment of the national automotive industry) and in the absence of planning policies.

The potential of mass transit in the KL is hindered by failures in physical integration between lines and poor accessibility of stations and lack of sufficient interchange stations; so each line or mode operates as a stand-alone system. Also the rail system suffers from poor integration with the city’s land-use patterns and has a poor alignment and station locations in many key areas and as a result misses many important activity centers (Teriman et al, 2009). Furthermore, buses are vulnerable to traffic congestion; thus buses in KL arrive late. As a consequence, the public transportation has witnessed a continuous decline in its number of passengers. In 2010, in Klang Valley, only 17% (or 1.24 million) of approximately 7.24 million trips each day were completed using public transport, while the remainder 83% (or 6 million trips) were made using private transport with single occupancy vehicles being the norm (Chiu Chuen et al., 2014).

On the other hand, the road system in KL has been developed in a piecemeal fashion and thus, poor connections between major and minor roads resulted in lack of clarity in movement patterns (see Fig. 4a). A major deficiency, especially in the city center, is the lack of pedestrian connectivity. Activities such as unlicensed hawkers and vendors intruding into pedestrian walkways and buildings not permitting public access across their property boundaries resulted in leaving little or no space for pedestrians (see Fig. 4b). Lack of street

connectivity according to Pucher et al. (2011b) tend to lengthen trip distances, thus deterring walking and more crucially for cycling. In recent years, there has been a gradual improvement in the provision of street connectivity in newer neighborhoods but the shortcomings of earlier development remain (Kuala Lumpur Structure Plan, 2020).

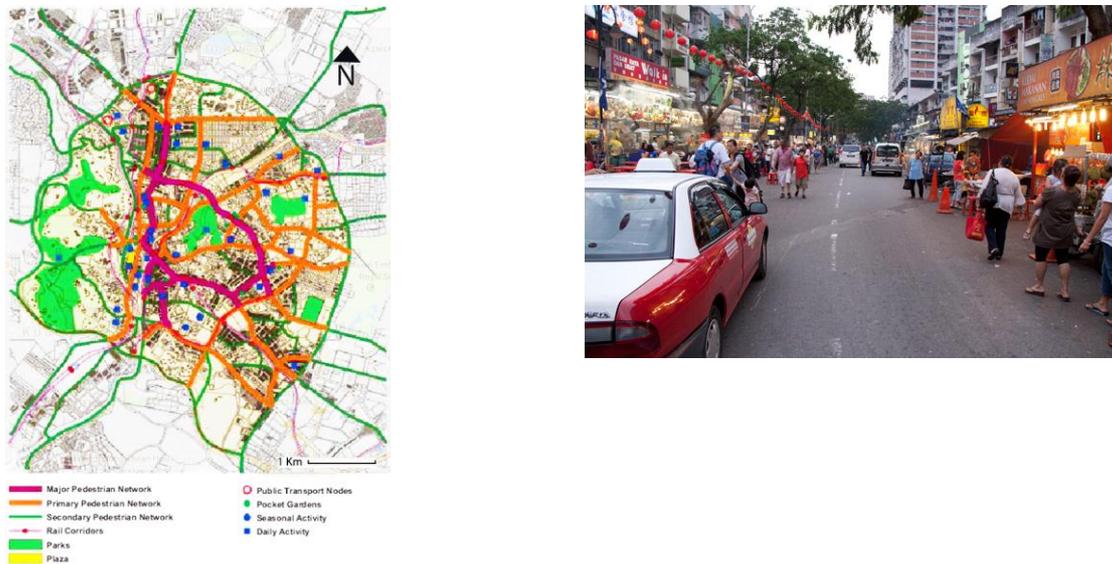


Fig. 4. The road network inside the City of KL and its problems: (a) chaotic patterns and thus poor connectivity between major and minor roads (left); (b) lack of dedicated road space for pedestrians (right)

2.3. Cycling infrastructure in Kuala Lumpur

When it comes to cycling, the situation in KL is even worse. Cycling infrastructure is sparse in KL and although some cycle lanes (approximately 10 km) have been provided they are often of very poor quality and do not form part of a coherent network. There is also considerable danger posed to cyclists because of the speed of traffic, on street parking, and shared used of cycling pathways with motorcycles. Unfortunately there is not any official educational program for drivers on giving priority to cyclists or educational programs for cyclists to learn how to ride a bike safely in traffic (Kuala Lumpur Structure Plan, 2020).

Another issue is the presence of the ‘gated communities’ in KL that became a practice in residential development in late 1980s and has been growing rapidly in both high-rise properties and houses ever since (see Fig.5.). This concept divides the residential areas by walls and gates into private communities with restricted access, in which what would normally be considered as public spaces are privatized, and reduce the route choice for pedestrians and cyclists, thus discouraging the use of bicycle (Planning Guideline, GP 022, Ministry of Housing and Local Department, MY, Federal Town and Country Planning Department, Sep. 2010).



Fig. 5. An example of gated community in KL

2.4. Weather Condition and Air Pollution

The tropical climate could also be a deterrent for cyclists in K. Meng et al. (2016) for the very similar climate conditions of Singapore found; cyclists prefer relatively lower temperature (29.5°C - 31.5°C) and humidity (52.3% - 62.7%) and no rainfall (in past 60 minutes). However, Kuala Lumpur has a year-round tropical climate that is warm and sunny, along with a lot of rainfall. The city does not have a true dry season; however, experiences noticeably heavier rainfall from August to January. The city sees on average about 2700 mm of precipitation annually. Temperatures in KL tend to remain constant between 23.3 and 33 °C with an average humidity of 75-85 %.

Poor air quality is another barrier to promoting cycling. Cyclists are exposed more than any other commuter group to increased levels of air pollution because they are often in close proximity to vehicle emissions. This exposure to traffic-related air pollution is not only making the travel experience an unpleasant one for cyclists but also is known to contribute to adverse respiratory and cardiovascular outcomes (Peters et al., 2004; Weichenthal et al., 2011). Not only KL does not have a favorable weather for cycling, it suffers from serious air pollution due to dust particles from forest fires from nearby Sumatra that every year cast a haze over the region (especially bad between May and August). Land transportation in KL is also contributing to its air pollution (Afroz et al., 2003; Ling et al., 2010) something limiting cycling's overall appeal. Moreover, flooding is also a frequent occurrence in Kuala Lumpur whenever there is a heavy downpour, especially in the city center and downstream areas (Mat Yazdi et al., 2011).

2.5. Commuting Distance

The commuting distance crucially affects the potential for growth in cycling according to Pucher et al. (2011b). The Malaysian Census provides no publicly available information on this important dimension of travel behavior. However a recent gender-oriented study about telecommuting in KL (Hamsa et al., 2016) suggests, based on a sample of 454 questionnaires, that the average commute distance for all travel modes in KL is 17.4 km; a distance which is normally too long for utilitarian cyclists. It could be one of the reasons that KL has 'diminished' the use of bicycles to a common means of transportation among lower income communities who typically do not have access to private motorized transport and who are inhibited from using public transport because of its cost or because this involves a lot of walking (Pojani & Stead, 2015).

Considering the current situation and barriers, multi level policies is required to achieve the goal of reducing 40% of green house gases. For achieving these levels of CO₂ emission reductions, addressing the transport sector, as two-thirds of the greenhouse gas emissions come from fuel combustion related to transport, needs to be prioritized. Therefore, the idea of transit oriented development started to gain recognition after its inclusion in the Kuala Lumpur Structure Plan and the draft of Kuala Lumpur 2020 City Plan (Kuala Lumpur Structure Plan, 2020). In the following section, the cycling-oriented interventions and policies that the city introduced will be discussed.

3. Policies to Promote Cycling and Cycling Advocacy in Kuala Lumpur

The first evidence of any political attention being given to sustainable transportation in KL was as recent as 2010, when the Economic Transformation Program (ETP) was launched on; this program is an initiative by the Malaysian government to turn the country into a high-income nation and turn KL into a livable city by 2020. The focus of the KL City Plan has four areas: physical/urban development, economic growth, social harmony and environmental sustainability. The City tried to reach this goal by building an integrated urban mass rapid transit system (141 km) capable of serving 64 % of travel in and out of city center, with Park and Ride facilities in the stations by 2020, and developing non-motorized modes of transportation (Kuala Lumpur Structure Plan, 2020).

The ETP also attempts to improve the quality of life in KL, through “the River of Life” project. It attempts to revitalize the Klang River through the redevelopment of several locations along a 10-kilometer stretch of the river, a thorough river cleanup program and beautifying the riverbank. The first cycling pathway in KL stretches for 5.5 km along Klang River; and it is part of the river’s revitalizing process; however, some parts of that is shared with motorbikes. It starts in front of the city hall and takes the cyclist to one of the shopping malls in outer city center. The route is extended for 18 km after that shopping mall along the highway that is built for motorbikes and can be shared with cyclists (see Fig.6). This cycling lane is one of the three routes that will be implemented by the local government; the length of the others will be 4 km and 2 km (Kuala Lumpur Structure Plan, 2020). Moreover, wherever it is possible, municipalities connect the existing walkways by coloring the floor to encourage cycling in that particular area (e.g. Ara Damansara, one of the suburban area in KL).

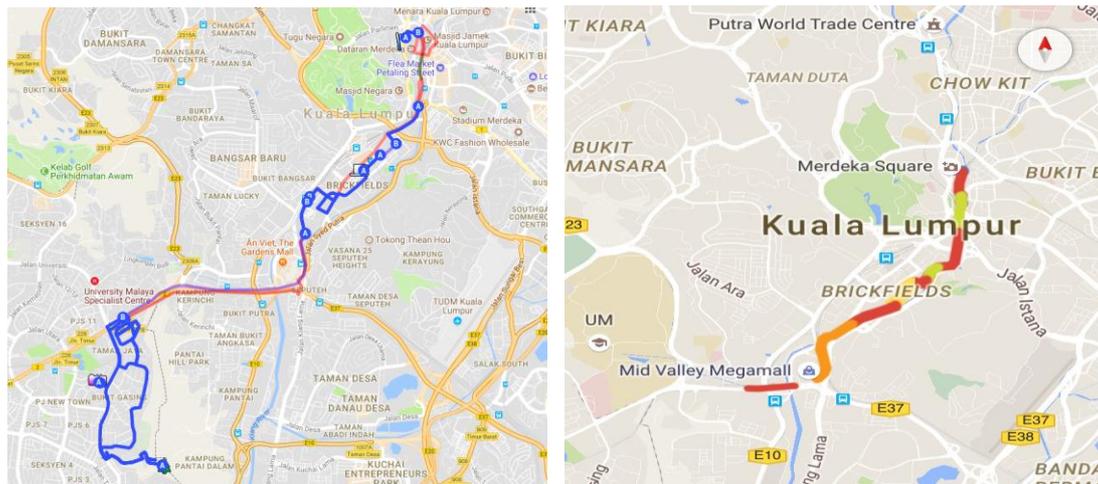


Fig. 6: The above sketchy maps are created by advocacy groups as a guide for those who want to use it for the first time, cycling routes are not available officially on Google maps. (right) Shows the first biking pathway from city hall to Midvalley and (Left) shows its extension that’s in fact for motorbikes to separate them from highway.

3.1. Cycling Advocacy Groups

Two active cycling advocacy groups in KL are closely working with “The River of Life” project directors to improve the bike lane. “Cycling Kuala Lumpur, Bicycle Map Project”, started in 2012, and attempts to claim space for the bicycle by pressurizing the government to build cycling lanes. They published a map as a guide for cyclists that is not an accurate road representation. All cycle routes have been surveyed and ridden by volunteer cyclists. The group also organizes cycling events and campaigns to raise awareness in the local media. The second group is “Kesas Night Riders” that was set up in January 2014 seeking to promote cycling for health and recreation. Kesas is part of the comprehensive network of road; it is a 34.5 km long expressway. The group has created a Facebook page and encourages the public to take part in their organized social/leisure night rides using the motorcycle lanes along the expressway on Thursdays at 8 pm, to avoid the heat. They started with a small group of 20 people and now have over 300 cyclists. Both groups aim towards helping the development of a cycling culture in KL. Although the advocacy group does not have any institutional powers, city government, including the City Mayor, invited them for consultation on utilitarian cycling.

3.2. Cycling Events

The Mayor of Kuala Lumpur has long been a strong advocate for cycling as a healthy and sustainable mode of transport, having pledged bicycle lanes for Earth Hour and having recently proposed Cycle-in-KL packages for tourists following the successful run of KL Car Free Morning. KL Car Free Morning started in January 2014 to promote a healthier lifestyle as well as create awareness about the alternative modes of transportation. On the first and third Sunday every month, a small number of roads around the City Hall in the city center of KL would be closed to traffic for two hours from 7 am to allow for a 6 km bicycle ride completely undistracted by cars. Moreover, KL City Hall has constructed cycle lanes, improved the existing pavements for cycling and provided opportunities for cyclists to combine their trips with public transportation (e.g. foldable bicycles can be carried on train during off-peak hours, between 9am and 4.30pm and after 7pm on working days, preferably wrapped; while bicycle racks are provided in LRT stations) (Kuala Lumpur Structure Plan, 2020).

Other national and international events also are indirectly promoting cycling; these include Cycle Asia KL that took place from 12-14 June 2015 at Dataran Merdeka through iconic landmarks such as Lake Gardens, the Petronas Twin Towers, and Muzium Negara with the support of The Mayor of Kuala Lumpur, Ministry of Youths and Sports and Dewan Bandaraya Kuala Lumpur (DBKL). “Cycle Asia Kuala Lumpur” was rolling out five different categories, ranging in distance from 100m to 48km.

Unfortunately, as recorded in Fig. 1, there are no official statistics available about the number of trips taken by bike or the percentage of the overall share of cycling in all journeys, since despite many recent efforts cycling has not been a common means of travel in Malaysia yet.

4. Research Methodology

This research has focused on Kuala Lumpur for two main reasons. First, the city government of Kuala Lumpur aim to transform KL into a sustainable city by 2020; however, the city is at the very early stage of facilitating cycling, so there are very limited cycling pathways, mostly with poor quality. Second, there is limited research about cities in developing country, and with tropical climate. Current condition of urban growth, traffic and personal safety, transportation system, and intervention to stimulate cycling were studied, and physical problems of the first cycling pathway were identified. In regard to answer the research question, this study attempt to identify the challenges in a car dependent city in promoting cycling, as well as the residents’ attitudes towards commuting bicycle. To be able to answer this question, we used different method of data collection. We did some desk research, survey of participants of cycling events, interview with city officials and cycling advocacy groups, observing the physical attributes of the first cycling pathway in KL.

4.1. Participants’ survey of cycling events

Owing to time and budget limitation, the principal researcher was not able to recruit a representative sample of KL residents. However, socio-demographics, attitudinal data and perceptions of participants in cycling events (e.g. Car Free Morning) and those who tried the new cycling pathway (on foot, or bike), were drawn from the survey. To better understand the situation, urban characteristics, transportation system, safety and cycling policies/programs were studied and examined carefully.

Participants were recruited randomly among those residents, who are interested in cycling, and have tried to cycle or have a plan to use bicycle in future (e.g. those who participate Car Free Morning Events). A structured questionnaire was used but most of the questions gave the option “other” as an alternative answer. The survey was created using Google forms and was available from the city hall website in KL (the organizer for Car Free Morning) between September and November 2014. People were also invited to take part in the survey through social media such as Face Book pages for Cycling in KL or Car Free Morning.

The survey also shows the perceived barriers and motivation for using bicycle and also provided basic demographic information, dominant mode of travel during a typical week and approximate daily commuting distance, purpose of using bicycle, knowledge about the built environmental information, and future plans to use bicycle. This data collection approach is in line with the work of others scholars (e.g. Dickinson & Robbins, 2009; Pikora et al., 2003; Sahlqvist et al., 2015).

4.2. Interview with City officials

Semi-structured interviews with city officials of approximately one-hour were conducted either during the Car Free Morning events or in the City Hall at their convenience time from April to August 2014. The interviews focused around three themes -their policies/programs to promote cycling in KL, the feedback they received from people using the pilot cycling pathway and the impact that their interventions on raising the awareness of cycling had. All the interviews were conducted in English by the lead author. Since all the participants were proficient English speakers (i.e. English is the second language for Malaysians) additional language support was not necessary. The interviews were digitally audio-recorded and fully transcribed. For the analysis the lead author took the overall responsibility for coding based on the themes that guided semi-structured interview (Ritchie et al., 2013). All quotes reproduced in this paper have been anonymized to protect participants' identity.

4.3. Observing physical attributes of the new cycling pathway in KL as well as users' experiences

Observation is accepted as a strategic research tool that comprises several methods at once and subsumes of what is called field research (DeWalt & DeWalt, 2010; Bernard, 2011). According to Holloway et al. (2010) using the twin methods of participant observation and interviewing offers an unparalleled insight into participants' world. Participant observation, usually in conjunction with interviews, has been used before in cycling research (e.g. Aldred, 2013; Fullagar & Pavlidis, 2012; O'Connor & Brown, 2007; Telfer et al., 2006). The first author cycled along the new cycle lane with a group of cyclists in order to get a deeper insight of the challenges they face while cycling in KL. The participant observation was an overt one; the researcher revealed her true identity and purpose to the group. The participation exercise was attended by 20 cyclists including representatives of the local Urban Planning Department, local advocacy groups, and practitioners responsible for the delivering the River of Life project, bicycle shops owners and other local people with an interest in cycling. The observation took place in November 2014.

5. Results and Discussion

5.1. Barriers to Cycling in KL (From city officials' perspective)

There was a general acceptance among our interviewees that city cycling is not always feasible or pleasant due to absence of coherent cycling pathway network and their low quality. As city officials stated, there are facing three major challenges to stimulate cycling: 1) data collection about transportation is often irregular and insufficient for developing and evaluating policies/programs, also there is lack of knowledge about active transportation 2) In most part, significant changes are required to improve infrastructure which is difficult, and 3) Lack of budgets and skills to build cycling pathways with high quality.

Barriers to policy development and evaluation

There are many different organizations responsible for often overlapping, aspects of transportation, and there is an absence of a lead agency for sustainable transportation. Communication of related policies to the appropriate authorities is sometimes insufficient. Moreover, there is lack of human resources for monitoring and evaluating, also sustainable transportation is not fully understood by many government officials. Generally, economic

effects and growth are the main aim and environmental affects are secondary objective, surprisingly health benefits of cycling are not considered while developing policies, and it is also mentioned in Malaysia Stocktaking Report on Sustainable Transport and Climate Change, (2016). It causes some unwillingness in building more cycling pathways as the economic benefits of that is not obvious in KL.

Physical and infrastructural barriers to cycling

As noted earlier, the street network of KL is fragmented and streets are generally narrow. Also there are many highways and expressways that do not accommodate the construction of cycling pathways separated from traffic. As a consequence in many areas municipalities attempt to connect the existing pavements with marked cycle paths that usually have a width of two feet, and are of poor quality (Fig.7a). However, this strategy is not feasible everywhere, as in some streets, walkways are totally absents and/or obstructed (Fig.7b and 7c).



Fig. 7. Problems with cycling “fitting” into the City: (a) a bicycle path uses the existing pedestrian pavement in the area of Ara Damaansara (left); (b) typical walkways in shop lots in Kuala Lumpur with stairs (middle) (c) Typical residential streets without pedestrians walkway (right)

Another issue is insufficient parking spaces for cars and lack of regulations and enforcement, leading to parking on the road. Accommodating cyclists on the road would generally require removing on-street parking. It was revealed that this is often controversial because the ability to park a car freely (or in a cheap price) on streets outside homes and businesses is seen by the drivers as a “right”. Cycling pathways are perceived as a threat to that right and an inconvenience to car users and local businesses (Fig. 8a).

Similarly, providing bicycle racks at LRT stations means taking space from motorbike parking bays. There are 49 stations on the Ampang and Kelana Jaya LRT lines and out of them, 17 have bicycle racks as an added facility (Fig. 8b). Although these racks have long been in existence, they seem to be under-utilized. Instead, “motorcyclists are using the majority of them” (Fig. 5c). One of the City Hall officers commented when revealing reluctance within the Planning Department to try implement this type of facility in a large scale, ‘*If we construct a cycle pathway we are always scared that the moment we take space away from car parking there is always the danger that people will not use the cycle lanes (like bike racks in LRT stations) and people will say... but nobody is using them!*’ However, it also acknowledged the poor management and planning that discouraging for cyclists.



Figure 8: (a) on street parking blocked some parts of the cycling pathway (left) (b) motorcycles occupy the bicycle parking racks in Klana Jaya LRT station (right).

Lack of budget, skills and guidelines to build Cycling pathways with high quality

There was also recognition that the City Hall lacked the skills on how to build a good bicycle network. According to city officials, due to lack of budget and skills, they tried to use the existing walkways/streets as much as possible to design the cycling pathway from City Hall to Midvalley Shopping Mall. Therefore, there is no consistency in design of the trail from one end to another. Blue color marked on the floor also mostly help riders not to get lost on the way; however, they are far behind the standard of on road cycling pathway. Few parts of the cycling pathway, mostly along the highway, and those parts that are shared with motorbikes, have enough width and consistent surface, as there is an established guideline for designing motorbike lane in Malaysia.

The city officials commented that they understood what cyclists had to face by this “planning approach” but were unable to confirm whether any infrastructure improvements were going to be implemented for addressing these issues. They also added that the City Hall was still at an early stage of developing a comprehensive bicycling network, and there was therefore an urgent need to secure finance and the necessary competencies for achieving this.

5.2. Findings of Observation

This section presents some design flaws of the new cycling pathways based on observation. For instance figure 9 shows some parts of the first cycling pathway in KL where this is introduced as a buffer between on street parking and the space allocated for car traffic, that something could be potentially unsafe for cyclists. Also, the marked cycle pathway is barely one meter-wide parallel to a narrow two-lane residential street, leaving insufficient space between the two cycle pathways for cars to drive through that is dangerous for cyclists, and shows lack of skills in designing bike pathways (see Fig. 9b).

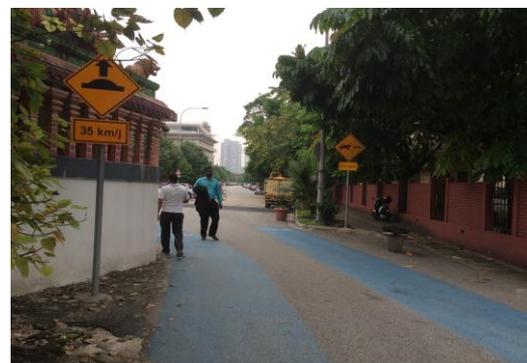


Fig. 9. Problems with the new cycling pathway in KL in Brickfields area: (a) a bike pathway is “squeezed” between on-street parking and traffic (left); (b) not enough space is left for cars to drive through between the two newly introduced bike pathways (right).

Not surprisingly, the majority of bicycle users currently avoid using these bicycle pathways on their own; instead they cycle in groups mostly during weekends when traffic is usually calm.

Bollards are used on the cycling pathways to protect cyclists from traffic while they have to cross a main road or a highway that is very inconvenient (see Figure 10).

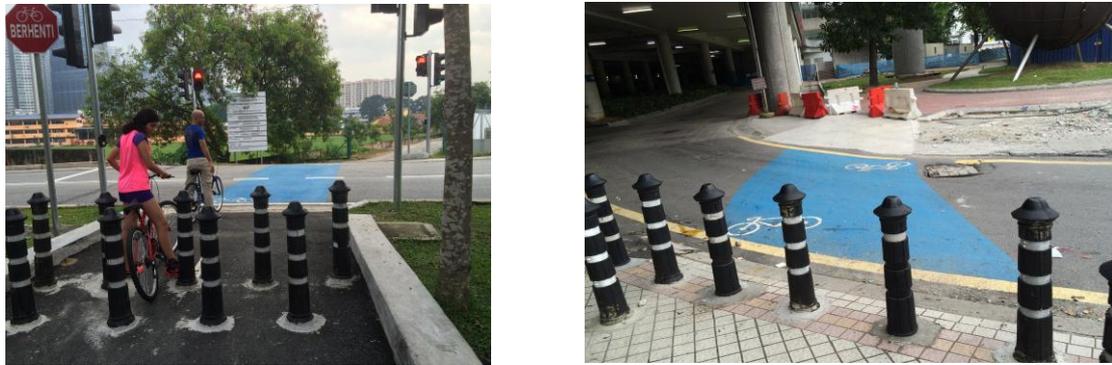


Fig. 10. Problems with the new cycling pathway in KL: (a) Bollards to force cyclists to stop before crossing the highway (left); (b) Bollards to force cyclists to stop before crossing a main road

Figure 11 shows another design flaw just in front of the city hall. It is attempt to provide designated cycling pathway parallel to pedestrian crossing at intersections; however, cyclists have to hop the curb.



Fig. 11. Problems with the new cycling pathway in KL in front of the city hall and along the river: (a) designated cycling pathway at intersection that force cyclists to hop the curb (left); (b) obstacles in the middle of the cycling pathway that can potentially put cyclists at risk if two cyclists have to pass by each other.

Another issues along the pathway is the lack of clarity of the cycling pathway in some parts, existing of steep slops ramp, and absence of signage that has negative impact on having a safe and effective travel on bike using this route (see Fig. 12). Also sharing most parts of the cycling pathway with motorbikes, who can ride as fast 80 km, potentially is unsafe for cyclists, although those parts are wide enough with smooth surface (see Figure 13).



Fig. 12. Inadequate clearance on the cycling pathway, just before Brickfields area, it is difficult to find the route to continue your journey.

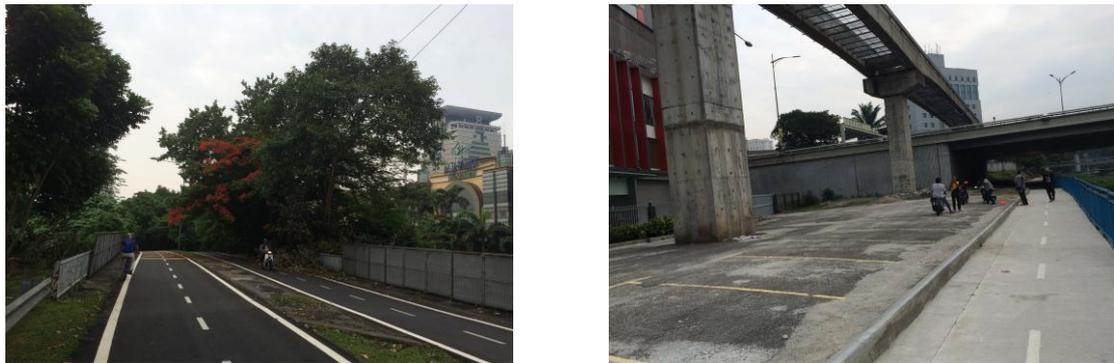


Fig. 13. Problems with the new cycling pathway in KL Sharing large parts of the cycling pathway with motorbikes that can ride as fast as 80 km will put cyclists at risk.

Taking into account all these conditions that the present study highlighted, KL is far behind having a good quality pathway, and developing and implementing effective cycling policies. However, understanding the cyclists' (or potential cyclists') perception of safety and their attitudes towards cycling will be useful to improve the policies. This is what Section 5.3 is set to do.

5.3. Cyclists and potential cyclists' Views on Cycling in KL: Sketching the Profile of the Likely Cyclist

Other study suggests that the perceptions of a substantial population of a car dependent city about cycling, who are interested in bicycling but never did it, may be different than for individuals who already commute by bicycle at least occasionally, so it is important to explore it.

A total of 113 adult cyclists and non-cyclists (33.6% cyclists and 66.4% non-cyclists) participated in the study. Cyclists are those participants who at least cycle for any reason 1-3 days a month. Only 4.8 % of participants consider themselves as commuting cyclists. Participants were evenly balanced between sexes, while the average respondent age was 30 years old; the age range was between 18 and 50. In respect to car ownership, 85% of the respondents had at least one car in their household, and 51.4 % had two cars or more. These percentages decreased to 45.1% for those who owned at least one bicycle and to 23 % for those who had two bicycles or more. However, more than 66 % of the participants never cycled, they stated that there is a possibility to use bicycle in future if more people cycle. Around 62% of participants go to work by car and more than 15 % of participants use motorbikes, they mentioned that, driving their own motorized vehicle is the easiest and fast way of traveling to work. The educational level of the sample was almost evenly distributed between high school (24.8%), bachelor (39.8%) and higher university degrees (35.4%), and

the median monthly household income of the respondents lied between 2000 to 4499 RM ¹, which is consider as a middle income.

Our results also showed that, women were less likely to be cyclists than men and younger people were more likely to be cyclists. Another study in Malaysia also showed that generally adult males make up the majority of bicycle users (Ismail et al., 2002). These findings are consistent with the existing literature (Norzalwi & Ismail, 2011; Pucher et al., 2011a; Zhou, 2012; Aldred et al., 2016) that clearly suggests, cycling is not evenly distributed across genders and age groups in low-cycling countries.

The potential barriers to cycling for women are well-documented as their perception of safety (traffic and personal safety) varies from men (Garrard et al., 2008; Beecham, R., & Wood, J., 2014), also how they perceive the feasibility of alternative transportation mode is different from male. One possible explanation is that, women relatively make more complicated journeys to incorporate childcare and shopping with work commuting, also cycling restrictions that might have to consider different dressing style if choose to cycle (Dickinson et al., 2003, Akar et al., 2013). There might be some other influential factors on choosing to cycle in a low-cycling city and cycling policies must be tailored to stimulate commuting cycling in car dependent cities (Heesch et al., 2014). Other studies show, cycling makes the traveler visible, many people, and in particular women, do not feel comfortable to cycle in a low-cycling city and/or Muslim dominant society (Steinbach et al., 2011; Lenneis & Pfister, 2017). Furthermore, personal safety is an important issue in Malaysia and KL, one out of four women who commute using public transportation has experienced sexual harassment. Malaysian government has addressed this issue by providing Women-Only Coach KTM Komuter since 2010 (The oldest Rail transit in KL), because it covers the outer city areas. Lack of personal safety has been identified as one of the most important barriers to cycling in other studies (Bachok et al., 2014).

Relationships between age and cycling have generally received less attention but are potentially very important, as the health benefits of cycling are the largest at older ages or adolescents (Woodcock et al., 2014). Existing literature is in line with our finding suggesting that people in their twenties and early thirties are in general more likely to cycle for leisure than people older than 35 or 40 (Aldred et al., 2016; Heesch et al., 2014).

The likelihood of being a cyclist was higher for middle-income people in comparison to high income or low income ones. This was not an expected result, as usually people with lower income are more likely to cycle for commuting (Piatkowski and Marshall, 2015; Xing et al., 2010) and higher income is associated with recreation cycling, and cycling in KL is mostly recreation (Heesch et al., 2014). Steinbach et al. (2011), argue that class identities might shape the uptake of commuting cycling, and that is also an important factor in KL. In Asia in general and in Malaysia in particular, owning a car is a symbol of power and prosperity (Mohamad & Kiggundu, 2007). Our findings shows those amongst the middle class, who do use bicycles for transport, do so by choice or because of the health benefits of cycling and not out of economic necessity, and it is in line with other studies (Bauman et al., 2010).

Absence of traffic and personal safety is a growing concern in Malaysia. With an average of 19 persons killed in road accidents every day in Malaysia, road accidents consider a serious threat to public health. It also underlines the urgent need for an effective policy response (Road Safety Plan of Malaysia 2014-2020). Lack of safety was also an issue for the majority of our respondents, and has been identified as a major constraint on cycling by many others too (e.g. Rietveld & Daniel, 2004; Xing et al., 2010). Especially in countries with low rates of cycling and high rates of car use, like KL (Garrard et al., 2008). One solution to improve the perception of safety is to design solely off-road cycling lanes, as it has been a successful strategy in the neighbor country, Singapore (Meng et al., 2014).

The majority (more than 80%) stated that they do not feel comfortable to cycle on hot and rainy days. Singapore with a similar weather condition built more than 200 km off-road cycling pathways, along with good bicycle sharing system and concentrating on facilitating

¹ One Malaysian RM equals approximately 0.234 USD.

short cycling trips, made cycling a viable alternative to the car (Meng et al., 2014). Cycling has been recognized as an important means to promote public health (e.g. Bauman & Rissel, 2009; Nielsen et al., 2013; Oja et al., 2011; Pucher, & Dijkstra, 2003) and earlier studies actually show that those who are aware of the cycling-oriented health benefits tend to cycle more often or have an intention to do so in future (Monda et al., 2007; Bauman et al., 2010). The study results also show concerns about environmental and health benefits of cycling are the greatest motivation to cycle (Fig. 14). This indicates policy makers in KL should highlight the environmental and health benefits of cycling to design the programs to see more changes.

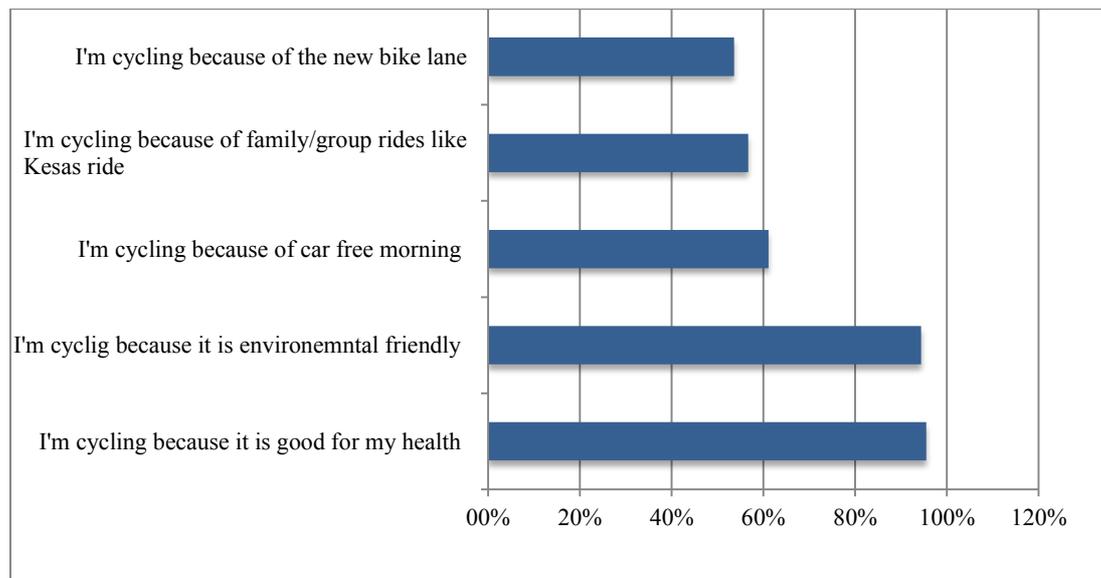


Fig. 14: Motivation to cycle in Kuala Lumpur

As Goodwin et al. (2004) stated travel behavior does change significantly and quite naturally, over the years. In this study, the most important barriers to cycling is lack of personal safety, followed by shared cycling pathways with motorbikes (they can ride as fast as 80 km per hour) that acknowledged poor managing the city and lack of skills in planning bike pathways in KL. Increasing in number of cyclists is always accompanied by improving the safety as they will be more visible and it can also improve the social norm of cycling (Heinen et al. 2010; Heinen & Handy, 2012; Willis et al., 2013). Most of the respondents mentioned that there might be a possibility for them to use bicycle in the future if many others do that. Others factors such as high-speed traffic, long commuting distance, and tropical weather condition also mentioned as barriers to cycling in KL. According to ecological models (Sallis et al., 2006), and studies that used Theory of Planned Behavior, strategies to increase utility cycling must be multi-level; at individual level, social and physical environment. Thus, authorities in KL must have a more holistic approach at different level if they want to stimulate cycling.

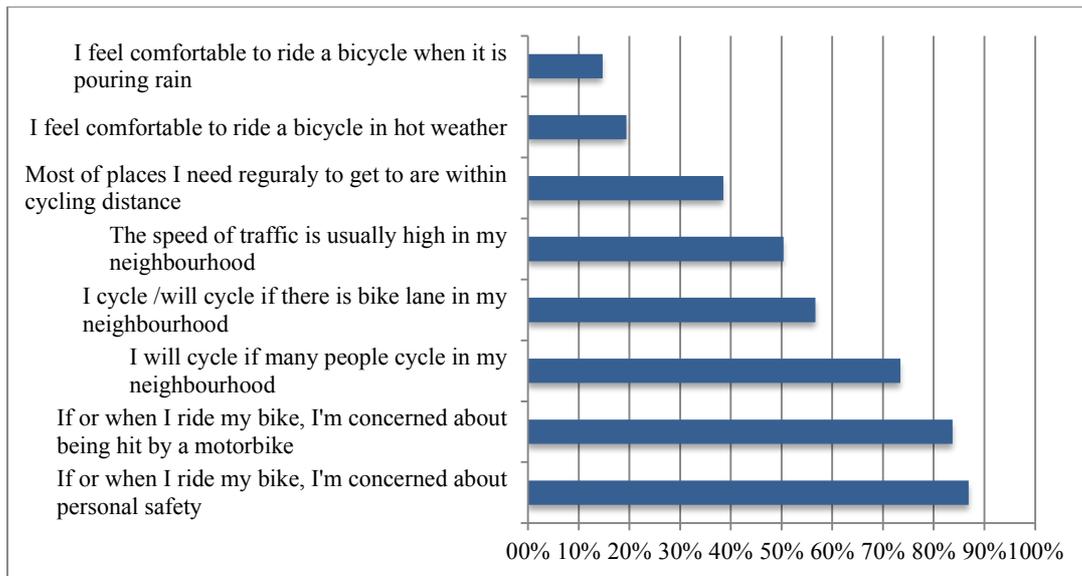


Fig. 15. Perceived barriers to cycling, self- efficacy, and social norms in Kuala Lumpur

The subjective barriers and lack of awareness about benefits of active transportation combined with the absence of cycling facilities (or poor quality of the facilities), lack of personal safety, and lack of skill to develop and implement policies and interventions, creates a challenge in KL. A recent study that developed a model for accepting active transportation in Greater KL also revealed that contributing factors towards public acceptance of cycling include awareness, government actions, and service availability (Khoo and Ong, 2015). Making the transition from a context where “bicycling” is a minor urban planning consideration under the shadows of automotive transport and “cyclist” is mostly an “unwanted label” for commuters to a context where cycling is a genuine modal alternative favored by the public, is a tough and not particularly straightforward task. Thus the authorities response slowly to initiate, invest, and change built environment that could effectively re-brand bicycle in KL.

6. Conclusions

This paper means to provide an overview of the urban growth and transportation planning in greater KL and to evaluate the policies and interventions over recent years that were designed to stimulate cycling. Bicycling can be closely associated with efforts reducing traffic congestion and car emissions by 2020, and towards promoting healthier lifestyles for the citizens of KL. However, utilitarian cycling in KL is invisible mainly because the lack of personal safety, shared cycling pathways with motorbikes that decreases the perception of safety, and overall limited and poor quality cycling facilities. On the other hand, recreational cycling has recently been visible mainly because it has been adopted as a leisure activity by the middle class and practiced mainly within designated and car free areas, or in residential areas on weekends that traffic is calm and during cycling events like the Car Free Morning.

The majority of our respondents do not feel comfortable to cycle when it is hot and rainy. Although the weather condition is a factor that cannot be improved by policy makers, the consequences of bad weather can be changed. For instance, adding some shady trees along the cycling pathways, or building covered biking pathways wherever is possible, can help a lot.

Observation confirmed that the existing cycling infrastructure has a poor quality, and in many cases is unsafe especially when is incorrectly implemented and shared with motorbikes. Furthermore, it is short and not part of a coherent cycling network; as such it has not

promoted commuting cycling, but it is used for leisure cycling on weekends. Some of the participants made it clear that they would wait until the opportunity (e.g. more and better bicycle infrastructure and public transportation services) for adopting cycling is a real one. It shows some individual interventions can increase bicycling to varying degrees; however, will be more effective as a part of a more comprehensive effort. City officials need to make sure that cycling is safe and propagate this message in a clear way, perhaps by constructing cycling infrastructure in the city center that connects popular destinations (e.g. major shopping malls and universities to LRT stations), imposing speed limits, improving traffic regulation enforcement, introducing car free areas, separated cycling routes with motorbikes, and learning from other countries, they would facilitate cycling for short distance (e.g. home to the nearest LRT station).

The other big challenge for the City Government of KL, is to develop a culture where cycling is seen as a normal means of transport for Malaysians. For example, increasing awareness about the health benefits of cycling, the most important motivation for our participants, can promote positive social norms to stimulate regular cycling. However, whilst getting in a car is perceived to be the quickest and most convenient mode for most people, only those most dedicated to cycling will use a bicycle in a regular basis. Therefore, car use must be transformed to a less convenient and attractive activity than what it is today.

It can be argued that authorities in KL needs to learn from successful cities that stimulated cycling (e.g. Singapore) and adopt some guidelines to design better bike pathways. Moreover, policies meaning to increase cycling need to follow much more fundamental changes in society and urban structure (e.g. coordinating land use) that will allow more flexibility in how and when people travel, and decrease the commuting distance, so that cycling can be more easily embraced by households as a utilitarian mode and not simply as leisure-only activity. Even with all such measures in place it is unlikely that cycling would be appropriate for all trips in KL, due to its tropical climate, and average commute distance but they could lead to a substantial increase in cycling across a range of households for short trips at least.

7. Limitations and Future Research

Despite the significance and the originality of the present research, and being one of the rare studies examining challenges and opportunities for increased bicycling uptake in the context of a Southeast Asian metropolis with tropical weather conditions, it should be acknowledged that our study had some limitations. Our sample represents more of a recreational bicycling population, or occasional commuters and those who are interested in cycling, but never tried. Thus demographics, attitudes and behaviors may be different to regular commuting cyclists. We must therefore caution that our results only pertain to this sampled population. To paint a better picture, future studies may benefit from a stratified sampling approach, and a larger sample overall, one that specifically recruits more commuting cyclists, and compare attitudes and barriers to cycling among different races.

Acknowledgments

We would like to thank Prof. Dr. Martin Dijst , professor at the Department of Human Geography and Spatial Planning at the University of Utrecht for his constructive comments on our first draft. Also, to all of our participants who willingly gave up their time to provide us with understanding of the cycling status in KL.

References:

- Aditjandra, P.T., Mulley, C., Nelson, J.D., 2013. The influence of neighbourhood design on travel behaviour: Empirical evidence from North East England. *Transport Policy*, 26, 54-65.
- Afroz, R., Hassan, M.N., Ibrahim, N.A., 2003. Review of air pollution and health impacts in Malaysia. *Environmental research*, 92(2), 71-77.
- Akar, G., Fischer, N., & Nangung, M., 2013. Bicycling choice and gender case study: The Ohio State University. *International Journal of Sustainable Transportation*, 7(5), 347-365.
- Aldred, R., 2013. Incompetent or too competent? Negotiating everyday cycling identities in a motor dominated society. *Mobilities*, 8(2), 252-271.
- Aldred, R., Woodcock, J., Goodman, A., 2016. Does more cycling mean more diversity in cycling?. *Transport Reviews*, 36(1), 28-44.
- Almselati, A.S.I, Rahmat, R.A.O.K., Jaafar, O., 2011. An overview of urban transport in Malaysia. *The Social Sciences*, 6(1), 24-33.
- Bachok, S., Osman, M. M., Murad, M., & Ibrahim, M., 2014. An assessment of commuters' perceptions of safety and comfort levels of 'Women-Only Coach': The case study of KTM Komuter Malaysia. *Procedia Environmental Sciences*, 20, 197-205.
- Barter, P.A., 2004. Transport, urban structure and 'lock-in' in the Kuala Lumpur metropolitan area. *International Development Planning Review*, 26(11), 1-24.
- Bauman, A. E., Rissel, C. 2009. Cycling and health: an opportunity for positive change. *Med J Aust*, 190(7), 347-8.
- Bauman, A., Ma G., Cuevas, F., Omar, Z., Waqanivalu, T., Phongsavan, P., Keke, K., Bhushan, A., 2010. Cross-national comparisons of socio-economic differences in the prevalence of leisure-time, occupational physical activity, and active commuting in six Asia-Pacific countries. *Journal of Epidemiology and Community Health*, 65(1), 35-43.
- Beecham, R., & Wood, J., 2014. Exploring gendered cycling behaviours within a large-scale behavioural dataset. *Transportation Planning and Technology*, 37(1), 83-97.
- Bernard, H.R., 2011. *Research methods in anthropology: Qualitative and quantitative approaches*. Rowman Altamira.
- Buekers, J., Dons, E., Elen, B., Panis, L.I., 2015. Health impact model for modal shift from car use to cycling or walking in Flanders: application to two bicycle highways. *Journal of Transport & Health*, 2(4), 549-562.
- Buehler, R., & Pucher, J., 2017. Trends in walking and cycling safety: recent evidence from high-income countries, with a focus on the United States and Germany. *American journal of public health*, 107(2), 281-287.
- Bunnell, T., Barter, P.A., Morshidi, S., 2002. Kuala Lumpur metropolitan area: A globalizing city-region. *Cities*, 19(5): 357-370.
- Böcker, L., Dijst, M., Prillwitz, J., 2013. Impact of everyday weather on individual daily travel behaviours in perspective: a literature review. *Transport reviews*, 33(1), 71-91.
- Cervero, R., 2002. Built environments and mode choice: Towards a normative framework. *Transportation Research Part D: Transport and Environment*, 7(4), 265-284.
- Cherry, C.R., Yang, H., Jones, L.R., He, M., 2016. Dynamics of electric bike ownership and use in Kunming, China. *Transport Policy*, 45, 127-135.

- Chiu Chuen, O., Karim, M.R., Yusoff, S., 2014. Mode choice between private and public transport in Klang Valley, Malaysia. *The Scientific World Journal*, 2014.
- de Nazelle, A., Nieuwenhuijsen, M.J., Anto, J.M., Brauer, M., Briggs, D., et al., 2011. Improving health through policies that promote active travel: A review of evidence to support integrated health impact assessment. *Environment International* 37, 766-777.
- DeWalt, K.M., DeWalt, B.R., 2010. *Participant observation: A guide for fieldworkers*. Rowman Altamira.
- Dickinson, J.E., Kingham, S., Copsey, S., Hougie, D.J.P., 2003. Employer travel plans, cycling and gender: will travel plan measures improve the outlook for cycling to work in the UK?. *Transportation research part D: transport and environment*, 8(1), 53-67.
- Dickinson, J.E., Robbins, D., 2009. "Other people, other times and special places": A social representations perspective of cycling in a tourism destination. *Tourism and Hospitality Planning & Development*, 6(1), 69-85.
- Fishman, E., Cherry, C., 2016. E-bikes in the mainstream: Reviewing a decade of research. *Transport Reviews*, 36(1), 72-91.
- Flynn, B.S., Dana, G.S., Sears, J., Aultman-Hall, L., 2012. Weather factor impacts on commuting to work by bicycle. *Preventive medicine*, 54(2), 122-124.
- Fullagar, S., Pavlidis, A., 2012. "It's all about the journey": Women and cycling events. *International Journal of Event and Festival Management*, 3(2), 149-170.
- Garrard, J., Rose, G., Lo, S.K., 2008. Promoting transportation cycling for women: the role of bicycle infrastructure. *Preventive Medicine*, 46(1), 55-59.
- Goodwin, P., Cairns, S., Dargay, J., Hanly, M., Parkhurst, G., Stokes, G., Vythoukas, P., 2004. Changing travel behaviour. Presented at: ESRC Transport Studies Unit Final Conference, UK.
- Hamsa, A.A.K., Jaff, M.M., Ibrahim, M., Mohamed, M.Z., Zahari, R.K., 2016. Exploring the effects of factors on the willingness of female employees to telecommute in Kuala Lumpur, Malaysia. *Transportation Research Procedia*, 17, 408-417.
- Handy, S. L., Xing, Y. and Buehler T.J., 2010. Factors associated with bicycle ownership and use: A study of six small U.S. cities. *Transportation* 37 (6), 967 – 985.
- Heesch, K.C., Giles-Corti, B., and Turrell, G., 2014. Cycling for transport and recreation: associations with socio-economic position, environmental perceptions, and psychological disposition. *Preventive Medicine*, 63, 29-35.
- Heinen, E., Handy, S., 2012. Similarities in attitudes and norms and the effect on bicycle commuting: Evidence from the bicycle cities Davis and Delft. *International Journal of Sustainable Transportation*, 6(5), 257-281.
- Heinen, E., Van Wee, B., & Maat, K., 2010. Commuting by bicycle: an overview of the literature. *Transport Reviews*, 30(1), 59-96.
- Helbich, M., Böcker, L., & Dijst, M., 2014. Geographic heterogeneity in cycling under various weather conditions: Evidence from Greater Rotterdam. *Journal of Transport Geography*, 38, 38-47.
- Holloway, I., Brown, L., Shipway, R., 2010. "Meaning not measurement: Using ethnography to bring a deeper understanding to the participant experience of festivals and events". *International Journal of Event and Festival Management*, 1(1), 74-85.
- Indati, M.S., Bekhet, H.A., 2014. Highlighting of the factors and policies affecting CO2 emissions level in Malaysian transportation sector. *International Journal of Environmental, Earth Science and Engineering*, 8(1), 10-18.
- Jones, T., 2012. Getting the British back on bicycles—The effects of urban traffic-free paths on everyday cycling. *Transport Policy*, 20, 138-149.
- Kamba, A.N. Rahmat, R.A.O.K., Ismail, A., 2007. Why do people use their cars: a case study in Malaysia. *Journal of Social Sciences*, 3(3), 117-122.
- Kari, F., Rasiah, R., 2008. Automobile emissions and the environment: The Malaysian experience. *Making Choice about Hydrogen*. *Transport issues for developing countries*. Available from: 132167-201-1-DO_TOPIC.html.

- Khoo, H. L., & Ong, G. P., 2015. Understanding sustainable transport acceptance behavior: a case study of Klang valley, Malaysia. *International Journal of Sustainable Transportation*, 9(3), 227-239.
- Koetse, M.J., Rietveld, P., 2009. The impact of climate change and weather on transport: An overview of empirical findings. *Transportation Research Part D: Transport and Environment*, 14(3), 205-221.
- Kuala Lumpur Structure Plan, 2020: <http://www.dbkl.gov.my/pskl2020/english/index.htm>
- Lenneis, V., Pfister, G., 2017. When girls have no opportunities and women have neither time nor energy: The participation of Muslim female cleaners in recreational physical activity. *Sport in Society*, 1-20.
- Ling, O.H.L., Ting, K.H., Shaharuddin, A., Kadaruddin, A., Yaakob, M.J., 2010. Urban growth and air quality in Kuala Lumpur city, Malaysia. *Environ Asia*, 3(2), 123-8.
- Lim, S.; Lee, K.T., 2012. Implementation of biofuels in Malaysian transportation sector towards sustainable development: A case study of international cooperation between Malaysia and Japan, *Renewable and Sustainable Energy Reviews*, 16(4), 1790-1800.
- Mäkinen, K., Kivimaa, P., Helminen, V., 2015. Path creation for urban mobility transitions. *Management of Environmental Quality: An International Journal*, 26(4), 485-504.
- Mat Yazid, M.R, Ismail, R., Atiq, R., 2011. The use of non-motorized for sustainable transportation in Malaysia. *Procedia Engineering*, 20, 125-134.
- McIntosh, J., Trubka, R., Kenworthy, J., & Newman, P., 2014. The role of urban form and transit in city car dependence: Analysis of 26 global cities from 1960 to 2000. *Transportation Research Part D: Transport and Environment*, 33, 95-110.
- Meng, M., Koh, P. P., Wong, Y. D., & Zhong, Y. H., 2014. Influences of urban characteristics on cycling: Experiences of four cities. *Sustainable Cities and Society*, 13, 78-88.
- Meng, M., Zhang, J., Wong, Y.D., Au, P.H., 2016. Effect of weather conditions and weather forecast on cycling travel behavior in Singapore. *International journal of sustainable transportation*, 10(9), 773-780.
- Mohamad, J., Kiggundu, A.T., 2007. The rise of the private car in Kuala Lumpur, Malaysia: assessing the policy options. *IATSS research*, 31(1), 69-77.
- Mohd Shariff, N., 2012. Private Vehicle Ownership and Transportation Planning in Malaysia, 2012 International Conference on Traffic and Transportation Engineering (ICTTE 2012) IPCSIT, 26.
- Monda K.L., Gordon-Larsen P., Stevens J., 2007. China's transition: the effect of rapid urbanisation on adult occupational physical activity. *Social Science & Medicine*, 64(4), 858-870.
- Morikawa, T., Yamamoto, T., Dissanayake, D., 2003. Travel behavior analysis and its implication to urban transport planning for Asian cities: Case studies of Bangkok, Kuala Lumpur, Manila, and Nagoya. ICRA Project Report, Graduate School of Environmental Studies, Nagoya University, Nagoya.
- Nielsen, T.A.S., Olafsson, A.S., Carstensen, T.A., Skov-Petersen, H., 2013. Environmental correlates of cycling: Evaluating urban form and location effects based on Danish micro-data. *Transportation Research Part D: Transport and Environment*, 22, 40-44.
- Norzalwi, N. and Ismail, A., 2011. Public Approach Towards Sustainable Transportation in UKM's Campus. *Australian Journal of Basic and Applied Sciences*, 5(5), 1332-1337.
- O'Connor, J.P., Brown, T.D., 2007. Real cyclists don't race informal affiliations of the weekend warrior. *International Review for the Sociology of Sport*, 42(1), 83-97.
- Oja, P., Titze, S., Bauman, A., De Geus, B., Krenn, P., Reger-Nash, B., Kohlberger, T., 2011. Health benefits of cycling: a systematic review. *Scandinavian Journal of Medicine & Science In Sports*, 21(4), 496-509.
- Oke, O., Bhalla, K., Love, D.C., Siddiqui, S., 2015. Tracking global bicycle ownership patterns. *Journal of Transport & Health*, 2(4), 490-501.

- Ong, H.C.; Mahlia, T.M.I.; Masjuki, H.H., 2012. A review on energy pattern and policy for transportation sector in Malaysia. *Renewable and Sustainable Energy Reviews*, 16, 532-542.
- Peters, A., Von Klot, S., Heier, M., Trentinaglia, I., Hörmann, A., Wichmann, H.E., Löwel, H., 2004. Exposure to traffic and the onset of myocardial infarction. *New England Journal of Medicine*, 351(17), 1721-1730.
- Piatkowski, D.P., Marshall, W.E., 2015. Not all prospective bicyclists are created equal: The role of attitudes, socio-demographics, and the built environment in bicycle commuting. *Travel Behaviour and Society*, 2(3), 166-173.
- Pikora, T., Giles-Corti, B., Bull, F., Jamrozik, K., Donovan, R., 2003. Developing a framework for assessment of the environmental determinants of walking and cycling. *Social Science & Medicine*, 56(8), 1693-1703.
- Planning Guideline, GP 022, ministry of housing and local department, MY, federal town and country planning department, Sep. 2010, https://issuu.com/anwar_townplan/docs/gp_gated_english_merged.
- Pojani, D., & Stead, D., 2015. Sustainable urban transport in the developing world: beyond megacities. *Sustainability*, 7(6), 7784-7805.
- Pucher, J., Dijkstra, L., 2003. Promoting safe walking and cycling to improve public health: Lessons from the Netherlands and Germany. *American Journal of Public Health*, 93(9), 1509-1516.
- Pucher, J., Dill, J., Handy, S., 2010. Infrastructure, programs, and policies to increase bicycling: An international review. *Preventive Medicine*, 50, S106-S125.
- Pucher, J., & Buehler, R., 2016. Safer Cycling Through Improved Infrastructure.
- Pucher, J., Buehler, R. and Seinen, M., 2011a. Bicycling renaissance in North America? An update and re-appraisal of cycling trends and policies. *Transportation Research Part A: Policy and Practice*, 45, 451-475.
- Pucher, J., Garrard, J., Greaves, S., 2011b. Cycling down under: a comparative analysis of bicycling trends and policies in Sydney and Melbourne. *Journal of Transport Geography*, 19, 332-345.
- Rietveld, P., Daniel, V., 2004. Determinants of bicycle use: do municipal policies matter?. *Transportation Research Part A: Policy and Practice*, 38(7), 531-550.
- Ritchie, J., Lewis, J., Nicholls, C.M., Ormston, R., (Eds.), 2013. *Qualitative research practice: A guide for social science students and researchers*. Sage.
- Sahlqvist, S., Goodman, A., Jones, T., Powell, J., Song, Y., Ogilvie, D., 2015. Mechanisms underpinning use of new walking and cycling infrastructure in different contexts: mixed-method analysis. *International Journal of Behavioral Nutrition and Physical Activity*, 12(1), 185.
- Sallis, J. F., Cervero, R. B., Ascher, W., Henderson, K. A., Kraft, M. K., & Kerr, J., 2006. An ecological approach to creating active living communities. *Annu. Rev. Public Health*, 27, 297-322.
- Saneinejad, S., Roorda, M.J., Kennedy, C., 2012. Modelling the impact of weather conditions on active transportation travel behaviour. *Transportation Research Part D: Transport and Environment*, 17(2), 129-137.
- Senbil, M., Kitamura, R., Mohamad, J., 2009. Residential location, vehicle ownership and travel in Asia: a comparative analysis of Kei-Han-Shin and Kuala Lumpur metropolitan areas. *Transportation*, 36, 325-350.
- Shuid, S., 2004. Urbanisation and housing in Kuala Lumpur city-center: Issues and future challenges. 19th EAROPH World Planning and Housing Congress, Melbourne-Australia.
- Steinbach, R., Green, J., Datta, J., Edwards, P., 2011. Cycling and the city: A case study of how gendered, ethnic and class identities can shape healthy transport choices. *Social Science & Medicine*, 72, 1123-1130.
- Telfer, B., Rissel, C., Bindon, J., Bosch, T., 2006. Encouraging cycling through a pilot cycling proficiency training program among adults in central Sydney. *Journal of Science and Medicine in Sport*, 9(1), 151-156.
- Teriman, S., Yigitcanlar, T., Mayere, S., 2009. Urban sustainability and growth management in South-East Asian city- regions: The case of Kuala Lumpur and Hong Kong. *Journal of the Malaysian Institute of Planners*, 7, 47 – 68.

Wadud, Z. 2014. Cycling in a changed climate. *Journal of Transport Geography*, 35, 12-20.

Weichenthal, S., Kulka, R., Dubeau, A., Martin, C., Wang, D., Dales, R., 2011. Traffic-related air pollution and acute changes in heart rate variability and respiratory function in urban cyclists. *Environmental Health Perspectives*, 119(10), 1373.

Willis, D., Manaugh, K., El-Geneidy, A., 2013. Cycling under influence: Summarizing the influence of attitudes, habits, social environments and perceptions on cycling for transportation. 92nd Transportation Research Board Annual Meeting, Washington DC, USA.

World Bank, 2015. Urban population (% of total). Available from: <http://data.worldbank.org/indicator/SP.URB.TOTL.IN.ZS>

Xing, Y., Handy, S., Mokhtarian, P., 2010. Factors associated with proportions and miles of bicycling for transportation and recreation in six small U.S. cities. *Transportation Research Part D: Transport and Environment*, 15, 73-81.

Yang, J., Chen, J., Zhou, M., Wang, Z., 2015. Major issues for biking revival in urban China. *Habitat International*, 47, 176-182.

Yang, R., Long, R., 2016. Analysis of the influencing factors of the public willingness to participate in public bicycle projects and intervention strategies—a case study of Jiangsu Province, China. *Sustainability*, 8(4), 349.

Zhang, L., Zhang, J., Duan, Z. Y., Bryde, D., 2015. Sustainable bike-sharing systems: characteristics and commonalities across cases in urban China. *Journal of Cleaner Production*, 97, 124-133.

Zhou, J., 2012. Sustainable commute in a car-dominant city: Factors affecting alternative mode choices among university students. *Transportation Research Part A: Policy and Practice*, 46, 1013-1029.