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Factors associated with adolescent active travel: A perceptive and mobility culture approach – Insights from Ho Chi Minh City, Vietnam

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ABSTRACT

Sustainable transport modes, such as walking and cycling, have great benefits but the uptake is decreasing in Vietnam due to motorisation. Individual perceptions of travel and wider mobility cultures are increasingly seen as an important aspect in shaping travel patterns, in particular active travel. The understanding of this in youth active travel in Vietnam is not clear. The aim of this study is to understand how social factors and the physical environment influence adolescent active travel in Ho Chi Minh City (HCMC). A survey in HCMC targeting adolescents aged 11–16 (n = 525) across nine districts around the city centre was conducted. We adapted a comprehensive conceptual framework of active travel behaviour in the context of data availability and the study area. We also included variables pertaining weather, traffic safety, street vendors and road accident experiences, which are more relevant in powered two-wheeler (PTW) traffic saturated, tropical cities in a South East Asian setting. The results show positive association between favourable built environments (obstruction free pathways, food attractions and tree cover), social interactions (peer groups, parents and neighbourhoods) and negative association with traffic, air pollution and prior accident experiences. The findings highlight the importance of considering the interrelations of variables, whilst also identifying future research directions. Policy makers in HCMC, or in similar cities, should consider developing intervention strategies to improve the attractiveness of active travel.

1. Introduction

Active travel is receiving increasing attention in transport policy, in particular, its potential benefits for public health (de Nazelle et al., 2011; Faulkner et al., 2009; Jarrett et al., 2012; Mueller et al., 2015; Zapata-Diomedi et al., 2017). Motorisation has greatly reduced the active travel mode share, including utility trips such as travel to school (Hillman et al., 1993; Trang et al., 2012). A safe environment for children or adolescents is a key determinant of active travel (Tranter and Pawson, 2001). In recognition of the drop in rates in children's active travel (Hillman et al., 1993; Tudor-Locke et al., 2001), research into active travel in this age group has been increasing globally (Ding et al., 2011; Herrador-Colmenero et al., 2014; Pang et al., 2017; Rojas Lopez and Wong, 2017; Sirard and Slater, 2008), as development years form important lifelong habits and promote better health outcomes (D'Haese et al., 2015; Falconer et al., 2015). Adolescence is an age at which travel independence is growing, but parental control remains important (Stark

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Table 1
Population, motorisation and mode share trends in HCMC (1996–2014).

	1996	2002	2012	2014
Population	4,747,900	5,619,400	7,750,900	7,955,000
Motorisation level				
PTW registrations	1,056,000	2,284,870	5,460,000	6,400,000
Automobile registrations	96,000	158,172	536,983	586,000
PTW per 1000 persons	222.41	406.60	704.43	804.53
Automobile per 1000 persons	20.22	28.15	69.28	73.66
Mode share				
Bicycle	32.0	11.4	7.0	8.2
Walking	No Data	16.0	7.0	No Data
PTW	64.0	65.5	75.0	85.0
Car/truck	1.0	1.9	4.0	1.1
Public transport (mainly bus)	2.0	3.1	4.0	2.1
Other (incl. taxi)	1.0	2.2	3.0	3.6

Vehicle registration source: Ho Chi Minh City Road Traffic Police Department.
Mode share sources: MVA Asia (1996), ALMEC Corp. (2004), Nguyen et al. (2013), Huyn and Gómez-Ibáñez (2017).

et al., 2018). Another concern for adolescents is that they reach driving age as they mature towards adulthood and so they become less likely to travel actively (Emond and Handy, 2012; Frank et al., 2007).

While emerging economies are motorising rapidly, (Barter et al., 2003; Hickman and Banister, 2014) and active travel mode share reducing (Trang et al., 2012), many still have higher rates of active travel or physical activity than developed counterparts (Hallal et al., 2012). If decisive actions are not in place to retain walking, cycling, urban forms and travel habits, these are likely be replaced by motorised modes of travel (Pojani and Stead, 2016). Developed countries are now recognising the perils of car dependence, but entrenched urban forms and habits are difficult to reverse (Newman and Kenworthy, 2015). Research into active travel and the physical activity of children or adolescents in developing and emerging countries (in particular China) are growing (Day, 2016, 2018), however there is a disproportionately larger number of studies based on developed countries (Ding et al., 2011). In particular, a research gap exists in this area for tropical countries in Africa and Asia (Rojas Lopez and Wong, 2017), such as Vietnam. This is one of the main motivation for this study in which we explore how the culture of mobility and its constraints shape Vietnamese adolescents' active travel participation, using a perception based survey.

In Vietnam, the 1986 *Doi Moi* market reforms opened up the once isolated and impoverished country to the world – transforming it into a vibrant, export oriented market economy. This has greatly improved people's livelihoods, but also bought forth rapid motorisation. As demonstrated in Table 1, motorisation rates have rapidly increased while active travel has dropped markedly. Motorcycles are becoming essential to Vietnamese life, and are a principal means of travel and a status symbol (Hansen, 2017; Truitt, 2008). While the car mode share remains low by global standards, ownership rates are growing as more people are able to afford automobiles. It was estimated that in 2017, Ho Chi Minh City (HCMC, also known as Saigon) had 7.3 million powered two-wheelers (PTW is a technical term for motorcycles or scooters) while the population was around 8.6 million (Duc, 2017).

Public transport promotes active travel, incidentally or as substitution for private motorised modes (Lachapelle et al., 2011). However, this is a challenge in many South East Asian counties due to a lack of investment and competing funding priorities - Vietnam is one of these examples (OECD, 2018). Cities (in particular in South East Asia) with rapid motorisation in the form of PTW might provide a form of affordable travel, but it also makes provisions for public transport difficult (Barter, 2004). Vietnam is ranked 25th out of 193 in the world, based on fatalities from road accidents (Sivak and Schoettle, 2014). In a traffic saturated environment, pedestrians and cyclists are subjected to greater risks due to their lack of protection. In Vietnamese cities, adolescents are the group that is at the highest risk of road fatalities (Phuong et al., 2013). Unless a car restraint and public transport focused agenda is in place, it seems that it will be difficult to reverse the impact of motorisation and increasing traffic (Barter, 2000). The majority of trips in Vietnamese cities were found to be less than 5 km because of the compact urban environment. Because of these short distances, there is great potential for motorised trips to be replaced by cycling (Huyn and Gómez-Ibáñez, 2017), however, because of the hotter climate, people may prefer to use motorised modes. Tree cover, shade, protected walkways or bikeways can help to promote active travel modes, but they are not common in Vietnamese cities. Another feature of Vietnamese urban areas is the higher level of informal housing due to an influx of internal migrants from less urbanised areas who are seeking better economic opportunities. Informally built areas tend to feature poorer quality roads with more obstructions (Seo and Kwon, 2017). Combined with PTW traffic, these make active travel less attractive. In view of the situation in Vietnam, the objective of this study is to better understand the factors that may influence walking and cycling among adolescents in HCMC, the largest city in Vietnam. This objective is assisted by a survey of active travel behaviour and perceptions. We employed statistical analysis (district level correlation and individual level binary logistical regression) to help establish the associations of physical environment (natural and built), socio-demographic, and mobility culture (individuals, peers, parents and community) factors within a comprehensive framework adapted from existing literature.

This paper is organised as follows: Section 2 provides a concise review of children's or adolescent's travel studies and research, frameworks and theory underpinnings. Section 3 describes the context, methodology and descriptive statistics of this paper. Section 4 provides the results of statistical analysis. Section 5 outlines the limitations and possible future research directions. Finally, Section 6

offers a discussion of the implications and some concluding remarks which summarise the paper with its key contributions.

2. Literature review

Active travel studies encompass the fields of transport, health and the environment. An evidence base of the relationships among transportation, land use and physical activity is increasingly established from existing studies which show consistent positive associations with built environment factors (higher urban density, land use mix, proximity to destinations) that are favourable to walking or cycling (Handy, 2005; Saelens et al., 2003). This also applies to children's or adolescent's active travel, however, social factors also come into play – as parenting and schooling are central to their lifestyles and travel needs. A large number of parents pick up and/or drop off their children, as was found in a study based in Hanoi, the capital of Vietnam (Tran et al., 2016). Ding et al. (2011) reviewed and summarised the directions and associations of key variables – land use mix and residential density were the most supported correlates for youth active travel, while parents' safety concerns can be eased in places which are more "walkable" and which allow independent mobility (IM).

The physical environment (e.g., street design, density, tree cover), mobility related preferences (e.g., mode choice, comfort) and socio-economic factors (e.g., income) have been widely assessed. Studies from the developed countries tend to offer a wider coverage of factors. Physical environmental factors are relatively well studied in developing countries but these studies tend not to include mobility related preferences and communication (e.g., with peers, parents, community) considerations, possibly due to more limited data collection (Day, 2016, 2018). A striking observation is that air pollution has not been greatly considered in active travel studies in developing countries, despite their more acute pollution levels (Rojas Lopez and Wong, 2017). HCMC is one of the most polluted cities in Vietnam due to the concentration of transport and industrial activities, posing a significant health threat (Phung et al., 2016). Despite such risk, studies show that the net benefit of physical exercise may outweigh the impact of exposure to air pollution (Tainio et al., 2016). A handful of adolescent active travel studies, such as those by Hatzopoulou et al. (2013) and Int Panis et al. (2010) have considered the impact of the exposure to traffic pollution during active travel. Another overlooked factor suggested by Rojas Lopez and Wong (2017) is tropical weather. These are relevant to HCMC - located in southern Vietnam where outdoor temperatures reach 29–33 Celsius throughout the year. Nkurunziza et al. (2012) investigated the relationship between weather and cycling behaviour in Tanzania, where a subtropical, hot, humid climate discourages cycling.

Different models or conceptual frameworks, for both the general population and children/adolescents, have been developed to help understand the factors contributing to active travel in a more systematic way. The social ecological model considers how multi-levels of interrelating factors of the physical environment (natural and built), the social/cultural environment, the policy regulatory environment and intra-individual factors are influencing travel behaviour (Sallis et al., 2008). While this model has been the mainstay of the analysis of active travel, it tends to assume environmental determinism, where individuals are more likely to travel actively when there is favourable environment. On the other hand, mobility patterns are not only a product of the built environment, but are also created by certain cultural factors. This can be explained by the mobility culture framework (Götz and Deffner, 2009; Kuhnimhof and Wulfhorst, 2013), which suggests the way inhabitants travel is based on an interrelated system where travel behaviour is a product of the triad forces of: (i) policymaking and governance, (ii) spatial structure and transport supply and (iii) perceptions and lifestyle orientations. The mobility culture framework is useful in this regard as it combines both "hard" and "soft" elements of transport, and is proving useful for active travel research. In a study comparing four UK settlements, cycling rates are higher in places where a "culture of cycling" can produce positive social reinforcement effects (Aldred and Jungnickel, 2014). However, mobility culture framework has not been well applied in the setting of a developing country, especially at a local level, such as suburb/district or intra-urban levels, or at household/individual level.

While many studies assume rationality in decision making, recent research has begun to recognise that travel could be emotional or impulsive, as developed from the notion of "emotional geography" (Anderson and Smith, 2001). Personal aspects are better captured in travel behaviour models or theory which offers a framework that focuses on social, psychological and cognitive factors using an individual centred view (Van Acker et al., 2010). Compared to objective measures (e.g., quantitatively measurable variables such as travel distance, frequency, physical activity), perceptions and lifestyle aspects were less thoroughly researched, possibly due to the less quantitative nature of this area and difficulties in obtaining valid data (Scheiner and Holz-Rau, 2007). Nevertheless, the importance of perceptive factors is increasingly recognised in studies of youth active travel habits (Mehdizadeh et al., 2017a; Oyeyemi et al., 2014; Panter et al., 2008). However, perceptive studies focusing on an Asian or a developing country setting are relatively meagre. A particular limitation for developing countries is that the research community is less developed, as resources are less available. In addition, reliable national or municipal statistics (such as census) for objective measures also tend not to be easily accessible to the public. Instead of relying on secondary sources, this study aims to understand mobility culture by conducting a perceptive study of HCMC. We aim to understand how mobility culture affects adolescents' active travel, and to compare this with previous studies in the literature. To date, mobility culture studies tend look at aggregated levels and usually compare between cities. Applying the mobility culture framework into individual level is needed. Recently, Götschi (2017) attempted to synthesise a number of active travel frameworks, namely the PASTA (Physical Activity through Sustainable Transport Approaches) framework, which combines behavioural decision making and socio-spatial structural relationships (the social ecological layers), including mobility culture. As shown in Fig. 1, we adapted the PASTA framework in the context of data availability and in the context of HCMC, where the tropical climate, air pollution, street vendors and parenting influences are included. The PASTA framework acknowledges the multiple levels of variables and various domains (society/culture, natural/built environment), and how these influence household and individual levels, and ultimately active travel activity. The higher levels are also formed by many individuals. This framework is comprehensive and encompassing and is used to help organise the variables and study design, which we explain in more detail in the

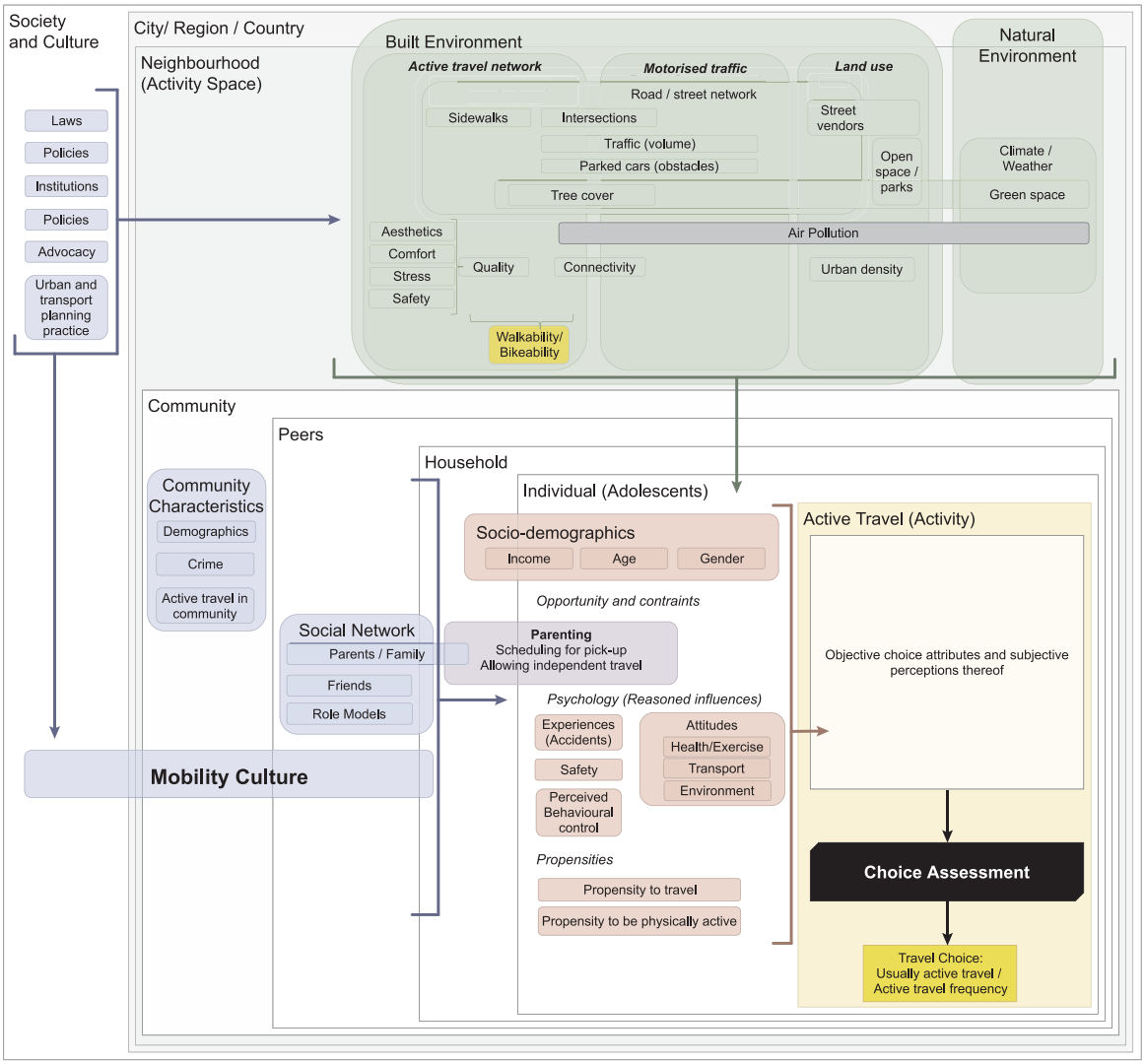

Fig. 1. Götschi's (2017) PASTA framework adapted for adolescent travel in HCMC.

following section.

3. Context, methodology, and descriptive statistics

In the global mobility culture typology assessment of 41 global cities (Wulfhorst et al., 2013), our study area HCMC is assessed as a "traffic saturated city", alongside Bangkok, Jakarta, Kuala Lumpur, Cairo and Tehran. These cities generally have serious traffic congestion issues, are located in developing countries, feature medium to high urban density, and have limited road and public transport infrastructure. Density does not necessarily result in higher pubic transport use, but narrow streets and saturated traffic can help in making full-sized automobiles less useful, compared with cities in the developed world which have better roads and highways. In traffic saturated cities, transport needs are often met by PTW, which are affordable, nimble and able to weave their way through congested traffic. However, this also comes at the cost of an increase in air pollution, as most PTWs are based on two-stroke engines, and heightened road trauma risks due to lack of occupant protection. This study places greater emphasis on heavy traffic and road trauma and their impacts on the active travel of youths, along with air and weather considerations which have not often been well-studied in prior youth travel studies.

While it would be most useful to conduct a city-wide study in HCMC, this is not feasible due to the costs involved. Instead, we selected nine districts with varying levels of income and urban characteristics that are within the central continuous urbanised area and are located to the west of Saigon River. Rural areas of HCMC are not of interest in this study but could be investigated in the future for their differences in mobility culture and travel behaviour. Based on the findings of the literature review and the active travel frameworks (mobility culture and adapted PASTA), we first conducted the initial survey (n = 964) aimed at eliciting income

Table 2 (*continued*)

Mobility culture	PASTA framework	Variables/questions included in this study	Source	Shortened name	Supporting literature
	Motorised traffic - safety	I am afraid of being injured by the traffic		Fear of traffic injury	
		There is so much traffic and it is not safe to walk or cycle		Excessive traffic, feeling unsafe	Carver et al. (2005), Mehdizadeh et al. (2018), Timperio et al. (2006)
	Motorised traffic – perceptions of driver attitude	Most vehicle drivers are oblivious to pedestrians/cyclists		Oblivious motorists	
	Community characteristics - crime	My parents warn me about strangers when going out alone		Parent worries crime for CIM	Jones et al. (2000), Kerr et al. (2006), Timperio et al. (2006)

variables and identifying households with adolescents aged 11–16 during June and July 2017, as part of a wider survey of income and travel in HCMC. The households were randomly selected to cover different locations within the same district, with proximity to schools as well as recreation facilities. We also used this opportunity to ask the next of kin of the adolescents some probing questions related to active travel, which helped in developing the travel perception survey of this study. Based on their responses, additional variables relating to air pollution, traffic and personal safety, accident experience, and street vendors were included. The supporting literature and the relevance to mobility culture and PASTA framework are identified, as shown in Table 2.

The survey questions included socio-demographic variables (age, gender and household income), travel behaviour, and perceptions. Perception variables are measured by a 5-point Likert scale (1 = Strongly disagree, 2 = Disagree, 3 = Neutral, 4 = Agree and 5 = Strongly Agree). A pilot survey with 22 adolescent respondents was conducted with these questions to test the survey and help improve the structure and wording of the final questionnaire. The households that were the respondents in the first survey were later revisited for a second survey (n = 525), with the final active travel perception questionnaire targeting adolescents aged 11–16 during August and September 2017. The reduction of sample size in this survey is due to respondent attrition, as some were not able to be contacted, or refused to be surveyed again. District level population and land use data were also included in this study. Several prior researchers used objective measures to examine the dependency of active travel (such as lack of vehicle ownership), however in our case, we used adolescents' perceptions of factors rather than objective measures. A justification for this is that a number of previous studies (Alton et al., 2007; Carver et al., 2005; Frank et al., 2007; Ma and Cao, 2017) have confirmed there is a close correlation between perceptions and the physical environment objective measures. Another reason is that there is a direct effect from perception on behaviour, rather than objective measures (Bauman et al., 2002; Handy et al., 2010). The objective measures of the environment are in turn affected by subjective perceptions (Ma and Cao, 2017; McCormack et al., 2009).

Fig. 2 shows the map of the nine surveyed districts and overall land use cover of HCMC. Table 3 shows the descriptive statistics of the population, land use and travel characteristics. Some additional variables not considered in the statistical analysis due to lack of statistical association are included here to provide additional information. They are leisure related land use (e.g., parks, sports grounds) per capita and poverty level. Poverty level is based on the World Bank poverty estimates (the percentage of population with an income lower than the 40th national percentile) as a district level socio-economic indicator. The income levels collected in the survey resembles the district level poverty level. We were unable to compare survey income level data directly with the census. The last census was conducted in 2009 and the data is not publicly available.

HCMC's urban centre is located in District 1, where resident population density has been reduced in recent years due to increased demand for commercial and office land uses. Denser districts include Districts 3, 4 10 and 11. The higher number of effective (complete) samples in District 8 is possibly due to the area's lower socio-economic level. Slums (self-built) housing in HCMC occupy more land area than is the case in Hanoi (Seo and Kwon, 2017), and District 8 contains more slums due to its outer location. Based on our observation, respondents in poorer districts tend to be more willing to provide active travel perceptions, anticipating that undertaking the survey might help alleviate their situation. This may cause over-sampling of this district, and under-sampling of other districts. While this is a limitation of this study, we nonetheless compared the income values with the district poverty averages and mode share figures to ensure that representation was sufficient.

The land use characteristics of the districts varied considerably - Go Vap and District 1 (the city centre) has the highest road and park availability. To the northeast, Tan Binh features the Tan Son Nhat International Airport. As the airport occupies large swathes of land, urban density, which is measured using only the urban area rather than the whole district's area size, is preferred. Our samples of Tan Binh show that it is a fairly high income district, as most of the schools are located in well-off areas. However, in district-wide poverty estimates, this rapidly developing area contains some of the airport workers' accommodation.

To better demonstrate the "mobility culture", we present some images of the streetscape of District 4 (closer to city centre) and Binh Thanh (suburbs) in Figs. 3 and 4 respectively. District 4 (on the left in Fig. 3) is more densely populated and is well used by pedestrians. This area is known to be a "street food paradise" by locals, offering a multitude of food choices. However, the street vendors are often considered to be obstructing the sidewalk, and the rubbish they generate is considered to be unsightly. However, lack of regulation, and construction sites (on the right in Fig. 3) could render the sidewalks closed, with pedestrians being forced to walk on the roads with motorcycle/vehicular traffic. Binh Thanh is more suburban in nature. Some streets (on the left in Fig. 4) are more attractive for active travel with street vendors and shade, however motor scooters remain the dominant transport mode. This

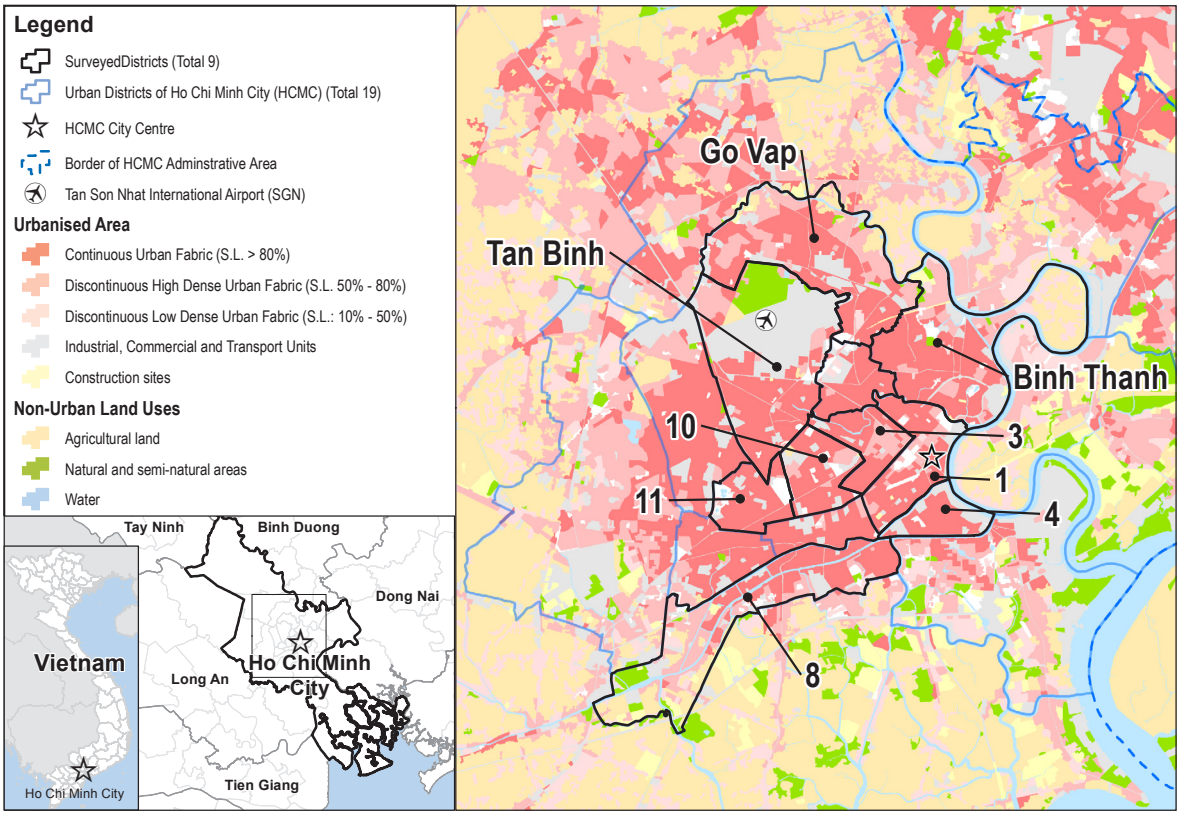

Fig. 2. Location of the study area and urban districts of Ho Chi Minh City. S.L. = Sealing level of soil (an urbanisation measure).

street's (on the right in Fig. 4) sidewalk is non-existent, occupied by vehicles and shops, with a muddy and uneven road. The most reported usual mode of travel undertaken by our participants is motorcycle, followed by walking and cycling. Bus and car use is very low. Different districts display disparity in reported mode use. More affluent districts tend to have higher motorcycle use, but this is mixed. Most motorcyclists reported that they were passengers, with some rare cases (up to 0.2%) of self-driving, which indicates driving without a licence. Public transport and taxi usage is extremely low.

In considering the nature of the data, we employed both correlation and binary logistic regression to identify the possible relationship between the variables. Similar approaches have been identified in prior active travel survey studies (Feng, 2016; Nkurunziza et al., 2012; Pojani and Boussauw, 2014; Villanueva et al., 2013). We first calculated the Pearson correlation coefficient of the district aggregates (averages) of the variables to establish their possible relationships, then a binary logistic regression model was used. The dependent variable is whether the respondent's usual mode is active (walking or cycling), to which a binary value of 1 is assigned. This is tested against other independent variables, as outlined in Table 2. The interpretation of the results is based on the odds ratio (OR). We also tested the multicollinearity properties of the sets of explanatory variables to avoid spurious and erroneous modelling. The variance inflation factor (VIF) was used. An exclusion cut-off of VIF signalling multicollinearity in logistic regression is 2.5 or higher (Midi et al., 2010). All of the selected variables had VIF values between 1.0 and 2.3.

4. Results

The correlation analysis at district level shows the overall interrelationship between the variables. Due to the number of variables, instead of a correlation matrix, we present the data in the form of a correlation network diagram created by the *Gephi* software, as shown in Fig. 5.

To allow for clearer presentation, only the pairs with correlation value over 0.6 are shown in the form of red[1] and blue lines (edge). The blue lines denote positive correlations while the red lines denote negative correlations. Thicker lines denote higher correlation and vice versa for thinner lines. Statistically significant pairs are marked (** = $p \leq 0.01$, * = $p \leq 0.05$). Only two travel mode-related variables fits have pairs over 0.6 – active mode frequency and motorcycle mode share. The circles (node) are based on the overall correlation value with other variables (weighted network degree, WND), and are colour coded by their type. A larger

[1] For interpretation of colour in Fig. 5, the reader is referred to the web version of this article.

Fig. 3. Streetscapes of District 4.
Source: Authors.

circle would imply higher overall correlation with other variables. Of particular interest are the correlation pairs of the travel variables, as they reflect travel behaviour. Street vendors, preference for travelling with peers and short travel distance are positively correlated with district level active travel frequency; whereas income and prior traffic injury experience are negatively correlated with it. For district level motorcycle mode share, income is positively correlated, as is parents' ability to drive children. It is also correlated with negative aspects of active travel, such as excessive traffic. The variables (nodes) with the highest correlation network degree value are "parent allows IM" (WND = 31.78), followed by "active travel if distance is short" (WND = 31.25) and "obstacle free paths" (WND = 28.49). These variables have mostly positive correlations with others. "Prior active traffic injury" has the fourth highest degree value (WND = 28.25) and has negative correlations with other active travel related variables and is positively correlated with "parent able to drive me" and "fear of traffic injury".

While the district level correlation shows some of the interrelation of variables, it does not suggest causation, nor reflect individual level variations. To address this, binary logistic regression is employed and the results are presented in Table 4. Individual regression results are similar to those for district level correlation, but more variables are shown. In our sample, age is not found to be a significant variable and is not included in regression analysis. This is probably due to the rather narrow range of ages surveyed (11–16 years old). Those who reported that they usually travel actively are also more likely to travel actively at higher frequency (OR = 1.47). Built environment variable associations are higher urban density (OR = 1.41), lower road density (OR = 0.5), better pathway quality (free of obstruction (OR = 1.29) or with tree cover (OR = 1.35)) and availability of open spaces in neighbourhood for exercising (OR = 1.38). In a hot and humid climate, trees and shade can help improve comfort in active travel, which is confirmed by this survey and statistical analysis. Pedestrian or cyclist dedicated pathways are a rare sight HCMC, except in District 1. Virtually all the roads in HCMC share active and motorised traffic. Higher road supply might imply more traffic and less favourable conditions for adolescents' active travel. The presence of street vendors is a variable that is unique in Vietnam and in developing countries. Their presence in the neighbourhood (OR = 1.35) and on the route to school (OR = 1.32) are also associated with active travel but they also cause obstruction to pathways, which has a negative impact (OR = 0.74). This complements the findings of Carver et al. (2005), which suggests that convenience stores near homes are positively associated with active travel at weekends.

Shorter travel distances for active travel are strongly preferred by respondents (OR = 2.69), affirming prior studies (Carver et al., 2005; Cole et al., 2007; Emond and Handy, 2012; Martens, 2004; Schlossberg et al., 2006; Sirard and Slater, 2008; Sjolie and Thuen, 2002). Other individual variables that are associated with active travel are feeling comfortable about travelling alone (2.19), while there is a lesser preference when considered to be a form of recreation (OR = 1.67). Wider environmental variables such as hot

Fig. 4. Streetscapes of Binh Thanh.
Source: Authors.

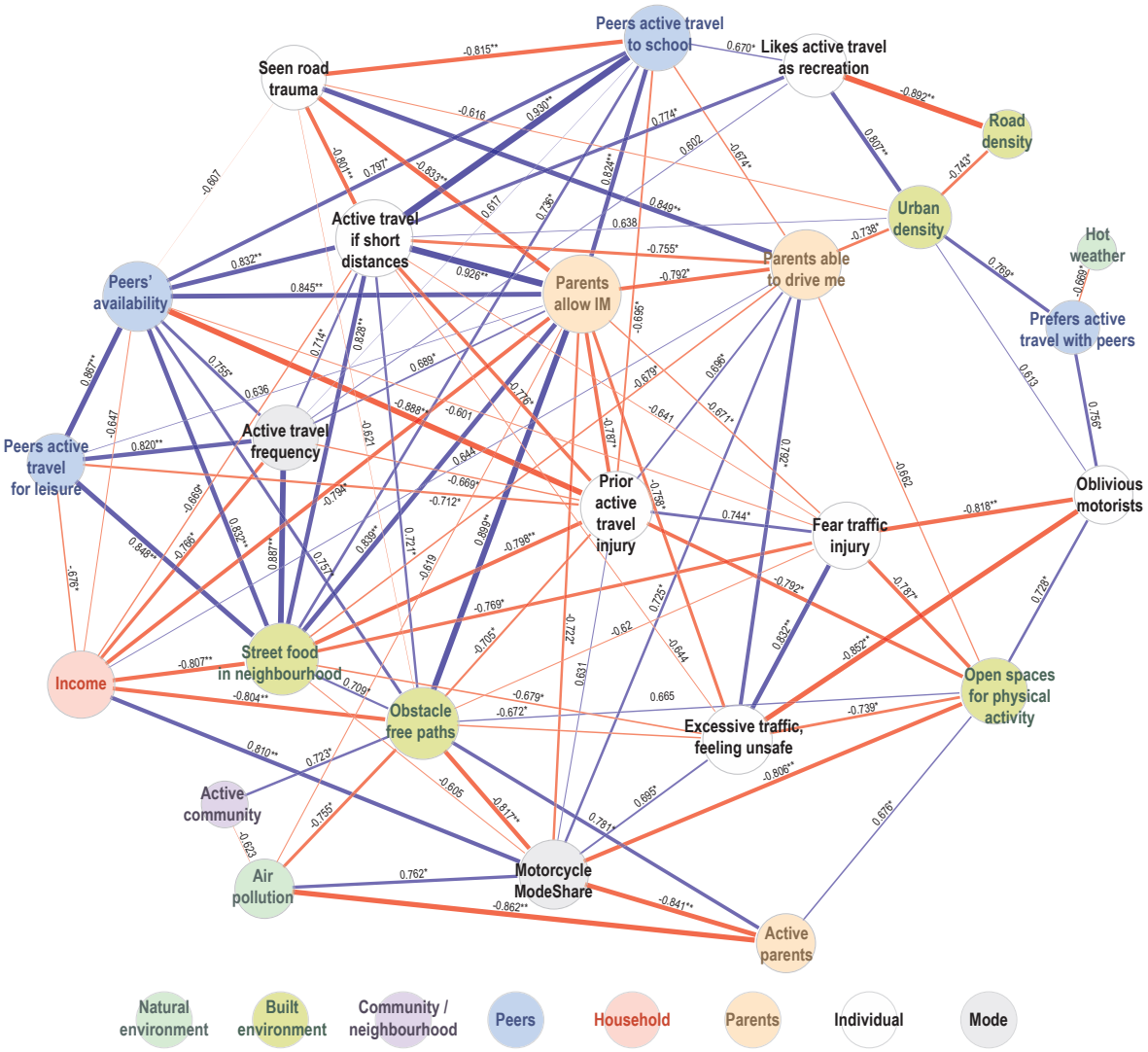

Fig. 5. Correlations network diagram of variables at district level.

weather (OR = 0.5) and traffic exhaust air pollution are also negatively associated with active travel (OR = 73), which is not as strongly reflected in district level correlations. For socio-demographic variables, females are less likely to travel actively (OR = 0.41), confirming prior studies in both both developed (Garrard, 2009; McMillan et al., 2006; O'Brien et al., 2000), and developing country settings (Amornsriwatanakul et al., 2017; Oyeyemi et al., 2014; Peltzer, 2009) and also locally in HCMC (Trang et al., 2012).

The reasons against females walking or cycling unaccompanied could be because of safety concerns. Female adolescents in developing countries also tend to be more restricted due to cultural norms (Trang et al., 2012). In Nigeria (Oyeyemi et al., 2014), there are gender constructed expectations that females undertaking active travel are frowned upon. Income is negatively associated with active travel (0.6) and this confirms other findings, such those as from HCMC (Trang et al., 2012), Australia (Rachele et al., 2015), China (Shi et al., 2006) and South Africa (Lennox et al., 2008). Peers, parents and communities may serve as role models – if they are more willing to conduct active travel, so do the adolescents as well. Peers are of particular importance, as active travel offers opportunities for social interaction (Emond and Handy, 2012) and this is also confirmed in our study. Parents being able to take their children as passengers on motorised modes are likely competing with active travel opportunities (OR = 0.5). The role model effect from parents (OR = 1.44), peers (active travel for leisure, OR = 2.46; active travel to school, OR = 2.12) and neighbourhoods (OR = 1.27) is evident if they also travel actively. The accompaniment of peers makes active travel more likely by making it safer and more enjoyable, as expressed in the preference for having peers during active travel rather than being alone (OR = 2.34). The availability of peers is also important (OR = 1.98). In HCMC, traffic has a negative association with the likelihood of active travel, in particular if the respondent feels that motorists are oblivious (0.47) and if they have witnessed road trauma (OR = 0.49). Parents are also quite likely to warn their children about strangers if they travel actively (OR = 0.59), as the kidnapping of children or youth is perceived by many parents in Vietnam as being a threat. Discouraging active travel because of parental concerns about safety is also evident in the UK (Jones et al., 2000).

Table 4
Binary logistic regression model for usual active traveller vs non-active traveller.

Independent variables	Coef	Sig.	OR
Urban density	0.346	0.001	1.41
I feel uncomfortable to walk/cycle when it is too hot	−0.698	0.026	0.50
I feel uncomfortable because of the exhaust fumes/dust from vehicles when walking/cycling	−0.311	0.001	0.73
Road length per 1000 persons	−0.701	0.001	0.50
The paths or streets are free of obstacles	0.258	0.021	1.29
Stores and street vendors are occupying the sidewalks or roads	−0.301	0.015	0.74
There are lots of trees along my route to destinations	0.301	0.012	1.35
Our neighbourhood has open spaces where I or my peers can exercise	0.322	0.001	1.38
There are street vendors/stores in my neighbourhood	0.301	0.033	1.35
There are street vendors/stores along the way to school	0.28	0.021	1.32
Household income (monthly)	−0.511	0.026	0.60
Gender (reference = female)	−0.891	0.000	0.41
Frequency of active travel	0.387	0.011	1.47
I am more likely to walk or cycle to destinations if the travel distance is shorter	0.988	0.001	2.69
Likes active travel as a form of recreation	0.511	0.001	1.67
I feel comfortable getting to places on my own	0.786	0.001	2.19
My peers often ride their bikes/walks around my neighbourhood for leisure	0.902	0.005	2.46
I have many peers to hang out with often	0.685	0.006	1.98
I like bicycling/walking to school with friends rather than by myself	0.851	0.015	2.34
My friends walk or cycle to school	0.75	0.010	2.12
My parents/next of kin are able/willing to drive me to places	−0.701	0.001	0.50
One or both of my parents/next of kin walk or cycle frequently	0.367	0.002	1.44
My parents/next of kin allow me to go out by myself	0.211	0.032	1.23
In my neighbourhood, many people engage in walking/cycling	0.241	0.002	1.27
I have been injured while cycling/walking before	−1.302	0.001	0.27
I have witnessed the death/injury of motorcyclist/bicyclist/pedestrian	−0.723	0.003	0.49
I am afraid of being injured by the traffic	−0.547	0.002	0.58
There is so much traffic and it is not safe to walk or cycle	−0.591	0.001	0.55
Most vehicle drivers are oblivious to pedestrians/cyclists	−0.755	0.010	0.47
My parents warn me about strangers when going out alone	−0.523	0.001	0.59
Sample size		N = 525	
−2 Log likelihood		101. 502	
R^2 (Nagelkerke)		0.389	

5. Limitations and further research opportunities

This study has some limitations. The design of the study is explorative rather than being fully representative. We hope future attempts will be able to conduct a better survey design that covers a larger area, with larger sample sizes, or wider age ranges. More sophisticated methods could be employed, such as structural equation modelling, as performed in other youth active travel studies (Van Acker et al., 2010). Our trip data is also rather simplistic, offering only usual mode and active travel frequency. Alternative and innovative data collection methods which allow for better trip details should be considered in future studies, such as using GPS devices to track children's active travel and actual distances. This approach was employed in a study in Perth, Australia (Babb et al., 2017). Further studies should investigate how disadvantaged households are travelling differently, in comparison with more advantaged households in Vietnam (Veitch et al., 2017). In this study, like other mobility culture studies, we are not able to measure the effects of wider political or urban planning decisions due to the difficulty of associating these decisions with adolescents' travel behaviour and perceptions. Such a study would require some form of longitudinal analysis. Nevertheless, the findings of this study offer new local knowledge, and could help policy makers in Vietnamese cities, or similar cities, to devise better urban and transport planning activities.

6. Discussion and concluding remarks

This study is likely the first of its kind in HCMC and has provided valuable insights on the active travel of adolescents, based on a wide range of their perceptions of environmental (built and natural) and social (personal, peers, parenting, and neighbourhood) factors. We have presented the mobility culture aspect of youths' active travel in HCMC. We found that the respondents showed a strong preference for active travel if the distances were shorter. However, this is restricted by numerous barriers. The mobility culture in Vietnam today does not promote active travel. Active travel policy guidelines are usually available in developed countries (Bauman et al., 2002) but this is not as developed in Vietnam. At a macro-scale level, Vietnamese transport policy makers should consider greater investment in public transport and private vehicle restraint policies. This is already underway in HCMC, as the underground metro railway is currently under construction and is aiming to commence operations in 2020. To reduce the impacts of traffic (air pollution and unsafe roads), private vehicle restraints should be considered in order to curb motorisation. This is actually possible in the Vietnamese context, as the touristic city of Hoi An is able to restrict car use and only allows active transport in the historic town area. This links to urban design or physical environment solutions – the inclusion of cycle tracks and walking infrastructure is an