Determinants of Children's Independent Mobility in Hong Kong

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Abstract: This study examines children's independent mobility (CIM) among primary school students during their home-school journeys in Hong Kong. It represents an empirical research to assess the impact of individual, family and environmental determinants in influencing the level of CIM. Using territory-wide travel diary data from the Travel Characteristic Survey 2002 (TCS02), logistic regression modeling is used to understand the key factors associated with increased level of CIM among children in the city. The present study found that approximately one third of school journeys were conducted by children on their own. CIM were highly associated with the distance to schools, age group of children, median household income, family structure, working status of mothers, employment of domestic helper, neighborhood settlement types and density of school places. These findings can provide input to strategies for promoting increased level of CIM to improve children's well-being.

Keywords: Children, Independent Mobility, Travel Behavior, School Journeys, Asia

1. INTRODUCTION

Children's independent mobility (CIM) refers to the opportunity for children to walk, to cycle, skateboard or rollerblade and to use public transport to reach various destinations without the direct supervision of adults. It represents a valuable opportunity for young children to explore and experience their surroundings. CIM can form a foundation for children's personal development but research on children's activity travel pattern has shown a remarked decline in CIM enjoyed by children. For instance, the level of CIM by children in the United States (US) and United Kingdom (UK) have dropped sharply from 90% and 80% in 1960/70s to only 13.5% and 10% in 1990/2000s (Surface Transportation Policy Project, 2003; Hillman et al. 1990). Many children of this generation are more protected by their families, they are not allowed to go out freely on their own when comparing to their parents and even more so their grandparents. Researchers have warned that such change could exert adverse effects on the behavioral, cognitive, emotional and physical development of children (Anthikad, 2007).

The trend of prohibiting CIM has mainly been made on safety grounds. Many parents have a preoccupation to protect their children from being harmed by busy traffic and by strangers while travelling (Valentine, 1997). In pursuit of this understandable aspiration to safeguard their kids, parents are now having the tendency of denying their children independence in their local surroundings (Qvortrup et al., 1994). Nowadays, children's mobility is often under parental surveillance. The intense desire to protect children often results in many children being escorted,

commonly by motor vehicles, to schools. For example in the UK and US, half and three-quarters of children were taken to schools by cars (Dickson, 2000; National Center for Chronic Disease Prevention and Health Promotion, 2001). This heavy reliance on motorized modes implies that the amount of active commuting like walking by children is on a decline. The global childhood obesity epidemic has been linked to a car-dominated environment which promotes sedentary lifestyle among young children (Tucker, 2008). With parents' dropping off and picking up their children to and from schools, heavy traffic around school communities generates much inconvenience to residents nearby (Black et al., 2001). In addition, emissions from these vehicles at school communities also represent a potential source of pollutant affecting children's health. Traffic-related air pollution near schools has been linked to the development of cardiorespiratory deficiency such as asthma in young children (McConnell et al., 2010). Similarly, increased vehicular traffic can lead to a greater number of children exposed to crash risk. Above all, the restricted mobility of children can reduce their choice, risk their health and prevent them from participating fully in the wider community through exploring their surroundings. This could have a detrimental effect on their well-being. More importantly, children are the decision-makers on future transport development and planning, their current travelling style could exert a great impact on their transport decision making for now and the future.

1.1.   Independent Mobility of Children in the Chinese Context

Granting children the permit to go freely on their own arises in a multivariate context. It is not only associated with the characteristics of children and their family, but also with the cultural, socioeconomic and environmental factors. For instance, neighborhood environment was found to have different effects on CIM. By comparing settlement types, a Japan-based research discovered that children living in urban area enjoyed a much higher level of independent travel than their counterparts (Driana and Kinoshita, 2011). A Finnish study (Kyttä, 1997) found out that lower-density settlements in rural area were more favorable to increased level of CIM. But a more recent Nordic study by Broberg et al (2013) found out that dense urban structures promote independent travel. While an Australian study discovered that there were no significant differences by urban and rural locations (Carver et al., 2012). Population density was also found to exert different effects on CIM. In Osaka metropolitan area in Japan, population density was reported to be positively correlated with children's autonomous travel (Waygood and Kitamura, 2009), displaying a contradictory stance regarding the effect of density in a Canadian study (Bonner, 1997). Drawing from these examples, one can thus question whether CIM varies across time, cultures and settings.

Most studies on CIM have been focused on Western children, only with a few exceptional cases of study in Africa, Australia, Japan (Malone, 2011) and Taiwan (Chen, 2002; Lin and Chang, 2010). Nonetheless, it is crucial to note the great socioeconomic, political and cultural differences, such as child-rearing practices, between different countries and cultures, could lead to different behaviors. Parental child-rearing practices play an important role in the development of children (Lai et al., 2000). In terms of attitudes and beliefs, Western parenting emphasizes the development of independence and individualism, whereas for Eastern practice, which is very much influenced by Confucianism, stresses the development of interdependence and family closeness (Lai et al., 2000; Liu et al., 2005). Therefore, results from Western studies may not be generalizable to Asian children. In terms of CIM in Eastern Asia, Japan has one of the highest levels of CIM in the world (Driana and Kinoshita 2011). A study by Waygood (2011) found out

that approximately 85% of children's trips were made by themselves, despite the majority of mothers worked as homemakers in Japan. In addition, a study in Taiwan discovered that a comparatively high percentage (65%) of home-school journeys was conducted by children independently (Chen, 2002). Despite the evidence from Taiwan, the overall picture in East Asia and the Chinese communities are far from being clear. A study by Ho (1986) highlighted that parents in Chinese societies are commonly highly concerned with impulse control and they discourage their children's adventurous activities. Another study has also concluded that Chinese parents are viewed as more protective and controlling in child-rearing (Lin and Fu, 2008). In this way, children's who are allowed to explore their surroundings via CIM are very much likely to be prohibited. Putting this proposition into the study of independent travel among Chinese children needs further exploration. It is necessary to further test the situation of CIM in different Chinese communities if generalizations are to be made and this study provides insights and investigation into this underexplored area.

1.2. Hong Kong Children and their Journey-to-School

This study represents an initiative to investigate CIM in the Chinese context with a sample of primary school children from Hong Kong. Home-school journey represents an important part of children's everyday experiences and therefore this study particularly focuses on their journeys-to-schools as an attempt to explore CIM in the Chinese context. Hong Kong, located on China's southern coast is a Special Administrative Region of the country. About 93.6% of the population are ethnic Chinese and around 90% of the population speak Cantonese, the local dialect (Census and Statistics Department, 2012). Before Hong Kong's sovereignty was transferred from Britain back to China in 1997, the society has gone through 156 years of British colonial rule producing a mixture of Western and Chinese cultures. The rapid urbanization and modernization in the past century have also resulted in a fast structural change in the economy, away from a small fishing village to an international financial center. In particular, women's participation in the labor force and increasing levels of education has a demonstrated influence upon reducing birth rate. The city has one of the world lowest fertility rates with 9.6 infants per 1000 population in 2006 (Census and Statistics Department, 2012). These profound changes in the economic and social life of the people are expected to exert a change to the roles and functions of family members, and play a crucial role in determining the pattern of children's travel.

In the present study, Hong Kong is used as a case study area to examine CIM in the Chinese context. It is nevertheless vital to note that CIM varies across continents and cultures and there are sub-cultures within culture. As a Chinese-dominated society sharing the same cultural root, Hong Kong may differ from other parts of Chinese societies in terms of its economic, political and social environments (Shively and Shively, 1972). In addition, this study also focuses on the associations of extra-familial context like the surrounding neighborhood in altering children's school travel mode and their parental escort decisions. In acknowledging the intra-cultural variability with respect to different settings, the present case study of Hong Kong adds a missing piece to the complicated puzzle of CIM in the Chinese context. By doing so, the current study attempts to provide some insights to the growing literature of CIM. With a special focus on Hong Kong children, this study sought to understand the key domains that influence children's levels of independent mobility during their journeys-to-schools. In particular, it explores how personal, family and environmental factors affected CIM. The current paper has three goals. Firstly, it explores the overall state of CIM of children in Hong Kong. Secondly, this study

examines how different domains of factors would distinguish CIM among children in the city. The analysis presumes that certain characteristics of an individual's personal or family as well as the neighborhood environment in which one lives will have a positive effect on children's freedom to go out on their own to schools. Thirdly, the findings of the study will be of significant value in filling in the gaps that exist in the literatures to date in the examination of CIM in the Chinese context.

2. METHODS

2.1 Sample Selection

The main source of data used in this research was the travel diary data extracted from the Travel Characteristics Survey 2002 (TCS02) (Transport Department, 2002). TCS02 was collected by government consultants commissioned by Transport Department (TD) in December 2001 in Hong Kong. It provides a territory-wide travel database with comprehensive information on the trips made by residents on a normal weekday (excluding public holidays) during September and December 2002. The main data used in this study followed a four-level hierarchical structure, ranging from the highest unit, living quarter based (LQ) to household based (HH) to household member based (HM) and to the smallest unit, trip based (TB) information. Information was collected by means of face-to-face interviews which recorded detailed trip information of respondents who aged 3 or above (To, Yau, & Lam, 2005). By exploring and linking different databases, the data provide detailed information about personal and household socio-demographic information as well as information for each of the trips and trip-segments made by the respondents on the reference travel day.

Children aged 6 – 12 year and studying at primary schools during the study year are the target sample population for the study. Using stratified-random sampling, this study sought a sample size of 2,110 children from 1,672 families. In terms of geographical variability, the study sample lived in 65 different neighborhoods, as expressed in terms of Small Tertiary Planning Units (STPU) which are contained within six districts, out of the eighteen districts of Hong Kong (Figure 1). STPU is demarcated by the Planning Department for town-planning purpose. This census-block group is used as proxy for neighborhoods for the study. The six districts include Central and Western, Sham Shui Po, Kwun Tong, Yuen Long, Tai Po and Sai Kung Districts. They were selected to provide geographic distribution throughout the city and the STPUs were further classified to represent urban, sprawl and rural locales based on population density and the history of development. The first three Districts belong to the urban group which are located in densely populated core regions with a long history of development ever since the city's very founding. The last three are classified as sprawl and rural development. In particular, they include all the twelve new towns with rapid population growth since the 1980s. Among the six districts, Kwun Tong is the most densely populated one with 49910 people per km^2. In terms of socioeconomic status, Central and Western District has the highly median household income in 2001 (HKD25350). For more details of the classifications of settlement types, refer to Loo and Chow (2011).
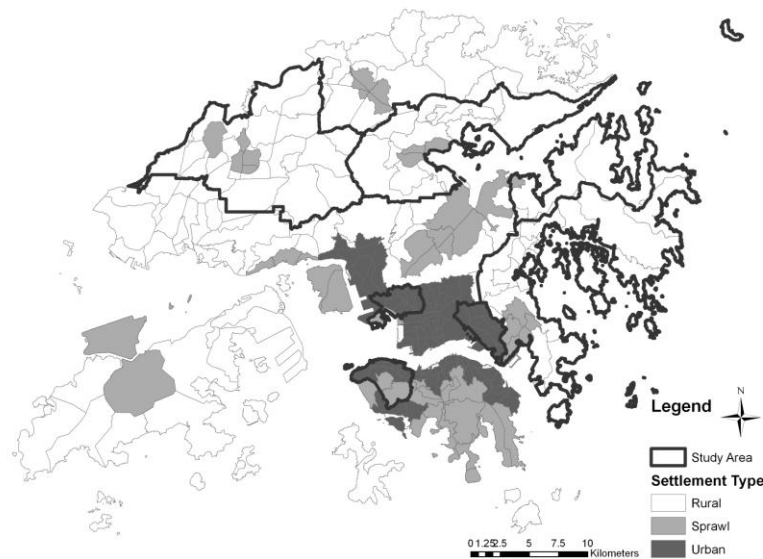
Figure 1 Study area

2.2 Measures

2.2.1. Assessment of children independent mobility

Children were identified as having independent mobility if no adults accompany s/he to schools, irrespective of the mode of transport they used. The level of CIM was assessed using the HH, HM and TB information from TCS02. Though the database does not provide a direct indicator of whether the child respondent was escorted to school or not, with the detailed account of the activity travel data of the respondents, as well as their family members, it would be possible to gauge a generous estimate of the indicator of CIM. In particular, by looking at the household members' trip purpose stated as "Escorting children to / from schools", it would be possible to identify their adult companions. Also, CIM was evaluated by looking at the mode of transport children used. Children who were passengers of private cars, school bus or school private light bus (or more commonly known as nanny vans in the local context) during their home-school journey were identified as not having CIM as there were adults companions. Nonetheless, one limitation of the present extraction method is that it would be difficult to identify children going to school with other companion such as their brother(s), sister(s), friend(s), neighbor(s), nann(ies), and/or a relative(s) who lives in a separate home on their way to school. But given the purpose of this text, it is acceptable because the major aim is to identify children accompanied to school by adults and the remaining are expected not to make up a high portion of trips. For the purposes of the analysis, the CIM variable was recorded into a dichotomous variable representing children who have CIM (yes=1) versus those without (no=0).

2.2.2. Individual factors

For the 2110 children, TCS02 provides basic personal socioeconomic status (SES) of children

such as age and gender as well as the location of residence and school recorded as zones at street block level (the smallest demarcation system available for analysis in Hong Kong). The study is also interested in understanding how the characteristics of children's school journey affect their level of CIM. For the sake of brevity, the details of children's home-school journeys will not be reported here. All of the key aspects of the journeys are discussed in depth in an upcoming paper (Loo and Lam, In Press)

2.2.3. Family factors

TCS02 further includes information about the household information at the LQ and HH level. Living quarter attributes including housing type classified as public rental housing, subsidized sale flats and private housing. Household member's relationship in HH was used to identify the mother and/or father of the children and maternal attributes such as their working status. It was also used as a base to classify the structure of the family into extended, nuclear and single parent family. With this extensive data, the number of siblings under the age of 13, the presence of grandparents living under the same roof and whether the household recruited domestic helpers can all be identified. Together with other attributes like household size, household income and household car ownership. All these information provide a detailed view on the SES profile of the sample population at the household level.

2.2.3. Environmental factors

Environmental data were linked to the child's home neighborhood. Data on year 2001 socio-demographic and economic indicators such as population density and median household income indexed by STPU census block groups were obtained from the Census and Statistics Department. This study also included other geographical attributes like school density and network density (network of all public transport and roads) for exploration. School density was calculated by dividing the number of primary school places by the estimated 2001 population of children attending primary education. Higher density is normally associated with highly accessibility and choice, competition or cooperation, which would have play a part in affecting CIM of children (Gibbons and Silva, 2008). To encompass the social setting of the neighborhood, this study used the social deprivation index (SDI) as a measure of neighborhood SES. It reflects the sum of socio-demographic adversities that neighborhoods face. The specific calculation of the index can be found at Loo and Yao (2010). Since personal safety might affect the chance that children will be allowed to go out on their own, a three-year average of crashes involving children in year 2001 to 2003, using the crash records from the police reported Traffic Accident Database System (TRADS), was gauged. It was used as a proxy of neighborhood safety. The measure was weighted by the total number of children living in the same neighborhood from the census data. Another environmental attribute taken into account was land use mix. It refers to the degree to which different land uses are locating close together. In this study, it was calculated based on the Simpson Diversity Index, this biological measure of diversity evaluates the number of land use types within a STPU. The land use is broadly divided into five categories (residential, commercial, industrial, institutional and others such as open space and other specified uses) in this study. The detailed formation can be found in Loo and Lam (2011).

2.3. Statistical Analysis

A main objective of this study is to investigate which factors of the three stated domains are determinants for increased level of CIM for children in Hong Kong. Descriptive statistics were first used to characterize the sample population and their state of CIM. In order to identify the most important factors associated with CIM, the one-to-one association of various parameters with CIM was first evaluated using univariate logistic regression. As a future step to explore which were the most important determinants, multivariate logistic regression models with all statistically significant factors from the univariate analysis were used as independent variables and with the dichotomous CIM indicator as the outcome variable, the final model has the following formation:

$$p = \frac{e^{(\beta_0 + \beta_1 X_1 + \beta_2 X_2 + ... + \beta_n X_n)}}{1 + e^{(\beta_0 + \beta_1 X_1 + \beta_2 X_2 + ... + \beta_n X_n)}} \tag{1}$$

Where:

p = the probability that a child had CIM during his/her home-school journeys,
e = the base of natural logarithms,
β_0 = the intercept,
$\beta_1 \beta_2, ... \beta_n$ = the coefficient of the predictor variables, containing metric, binary and ordinal variables.

For the cases of the binary and ordinal variations, logit transformation defined as follows are required:

$$\text{logit}(p) = \ln\frac{p}{1-p} = \beta_o + \beta_1 X_1 + \beta_2 X_2 + ... + \beta_n X_n \tag{2}$$

Knowledge of determinants of CIM is of utmost importance in order to establish effective strategies to promote CIM among children. Since each context level contained many variables, it was necessary to reduce the number of variables in each domain and protect again a Type I error resulting from multiple comparisons against correlated variables. This study initially selected 18 variables and then performed a stepwise regression to reduce the number of variables into the final model. All statistical analyses were conducted using STATA 12.

3. RESULTS

3.1. Characteristics of study participants

The characteristics of the sample population are shown in Table 1. The gender of the sample was balanced with 51.61% females and 48.39% males and the mean age was 8.77 years. 78.78% of the subjects lived in nuclear families consisted of the father, mother and offspring. Nearly 40% of mothers worked outside home, either working full-time or part-time. Among the children, the average number of sibling under the age of 13 was 1.06 (SD=0.68). There were 0.17 grandparents living together in the same household of the children. On average, one household

out of six employ domestic helpers to assist with the household chores. 24.27% of the sample lived in families with household monthly income below HKD$10,000, which were below the territory-wide average. The average household car ownership was low, with an average of 0.22 cars per household, reflecting the overall low car ownership rate of the city. The proportion of children living in public and private housings spread evenly with each type accounting for approximately 40% of the sample. Of the children, 39.19% were living in urban core, 47.82% in sprawl and 12.99 in rural area. Nearly half of the sample lived in sprawl locations in Hong Kong. These areas are mainly new towns development in the city to combat the rapid population growth since 1980s.

3.2.   Patterns of children's independent mobility

Overall, the level of CIM by Hong Kong children was 29.4%. Differences between children with and without independent mobility are also shown in Table 1. The table presents the descriptive analysis and statistic tests (chi-square or t-tests) to compare the relationships based on different parameters. Notably, children living further away from their schools were significantly less likely to have CIM. On average, boys had greater levels of independence than girls but it is not statistically significant (p=0.139). Age played a crucial role in affecting the level of independent travel, with more senior children allowed to travel on their own to schools. Among different modes of transport, children who took buses to school enjoyed the highest level of autonomous travel. The bus network has an extensive spatial coverage in the territory, providing easy access to reach destinations. It has the highest percentage share of public transport patronage by mode in 2001, accounting for nearly 40% of the share (Census and Statistics Department, 2010). For family characteristics, there was statistically significant difference found among the types of family structure. Children from single parent households had a higher chance to travel independently. A statistical test also confirms that the lower rate (6.64%) of CIM of children living in more affluent households, as reflected by household monthly income with more than HKD40,000. Similarly, children living in private permanent housings were less likely to have CIM. Household car ownership rate also negatively affected the level of independent travel. Regarding the impact of family members on the state of independent mobility, maternal working status had a remarkably positive impact on the level of CIM. Also, the more siblings the child had, the more likely that kids would make independent commuting to their schools. On the other hand, the numbers of grandparents and domestic helpers had a statistically significant impact in reducing the opportunity for children to travel independently. Turning to the effects of neighborhood, children living in sprawl area were having more chances to travel by themselves. Population and network density both had a negative and significant sign on CIM. School density as calculated by the number of school places weighted by the number of children living in the same neighborhood was found to positively influencing the level of independent travel. While crashes involving children, social deprivation level of the neighborhood and land use mix were not statistically significant.

Table 1 Sample characteristics, by state of children independent mobility

Parameter		All[a]		With[b]		Without[c]		Statistical test p value
		n[d]	%[d]	n[d]	%[d]	n[d]	%[d]	
Personal and trip characteristics								
Distance to school	Less than 1 km	722	34.22	314	43.55	408	56.45	x^2=117.28, df=3, p<0.001
	1 - 2km	505	23.93	126	24.95	379	75.05	
	2.1 - 4 km	453	21.47	114	25.17	339	74.83	
	More than 4km	67	3.18	67	15.58	363	84.42	
Gender	Male	1021	48.39	336	30.85	753	69.15	x^2=2.19, df=1, p=0.139
	Female	1089	51.61	285	27.91	736	72.09	
Age group	6-7	600	28.44	96	16.00	504	84.00	x^2=157.70, df=2, p<0.001
	8-9	697	33.03	161	23.10	536	23.10	
	10-12	813	38.53	364	44.77	449	44.77	
Transport Mode	Walking	1077	51.04	494	45.87	583	54.13	
	Cycling	16	0.76	5	31.25	11	68.75	
	Private Car	85	4.03	0	0.00	85	100	
	School Bus	692	32.80	0	0.00	692	100	x^2=516.77, df=6, p<0.001
	Bus	128	6.07	71	55.47	57	44.50	
	Minibus	30	1.42	10	33.33	20	66.67	
	Railway	82	3.89	41	50.00	41	51.22	
Family characteristics								
Family Structure	Extended family	340	16.11	84	24.71	256	75.29	x^2=12.67, df=2, p<0.05
	Nuclear family	1662	78.77	491	29.54	1171	70.46	
	Single parent family	1089	5.12	46	42.59	62	57.41	
Household income groups	Below HKD10,000	512	24.27	207	40.43	305	59.57	x^2=93.86, df=2, p<0.01
	HKD10,000-39,999	1342	63.60	397	29.58	945	70.42	
	HKD40,000 or above	256	12.13	17	6.64	239	93.36	
Housing Type	Public rental housing	828	39.24	320	38.65	508	61.35	x^2=65.05, df=2, p<0.01
	Subsidized sale flats	396	18.77	116	29.29	280	70.71	
	Private permanent housing	886	41.99	185	20.88	701	79.12	
Mother working outside home		842	39.91	280	33.25	562	66.75	x^2=9.86 df=1, p<0.05
Number of siblings		M=1.05	SD= 0.68	M= 1.15	SD= 0.70	M= 1.01	SD= 0.61	t=4.24, df=2108, p<0.01
Number of grandparents		M=0.17	SD= 0.47	M= 0.13	SD= 0.42	M= 0.19	SD= 0.49	t=-2.58 df=2108, p<0.05
Number of domestic helpers		M=0.17	SD= 0.47	M= 0.02	SD= 0.14	M= 0.19	SD= 0.39	t=-10.57 df=2108, p<0.01
Household car ownership		M=0.22	SD=0.52	M= 0.13	SD=0.44	M= 0.26	SD=0.54	t=-5.54 df=2108, p<0.01

Table 1 Sample characteristics, by state of children independent mobility (Continued)

Neighborhood characteristics

Settlement type	Urban core	827	39.19	188	22.73	639	77.27	x^2=34.06, df=2, p<0.01
	Sprawl	1009	47.82	355	35.18	654	64.82	
	Rural	274	12.99	78	28.47	196	71.53	
Population density		M= 38133.42	SD= 27108.56	M= 36884.64	SD= 26978.04	M= 38654.24	SD= 27154.87	t=-1.37, df=2108, p<0.05
School density		M= 4.70	SD= 2.83	M= 5.015	SD= 2.748	M= 4.57	SD= 2.85	t=3.32, df=2108, p<0.05
Network density		M= 11.65	SD= 5.62	M= 11.2	SD= 5.16	M= 11.83	SD= 5.80	t=-2.37, df=2108, p<0.05
Crashes involving children/1000 chilren		M= 1.25	SD= 1.42	M= 1.22	SD= 1.07	M= 1.27	SD= 1.55	t=-0.50, df=2108, p<0.01
Social deprivation index		M= 0.22	SD= 0.53	M= 0.28	SD= 0.49	M= 0.2	SD= 0.54	t=-3.28, df=2108, p=0.11
Land use mix		M= 0.32	SD= 0.12	M= 0.31	SD= 0.12	M= 0.32	SD= 0.13	t=-2.34, df=2108, p=0.14

[a]n=2110 621. [b]n=621 [c]n=1488 [d]Unless otherwise indicated

3.3. Logistic regression modeling

Table 2 shows the results of the logistic regression analysis developed to assess the association between the three domains of characteristics and the level of CIM during primary children's home-school journeys. The final model represented a significant improvement over the null model with the -2 log likelihood chi square as 497.84 and it was highly significant (p<0.001). This study used stepwise selection procedures to create a final model which contains only significant predictors of CIM. Looking at the individual factors, distance to schools and the age group of children were retained in the final model. When considering the effect of proximity of primary schools to children's homes, children living close to a school were more likely to have enjoyed CIM when comparing to those living further away. After adjustment, children living 1-2 km away from schools made nearly twice less the trips with CIM in comparison to those living close to their attended primary schools. The odd ratio (OR) was 0.43 (95% 0.32-0.56). CIM progressively decreases with distance, with children living at 2.1 - 4 km from their schools 2.5 times less likely to travel independently (OR=0.39 95% CI 0.29 - 0.52). As the distance between home and school increased to 4 km or more, children were four times more likely to be accompanied to schools (OR=0.22; 95% CI 0.15 to 0.32). Turning to their respective age groups, senior children at 10-12 years old were about four times (95% CI 3.02-5.30) more likely to be actively involved in independent travel than were children of a younger age at 6-7. Children at the middle (8 − 9) were also having higher CIM (OR=1.44; 95% CI 3.02 to 5.30) than their young counterparts.

At the household level, when other confounding factors are taken into considerations, children from wealthier households were 3.7 times (OR=0.27; 95% CI 0.15 to0.5) more likely to be escorted to schools. In terms of family structure, children from extended families comprising of at least three generations still living together were most common to be escorted to school among all family types. While children from single parent families had a higher likelihood of being independent during their home-school journeys (OR=1.75; 95% CI 1.03-2.98). In addition,

maternal employment status has a positive impact on CIM (OR=2.72; 95% CI 2.16-3.43). The employment of domestic helper at home reduced the likelihood of CIM by nearly 9 times. Regarding neighborhood characteristics, children living in the sprawl and rural area were 1.72 times (95% CI 1.36-2.17) and 3.28 times (95% CI 2.10 – 5.12) more likely to have CIM than their urban counterparts. When other confounding factors were considered, school density increased the chance of CIM (OR=1.05; 95%CI 1.00-1.10).

Table 2 Adjusted odd ratio (AOR) and 95% Confidence Interval (CI) from logistic regression models predicting children's independent mobility during their home-school journeys

	AOR	95%CI			P Value
Trip Characteristics					
Distance to school					
Less than 1km	1.00		-		-
1-2 km	0.43	0.32	-	0.56	***
2.1 - 4 km	0.39	0.29	-	0.52	***
More than 4 km	0.22	0.15	-	0.32	***
Personal Characteristics					
Age Group					
6-7	1.00		-		-
8-9	1.44	1.07	-	1.95	**
10-12	4.00	3.02	-	5.30	***
Familial Characteristics					
Household income group					
Below HKD10,000	1.00		-		-
HKD10,000 - 39,000	0.61	0.47	-	0.78	**
HKD40,000 or above	0.27	0.15	-	0.50	***
Family structure					
Extended family	1.00		-		
Nuclear family	1.28	0.94		1.74	
Single parent family	1.75	1.03		2.98	**
Mothers work outside home	2.72	2.16	-	3.43	***
Domestic helper at home	0.11	0.06		0.22	***
Neighborhood Characteristics					
Neighborhood classification					
Urban core	1.00				
Sprawl	1.72	1.36	-	2.17	***
Rural Area	3.28	2.10	-	5.12	***
School density	1.05	1.00	-	1.10	*

*p≤0.1; **p≤0.05; ***p≤0.001

4. DISCUSSION

Three key domains of social context affecting the level of CIM were examined in this study. Knowledge of the prevalence of and factors affecting CIM among children in Hong Kong is important for identifying strategies to further increase the level of independent travel among

children to foster their development. The challenge ahead is to discover what combinations of factors are affecting CIM, how these factors work to promote positive well-being, and whether they help to maintain CIM over the long-term in the city. Based on the study results, one third of Hong Kong children were allowed to go out on their own during their home-school journeys. The percentages of children having CIM were somewhere in between comparative western and eastern samples, suggesting that children in Hong Kong are having an average level of independence during their trips to school. This might be partly related to the mixture of cultures the city has. This study adds to the growing body of literature that has explored the issue of CIM, especially among children in Chinese communities which are underexplored. The fundamental question asked by this study is "Do individual, family and environmental components distinguish children with and without CIM?" The follow sections will be devoted to discuss this question in details.

4.1. Individual factors

The descriptive analysis showed that a vast majority (50.1%) of children who had CIM attended schools that are easily accessible from home (within 1 km). Distance to schools appeared to be a significant predictor of children's travel behavior, with those who had shorter journey distances being more likely to travel independently. In line with a number of previous reports, shorter distance to school was significantly associated with higher level of CIM. The greater the distance, the more likely children to be transported by motorized vehicles (Hillman et al., 1990; DiGuiseppi et al., 1998). In general, shorter distance implies a more direct route to school and makes autonomous travel of children possible. For the present study, 79.8% of children travelled to schools on their own on foot. The results echo other studies which have discovered that shorter journey is associated with more active commuting. Children having independent travel may spend more time outdoors and being physically active (Page et al., 2009). Proximity clearly affects whether children can conveniently walk to school independently.

Children's age played a pivotal role in predicting the likelihood that they travel to schools independently. This progressive increase in CIM with age for Hong Kong children is in line with other similar studies that show that children's age has repeatedly been identified as a strong correlate of CIM (Hillman et al., 1990; Blakely, 1994; McDonald, 2006; Björklid and Gummesson, 2013; Broberg et al, 2013). Older children tend to make a larger proportion of trips unaccompanied. This might be related to the fact that parents place more confidence about the abilities in more senior children, for instance their ability to negotiate traffic and maintain personal safety, based on the trust they built over the years. Their higher level of CIM might suggest that older children are viewed as having a greater level of maturity, autonomy and independence. It has been suggested by other literature that boys are generally having greater independent mobility (Spencer and Woolley, 2000; Prezza et al., 2001). In the case of Hong Kong, the social stereotype that boys are given more freedom is not so pronounced and the difference of CIM between the two genders is not significant. This might be partly related to the well-accepted traditional Chinese culture that girls are more capable of self-caring whereas boys are stronger in their physical strength. Both genders have their naturally born strength and weakness (Wong et al., 2002). Similarly, the Japanese sample also found out that gender differences did not have a significant influence on the travel pattern of children (Susilo and Waygood, 2012).

4.2. Family factors

The present study found that social class influence plays a significant role in determining whether children go to schools independently. From the study data, children from lower income households were having more CIM and they were more likely to walk to nearby schools in their neighborhoods. On the contrary, children from the middle to high-income family were frequently chauffeured to schools within and beyond their neighborhoods. The study ties in with the results from previous literatures, suggesting that children from higher income class households are generally having fewer chances to travel on their own (Hillman et al., 1990; Tranter and Pawson, 2001; Mackett et al., 2005). In Hong Kong, the prevailing low child birth rate has leaded to the creation of "prince and princess syndrome" of children (South China Morning Post, 2012). This social phenomenon leads to the creation of a generation of spoiled kids or colloquially known as "Hong Kong Children" (Wong, 2009). With more resources devoted to only a few children, children nowadays are being overindulged and overprotected by their parents and guardians such as their grandparents in an overly sheltered environment.

Chinese culture in terms of parenting is that parents assume a lot of responsibility to protect their children and to make sacrifices for the benefits of them (Lam, 2005). Parents are becoming too involved in children's lives and children are said to be infantilized for their respective ages and are developmentally lacking-age appropriate skills (Wong, 2009). This reflects a parenting phenomenon that has been highly discussed in the city which is called by many names such as "helicopter parents" and "monster parents" (Yau, 2011). These parents are always ready to step in to help their children to work out their problems. Studies have confirmed that such kind of parenting practices is extremely prevalent in middle, upper middle and upper class homes (Nelson, 2010). Linking to CIM, such parents are expected to discourage their children from freely exploring their environment because they believe that the world itself is a very dangerous place. This style of parenting in the city may increase the likelihood of reduced level of CIM. Whether these associations are causal worth further exploration, but this potential factor that might contribute to the lower rates of CIM among children from higher income households should not be ignored. Being spoiled and overprotected, children are generally presumed to develop characteristics like over dependent, egocentric, less cooperative, timid and have difficulties in handling adversity as they grow older (Liu et al., 2005).

Certain results are also noteworthy. First is the working status of mothers. Interestingly, this research found out that women's working status has a positive impact on CIM. Specifically, it is found that children were more likely to travel alone to school if their mothers work outside home. Children's dependent mobility on their parents might exacerbate their parents' workload and especially for the case of mothers (Gershuny, 1993). Hong Kong has experienced rapid urbanization, modernization and economic growth in these recent decades. More and more women received higher education. Taking census data on women characteristics to illustrate, the percentage of students in higher education by female was 54.4% in 2001/02. With increasing educational opportunity, the opportunity for women to work has increased tremendously. The role of mothers in Hong Kong has changed drastically. They are previously expected to serve as the mistress of the home and play the role of primary caregiver, in ways congruent with the traditional roles of women in Chinese societies. Today, many women have more than the childbearing and childrearing roles to define their lives, they started to contribute more towards

society, and have increasing participation in economic activities and enjoy financial independence (Women's Comission, 2009). Since working mothers are shouldering multiple tasks in a day with their tight time budget in many cases, they face the difficulties in balancing family commitments and work (Loo and Lam, 2011). This might be a plausible reason that they choose to allow their children greater independence and resulting in the higher level of CIM of their children.

With more women entering the workforce, it is also not uncommon for them to rely on their extended family members or seek support from domestic helpers, child care centers or social service institutions to take care of their children. Results showed that there was a significant negative relationship between the number of grandparents living under the same roof and CIM of children when examined for the sample as a whole (OR=0.70; 95% CI 0.49-0.98). Grand-parenting refers to the state that children are looked after by the grandparents for parents who have to go out for work. Yet this variable failed to emerge as a main effect on CIM in the final model. Turning to other supporting members in a household, many families in Hong Kong employ foreign domestic helpers from developing Southeast Asian countries to take care for their families. Employing live-in domestic helpers is a common occurrence in middle and upper income households in the city (Lee, 2002). The number of foreign domestic helpers in Hong Kong has been constantly rising since the late 1980s, with a record high of nearly 240,000 in 2002 (Census and Statistics Department, 2008). Since one of the duties by these foreign helpers is to look after the young children of their employers, the rate of CIM was therefore unsurprisingly low for children from these households.

Another intriguing predictor of the rate of CIM was the family structure. Comparing the three family types, children from extended households exhibited a comparatively lower level of CIM. A plausible reason is that they might have grandparents or relatives who can help with household chores such as accompany children to school. Whereas children from nuclear families might have fewer household members to perform such function, and led to their comparatively higher level of CIM when compared to their extended family counterparts. Along the same vein, the chances for children from single parenthood to travel independently were remarkably high. Single parenthood is not a new phenomenon in the society of Hong Kong. The dramatic growth in the number of single parents in Hong Kong over the past two decades has been a major contributory factor in the fundamental changes that have taken place in the city's demographic and social structure. There were 72,326 single parents in Hong Kong in 2006, a doubling since 1986 (Census and Statistics Department 2007), which accounts for around 5% of all households with children in Hong Kong. The number of single parent households from the study sample also resembles the city-wide figure (5.12%). For the study population, about 70% of single-parent families were headed by women. Life is full of challenges for any parent, and particularly so for single parents who do not have someone with whom to share the responsibility of running a household. Being the sole supporter of the family might mean that many single parents face unique challenges in balancing their lives such as child rearing, finances and careers and more. Time management becomes a major concern for them. Especially for those working single parents, the challenges brought by the lack of time becomes more acute. Workers in single parenthood are shouldering dual responsibilities and are suffering from double time deprivation in balancing their work and family lives. Though one cannot negate that single parents might rely on neighborhood support in child care, the dilemmas of long working hours might have restricted and reduced their time on other activities, including time spent with their children, such as accompanying them to schools in this case. The importance of time use stems in part from

understanding that the welfare of individuals and households is a function not solely of their income or consumption or by the attributes of their neighborhood, but also of their freedom in allocating time. Clearly, time use allocation and constraints have implications in affecting the livelihood of single parent families.

4.3. Environmental factors

Neighborhood factors may impinge directly on children CIM or indirectly via their effects on parents' perceptions and resultant parenting practices. By including neighborhoods classified as urban, sprawl and rural, this study takes into account settlement types in terms of the city's history of development, population and geography. The results show significant variations in the levels of CIM according to the area in which children live. Before moving on, given the ultra-high density development of the city, a point to clarify is that the concepts of sprawl and rural areas have to be understood in the local context; and their definitions differ quite remarkably from the traditional classifications based on the literature in the Western world. In Hong Kong, sprawl development away from the urban core are are mostly government-planned new towns containing high density public housing estates, with high income groups living in villas which are more scattered in the area (Loo and Chow, 2008)

The study results suggested that children living in rural area in Hong Kong had the highest level of CIM to go to schools on their own. A consistent result of many studies is that children who live in rural or lower-density environments enjoy more freedom to move around than do children in high-density urban environments (O'brien et al., 2000; Kyttä, 1997). A previous study by Bonner (1997) had highlighted people's perception about the advantages of a rural setting over an urban one for raising children. This may reflect the greater confidence that parents have about the safety of their children in such settlement type. The less vehicular traffic and better air quality might encourage independent commuting of children. Also, children living in sprawl region also enjoyed more freedom when comparing to their urban counterparts. The objective of new town development of the city is to provide a self-contained and balanced community. It is expected that children will attend nearby schools in the planned new towns. In Hong Kong, urban children living in the core area are less likely to have enjoyed CIM. The result suggests that the buzzing urban environment may be a hindrance to increased level of CIM. Parental concern about heavy traffic, more acute pollution in urban streets and pedestrian safety might act upon potential barriers for increased level of independent travel of children. Educating children about road and traffic safety may be seen as one plausible solution to alleviate parental fears about the busy traffic environment in urban area. Nonetheless, the increased risk of road crashes does not seem to hold as explanation for the reduced CIM in the Hong Kong case. The univariate analysis shows that the effect of crashes involving children was not significant (p=0.215). This might reveal the gap between perception and reality of neighborhood safety. Drawing from this, it is crucial to note that one limitation of the study is that the use of travel diary data does not capture parental perception of social danger and criminality. The discovery of these dimensions on CIM provides scope for future research. Turning to other environmental attributes, school density was found to promote CIM in Hong Kong children. This might be related to the fact that the more school choices nearby home, the higher the probability that parents will choose neighborhood schools for their children. This can reduce the need for cross-district travelling. Strategically locating schools near children's residences and by ensuring safe routes to school is expected to foster increased CIM among Hong Kong children.

5. CONCLUSION

The current study adds to the growing literature of CIM by identifying factors that are associated with CIM in Hong Kong. The present study found out that nearly one third of children in Hong Kong enjoyed independent mobility during their home-school journeys. Results of the study are in general in line with the previous research. The study also indicates that the effect of detailed family structural difference in the correlates of CIM that, to the authors' knowledge, has not been extensively identified in previous literature. There is a Chinese adage says "Rearing a child to 100 years old will give you worries for 99 years". Worries among parents are understandable. Regardless of which factors become the focuses of the intervention efforts to promote CIM, the study suggests that such efforts should focus not only on children and their families but potentially, characteristics of the neighborhoods in which children live.

In the present study, Hong Kong is used as the case study area to examine in details the factors affecting CIM. The results of the study may help filling in a piece of the missing link about CIM in the Chinese context. It is vital to remember that CIM varies across culture and there are cultures within culture. Given that marked cultural variations exist at a subcultural level, future directions for comparison among different Chinese societies are suggested. Moreover, additional research can be conducted to investigate what cultural factors such as child-rearing beliefs, attitudes and practices contribute to higher level of CIM among children of different cultural groups. More importantly, there is a need to understand how the level of CIM in different contexts impact on children's development. Above all, creating a child-friendly living milieu to promote CIM is expected to foster the growth of children.

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