



# Active commuting among junior high school students in a Chinese medium-sized city: Application of the theory of planned behavior

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## ABSTRACT

In China, junior high school students are considered as adolescents, and their parents have guardianship of them. If junior high school students want to travel by motorized vehicles, they need to get assistance from their parents. The present study uses the theory of planned behavior to construct a model of dependent travel behavior that depicts the active commuting of junior high school students to school. A total of 449 junior high school students' parents in Jinjiang city of Fujian Province in China were surveyed by using a questionnaire. Non-parametric test, reliability and validity test, factor analysis, and a logistic model were performed to test the model. The results show that the model is a good fit for the junior high school students' active travel to school in the morning, and the Nagelkerke  $R^2$  of the model is 0.68. Behavioral intention and perceived behavioral control of parents affect students' active commuting behavior, and behavioral intention is larger on behavior. Besides the inner attitude, the external environment such as non-motorized traffic facilities and the road traffic conditions along the way to school have significant effect on the behavior. In contrast to our expectations, parents leaving home for work in the morning, children's gender, grade, and household income have no significant influence on the behavior. Measures should be taken by the local government to promote students' active commuting to school, such as improving road traffic environment and providing safe routes.

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## 1. Introduction

Junior high school students, aged 12–15 years, show rapid physical development. They begin to possess the capacity of independent active travel. In China, however, active commuting by junior school students is less, and motorized travel occurs frequently, especially in some demonstration schools. Active commuting to school means that the student who is between 5 and 18 years either walks or rides a bike to school. Outside of China, many researchers focus on the active commuting choice, but there are few studies on Chinese students, especially on junior high school students.

According to the general principles of the civil law of China (The National People's Congress, 1987), junior high school students are adolescents and their parents have guardianship of them; thus, the attitude of the parents concerning safety

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problems may have a great influence on students' school commuting mode choice. According to the requirements for application and use of motor vehicle driver license in China (Ministry of Public Security of the People's Republic of China, 2012), adolescents cannot have a motor vehicle driver license; thus, when they want to drive a private car, they also need the help from their parents. As such, junior high school students are considered to be dependent travelers. Because of the dependency relationship between Chinese students and parents, the research not only needs to consider the objective factors affecting active commuting choice, but also needs to consider the parents' subjective attitude of active commuting choice.

As junior high school students' active travel needs to involve parents' subjective attitude, we need to verify the relationship between the above two by the attitude–behavior theory. The theory of planned behavior (TPB), which was improved by Ajzen based on the Theory of Reasoned Action, is a well-known theory explaining the relationship between beliefs and behaviors in the field of social psychology (Ajzen, 1991). Some scholars have studied mode choice behavior by using TPB and have obtained satisfactory forecast results (Abrahamse, Steg, Gifford, & Vlek, 2009; Eriksson & Forward, 2011; Hsiao & Yang, 2010; Thøgersen, 2006), while we study the active commuting mode choice of junior high school students by using TPB. Existing research reveals that the students' active travel behavior is affected by personal, family, social, and environmental factors (Timperio et al., 2006). We additionally consider external objective factors to construct an active commuting behavior model of the junior high school students.

Because the components of TPB study the inner processes of a person, the relationship between external factors and inner attitude requires a theoretical framework. We first explain dependent travel behavior and then introduce TPB about behavioral structure and the behavior-affecting variables. There are many studies on students' active travel behavior, and we summarize these studies to find the influencing factors. We then derive hypotheses about the expected relationship between active commuting behavior and the travel behavior variables.

Junior high school students' dependent travel behavior needs to consider parents' attitude toward students' active commuting choice. We conducted surveys on parents' perception of influencing factors on students' active commuting choice and the students' actual active commuting behavior. We then analyzed the formation of junior high school students' active commuting behavior. The purpose of this study is to determine the real and perceived barriers of the junior high school students' active commuting to school, which can provide the basis for corresponding traffic policy-making.

### 1.1. *Dependent travel behavior*

Students' active travel dependence on their parents differs as they grow older. When the students are young, they require their parents to accompany them on their active travel; thus, parental work patterns affect the probability of younger children walking or biking to school (McDonald, 2008a,b). When the children grow up and independently travel in a traffic environment, their parents most likely worry about the security of road facilities. Hume et al. (2009) reported that adolescents whose parents perceived insufficient traffic lights and pedestrian crossings in their neighborhood were less likely to increase their active commuting. Unfortunately, there are few studies on the dependent travel behaviors of junior high school students from the perspective of psychological behavior. Because the students' active travel is affected by the inner attitude of the parents and the external factors, the construction of the behavior based on the TPB will help to interpret the interactions and the influence variables.

### 1.2. *The construction of the theory of planned behavior*

The TPB components are a person's attitude, subjective norm, perceived behavioral control, intention, and behavior. On the basis of TPB, behavioral intention is the direct predictive variable to objective behavior; In turn, behavioral intention is assumed to be determined by attitude, subjective norm, and perceived behavioral control (Ajzen, 1991). On the basis of TPB, existing research focuses on travel mode choice, exceeding the speed limit, dangerous driving, traffic violence, etc. (Paris & Broucke, 2008; Tunnicliff et al., 2012; Zhou & Horrey, 2010). Among the studies on travel mode choice, few are concerned with the students' active commuting to school, and most were conducted on private cars for commuting, the usage of public transit, or the intention of take high speed trains (Abrahamse et al., 2009; Eriksson & Forward, 2011; Hsiao & Yang, 2010; Thøgersen, 2006).

In the composition of TPB, behavioral intention can directly predict behavior; in some cases, perceived behavioral control has a direct effect on behavior (Abrahamse et al., 2009; Paris & Broucke, 2008). Perceived behavioral control means the degree of difficulty that an individual perceives when they perform a specific behavior. It reflects the individual's perception of promoting or blocking behavioral factors. Abrahamse et al. (2009) reported car use for commuting by Canadian office workers and found that car use for commuting was mostly explained by variables related to individual outcomes such as perceived behavioral control. Furthermore, a study on drivers from Paris and the study by Paris & Broucke (2008) found that self-reported speeding was predicted by intention and perceived internal control.

There have been many studies on the objective factors of students' active travel; students' active commuting to school is affected by travel distance, socioeconomic characteristics, environment, and other factors. Distance is an important factor of active commuting to school. The longer the distance, the less is active travel (McDonald, 2007). Socioeconomic characteristics include students' personal characteristics and family characteristics. Personal characteristics include age, gender, degree of independence, etc. Children using active transport to commute were older (Yeung, Wearing, & Hills, 2008) and more independent (Merom, Tudor-Locke, Bauman, & Rissel, 2006). With regard to gender, the proportion of boys biking to school is

higher than that of girls (Leslie, Kremer, Toumbourou, & Williams, 2010), whereas the proportion of those walking is equal (Leslie et al., 2010; McDonald, 2012). Family characteristics include family income, vehicle ownership, work patterns of parents, etc. McDonald (2008a,b) showed that students from low-income groups use active travel modes to reach school at much higher rates than those from higher-income groups. Because of the relationship between cars and family incomes, research also found that the number of cars in the household was significantly associated with increased regular car trips (Borrestad, Andersen, & Bere, 2011). Considering that active commuting occurs in the traffic environment, it is necessary to consider the environmental factors. Nevelsteen, Steenberghen, Van Rompaey, and Uyttersprot (2012) found that specified infrastructural measures (a bicycle or pedestrian lane) have a positive effect on parental safety perception and can increase children's autonomous travelling. Hume et al. (2009) found that beside traffic environment, the social environment also affects active commuting to school. Children whose parents knew many people in their neighborhood were more likely to use an active commuting mode compared with other children.

In general, the choices of travel mode mainly consider two indicators: the travel duration and travel cost, which are used to compare the advantages and disadvantages of a travel mode. Therefore, we increase variables of travel mode characteristics. Summing up the literature, we believe that the students' active commuting behavior is related to behavioral intention, perceived behavioral control, travel distance, socioeconomic characteristics, traffic environment, social environment, and traffic mode characteristics (see Fig. 1).

## 2. Methods

### 2.1. Respondents and procedure

The urban spatial structure of Jinjiang is composed of a main urban area, west area, andong area, and south area. Because of the differences of educational quality in different areas, these differences are also reflected in students' travel modes (He & Li, 2007). According to the educational quality, we selected different types of schools in different areas; in the different schools, parents in different grades were interviewed. On the basis of the urban spatial distribution, one junior school was selected in every area, including two demonstration junior schools and two regular junior schools. Demonstration schools have higher quality of education than regular schools. Then, parents in two classes were selected randomly in every grade and every school. A questionnaire survey was conducted from December 24 to December 28, 2012.

A total of 480 parents were investigated. A total of 449 valid samples were collected. The percentage of males was about 62%. The majority of parents were aged 40–49 years (63.47%), and 42.09% families' income was about 3000–6000 RMB (about 435–870 dollars) per month. In the actual trip to school for junior high school students, the proportion of active travel to school was 50.11%, whereas the proportion of active travel from school was 71.03%. The difference in the proportion of active commuting to school was obvious; hence, there was a need to perform a separate analysis for the behavior of active travel to school and active travel from school.

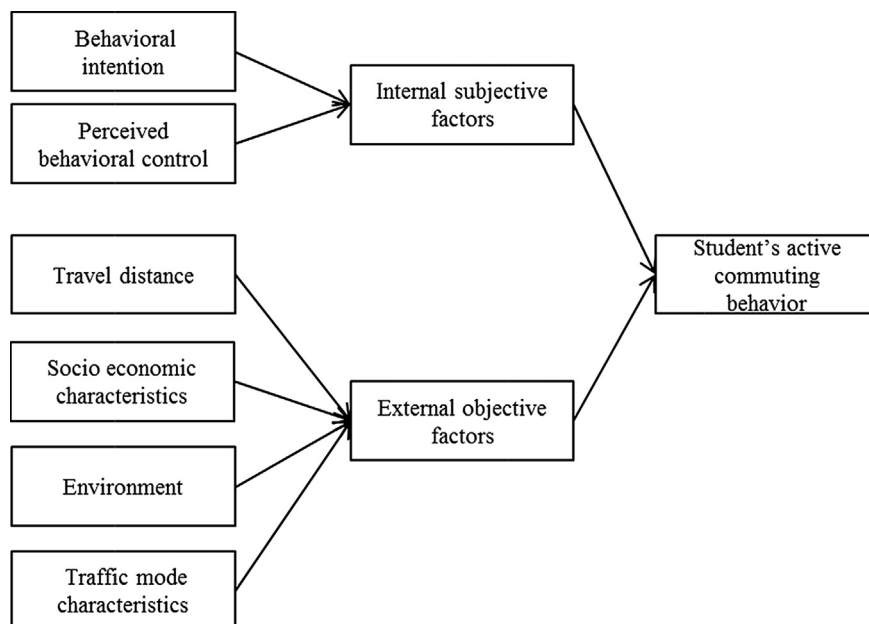


Fig. 1. Structure of a student's active commuting behavior model.

## 2.2. Measurements

### 2.2.1. Subjective variables based on the theory of planned behavior

Behavioral intention means that the parents plan to let their children walk or ride a bike to school. Perceived behavioral control is gathered from the children and parents, which is to perceive that the children have capacity (such as physical strength, independence, and desire) to walk or ride to school or to perceive that the parents have no time to shuttle children, from “Totally Disagree” (1 point) to “Totally Agree” (5 points) (see Table 1).

### 2.2.2. External environment for students' active commuting to school

The external environment for students' active commuting to school includes the traffic environment on the way to school and social environment around the campus. Besides the road traffic facilities, traffic environment also includes traffic conditions and transportation management. Road traffic facilities were tested for road classification, non-motorized traffic constitution, and bus configuration. Traffic conditions were tested for vehicle constitution and traffic jams. In addition, social environment means the social crime rate, traffic accident rate, and theft rate of bicycles around the campus.

Because the external environment cannot be a unified quantization, latent variables were surveyed to represent the external environment, which is through parents' subjective perception to reflect the effects of external environment on students' active commuting to school. All items were measured on a five-point scale from 1 = “does not describe it at all” to 5 = “describes it fully.”

### 2.2.3. Travel distance and travel mode characteristic

The socioeconomic characteristics and student travel information were investigated directly; during the investigation, parents did not know the distance of home to school precisely. Therefore, the distance was classified as “0–1 km” (1 point), “1–2 km” (2 points), “2–3 km” (3 points), “>3 km” (4 points). Compared with the motorized traffic mode, we focused on the cost, duration of students' active travel mode, and safety of traffic tools from “Totally Disagree” (1 point) to “Totally Agree” (5 points).

After adding and revising the items (such as deleting the school bus item as none of Jinjiang's public schools are equipped with school buses), there were 51 items in this questionnaire (see Table 1). The remaining items (1–17) are about the students' travel and socioeconomic features.

**Table 1**

Seven-factor solution of active travel to school.

Factors/items	Factor 1	Factor 2	Factor 3	Factor4	Factor 5	Factor 6	Factor 7
<i>Factor 1 parents' behavioral intention</i>							
48 I request my child to walk or ride to school in the morning	0.90						
49 Now I intend to let my child walk or ride to school in the morning	0.90						
<i>Factor 2 social environment</i>							
37 The social crime rate in your area		0.85					
38 Traffic accident rate in your area		0.83					
39 Theft rate of bicycles around campus		0.71					
<i>Factor 3 non-motorized traffic facilities</i>							
26 Pedestrian sidewalk along the way to school			0.84				
27 Pedestrian crosswalk along the way to school			0.84				
28 Traffic lights along the way to school			0.55				
29 Bikeways along the way to school			0.65				
<i>Factor 4 road traffic conditions</i>							
19 Students cross major road on the way to school, such as four-lane road				0.61			
20 Traffic volume on the way to school				0.77			
21 Trucks on the way to school				0.82			
22 Traffic congestion on the way to school				0.54			
<i>Factor 5 travel mode economic features</i>							
40 Compared with motorized travel mode, travel cost for children walking or riding to school					0.69		
41 Compared with motorized travel mode, travel duration for children walking or riding to school					0.82		
<i>Factor 6 parents' perceived behavioral control</i>							
46 Other adults and I in my family cannot pick up my children to school because of lack of time						0.86	
<i>Factor 7 other optional travel mode</i>							
33 It is convenient for children to take bus to school							0.72
Initial Eigenvalues (%)	22.07	13.64	8.00	7.19	5.39	4.75	4.36
Variance Explained (%)	14.02	12.46	11.43	10.82	6.90	5.04	4.75

### 3. Results

#### 3.1. Data validation

The independent-samples *T*-test was used on subjective variable items. Kolmogorov-Smirnov and Mann-Whitney *U* test were used on objective variable items excluding the indistinguishable items. We found that nine subjective variable items passed the independent-samples *T*-test. The Kolmogorov-Smirnov test showed that the *p*-values to all objective variables were less than 0.05. This means that there are significant differences between the values of objective variables and the normal distribution. Therefore, Mann-Whitney *U* test was conducted on the objective variables. In 24 items about the external environment, 4 items did not pass the Mann-Whitney *U* test. Item 25 (traffic congestion on the way back home in the afternoon) did not pass because the time for students to go home is elastic, with low sensitivity to traffic congestion. Item 30 determined whether there existed enough bicycle parking spaces on campus; according to field investigation, the four schools have enough bicycle parking spaces around campus. Thus, bicycle parking space is not an influential factor for students who are actively commuting to school. Even though it is medium-sized city, Jinjiang lacks transportation management. Therefore, item 32 (there exists some traffic management people on the way to school in the morning) and item 35 (there exists some traffic management people on the way back home in the afternoon) should maintain the original hypothesis. Reliability and validity testing was completed separately to active travel to and from school. The alpha value of 23 items on active travel to school was 0.79, larger than 0.7; value of KMO was 0.82, more than 0.7; and value of Bartlett test of sphericity  $\chi^2$  significance probability was 0.00, less than 0.05. The alpha value of 22 items on active travel from school was 0.75; value of KMO was 0.79; and value of Bartlett test of sphericity  $\chi^2$  significance probability was 0.00. From the reliability and validity test, data correlation matrix was not a unit matrix, which is suitable for factor analysis.

#### 3.2. Factors of students' active commuting behavior

Principal component analysis was used to extract the common factors and Varimax rotation with Kaiser Standardization. Then, seven common factors were extracted on the students' active travel to school, which explained 65.43% of total variance. Factor 1 included two items (item 48 and item 49) that reflect the behavioral intention for parents to let their children walk or ride to go to school in the morning. Factor 2 included three items (items 37, 38, and 39) that reflect the social environment about students' active travel to school. Factor 3 included four items (items 26, 27, 28, and 29) that reflect non-motorized traffic facilities on the way to school. Factor 4 included four items (items 19, 20, 21, and 22) that show the road traffic conditions on the way to school. Factor 5 included two items (item 40 and 41) that illustrate the economic characteristics of travel mode. Factors 6 and 7 included only one item each: the parents' perceived behavioral control and the other optional travel mode in traffic environment, respectively.

The same method was applied to the students' active travel from school in the afternoon. Six common factors were extracted, which explained 59.43% of total variance. Compared with the results in the morning, the common factors lack the other optional travel mode in traffic environment and include behavioral intention, non-motorized traffic facilities, social environment, road traffic conditions along the way, economic features of travel mode, and the parents' perceived behavioral control.

#### 3.3. Regression results

A binary logistic regression model was established on the basis of the results of factor analysis. Socio-economic variables were expressed as dummy variables. Overall, the value of Nagelkerke  $R^2$  was 0.68 for students' active travel to school in the morning, whereas the value for students' active travel from school in the afternoon was 0.52, as shown in Table 2.

With regard to the socioeconomic characteristics, type of school had a positive influence on junior high school students' active travel to school in the morning. Vehicle ownership had a negative influence on junior high school students' active travel to school in the morning. Household income, whether parents leave home for work in the morning, children's gender, and grade had no significant influence on junior high school students' active travel to school in the morning. Type of school had no significant influence on junior high school students' active travel from school in the afternoon whereas it had the largest influence on junior high school students' active travel to school in the morning ( $B = 1.73$ ).

From the aspect of personal subjectivity, behavioral intention and parents' perceived behavioral control had a positive influence on junior high school students' active travel to school. The effect of behavioral intention was slightly larger than the effect of parents' perceived behavioral control. In junior high school students' active travel to school in the morning, the effect of behavioral intention ( $B = 1.12$ ) was the second largest, and the largest effect was type of school ( $B = 1.73$ ). In junior high school students' active travel from school in the afternoon, behavioral intention had the largest effect with a value of 1.00. These findings further verify that the behavioral intention and perceived behavioral control had a direct effect on behavior, in accordance with our expectations.

With regard to traffic environment, non-motorized facilities and road traffic conditions on the way to school had a positive influence on junior high school students' active commuting to school. Economic characteristics of travel mode also had a positive influence on junior high school students' active commuting to school. This means that when the non-motorized

**Table 2**

Estimated and test values of junior high school students' active commuting to school choice model variables.

Variables	B value	
	Go to school in the morning	Back home in the afternoon
<i>Parents work pattern</i>		
Parents go to work in the morning	−0.36	–
<i>Household income</i>		
0–1000 RMB per month	0.30	0.34
1000–3000 RMB per month	0.08	−0.28
3000–6000 RMB per month	0.11	−0.41
6000–10,000 RMB per month	0.42	0.20
<i>Grade</i>		
Grade one	−0.42	−0.60
Grade two	−0.18	0.10
<i>Other socioeconomic</i>		
Number of cars in household	−0.87 <sup>*</sup>	−0.93 <sup>*</sup>
Male (Parents' gender)	−0.26	−0.20
Regular junior school	1.73 <sup>**</sup>	0.20
<i>TPB</i>		
Parents' Behavior intention	1.12 <sup>**</sup>	1.00 <sup>**</sup>
Parents' perceived behavioral control	0.93 <sup>**</sup>	0.82 <sup>**</sup>
<i>Environment</i>		
Non-motorized traffic facilities	0.72 <sup>**</sup>	0.78 <sup>**</sup>
Road traffic conditions	0.63 <sup>**</sup>	0.81 <sup>**</sup>
Bus facilities	−0.20	–
Social environment	0.12	0.01
<i>Travel mode characteristic</i>		
Economic features of travel mode	0.54 <sup>**</sup>	0.34 <sup>*</sup>

<sup>\*</sup>  $p < 0.05$ .<sup>\*\*</sup>  $p < .001$ .

environment becomes better and the road traffic conditions become simpler, the probability of junior high school students' active commuting to school will increase. In addition, considering the travel proportion of bus was only 7.9%, the bus configuration had no significant influence on junior high school students' active commuting to school. Social environment also had no significant influence on junior high school students' active commuting to school. The reason may be that the average travel distance of students' active commuting to school is about 2.08 km, which is based on the investigation results with short distance to range of activity.

#### 4. Discussion

The research is based on TPB from the internal subjective factors and external objective factors that constructed the junior high school student's active commuting choice model. Because Chinese parents have guardianship of junior high school students according to the Chinese law, we analyzed the student's active commuting real behavior and the relationship between the parents' inner attitudes and external factors, and constructed the model. Through non-parametric test, reliability and validity test, factor analysis, and a logistic model to test our constructed model, we found that active commuting behavior was affected by behavioral intention, perceived behavioral control of parents, car ownership, non-motorized traffic facilities, road traffic conditions, and economic features of travel mode. Active travel to school in the morning was also influenced by school types.

The relationships between behavioral intention, perceived behavioral control and students' active commuting behavior support TPB. Behavioral intention had a larger effect on behavior than perceived behavioral control in this case. Although the relationship between perceived behavioral control and behavior is not always valid, but as expected from the literature reviewed above, perceived behavioral control has a direct effect on students' active commuting behavior. The difference from other behaviors is that the junior high school students' active commuting to school is a dependent behavior that is affected by the parents' subjective cognition. The perceived behavioral control of students themselves has less effect on their own travel choice, which verifies the hypothesis. In other words, the less time parents and family members pick up the students, the higher is the chance that students will actively commute to school.

In addition, this research extended the TPB and included the external factors. The results show that non-motorized traffic facilities and the road traffic conditions along the way to school have significant effects on the junior high school students' active commuting to school. In line with the literature review, we found direct relationships between infrastructure characteristics and parental decision-making on the children's mode choice (Nevelsteen et al., 2012), but apart from traffic facilities, the more complicated the road traffic conditions are, the more parents worry about students' active commuting to



school. This means that the probability of the students' active commuting to school will decrease. Because of the complexity of the road traffic conditions, increasing the exposure of students' active commuting, which may increase the active travel crash injuries, and the probability of the students' active commuting to school will decrease. This is related to the traffic congestion around schools during students' active commuting to school in many cities of China, and the traffic management is weaker around schools in medium-sized Chinese cities. Differing from our expectations, social environment is not a significantly influencing factor on students' active commuting to school. For the nearby enrollment policy of the compulsory education phase in China (Standing Committee of the National People's Congress, 2006) causes the students' travel distance is short, and the impact of social environment is not significant. These results can be interpreted as reciprocal determinism, which was put forward by Albert Bandura. In the model of reciprocal causality, internal personal factors, behavioral patterns, and environmental influence operate as interacting determinants that influence each other bidirectionally (Bandura, 2001). Because human behavior is not only affected by the internal thinking process of man, but also by the external environment, we need to consider external environment in the students' active commuting behavior. Traffic environment around the schools needs to be improved in the future in order to provide safe routes to attract students' active commuting in medium-sized Chinese cities.

In contrast to our expectations, parents leaving home for work in the morning, children's gender, grade, and household income did not have significant influence on junior high school students' active commuting to school. The number of families with one child was increasing and these family members were likely to take the child to school by themselves to away from possible injuries, so the first 3 factors mentioned above had no significant influence on students' active commuting to school, which led to the proportion of students' non-active commuting was not low in the survey (39.92%). With regard to household income, this is related to the economy level of the city Jinjiang has been included in the top 10 of the top 100 counties in China for a long time, and household income has no significant influence on junior high school students' active commuting to school whatever the investigated families' household income is high or not. In the long run, other cities can be studied using the method by considering different size and different average household income levels. A comparison of the socio-economic variables in students' active commuting to school can then be made.

In this study, we used the theory of planned behavior to construct a model of dependent travel behavior that depicts the junior high school students' active commuting to school in China. The factors influencing students' active commuting to school based on TPB are limited. With regard to subjective factors, Gardner and Abraham (2008) found a strong effect of habit on behavior through potentially modifiable psychological correlates of car use and intention to drive. Habit capture more effects on repeated car use decisions, whether habit can be an influence factor on students' active commuting can be studied in the future for students' active commuting is also performed frequently. With regard to objective factors, Mitra and Buliung (2012) found that the built environment, such as block density, was associated with active travel. In the future, more variables can be added to the model or different models can be tested to study the behavior of the junior high school students' active commuting to school. Although junior high school students' active commuting is a dependent travel behavior, we would further measure the effect of students' inner attitudes and then compare the results.

## Conflict of interest

The authors declare there is no conflict of interest.

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