Published in final edited form as:
Prev Med. 2011 June 1; 52(6): 423–427. doi:10.1016/j.ypmed.2011.04.005.

Temporal trends and correlates of passive commuting to and from school in children from 9 provinces in China

Zhaohui Cui, MPH, **Adrian Bauman, PhD**, and **Michael J. Dibley, MB, BS, MPH**
Sydney School of Public Health, Sydney Medical School, University of Sydney, NSW 2006, Australia

Abstract

Objective—To examine trends and correlates of passive (inactive) commuting to school among Chinese children aged 6–18 years in nine provinces.

Methods—The trends analysis used school commuting data from the China Health and Nutrition Surveys in 1997 (n=2454), 2000 (n=1978), 2004 (n=1549) and 2006 (n=1236). Generalised estimating equations examined trends after adjusting for age, sex and region, and also explored the correlates of passive commuting to school in urban and rural areas (n=6935).

Results—An increase in passive commuting to school was noted (3.6% in 1997, 14.1% in 2006, $P < 0.0001$). Children attending schools not located in their local community were more likely to passively commute. In urban areas, maternal education was associated with increased passive commuting (AOR = 1.41, 95%CI: 1.03–1.92). In rural areas, family income (AOR $_{high/low}$ = 2.12, 95%CI: 1.52–2.96), paternal education (AOR $_{high/low}$ = 1.56, 95%CI: 1.17 – 2.07), motorcycle ownership (AOR = 1.57, 95%CI: 1.19–2.07) were associated with passive commuting.

Conclusion—Passive commuting to school increased in China over a decade and was associated with family socioeconomic status, school location, and in rural children, with access to motorised vehicles.

Keywords

Children; trend; correlates; commuting; China

Introduction

Passive commuting (inactive modes of travel) to and from school can contribute to decreases in daily physical activity among children (Cooper, 2003; Tudor-Locke, 2003). Understanding the factors associated with children s commuting to school is useful for maintaining physically active populations. Previous studies in high income countries have indicated increasing rates of passive commuting among children (Grize et al., 2010; McDonald, 2007; Van der Ploeg et al., 2008) and that the major barriers for children

Correspondence: Zhaohui Cui, Room 307A, Edward Ford Building (A27), the University of Sydney, NSW 2006, Australia. cuizhaohui2008@yahoo.com.cn, Fax: +61 2 9351 5049, Telephone: +61 2 9351 3620.

Conflict of Interest Statement:
The authors declare that there are no conflicts of interest

walking or cycling to school were distance, school affiliation, parental concern for their child s safety, the nature of the built environment (Hillman, 1990; Kerr, 2006; Merom, 2006), the child s level of independence, and the perceived benefits of active commuting (Hillman, 1990; Merom, 2006).

The situation in China, which has been undergoing rapid socioeconomic development, may be very different from that in high income countries. In high income countries, vehicle ownership is widespread and transportation by motorized vehicles is ubiquitous, while adults and children in China have historically commuted through walking and cycling. Although passive commuting of Chinese children to school (Ma and Kong, 2006) currently remains at a lower level than in the US (Fulton, 2005) and Australia (Merom, 2006), it is expected to increase with the rapid urbanisation and increases in motorised vehicles (National Bureau of Statistics of China, 2007). Preventing increases in passive commuting to school could contribute to maintaining physical activity levels among children and adolescents. There are limited data on commuting to school reported from developing countries (Davison, 2008). Therefore, the present paper aims to examine temporal trends and correlates of passive commuting to school among Chinese children using data from 1997 to 2006 in nine provinces of China.

Methods

Study design

Analysis was based on data from the repeat cross-sectional and longitudinal China Health and Nutrition Surveys conducted in eight provinces in 1997 and nine provinces in 2000, 2004 and 2006. These provinces varied substantially in geography, economic development and health indicators. The sampling procedure has been described elsewhere (Cui, 2010), and comprised a multistage random-cluster sample selected in each province. Firstly, four counties (one low-, two middle- and one high-income county defined on the basis of per capita income) were randomly selected from each province using a weighted sampling method. In addition, the provincial capital and a low income city were selected when feasible. Then the township capital and three villages within the counties and urban and suburban neighborhoods within the cities were randomly sampled, and twenty households were randomly selected within each neighborhood. All individuals in each household were interviewed (Popkin et al., 2010).

Survey protocols, instruments, and the process for obtaining informed consent for this study were approved by institutional review committees of the University of North Carolina at Chapel Hill and the National Institute for Nutrition and Food Safety, China Center for Disease Control and Prevention.

Subjects

Children aged 6 –18 years with complete information on age, sex, region, and commuting to school were included in the descriptive analysis. There were 2454, 1978, 1549, and 1236 children included in the four consecutive surveys (1997, 2000, 2004 and 2006), respectively, for trend analysis. Of those, a total of 6935 observations that had both general family information and community information were included in the analysis of factors influencing passive commuting. Of those, 4732 were from children and adolescents, who were measured in a longitudinal manner, with assessments made twice or more across the four surveys. Trained investigators collected the information from all participants by interview.

General information

Information on birth date, sex, region, general family information (relationship to head of household, family income, parental education level, parental work and marital status and numbers of commuting devices owned), was collected using the household questionnaire. Per capita household income was categorized into tertiles (high, medium and low income), and categorized by urban and rural residence.

Community information

Leaders of villages or communities were interviewed using the community questionnaire to collect information about schools in the local community, and bus stops in the neighborhood.

Commuting type

In the children s questionnaire there were two questions about walking, bicycle use and motorized transportation: “Do you travel to and from school this way? How long does a round trip take?” In 1997 and 2000, motorized transportation included bus and subway, while in 2004 and 2006, another section (car, taxi and motorcycle use) was added to reflect changes in transportation modes used. In 2004 and 2006, bicycle use was separated into two independent variables: actually pedaling or being a bicycle passenger. Passive commuters were those who predominantly used motorised transport to school.

Statistical analysis

All analyses were conducted separately for urban and rural residents. For continuous variables, the mean and standard deviation were used to describe the distribution, and ANOVA analysis used to compare differences among survey years. For categorical variables, the Cochrane–Mantel–Haenszel test for trend was used to examine temporal trends in the prevalence in each stratum. χ^2 test was used to determine the differences in the proportion by sex, parental marital status between survey years. To take account of the within-subject correlation from repeated measurements across surveys, generalised estimating equations analysis with backward stepwise procedure provided unadjusted and adjusted association between correlates and passive commuting to school in urban and rural strata. All factors listed in Table 3 and its interaction items with survey year were used as explanatory variables in the full model. Age and sex were retained in the model regardless of statistical significance. All analyses were conducted using SAS (Version 9; SAS Institute, Cary, NC, USA).

Results

Table 1 provides the demographic characteristics of the samples in the 1997, 2000, 2004 and 2006 surveys, stratified by urban and rural residence. The average age ranged from 12.0 to 12.9 years in urban areas and from 11.6 to 12.1 years in rural areas. The proportion of boys was approximately 51% and 54% in urban and rural areas, respectively.

The proportion of schools that were not in the students local community increased in urban areas from 44.4% in 1997 to 55.5% in 2006 ($P < 0.0001$), and similarly in rural areas from 33.4% in 1997 to 38.1% in 2006 ($P = 0.0025$). Household bicycle ownership significantly decreased from around 80% in 1997 to about 60% in 2006 in both urban and rural areas ($P < 0.0001$). In contrast, the household motorcycle ownership increased from 16.0% in 1997 to 32.2% in 2006 ($P < 0.0001$) in urban areas, with even greater increases in rural areas, from 12.8% in 1997 to 40.7% in 2006 ($P < 0.0001$).

Table 2 summarizes passive commuting to school by age group, sex and region of residence in Chinese children aged 6 –18 years from 1997 to 2006. Overall, passive commuting increased from 3.6% in 1997, to 4.2% in 2000, to 11.9% in 2004 and to 14.1% in 2006 (Mantel-Haenszel test for trend $P < 0.0001$). The prevalence of passive commuting to school steadily increased in all subgroups (by age, sex, and urban/rural residence). The association between passive commuting and survey year were significantly modified by age in both urban and rural areas. After adjustment for sex, passive commuting was more likely in 2006 compared to 1997 for: urban children aged 6–12 years (AOR=13.29, 95%CI: 5.86 – 30.12), urban children aged 13–18 years (AOR: 4.72, 95%CI: 2.71 – 8.24), rural children aged 6–12 years (AOR: 6.47, 95%CI: 3.79 – 11.02) and rural children aged 13–18 years (AOR: 1.57, 95%CI: 0.99–2.50).

Table 3 shows the factors associated with passive commuting to school for urban and rural children. In urban areas, after adjusting for other co-factors, children whose school was not in the community, were nearly twice (AOR = 1.94, 95%CI: 1.42 – 2.66) as likely to passively commute as were children whose school was in the local community. Children whose mother had senior high school education or above had 41% higher odds of passively commuting to school compared to their peers whose mother had a junior high school or lower level of education.

As seen in Table 3, in rural areas, children whose school was not in the community, were nearly four times more likely (AOR = 3.73, 95%CI: 2.81 – 4.96) to passively commute to school than were children whose school was in the community. Children whose family owned one or more motorcycles were 57% more likely to passively commute to school. Children from high income families were over twice as likely to be passive commuters compared to those from low income families. Children whose father completed senior high school education or higher had a 56% higher odds of choosing passive modes of commuting to school.

Discussion

This analysis found that the proportions of Chinese children passively commuting to school increased more than threefold between 1997 and 2006. The strongest factor associated with passive commuting was the children s school not being located in the local community. Children from high socioeconomic status households were also more likely to rely on passive commuting. In rural areas, household motorcycle ownership was associated with passive commuting. Because active commuting may be a simple and cost-effective method to increase physical activity among children, the results of this study suggest an important area for public health intervention, to preserve physically active commuting patterns among children in China.

Similarly to studies in the US and Australia (McDonald, 2007; Van der Ploeg et al., 2008), the present study found that passive commuting to school in China increased during the last decade, although starting at a much lower rate. In the US the prevalence of passive commuting to school increased from 59.3% in 1969 to 87.1% in 2001 (McDonald, 2007), and in Australia, the proportion of children driven to school increased from 22.8% in 1971 to 66.6% in 2003 (Van der Ploeg et al., 2008). Recent Swiss data also showed increases in passive commuting among 6–14 year old children from 21.6% in 1994 to 28.6% in 2005 (Grize et al., 2010).

As expected, schools not located in the local community showed a strong association with passive commuting. In our study, the presence of a local school is a proxy measure for the distance from home to school. Previous studies in high income countries (Bere, 2008;

Bringolf-Isler, 2008; DiGuiseppi, 1998; McDonald, 2007; Merom, 2006; Nelson, 2008; Timperio, 2006; Yelavich, 2008) also reported that the distance from home to school was an important barrier for active commuting to school. In China, the number of communities without a school has increased, in tandem with declining numbers of children, resulting from the one-child policy. This can be indirectly demonstrated by the decline in the number of primary schools in China which dropped from 628 840 in 1997 to 341 639 in 2006, and similarly for high schools which dropped from 88 689 to 82 803 over the same period (National Bureau of Statistics of China, 2007). This decline in the number of schools would increase trip distances to school, making active commuting less likely. This is especially problematic for rural China, as educational facilities are increasingly being centralized in the townships. Preventive programs could target students whose schools are within a walkable or bikeable distance (Bere, 2008; Bringolf-Isler, 2008; Nelson, 2008), and they should be encouraged to walk or cycle to school (Nelson, 2008). In addition, to compensate for changes in school distance, education authorities should prioritize the daily one hour in-school physical activity policy (CPCCC & State Council, 2007). Further, we speculate that parents in urban China might drive their children further to a school with a higher educational reputation. This might partly explain increased passive commuting in urban areas, and should be addressed by policies that focus on an equitable distribution of educational resources.

Motorised vehicle ownership has been considered a correlate of passive commuting in developed countries (Carlin, 1997; DiGuiseppi, 1998; Evenson, 2003; McDonald, 2007; Merom, 2006; Yelavich, 2008) and in the Philippines (Tudor-Locke, 2003). Similarly in our analysis, ownership of motor cycles in rural areas was associated with passive commuting. The rapid increase in motorcycle ownership in rural China from 12.8% in 1997 to 40.7% in 2006 (National Bureau of Statistics of China, 2007) is consistent with the increase in passive commuting in rural populations. Although motorcycles may improve transportation and living standards of rural people who do not have access to a well-established public transportation system, they may also contribute to increases in passive commuting to school.

Consistent with previous research (Chillon, 2009; Evenson et al., 2007; Martin, 2007; McDonald, 2007; Mota, 2007), our study suggests that children from high socio-economic backgrounds are more likely to passively commute to school. In urban areas, maternal socio-economic factors were important. This is concordant with the literature that suggests maternal characteristics have a greater influence than those of fathers on children s health related behaviours (Matheson, 2006). In rural areas, paternal education level and household income households were associated with more passively commuting, possibly because fathers are the main economic source for rural families.

Limitations and strengths

One of the strengths of the study is the sampling and data collection methods were identical in each survey. In addition, short intervals between surveys allowed us to carefully examine the trends and correlates associated with passive commuting in China. One of limitations of the study is that clustered samples are not ideal for travel surveys because the nature of some modal transport choices is highly dependent on small geographic areas. Also, the objective distance from home to school was not assessed. In addition, we were unable to model some other known correlates of passive commuting including perceived safety, street connectivity, and changes in school policy as these questions were not asked. Finally, we could not distinguish in the 1997 and 2000 surveys if children reporting cycling were in fact pedalling or were passengers on the bike. Although these limitations need to be considered when interpreting our results, they do not reduce the significance of this study in being one of the

first studies to identify important passive commuting trends in China that may reduce children s health-related physical activity.

Conclusion

Passive commuting to school increased in the last decade in Chinese children. The strongest factor associated with passive commuting was children schools not in the local community. To compensate for the loss of physical activity incurred by increasing passive commuting, sustainable local community campaigns should encourage active commuting. In addition, effective implementation of the daily one hour in-school physical activity policy could mitigate the effects of these commuting trends.

Acknowledgments

We thank the National Institute of Nutrition and Food Safety, China Center for Disease Control and Prevention, Carolina Population Center, the University of North Carolina at Chapel Hill, the NIH (R01-HD30880, DK056350, and R01-HD38700) and the Fogarty International Center, NIH for financial support for the China Health and Nutrition Surveys data collection and analysis files. We also thank the Australian Agency for International Development (AusAID) for funding Zhaohui Cui s doctoral scholarship in International Public Health at the University of Sydney, Australia, and this analysis, which is part of the requirements for his PhD studies.

References

Communist Party of China Central Committee (CPCCC) and State Council. View on strenthening youth sports and enhancing adolescent physical fitness. Beijing: 2007.

Bere E. Socio-demographic factors as correlates of active commuting to school in Rotterdam, the Netherlands. Prev Med. 2008; 47:412–416. [PubMed: 18657568]

Bringolf-Isler B. Personal and environmental factors associated with active commuting to school in Switzerland. Prev Med. 2008; 46:67–73. [PubMed: 17662380]

Carlin JB. Walking to school and traffic exposure in Australian children. Aust NZ J Publ Heal. 1997; 21:286–292.

Chillon P. Socio-economic factors and active commuting to school in urban Spanish adolescents: the AVENA study. Eur J Public Health. 2009; 19:470–476. [PubMed: 19535607]

Cooper AR. Commuting to school: Are children who walk more physically active? Am J Prev Med. 2003; 25:273–276. [PubMed: 14580626]

Cui Z. Temporal trends in overweight and obesity of children and adolescents from nine Provinces in China from 1991–2006. Int J Pediatr Obes. 2010; 5:365–374. [PubMed: 20836722]

Davison KK. Children's active commuting to school: current knowledge and future directions. Prev Chronic Dis. 2008; 5:A100. [PubMed: 18558018]

DiGuiseppi C. Determinants of car travel on daily journeys to school: cross sectional survey of primary school children. BMJ. 1998; 316:1426–1428. [PubMed: 9572753]

Evenson KR. Statewide prevalence and correlates of walking and bicycling to school. Arch Pediatr Adolesc Med. 2003; 157:887–892. [PubMed: 12963594]

Evenson KR. Measurement of perceived school climate for active travel in children. Am J Health Behav. 2007; 31:86–97. [PubMed: 17181465]

Fulton JE. Active transportation to school: findings from a national survey. Res Q Exerc Sport. 2005; 76:352–357. [PubMed: 16270712]

Grize L. Trend in active transportation to school among Swiss school children and its associated factors: three cross-sectional surveys 1994, 2000 and 2005. Int J Behav Nutr Phys Act. 2010; 7:28. [PubMed: 20398320]

Hillman, M. One false move: a study of children's independent mobility. PSI Publishing; London: 1990.

Kerr J. Active commuting to school: Associations with environment and parental concerns. Med Sci Sports Exerc. 2006; 38:787–794. [PubMed: 16679998]

Ma, GS.; Kong, LZ. Report on 2002 China National Nutrition and Health (9): behaviors and lifestyles. People's Medical Publishing House; Beijing: 2006.

Martin SL. National prevalence and correlates of walking and bicycling to school. Am J Prev Med. 2007; 33:98–105. [PubMed: 17673096]

Matheson DM. Do Mexican-American Mothers' Food-Related Parenting Practices Influence Their Children's Weight and Dietary Intake? J Am Diet Assoc. 2006; 106:1861–1865. [PubMed: 17081838]

McDonald NC. Active transportation to school: trends among U.S. schoolchildren, 1969–2001. Am J Prev Med. 2007; 32:509–516. [PubMed: 17533067]

Merom D. Active commuting to school among NSW primary school children: implications for public health. Health Place. 2006; 12:678–687. [PubMed: 16263323]

Mota J. Active versus passive transportation to school-differences in screen time, socio-economic position and perceived environmental characteristics in adolescent girls. Ann Hum Biol. 2007; 34:273–282. [PubMed: 17612859]

National Bureau of Statistics of China. China Statistics Yearbook 2007. China Statistics Press; Beijing: 2007.

Nelson NM. Active commuting to school: How far is too far? Int J Behav Nutr Phys Act. 2008; 5:1. [PubMed: 18182102]

Popkin BM. Cohort Profile: The China Health and Nutrition Survey--monitoring and understanding socio-economic and health change in China, 1989–2011. Int J Epidemiol. 2010; 39:1435–1440. [PubMed: 19887509]

Timperio A. Personal, Family, Social, and Environmental Correlates of Active Commuting to School. Am J Prev Med. 2006; 30:45–51. [PubMed: 16414423]

Tudor-Locke C. Objective physical activity of Filipino youth stratified for commuting mode to school. Med Sci Sports Exerc. 2003; 35:465–471. [PubMed: 12618577]

Van der Ploeg HP. Trends in Australian children traveling to school 1971–2003: burning petrol or carbohydrates? Prev Med. 2008; 46:60–62. [PubMed: 17628653]

Yelavich S. Walking to school: frequency and predictors among primary school children in Dunedin, New Zealand. N Z Med J. 2008; 121:51–58. [PubMed: 18392062]

Highlight

- Passive commuting to school increased in China over a decade.
- Child's school not in the local community were more likely to passively commute.
- Socioeconomic status was associated with passive commuting.
- In rural areas, motorcycle ownership was associated with passive commuting.

Table 1

Demographic characteristics of study population by urban and rural areas from 1997 to 2006: The China Health and Nutrition Surveys [*]

	Urban				*P*	Rural				*P*
	1997	**2000**	**2004**	**2006**		**1997**	**2000**	**2004**	**2006**	
Age [§]	12.0±3.2	12.6±3.0	12.9±3.5	12.7±3.6	<0.0001	11.6±3.0	11.9±2.8	12.1±3.2	11.6±3.1	<0.0001
Sex										
Boys	52.0	51.1	50.1	49.3		52.7	54.9	53.8	54.6	
Girls	48.0	48.9	49.9	50.7	0.84	47.3	45.1	46.2	45.4	0.64
Relationship to head of household										
Son/daughter	81.4	80.1	73.6	67.3		90.3	86.6	77.0	68.4	
Others	18.6	19.9	26.4	32.7	<0.0001	9.7	13.4	23.0	31.6	<0.0001
Parental marital status										
Married	96.2	91.6	90.4	93.7		96.2	94.6	93.8	95.3	
Others	3.8	8.4	9.6	6.3	0.0007	3.8	5.4	6.2	4.7	0.048
Respondent's school in local community										
Yes	55.6	54.4	45.9	44.5		66.6	63.0	61.0	61.9	
No	44.4	45.6	54.1	55.5	<0.0001	33.4	37.0	39.0	38.1	0.0025
Bus stop in the village/neighbourhood										
Yes	71.0	90.5	77.4	75.6		57.1	64.1	58.0	51.6	
No	29.0	9.5	22.6	24.4	0.23	42.9	35.9	42.0	48.4	0.013
Number of bicycles in household										
0	24.3	29.1	38.5	39.8		18.4	20.6	28.4	37.8	
1	31.3	25.6	29.8	27.4		36.8	33.8	36.3	34.1	
2	26.1	27.7	18.6	23.7		27.9	28.4	23.5	19.5	
≥3	18.2	17.5	13.1	9.1	<0.0001	16.9	17.2	11.8	8.6	<0.0001
Household ownership of motorcycle(s)										
No	84.0	75.0	69.4	67.8		87.2	79.5	63.6	59.3	
Yes	16.0	25.0	30.6	32.2	<0.0001	12.8	20.5	36.4	40.7	<0.0001
Household ownership of automobile(s)										
No	95.5	95.9	95.0	94.1		97.1	96.0	96.4	94.9	
Yes	4.5	4.1	5.0	5.9	0.28	2.9	4.0	3.6	5.1	0.022

*Mantel-Haenszel test for trend.

§Mean ± SD, ANOVA analysis for test of statistical difference between survey years.

Table 2

Proportions of students reporting passive commuting to school among children in China from 1997 to 2006 *

Age (yrs)	Total				Urban				Rural			
	1997 (n=2454)	2000 (n=1978)	2004 (n=1549)	2006 (n=1236)	1997 (n=741)	2000 (n=583)	2004 (n=463)	2006 (n=373)	1997 (n=1713)	2000 (n=1395)	2004 (n=1086)	2006 (n=863)
Boys												
6–12	1.5§	4.3	11.2	11.7	1.2§	8.5	11.6	12.4	1.6§	3.0	11.1	11.5
13–18	7.9§	4.4	12.8	16.9	7.1§	4.3	22.5	28.1	8.2	4.5	7.3	10.4
Girls												
6–12	1.7§	2.8	12.5	12.7	1.8§	6.4	21.3	22.6	1.7§	1.5	8.9	8.5
13–18	7.0§	6.1	10.8	17.2	7.7§	11.4	19.8	25.6	6.7§	2.9	6.3	12.5
All												
6–12	1.6§	3.6	11.8	12.2	1.5§	7.5	17.1	17.9	1.6§	2.3	10.1	10.2
13–18	7.5§	5.2	11.9	17.1	7.4§	7.9	21.3	26.9	7.5	3.8	6.8	11.4

*Passive commuters were those who dominantly used motorised transport to school.

§Mantel-Haenszel test for trend across this group was significant ($P < 0.05$).

Table 3

Factors associated with passive commuting* to school in children in 9 provinces in China from 1997–2006 §

	Urban (%) †						Rural (%) †					
	1997 (n=708)	2000 (n=577)	2004 (n=443)	2006 (n=372)	Unadjusted OR	Adjusted OR	1997 (n=1634)	2000 (n=1333)	2004 (n=1044)	2006 (n=824)	Unadjusted OR	Adjusted OR
Age group												
6–12 years	1.5	7.6	17.1	17.9	1.0	1.0	1.7	2.3	10.1	10.2	1.0	1.0
13–18 years	7.2	7.8	21.5	26.4	1.60 (1.20–2.13)	3.99 (1.63–9.78)	7.6	3.6	6.9	11.2	1.43 (1.12–1.82)	2.67 (1.52–4.72)
Sex												
Boys	3.4	6.7	18.1	20.7	1.0	1.0	3.9	3.4	9.4	11.0	1.0	1.0
Girls	3.9	8.8	20.8	23.3	1.21 (0.90–1.62)	1.24 (0.92–1.68)	3.5	2.1	8.0	9.9	0.83 (0.64–1.07)	0.83 (0.64–1.08)
Family income												
Low	3.8	5.3	13.0	19.7	1.0		2.9	1.6	4.7	6.9	1.0	1.0
Medium	1.5	4.2	19.9	24.7	1.16 (0.73–1.83)	—	3.2	1.3	7.9	7.3	1.20 (0.87–1.67)	1.09 (0.78–1.54)
High	4.8	10.8	22.9	23.4	1.63 (1.07–2.48)		5.8	6.5	14.0	17.2	2.81 (2.06–3.84)	2.12 (1.52–2.96)
Relationship to head of household												
Son/daughter	4.1	7.8	19.4	20.3	1.0	—	4.0	2.7	9.2	10.2	1.0	—
Others	1.4	7.8	19.7	25.4	1.02 (0.73–1.41)		1.2	3.7	7.2	11.4	0.90 (0.65–1.24)	
If father currently work												
Yes	3.8	8.2	19.4	24.4	1.0	—						
No	4.8	5.3	18.5	18.6	0.83 (0.56–1.23)							
If mother currently work												
Yes	3.4	6.4	18.9	21.9	1.0	—						
No	5.8	12.9	19.8	25.6	1.37 (1.01–1.87)							
Father’s education												
Junior high school and below	2.7	6.5	17.2	22.8	1.0	—	3.2	2.2	8.1	8.3	1.0	1.0
Senior high school and above	5.6	10.0	24.0	20.6	1.34 (0.99–1.81)		5.3	4.6	11.3	18.9	1.88 (1.44–2.46)	1.56 (1.17–2.07)
Mother’s education												
Junior high school and below	3.1	7.6	17.6	19.0	1.0	1.0	3.5	2.4	8.4	9.3	1.0	—
Senior high school and above	5.0	7.9	22.9	27.5	1.39 (1.03–1.87)	1.41 (1.03–1.92)	4.9	5.0	11.4	18.2	1.75 (1.28–2.40)	
Respondent’s school in local community												
Yes	2.2	4.4	16.0	16.3	1.0	1.0	1.7	0.7	4.8	7.3	1.0	1.0

	Urban (%) †						Rural (%) †					
	1997 (n=708)	2000 (n=577)	2004 (n=443)	2006 (n=372)	Unadjusted OR	Adjusted OR	1997 (n=1634)	2000 (n=1333)	2004 (n=1044)	2006 (n=824)	Unadjusted OR	Adjusted OR
No	5.6	11.7	22.6	26.6	2.00 (1.48–2.68)	1.94 (1.42–2.66)	7.7	6.4	15.3	15.8	3.75 (2.90–4.84)	3.73 (2.81–4.96)
Bus stop in the village/neighbourhood												
Yes	4.5	7.5	19.0	23.0	1.0	—	3.0	3.4	7.3	14.4	1.0	—
No	1.9	9.1	21.4	18.7	0.87 (0.61–1.24)		4.7	1.7	10.8	6.5	0.92 (0.72–1.19)	
Number of bicycles in household												
0	2.3	4.8	18.8	21.6	1.0	1.0	4.3	3.2	4.9	8.3	1.0	
1	5.8	12.2	19.1	31.4	1.52 (1.08–2.12)	1.45 (1.03–2.04)	3.3	1.9	9.2	14.0	1.33 (0.96–1.85)	—
2	3.2	8.1	22.4	15.9	1.00 (0.68–1.48)	0.91 (0.61–1.37)	4.6	2.6	10.3	10.2	1.37 (0.95–1.96)	
3 +	1.5	5.9	18.3	11.8	0.75 (0.46–1.23)	0.60 (0.35–1.02)	2.9	4.2	14.2	8.1	1.51 (1.00–2.28)	
Household ownership of motorcycle(s)												
No	4.0	7.9	18.1	19.8	1.0	—	3.4	2.3	7.3	8.4	1.0	1.0
Yes	0.9	7.7	22.7	26.7	1.18 (0.87–1.59)		6.2	4.6	11.5	13.7	1.73 (1.33–2.26)	1.57 (1.19–2.07)
Household ownership of automobile(s)												
No	3.8	7.5	18.6	21.4	1.0	—	3.6	2.7	8.8	10.5	1.0	—
Yes		12.5	34.8	31.8	1.63 (0.96–2.76)		6.0	5.4	7.7	11.4	1.26 (0.72–2.21)	

* Passive commuting refers to predominantly motorised commuting to school.

§ Generalised estimating equations (GEE) analysis was used and survey years and its interaction item with age group have been adjusted for.

Slightly different sample size (to Table 2) because of missing data in covariates in Table 3.

† Percentage of passive commuting.