ACTIVE SCHOOL TRANSPORT IN THE GREATER TORONTO AREA

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Introduction

During the past several decades, there has been a dramatic increase in the prevalence of obesity among Canadian children and youth. In 1978/79, 12% of 2 to 17-year-olds were overweight, and 3% were obese - a combined overweight/obesity rate of 15%. By 2004, the combined rate increased to 26%, with 18% of children and youth overweight and 8% obese[1]. Physical inactivity contributes to this increasing obesity prevalence, which is considered to be a serious threat to public health. Research indicates that obesity may be more closely associated with the physical activities that have been replaced by sedentary behaviour in our daily lives than it is with leisure-time exercise[2]. For youth, as time spent on physical activity in school declines[3,4], travel to and from school may be an important and consistent source of physical activity.

Canadian governmental and professional organizations have recently taken notice of the links between childhood obesity and active transportation. The Ontario Government's Active 2010 strategy paper, for example, recommends creating supportive environments that can facilitate walking or cycling to school, as a way to improve participation in daily physical activities[5]. The Ontario Professional Planners Institute's (OPPI) position paper on healthy communities also acknowledges the links between walking to school and obesity in children and youth[6]. The report reviews research on land use, urban design, and transportation and identifies active travel as a planning priority. Other provinces in Canada have also adopted, or are in the process of adopting, similar policy positions. But surprisingly, active school travel (AST: walking and cycling) has remained an under-examined aspect of travel behaviour in the Canadian context. There is no Canadian research to date that has comprehensively studied AST over space and time. Domestic policy appears to be primarily based

on the findings from research conducted elsewhere. The reliability of this approach to policy development is questionable, particularly in view of the social and economic geography and climatic conditions that may distinguish Canadian city regions from cities where studies have been conducted. It is arguably important, therefore, that the policies encouraging healthy behaviour be based on local evidence.

It is within this context that this paper explores the mode share for school trips in the Greater Toronto Area (GTA) over the past 20 years. Regional trends in school trips for children and youth aged 11-13 years have been studied, with particular emphasis on active modes of travel (walking and cycling). Systematic variation in the mode choice between days of the week and time of the day are also discussed.

AST and Healthy Living

Research shows that children who actively commute to school are likely to be more active overall than passive commuters[7,8,9,10]. These studies indicate that increasing the prevalence of children actively commuting may provide an important source of overall daily energy expenditure. Although there is little evidence to suggest that active school commuters have healthier body weights, it is expected that differences in energy expenditure between active and passive school commuters may attenuate weight gain if AST is maintained. For example, Saksvig and colleagues[11] suggest a 0.59 kg of weight gain prevention for active school commuters over an average 30-week school year.

The benefits of active commute interventions for the journey to school have the potential to extend beyond improvements to individual health status. Speculatively, encouraging youth to adopt active transportation may track as a habit into adulthood[12]. Early adoption of AST, therefore, can potentially lead to longer-term improvements in health status at the population level, with active travel decisions becoming part of the adult experience. Engaging in AST could also contribute toward environmentally sustainable travel behaviour by reducing automobile emmission[13,14].

AST in Space and Time

The decline in active travel for the journey to school has previously been documented in the US, the UK, and Australia. Transportation survey data demonstrate a systematic mode shift in school trips toward passive (motorized) modes during the past few decades, although the magnitude of this effect appears to vary from country to country. The US National Household Travel Survey (NHTS) shows that less than 16% of the children aged 5-15 years walked or biked to school in 2001 compared to 48% three decades ago[15]. The National Travel Survey in the UK reveals that the proportion of youth under 16 years of age who travel to school by car increased from 16% in 1985/86 to 30% in 1997/98[9]. In England, prevalence of walking to school in the youth aged 11-16 years has decreased from 52% to 43% between the years 1985/86 and 1999/2001[16]. Studies from Australia also demonstrate similar results. Ploeg and colleagues'[17] exploration of Household Travel Surveys by the New South Wales Government Department of Planning shows that between 1971 and 1999/2003, the proportion of walking school trips by children aged 10-14 years decreased from 44.2% to 22.1%.

With respect to the determinants of AST, the quality of the built environment appears to have some influence. Even though Canadian research is relatively scarce, recent studies conducted outside of Canada suggest that mode choice (e.g., walk, bike, parental drop-off) for the journey to school is associated with a range of urban form and built environment characteristics. Distance to school[18,19,20,21], street connectivity, and the presence of sidewalks[15,18] are positively related to active commuting, while higher average household income[18,21] and traffic levels[19,20,21] are negatively associated with AST. Perceived environment and parental concerns (e.g., safety, crime) are also identified as barriers to AST[19,20,22]. These findings suggest that mode choice for school trips likely systematically varies with changes in urban form and the built environment across the city region. In the only empirical research on AST in Canada to date, Pabayo and Gauvin[23] reported significant variation in mode share across urban and rural locations in the Province of Quebec; rural children were less likely to walk to school.

Short-term, within-day variation in mode choice for school trips has received relatively less attention in the existing literature. The majority of the AST research does not take into consideration possible variation in mode choice between the a.m. (to-school) and p.m. (from school) periods. Limited empirical evidence shows higher parental drop-offs (car trips) in the morning hours (trips to-school) compared to the afternoon. Walking is found to be more prevalent for trips from school to home[16,17,20]. Day-to-day variation in school mode choice is also poorly understood. Conflicting findings have been reported in available research. Some researchers (using self-reporting surveys) have found differences between the numbers of youth who use active modes "once a week" and those who "usually" walk to school[15,20]. In other research, no noticable variation was found in children's travel mode across schooldays[16].

The AST literature discussed above motivates the formulation of the following four research questions to advance current understanding of changes in AST within the GTA: 1) How has participation in AST changed over time? 2) What sort of variation in AST is there across space, at the regional scale? 3) To what extent do trip rates for AST vary between the morning (to-school) and afternoon (from-school) periods? and 4) To what extent do AST trip rates vary across school days (i.e., Monday - Friday)?

Method and Data Source

The study uses Transportation Tomorrow Survey (TTS) data for the GTA. The TTS is a series of comprehensive travel surveys conducted within the Greater Toronto Region once every five years, starting in 1986[24]. The TTS provides statistically reliable travel behaviour data of a "typical" fall weekday of each survey year, including school trips for children and youth aged 11 years or older.

The TTS database contains telephone survey responses, collected using a reasonably consistent survey instrument, procedure, and set of questions[25]. The 1986 TTS, the first of the series, comprises completed interviews for a 4.2% random sample of all households in the GTA[24]. The 1991 TTS was a smaller update of the 1986 survey with primary focus on geographic areas that had experienced high

growth since 1986; the sample size for the survey was 1% of the total GTA residents. The 1996 TTS obtained approximately 115,000 completed interviews, representing a 5% random sample of the total population in the survey area. The 2001 TTS has 137,000 completed interview records (a 5% random sample of total population), consisting of more than 817,000 trip records. The 2006 TTS is essentially a repetition of the two previous surveys, with an estimated 150,000 interviews. All TTS data are expanded to the population level. It should be noted that the study area for the TTS has changed over time, with some regions within the GTA covered consistently by all five surveys.

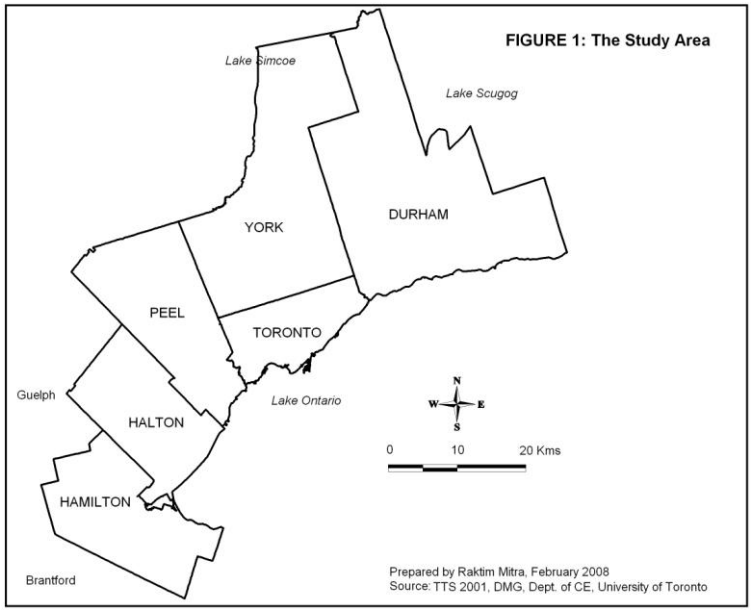
This study uses TTS school trip data for both the a.m. period (home-to-school trips between 6 and 11:30 a.m.) and p.m. period (school-to-home trips between 2:30 and 6 p.m.) for the years 1986, 1996, 2001, and 2006. The 1991 TTS data was not included in the analysis because of its limited sample size. The study area is limited to the City of Toronto, and the five surrounding regional municipalities (Durham, York, Peel, Halton and Hamilton), which were commonly included in all of the TTS surveys (Figure 1). Urban form in Toronto and Hamilton are generally "urban" with respect to the built-environment, whereas the other regions within the study area are predominantly "suburban". Peel region, however, has become increasingly urban during the past 20 years, and now hosts Canada's 6th largest city; Mississuaga.[26]

Preliminary analysis of the TTS data showed a higher prevalence of AST in children and youth within the 11-13 age group compared to older youth. Hence, for the purpose of the study, the subpopulation is fixed to children and youth 11-13 years of age. The travel data are aggregated to the scale of the regional municipality to investigate spatial variation in trip-making behaviour. Spatio-temporal variation in mode choice is presented in a series of tables.

Findings

The analysis of the TTS school trip data demonstrates variations over time and space. The discussion that follows addresses the observed trends in the light of the research questions posed earlier. Table 1

contains mode share data for the a.m. (home-to-school) and p.m. periods (school-to-home), for the years 1986, 1996, 2001, and 2006. During this 20-year period, the total number of school trips has increased alongside the rapid population growth of the GTA. At the same time, a consistent modal shift has occurred toward "passive" alternatives (primarily car). Differences in the mode share between the a.m. and p.m. periods are also evident (Table 1). Parental drop-off trips (car trips) have remained consistently and considerably higher in the morning period, while the prevalence of walking is higher in the afternoon.



With respect to a.m. trips, walking mode share has decreased from 53.4% in 1986 to 42.5% in 2006. Cycling accounts for a consistently marginal share of school travel across all years. Notably, cycling mode share for the a.m. period has declined from 2.5% to 0.8%. During this time period, the use of transit has also decreased. Overall decreases in active or semi-active (i.e., walk, cycle and transit) modes have been supplemented by the increased use of "passive" modes.

Between 1986 and 2006, the mode share for automobile trips (parental drop-off) increased from 14.3% to 28.5% (a 14.2% increase in total mode share). The role of the school bus in the journey to school has also increased, albeit marginally, over the 20-year period.

For trips from school to home (p.m. period trips), walking mode share has decreased from 56.9% (1986) to 49.5% (2006). The rate of decline over the years was moderate compared to a.m. period walking trips (a decrease of 7.4% versus 10.1% of total trips). Mode share for cycling is similar across the a.m. and p.m. periods, which is expected because cyclists likely return home by the same mode. Similar to the a.m. period trends, transit trips have decreased over time and trips by car have consistently increased. School bus mode share shows an irregular trend over time, with observable differences between the a.m. and p.m. periods. It appears that the rate of using a school bus in the afternoon (school-to-home) has actually decreased in recent years.

Regional variation in mode choice for school trips is evident in Table 2. Toronto, the largest and the most urban of all regions, has maintained a higher prevalence of walking compared to the GTA as a whole (Table 1), while auto mode share has remained lower than average. On the other hand, York and Halton regions have a much lower prevalence of walking, and marginally higher auto-based school trips when compared with the GTA average. Interestingly, mode share for walking trips has increased in recent years in these two regions, probably driven by the urbanization processes taking place within these regions. In general, walking is more common in the afternoon period across all the regions.

The rate of transit use to school has decreased in all regions over time. But in general, more urban regions (Toronto, Hamilton, Peel) have higher transit use than the more suburban regions (Durham, York, Halton), probably due to variations in the availability and

TABLE 1: School Trip Mode Shares in the GTA by Year (For Youth Aged 11-13 Years)

	To School (6 to 11:30 am)				From School (2:30 to 6 pm)			
	1986 (N=61817)	*1996* (N=176193)	*2001* (N=198183)	*2006* (N=215355)	*1986* (N=60112)	*1996* (N=164320)	*2001* (N=184374)	*2006* (N=206601)
Walk	53.4	47.3	44.7	42.5	56.9	50.6	49.5	49.5
Cycle	2.5	1.8	1.3	0.8	2.4	1.8	1.3	0.8
School bus	19.9	22.8	23.7	23.4	20.1	24.6	26.0	24.8
Transit	9.8	6.6	5.3	4.8	11.0	7.9	6.5	5.8
Auto	14.3	21.5	24.9	28.5	9.5	15.1	16.7	19.2

Source: TTS, 1986,1996,2001,2006

TABLE 2: School Trip Mode Shares in The GTA by Region and Year (For Youth Aged 11-13 Years)

		To School (6 to 11:30 am)				From School (2:30 to 6 pm)			
		1986	*1996*	*2001*	*2006*	*1986*	*1996*	*2001*	*2006*
		(N=30067)	(N=68975)	(N=71956)	(N=75911)	(N=29047)	(N=63874)	(N=66616)	(N=73343)
Toronto	Walk	56.8	52.8	50.7	48.0	59.3	55.3	55.3	54.8
	Cycle	1.6	1.1	1.1	0.7	1.3	1.1	1.1	0.7
	School bus	10.5	10.8	10.2	10.9	11.3	12.0	11.8	12.0
	Transit	17.5	14.6	12.9	12.1	19.1	17.7	15.9	14.1
	Auto	13.6	20.7	25.0	28.3	9.0	14.0	15.9	18.5
		(N=6470)	(N=19366)	(N=22785)	(N=22624)	(N=6272)	(N=17743)	(N=20543)	(N=21587)
Durham	Walk	57.2	47.8	46.5	43.3	59.6	50.6	50.5	50.8
	Cycle	3.2	2.2	2.0	0.8	3.8	2.2	1.9	0.9
	School bus	25.4	28.6	29.6	30.9	26.4	30.9	32.9	32.6
	Transit	1.3	1.8	0.8	0.5	1.8	1.7	0.7	0.5
	Auto	12.8	19.6	21.1	24.6	8.5	14.6	14.0	15.2

Source: TTS, 1986,1996,2001,2006

TABLE 2 (Continued)

		To School (6 to 11:30 am)				From School (2:30 to 6 pm)			
		1986	*1996*	*2001*	*2006*	*1986*	*1996*	*2001*	*2006*
		(N=7666)	(N=25036)	(N=30466)	(N=35360)	(N=7534)	(N=23341)	(N=28686)	(N=33831)
York	Walk	40.0	39.5	34.2	36.1	41.9	42.9	39.2	43.2
	Cycle	3.0	2.2	0.6	0.7	3.1	2.1	0.6	0.7
	Schoolbus	37.3	31.4	35.4	29.8	34.8	33.9	37.7	31.2
	Transit	2.5	1.1	0.7	0.4	4.1	1.4	0.9	1.0
	Auto	17.2	25.8	29.0	33.0	16.2	19.7	21.6	23.9
		(N=11256)	(N=33432)	(N=40174)	(N=47938)	(N=11181)	(N=31833)	(N=37721)	(N=46030)
Peel	Walk	54.3	46.3	44.2	40.6	62.9	50.7	49.4	47.2
	Cycle	4.0	1.3	1.3	1.0	3.3	1.3	1.4	0.9
	Schoolbus	24.9	31.1	29.7	29.0	25.6	33.1	31.5	30.3
	Transit	2.9	1.4	1.1	1.3	2.9	1.7	1.7	1.7
	Auto	13.9	19.9	23.7	28.1	5.4	13.2	15.9	19.9
		(N=2839)	(N=13220)	(N=14993)	(N=16712)	(N=2764)	(N=12236)	(N=14157)	(N=16029)
Halton	Walk	44.5	36.9	35.3	37.0	46.1	41.9	42.4	46.4
	Cycle	3.9	5.1	3.6	1.5	4.7	5.2	3.7	1.6
	Schoolbus	29.1	30.0	28.7	27.7	29.1	31.9	32.2	30.8
	Transit	4.0	0.9	0.8	0.1	5.1	1.0	0.8	0.5
	Auto	18.5	27.1	31.6	33.7	15.0	19.9	20.9	20.6
		(N=3483)	(N=16148)	(N=17795)	(N=16789)	(N=3316)	(N=15294)	(N=16654)	(N=15783)
Hamilton	Walk	51.8	46.2	45.4	40.3	53.5	49.9	48.6	45.8
	Cycle	2.5	1.8	0.7	0.3	3.4	2.0	0.7	0.5
	Schoolbus	28.1	30.3	33.1	36.0	26.9	32.0	36.4	37.4
	Transit	3.4	2.1	1.8	1.7	6.3	2.6	1.5	1.8
	Auto	14.2	19.6	19.0	21.7	9.9	13.5	12.7	14.5

Source: TTS, 1986,1996,2001,2006

service level of transit infrastructure. Although cycling has declined across the GTA in recent years, surprisingly, the data suggest that suburban regions have higher cycling rates to school than elsewhere. School bus mode share has remained relatively stable in Toronto during the 20-year period, but has increased over time in Durham, Peel and Hamilton regions, and decreased in the more suburban regions (York and Halton). The school bus appears to be a popular mode for school transport in all the regions outside the City of Toronto. While only about 10-12% of 11-13 year olds in Toronto used school buses in 2006, in other regions this mode captured about one-third of total trips (e.g., 30.9% a.m. trips and 32.6% p.m. trips in Durham region in 2006).

Table 3 summarises walking mode share, by region, for the five school days of a week, over the 20-year period. It should be noted that the trips shown for each day are daily cross-sections based on the day of the week when the data were collected. That is, the data do not demonstrate intra-personal variation in travel behaviour. The data suggest that although there were some daily variations in walking trip rates in 1986, these differences appear to have decreased by 2001 in Toronto, and by 2006 in other regions across the GTA. Although day-to-day differences are apparent within Durham and Hamilton (e.g., mode share for a.m. walking trips on an average Tuesday in 2006 was 8.3% more than Friday in Durham), no general pattern of variation can be identified from the data. In Toronto and Peel the evidence suggests there is minimal daily variation in walking to school.

Discussion

This study is probably the first attempt to explore the prevalence of AST in the GTA. With respect to the scope of the data and time period studied, the present research presents the most comprehensive trend analysis in the Canadian context. From this perspective, this study establishes a baseline for pursuing further AST research in the local context. Findings from this study show that AST (walking and cycling) is surprisingly dominant among modes used for school trips in the GTA (e.g., 43.3% of morning, and 50.3% of afternoon trips in

TABLE 3: Day-to-Day Variation in the Mode Shares for Walking School Trips by Region and Year (For Youth Aged 11-13 Years)

		To School (6 to 11:30 am)				From School (2:30 to 6 pm)			
		1986	*1996*	*2001*	*2006*	*1986*	*1996*	*2001*	*2006*
Toronto	Monday	57.5	52.0	48.5	45.7	61.7	52.7	53.8	53.5
	Tuesday	59.2	51.8	53.1	48.1	60.8	56.4	57.6	55.7
	Wednesday	57.2	52.5	52.1	48.2	59.1	53.1	56.4	53.6
	Thursday	53.5	56.5	49.1	48.4	57.8	58.3	52.9	55.2
	Friday	56.3	51.2	50.5	49.1	57.4	55.4	55.5	55.6
Durham	Monday	46.9	49.2	44.3	41.1	46.7	54.7	46.6	50.9
	Tuesday	59.6	45.1	45.7	47.7	66.6	49.1	54.8	51.8
	Wednesday	61.1	50.8	47.0	46.0	68.9	51.2	50.5	51.3
	Thursday	51.5	53.6	45.7	41.1	48.5	58.1	48.5	48.4
	Friday	66.2	42.8	49.0	39.4	66.6	42.7	52.1	51.3
York	Monday	33.8	35.4	33.8	35.3	35.6	34.7	38.4	40.9
	Tuesday	27.4	36.8	33.2	37.0	29.7	40.0	42.2	44.3
	Wednesday	45.0	43.7	35.8	34.5	44.2	50.0	33.9	43.1
	Thursday	40.1	43.2	35.6	36.8	45.7	46.8	42.7	43.1
	Friday	51.7	39.7	33.0	36.7	53.0	44.5	38.5	44.4
Peel	Monday	52.5	49.7	40.9	41.1	63.7	56.6	44.9	48.8
	Tuesday	54.9	47.6	44.5	43.1	67.9	52.1	52.9	47.0
	Wednesday	48.3	44.1	44.7	40.5	55.6	46.4	49.4	49.0
	Thursday	54.6	44.8	47.3	40.3	60.3	47.4	51.2	47.0
	Friday	60.4	45.4	42.9	38.8	67.3	51.0	48.2	44.9
Halton	Monday	38.3	38.4	36.6	38.0	50.3	45.7	45.3	47.0
	Tuesday	58.2	33.1	42.4	37.3	58.6	37.2	47.7	48.5
	Wednesday	31.8	31.1	32.7	35.0	33.3	34.7	42.0	43.7
	Thursday	50.1	41.7	33.4	37.6	50.1	48.6	37.7	48.0
	Friday	37.0	40.3	33.2	36.9	31.8	43.8	40.9	44.8
Hamilton	Monday	58.9	44.1	50.0	37.4	61.9	49.5	51.0	45.0
	Tuesday	62.2	40.8	48.9	45.2	63.7	46.0	53.7	47.4
	Wednesday	42.1	41.0	48.4	39.2	45.1	45.8	51.9	45.5
	Thursday	45.1	53.5	47.2	42.4	45.5	56.1	50.1	46.4
	Friday	51.5	49.2	36.2	37.6	52.1	50.9	40.0	44.8

Source: TTS, 1986,1996,2001,2006

2006). The GTA's AST mode share is reasonably high, when compared to urban regions in the US[15], Australia[17] and England[16]. However, participation in AST has decreased over time. In the past

two decades, the share of AST has declined by 12.6% in the a.m. period, and 9% in the p.m. period. Spatial variation is also observed across the GTA with respect to mode share. Change of this sort is not insignificant and should provide some focus for the development of local AST policy.

Mode share for auto trips has consistently remained higher for a.m. school trips compared to p.m. trips over the study period. On the other hand, more youth walk home from school in the afternoon. This finding suggests that broader patterns of household activity-travel behaviour influence school trip mode choice. For example, children are potentially driven to school during the parent(s)' a.m. commute, only to walk home at the end of the day when parents are not available for a ride. Differences in school trip mode choice across days of the week have decreased over time, and across regions. This reduction of "difference" in mode choice is potentially indicative of the possibility that school trips are increasingly nested within the "typical" daily household activity-pattern.

The data reveal that the total number of p.m. period trips (directly from school-to-home) is lower than the a.m. period trips (directly from home-to-school), and that this difference has increased over the years. This may represent increased participation of children in extracurricular activities after the school hours in recent years. Although this possibility was not explored here, these trips may be significantly tied to the household's activity-scheduling. This can be critically important for interventions to promote AST, such as "walking school bus" schemes. Further research is required to understand the expected influence of pre and post-school activities on AST decision-making within households.

Conclusion

This study explores mode choice for school trips by children and youth aged 11-13 years in the GTA. Findings suggest that active school transport (AST) in the GTA has decreased between 1986 and 2006, and that the levels of AST vary across the city region. Walking trips are more prevalent during the afternoon than in the morning

period, and differences in mode choice across the days of the week have decreased over time.

The diversity of urban form, and spatial variation in AST levels across the GTA, provide an opportunity to explore the socio-demographic, built-environment (both objective and perceived), and behavioural correlates of AST in the local context, which should be the priority for future research. Evidence from this exploratory work, and the explanatory research to follow, will help with the formulation of appropriate planning strategies to promote urban environments that encourage healthy travel behaviour.

Reference

1. Shields, M. (2004) *Overweight Canadian children and adolescents*, Ottawa: Statistics Canada.
2. Spanier, P.A., Marshall, S.J., & Faulkner, G.E. (2006) "Tackling the obesity pandemic: A call for sedentary behaviour research", *Canadian Journal of Public Health*, 97, 255-7.
3. Faulkner, G., Adlaf, E., Irving, H., Allison, K., Dwyer, J., & Goodman, J. (2007) "Participation in high school physical education–Ontario, Canada, 1999-2005", *MMWR*, January 26, 52-54.
4. Dwyer, J.J., Allison, K.R., LeMoine, K.N., Adlaf, E.M., Goodman, J., Faulkner, G.E., & Lysy, D.C. (2006) "A provincial study of opportunities for school-based physical activity in secondary schools", *Journal of Adolescent Health*, 39, 80-6.
5. Ministry of Health Promotion (2005) *Active 2010: Ontario's sport and physical activity strategy*, Govt. of Ontario, August, 2005.
6. Ontario Professional Planners Institute (2007) *Healthy communities, sustainable communities: The 21st century planning challenge*, Toronto: OPPI, Fall 2007.
7. Heelan, K.A., Donnelly, J.E., Jacobsen, D.J., Mayo, M.S., Washburn, R., & Greene, L. (2005) "Active commuting to and from school and BMI in elementary school children-preliminary data", *Child Care Health Dev*, 31, 341-9.
8. Alexander, L.M., Inchley, J., Todd, J., Currie, D., Cooper, A.R., & Currie, C. (2005) "The broader impact of walking to school

among adolescents: seven day accelerometry based study", British *Medical Journal*, 331, 1061-2.
9. Cooper, A.R., Page, A.S., Foster, L.J., & Qahwaji, D. (2003) "Commuting to school: are children who walk more physically active?" *American Journal of Preventive Medicine*, 25, 273-6.
10. Cooper, A.R., Andersen, L.B., Wedderkopp, N., Page, A.S., & Froberg, K. (2005) "Physical activity levels of children who walk, cycle, or are driven to school", *American Journal of Preventive Medicine* ,29, 179-84.
11. Saksvig, B.I., Catellier, D.J., Pfeiffer, K., Schmitz, K.H., Conway, T., Going, S., Ward, D., Strikmiller, P., & Treuth, M.S. (2007) "Travel by walking before and after school and physical activity among adolescent girls", *Arch Pediatr Adolesc Med*, 161, 153-158.
12. Evenson, K.R., Huston, S.L., McMillen, B.J., Bors, P., & Ward, D.S. (2003) "Statewide prevalence and correlates of walking and bicycling to school", *Arch Pediatr Adolesc Med*, 157, 887-92.
13. Garrison, W. (2007) *Increasing the flexibility of legacy systems*, Proceedings of the 2007 Anderson Lecture, Applied Geography Specialty Group, Annual meeting of the Association of American Geographers, San Francisco, CA. April 2007.
14. Black, C., Collins, A. and Snell, M. (2001) "Encouraging walking: The case of journey-to-school trips in compact urban areas", *Urban Studies*, 38 (7), 1121-1141.
15. Boarnet, M. G., Anderson, C. L., Day, C., McMillan, T. and Alfonzo, M. (2005) "Evaluation of the California Safe Roots to School Legislation: Urban form changes and children's active transport to school", *American Journal of Preventive medicine*, 28(2S2), pp. 134-140.
16. Gilhooly, P. & Low, D.J. (2005), "Primary school travel behaviour in Midlothian, UK", *Proceedings of the Institution of Civil Engineers – Municipal Engineer*, 158, 129-136.
17. Ploeg, H.P., Merom, D., Corpuz, G. and Bauman, A.E. (2008) "Trends in Australian children travelling to school 1971-2003: Burning patrol or carbohydrates", *Preventive Medicine*, 46, 60-62.
18. Ewing, R., Schroeer, W., & Greene W. (2004) "School location and student travel - Analysis of factors affecting mode choice", *Transportation Research Record*, 1895, 55-63

19. Schlossberg, M., Phillips, P.P, Johnson, B., & Parker, B. (2005) "How do they get there? A spatial analysis of a 'Sprawl School' in Oregon", *Planning, Practice, & Research*, 20, 147-62.
20. Schlossberg, M., Greene, J., & Phillips, P.P. (2006) "School trips - Effects of urban form and distance on travel mode", *Journal of the American Planning Association*, 72, 337-346.
21. Timperio, A., Ball, K., Salmon, J., Roberts, R., Giles-Corti, B., Simmons, D., Baur, L.A., & Crawford, D. (2006), "Personal, family, social, and environmental correlates of active commuting to school", *American Journal of Preventive Medicine*, 30, 45-51.
22. Kerr, J., Rosenberg, D., Sallis, J. F., Saelens, B. E., Frank, L. D. and Conway, T. L. (2006) "Active commuting to school: Associations with environment and parental concerns", *Medicine and Science in Sports and Exercise*, 38 (4), 787-794.
23. Pabayo, R. And Gauvin, L. (2008) "Proportions of Students who use various modes of transportation to and from school in a representative population-based sample of children and adolessents, 1999", *Preventive Medicine.* 46, 63-66.
24. Data Management Group (2005) "Transportation Tomorrow Survey", Joint Program in Transportation, Toronto: University of Toronto, URL: http://www.jpint.utoronto.ca/dmg/tts.html, accessed January, 2008.
25. Miller, E. J. and Shalaby, A. (2003) "Evolution of Personal Travel in Toronto Area and Policy Implications", *Journal of Urban Planning and Development,* ASCE, 129(1),1-26.
26. Mitra, R. (2007) *Evolution of Urban Form and Travel Behaviour in the Greater Toronto Area, 1986-2001: An Overview*, M. Pl. Thesis, School of Urban and Regional Planning, Kingston: Queen's University.