Factors associated with active commuting among a nationally representative sample of Canadian youth

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ABSTRACT

OBJECTIVES: Given the link between active commuting and physical activity, this study examined factors associated with active commuting among a nationally representative sample of Canadian youth.

METHODS: Using data from the 2010-11 Youth Smoking Survey, this study examined different forms of commuting (active, inactive, mixed) and factors associated with either mixed or active commuting among grade 6 to 12 students.

RESULTS: Among Canadian youth in 2010-11, only 22.1% reported being an active commuter and only 25.7% reported being a mixed commuter. Students were more likely to commute actively if they were male, in younger grades (grades 6-10), a normal weight, a current smoker, or lived in urban areas.

CONCLUSION: There is substantial opportunity to promote active commuting within the Canadian context since most youth were inactive commuters. Future research should explore the underlying facilitators or barriers to active commuting so that we better understand how best to promote active commuting among the subpopulations of youth (e.g., females, overweight youth, non-smokers, youth in rural areas) who are less likely to commute actively.

KEY WORDS: Adolescent; physical activity; active commuting; body mass index; smoking

La traduction du résumé se trouve à la fin de l'article.

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Data from the 2007-09 Canadian Health Measures Survey (CHMS) suggest that among Canadian youth aged 15 to 19, 31% of boys and 26% of girls are overweight or obese.[1] This represents a dramatic population-level increase from 25 years ago when only 14% of boys and 14% of girls were considered overweight or obese.[1] Given these changes, obesity prevention among youth should be considered a public health priority in Canada.

In recent years, numerous policy- and community-level initiatives have been launched to change one or both sides of the energy-balance equation for children and adolescents (youth) by reducing calories consumed or increasing calories expended from physical activity (PA).[2] However, since evidence suggests that dietary factors are not strongly associated with obesity in youth populations,[3,4] efforts to reduce or prevent obesity among youth may be more effective if they focus on PA.[5] Given the challenges associated with increasing PA among the youth populations,[6] further investigation into the predictors of different forms or types of PA that are amenable to intervention is warranted.

One form of PA receiving interest in recent years is active commuting to school.[7,8] Active commuting to school is considered important as evidence suggests that youth who walk and bike to school are more active than their non-commuting counterparts.[9,10] Given the interest among policy-makers, the potential reach and impact and the relatively low cost associated with school-based programming to promote active commuting, this activity has been identified as an important population-based intervention to increase PA levels.[9] For instance, in a recent provincial report "Taking Action to Prevent Chronic Disease – Recommendations for a Healthier Ontario", active commuting to school was recommended as an important intervention to improve the health of youth in Ontario.[11] Similar provincial strategy documents in other Canadian provinces (e.g., British Columbia[12] and Manitoba[13]) have also recommended promoting active commuting to school. As such, understanding the prevalence of and the factors associated with active commuting among Canadian youth would help to inform the development and potential implementation of such policy initiatives.

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Conflict of Interest: None to declare.

Table 1. Descriptive statistics for Canadian youth in grades 6 to 12 (weighted)

	Active (*N*=600,900) (22.1%) %	Mixed (*N*=699,400) (25.7%) %	Non-active (*N*=1,420,000) (52.2%) %	Chi-square (df)
Gender				
Female	43.4	49.9	50.8	37.08 (2)
Male	56.6	50.1	49.2	$p<0.001$
Grade				
6	20.8	13.0	10.5	215.59 (12)
7	15.0	14.8	13.1	$p<0.001$
8	15.2	15.2	13.4	
9	13.6	15.2	14.4	
10	12.0	15.5	16.2	
11	11.3	14.7	16.4	
12	12.1	11.6	16.0	
Weight status*				
Underweight	3.3	2.6	2.8	3.27 (4)
Healthy weight	75.3	74.3	74.1	$p = 0.51$
Overweight/obese	21.4	23.1	23.1	
Smoking status				
Current smoker	5.5	4.3	6.0	10.69 (4)
Former smoker	0.7	1.3	1.0	$p<0.05$
Non-smoker	93.8	94.4	93.0	
Sedentary behaviour†				
Low	1.1	0.6	0.8	17.33 (4)
Moderate	25.2	21.9	22.2	$p<0.01$
High	73.7	77.5	77.0	
School location‡				
Rural	5.3	5.9	13.4	397.96 (4)
Urban	62.1	34.6	39.6	$p<0.001$
Suburban	32.6	59.5	47.0	

* Weight status: Underweight (0-5th percentile BMI), Healthy weight (6-84th percentile BMI), Overweight/obese (>85th percentile BMI).
† Sedentary behaviour: Low (<1 hour/day), Moderate (1-3 hours/day), High (>3 hours/day).
‡ School location: Rural (residential density <400 people/km²), Suburban (population = 1000–99,999 and residential density >400 people/km²); Urban (population ≥100,000 and residential density >400 people/km²).

Existing research has identified various modifiable student characteristics associated with active commuting. For instance, youth are more likely to actively commute if they are a non-smoker[8] or are physically active.[8-10] However, it has also been suggested that there is a need to move beyond only examining individual student characteristics if we want to understand how to best target school-based interventions so that they are most likely to have impact.[8] As such, there is also evidence demonstrating that youth are more likely to actively commute if they attend a school located in an urban setting.[14-17] Considering that within the Canadian context, much of the work examining correlates of active commuting has focused on students in the province of Ontario,[8,14,15,18] the aim of the current study is to assess the prevalence of active commuting and explore the factors associated with active commuting and mixed (active/inactive) commuting using nationally representative data.

METHODS

Design

This study used data collected from 50,949 students in grades 6 to 12 (aged 11 to 19 years) who participated in the 2010-11 Canadian Youth Smoking Survey (2010 YSS), a nationally representative school-based survey of youth in Canada. In brief, the population of interest for the data used in this study consisted of all young Canadian residents in grades 6 to 12 attending public and private secondary schools in nine Canadian provinces; youth residing in the Yukon, Nunavut, the Northwest Territories and New Brunswick were excluded from the population of interest, as were youth living

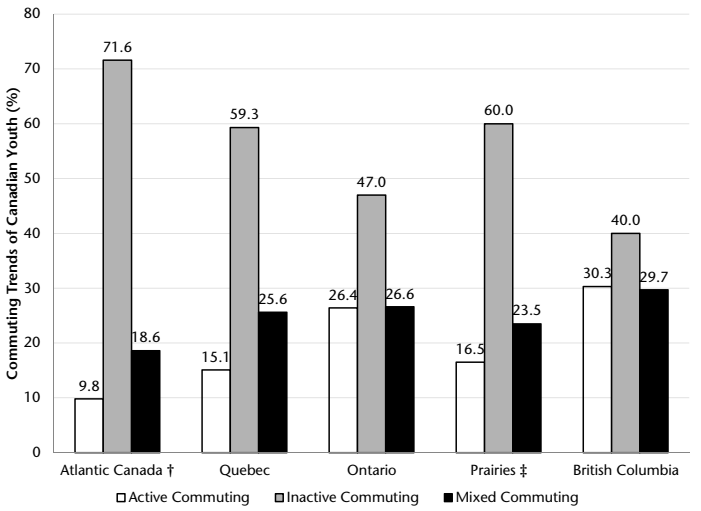

Figure 1. Prevalence of active, inactive and mixed commuting among Canadian students in Grades 6 to 12 by region, 2010/2011 (weighted)
Source: 2010/2011 Canadian Youth Smoking Survey.
Active *N* = 600,900; Inactive *N* = 1,420,000;
Mixed *N* = 699,400.
† New Brunswick, Nova Scotia, Prince Edward Island, Newfoundland and Labrador.
‡ Alberta, Saskatchewan, Manitoba.

in institutions or on First Nation Reserves, and youth attending special schools or schools on military bases. While New Brunswick participated in all prior cycles of YSS, the provincial government chose not to participate in 2010 YSS. As described in more detail in the user guide, the sampling of schools for the 2010 YSS was based on a stratified single-stage design. Within most provinces, stratification was based on two classifications: 1) health region smoking rate, and 2) type of school (elementary or secondary). Different sampling strategies were used in Prince Edward Island (all schools) and Quebec (schools in 30 of 36 targeted health regions). The survey design and sample weights allow us to produce population-based weighted sample estimates. The University of Waterloo Office of Research Ethics and appropriate School Board Ethics committees approved all procedures. Detailed information on the 2010 YSS sample design, methods, response rates and measures are available.[19]

Measures

Consistent with previous research,[8] students were asked "How do you usually get to and from school?", with response options of "Actively (e.g., walk, bike)", "Inactively" (e.g., car, bus)", or "Mixed (actively and inactively)." Students who reported being inactive commuters (referent) were compared to students who reported being either active commuters [Active (1) vs. Inactive (0)] or mixed commuters [Mixed (1) vs. Inactive (0)].

Using previously validated measures of self-reported height and weight,[20] body mass index (BMI) was calculated for each student using the measures of weight (kg) and height (m) (BMI=kg/m²). Weight status was then determined using the BMI classification system of the World Health Organization,[21] based on age- and sex-adjusted BMI cut-points where students within the lowest 5th percentile for BMI adjusted for age and sex were classified as underweight, those within the 6th–84th percentile as normal weight, and those within the highest 15th percentile as overweight or obese.

Table 2. Logistic regression models examining factors associated with active commuting and mixed commuting among Canadian youth in grades 6 to 12 (weighted)

	Odds ratio (95% CI)*	
	Model 1	Model 2
Variables	Active vs. non-active	Mixed vs. non-active
Gender		
Female	1.00	1.00
Male	1.45 (1.44, 1.45)***	1.09 (1.09, 1.10)***
Grade		
6	1.00	1.00
7	1.10 (1.08, 1.11)***	1.41 (1.39, 1.43)***
8	1.03 (1.02, 1.05)***	1.16 (1.14, 1.17)***
9	1.25 (1.23, 1.27)***	1.23 (1.21, 1.25)***
10	1.06 (1.04, 1.08)***	1.22 (1.20, 1.24)***
11	0.86 (0.84, 0.87)***	1.08 (1.06, 1.09)***
12	0.73 (0.71, 0.74)***	0.86 (0.85, 0.88)***
Weight status†		
Normal weight	1.00	1.00
Underweight	1.03 (1.02, 1.05)***	1.09 (1.08, 1.09)***
Overweight	0.82 (0.82, 0.83)***	0.86 (0.85, 0.88)***
Physical activity		
Each 1 unit change in KKD	1.02 (1.02, 1.02)***	1.01 (1.01, 1.01)***
Smoking status		
Non-smoker	1.00	1.00
Current smoker	1.64 (1.63, 1.66)***	0.86 (0.86, 0.87)***
Former smoker	1.05 (1.03, 1.08)***	2.08 (2.04, 2.11)***
Sedentary behaviour‡		
High	1.00	1.00
Moderate	0.95 (0.94, 0.95)***	0.96 (0.96, 0.97)***
Low	1.20 (1.16, 1.24)***	0.54 (0.52, 0.56)***
School location§		
Urban	1.00	1.00
Rural	0.15 (0.06, 0.38)***	0.26 (0.13, 0.55)***
Suburban	0.58 (0.27, 1.23)	0.59 (0.32, 1.09)

* Values are adjusted for all other variables in the model.
† Weight status: Underweight (0-5th percentile BMI), Healthy weight (6-84th percentile BMI), Overweight/obese (>85th percentile BMI).
‡ Sedentary behaviour: Low (<1 hour/day), Moderate (1-3 hours/day), High (>3 hours/day).
§ School location: Rural (residential density <400 people/km^2), Suburban (population = 1000–99,999 and residential density >400 people/km^2); Urban (population ≥100 000 and residential density >400 people/km^2).
CI = Confidence interval.
KKD = kilocalories per kilogram per day.
* p<0.05, ** p<0.01, *** p<0.001.
Model 1: Active N = 600,900; Inactive N = 1,420,000.
Model 2: Mixed N = 699,400; Inactive N = 1,420,000.

Using previously validated measures,[20] students were asked how many minutes of vigorous PA (VPA) they engaged in on each of the last 7 days. Consistent with Wong et al.,[20] our measure of PA was based on the average kilocalories per kilogram of body weight per day (KKD) expended in VPA calculated as: KKD = (Hours of VPA*6MET)/7 days. Tobacco use was assessed by asking respondents, "Have you ever smoked 100 or more whole cigarettes in your life?" and "On how many of the last 30 days did you smoke one or more cigarettes?" Consistent with validated measures of smoking,[22] students who reported ever smoking 100 cigarettes and any smoking in the previous 30 days were classified as current smokers and students who had smoked 100 or more cigarettes but had not smoked in the previous 30 days were classified as former smokers; non-smokers were defined as those who had not smoked 100 or more whole cigarettes in their lifetime but might have smoked a whole cigarette. Sedentary behaviour was assessed with a single item asking students to report the amount of time (hours per day) they spent: watching movies/TV, playing computer/video games, surfing on the internet, talking on the phone/instant messaging and reading over each of the previous 7 days.[8] Students who reported <1 hour per day (low sedentary) were compared to students who reported 1 to 3 hours (moderate sedentary) and >3 hours (high sedentary) per day of sedentary behaviour. According to Statistics Canada, population centres are geographic areas with a population of at least 1,000 people and a population density of at least 400 people per square kilometre.[23] Based on this definition, an urban location was defined as the school being located in a large urban population centre with a population of 100,000 people or more, and a suburban location was defined as the school being located in a small or medium population centres with a population between 1,000 and 99,999 people; a school was defined as being in a rural location if it was located outside a population centre of less than 1,000 people or in a region with a residential density of less than 400 people per square km.

Analyses

Survey weights were used in all analyses to adjust for non-response between provinces and groups, thereby minimizing any bias caused by differential response rates across regions or groups. Weighted descriptive analyses of active commuting rates were examined by province, by grade and by sex. Generalized linear mixed models using proc glimmix analysis were used to explore the association between active or mixed commuting and the predictor correlates, while adjusting for clustering within schools. The statistical package SAS 9.2 was used for all analyses.

RESULTS

Descriptive statistics

Among Canadian youth in grades 6 to 12 in 2010, 52.2% (n=1,420,000) were inactive commuters, 22.1% (n=600,900) were active commuters and 25.7% (n=699,400) were mixed commuters. As shown in Table 1, males were more likely than females to actively commute (χ^2=37.08, df=2, p<0.001). Students attending a school in an urban location were more likely to actively commute than students attending a school in a suburban or rural location (χ^2=397.96, df=4, p<0.001).There were also differences identified across Canadian regions (see Figure 1). For instance, the highest prevalence of youth who commute actively was in British Columbia (30.3%) and Ontario (26.4%), whereas, Atlantic Canada (9.8%) and Quebec (15.1%) had the lowest rates of active commuting.

Factors associated with active commuting

As shown in Table 2 (Model 1), male students were more likely than female students to actively commute (OR=1.45, 95% CI 1.44-1.45). Low sedentary students were more likely to be active commuters compared to those who were highly sedentary (OR=1.20, 95% CI 1.16-1.24). Current smokers also had a higher likelihood of being active commuters compared to non-smokers (OR=1.64, 95% CI 1.63-1.66). Compared to grade 6 students, students in grade 7 (OR=1.10, 95% CI 1.08-1.11), grade 8 (OR=1.03, 95% CI 1.02-1.05), grade 9 (OR=1.25, 95% CI 1.23-1.27) and grade 10 (OR=1.06, 95% CI 1.04-1.08) were more likely to commute actively, whereas students in grade 11 (OR=0.86, 95% CI 0.84-0.87) and grade 12 (OR=0.73, 95% CI 0.71-0.74) were less likely to actively commute. Overweight/obese youth were less likely than normal weight youth to actively commute (OR=0.82, 95% CI 0.82-0.83). Students attending a school in a rural location were less likely to be active commuters compared to students attending a school in an urban

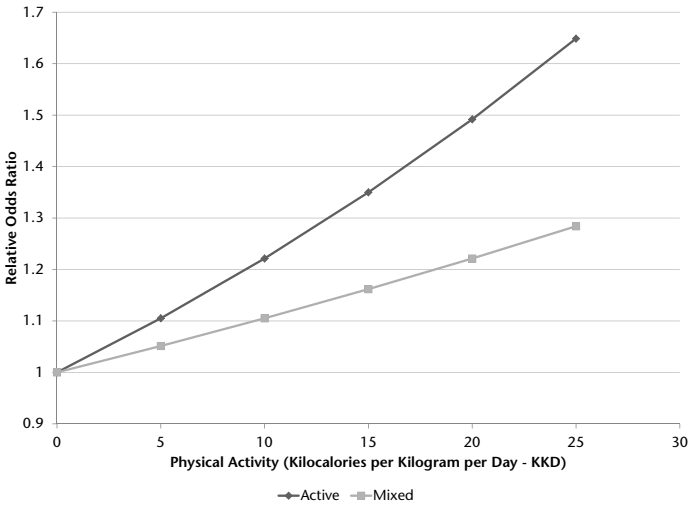

Figure 2. Model-based estimated odds ratio for being an active versus inactive commuter and a mixed versus inactive commuter as a function of physical activity
Using the model estimates, the odds of a student being an active commuter or a mixed commuter relative to an inactive commuter can be estimated as a function of the student's physical activity level [kilocalories per kilogram per day (KKD)]. In this figure, the model-based odds ratio of a student being an active commuter or a mixed commuter relative to an inactive commuter are presented as a function of different levels of physical activity (e.g., a low active youth expending 1 KKD compared to a highly active youth expending 25 KKD).

location (OR=0.15, 95% CI 0.06-0.38). As shown in Figure 2, as the amount of PA increases, the relative odds of being an active commuter increase.

Factors associated with mixed commuting

As shown in Table 2 (Model 2), male students were more likely than female students to be mixed commuters (OR=1.09, 95% CI 1.09-1.10). Former smokers were more likely to be mixed commuters than non-smokers (OR=2.08, 95% CI 2.04-2.11). Compared to grade 6 students, students in grade 7 (OR=1.41, 95% CI 1.39-1.43), grade 8 (OR=1.16, 95% CI 1.14-1.17), grade 9 (OR=1.23, 95% CI 1.21-1.25), grade 10 (OR=1.22, 95% CI 1.20-1.24) and grade 11 (OR=1.08, 95% CI 1.06-1.09) were more likely to be mixed commuters, whereas students in grade 12 were less likely to be mixed commuters (OR=0.86, 95% CI 0.85-0.88). Overweight/obese youth were less likely than normal weight youth to be mixed commuters (OR=0.86, 95% CI 0.85-0.88). Low sedentary students were less likely to be mixed commuters compared to highly sedentary students (OR=0.54, 95% CI 0.52-0.56). Students attending a school in a rural location were less likely to be mixed commuters compared to students attending a school in an urban location (OR=0.26, 95% CI 0.13-0.55). As shown in Figure 2, as the amount of PA increases, the relative odds of being a mixed commuter increases.

DISCUSSION

Using nationally representative data, we found that a majority of Canadian students in grades 6 to 12 commute to school using inactive modes of transportation; only roughly 1 in 5 Canadian students reported actively commuting to school. This is consistent with previous research that identified that more than half of students in a large sample of Ontario high schools commuted using inactive forms of transportation.[8] Given that the majority of Canadian youth are not currently active commuters, these results suggest that there is ample opportunity to intervene with programs and policies designed to promote active commuting among youth populations in Canada. As a first step, it will be important to identify the underlying facilitators or barriers to active commuting in order to develop appropriate interventions.

As expected, PA was found to be positively associated with active and mixed commuting.[7,8,24-26] However, given that the temporal relationship between active commuting and PA has yet to be determined, it is important for future research to identify if there is a causal association between PA and active commuting, and to determine if PA is the antecedent to active commuting or if active commuting is the antecedent to kids being more physically active. Longitudinal data from the COMPASS study can be used to examine such relationships within the Canadian context moving forward.[27] Such insight would be valuable for developing future obesity prevention and activity promotion interventions for youth.

We also identified that low sedentary students were more apt to commute actively. This finding was contrary to the existing evidence,[8] which previously reported that there was no association between sedentary behaviour and active commuting. Our new finding with this nationally representative sample suggests that it is possible that students may be less sedentary if they actively commute, possibly due to reducing the amount of time available to participate in sedentary pursuits before or after school. Additional research is required to determine the nature of the relationship between active commuting and sedentary behaviour. If interventions designed to promote and sustain active commuting have an additional benefit of reducing the amount of time youth spend in sedentary behaviour, this would be important knowledge moving forward, especially as research has previously identified youth sedentary behaviour as a public health concern in Canada.[28]

Unlike previous research which identified that youth smokers were less likely to actively commute,[8] we identified that being a current smoker was associated with an increased likelihood of being an active commuter. While it cannot be determined with these data, it is possible that youth smokers may use the time when actively commuting back and forth from school to smoke, especially since students in many jurisdictions (e.g., Ontario) are not allowed to smoke on school property and many youth smokers report that their parents do not know they smoke.[29] Further research is needed to understand the association between smoking and active commuting as it may have implications for tobacco control prevention programming (i.e., developing and testing interventions to dissuade youth from smoking during the commute to and from school). It would also be beneficial to understand why non-smokers are less likely to actively commute than smokers so that appropriate interventions can be developed to promote more active commuting among this subpopulation of youth.

The current study also identified some non-modifiable factors that were associated with being an active or mixed commuter. For instance, girls and older students (Grades 11 and 12) were less likely to commute actively than boys and younger students (Grades 6-10). Similar patterns were also observed among mixed commuters versus inactive commuters. Higher rates among boys of walking to and from school may be reflective of social tendencies of parents to

be more protective of girls and to place greater restrictions upon their mobility.[9] Although it cannot be determined with these data, the finding that active commuting declined among youth in older grades may be reflective of the acquisition of a driver's license in later grades, which increases vehicle access for students and peers within their social group.[9,30] Additionally, regional differences in the size and location of middle and high schools may result in their not being as accessible by active modes of transportation.[9,30] However, this finding is not surprising considering that students in rural schools would tend to live farther away from school, making it more likely they will use inactive forms of transportation. The research community interested in promoting active commuting may have to determine that active commuting interventions may not be as relevant or appropriate for rural or suburban settings, or will need to develop interventions that are feasible and practical within the rural context. Given that some youth in rural and suburban settings do report being active commuters (see Table 1), additional research could explore how or why such youth are able to commute actively.

Several limitations of this study must be considered. Because no data on socio-economic status were collected, we were unable to measure how active commuting may vary across different socio-economic groups. Furthermore, we were unable to determine how far students lived from schools, so we were not able to model the impact that distance to school would have on active commuting. In addition to lack of information on distance to school, we did not have detailed information about the walkability characteristics of different neighbourhoods which may impact the likelihood of actively commuting to school. Distance to school may be an important mitigating factor for large levels of inactive commuting among the rural population. Furthermore, we did not address the impact of school board bussing policy on high school student populations. The use of single-item questionnaires also limits the breadth of data (e.g., mode of commuting, time, frequency) collected. Additionally, causal relationships cannot be inferred from these cross-sectional data.

Despite these limitations, our findings highlight that few Canadian students consistently use active transportation as a means of getting to and from school. While active commuting may be considered a simple and cost-effective method for increasing PA levels among youth populations, we identified both modifiable and non-modifiable characteristics amenable to future intervention that are associated with both increased and decreased likelihoods of being an active or mixed commuter. Future research should evaluate whether active commuting has a meaningful population-level impact on obesity prevention among youth populations.

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RÉSUMÉ

OBJECTIFS : Étant donné le lien entre les déplacements actifs et l'activité physique, cette étude porte sur les facteurs associés aux déplacements actifs dans un échantillon représentatif national de jeunes Canadiens.

MÉTHODE : À l'aide des données de l'Enquête sur le tabagisme chez les jeunes de 2010-2011, l'étude examine différentes formes de déplacements (actifs, inactifs, mixtes) et les facteurs associés aux déplacements mixtes ou actifs chez les élèves de la 6e à la 12e année.

RÉSULTATS : Chez les jeunes Canadiens en 2010-2011, seulement 22,1 % disaient être des navetteurs actifs et seulement 25,7 % disaient utiliser des modes de transport mixtes. Les élèves étaient plus susceptibles d'être des navetteurs actifs s'ils étaient des garçons, moins avancés dans leur parcours scolaire (6e à 10e année), de poids normal, fumeurs actuels ou vivant en zone urbaine.

CONCLUSION : Il y a d'importantes possibilités de promouvoir les déplacements actifs dans le contexte canadien, car la plupart des jeunes emploient des modes de transport inactifs. Les études futures devraient explorer les éléments sous-jacents qui facilitent ou qui font obstacle aux déplacements actifs pour pouvoir mieux comprendre les meilleurs moyens de promouvoir ce type de déplacements dans les sous-populations de jeunes (p. ex., filles, jeunes en surpoids, non-fumeurs, jeunes en milieu rural) moins susceptibles d'être des navetteurs actifs.

MOTS CLÉS : adolescent; activité physique; déplacements actifs; indice de masse corporelle; tabagisme