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Assessing Modes and Frequency of Commuting to School in Youngsters: A Systematic Review

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The first objective was to review and analyze self-reported measures used for assessing mode and frequency of commuting to and from school in youngsters (4–18.5 years old). The secondary objective was to conduct a qualitative appraisal of the identified studies. We searched five online databases: PubMed, SportDiscus, ProQuest, National Transportation Library, and Web of Knowledge. Four categories of search terms were identified: self-report, active transportation, school-aged children and school. Titles and abstracts were reviewed to determine whether the studies met the inclusion criteria. The quality of the reporting of the measures was assessed using a tailored list. The electronic search strategy produced 5,898 studies. After applying the inclusion criteria, we identified 158 studies. Sixty-three studies (39.8%) specified the question about modes of commuting to school. One hundred seven studies (67.7%) directly questioned the study subjects (i.e., children and/or adolescents). Twenty studies (12.7%) posed a valid and reliable question. The quality assessment of the self-report measures was medium. The self-report measures used in the literature for assessing commuting to school tend to be heterogeneous and make difficult interstudies comparisons. Therefore we put forward the idea of a standard question designed to elicit reliable, comparable information on commuting to school.

Keywords: healthy behavior, physical activity, adolescent, children

Active commuting to school, defined as the use of active means, such as walking or biking to and from school, may have important implications for the health of young people. Active commuting to school is an opportunity to increase children's daily physical activity (29,31,34,144). Moreover, active commuting to school has been positively associated with cardiorespiratory fitness levels, especially when biking (34,44,162), and, in some studies, with a healthier body composition (91), although it remains inconclusive.

Thus there is growing interest in active commuting to school, which is reflected in the increasing number of scientific studies published over the last several years. Some studies have looked into how best to assess modes of commuting to school, but there is still no standard definition nor tool for assessing and measuring active commuting to school (49,91). A child questionnaire seems to be the most common method of assessing the mode of commuting to school, whereas some studies use parents' estimates of their children´s frequency of walking or biking to school (49). Similarly, there is a variety of ways to determine frequency of active travel. Some studies ask about the mode of commuting to school during a usual week (17,60,61) whereas others ask about that same day (24,62) or usual mode of transport (11,33,43). The heterogeneity of research questions and methods makes it difficult to compare prevalence between studies or to investigate the relationship between active commuting and health-related outcomes, such as fitness levels, body composition or metabolic risk factors.

The main aim of this systematic review was to analyze in detail the self-report measures used for assessing modes and frequency of commuting to and from school in children, aged 4–18.5 years old. We also appraised the quality of reporting self-report measures and identified issues for measuring commuting to school in future research.

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Methods

Search Strategy

We searched PubMed, SportDiscus, ProQuest, National Transportation Library and Web of Knowledge through August 2013. Four categories of search terms were identified: self-report, active commuting, school-aged children, and school. Specific terms used in the search were obtained from previous active commuting to school

review studies (118,130), from the subject headings (MeSH list) within PubMed, and from the librarians' and researchers´ expertise, and then adapted for each database (see Supplementary File 1 for more detail). The searching strategy was: [("Question*" OR "Survey" OR "Self-Reported") and ("Travel" OR "Commuting" OR "Commute*" OR "Walkability" OR "Active transportation") and ("child*" OR "Adolescent*" OR "Youth" OR "student" OR "Pupil" OR "Pupils") and ("*school*" [Title/Abstract])]. In addition to these online databases, we also reviewed our own archives of published documents. All publications in English up to August 2013 were included.

Selection and Review Process

Once potentially relevant studies were identified, their titles and abstracts were reviewed by a member of the study team to determine whether they met the following inclusion criteria: a) focus on children and adolescents aged 4–18.5 years; b) assess active commuting to school using a self-reported measure; c) published in a peer-reviewed journal; d) written in English. We then went on to extract the following data from the studies: general characteristics of the study (i.e., authors, country and city, sample size, gender and age) and specific characteristics of the commuting to school self-report measure (See Figure 1).

Figure 1 — Characteristics of the Commuting to School Self-Report Measure

1. Commuting to school question
2. Commuting to school responses
3. Trip direction
4. Outcome
5. Recall period
6. Type of administration
7. Reliability
8. Validity

Any information lacking in the studies was requested from the authors by e-mail. The data extracted from a random selection of half of the studies was independently audited by two researchers of the study team to resolve any differences of opinion. Any disagreements were resolved through discussion among the research team.

Quality Assessment of the Question

The quality assessment of the question was done on the basis of a standardized assessment list (136). The list included eight items according to the previously mentioned characteristics of the commuting to school question. Each item was rated as "1" (it was reported) or "0" (it was not reported; see Table 1). A total quality score for each study was calculated as the sum of all the items. Studies were defined as low quality if their total score was four or lower; a score between 5 and 6 was defined as medium quality; and 7 or 8 were rated as high quality. The internal validity of the quality score was addressed by two researchers reviewing a random selection of half the studies to resolve any differences of opinion.

Results

Study Selection

The search strategy of the 5 online databases came up with a total of 5,898 studies: 121 from PubMed, 70 from SportDiscus, 4,924 from ProQuest, 391 from National Transportation Library and 392 from Web of Knowledge, of which 5,167 remained after discarding duplicates. From these 5,167 studies, 148 had titles and abstracts which met the inclusion criteria. Ten further studies were located through a manual search of our own archives. Consequently a total of 158 studies were finally included in the review.

Study Settings and Characteristics

The characteristics of the various studies identified are set out in Table 2 The studies took place in the United States (n = 36, 22.8% studies), Australia and England (n = 17 per country, 10.8%), Canada (n = 13, 8.2%), Belgium (n = 7, 4.4%), United Kingdom and Denmark (n = 5 per country, 3.2%), New Zealand, Portugal, Ireland and Norway (n = 4 per country, 2.5%), Brazil, China, Germany and Spain (n = 3 per country, 1.9%), Netherland, Philippines, Russia, Sweden and Switzerland (n = 2 per country, 1.3%) and Cyprus, Scotland, Saudi Arabia, Colombia, Bosnia and Herzegovina, Slovenia, Finland, Vietnam, Nigeria and Iran (n = 1 per country, 0.6%), thus encompassing four continents: Europe, America, Africa, Asia and Oceania. Seven of the studies were multicentre and three failed to name their location.

The sample size differed across studies. The smallest sample was 17 children, 13–15 years old (79), while the largest involved 150,147 participants, 5–14 years old (102).

Assessment of Commuting to School Self-Report Measure

1. Commuting to School Question As far as commuting to school is concerned, 63 studies (39.8%) asked the children: "How do you usually go to school?" (6,8,9,13,15–18,23,25,28–30,34,36,37,42–44,46,48,52–54,59–62,65,67,72,77,84,85,89,95,97,99,101–104,106–108,121,124–126,129,131,132,139,141,143,145,161–165,169,170) and 93 (58.9%) of the studies mentioned that commuting to school was assessed (e.g., "We asked children about their mode of commuting to school"; 1, 3–5, 7, 10–12, 19–22, 24, 26, 27, 31–33, 35, 38, 39, 41, 45, 47, 50, 51, 55–58, 63, 64, 66, 68–71, 73–76, 78–83, 86–88, 90, 93, 96, 98, 100, 105, 109, 110, 114–117, 119, 120, 122, 123, 127, 128, 133–135, 137, 138, 140, 142,

Table 1 Quality Assessment of the Questions Assessing Mode of Commuting to School

Authors	Commuting to School Question	Commuting to School Response	Trip Direction	Outcome	Recall Period	Type of Administration	Reliability	Validity	Total Score
Carlin et al.(1997)	1	0	1	1	1	1	0	0	5
Tudor-Locke et al. (2002)	1	1	1	1	1	1	0	0	6
Cooper et al. (2003)	1	1	1	1	1	1	0	0	6
Evenson et al. (2003)	1	1	1	1	1	1	0	0	6
Tudor-Locke et al. (2003a)	1	1	1	1	0	1	0	0	5
Tudor-Locke et al. (2003b)	1	1	1	1	1	1	0	0	6
Tudor-Locke et al. (2003c)	1	1	1	1	1	1	0	0	6
Cooper et al. (2005)	1	1	1	1	1	1	0	0	6
Fulton et al.(2005)	1	1	1	1	1	1	0	0	6
Heelan et al. (2005)	1	1	1	1	1	1	1	1	8
Lee and Tudor-Locke (2005)	1	0	1	0	1	1	0	0	4
Santos et al. (2005)	1	1	1	1	0	1	0	0	5
Sirard et al. (2005)	1	1	1	1	1	1	0	0	6
Al-Hazzaa (2006)	1	1	1	1	0	1	0	0	5

Table 2 Characteristics of Questions on Commuting to School

Authors	Country (City)	Sample Size and Age (y)	Commuting to School Question	Commuting to School Response	Trip Direction	Outcome	Recall Period	Type of Administration	Reliability	Validity
Carlin et al.(1997)	Australia (Melbourne and Perth)	Melbourne 3,198 (gender not reported) Perth 2,781 (gender not reported) 6–9 y	The questionnaire divided the day into four parts (before school, going to school, coming home from school and after school) and asked whether the child walked in each period	Not reported	To and from school	% mode of commuting to and from school % as pedestrian that spent £5 min	In that day	Self-reported by children and reported by parents	Not reported	Not reported
Tudor-Locke et al. (2002)	Russia	1,094 (572 males and 522 females) 7–13 y	Questions were asked to assess typical mode of commuting to school and total duration of commute	Car, walk or bicycle	To and from school	% mode of commuting to school	Usual	Reported by parents	Not reported	Not reported
Cooper et al. (2003)	England (Bristol)	114 (59 males and 55 females) 10 y	Daily travel to school was measured using a brief questionnaire asking how the children usually traveled to and from school	Car, cycle, bus and walk	To and from school	% mode of commuting to school	Usual	Not reported	Not reported	Not reported

(continued)

Table 2 *(continued)*

Authors	Country (City)	Sample Size and Age (y)	Commuting to School Question	Commuting to School Response	Trip Direction	Outcome	Recall Period	Type of Administration	Reliability	Validity
Evenson et al. (2003)	United States (North Carolina)	Middle school 2,151	*"When the weather permits, on how many days per week do you usually walk to school?"*	0–5 days	To school	% prevalence of walking and bicycling to school by number of days	Usual	Self-reported by children	Not reported	Not reported
		(1,039 males and 1,108 females), High school 2,297 (1,126 males and 1,169 females) 6–12 y	*"When the weather permits, on how many days per week do you usually ride a bicycle to school?"*							
Tudor-Locke et al. (2003a)	China (Guangxi, Guizhou, Heilongjiang, Henan, Hubei, Hunan, Jiangsu, Shong)	2,675 (1,423 males and 1,252 females) 6–18 y	Survey question focused on commuting mode to school	Motorized vehicle, bicycle, or walking	To school	% mode of commuting to school	Not reported	Self-reported by children (parents Reported for children younger than 10 y)	Not reported	Not reported
Tudor-Locke et al. (2003b)	Philippines (Metropolitan Cebu area)	1,518 (691 males and 827 females) 14–16 y	Adolescents were also asked about their habitual commuting modes to school	1) walk; 2) ride bicycle; 3) ride in/ on motorized vehicle (car, jeepney,bus, tricycle, etc.); 4) combination of 1 and 3; or 5) other	To school	% mode of commuting to school	Usual	Self-reported by adolescents	Not reported	Not reported

(continued)

Table 2 *(continued)*

Authors	Country (City)	Sample Size and Age (y)	Commuting to School Question	Commuting to School Response	Trip Direction	Outcome	Recall Period	Type of Administration	Reliability	Validity
Tudor-Locke et al. (2003c)	Philippines (Metropolitan Cebu area)	2,043 (1,053 males and 990 females) 14–16 y	Youth attending school were asked to identify usual mode of commuting to school	(1) walking (2); bicycling (3); riding a motorized vehicle (4); a combination of 1 and 3; or (5) other	To school	% mode of commuting to school	Usual	Self-reported by adolescents	Not reported	Not reported
Cooper et al. (2005)	Denmark (Odense)	323 (152 males and 180 females) 9.7 y	"How do you usually travel to school?" with a similar question for travel home	By car or motorcycle, by bus or train, by bicycle, on foot	To and from school	% mode of commuting to school	Usual	Self-reported by children	Not reported	Not reported
Fulton et al. (2005)	United States	1,395 parent-child pairs (727 males and 668 females) 9–17 y	"How do you normally get to and from school?"	Walk, ride bike, or as motor vehicle	To and from school	% mode of commuting to school	Usual	Self-reported by children	Not reported	Not reported
Heelan et al. (2005)	United States (Nebraska)	320 (gender not reported) 9–11 y	Check how they got to and from school	Walking, riding a bike, skateboarding/ scooter, bus or by car	To and from school	% mode of commuting to and from school separately	That day	Self-reported by children	Reliable (97% of concordance)	Valid (97.5% of concordance)
Lee and Tudor-Locke (2005)	United States	81 (13 males and 14 females) 11 y	"During a typical week, how many days do you walk to school?"	Not reported	To school	Not reported	Typical week	Self-reported by children	Not reported	Not reported
Santos et al. (2005)	Not reported	450 (220 males and 230 females) 12–18 y	They asked if they walked, bicycled, went by car, or went by bus to and from school	Walked, bicycled, went by car, or went by bus	To and from school	% active and passive commuting to and from school	Not reported	Self-reported by adolescents	Not reported	Not reported

(continued)

Table 2 *(continued)*

Authors	Country (City)	Sample Size and Age (y)	Commuting to School Question	Commuting to School Response	Trip Direction	Outcome	Recall Period	Type of Administration	Reliability	Validity
Sirard et al. (2005)	United States (Columbia, South Carolina)	219 (96 males and 123 females) 10 y	Each day for five consecutive school days, students were asked, "How did you get to school?" They were also asked the mode of transportation used where they went directly after school.	School bus, city bus, parent's car, other car (neighbor, relative), walk and take the bus on a single trip, walk and get driven on a single trip, bicycle, walk, and other.	To and from school	% active and passive commuting to school	Today (to school) Yesterday (from school)	Self-reported survey by children	Not reported	Not reported
Al-Hazzaa (2006)	Saudi Arabia (Riyadh)	702 males 6–14 y	Students were asked to respond to question related to how they travel to and from school	Walk or use car	To and from school	% mode of commuting	Not reported	Interview to children	Not reported	Not reported
Cooper et al. (2006)	Denmark, (Odense)	919 (447 males and 472 females) 9 and 15 y	*"How do you usually travel to school?"*	By car or motorcycle, by bus or train, by bicycle, or by foot	To school	% mode of commuting to school	Usual	Self-reported by children and adolescents	Not reported	Not reported
Evenson et al. (2006)	United States (Baltimore, MD; Columbia, SC; New Orleans, LA; Minneapolis, MN; San Diego, CA; and Tucson, AZ.)	610 girls 10–15 y	*"How many days in the past week did you walk, bike or skate to school?"*	Number of days (None, 1 day, 2–3 days, 4 days, or every day) that walk, bike or skate	To school	% active commuting to school	The past week.	Self-reported by adolescents	Reliable (k= 0.60; % agree = 74)	Not reported

(continued)

Table 2 *(continued)*

Authors	Country (City)	Sample Size and Age (y)	Commuting to School Question	Commuting to School Response	Trip Direction	Outcome	Recall Period	Type of Administration	Reliability	Validity
Kerr et al. (2006)	United States (not reported)	259 parents with children between 5–18 y	Parents reported how many days per week, in an average school week, their child walked or biked, rode in a car or school bus, or took public transportation to and from school.	Walked, biked, rode in a car, school bus or public transportation	To and from school	% active commuting to and from school	An average school week	Reported by parents	Reliable	Not reported
Merom et al. (2006)	Australia (New South Wales)	812 (160 males and 652 females) 5–12 y	"In a usual week, how does your child get to school on Monday morning?" It repeat the same question for each day of a usual week and the trip from school	walk, cycle, car or public transport	To and from school	% active commuting to school	Typical week	Reported by parents	Not reported	Not reported

(continued)

Table 2 *(continued)*

Authors	Country (City)	Sample Size and Age (y)	Commuting to School Question	Commuting to School Response	Trip Direction	Outcome	Recall Period	Type of Administration	Reliability	Validity
Timperio et al. (2006)	Australia (Melbourne)	235 (119 males and 116 females) 5–6 y 677 (316 males and 361 females) 10–12 y	Parents reported whether their child usually traveled by walking to school during a typical week since the start of the school year (not including school holidays) and how frequently (to and from school equaled two times). These questions were repeated for cycling to school.	Times per week that walk or cycle	To and from school	% active commuting to school	Typical week	Reported by parents	Reliable (Percent agreement = 73.0% for each item)	Not reported
Tudor-Locke et al. (2006)	Philippines (Metropolitan Cebu area) China. (Guangxi, Guizhou, Heilongjiang, Henan, Hubei, Hunan, Jiangsu Shong)	Philippines 1,632 (760 males and 872 females) 14–16 y Chinese 399 (202 males and 197 females) 14–16 y	They ask about type, frequency duration of commuting mode to school	Motorized vehicle, bicycle, or walking	To school	% Active commuting to school % mode of commuting to school	Usual	Self-reported by adolescents	Not reported	Not reported
Alton, Adab, Roberts and Barrett (2007)	England (Birmingham)	473 (250 males and 223 female) 9–11 y	They asked about walking frequency in the past 7 days, to or from a list of destinations.	Not reported	To and from school	% mode of commuting to school	The past week	Self-reported by children	Not reported	Valid (k = 0.59)

(continued)

Table 2 *(continued)*

Authors	Country (City)	Sample Size and Age (y)	Commuting to School Question	Commuting to School Response	Trip Direction	Outcome	Recall Period	Type of Administration	Reliability	Validity
Booth et al. (2007)	Australia (New South Wales)	2,750 (1,448 males and 1,302 females) 10–16 y	"How they travelled to school in a usual week?" "How they travelled home from school in a usual week?"	walking, train, bicycle, car, school bus, other bus, ferry or boat, and 'other'	To and from school	% mode of commuting to school	Typical week	Self-reported by children	Not reported	Valid
Cole et al. (2007)	Australia (Queensland)	559 (256 males and 293 females) 5–7 y	*"On a normal school day, what is the main form of transport your eldest primary school child uses to get to and from school?" "In the last five days, on how many days did you eldest primary school child walk or ride a bike either to or from school?"*	Not reported	To and from school	% mode of active commuting to and from school	Usual	Interview to parents	Not reported	Not reported
Dollman and Lewis (2007)	Australia	1,790 parents (821 males and 969 females) with children between 9–15 y	"How does your child usually get to/from school?"	by car, by public transport, rides a bike, walk, skateboard	To and from school	% active and passive commuting to school	Usual	Reported by parents	Not reported	Not reported

(continued)

Table 2 *(continued)*

Authors	Country (City)	Sample Size and Age (y)	Commuting to School Question	Commuting to School Response	Trip Direction	Outcome	Recall Period	Type of Administration	Reliability	Validity
Evenson et al. (2007)	United States (North Carolina)	347 (gender not reported) 9–11 y	"Was assessed by asking children each day for 1 week how they got to school and how they would get home in the afternoon."	Bus, car or track, walked, biked, skateboard / scooter / inline skate, others.	To and from school	% mode of commuting to school	A week	Self-reported by children	Reliable	Valid
Martin, Lee and Lowry (2007)	United States	7,433 parent/child pairs (3,847 males and 3,586 females) 9–15 y	Among those living _1 mile, usual number of days walking or bicycling to school was reported by the parent	0–5 days	To school	% active commuting per number of days.	Usual	Self-reported by children and reported by parents	Not reported	Not reported
McDonald (2007)	United States	In 2001, 14,553a 5–18 y	"How did [child's name] usually get to school?"	Not reported	To school	% active commuting to school	Usual	Survey member of selected household	Not reported	Not reported
McKee, Mutrie, Crawford and Green (2007)	Scotland (Dunbartonshire)	60 (24 males and 36 females) 9–10 y	Children were asked about their usual method of travel to school	Not reported	To school	Not reported	Usual	Self-reported by children	Not reported	Not reported
Mota et al. (2007)	Portugal (Aveiro District)	705 females Average age 17.7 y	Asked if they walked, bicycled, went by car, or went by bus to and from school.	Walked, bicycled, went by car, or went by bus	To and from school	% active and passive commuting to and from school % mode of commuting to and from school	Not reported	Self-reported by children	Not reported	Not reported

(continued)

Table 2 *(continued)*

Authors	Country (City)	Sample Size and Age (y)	Commuting to School Question	Commuting to School Response	Trip Direction	Outcome	Recall Period	Type of Administration	Reliability	Validity
Salmon et al. (2007)	Australia (all capital cities)	720 (354 males and 366 females) 4–13 y	Parents were asked to report their child's usual mode of transport (car, public transport, cycling, or walking) to and from school in a typical week during the current school term	Car, public transport, cycling, or walking	To and from school	% mode of commuting to and from school	Usual	Reported by parents	Reliable	Valid
Baslington (2008)	England (West Yorkshire town)	555 children (255 males and 300 females) 7–11 y 22 parents of children (2 males and 20 females)	They asked travel to and from school. The could mark different options	Pictorial representations of six transport modes	To and from school	% mode of commuting to and from school	Not reported	Self-reported by children and reported by parents	Not reported	Not reported
Beck and Greenspan (2008)	Not reported	2,274 (1,131 males and 1,143 females) 5–14 y	They asked of travel to school mode	Family car, school bus and walk (other responses was excluded by slow number of responses)	To school	% mode of active commuting to school	Usual	Self-reported by children	Not reported	Not reported
Bere et al. (2008)	Netherland (Rottherdam)	1,361 (752 males and 609 females) 12–15 y	*"How many days a week do you travel to school (1); walking (2), cycling (3), by public transport or car."*	Response categories were never, 1 day/week, 2 days/week, 3 days/week, 4 days/week, and 5 days/week.	To school	% mode of commuting to school	A week	Self-reported by adolescents	Not reported	Not reported

(continued)

Table 2 *(continued)*

Authors	Country (City)	Sample Size and Age (y)	Commuting to School Question	Commuting to School Response	Trip Direction	Outcome	Recall Period	Type of Administration	Reliability	Validity
Bringolf-Isler et al. (2008)	Switzerland (Bern and Biel)	1,031 (503 males and 528 females) 6–14 y	Parents reported how their child usually travels to and from school, during winter and summer	Walking, traveling by bicycle/ kick scooter/ inline skates, traveling by car, using bus/ tram/train or 'others'	To and from school	% mode of commuting to school	Usual	Reported by parents	Not reported	Not reported
Cooper et al. (2008)	Denmark (Odense)	384 (170 males and 214 female) 8–10 y	Usual travel to/from school was assessed	car/motorcycle, bus/train, bicycle, foot	To and from school	% mode of commuting	Usual	Self-reported by children	Not reported	Not reported
Duncan, Duncan and Schofield (2008)	New Zealand (Auckland)	1,648 (females) 5–16 y	Asked about travel mode usually used to travel to and from school	Not reported	To and from school	% mode of active commuting to school	Usual	Self-reported by children	Not reported	Not reported
Evenson et al. (2008)	United States (North Carolina)	Reliability, 52 (24 male and 28 females) 8–11 y Validity, 28 (13 male and 15 females) and their parents 8–10 y	*"How did you get to school today?" and How will you get there?*	Bus, car or truck, walked, biked, skateboard, scooter or rollerblade and other.	To and from school	% mode of commuting to school	Today	Self-reported by children (and reported by parents to validity)	Reliable (k = 0.96)	Valid (k = 0.80)
Forman et al. (2008)	Unites States (San Diego, Boston Cincinnati)	Parents of 289 (52 males and 237 females) 5–18 y Parents of 189 (91 males and 98 females) 12–18 y	They indicated whether the youth walked or cycled to school	Not reported	To school	Average of active and passive commuting to school	Not reported	Reported by parents and self-reported by adolescents	Not reported	Not reported

(continued)

Table 2 *(continued)*

Authors	Country (City)	Sample Size and Age (y)	Commuting to School Question	Commuting to School Response	Trip Direction	Outcome	Recall Period	Type of Administration	Reliability	Validity
Ham, Martin and Kohl (2008)	United States (Columbia)	49,883 (gender not reported) 5–18 y	"How did [student's name] usually get to school?"	school bus, no charge; public transportation, no charge; school bus, charge; public transportation, charge; walk or bicycle; automobile, driver; automobile, passenger; motorcycle; other	To school	% mode of commuting to school	Usual	Interview to parents and adolescents	Not reported	Not reported
Hohepa et al. (2008)	Australia, New Zealand, Fiji, and Tonga	236 (gender not reported) 12–18 y	"How they traveled to and from school on each of the previous 3 school days"	Car, bus, walk, and bike	To and from school	% Mode of commuting to and from school separately	Previous 3 school days	Self-reported by children	Not reported	Not reported
Hulley et al. (2008)	England (North West Leeds)	99 (46 males and 53 females) 5–10 y	They asked about the mode of travel to school	Car, pedestrian, cyclist and bus	To school	% mode of commuting to school	Not reported	Interview to children	Not reported	Not reported
Landsberg et al. (2008)	Germany (Kiel)	626 (328 males and 298 females) 14 y	"How do you typically get to and from school?"	(1) by walking (2), by bicycle (3), by bus (4), by car and (5) other	To and from school	% mode of commuting to school	Usual	Self-reported by children	Reliable (r = .93)	Not reported
Loucaides and Jago (2008)	Cyprus (Lemesos)	247 (124 males and 123 females) 10–11 y	Children noted how they traveled to school each morning and a further question also asked children to note their usual mode of travel to school	Walk or car	To school	% mode of commuting to school	Usual	Self-reported by children	Not reported	Not reported

(continued)

Table 2 *(continued)*

Authors	Country (City)	Sample Size and Age (y)	Commuting to School Question	Commuting to School Response	Trip Direction	Outcome	Recall Period	Type of Administration	Reliability	Validity
Martinez et al. (2008)	United States (California)	800 parents (24 males and 776 females) of children with average age 6 y	"In a typical week, how many days does your child (1)… get to school by a) walking, and b) riding in a car/bus; and (2)… get home from school by a) walking and b) riding in a car/bus?"	Walking or riding car/bus.	To and from school	Number of days a child walked to and from school	Usual	Reported by parents	Not reported	Not reported
Nelson et al. (2008)	Ireland	4,013 (2,083 males and 1,930 females) 15–17 y	The usual mode of travel was assessed using a self-report questionnaire that was completed under supervision	Not reported	To school	% mode of commuting to school	Usual	Self-reported by children	Reliable (Inter and intra test reliability = 0.7)	Not reported
Robertson-Wilson, Leatherdale and Wong (2008)	Canada (Ontario)	21,345 (10,747 males and 10,598 females) 14–18 y	*"In the last 7 days, how did you usually get to and from school"*	"actively" (e.g., walk, bike), "inactively" (e.g., car, bus), or "mixed"	To and from school	% mode of commuting to school	The past week	Self-reported by children	Not reported	Not reported
Tudor-Locke, Ainsworth and Popkin (2008)	Russia	6,780 (3,507 males and 3,273 females) 7–13 y	Questions were asked to assess the typical mode of commuting to school both to and from school.	Car, walk or bicycle	To and from school	% active commuting to school	Usual	Reported by parents	Not reported	Not reported

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Table 2 *(continued)*

Authors	Country (City)	Sample Size and Age (y)	Commuting to School Question	Commuting to School Response	Trip Direction	Outcome	Recall Period	Type of Administration	Reliability	Validity
Wen et al. (2008a)	Australia (west of Sydney)	983 (gender not reported) 10–12 y	*"How did you get to school yesterday? How did you get home yesterday?"* *"In a usual school week, how many mornings does your child go to school by each of the following ways?"* *"In a usual school week, how many afternoon does your child go to school by each of the following ways?"*	walked all the way, walked part of the way, went by car, went by bus or train, rode a bike	To and from school	% mode of commuting to and from school separately	Yesterday	Self-reported by children and reported by parents	Not reported	Not reported
Wen et al. (2008b)	Australia. (western Sydney)	1,603 (753 males and 850 females) 9–11 y	*"How did you get to school yesterday? How did you get home yesterday?*	Walked all the way, walked and caught bus or train, or by car and so on	To and from school	% mode of commuting to school	Yesterday	Self-reported by children	Reliable	Valid
Yeung, Wearing and Hills (2008)	Australia (Queensland)	318 (149 males and 169 females) 4–12 y	Asked about mode traveled to and from school	Not reported	To and from school	% active and passive commuting to school	Not reported	Reported by parents	Not reported	Not reported
Zhu, Arch and Lee (2008)	United States (Austin, Texas)	1,281 parents with children between 5–18 y	Questionnaire was developed to capture the child's typical school travel mode	Not reported	Not reported	% mode of commuting to and from school separately	Usual	Reported by parents	Not reported	Not reported

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Table 2 *(continued)*

Authors	Country (City)	Sample Size and Age (y)	Commuting to School Question	Commuting to School Response	Trip Direction	Outcome	Recall Period	Type of Administration	Reliability	Validity
Aarts, van der Goor, van Oers and Schuits (2009)	Netherland (Tilburg, Breda, 's Hertogenbosch and Roosendaal)	6,601 parents with children between 3–13 y 3,449 children (gender not reported) 9–13 y	They were asked active commuting to and from school	Not reported	To and from school	Not reported	Not reported	Self-reported by children and reported to parents	Not reported	Not reported
Babey, Hastert, Huang and Brown (2009)	United States (California)	3,983 (1,028 males and 1,955 females) 12–17 y	*"How many days in the past week did you walk, bicycle, or skateboard to school? and, how many days in the past week did you walk, bicycle, or skateboard home from school?"*	Not reported	To and from school	% active commuting to and from school	The past week	Self-reported by adolescents	Reliable	Not reported
Baig et al. (2009)	England (Birmingham)	376 (301 males and 372 females) 11–14 y	Adolescents were asked to indicate their principal mode of travel (car, bus, walking, train or cycling) to/from school in the previous 7 days and past 12 months using items from a previous study	Car, bus, walking, train or cycling	To and from school	% walking to and from school	Previous 7 days and past 12 months	Interview to children	Not reported	Not reported

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Table 2 *(continued)*

Authors	Country (City)	Sample Size and Age (y)	Commuting to School Question	Commuting to School Response	Trip Direction	Outcome	Recall Period	Type of Administration	Reliability	Validity
Bere and Bjorkelund (2009)	Norway(City of Kristians)	106 (39 males and 67females) 11–12 y	"In a matrix, the pupils filled out how many days a week they normally (1) walk (2), cycle, are driven by (3) car or (4) bus to and from school during fall, winter and spring"	Walk, cycle, are driven by car or bus	To and from school	% mode of commuting to school	Days a week in fall, winter and spring.	Self-reported by children	Reliable (Spearman between 0.95–0.82)	Not reported
Buliung, Mitra and Faulkner (2009)	Canada (Greater Toronto Area)	In 2001 to school (n = 3,137; gender not reported) a From school (n = 2,916; gender not reported) a 11–15 y	A one-day retrospective, telephone interview was used to collect travel behavior data for a single weekday in the fall of the year	Not reported	Not reported	% mode of commuting to school	A single weekday in the fall of the year.	Telephonic interview to parents	Not reported	Not reported
Bungum, Lounsbery, Moonie and Gast (2009)	United States (northern Utah community)	2,692 (1,335 males and 1,357 females) 10–15 y	"How do you usually get to and from school?"	Car, bus, walk, bicycle, or some other way	To and from school	% mode of active commuting to school	Usual	Self-reported by children	Not reported	Not reported
Chillón et al. (2009)	Spain (cities Granada, Madrid, Murcia, Santander and Zaragoza)	2,183 (1,041 males and 1,142 females) 13–18.5 y	"How do you usually travel to school?"	Car, walking, biking, bus/subway, motorcycle or other	To school	% mode of commuting to school	Usual	Self-reported by children	Not reported	Not reported
Heelan et al. (2009)	United States (Nebraska)	324 (145 males and 179 females) 5–11 y	A tool designed to capture mode of transport to and from school over a full week was used	Walking, biking, or ridding in a car or bus	To and from school	Average of active and passive commuting	A week	Self-reported by children	Reliable (97.5% concordance test-retest)	Valid (97% concordance between child and parent, 91% concordance between child report and direct observation)

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Table 2 *(continued)*

Authors	Country (City)	Sample Size and Age (y)	Commuting to School Question	Commuting to School Response	Trip Direction	Outcome	Recall Period	Type of Administration	Reliability	Validity
Hohepa et al. (2009)	New Zealand (South Auckland)	3,471 (1,666 males and 1,805 females) 12–18 y	They reported the number of trips he/she made by biking or walking to or from school over the previous five school days	Number of trips	To and from school	Average and standard deviation of active trips/week	Over the previous five school days	Self-reported by adolescents	Not reported	Not reported
Hume et al. (2009)	Australia (Melbourne)	121 children with average age of 9 y 181 adolescents with average age 14 y (142 male and 160 female)	Whether their child usually walked or cycled to/from school in a typical week	Not reported	To and from school	Average of active commuting to and from school	Typical week	Self-reported by adolescents and reported by parents of children	Reliable	Valid
Larsen et al. (2009)	Canada (Ontario)	614 (273 males and 314 female) 11–13 y	They asked about mode of transporting to and from school	Not reported	To and from school	% mode of commuting to and from school separately	Not reported	Self-reported by children	Not reported	Not reported
Mendoza, Levinger and Johnston (2009)	United States (Central District of Seattle, Washington)	653 (gender not reported) 5–11 y	"How did you get to school today?"	Walked with an adult, walked without an adult, biked, (d) by school bus, by metro bus, by carpool, and by car.	To school	% mode of commuting to school	Today	Self-reported by children	Not reported	Not reported
Panter, Jones, Van Sluijs and Griffin (2009)	England (Norfolk)	2,012 (899 males and 1113 female) 9–10 y	Usual travel mode to school	by car, by bus or train, on foot and by bike	To school	% mode of commuting to school	Usual	Self-reported by children	Not reported	Not reported

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Table 2 *(continued)*

Authors	Country (City)	Sample Size and Age (y)	Commuting to School Question	Commuting to School Response	Trip Direction	Outcome	Recall Period	Type of Administration	Reliability	Validity
Rodriguez and Vogt (2009)	United States (Michigan)	1,897 (995 males and 902 females) 7–13 y	Students were asked about their transportation behavior: today's method of getting to school	Not reported	To school	% mode of commuting to school	Today	Self-reported by children	Not reported	Not reported
Rosenberg et al. (2009)	United States (Boston, Cincinnati, and San Diego areas)	287 parents (88 males and 199 females) and 171 adolescents (gender not reported) 5–18 y	They were asked about the frequency of walking to and from school	Not reported	To and from school	% walk to school	Not reported	Reported by parents of children and adolescents and self-reported by adolescents.	Not reported	Not reported
Santos, Oliveira, Ribeiro and Mota (2009)	Portugal (Barcelos, District of Braga)	721 (359 males and 362 females) 13–18 y	*"How they usually travel to and from school"*	Walk, bicycle, car and bus	To and from school	% mode of commuting to school	Usual	Self-reported by adolescents	Not reported	Not reported
Trang, Hong, Dibley and Sibbritt (2009)	Not reported	2,684 (1,332 males and 1328 females) 11–16 y	Question about type of transportation to school	Not reported	To school	% mode of commuting to school	Not reported	Self-reported by adolescents	Not reported	Not reported
Van Dyck, Cardon, Deforche and De Bourdeaudhuij (2009)	Belgium (Izegem)	120 (47 males and 73 females) 12–18 y	The sample response the Neighborhood Physical Activity Questionnaire and the Flemish Neighborhood Environmental Walkability Scale	Not reported	Not reported	% mode of active commuting to school	Not reported	Self-reported by adolescents	Not reported	Not reported
Van Sluijs et al. (2009)	England (Bristol)	4,688 (2247 males and 2441 females) 11 y	Asked about usual travel mode to and from school	Car, walking, cycling, public transport, school bus, wheelchair and other	To and from school	% mode of commuting to school	Usual	Self-reported by children	Not reported	Not reported

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Table 2 *(continued)*

Authors	Country (City)	Sample Size and Age (y)	Commuting to School Question	Commuting to School Response	Trip Direction	Outcome	Recall Period	Type of Administration	Reliability	Validity
Zhu and Lee (2009)	United States (Austin, Texas)	2,695 (gender not reported) 5–18 y	*"On a normal day, how does your child travel from home to school (from school to home)?"*	Walk alone, walk with friends, walk with a parent/ adult, bike, School bus, public bus, and private car, including carpool	To and from school	% mode of commuting to and from school separately	A normal day	Reported by parents	Reliable	Valid
Carson, Kuhle, Spence and Veugelers (2010)	Canada (Alberta)	3,028 (1453 males and 1,575 females) students and their parents 10 y	*"Please indicate how your grade five child usually travels to and from school?"*	School bus, city bus, walks/bikes, driven, or other	To and from school	% active commuting to and from school	Usual	Reported by parents	Not reported	Not reported
Chillón et al. (2010)	Estonia (Tartu) Sweden (Stockholm area and Örebro)	2,271 (1,053 males and 1,218 females) 9–10 y and 15–16 y	*"How do you usually travel to school?"*	By car or motorcycle, by bus or train, by bicycle, and on foot	To school	% mode of commuting to school	Usual	Self-reported by children and adolescents	Not reported	Not reported
Cooper et al. (2010)	England (London)	137 (60 males and 77 females) 11 y	Usual travel mode to/from home and school was assessed	Walk, cycle, car and bus	To and from school	% mode of commuting to school	Usual	Self-reported by children	Not reported	Not reported
Da Costa and Liparotti (2010)	Brazil (Natal)	101 (57 males and 44 females) 7–12 y	Physical Activity and Food Consumption asked about commuting to school	Not reported	To school	% mode of commuting to school	Not reported	Self-reported by children	Not reported	Valid (74% concordance and k = 0.28 for physical activity items)

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Table 2 *(continued)*

Authors	Country (City)	Sample Size and Age (y)	Commuting to School Question	Commuting to School Response	Trip Direction	Outcome	Recall Period	Type of Administration	Reliability	Validity
Grize, Bringolf-Isler, Martin and Braun-Fahrlander (2010)	Switzerland	4,244 (2,247 males and 1,997 females) 6–14 y	Household members were asked to provide information on mode of transportation for all stages of a trip	Foot only, bike, public transport and any car use,	Not reported	% mode of commuting to school	Yesterday	Reported by household members	Not reported	Not reported
Johansson, Hasselberg and Laflamme (2010)	Sweden (Stockholm)	1,008 (495 males and 513 females) 13–14 y	Active commuting to and from school during the week (walking or cycling); and whether their family owned a car.	Walking, cycling and car ownership	To and from school	% active commuting to school	A week	Self-reported by children	Not reported	Not reported
Johnson et al. (2010)	United States	547 (236 males and 311 females) 12–15 y	"What was your primary mode of transportation to school during our pedometer study" and "what was your primary mode of transportation from school during our pedometer study"?	Walking, car, bus, or bicycle	To and from school	% mode of commuting % active commuting	During the pedometer study (6 days)	Self-reported by children	Not reported	Not reported

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Table 2 *(continued)*

Authors	Country (City)	Sample Size and Age (y)	Commuting to School Question	Commuting to School Response	Trip Direction	Outcome	Recall Period	Type of Administration	Reliability	Validity
Marshall et al. (2010b)	United States	1,246 (gender not reported) 5–12 y	"Please, circle the number of days last week your child travel to school using each type of transportation." "Please, circle the number of days last week your child travel from school using each type of transportation."	The number of days last week that their child traveled to- and from school via private vehicle, school bus, walking, bicycling, or another mode	To and from school	% mode of active commuting	The past week	Reported by parents	Not reported	Not reported
McDonald, Deakin and Aalborg (2010)	United States (San Francisco, California)	357 (175 males and 182 females) parents of 10–14 y	*"What is the primary way your child travels to school?"*	Walked, biked, skated, or scooted	To school	% mode of active commuting to school	Not reported	Reported by parents	Not reported	Not reported
Mendoza et al. (2010)	United States (Houston, Texas)	97 (42 males and 55 females) 9–11 y	*"How did you get to school today?" and "How did [child's name] get to school today?"*	Rode school bus, came by carpool, came by car, rode metro bus, walked with an adult, walked without an adult, or biked	To school	% mode of commuting to school	Today	Self-reported by children and reported by parents	Reliable (k = 0.97)	Valid (k = 0.52)
Nelson and Woods (2010)	Germany (Dublin)	2,159 (1,143 males and 1,016 females) 15–17 y	Usual mode of transport to school	Walking, bicycling, car, or mixed mode commuting by bus or train	To school	% mode of commuting to school	Usual	Self-reported by children	Not reported	Not reported

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Table 2 *(continued)*

Authors	Country (City)	Sample Size and Age (y)	Commuting to School Question	Commuting to School Response	Trip Direction	Outcome	Recall Period	Type of Administration	Reliability	Validity
Page, Cooper, Griew and Jago (2010)	United Kingdom city	1,300 (661 males and 639 females) 10–11 y	*"How do you usually get home from school?"*	Walk, cycle, car, bus or train	From school	% mode of commuting from school	Usual	Self-reported by children	Not reported	Not reported
Panter, Jones, Van Sluijs and Griffin (2010)	England (Norfolk)	2,012 (899 males and 1,113 females) 9–10 y	Usual travel mode to school	Car, bus or train, on foot, or bike	To school	% mode of commuting to school	Usual	Self-reported by children	Not reported	Not reported
Van Dyck, De Bourdeaudhuij, Cardon and Deforche (2010)	Belgium (Flanders)	1,281 (546 males and 735 females) 17–18 y	Transportation mode to school was queried in the questionnaire Flemish Physical Activity Questionnaire.	Walking, cycling, passive transportation	To school	% mode of commuting to school	Not reported	Self-reported by adolescents	Not reported	Valid
Voorhees et al. (2010)	United States (Baltimore, Maryland; Minneapolis/St. Paul, Minnesota; Columbia, South Carolina; Tucson, Arizona; San Diego, California; and New Orleans, Los Angeles)	890 females 11–12 y	*"During the last 7 d not including today, how many days did you walk A) to school? B) from school?"*	Response options for both questions ranged from 0 to 5 d.	To and from school	% active commuting to and from school	The past week	Self-reported by children	Not reported	Not reported
Voss and Sandercock (2010)	East of England	5,927 (3,135 males and 2,792 females) 10–15 y	*"How do you usually get to school?"*	Walk, cycle, public transport, car or other	To school	% mode of active commuting	Usual	Self-reported by children	Not reported	Not reported
Aires et al. (2011)	Portugal (Valongo)	1,708 (708 males and 919 females) 11–19 y	Participants were asked how they do commute home/school, and how much time it took.	Car, bus, train, bicycle, or walking	To and from school	% mode of commuting % passive and active commuting	Not reported	Self-reported by children	Not reported	Not reported

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Table 2 *(continued)*

Authors	Country (City)	Sample Size and Age (y)	Commuting to School Question	Commuting to School Response	Trip Direction	Outcome	Recall Period	Type of Administration	Reliability	Validity
Andersen et al. (2011)	Denmark (Odense)	384 (172 males and 212 females) 9 y	*"How do you usually travel to school?"*	By car or motorcycle, by bus or train, by bicycle, by foot	To school	% mode of commuting % passive commuting	Usual	Self-reported by children	Not reported	Not reported
Arango et al. (2011)	Colombia (Monteria)	546 (278 males and 268 females) 11–18 y	Students were asked to report, how they traveled to and from school in a usual week.	Walk, bicycle, car, bus, motorcycle, and other	To and from school	% mode of commuting % active commuting	Typical week	Self-reported by children	Reliable (k= 61–100%)	Not reported
Atikovic, Tabakovic, Cuk and Pecek (2011)	Bosnia and Herzegovina (Tuzla)	169 (79 males and 90 females) 9.7 y	*How you usually travel to / from school*	Not reported	To and from school	% mode of commuting to and from school	Usual	Self-reported by children	Reliable	Valid
Bere et al. (2011a)	Netherland (Rotterdam)	890 (475 males and 415 females)	Adolescents indicated how many days of the week they traveled to school walking, cycling, or by public transport or car	Never—five days a week: they traveled to school walking, cycling, or by public transport or car	To school	% cyclist and no cyclist to school	Usual and a week	Self-reported by adolescents	Not reported	Not reported
	Norway (Kristiansand)	13 y	*"By what mode of transportation do you usually go to school?"*	Bus, car, walking, cycling, rollerblades and scooter						
Bere et al. (2011b)	Netherland (Rotterdam)	1,361 (748 males and 713 females) 12–13 y	*How many days of the week they traveled to school (1) walking (2), cycling (3) by public transport or car*	Never to 5 days/week walking, cycling and by public transport or car	To school	% mode of commuting	A week	Self-reported by adolescents	Not reported	Not reported
	Norway (Kristiansand)	1,197 (622 males and 575 females) 14–15 y								

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Table 2 *(continued)*

Authors	Country (City)	Sample Size and Age (y)	Commuting to School Question	Commuting to School Response	Trip Direction	Outcome	Recall Period	Type of Administration	Reliability	Validity
Borrestad, Andersen and Bere (2011)	Norway (Hedmark and Telemark)	1,339 (643 males and 696 females) 10–12 y	*"How many days a week do you travel to/from school?"*	Walking, cycling, by car, or by public transport	To and from school	% mode of commuting	A week	Self-reported by children	Not reported	Not reported
Brophy et al. (2011)	United Kingdom	17,561 singleton children (gender not reported) Years not reported	Factors associated with walking to school was assessed	Not reported	To school	% walking to school	Not reported	Reported by primary carer	Not reported	Not reported
Carver et al. (2011)	Australia (Melbourne)	335 (134 males and 201 females) 5–6 y and 10–12 y	How often per week their children walked/ cycled to neighborhood destinations including school, sports facilities, shops and friends' homes	Not reported	To school	% active commuting	Not reported	Self-reported by children and reported by parents	Reliable (parents response ICC = 0.86 and children response ICC= 0.68)	Not reported
Chillon et al. (2011)	Grece (Athens and Heraklion) Germany (Dortmund), Belguim (Ghent), France (Lille), Hungary (Pecs), Italy (Rome), Sweden (Stockholm), Austria (Vienna) and Spain (Zaragoza)	3,112 (1,472 males and 1,640 females) 12.5–17.49 y	Active commuting information was assessed by self-report using questions related to transportation from the International Physical Activity Questionnaire for Adolescents	Minutes per day in vehicle (train, bus, car or tram), walking and biking for commuting were computed	Not reported	% mode of commuting	Not reported	Self-reported by children	Reliable	Valid

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Table 2 *(continued)*

Authors	Country (City)	Sample Size and Age (y)	Commuting to School Question	Commuting to School Response	Trip Direction	Outcome	Recall Period	Type of Administration	Reliability	Validity
Christie et al. (2011)	England	4,286 (2,186 males and 2,100 females) 9–14 y	Children were asked to indicate on the questionnaire, from a specified list, which places they had been to in the last week and how they had traveled from a specified list of destinations	Not reported	To and from school	% mode of commuting to and from school separately	The past week	Self-reported by children	Not reported	Not reported
Coulter and Woods (2011)	Ireland (Dublin)	663 (374 males and 289 females) 5–14 y	*"How did you travel to/from school yesterday?"*	Walk, cycle, car, or bus	To and from school	% mode of commuting to and from school separately % passive and active commuting to and from school	Yesterday	Self-reported by children	Reliable (Agreement = 76–98%)	Not reported
Cui, Bauman and Dibley (2011)	China	4,732 (gender not reported) 6–18 y	*"Do you travel to and from school this way?*	Walking, bicycle use and motorized transportation	To and from school	% passive commuting to school	Not reported	Self-reported by children	Not reported	Not reported
Cuk, Atikovic and Pecek (2011)	Slovenia	232 (122 males and 110 females) 8.7 y	A questionnaire to assess travel to and from school, including mode, travel companion, and destination after school, was used.	Not reported	To and from school	% mode of commuting to and from school separately	Not reported	Self-reported by children	Reliable	Valid

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Table 2 *(continued)*

Authors	Country (City)	Sample Size and Age (y)	Commuting to School Question	Commuting to School Response	Trip Direction	Outcome	Recall Period	Type of Administration	Reliability	Validity
D'Haese et al. (2011)	Belgium	696 parents 11–12 y	Flemish Physical Activity Questionnaire "How does your child usually go to school?"	On foot, by bike, or with motorized transport (by car, train or bus)	To school	% mode of commuting to school	Usual	Reported by parents	Not reported	Valid
Dalton et al. (2011)	United States (New Hampshire and Vermont)	1,552 (748 males and 804 females) 12–17 y	*"On average how many days a week do you walk [bike] to or from school in the [Fall/Winter/Spring]?"*	Not reported	To and from school	% active commuting	In the past 12 months.	Self-reported by adolescents	Not reported	Not reported
Hinckson, Garrett and Duncan (2011)	New Zealand (Auckland, North Shore, Waitakere and Manukau along with the rural districts of Rodney, Papakura and Franklin)	57,096 (gender not reported) 5–10 y	Travel mode to and from school that morning	Family car, friend's car, walking, cycling, walking school bus, public transport, scooter (nonmotorized) and other	To and from school	% active commuting	Today	Self-reported by children	Reliable	Valid
King et al. (2011)	England	480 (244 males and 236 females) 7 y	Child active commuting to school was assessed	Not reported	To school	Correlation between active commuting to school and physical activity	Not reported	Reported by primary carer	Not reported	Not reported

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Table 2 *(continued)*

Authors	Country (City)	Sample Size and Age (y)	Commuting to School Question	Commuting to School Response	Trip Direction	Outcome	Recall Period	Type of Administration	Reliability	Validity
Larouche, Lloyd, Knight and Tremblay (2011)	Canada	315 (gender not reported) 9–12 y	"Please circle how you get to school most of the time in the Fall/ Winter (during cold or snowy weather) and in the Spring/ Summer (during nice weather)?"	Not reported	To school	% passive and active commuting	Usual	Self-reported by children	Not reported	Not reported
Martinez-Gomez et al. (2011a)	Spain (Madrid)	2,029 (979 males and 1,050 females) 13–17 y	Adolescents reported their habitual mode of transportation to school	Walking; cycling; bus/ subway; car; or motorcycle.	To school	% mode of commuting	Usual	Self-reported by children	Not reported	Not reported
Martinez-Gomez et al. (2011b)	Spain (Granada, Madrid, Murcia, Santander, and Zaragoza)	1,700 (808 males and 892 females) 13–18.5 y	"how do you usually travel to school?"	Walking, biking, car, bus or subway, motorcycle, and others	To school	% passive and active commuting to school	Usual	Self-reported by children	Not reported	Not reported
McCormack et al. (2011)	Australia (Perth)	1,332 parents and 1,480 (720 males and 760 females) 10–12 y	Parents also reported whether their child traveled to and from school by motor vehicle	Not reported	To and from school	Not reported	Typical week	Reported by parents	Reliable (k = 0.72)	Not reported
McDonald, Brown, Marchetti and Pedroso (2011)	United States	150,147 household 5–14 y	"On most school days, how did [. . .] usually get to school?" *"How did you get to school today?"*	Not reported	To school	% mode of commuting	Usual	Self-reported by children	Not reported	Not reported

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Table 2 *(continued)*

Authors	Country (City)	Sample Size and Age (y)	Commuting to School Question	Commuting to School Response	Trip Direction	Outcome	Recall Period	Type of Administration	Reliability	Validity
McDonal et al. (2011)	United States (North Carolina)	542 (gender not reported) 5–11 y	"How did you get to school yesterday?" and "How did you get home from school yesterday?"	Walk, bicycle, school bus, family vehicle, carpool or other	To and from school	% mode of commuting to school	Yesterday	Self-reported by children	Reliable	Valid
Meron, Rissel, Reinten-Reynolds and Hardy (2011)	Australia (New South Wales)	7,023 (3,756 males and 3,267 females) 11–16 y	Students were asked how they traveled to and from school on each day in a usual week	Walk, cycle, skateboard or scooter, driven by car, take the bus, or train or ferry/boat with additional "other" options	To and from school	% passive and active commuting to and from	Usual	Self-reported by children	Not reported	Not reported
Murtagh and Murphy (2011)	Ireland (Limerick City)	140 (85 males and 55 females) 9–11 y	Children were asked how they usually traveled to and from school	Car, motorcycle, bus, train, bicycle and walking	To and from school	% mode of commuting % passive and active commuting to school	Usual	Self-reported by children	Not reported	Not reported
Pabayo, Gauvin and Barnett (2011)	Canada	7,690 (3,918 males and 3,772 females) 5–12 y	Parents were asked how their child usually gets to school	School bus, using public transit, walking or bicycling, being driven, or using multiple modes	To school	% active commuting to school	Usual	Reported by parents	Not reported	Not reported

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Table 2 *(continued)*

Authors	Country (City)	Sample Size and Age (y)	Commuting to School Question	Commuting to School Response	Trip Direction	Outcome	Recall Period	Type of Administration	Reliability	Validity
Silva et al. (2011)	Brazil (Caxias do sul)	1,672 (783 males and 889 females) 11–17 y	*"What is the mode of transport that you usually use to go to school?"* "How many days a week do you usually go to the school by foot or bike?"	Walk, bike, bus, motorcycle, car, other	To school	% active and passive commuting	Usual	Self-reported by children	Reliable (ICC = 0.88)	Not reported
Trapp et al. (2011)	Australia	1.197 (573 males and 624 females) 10–13 y	Children kept a 5-day travel diary indicating their mode of transport to and from school on each day of the school survey week	Not reported	To and from school	% number of trips by mode of commuting to and from school	A week	Self-reported by children	Not reported	Valid
Wong, Faulkner, Buliung and Irving (2011)	Canada (Ontario)	3,568 (1,692 males and 1,876 females) 12–18 y	*'How do you usually travel i) to and ii) from school?'*	Not reported	To and from school	% active and passive commuting to and from	Usual	Self-reported by adolescents	Not reported	Not reported
Zhu, Lee, Kwok and Varni (2011)	United States (Texas)	680 parents (gender not reported) Years not reported (children in school age)	*"On a normal day, how does your child travel from home to school (from school to home)?"*	Walking alone, walking with friends, walking with a parent /adult, school bus, public bus and private car, including carpool	To and from school	% walking to and from school	A normal day	Reported by parents	Reliable (k = 0.72)	Not reported

(continued)

Table 2 *(continued)*

Authors	Country (City)	Sample Size and Age (y)	Commuting to School Question	Commuting to School Response	Trip Direction	Outcome	Recall Period	Type of Administration	Reliability	Validity
Borrestad, Ostergaard, Andersen and Bere (2012)	Norway	78 (36 males and 42 females) 10–12 y	Information about commuting were assessed by a matrix, the pupils filled out how many days a week they normally I) walk, 2) cycle, 3) are driven by car, or 4) bus to and from school during fall season	Walk, cycle, are driven by car, or bus	To and from school	% mode of active commuting to school	A week	Self-reported by children	Not reported	Not reported
Chillon et al. (2012)	Sweden	262 (120 males and 142 females) 9 y at entry	*"How do you usually travel to school?"*	By car or motorcycle, by bus or train, by bicycle, and on foot	To school	% active and passive mode of commuting to school	Usual	Self-reported by adolescents	Reliable	Valid
Cleland, Dwyer and Venn (2012)	Australia	6,412 (gender not reported) 9–15 y	Participants self-reported past week duration and frequency of walking and cycling to and from school	Number of days that walk or cycling	To and from school	Not reported	The past week	Self-reported by adolescents	Not reported	Not reported

(continued)

Table 2 *(continued)*

Authors	Country (City)	Sample Size and Age (y)	Commuting to School Question	Commuting to School Response	Trip Direction	Outcome	Recall Period	Type of Administration	Reliability	Validity
Cooper, Jago, Southward and Page (2012)	United Kingdom	1,307 (gender not reported) 11 y	*"How do you usually travel to (alternatively from) school?"*	By car or motorcycle, by bus, by bicycle, and by foot	To and from school	% mode of commuting to school	Usual	Self-reported by children	Not reported	Not reported
Costa et al. (2012)	Brazil (Florianopolis)	1,232 (gender not reported)	They were asked to indicate their main mode of transportation to school on a usual weekday.	Walking, cycling, car, motorcycle, bus	To school	% mode of commuting to school	Usual and yesterday	Self-reported by children	Not reported	Valid
		7–10 y 1,594 (gender not reported) 7–15 y	Asked to indicate the mode of transport used on the previous day rather than how they usually traveled to school							
Cui et al. (2012)	China (Beijing)	682 (353 males and 329 females) 12 y	Commuting to and from school was recorded using a 4-item scale, including walking, cycling, public transportation and picking up by parents	Not reported	To and from school	Not reported	Not reported	Reported by parents	Not reported	Valid
De Meester et al. (2012)	Belgium (Ghent)	637 (316 males and 321 females) 13–15 y	The Flemish Physical Activity Questionnaire was used	Time of walking or cycling	To and from school	% active commuting to and from school	Not reported	Self-reported by children	Reliable	Valid

(continued)

Table 2 *(continued)*

Authors	Country (City)	Sample Size and Age (y)	Commuting to School Question	Commuting to School Response	Trip Direction	Outcome	Recall Period	Type of Administration	Reliability	Validity
de Wit, Loman, Faithfull and Hinckson (2012)	New Zealand (Auckland)	118 (gender not reported) 7.1 y	*"How did you get to school this morning?"* *"How did your son/ daughter get to school this morning?"*	Car, bus, bike, scooter / skateboard, walking, walking school bus, or a mixed mode of transport.	To school	% mode of commuting	This morning	Self-reported by children and reported by parents	Reliable (k = .96, 95% CI = 0.92–1.00)	Valid (k = .91, 95% CI = 0.85–0.98)
Drake et al. (2012)	United States (New Hampshire and Vermont)	1,718 (849 males and 869 females) 9–12 y	*"On average, how many days a week do you [walk/ bike] to or from school in the [fall/ winter/ spring]?"*	Number of days walking or cycling	To and from school	% active commuting to school Average days per week of active commuting to school	fall/winter/ spring	Self-reported by children	Not reported	Valid
Ducheyne, De Bourdeaudhuij, Spittaels and Cardon (2012)	Belgium (Flanders)	850 parents (432 males and 418 females) with children between 8–13 y	How many days a week their child (1) walked (2), cycled, was (3) driven by car or (4) public transport to and from school during fall, winter and spring	Number of days walking, cycling, driving by car o public transport	To and from school	% mode of commuting to school	fall/winter/ spring	Reported by parents	Reliable	Not reported
Durand, Dunton, Spruijt-Metz and Pentz (2012)	United States (San Bernardino Gounty, California),	365 families (one parent and one child 9–14 y)	How they usually get to and from school	Walking, skating, biking, car, and bus.	To and from school	% active commuting to school	Usual	Self-reported by children	Not reported	Not reported
Kelly et al. (2012)	England	17 (6 males and 11 females) 13–15 y	Participants completed a daily researcher-administered travel questionnaire on journey mode and duration	Not reported	Not reported	% mode of commuting	Not reported	Self-reported by adolescents	Not reported	Not reported

(continued)

Table 2 *(continued)*

Authors	Country (City)	Sample Size and Age (y)	Commuting to School Question	Commuting to School Response	Trip Direction	Outcome	Recall Period	Type of Administration	Reliability	Validity
Kytta, Broberg and Kahila (2012)	Finland (Turku)	1,837 (937 males and 900 females) 10–15 y	The mode of school travel was studied by asking how the child most often travels to and from school during the ongoing week	On foot, by bicycle, by bus, by car, or other mode	To and from school	Odds ratios of active commuting with BMI, Daily symptoms and perceived health	The ongoing week	Self-reported by adolescents	Reliable	Not reported
Larsen, Gilliland and Hess (2012)	Canada (London, Ontario)	614 (273 males and 314 females) 12–14 y	The questionnaire completed by students asked the method of travel for both the to-school and from-school trip	Not reported	To and from school	% modeof commuting to and from school separately	Not reported	Self-reported by adolescents	Not reported	Not reported
Mammen, Faulkner, Buliung and Lay (2012)	Canada (Toronto, Hamilton, Peel, Durham, York and Halton)	1,016 parents with children between 6–14 y	Parents were asked to report how their child usually travels to/from school	Driven by a member of the household or family member, driven- as part of a carpool with neighbors or friends, by school bus, by public transit-bus, by public transit-subway or streetcar, by walking, by cycling, and other	To and from school	% active commuting to school	Usual	Reported by parents	Not reported	Not reported

(continued)

Table 2 *(continued)*

Authors	Country (City)	Sample Size and Age (y)	Commuting to School Question	Commuting to School Response	Trip Direction	Outcome	Recall Period	Type of Administration	Reliability	Validity
Mitra and Faulkner (2012)	Canada (Toronto)	1,992 (1,052 males and 940 females) 11–12 y	Data were collected for a randomly selected weekday in fall or winter; an adult household member proxy reported travel data (e.g., primary travel mode)	Not reported	Not reported	% mode of commuting	A weekday	Reported by an adult household member	Not reported	Not reported
Ostergaard et al. (2012)	Denmark (Odense)	3,847 (1,860 males and 1,987 females) 12–16 y	Transport to school, was determined from a question on whether the participant was walking to school or if he/she came by bicycle, moped, car, or bus/taxi the respective day the survey was conducted	Walking, cycling, moped, car, or bus/taxi	To school	% mode of active commuting % passive commuting to school	Today	Self-reported by children	Not reported	Not reported
Owen et al. (2012)	United Kingdom (London, Birmingham and Leicester)	2,035 (974 males and 1,061 females) 9–10 y	*"How do you usually travel to school?"*	By car, by bicycle, By bus or train or walking	To school	% mode of commuting to school	Usual	Self-reported by children	Not reported	Not reported
Pabayo et al. (2012a)	Canada (Quebec)	710 (343 males and 367 females) 6 y	Parents were asked how their child usually gets to school.	Response options were categorized as school bus, public transit, walking/bicycling, is driven, or uses multiple modes	To school	% active and passive commuting to and from school	Usual	Reported by parents	Reliable (k= 0.80)	Valid (k= 0.80; mean percent agreement= 88.4%)

(continued)

Table 2 *(continued)*

Authors	Country (City)	Sample Size and Age (y)	Commuting to School Question	Commuting to School Response	Trip Direction	Outcome	Recall Period	Type of Administration	Reliability	Validity
Pabayo et al. (2012b)	Canada (Alberta)	688 (318 males and 370 females) 10–11 y	*"Please indicate how your grade five child usually travels to and from school?"*	School bus, city bus, walks/bikes, drive, or other.	To and from school	% active and passive commuting to school % mode of commuting to and from school separately	Usual	Reported by parents	Not reported	Not reported
Roth, Millett and Mindell (2012)	England	4,468 (2,233 males and 2,235 females) 5–15 y	How many days the child had been to school in the previous 7 days; if they had walked or cycled to and/or from school on any of those days; if so, the number of days they walked or cycled and the duration of this journey	Number of days walked or cycled	To and from school	% mode of active commuting % passive commuting to and from school	Previous 7 days	Reported by parents	Not reported	Valid
Sandercock and Ogunleye (2012)	England	6,819 (3,614 males and 3,205 females) 6–16 y	*"How do you usually get to school?"*	Walking, cycling, by car, by bus or by train.	To school	% active and passive commuting	Usual	Self-reported by adolescents	Not reported	Not reported
Seraj et al. (2012)	United States (California)	1,000 parents of school aged child	2009 National Household Travel Survey ask on the attitudes of parents toward their children walking and bicycling to school	Not reported	To and from school	% mode of commuting to and from school separately	Not reported	Reported by parents	Not reported	Not reported

(continued)

Table 2 *(continued)*

Authors	Country (City)	Sample Size and Age (y)	Commuting to School Question	Commuting to School Response	Trip Direction	Outcome	Recall Period	Type of Administration	Reliability	Validity
Smith et al. (2012)	England	812 (333 males and 479 females) 9–10 y	*"How do you usually travel to school?"*	Car, bus or train, walk, or bike	To school	% mode of commuting	Usual	Self-reported by children	Not reported	Not reported
Southward, Page, Wheeler and Cooper (1012)	England (Bristol)	141 (gender not reported) 11–12 y	Travel mode to/from school was reported in a travel diary	Walk, cycle, car or bus	To and from school	Not reported	Not reported	Not reported	Not reported	Not reported
Trang, Hong and Dibley (2012)	Vietnam (Ho Chi Minh)	759 (364 males and 395 females) 11.8 y	Participants were asked if they were driven, took a bus/minibus, motor-biked, or biked or walked to and from school every week-day,	Were driven, took a bus/minibus, motor-biked, or biked or walked	To and from school	% active commuting to school % mode of commuting to school	Every week-day	Self-reported by children	Not reported	Valid
Trapp et al. (2012)	Australia (Perth)	617 males 10–13 y 681 females 9–13 y	Children kept a 5-day travel diary indicating their mode of transport to and from school during the week of the survey	Not reported	To and from school	% mode of commuting to and from school	5 days	Self-reported by children	Not reported	Valid
Yang and Markowitz (2012)	United States (Lane country, Oregon)	1,197 parents 5–11 y	The survey included questions about children's school travel behavior	Not reported	Not reported	% mode of commuting to school	Not reported	Reported by parents	Not reported	Not reported

(continued)

Table 2 *(continued)*

Authors	Country (City)	Sample Size and Age (y)	Commuting to School Question	Commuting to School Response	Trip Direction	Outcome	Recall Period	Type of Administration	Reliability	Validity
De Meester et al. (2013)	Belgium (Ghent)	637 (315 males and 322 females) 13–15 y	The Flemish Physical Activity Questionnaire was used	Time of walking or cycling	To and from school	% active commuting to and from school	Not reported	Self-reported by adolescents	Reliable	Valid
Ducheyne et al. (2013)	Belgium (Flanders)	93 (46 males and 47 females) 9.17 y	Parents were asked about their child's mode of transportation to school	Number of days walked, cycled, was driven by car or public transport	To school	Not reported	Not reported	Reported by parents	Reliable	Not reported
Foty et al. (2013)	Canada (Toronto)	5,342 (2,660 males and 2,682 females) 5–9 y	The primary outcome was the mode of transportation to school	Walks, driven by car, or driven by school bus	To school	% mode of commuting to school	Not reported	Self-reported by children	Not reported	Not reported
Ipingbemi and Aiworo (2013)	Nigeria (Benin)	373 (gender not reported) 11–17 y	The questionnaire ask information on travel patterns to school and mode of transport	Not reported	To school	% mode of commuting to school	Not reported	Self-reported by adolescents	Not reported	Valid
Kamruzzaman and Hine (2013)	Ireland	1,331 (738 males and 593 females) Primary and secondary pupils	Determinants of mode choice behavior were identified only for those modes that were found to have a larger share of the overall commuting behavior and included car, bus, and walk	Car, bus, and walk	Not reported	% mode of commuting	Not reported	Self-reported by adolescents	Not reported	Valid

(continued)

Table 2 *(continued)*

Authors	Country (City)	Sample Size and Age (y)	Commuting to School Question	Commuting to School Response	Trip Direction	Outcome	Recall Period	Type of Administration	Reliability	Validity
Kuhnis et al. (2013)	Liechtenstein (Liechtenstein) and Swiss (Canton of Schwyz)	418 (199 males and 219 females) Average 10 y	Commuting to and from school (daily duration, frequency and mode of transport) was operationalized by using a weekly diary	Not reported	To and from school	% active commuting to school	Not reported	Self-reported by children	Not reported	Not reported
Lee, Zhu, Yoon and Varni (2013)	United States (Austin,Texas)	601 child pairs	The surveys included items related to school travel mode and physical activity behaviors	Not reported	To school	% walker and driver	Not reported	Self-reported by children	Reliab (0.998 averaging ICCs and k mean of 0.718)	Not reported
Ostergaard et al. (2013)	Norway	1,694 (883 males and 811 females) 9 and 15 y	Two questions regarding usual transport mode to and from school was used	Walker, cyclist, by car, by motorcycle or by bus/train	To and from school	% mode of active commuting to school % passive commuting to school	Usual	Self-reported by children and adolescents	Not reported	Not reported
Panter et al. (2013)	United Kingdomn (Norfolk)	912 (373 males and 539 females) 10.2 y	*"How do you normally travel to school?"*	By foot, by bike, by car, by bus or by train	To school	% mode of commuting to school	Usual	Self-reported by children	Not reported	Not reported

(continued)

Table 2 *(continued)*

Authors	Country (City)	Sample Size and Age (y)	Commuting to School Question	Commuting to School Response	Trip Direction	Outcome	Recall Period	Type of Administration	Reliability	Validity
Pizarro et al. (2013)	Portugal (Porto)	229 (108 males and 121 females) 11–13 y	*"How do you usually travel to school?" and "How do you usually travel from school?"*	Walking, cycling, by car or by public transport.	To and from school	% active commuting % mode of commuting	Usual	Self-reported by children	Reliable	Valid
Reimers et al. (2013)	Germany	1,828 (938 males and 890 females) 11–17 y	*"How do you usually get to school"*	On foot, by bike, by bus or train, by car, and by motorbike or motorized scooter	To school	% mode of commuting to school	Usual	Self-reported by children and adolescents	Reliable (k=.92; p < .001)	Not reported
Samimi and Ermagun (2013)	Iran (Tehran)	3,441 (1,387 males and 2,054 females)	The modes of transportation selected by students throughout the week regarding transportation both to and from school were asked.	Not reported	To and from school	% active commuting to and from school	A week	Self-reported by adolescents	Not reported	Not reported

aThe highest sample size was included when several sample sizes were reported in a study k; kappa

146–160, 166–168). Two studies (1.3%) reported the exact question and mentioned that commuting to school was assessed (14,144).

2. Commuting to School Responses. Responses to the "commuting to school" question were reported in five different ways: a) modes of commuting to school (i.e., by car, on foot, by bicycle; *n* = 98, 62.1%; 3, 4, 6, 7, 10–13, 17–20, 23, 25, 29–37, 42–44, 46, 50–53, 58, 59, 62, 64–70, 72, 73, 76–78, 80, 83, 84, 90, 93, 97–99, 103, 104, 106–109, 114, 115, 117, 119–129, 131, 132, 137, 139–141, 143–146, 148, 152–157, 159, 160, 162–164, 169, 170); b) frequency of commuting to school (e.g., 3 times per week; *n* = 5, 3.2%; 16, 61, 71, 96, 161); c) both mode and frequency (n = 10, 6.3%; 14, 15, 27, 54–56, 60, 95, 135, 147); d) duration of commuting (n = 1, 0.6%; 41) and e) failed to report an answer (*n* = 44 27.8%; 1, 5, 8, 9, 21, 22, 24, 26, 28, 38, 39, 45, 47, 48, 57, 63, 74, 75, 79, 81, 82, 85–89, 100–102, 105, 110, 116, 133, 134, 138, 142, 149–151, 158, 165–168).

3.Trip Direction. Assessing commuting behavior can be based on either the trip to or from school or both. Studies either reported commuting mode, frequency, and other characteristics of both routes (*n* = 90, 57.0%; 1, 3–5, 7–11, 13, 17–20, 23–25, 27–33, 36–39, 45, 48, 50, 51, 53, 54, 56–59, 62, 65, 68–72, 74, 76, 77, 80, 82–84, 86, 87, 93, 95, 99, 100, 104, 108, 109, 114, 115, 120, 124, 129, 132, 134, 135, 137, 138, 140–142, 144, 146–148, 150, 151, 156, 157, 160, 161, 163–165, 167, 169, 170); solely the route to school (n = 58, 36.7%; 6, 12, 14–16, 21, 26, 34, 35, 42–44, 46, 47, 52, 55, 60, 61, 63, 64, 67, 73, 75, 81, 85, 88–90, 96–98, 101–103, 105–107, 116, 117, 119, 121–123, 126–128, 131, 133, 139, 143, 145, 149, 152–155, 159, 162); the route from school only (*n* = 1, 0.6%; 125); or did not report any route information (*n* = 9, 5.7%; 22, 41, 66, 78, 79, 110, 158, 166, 168).

4. Outcome. Most studies reported the prevalence of commuting to school (*n* = 144, 91.1%), although these were expressed in different ways (e.g., percentage by commuting mode, percentage of active versus passive travel). The percentage of commuting by modes was reported in 51 studies (32.3%; 5, 13, 16, 17, 20, 22, 29–32, 34, 35, 43, 44, 46, 47, 56, 59, 62, 64–67, 73, 75, 84, 90, 104, 106, 107, 116, 117, 121, 126–128, 131–133, 141, 148, 149, 152–155, 157, 159, 160, 164, 166). The percentage of active commuters to school (without specifying the mode) was reported in 12 studies (7.6%; 58, 60, 76, 82, 93, 101, 108, 122, 147, 148, 152, 156) . The percentage of active modes of commuting to school stratified by mode was reported in 7 studies (4.4%; 12, 19, 23, 57, 103, 120, 158); the percentage of modes of commuting to and from school separately was reported in 12 studies (7.6%; 36, 39, 45, 68, 72, 86, 87, 124, 142, 163, 168, 169); the percentage of mode of commuting without specifying the trajectory to or from school was reported by 18 studies (11.4%; 3, 4, 6, 7, 15, 18, 33, 41, 52, 77–79, 98, 102, 110, 115, 129, 145); the percentage of active and passive commuting to and from school was reported by 7 studies (4.4%; 36, 109, 114, 123, 124, 140, 165), and the percentage of active commuting to and from school was reported by 7 studies (4.4%; 9, 25, 50, 51, 80, 138, 161).

5. Recall Period. With regard to the recall period, the terms usual, normal, typical and habitual were compiled as usual. Sixty-five studies (41.1%) asked for usually (6,8,12,14,20,23,25,28–35,42–44,46,53,57,58,61,65,67,84,85,90,93,96–99,101,102,105,109,115–117,120–129,131,137,139,141,143,145,152,154–157,160,162,165,168). Other recall periods were a week (*n* = 10, 6.3%; 14–16, 18, 19, 59, 69, 76, 138, 150), that day or today (*n* = 9, 5.7%; 24, 62, 68, 70, 106, 107, 119, 133, 144), the past week (*n* = 8, 5.0%; 5, 9, 27, 45, 60, 95, 132, 161), a typical week (*n* = 7, 4.4%; 7, 17, 74, 89, 100, 108, 147) and yesterday (*n* = 7, 4.4%; 35, 36, 66, 104, 144, 163, 164). The less frequent recall periods were previous 3, 5 or 7 days (*n* = 4, 2.5%; 10, 71, 72, 135), during season (*n* = 4, 2.5%; 13, 22, 54, 56), during 5 or 6 days (*n* = 2, 1.3%; 77, 151), the past 12 month (*n* = 2, 1.3%; 10, 48), a normal day (*n* = 2, 1.3%; 169, 170) a week day (*n* = 1, 0.6%; 110), every weekday (*n* = 1, 0.6%; 148), this morning (*n* = 1, 0.6%; 52) and an average school week (*n* = 1, 0.6%) (80). Finally, 3 studies (1.9%) reported several record periods (14,35,144) and 37 studies (23.4%) did not refer to the period in any way (1,3,4,11,21,26,37–39,41,47,50,51,55,63,64,73,75,78,79,81,82,86–88,103,114,134,140,142,146,149,153,158,159,166,167).

6. Type of Administration. One hundred fifty of the studies (94.9%) involved written questionnaires, while just 6 (3.8%; 4, 10, 22, 28, 67, 73) relied on an interview and 2 (1.3%; 31, 146) did not reveal how it was conducted. One hundred seven studies (67.7%) asked the question directly to the child and/or adolescent participants (3–10,12–19,23,27,29,30,32–37,39,41–45,47,48,50,51,54,57–61,64,65,68–73,75–79,82–90,97,98,102,104–106,109,114–117,119–121,125–129,131–133,138–141,143–145,148–152,154,155,158–162,164,165), 14 (8.9%) to the parents and children or adolescents together (1,11,24,26,52,62,63,67,74,96,107,134,153,163), thirty (18.9%) to the parents alone (20,22,25,28,38,46,53,55,56,80,93,95,99,100,103,108,122–124,135,137,142,147,156,157,166–170) and 5 (3.2%) to a member of the household (21,66,81,101,110).

7. & 8. Reliability & Validity. As far as the validity and reliability of the self-report method, 20 studies (12.7%) reported using valid and reliable questions (8,39,41,42,50–52,59,62,68–70,74,104,107,123,129,137,164,169), 18 studies (11.4%) used reliable questions (7,9,13,26,36,55,56,60,80,83,84,88,100,116,131,143,147,170) and 14 (8.9%) used valid questions (5,17,35,38,46,47,54,75,78,135,148,150,151,159).

Fourteen studies reported values for reliability (13,52,60,62,68,69,84,88,100,107,123,131,147,170). The reported reliability measurements were concordance (ranking from 74% to 97.5%), kappa (0.60–1.00),

agreement (73–98%), correlation coefficient (0.93), interclass and intraclass correlation test (0.70), Spearman (0.82–0.95) and ICC (0.68–0.99).

Eight studies reported values for validity (5,47,52,62,68,69,107,123). The reported validity measurements were concordance (ranking from 74% to 97.5%), Kappa (0.28–0.910) and agreement (88.4%). In addition, some studies mentioned the measurement used for obtaining the reliability (8,9,39,41,42,50,51,55,56,70 ,74,80,129,137,164,169) and validity (8,38,39,41,42,46, 50,51,54,70,74,129,135,137,148,150,151,159,164,169), although they did not report these values.

Quality Assessment of the Question

The quality appraisal rated 36 studies (22.8%) high reporting quality (score of 7 and 8; 7, 8, 13, 17, 35, 36, 42, 46, 50–52, 54, 56, 59, 60, 62, 68–70, 74, 80, 83, 84, 104, 107, 123, 129, 131, 135, 137, 143, 147, 148, 164, 169, 170), 8 of which scored the highest mark possible. One hundred studies (63.3%) were rated as medium reporting quality (scores of 5 and 6; 3–6, 9–12, 14–16, 18–20, 23–26, 28–34, 37, 39, 41, 43–45, 47, 48, 53, 55, 57, 58, 61, 64–67, 71–73, 75–78, 85, 88, 90, 93, 95–103, 106, 108, 109, 114–117, 119–122, 124–128, 132, 133, 138–141, 144, 145, 150–157, 159–163, 165) and 22 studies (13.9%) as low reporting quality (scores of 4 and below; 1, 21, 22, 27, 38, 63, 79, 81, 82, 86, 87, 89, 105, 110, 134, 142, 146, 149, 158, 166–168). The individual items that were reported most often were the "commuting to school" question, the type of administration and outcome (100.0%, 99.4% and 94.9% of the studies reported them respectively). The individual items that showed a lower quality were validity and reliability (21.5% and 24.1% of the studies reported them respectively).

Discussion

We identified a total of 158 studies that assessed modes of commuting to and from school with a self-report measure. The research questions used across studies were heterogeneous. The main results revealed that: a) more than half of the studies used an exact question about commuting to school; b) the most frequently used question referred to a recall period "usually" and for both trip directions (routes to and from school); c) most of the studies used children/adolescent questionnaires; d) the results were most often percentages of modes of commuting to school and percentage of active commuting to school; e) only a few studies used valid and reliable questions. Most of the studies were evaluated as being of medium reporting quality.

Less than half the studies posed a direct question for assessing modes of commuting to school, very often, "How do you usually travel to school?" Most of the studies gave the answers to this question (i.e., by car, on foot, by bicycle) without reporting the frequency (i.e., 3 times per week by car). The combination of mode and frequency would of course provide fuller information and so compilers of these questionnaires should pose a complete and precise question and answers -concerning both mode and frequency- to guarantee an assessment that is both categorical (mode) and continuous (frequency) and facilitate replication and comparisons between studies.

The recall period usually was the most reported in the questionnaires. This question may well provide information about routine journeys to and from school, but it might not capture multimodal trips. Another recall period asked for was a specific day (yesterday, today). This may be more precise but might introduce a bias in the results by classifying a participant as active or passive on the basis of the mode used that day, which might be different from their usual mode of commuting to school. Other recall periods were a typical week or the past week. Questions with longer recall periods might be more difficult for young participants to complete.

The trip direction to school was asked for in more than half the studies. Presumably, some of the studies that only reported one of the trajectories might in fact have assessed both routes. Studies should indicate clearly in their methods section the routes they are measuring. Only one study assessed the correlation between the results going to and coming from school, reporting high correlations (160).

Most of the studies used a questionnaire for their self-report measure. In more than half the studies, children and adolescents completed the questionnaires independently. A couple studies showed that children's answers concur with those of their parents (62,107).

Percentage of commuting to school by mode was the most common outcome used, thus allowing researchers calculate percentages of active versus passive participants. This dichotomous variable occurs frequently in the scientific literature (40), although there is still no complete agreement on dichotomizing active versus passive. Public transport is classified as passive transport but children still need to walk to reach the bus stop (112,113). There is evidence that commuters who use a car to travel to and from school show a lower VO2max than those who rely on other modes of commuting (162), but the distinction between active, passive or "mixed transport" commuters remains undecided (46). Two review studies on active commuting to school concluded that a standard definition and measurement of commuting to school should be addressed in future studies (91,130).

Another type of result concerns the number of active or passive journeys per week (0–10 trips; 62). The use of this continuous variable might allow us to run more suitable statistical analyzes. The results might be interpreted in detailed terms of more active and less active participants instead of merely active versus passive. Moreover, the continuous variable may be categorized as a dichotomous variable, although there is still no consensus regarding the cut-off point for dichotomizing active versus passive. A study from the USA on the program Walk To School used 3 active journeys per week as the cut-off point (2).

Validity and reliability are important issues (92,94,111). In the current systematic review, only 33.0% of the studies indicated that the question used was valid, reliable or both. More efforts should be made to assess and report commuting to school with valid and reliable instruments. A standard question to assess commuting to school should be formulated in different languages and its validity and reliability should be addressed (i.e., comparing children´s reports about their mode of commuting to school with their parents' reports, a direct observation (130) or accelerometry (6,19) assays).

Quality Assessment of the Question

The majority of the studies identified were rated as being of medium reporting quality. Validity and reliability were the least reported items. The highest rating was reserved for the studies providing each of the identified items (Table 1), which is an important premise for the replication and comparison of studies in the literature. The items "validity" and "reliability" should always be indicated in the Methods or Results section.

Standardizing Commuting to School Self-Report Measure

Given our review of previous self-report methods used in the active travel to school literature, we put forward a standard form to allow comparability between studies. The assessment should afford the following characteristics: a complete and precise question and answer about commuting to school, asking about both trip direction to school and covering the whole school week (Monday to Friday). It should ask about both the mode (i.e., on foot, by bicycle, by car, by motorcycle, on the bus, and others) and the frequency for each mode. Students should fill in the questionnaire first thing every weekday morning with their teacher's help. At every morning session the students complete the mode used to go back home the previous day and the mode to school that morning. Doing so would provide the number of active and passive trips per week (from 0 to 10).

This method also lessens the risk of recall bias or incomplete questionnaires. The outcome of this questionnaire is a continuous variable regarding the number of journeys per week, which can be categorized in other values such as the number of active journeys per week, number of active journeys on the trip direction to school, a dichotomous active versus passive variable.

Strengths and Limitations

To our knowledge this is the first systematic review of self-reported methods focused on assessing modes of commuting to school used by school-aged children and adolescents from 4 to 18.5 years. The large number of studies included in our review (n = 159) also allowed us to draw broad conclusions which resulted in our recommendations for a standard self-report method.

Our review has some limitations. We may still have missed some relevant evidence due to poor indexing in some databases or indexing in databases not selected for the review process. Finally, the lack of assessing of the quality of evidence is other limitation.

In addition, we found some weakness of the available evidence. One limitation is the relative scarcity of methodological details reported in studies, including, for example, the "commuting to school" answer or the trajectories to and from school. Other limitation is that self-reported travel modes may be subject to social desirability bias, especially in the context of intervention studies. In addition, there is a lack of criterion measure against which self-reported commuting could be compared especially when children cycling (i.e., accelerometers).

Conclusions

Our appraisal found the reporting of self-report measures for commuting to and from school was heterogeneous and only a few studies presented a reliable and valid question. Overall, there was medium quality reporting of the self-report measure. The heterogeneity and incomplete reporting of the commuting to school measure makes comparison between studies and between behavior and health outcomes, such as body composition, metabolic risk factors or fitness levels, difficult. This in turn prevents firm conclusions being drawn and inhibits the implementation of effective strategies to increase the rate of active commuting to school among the young population.

We provide a standardized self-report measure and suggest a standard set of results to report which we hope will provide a common instrument in this research area and thus make it easier to replicate and compare studies. The proposal questionnaire includes a generic question that assesses the usual commuting to and from school (i.e., how do you usually go to/go back from school?) and a specific question that assess each trip during one week (i.e., how do you go to/go back from school this week?). The commuting to school responses is, in both questions: walking, cycling, car, motorcycle, bus and other.

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Supplementary File 1 Electronic Search for the Studies Including Database, Number of References Found and Terms Included

The electronic search was conducted through August 22nd 2013. Three categories of search terms were identified: 1) Questionnaire, 2) Commuting to school and, 3) Age. Relevant publications that contained at least one term from each of the 3 categories in the full text were identified. Moreover, use of the search term, school, was restricted to title and abstract to avoid its inclusion in the author's affiliation. The following terms were used for each category:

1) Questionnaire: "Question*" OR "Survey" OR "Self-Reported" AND
2) Commuting to school: "Travel" OR "Commuting" OR "Commute*" OR "Walkability" OR "Active transportation" AND
3) Age: "child*" OR "Adolescent*" OR "Youth" OR "student" OR "Pupil" OR "Pupils" AND
4) School: "*school*"[Title/Abstrac]

The electronic search was conducted in 5 databases:

1) PubMed: 121 studies.
"Question*" OR "Survey" OR "Self-Reported" AND
"Travel" OR "Commuting" OR "Commute*" OR "Walkability" OR "Active transportation" AND
"child*" OR "Adolescent*" OR "Youth" OR "student" OR "Pupil" OR "Pupils" AND
"*school*"[Title/Abstract]
2) SportDiscus: 70 studies, only in scientific journals.
"Question*" OR "Survey" OR "Self-Reported" AND
"Travel" OR "Commuting" OR "Commute*" OR "Walkability" OR "Active transportation" AND
"child*" OR "Adolescent*" OR "Youth" OR "student" OR "Pupil" OR "Pupils" AND
TI("*school*") OR AB("*school*")
3) ProQuest: 4,924 studies, only in scientific journals.
"Question*" OR "Survey" OR "Self-Reported" AND
"Travel" OR "Commuting" OR "Commute*" OR "Walkability" OR "Active transportation" AND
"child*" OR "Adolescent*" OR "Youth" OR "student" OR "Pupil" OR "Pupils" AND
ti("*school*") OR ab("*school*")
4) National Transportation Library: 391 studies.
"Question*" OR "Survey" OR "Self-Reported" AND
"Travel" OR "Commuting" OR "Commute*" OR "Walkability" OR "Active transportation" AND
"child*" OR "Adolescent*" OR "Youth" OR "student" OR "Pupil" OR "Pupils" AND
ti("*school*") OR ab("*school*")
5) Web of Knowledge: 392 studies.
"Question*" OR "Survey" OR "Self-Reported" AND
"Travel" OR "Commuting" OR "Commute*" OR "Walkability" OR "Active transportation" AND
"child*" OR "Adolescent*" OR "Youth" OR "student" OR "Pupil" OR "Pupils" AND
school