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# Children's opportunities to physical activity between home and school

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# Abstract

**Aim:**

Walking or bicycling to school can be an opportunity for children to increase their daily physical activity. The purpose of this study is to learn more about the topic active commuting in children and adolescents and find relevant researchable questions within the field. The primary focus is on children's active commuting modes, prevalence, distances, time, assessment methods, and the contribution of active commuting to children in meeting the existing physical activity guidelines.

**Method:**

A literature search was executed in PubMed. Following key words, active commuting, physical activity, active commuting in combination with physical activity, transport, transportation, transportation to school and active commuting to school were used to the literature search. Six publications of relevance were found and reviewed.

**Results and conclusion:**

Few studies have been done in this field. But by comparing the detected studies, which are from different parts of the world, one can say that active commuting can play a major role for children's physical activity. It contributes, in these countries, with 18-83% physical activity to children in meeting existing guidelines for physical activity.

Similar data has not been found for the Swedish children. On the basis of this, studies in Sweden are proposed to be carried out and the suggested objectives are the prevalence, distance, contribution to guidelines and the overall physical activity of active commuting in Swedish children.

The proposed assessment methods should be carefully studied to avoid errors and simplify the data treatment.

# Contents

# Introduction

Physical activity (PA) used to be an inevitable and natural part of our daily lifestyle. Almost everything in our daily occupation required active work, for example to reach somewhere we had to walk. After the industrial revolution and the huge evolution of computerizing and automatization in the latest century the human life has been changing from physically active to sedentarity.[1]

Many children of today are over consuming food and drinks[2, 3] and there is an anxiety about children not being physically active enough to expend all these calories, which may influence their health outcomes for instance their body weight.[4, 5] There are number of studies, which show that sedentarity is increasing among children.[6, 7, 8] This might depend on that opportunities to move safely and independently on foot or by bicycle in children's near surrounding has been declining.[9]

The PA guideline for children and adolescents is saying that young people should participate in any activity of moderate to vigorous level, during at least 60 minutes, every day.[10] Despite existing recommendation few children and adolescents are taking part of any kind of regular moderate to vigorous PA (MVPA) and the participation of after school sports is decreasing.[11]

Active commuting is transportation by PA like walking and bicycling compared to passive commuting, which means transportation by motorized vehicles. Active commuting is classified as a moderate PA.[12] Could active commuting to school have an important role for young people meeting this guideline and be an opportunity of daily MVPA?

Before promoting active commuting it is of importance to first identify young people's mode of transportation to school and to other destinations. We need to know the frequency of transportation and how long distances children commute to school. Another important aspect is the quantity of active commuting, how much PA is it? We also need to understand how active commuting influences the overall PA and its importance for the total daily PA. There is a need to learn more about the effects of active commuting on young people's health, if active commuting tracks trough childhood to adulthood and children's perception of active commuting.

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[1] Sallis and Owen. Physical activity & Behavioral Medicine, SAGE Publication, Inc, 1999;5-6.
[2] Saris WH, Blair SN, van Baak MA, Eaton SB, Davies PS et al. How much physical activity is enough to prevent unhealthy weight gain? Outcome of the IASO 1st Stock Conference and consensus statement. Obes Rev. 2003 May;4(2):101-14.
[3] Matheson DM, Killen JD, Wang Y, Varady A, Robinson RN. Children's food consumption during television viewing. Am J Clin Nutr. 2004 June, 79(6):1088-94.
[4] Ekelund U. Assessment of physical activity and energy expenditur in adolescents. Svensk Idrottsforskning 2002 (2):36-41.
[5] Andersen RE, Crespo CJ, Bartlett SJ, Cheskin LJ, Pratt M. Relationship of physical activity and television watching with body weight and level of fatness among children. JAMA 1998 March;279(12):938-42.
[6] WHO. Information sheet on obesity and overweight, 2004. www.who.int/topics/obesity/en/.
[7] Andersen RE, et al. 1998, p. 938.
[8] Sirard J, Pate RR. Physical activity assessment in children and adolescents. Sports Med. 2001;31(6):439-54.
[9] WHO. Information sheet on obesity and overweight, 2004.
[10] Health Education Authority, UK. Biddle, Sallis & Cavill, 1998. Sallis et al. 1999; p. 63.
[11] Everson KR, Huston SL et al. Statewide prevalence and correlates for walking and bicycling to school. Arch Pediatr Adolesc Med. 2003;157:887-92.
[12] Ainsworth BE, Haskell WL et al. Commpendium of physical activities: an update on activity codes and MET intensities. Med Sci Sports Exerc 2000 Sep;32(9 Suppl):498-504.

Depending on the need to promote active commuting the next step is to investigate the factors[13] that influence the choice of commuting mode. Parents, traffic, distance and socio-economic status are examples of external factors, which may affect children's commuting mode. There are also individual depending factors,[14] for instance genetic factors and interests that also influence children's choice of transportation mode.

Better understanding of above mentioned issues for commuting to school, may be of importance to children's future health. By integrating PA in a daily routine and perhaps establish good habits for the future, one could in turn prevent unhealthy weight gain or other health related illnesses.

# Background

## Assessment of physical activity in children

PA is a complex behaviour and it is not easy to assess, especially not in children, because of their impulsive PA and variation of activity patterns. Information from assessing PA is useful for better understanding about links between activity and health and the number of persons reaching recommendations of PA and trends over time can be identified.[15] There are many dimensions in PA, of which the basic ones are frequency, intensity and duration. Recommendations of PA are usually given in these dimensions.[16]

Methods of assessing PA are divided into subjective and objective methods.[17]

*Subjective methods*

Self-report (diary)
Questionnaires
Observations

*Objective methods*

Accelerometer
Pedometer
Heart rate monitoring
Double labeled water (DLW)

*Subjective methods* are cheap and simple, but lack valid objective assessments.[18] The methods are frequently used on children and on large populations. Several types of child PA self-reports exist, self-administered recall, interviewer-administered recall, diary and proxy-reports.[19]

*Objective methods* are more costly, but also more reliable for assessing children's PA.

[13] Schantz P, "Idrotten och miljön" in Perspektiv på sports management, ed. SISU idrottsböker (Stockholm, 2004), p.324.
[14] Schantz 2004, p.324.
[15] Sallis et al. 1999, p. 71-106.
[16] Ibid. p. 71.
[17] Ibid. p.72-92.
[18] Sallis et al. 1999, p. 79.
[19] Ibid. p. 79.

*Pedometer* is the cheapest objective method and is simple to use. It is usually a preferable method in interventions and surveys with large samples.

The instrument is measuring number of steps taken by the test person. It gives very rough measurements and is not correlated to energy expenditure (EE). The pedometer is not able to assess the intensity and duration of PA.

*Heart rate monitoring* has high sensitivity and provides information about frequency, duration and intensity. But, heart rate is not only related to activity, but also emotions and mental stress in the absence of PA. There for heart rate monitoring is more appropriate to measuring high level of PA. The method is also time consuming because of the need of individual calibrations.[20]

*DLW* is a very accurate but complex method that measures total EE (TEE), and it is easy to apply on both children and adults. With information about a person's resting metabolic rate (RMR), the total PA, physical activity level (PAL) can be calculated by the formula: PAL = TEE/RMR.[21]

The principle of the method is letting participants ingest a known amount of $^{2}H$ and $^{18}O$. These stabile isotopes are quickly distributed through the body in different velocities. $^{2}H$ is excreted through water in the urine and sweat, the metabolism of water. $^{18}O$ is also eliminated through water metabolism and through the production of carbon dioxide in the respiration. The difference in elimination velocity for the isotopes can be received by assessing the concentration of $^{2}H$ and $^{18}O$ before ingestion, during and after the test period (usually through a urine sample). This difference is the carbon dioxide production, which indirectly is the measure of the TEE.[22, 23]

More detailed description of *accelerometer*, which is applied in the reviewed studies, can be found in the text further down.

The suitability of a method is dependent on the aim of the study, study population and financial resources. Sometimes combinations of two or more methods are applied in the same study to make sure that all dimensions of PA are included.[24]

## Obesity worldwide

Childhood obesity is an epidemic in some part of the world and on other parts an increasing problem. The prevalence of overweight and obesity among children and adolescents are accelerating. About 22 million children under the age of five, worldwide, are diagnosed overweight.[25] In the USA the prevalence of obese children is an up-going trend. Since the 1960s till 1999 the prevalence of obese children and adolescents (6-17 years) has been tripled.[26] In Australia the prevalence of overweight and obesity combined has increased by

[20] Sallis et al. 1999, p. 86-87.
[21] Ekelund 2002, p 37.
[22] Ibid. p. 37.
[23] Sallis et al. p. 89-90.
[24] Ibid. p. 84-106.
[25] WHO. Information sheet on obesity and overweight, 2004. www.who.int/topics/obesity/en/
[26] The Surgeon General's Call to Action to Prevent and Decrease Overweight and Obesity, April 27 2004.

60% over a period of nearly 20 years (1969-1985)[27] while 18-25% of the Swedish children around 10 years old are overweight and 3- 4% of them are obese.[28]

## A motorized society

Today, a lot of children are chauffeured between home, school and other activities. 50% of children 4-11 years in the UK are driven regularly to school with a distance of less than 1 mile.[29] Only 14% of all school trips are made by foot or by bicycle in the USA, 1999[30] and between 1977-1995 active commuting decreased with 37%, while the proportion of school trips made by motorized vehicles increased.[31]

The reasons to why children are driven between destinations are mainly long distances and traffic danger, but other factors like weather conditions and crime danger do also influence parents' choice of commuting mode to school.[32, 33, 34] Mode of commuting has also been noticed to have relations with socio-economic factors like possession of motorized vehicle in the household and ethnicity.[35, 36]

Results from interventions with overweight young people suggest that changing lifestyle and integration of PA into daily routines are more effective on weight loss than structured exercise.[37, 38] This indicates that favouring cars and other motorized vehicles decrease the chances for spontaneous PA, which in turn may lead to deterioration of public health.

## Physical Activity Guidelines of young people

Because of little scientific data, PA guidelines provided for children and adolescents have earlier not been based on studies of PA and health in young people. The recommendations were more or less a generalization from the existing PA guidelines for adults. In 1994 two guidelines for adolescents were published. These were based on those few literatures and reviews that existed on young people aged 11-21. Data shows the importance and the

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[27] Booth ML, Chey T, Wake M, Norton K, Hesketh K, Dollman J, Robertson I. Change in the prevalence of overweight and obesity among yong Australians, 1969-1997. Am J Clin Nutr 2003;77(1):29-36.
[28] SBU – Statens Beredning för Medicinsk Utvärdering: Fetma – problem och åtgärder. En systematisk litteraturöversikt SBU-rapport nr. 160, Stockholm 2002; 51.
[29] Sleap M, Warburton P. Are primary school children gaining heart health benefits from their journeys to school? Child Care Health Dev. 1993;19(2):99-108.
[30] Center for Disease Control and Prevention. Barriers to children walking and bicycling to school – United States, 1999. Morb Mort Wkly Rep. 2002 Aug 16;51(32):701-4.
[31] Tudor-Locke C, Ainsworth BE, Popkin BM. Active commuting to school. An overlooked source of childrens' physical activity. 2001;31(5):309-313.
[32] Center for Disease Control and Prevention. Barriers to children walking and bicycling to school – United States, 1999. Morb Mort Wkly Rep. 2002 Aug 16;51(32):701-4.
[33] Zivianai J, Scott J, Wadley D. Walking to school: Incidental physical activity in the daily occupations of Australian children. Occup Ther Int. 2004;11(1):1-11.
[34] Loucaides CA, Chedzoy SM, Bennett N. Differences in physical activity levels between urban and rural school children in Cyprus. Health Educ Res. 2004 Apr;19(2):138-47.
[35] Everson KR, Huston SL, McMillen BJ, Bors P, Ward DS. Statewide prevalence and correlates of walking and bicycling to school. Arch Pediatr Adolesc Med. 2003 Sep;157(9):887-92.
[36] Tudor-Locke C, Ainsworth BE, Popkin BM. Physical activity in Filipino youth: the Cebu Longitudinal Health and Nutrition Survey. Int J Obes. 2003;27:181-90.
[37] Glenny AM, O'Meara S, Melville A, Sheldon TA, Wilson C. The treatment and prevention of obesity: a systematic review of the literature. Int J Obes Relat Metab Disord. 1997 Sep;21(9):715-37.
[38] Sallis et al. 1999, p 150-151

influence of PA for young people's health, but the outcome turned out to be consistent with the PA recommendations for adults.[39]

- All adolescents should be physically active daily, or nearly every day, as part of play, games, sports, work, transportation, recreation, physical education, or planned exercise, in the context of family, school and community activities.
- Adolescents should engage in three or more sessions per week of activities that last 20 minutes or more at time and that require moderate to vigorous levels of exertion.[40]

Three years later the Health Education Authority in the UK gathered an international group of scientists to once more compile and develop PA guideline for young people.[41]

- All young people should participate in physical activity of at least moderate intensity for one hour per day.
- Young people who currently do little activity should participate in physical activity of at least moderate intensity for at least half an hour per day.
- At least twice a week, some of these activities should help to enhance and maintain muscular strength and flexibility and bone health.[42]

Other later recommendation from the 2001-2002 President's Challenge Physical Activity and Fitness Awards Program is about taking enough number of steps per day[43]. The recommended amount of steps for young people is 11000 steps/day for girls and 13000 steps/day for boys.[44]

## PA and children's health

A lot of changes occur during puberty and PA is an important factor for growth in weight and length, development in the hormone system and changes in body composition.[45] Little is documented about health effects of PA in children and adolescents. Most studies are done on adolescents, aged 11-21.

*Longevity*
Majority of studies show that PA might affect causes of morbidity during childhood and adolescents and reduces risk for chronic diseases of adulthood.[46] Effects on morbidity could be reducing risks of catching colds through reinforcement of the immune system, decreasing the risk of overweight and obesity and reducing psychological stress.[47] By improving aerobic fitness during youth a person may prolong his or her life, because aerobic fitness seem to have long-term protective effect. Studies have shown that more fit adults usually lived longer.[48]

[39] Sallis et al. 1999, p. 67-68.
[40] International Consensus Conference on Physical Activity Guidelines for Adolescents. Sallis et al. 1999; p. 63.
[41] Sallis et al. 1999, p. 68.
[42] Health Education Authority, UK. Biddle, Sallis & Cavill, 1998. Sallis et al. 1999; p. 63.
[43] Tudor-Locke C, Bassett DE Jr. How many steps/day are enough? Preliminary pedometer indices for public health. Sports Med. 2004;34 (1):1-8.
[44] Ibid. p. 6.
[45] Ekelund 2002, p. 36.
[46] Sallis et al. 1999, p. 67.
[47] Sallis et al. 1999, p.35.
[48] Ibid. p. 16-19.

*Cardio vascular diseases (CVD)*
23% of all deaths in common chronic diseases in the USA among adults are caused by high blood cholesterol. There is evidence that PA increases the high density lipid cholesterol (HDL) in obese and diabetic children and in youth with a family history of heart disease. For the latter group evidence has also been found for PA lowering blood pressure, but PA seldom decreases blood pressure to completely normal levels. Normal blood pressure is not affected by PA, which means that the blood pressure will not become subnormal by physically active lifestyle.[49]

*Obesity*
PA reduces overweight by increasing total daily energy expenditure. And, because of overweight and obesity is related to chronic disease risks such as, osteoporosis, coronary heart disease, and other CVD, in adulthood, any effect on adiposity in youth have positive effect on the health during childhood and for the future.[50]

*Osteoporosis*
By performing activities, such as weight-bearing activities and resistance training, stimulate the calcium uptake in the bones, during adolescence, and denser bones are built up. This will minimize the risk of bone fractures in old age.[51]

*Psychological health*
Consequences of a sedentary lifestyle are deterioration of the intellect and negative effects on the psychosocial development.[52] By letting children move and play freely and safely in their neighbourhood, children may test them selves socially, mentally and physically. Of these experiences the children will be prepared for the real world.[53, 54]

## Active commuting and health outcomes

The health benefits of active commuting to school are still unknown. Studies on adults bicycling to work shows that the mode of commuting decreases the risk of all-cause mortality approximately 40%[55] and walking to work decrease the risk of hypertension.[56] A finish study, made on active commuting men and women, by walking or bicycling, resulted in increased proportion of HDL.[57] These results indicate that promotion of active commuting to school could be important in preventing and decreasing childhood obesity and by this prevent illnesses and chronic diseases caused by overweight and obesity. Also, if PA tracks through childhood to adulthood, active commuting to school could become a first step for children to establish a lifelong PA pattern.

[49] Sallis et al. 1999 p. 37.
[50] Ibid. p. 22-26, 68.
[51] Ibid. p. 28-29.
[52] WHO. Information sheet on obesity and overweight, 2004. www.who.int/topics/obesity/en/
[53] WHO. Information sheet on obesity and overweight, 2004. www.who.int/topics/obesity/en/
[54] Sallis et al. 1999, p. 51.
[55] Andersen LB, Schnohr P, Schroll M et al. All cause mortality associated with physical activity during leisure time, work, sports and cycling to work. Arch Intern Med 2000;160:1621-8.
[56] Tudor-Locke C et al. 2001, p. 310.
[57] Oja P, Vuori I, Paronen O. Daily walking and cycling to work: their utility as health-enhancing physical activity. Patient Educ Couns. 1998 Apr;33(1 Suppl):87-94.

## Aims

To, by studying existing literatures, learn more about the field and search for relevant questions of the issue and try to find relevant researchable queries about active commuting to school in young people and also learn more about assessment methods for this kind of PA.

The focus is on:

- in which kind of modes children and adolescents are commuting
- the prevalence of active and passive commuting and also the prevalence of the combination of these modes
- how long distances children are commuting (passive, active and a combination of both)
- time spent on active commuting
- the intensity of physically active commuting
- the contribution of PA by active commuting to the overall PA
- the contribution of active commuting to children in meeting existing guidelines for PA
- the relationship between active commuting and overall PA
- assessment methods in measuring active commuting

## Method

The literature search was executed in PubMed, in the autumn 2004. PubMed is designed to provide access to citations from biomedical literature and access as well as links to other molecular biology resources in the Entrez, a text-based search and retrieval system used at the National Centre for Biotechnology Information (NCBI) at the National Library of Medicine (NLM). PubMed also provides access to bibliographic information that includes for example MEDLINE and OLDMEDLINE. In PubMed limits can be set up to facilitate the search and exclude not related articles. For this paper limits were given for "all children 0-18 years".

The key words "active commuting" and "physical activity" combined gave 9 citations, of which Cooper et al. 2002[58], Tudor-Locke et al., 2002[59] and 2003 a[60] were of relevance for this study and discussed the issue "active commuting" in relation to the aim of this paper.

[58] Cooper AR, Page AS, Foster LJ, Qahwaji D. Commuting to school. Are children who walk more pysically active? Am J Prev Med 2003;25(4):273-76.
[59] Tudor-Locke C, Neff LJ, Ainsworth BE, Addy CL, Popkin BM. Omission of active commuting to school and the prevalence of children's health-related physical activity levels: the Russian Longitudinal Monitoring Study. Child Care Health Dev. 2002 Nov;28(6):507-12.
[60] Tudore-Locke C, Ainsworth BE, Adair LS, Popkin BM. Objective physical activity of Filipino youth stratified for commuting mode to school. Med Sci Sports Exerc. 2003 Mars;35(3):465-71.

Tudor-Locke et al. 2001[61] was the source of inspiration for this work. By searching for related publications to this article, 167 additional articles were found of which two contained interesting data, Roberts et al. 1997[62] and Tudor-Locke et al. 2003b.[63]

Related articles were searched to Cooper et al., Tudor-Locke et al. 2002, 2003a, 2003b and Roberts et al. 1997, but no other relevant publications could be found.

Other keywords such as transport, transportation, transportation to school, active commuting to school and commuting to school were used, but no other articles of relevance to this work were found.

Because the Russian article of Tudor-Locke et al. 2002 was based on data from Levin et al. 1997, this article was included to complement the first one.

# Results

### Review 1. Commuting to school. Are children who walk more physical active?[64]

*Cooper AR, Page AS, Foster LJ, Qahwwaji D.*

**Review**

***The purpose***

This study is focusing on the contribution of the active commuting to children's overall physical activity (PA), by comparing children who walked to school with those who travelled by car.

***Methods***

Children from five urban primary schools, in Bristol, were recruited. 82 children from upper/middle class (three schools) and 89 from lower social class (two schools). 114 (59 boys and 55 girls) of the children, aged 10.4±0.8, carried out the procedure.

PA was estimated by using an accelerometer, MTI/CSA model 7164, with the intention to measure for seven days. It was programmed to record the children's PA every minute. The instrument were worn on the right side of the hip. The CSA 7164 is a uniaxial accelerometer designed to detect vertical acceleration in magnitudes for detection of human motion and rejection of high frequency vibrations like activities from a lawn mower. Every detected movement is registrated as an activity count and the more counts that are registrated during one minute the more highly active are the person who wears the accelerometer. To determine

[61] Tudor-Locke C, Ainsworth BE, Popkin BM. Active commuting to school. An overlooked source of childrens' physical activity? Sports Med. 2001;31(5):309-313.
[62] Roberts I, Carlin J, Bennett C, Bergstrom E et al. An international study of the exposure of children to traffic. Inj Prev. 1997;3:89-93.
[63] Tudor-Locke, Ainsworth BE, Adair LS, Du S, Popkin BM. Physical activity and inactivity in Chinese school-aged youth: the China Health and Nutrition Survey.
Int J Obes Relat Metab Disord. 2003 Sep;27(9):1093-9.
[64] Cooper AR, Page AS, Foster LJ, Qahwaji D. Commuting to school. Are children who walk more pysically active? Am J Prev Med 2003; 25(4):273-76.

the grade of a persons PA the counts/minute are converted to MET-factors by using an age-specific equation developed by Freedson et al.[65]

$METs = 2.757 + (0.0015 \times cnt/min) - (0.08957 \times age_{(y)}) - (0.000038 \times cnt/min \times age_{(y)})$

* cnt/min = counts/minute, y = years

MET is an abbreviation for metabolic equivalent and is used as an index for the intensity of activities. 1 MET is equivalent to 3.5 ml $O_2$ per kilo body weight and minute.[66] In table 1 the MET-factor set for respectively intensity of PA can be seen.

| | | | |
|---|---|---|---|
| **MET-value** | 1-2.9 | 3-5.9 | ≥ 6 |
| **Grade of PA** | Low | Moderate | Vigorous |

**Table 1.** MET-factors for respectively intensity of physical activity.

A brief questionnaire identified the daily travel to school by asking the children how they usually travelled to and from school and how many minutes the journey took.

## Results

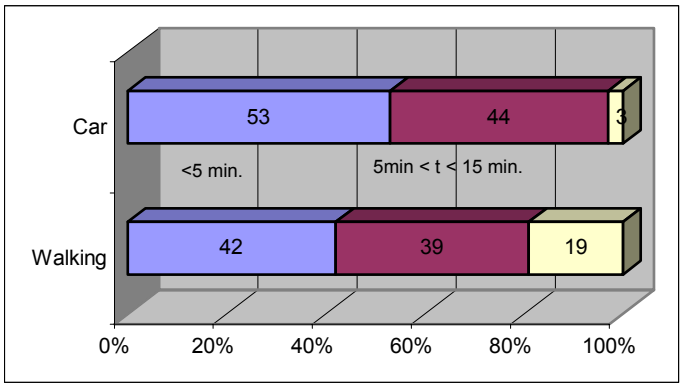


**Figure 1.** The distribution of how many children that have less than 5 respectively 15 minutes trip to school, by foot or by car.
* t, travel time.

***1.*** 64% of the children usually walked to school and the rest (36%) commuted by car. None of the children went by bus or by train to school. Only one child cycled and classified as active commuter and three children had different mode of travelling depending on if they went to or from school. These children were classified by the mode of journey to school. The proportions of children that had less than 5 respectively 15 minutes to walk and drive to school are presented in figure 1.

[65] Freedson PS, Sirard J, Trost SG, Dowda M, Pate RR, Sallis JF. Calibration of a uniaxial accelerometer for estimating exercise intensity in children. Med Sci Sports Exerc 1998; 30:629-33.
[66] Sallis JF, Owen N. Physical Activity&Behavioral Medicine, SAGE Publications, Inc 1999; 10.

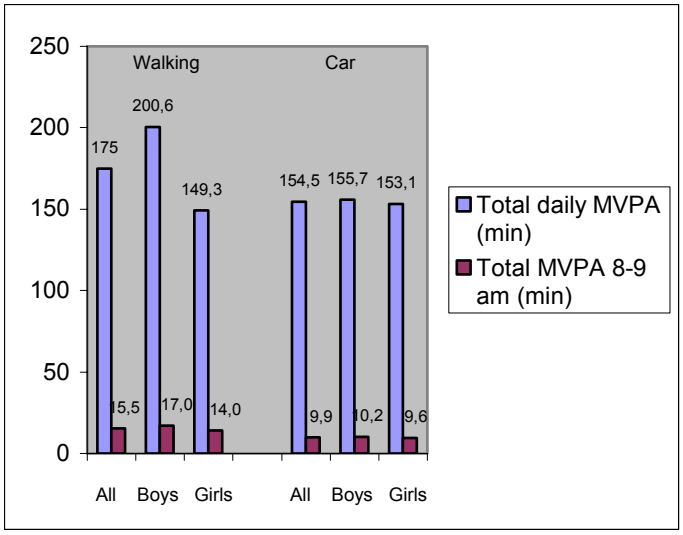


**Figure 2.** MVPA, moderat-to-vigorous physical activity

***2.*** Boys who walked to school were more moderate/vigorous physically active than girls who used the same mode of travelling to school. The differences in MVPA between the groups can bee seen in figure 2. Differences in PA between the groups during the day are described in figure 3. Comparing the results from the boys, there is a huge difference in PA between the two groups during leisure time ($3_{PM}$-$8_{PM}$). Those who walked to school were almost 30 minutes more physically active (can be calculated from fig. 2). These differences didn't appear when comparing PA for the girls. The only difference in amount of PA between the travel groups for girls were found between 8-9 o'clock in the morning (figure 3).No differences occurred in PA between those girls who walked and those children (boys and girls) who used the car. During week-end no differences were found between any groups.

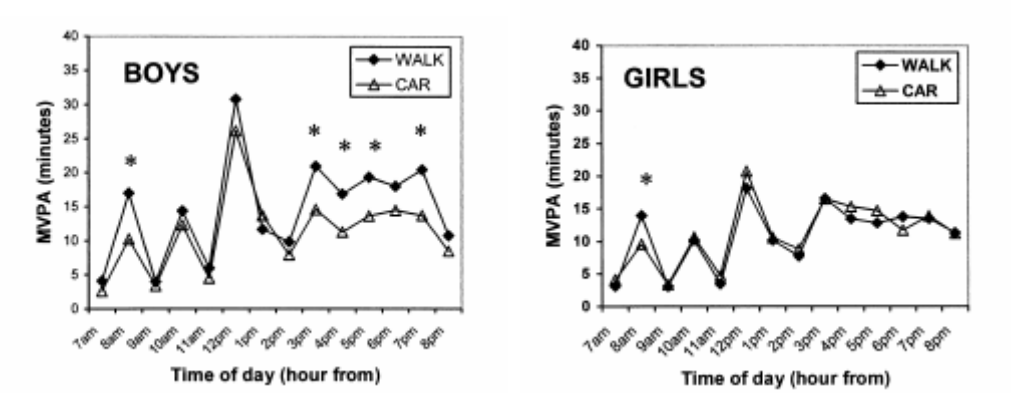


**Figure 3.** Mean hourly pattern of MVPA during the week for boys and girls by mode of travel to school. * Times at witch the difference between walk and car groups are statistically significant ($p<0.05$).

***3.*** The trip between home and school contributed 8-14 minutes of moderate to vigorous PA (MVPA).

***4.*** Almost 98% of the boys and 82% of the girls did reach the UK national guidelines for PA. No difference was found between travel groups in the proportion of children meeting these recommendations.

***5.*** The sex distribution was equal at all schools and no differences occurred in PA between the schools. Each school contributed with walking children with a proportion between 50% and 78%.

***6.*** No significant differences in BMI were found between the travel groups. Differences in energy expenditure between the boys did not appear to affect their present BMI.

**Authors' discussion**

***Re. 1*** The figures from this study are comparable with the national figures for primary children.

***Re. 2*** Differences between the boys and the girls travelling by the same mode, while none differences occurred between the girls travelling by different mode, might imply that the play the boys are taking part of are more physically exacting. But it can also mean that girls have restricted PA. These results do not match the results from another study were the Filipino female adolescents who actively commuted to school were more physically active than those female students who used motorized transportation to school.[67] More studies about leisure time PA in children are needed to be able to understand these differences between the boys and girls.

Because the aim of this study was not to investigate the differences in PA between children, no conclusions can be drawn about the cause and effect. But it might be, that vigorously active boys chose to walk to school or it could also imply that active travelling influence the boys over all PA. These results are comparable with another study, which showed that restricted PA for 9-year-old children in school influenced the PA in leisure time to be lower than normal. Encouraging active commuting and PA in school might promote more physically active leisure time. But, on the second hand, the mode of travelling to school for this age category is probably made by parents.

***Re. 4*** Even though the mode of travel to school did not seem to influence the children meeting the national guidelines for PA, active commuting might be of more importance to daily PA in older children and adolescents because of changes in children's behaviour towards PA.

***Re. 6*** The 45 minutes extra MVPA (equivalent to ~ 80 kcal per day) by the active commuting boys might be expected to influence the body weight between the two groups over time.

**My reflections**

***Re. methods***

The study did not describe how the children carried out the questionnaire. Did they have any help from the teachers or the authors? It could, for children, be difficult to estimate how long time a trip could take. This might have, if they did not have any help from adults, contributed to uncertainty in the results.

[67] Tudor-Locke C, Ainsworth BE, Adair LS, Popkin BM. Objective physical activity of Filipino youth stratified for commuting mode to school. Med Sci Sports Exerc 2003 Mars; 35(3): 465-71.

***Re. 1*** As seen in figure 1, 53% of the car commuting children had less than 5 minutes to drive, while 97% hade less than 15 minutes. Does this indicate short distances or a community with many high velocity roads? Even though a car trip takes 15 minutes, the reasons can be that the car has to stop many times for red lights or traffic jam. Perhaps it would take the same amount of time to walk the same distance.

The authors only described that the five selected schools were situated in an urban environment. All urban communities are not alike; there are huge differences depending on how near a city core it is situated. Some urban communities are residential districts with calm and small streets while other urban communities have lots of heavily trafficked roads.

It is of importance to have the information about how the community is structured if we want to learn more and understand the barriers and dangers that exist for active commuting and also how to easily promote it. In addition, it's also important to understand how the structure of the community influences the choice of transportation mode.

To understand the contribution and effect of active commuting it is of great importance to know how many of the children that had 1 minute or 14 minutes to school. If the majority of the 42% that had less than 5 minutes to walk to school, only had 1-2 minutes to walk, does active commuting contribute anything to the children's over all PA? Maybe not, but, in the opposite, if most of the children in the 39%-group (see fig. 1) did have 14 minutes to walk, the active commuting has a greater contribution to the daily PA and health. As the results are presented in the study, it's difficult to make any conclusions.

***Re. 2*** In fig. 2 the data shows that active commuting boys had 18% more PA than active commuting girls between 8 -9 o'clock in the morning. Does this mean that the majority of the boys had a longer trip than the girls, or is it just that these boys were more active than the girls during this one hour? If active commuting boys in average had a longer distance to walk than the girls, it might indicate that parents are more overprotecting and concerned about the girls than about the boys.

The authors discussed the reasons about the differences in PA between the sexes. Even though the probability of the conclusions might be true, the results can also be interpreted to that girls have other interests than boys. Further, as shown in figure 2, no differences in PA occurred between the car travelling boys and the girls in both groups. What conclusions can be made from these results? Does this mean that active commuting only influence boys over all PA or maybe parents to boys are more encouraging about PA?

Even though society of today is attempting to strive for equality, maybe boys and girls are still raised for different roles. This might affect the attitude to PA and also the attitude to active commuting to school.

***Re. 3*** The authors mentioned that active commuting contributed 8-14 minutes daily MVPA. These figures are calculated from the results detected by the accelerometer between $8_{AM}$-$9_{AM}$ (figure 2). 8 minutes are the difference in MVPA, between the two girl-groups (walk and car), times two (for the trip home from school) and, 14 minutes are likewise the difference in MVPA, between the two boy-groups, times two. How these figures are calculated and how the results are presented might indicate that the authors actually were not sure about when the children went home from school (figure 3).

Figure 2 is telling us that there's only a 6.8 –minutes-average difference respectively 4.4 minutes-average difference in MVPA for the boys and girls. Could this mean that the only difference in MVPA from 8 till 9 o'clock between the children is the way of commuting? Shouldn't the walking boys and girls, especially the walking boys, have had more MVPA above the commuting? According to the presented data (figure 3) in the study, the active commuting boys were approximately in average 15% more active than the other boys during the breaks. Even though these minutes do not have any statistically significance shouldn't these minutes also been seen between 8 and 9 in the morning?

This could be explained by that the active commuting boys were less active during the early morning and that the possibility of PA is limited during this hour when children have to eat breakfast and get dressed. But, it could also depend on a source of error in the accelerometer. Since the instrument detects body movements in the vertical plane, it might also register vertical movements from the car. And depending on how the children are positioned, for example a half lying position, the accelerometer might also be able to register the acceleration from the car as a vertical movement from the children. These possibilities were never mentioned and commented by the authors.

***Re. 4*** The purpose of this study was to analyze the magnitude of the contribution of active commuting to children's overall PA. But, strangely, the authors never discussed the issue.

The UK national guidelines say that children and young people should achieve at least 60 minutes of moderate PA every day. And, at least twice a week include activities that improve and maintain muscular strength, flexibility and bone health (activities that produce high physical stresses on the bone). Less physically active young people should participate at least 30 minutes per day in moderate PA.[68]

For those children who did not meet the guidelines, but still walked to school, what does 8-14 minutes daily commuting contribute to their daily MVPA? 8-14 minutes are in average 18% of the recommended 60 minutes and almost 37% of 30 minutes, that are recommended for children who do little PA. If a child does not reach recommended minutes for MVPA every day, the time spent on active commuting will be even more valuable and of a greater importance for their daily total MVPA. And as the authors pointed out, children tend to become less active as older they get, then active commuting do play an important roll for the PA in older children and adolescents.

Besides the 8-14 minutes of MVPA, could walking to school contribute to maintained muscular strength and enhanced bone health?

***Re. 5*** According to the authors, no differences occurred in PA between the schools. However, each school contributed with walking children with a proportion between 50% and 78%. This means that there is a difference between the schools that the authors did not comment. Could this indicate that there is a social-economic difference in the way of travelling to school? This was never mentioned in the study, which makes one wonder why the authors bother to provide an equal distribution among the social classes and also presented the proportion of the contribution to walking children, if they didn't troubled to analyze it.

[68] Health Education Authority, UK. Biddle, Sallis & Cavill, 1998. Sallis et al. 1999; p. 63.
Sallis et al. 1999; p. 63.

***Re. 6*** It might be of great interest and instructive to follow the same group over a longer period to see the effect of active commuting on the bodyweight and the pattern of PA.

## Review 2. Omission of active commuting to school and the prevalence of children's health related physical activity levels: the Russian Longitudinal Monitoring Study[69]

*Tudor-Locke C, Ainsworth BE et al.*

**Review**

### *The purpose*

The purpose was to evaluate how much PA active commuting contributes to school-aged children's prevalence of meeting three minimal health-related PA guidelines.

### *Methods*

Between 1992-1998 the Russian federation made a national household survey, The Russian Longitudinal Monitoring Study (RLMS). This survey is the first one that represents the whole country. PA data from the RLMS was obtained in November 1998 by asking parents about their children's PA. The questions were about children's participation (yes/no/I don't know) in school physical education classes and other PA outside school. The frequency (days/week) and duration (hours/week) of the participations were also included. By these answers a compilation of time spending on different intensity levels of PA for each child was obtained. By using MET-values the intensity levels were set[70] according to table 1. The definition of MET-value can be found in earlier pages, the review of Cooper et al. 2003.
Additionally, questions about the mode of children's commuting to school (walk/bicycle/car) and its duration (minutes/day), both to and from school, were included. Active commuting was classified as a moderate physical activity.

| | | | |
|---|---|---|---|
| **MET-value** | < 3 | 3-6 | > 6 |
| **Grade of PA** | Light | Moderate | Vigorous |

**Table 1.** MET-factors for respectively intensity of physical activity.

[69] Tudor-Locke C, Neff LJ, Ainsworth BE, Addy CL, Popkin BM. Omission of active commuting to school and the prevalence of children's health-related physical activity levels: the Russian Longitudinal Monitoring Study. Child Care Health Dev. 2002 Nov; 28(6):507-12.
[70] Ainsworth BE, Haskell WL et al. Commpendium of physical activities: an update on activity codes and MET intensities. Med Sci Sports Exerc 2000 Sep; 32(9 Suppl): 498-504.

Depending on how much PA the children had every week; they were divided into three groups defined by following health-related PA guidelines:

1. All adolescents should be physically active daily, or nearly every day, as part of play games, sports, work, transportation, recreation, physical education or planned exercise, in the context of family, school and community activities (Sallis & Patrick 1994).[71] This was defined, by Pate et al 1995,[72] as approximately 30 minutes PA every day, five days per week or 150 minutes per week or longer according to Levin et al. 1999.
2. Adolescents should engage in three or more sessions per week of activities that last 20 minutes or more at a time and that requires moderate to vigorous levels of exertion (Sallis & Patrick 1994).[73]
3. All young people should participate in PA of at least moderate intensity for one hour per day (Biddle et al. 1998).[74]

The study subjects were 1094 school children, 572 boys and 522 girls, aged 10.2 ± 1.9 years.

**Results**

***1.*** 91.6% of the children were reported, by their parents, as walking, while 0.2% were bicycling to school. 12.7% were using cars to school.

***2.*** If active commuting is omitted, the number of children meeting guideline 1, 2 and 3 drops significantly for both genders. Those children meeting guideline 1 decrease with 17-19%, similar declination can be seen for children meeting guideline 2 and those who meet guideline 3 decreases by 12-13%, fig. 1. By omitting active commuting the proportion of sedentary children increases from 7% to 22%.

[71] Sallis JF & Patrick K. Physical activity guidelines for adolescents: consensus statement. Ped Exerc Sci 1994; 6: 302-14.
[72] Pate RR, Pratt M, Blair SN, Haskell WL, Macera CA, Bouchard C et al. Physical activity and public health: a recommendation from the Centres for Disease Control and Prevention and the American College of Sports Medicine. J Am Med Ass 1995, 273, 402-407.
[73] Sallis et al. 1994, p. 6.
[74] Biddle S, Cavill N & Sallis J. Policy framework for young people and health-enhancing physical activity. In Young and Active, Health Education Authority, London.

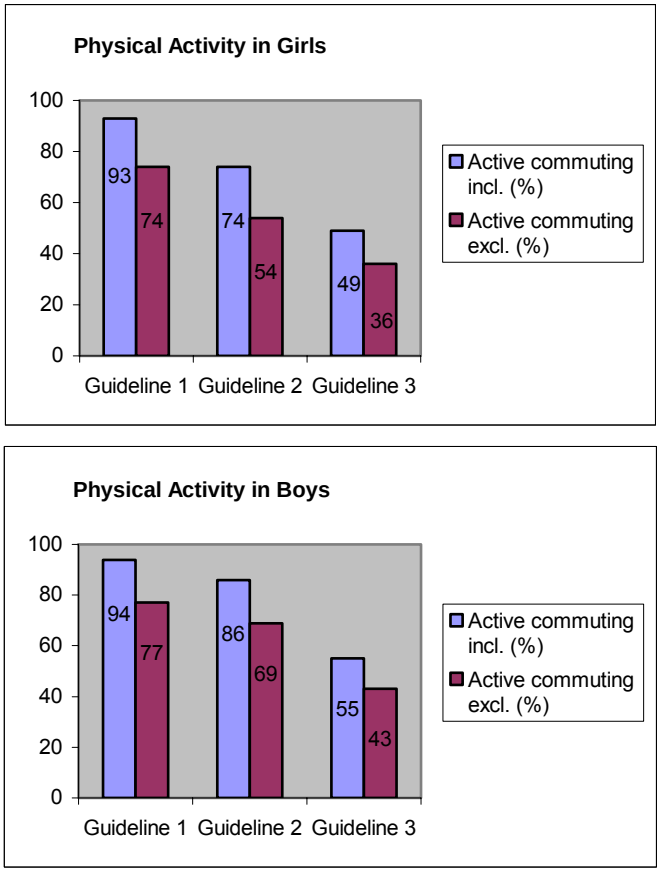


**Figure 1.** The proportion of children meeting health-related physical activity guidelines with active commuting included and excluded.

## Authors' discussion

***Re. methods.***

The method of assessing PA in children, parent-proxy, given by Armstrong & Welsman,[75] is more preferable than self-reporting methods. But the assessment method can in some circumstances, like in time-estimations, conduce to bias in estimation of prevalence and time spending on activities.

By asking about the mode of active commuting in study of PA, misclassification bias of children's PA levels was avoided.

Because of the design (cross-sectional) of this study, results can not be generalized.

***Re. 1*** Even though the aim of the study was on active commuting to school it seems as Russian children usually walk to where ever they need to go.

***Re. 2*** Guideline 3, recommend the highest minimum level of time in PA. To fulfil the recommendation by only active commuting it would require 10 one-way 42-minute trips on a school week. That is why, omitting active commuting to school have less impact on the proportion of children meeting guideline 3 then for the proportions of those meeting guideline 1 and 2.

[75] Armstrong N & Welsman J. Young People and Physical Activity. Oxford University Press 1997, Oxford.

***Further.***

The results of this study do not tell us about the effect of active commuting on children's health. Neither are the results telling us that active commuting is an appropriate PA. That is why more studies have to be done about children's commuting habits, choice of mode, the impact of active commuting and important health outcomes. A PA pattern of daily active commuting may provide health and economic benefits.

**My reflections**

***Re methods***

Guideline 1 is interpreted as a minimum of 150 minutes of PA per week or 30 minutes PA five days a week. The two definitions are in total time consistent. But, do the definitions differ in health outcomes? The first definition is not telling adolescents how many days per week they should be active, which could be interpreted as one day or seven days, while the second definition is saying that young people should be physically active five days every week.

The application of the guidelines may have resulted in an uncertainty about the number of children meeting the set activity levels. For example, guideline 2 is saying that children at least three days per week should do some kind of moderate PA for 20 minutes or more. Since the results of PA duration, from the questionnaire, were reported as hours per week the authors chose to set the minimum limit for meeting guideline 2 as engagement in MVPA for at least three hours per week on at least three separate days. Could this limit excluded children from guideline 2?

The authors have not separated children who were combining walking and car commuting from the other children who solely were walking or travelling by car. This makes it hard to know exactly how many children who only were walking and car driving.

***Re 1*** The problem with studying PA patterns is the assessment of PA. It is always difficult to know if one really measures the total PA, especially when it comes to questionnaires. The questionnaire, which was used in this study, might not have included the moderate PA of walking or bicycling to other destinations than to and from school. As the authors pointed out, the Russian children could likely walk to wherever they needed to go. Out-of-school PA was in this article not clearly defined as participations in structured PA, play and other movements between destinations. What information the parents got before answering the question is here unknown. Russia is a huge country with great distances. What the communities look like, we do not know. It could be that, movements from home to other destinations than to school, have great influence on the total PA. Also games and plays in this age may contribute to a large amount of moderate to vigorous PA. If these activities were included in the answers are not known. If not, this kind of PA and the movements between places could change the result and may lower the number of school-aged children not meeting guidelines. But still, as seen in the results active commuting to school has great importance on the children's PA.

***Re.2*** How much PA active commuting contribute to the Russian children's daily PA is not presented in this study, but if 17-19% of the children meeting guideline 1 are

classified as sedentary when omitting active commuting, it seems as the contribution of active commuting is of great importance for children's daily PA. As mentioned earlier we do not know anything about the Russian landscape. The country is large and wide and it could be that the Russian household are outspread and schools are situated far away from home. If distances to school are long, the Russian children might in average spend more time on walking to school than for example the British children.[76] The latter had in average 8-14 minutes daily active commuting, which are 18% of 60 minutes PA (recommended time spent on daily PA for children[77]). If these circumstances occur the contribution of active commuting to recommended 60 minutes is greater for Russian children than for the British ones. This indicates that differences in society structure could have importance to children having enough daily PA.

Only 33% of the Russian household reported owning a car and there are no school buses, which can be one of the reasons to the high number of children walking to school. This could also be evidence for less motorized vehicles in households and society affect the mode of commuting.

## Review 3. Patterns of physical activity among Russian youth. The Russian Longitudinal Monitoring Survey[78]

*Levin S, Ainsworth BE, et al.*

### Review

#### *The purpose*

The purpose was to describe the patterns of PA in Russian youth from the Russian Longitudinal Monitoring Survey (RLMS).

#### *Methods*

Between, 1992-1998 the Russian federation made a national household survey, The Russian Longitudinal Monitoring Study (RLMS). This survey is the first one that represents the whole country. PA data from the RLMS was obtained in November 1998, second phase of the survey. Parents were questioned about their children's participation in different PA. A compilation of duration, frequency and type of PA for each child was obtained. Additionally, questions about the mode of children's commuting to school (walk/bicycle/car) and its duration (minutes/day), both to and from school, were included. Active commuting is classified as a moderate physical activity.[79]

[76] Cooper et al. 2003, p. 275.
[77] Health Education Authority (Biddle, Sallis & Cavill, 1998): Sallis JF, Owen N. Physical Activity&Behavioral Medicine, SAGE Publications, Inc 1999; 63.
[78] Levin S, Ainsworth BE, Kwok CW, Addy CL, Popkin BM. Patterns of physical activity among Russian youth. The Longitudinal Monitoring Survey. Eur J Pub Health 1999;9:166-173.
[79] Ainsworth BE, Haskell WL, Leon AS, et al. Commpendium of physical activities: classification of energy costs of human physical activities. Med Sci Sports Exerc 1993;25(1):71-80.

By using MET-values the intensity levels were set[80] according to table 1. The definition of MET-value can be found in earlier pages, the review of Cooper et al. 2003.

| | | | |
|---|---|---|---|
| **MET-value** | < 3 | 3-6 | > 6 |
| **Grade of PA** | Light | Moderate | Vigorous |

**Table 1.** MET-factors for respectively intensity of physical activity.

Depending on how much PA the children had every week; they were divided into groups defined by following health-related PA guidelines:

1. All adolescents should be physically active daily, or nearly every day, as part of play games, sports, work, transportation, recreation, physical education or planned exercise, in the context of family, school and community activities (Sallis & Patrick 1994).[81] This was defined, by Pate et al 1995,[82] as 30 minutes PA every day, five days per week.
2. Adolescents should engage in three or more sessions per week of activities that last 20 minutes or more at a time and that requires moderate to vigorous levels of exertion (Sallis & Patrick 1994).[83]

The study subjects were 2101 school children, 1072 boys and 1029 girls, aged 11.82 ± 3.60 years.

Children were divided into three age groups regarded to school year:

6-11 years (elementary school)
12-16 years (high school)
17-18 years

The last age group (17-18 years) was only asked about their time spent on light activities (household activities).

**Results**

3. Most of the PA was practiced before and after school (> 5hours/week).

   ¾ of the girls and ½ of the boys (in total, less than 70%) met guideline 1. Less than 45% of the Russian children met guideline 2 and the majority are boys and girls in age group 6-11. Gender differences occurred first in older age group, where more boys than girls are meeting guideline 2.

[80] Ainsworth et al.1993 p. 71-80.
[81] Sallis et al. 1994, p. 6.
[82] Pate RR, Pratt M, Blair SN, Haskell WL, Macera CA, Bouchard C et al. Physical activity and public health: a recommendation from the Centres for Disease Control and Prevention and the American College of Sports Medicine. J Am Med Ass 1995, 273, 402-407.
[83] Sallis et al. 1994, p. 6.

4. Average time spent on active transportation to and from school for this population was 1.6 hours/week for both gender and age groups.

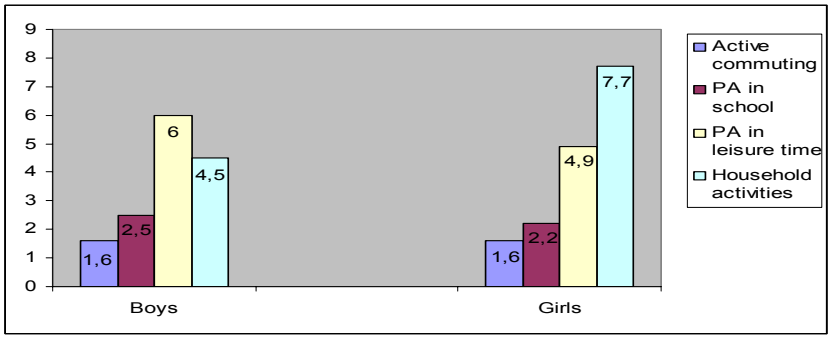


**Figure 1.** Weekly time (hours) spent on various physical activities in proportion to each other.
***** PA in leisure time is not including active commuting.

5. The average time for all Russian youths engaged in physical education classes was approximately 2 hours/week. 2.2 hours/week were spent by Russian children aged 6-11 years, while the older ones (12-16years) spent 2.7 hours/week. No gender differences could be found within age group for time spent on physical education classes. The majority participated twice a week and less than 1% participated every day.
6. Time spent on PA before and after school was higher in boys from both age groups compared to the girls. PA during leisure time, in girls, decreased with age, 5.3 hours/week (6-11years) compared to 4.5 hours/week (12-16 years).
7. Engagement in household activities is higher among girls and time spent on these activities increases with approximately 2 hours/week per age group.
8. Patterns of sedentary activities are similar for girls and boys. Approximately 28 hours/week are spent on sedentary activities of which 41% is time spent on watching TV.

## Authors' discussion

### *Re. methods*

Parent-proxy, which has been used in this study for assessing children's PA patterns and behaviour, is not an accurate or precise method.

PA data was missing for age group 17-18, which is the reason for excluding them from other activities but household activities. If this group is turning out to be inactive, the proportion of children meeting guidelines is overestimated.

The survey did not include youth, aged 17-18, enrolled in the army, which could have reduced the representativeness of the age group.

Time spent on PA was asked to be reported in hours/week. This made it difficult to classify children to guideline 1. That is the reason why guideline 1 was defined as 150 minutes/week which in time is equivalent to 30 minutes/day, 5 days/week.

Guideline 2 is recommending three 20 minutes sessions PA per week. Because this study assumed 1 hour of reported PA equals one session, the proportion of children meeting guideline 2 was underestimated.

***Re. 1*** It is difficult to compare the proportion youth meeting guideline 1 with other countries, because different studies have been assessing PA of different intensity levels. Data from the US Youth Risk Behaviour Survey (YRBS) is comparable with data from RLMS and the pattern of proportion children meeting guideline 1 is similar.

Proportion of Russian children meeting guideline 2 is low and similar pattern is seen in many countries.[84, 85, 86]

***Re. 3*** Similar patterns appear in Canada and in the USA[87, 88]. Most PA of moderate and vigorous levels occurs at leisure time and the participation of physical education classes is very low.

***Re. 6*** Russian youth are spending more time on sedentary activities compared to time spent on MVPA.

**My reflections**

***Re. methods***

As questioned in review 2, Tudor-Locket et al. 2002, is there any differences in health outcomes when children are physically active 30 minute/day five days per week or if children are physically active 150 minutes/week.

The question about school transportation is not specifying how children usually get to school. Subjects could have given two answers, for example by car and walking, even though subjects were more frequent walking or car driving.

***Re 1*** The reason to why more boys than girls in age group 12-16 years met guideline 2 could depend on that girls increased their time on household activities.

***Re. 2*** Active transportation to school is 96 minute/week, which per day results in 19.2 minutes of MVPA. This means that active commuting contribute with 32% daily MVPA to children in meeting the recommended 60 minutes of MVPA per day (international PA guidelines[89]).

[84] Ekelund UM, Sjostrom M. Levels of physical activity in adolescents in relation to published guidelines. Med Sci Sports Exerc. 1997;29(suppl):893.
[85] Gilbey H, Gilbey M. The physical activity of Singapore primary school children as estimated by heart rate monitoring. Pediatr Exerc Sci. 1995;7:26-35.
[86] Armstrong N, Balding J, Gnetle P, Kirby B. Patterns of physical activity among 11 to 16 year old British children. BMJ 1990;301:203-5.
[87] Stephens T, Craig CI. The well-being of Canadians: highlights of the Cambells' survey. Ottowa: Canadian Fintess and Lifestyle Research Institution, 1986.
[88] Ross JG, Dotson CO, Gilbert GG, Katz SJ. After physical education: physical activity outside of school physical education programs. J Phys Educat Recreat Dance 1985;56(1):77-81.
[89] Health Education Authority (Biddle, Sallis & Cavill, 1998): Sallis JF, Owen N. Physical Activity&Behavioral Medicine, SAGE Publications, Inc 1999; 63.

Approximately 17% of daily MVPA is active commuting to school. This is twice as much as the contribution of active commuting in the British children's daily MVPA.[90]

***Re. 3*** Less than 1% of the Russian children participate daily in school physical education classes. This leads to the conclusion that PA at school is not an important source of daily MVPA for the Russian children.

***Re. 4*** It seems as girls in age group 12-16 had to decrease their time in PA during after school in favouring the household activities. If this is a normal pattern, increased household activities decreases the time of MVPA in leisure time, active commuting could be of importance for older girls to meet the international guideline.[91]

## Review 4. Objective physical activity of Filipino youth stratified for commuting mode to school[92]

*Tudor-Locke C, Ainsworth BE et al.*

**Review**

***The purpose***

Comparing the PA in Filipino adolescents with different commuting mode to school was the main issue. But, the association of active commuting and socio-economic status were also examined.

***Methods***

The Cebu Longitudinal Health and Nutrition Survey (CLHNS) is a community-based study, designed for studying infant feeding patterns and practices. The children and their families, who participated in the survey, lived in the surrounding of Cebus area; both urban and rural communities were included. The children who took part of the survey were followed up through adolescence and adulthood for studies about their health. PA was one of the topics and was measured by self-report and objective assessment of energy expenditure with a Caltrac accelerometer during 24 hours observation.

The study population was 1518 youth (691 male and 827 female) enrolled in school, aged 15.5±0.5 (male) and 14.5±0.5 (female).

Caltrac (Muscle Dynamics, Torrence, CA) is an accelerometer assessing vertical acceleration from the test person's body. By entering data: age, weight, height and gender, in the Caltrac, the activity-related energy expenditure (EE), in kcal, is calculated. Because of the instrument's limit of storing data on a minute-by-minute level, the Caltrac can only be used

[90] Cooper AR, Page AS, Foster LJ, Qahwaji D. Commuting to school. Are children who walk more pysically active? Am J Prev Med 2003; 25(4):273-76.
[91] Health Education Authority (Biddle, Sallis & Cavill, 1998): Sallis et al. 1999; p. 63.
[92] Tudore-Locke C, Ainsworth BE, Adair LS, Popkin BM. Objective physical activity of Filipino youth stratified for commuting mode to school. Med Sci Sports Exerc. 2003 Mars; 35(3): 465-71.

for studies that measure total PA during a specific period of time[93]. The instrument has been classified as valid and reliable to objectively measure EE in PA[94, 95].

Time spent on active commuting was calculated for round trips and the energy expenditure of walking to school was determined by an individual adjusted formula.[96]

(3.5 METs * BW) * (Time/60 min)

* BW = body weight, Time = time for round trip, min = minutes

For the passive commuting group, time spent on walking to school was set to zero.

Self-reported PA behaviour was done by a questionnaire asking about PA on levels of at least moderate. Activities that were classified as sports and exercise and non sports/exercise were defined according to the Compendium of Physical Activity.[5] The PA pattern was identified by the reported frequency (days/week) and duration (minutes or hours/week) of activities at school, after school and also by reported mode of active commuting to school. The choice of answers for mode of commuting:

1. Walking
2. Bicycling
3. Using motorized vehicle
4. Combination of alternative 1 and 3
5. Other

**Results**

***1.*** Almost 47% respectively 37% of the male and female subjects are walking to school, while approximately 1/5, for both genders, is using motorized vehicles. More girls (42%) than boys (30%) use the combined mode of commuting.

TEE is higher in boys than in girls after adjustments for age, height and weight, 358.6 respectively 276.5 kcal/day.

Adjusted mean value of TEE for walking boys is 375.0 kcal/day compared to 330.8 kcal/day in passive commuting boys. The corresponding values of TEE for the active respectively passive commuting girls are 288.5 kcal/day and 255.3 kcal/day, se table 1.

The difference in EE between those adolescents who are walking and those who are using motorized vehicles is 44.2 kcal/day for male, respectively 33.2 kcal/day for female, table 1.

[93] Welk GJ. Physical activity assessments for health-related research, Iowa State University, 2002; 127-128.
[94] Pambianco G, Wing RR, Robertson R. Accuracy and reliability of the Caltrac accelerometer for estimating energy expenditur. Med Sci Sprots Exerc 1990, 22: 858-62.
[95] Sallis JF, Buono MJ, Roby JJ, Carlson D, Nelson JA. The Caltrac accelerometer as a physical activity monitor for school-age children. Med Sci Sports Exerc 1990, 22: 698-703.
[96] Ainsworth BE, Haskell WL et al. Commpendium of physical activities: an update on activity codes and MET intensities. Med Sci Sports Exerc 2000 Sep; 32(9 Suppl): 498-504.

| Gender | Walking | Motorized Transport | Combined |
|---|---|---|---|
| *Male (N=691)* | 323 (47%) | 160 (23%) | 208 (30%) |
| *Caltrac (kcal/day)* | 375.0 | 330.8 | 376.3 |
| *Female (N= 827)* | 303 (37%) | 177 (21%) | 347 (42%) |
| *Caltrac (kcal/day)* | 288.5 | 255.3 | 263.9 |

**Table 1**. Number of adolescents who walk, use motorized transport or both modes to school and adjusted (age, height, weight) mean total energy expenditure, measured by Caltrac, for respectively commuting mode and gender.

Reported median time spent on walking to school is from the girls 30 minutes/day and 20 minutes/day from the boys. Converted to EE the time spent on walking to school are equal to 58 kcal respectively 67 kcal.

Higher EE is observed in those male adolescents who are combining the two modes or just walking to school compared to motorized transport commuting boys, while the combination of the two modes and transportation by motorized vehicle are, for the young women, related to lower daily EE than for walking female adolescents, se table 1.

The active commuting data could not be estimated for those youth who combined the two different modes to school.

***2.*** Boys are significantly more physically active compared to the opposite sex. Their PA participation in school education classes and leisure time PA is more frequent and the duration is longer compared to the girls.

Time spent on exercise in/after school is not significantly related to the mode of commuting for both genders.

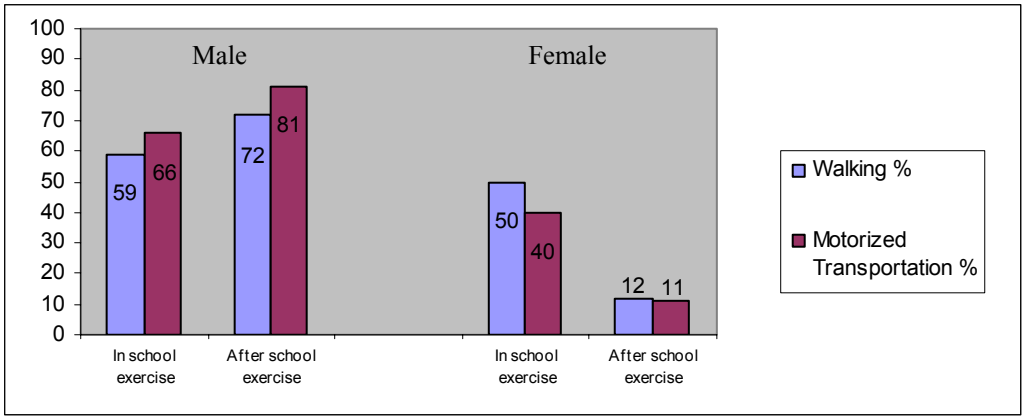


**Figure 1.** Proportion of youth engaging in PA during and after school related to the mode of commuting.

Commuting modes are not related to participation in PA in school and after school for both genders, except for the difference in school exercise participation between walking and motorized transport using female. A significant larger proportion of walking girls, than passive commuting girls, are taking part of school exercise, fig. 1.

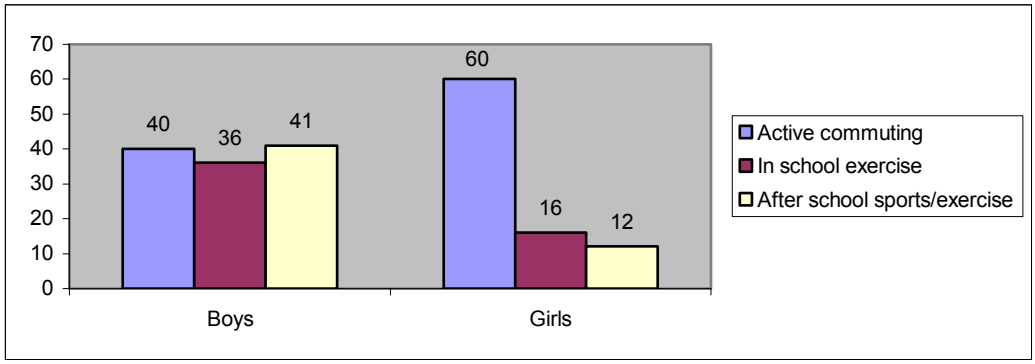


**Figure 2.** Median reported time spent on active commuting, in school and after school exercise per day.

***3.*** Significant differences are occurring, for both genders, between household characteristics and choice of mode commuting to school, fig. 3. Those with higher income tend to use motorized vehicles more than walk. Both ownership of motorized vehicles and televisions have negative relation to active commuting.

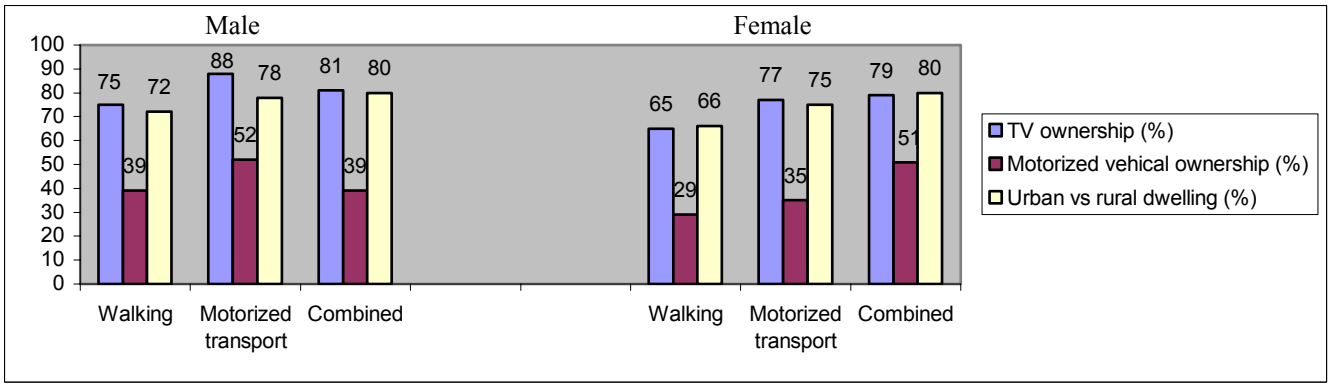


**Figure 3.** Household characteristics associated with mode of commuting

Greater proportion of youths that reports using motorized transport to school also reports owning any motorized vehicle and the same pattern occurs for television ownership. Less female than male subjects come from households owning motorized vehicle and television and urban dwelling was associated with passive commuting in young women.

No significant associations between settlement in rural or urban area and way of commuting to school for men but for women.

***4.*** The male students expend more energy, are taller and heavier than the female.

## Author's discussion

***Re. methods***

The primary limitation of this study is the incomplete contextual information about commuting to school in the Philippines. For example, female adolescents living in the urban was associated with passive modes. The reason could be of safety concerns for the young women living in metropolitan areas. High socio-economic status, indicated, in this study, by ownership of televisions and motorized vehicles, was also consistently associated with passive commuting in both male and female. But the availability of motorized vehicles does also give opportunities to sedentary behaviour.

Even though assessments of EE with the Caltrac only were for 24 hours, the obtained results are believed to be reliable because of the small SD.

EE data from the Caltrac was modified by adjustments for gender, age, height and weight for avoiding confounding.

***Re. 1*** The choice of commuting mode is influenced by numerous of factors:

- distance
- cost
- socio-economic status of the family
- availability of motorized vehicles

Comparing the prevalence of walking to school with the proportion of ownership of motorized vehicles, 40% of the Filipino youth and 10% of the adolescents in the USA, are walking, while 40% of the households in this study own a motorized vehicle, 92% of the American households have cars or other similar vehicles.

The difference in TEE between walking and passive commuting adolescents is of great deal during one year. Differences between commuting modes will, for this study, increase 2-3 lb yearly on those young people who use motorized transport, if other factors being held constant. This is based on that active commuting, according to data received from the Caltrac in this study, contributes with 33-44 kcal more per day, which during 200 school days in a year will turn to 6640-8840 kcal. And this is estimated to a weight gain of 2-3 lb.

The differences, between walking female and male, in reported time and EE might have been influenced by differences in travel distance and the speed of walking. But observed PA differences between genders are consistent with earlier findings, for both amount and duration of PA.

Data information of walking distances is difficult to measure for those who are both walking and using passive commuting mode. That is the reason why information about the walking distances for this group is missing.

***Re. 3*** A social and economic transition is occurring on the Philippines and this may not unexpectedly influence the people to a more sedentary lifestyle. The advantage of a modernized society may negatively influence the public health in a developing country. Even though vague evidence for changing commuting behaviour in adolescents, from active to passive, increases the risk for obesity, a cross-sectional and cohort study shows that availability of motorized vehicle in the household is associated to obesity in Chinese adults. And, procuring of a motorized vehicle

increases the risks of becoming obese in Chinese men during a period of eight years.[97] The prevalence of obesity is low in the Philippines, but an increasing of utilization of motorized vehicles is expected and it is of great importance to follow-up the trend of increasing ownership of motorized vehicles and its association to the active commuting.

***Further.***

Despite of the limits, this study is an important baseline for continuous researches about the influence of increasing motorized vehicles on PA and about the influence on the progressing of obesity in Filipino youth. It is also taking us one step forward towards the understanding of health effects of behaviour in short distance transportation modes.

If active commuting to school is a healthy PA for children, is still unknown but, studies on adults commuting actively to work have resulted in lower risk of breast cancer in women,[98] decreasing risk of all-cause mortality in adults[99] and also decreasing risk of hypertension in Japanese business men.[100] Further longitudinal analysis of some of the mentioned topics, influence of motorization on PA and its influence on obesity, is planned. This study is an additional evidence of the importance of active commuting to overall PA in young people.

**My reflections**

***Re. 1*** By using the formula, (3.5 METs * BW) * (Time/60 min),[101] the amount energy accumulated from 60 minutes of MVPA (recommended time and intensity according to PA guidelines for young people[102]) was calculated for this population (body weight 41.8 kg for female and 46.9 kg for male), 146.3 kcal for girls respectively 165.2 kcal for boys.

Reported median time of active commuting was 30 minutes for girls respectively 20 minutes for boys. This is equivalent to 58 kcal (girls) respectively 67 kcal (boys) in EE. Comparing median time spent on walking to school with recommended 60 minutes, girls are reaching 50% and boys 33%of the recommendation. Looking at the calculated EE for walking to school and comparing it with the recommendations converted to EE, boys are reaching 2/3(41%) of the recommended PA, in EE, and so do girls (40%). This makes one wonder if it is possible to compare an activity expressed in EE to the PA recommendations, which is expressed in time? As seen above EE and time are not equivalent.

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[97] Bell AC, Ge K, Popkin MB. The road to obesity or the path to prevention: motorized transportation and obesity in China. Obes Res 2002, 10: 277-83.

[98] Luoto R, Latikka P, Pukkala E, Hakulinen T, Vihko V. The effect of physical activity on breast cancer risk: a cohort study of 30548 women. Eur J Epidemiol 2000, 16: 973-80.

[99] Andersen LB, Schnohr P, Schroll M, Hein HO. All-cause mortality associated with physical activity during leisure time, work, sports and cycling to work. Arch Intern Med 2000, 160: 1624-28.

[100] Hayashi T, Tsumura K, Suematsu C, Okada K, Fujii S, Endo G. Walking to work and the risk for hypertension in men: the Osaka health survey. Ann Intern Med 1999, 130: 21-26.

[101] Ainsworth BE et al. 2000, p. 502.

[102] Health Education Authority (Biddle, Sallis & Cavill, 1998): Sallis JF, Owen N. Physical Activity&Behavioral Medicine, SAGE Publications, Inc 1999; 63.

Could the difference in commuting mode, over time, affect adolescents' health if passive commuting yearly contributes to 2-3 lb weight gain? Overweight and obesity are related to CVD, hypertension, diabetes type 2 and cancers.[103] If active commuting may prevent weight gain, it could also prevent health related diseases in adolescents' future adulthood.

***Re. 2*** As seen in earlier studies,[104, 105, 106] boys are more physically active than girls. Boys do also tend to take part of PA in longer duration. But, no relation between the tendency of active commuting and the overall PA can be found.

***Re. 3*** Could there be an association between the proportions of ownership of motorized transportation and the choice of commuting mode?

Regarding to the adolescents' mode of commuting to school, 22.2% reported transportation of motorized vehicles, 41.2% reported walking and 36.6% reported combining the two modes. If Filipino youths who are both walking and passively travelling to school are included in the active and passive commuting groups, the proportion of walking Filipino students would reach 77.8% and passive travelling Filipino youths would be 58.8%. Usually when people in the Philippines need to get somewhere a public transportation called jeepney is used. It is an inexpensive form of transportation. A jeepney is like a jeep, but modified, and has bench seating. Few persons are transported by car. It is most possible that those youth who are combining the both mode of transportation is walking to and from the jeepney stop.

Comparing these figures to earlier reviews (Cooper et al 2003 and Tudor-Locke et al. 2002), Filipino youths is less physically active, regarding commuting to school, than Russian children[107] (91.6% walking and 12.7% car driving) even though when the Filipino "combining" youths are included in the group of walking. Comparing the Filipino children to the British children[108] (64% walking and 36% car driving), proportionally more British ones are car travelling. Less Filipinos are solely walking to school than British children. It could depend on the difference in distance and community structure. But, if the "combining" Filipino children are included to the walking ones, the proportion of walking Filipino children would be larger than British children. Ownership of motorized vehicle is greater in the Philippines (40%) than in Russia (33%) and of greatest proportion in the GB. This could explain the different proportion of children and adolescents using cars.

Also the difference, between countries, in contribution of active commuting to the PA recommendations could be evidence for different structures in societies and socio-economic status being potential barriers for children choosing active commuting.

Those young person who are using motorized transport, might have longer to school than the other. It is hard to make any conclusion about the choice of commuting to school, when the landscape and the structure of the communities are unknown. It could be that schools in the smaller rural communities are closer to the habitations than schools in the urban or vice versa. But as the results show urban dwelling seem to influence young women's choice of commuting.

[103] Sallis J et al. 1999, p. 22-27.
[104] Cooper AR et al. 2003, p. 275.
[105] Tudor-Locke C et al. 2002, p.510.
[106] Levin S, Ainsworth BE, Kwok CW, Addy CL, Popkin BM. Patterns of physical activity among Russian youth: The Russian Longitudinal Monitoring Survey. Eur J Pub Health 1999;9:166-73.
[107] Tudor-Locke C et al. 2003, p. 509.
[108] Cooper AR et al. 2003, p.274.

It will be interesting to se the influence of a modernization on the Filipino way of commuting and using of motorized vehicle and how these factors in turn influence the body weight and health in the population. Will the society and its structure change according to the western influences and how is the promotion of public health adapted to these changes?

As the results show the modernization and increasing ownership of electrical domestics and motorized vehicles might indicate a declining active lifestyle in favour for sedentary. As the social and economic transition is occurring in the country, greater differences in social classes may appear and the structure in the society might also change. More barriers, for example crime, traffic dangers and increased worry of safety for active commuting will then appear and this can influence the way of commuting to school.

## Review 5. Physical activity and inactivity in Chinese school-aged youth: the China Health and Nutrition Survey[109]

*Tudor-Locke C, Ainsworth BE et al.*

**Review**

***The purpose***

The aim was to describe patterns and levels of PA and inactive in Chinese school children.

***Methods***

The China Health and Nutrition Survey (CHNS) was designed to examine how the socio-economic transformation of the Chinese society had effected the health and nutrition status in the Chinese population.[110]

PA and inactivity data were collected and analysed from1423 boys (11.5±3.2 years) and 1252 girls (11.5±3.3 years).

The children were questioned about their PA inside and outside school, the commuting mode to school and inactive occupations during leisure time. For all activities the duration was reported. Other occupations like household chores, childcare duties, gainful employments (question only for youth aged 16-18) and contribution to family income were also asked in the questionnaire. Children under the age of 10 had parents helping them to answer the questions.

The reported activities were assigned MET values by using "Compendium of Physical Activities"[111] and the intensity levels of the MET-factors were defined as earlier reviewed studies.[112, 113]

[109] Tudor-Locke C, Ainsworth BE, Adair LA, Du S, Popkin BM. Physical activity and inactivity in Chinese school-aged youth: China Health and Nutrition Survey. Inter J Obes. 2003;27:1093-99.
[110] Tudor-Locke et al. p. 1094.
[111] Ainsworth BE, Haskell WL et al. Commpendium of physical activities: an update on activity codes and MET intensities. Med Sci Sports Exerc 2000 Sep; 32(9 Suppl): 498-504.
[112] Cooper AR, Page AS, Foster LJ, Qahwaji D. Commuting to school. Are children who walk more pysically active? Am J Prev Med 2003; 25(4):273-76.

Because of the Chinese children under the age of 12 usually do not ride a bicycle themselves and 12 years is the age when children enter middle school, the children were divided in to two age groups, children younger than 12 years and children 12 years and older.

## Results

***1.*** Active commuting and PA in school contributed to the most of the daily PA in Chinese children independently of gender and age.

No significant difference, in proportion of children, was found between genders within age group for active commuting. But, significant age group differences occurred for both genders regarding reported time spent on active commuting. Older children (≥12 years) spent more time on active commuting and were more frequently walking then children in the younger age group. Furthermore, children under 12 years usually commute passively to school on their parents' bicycle.

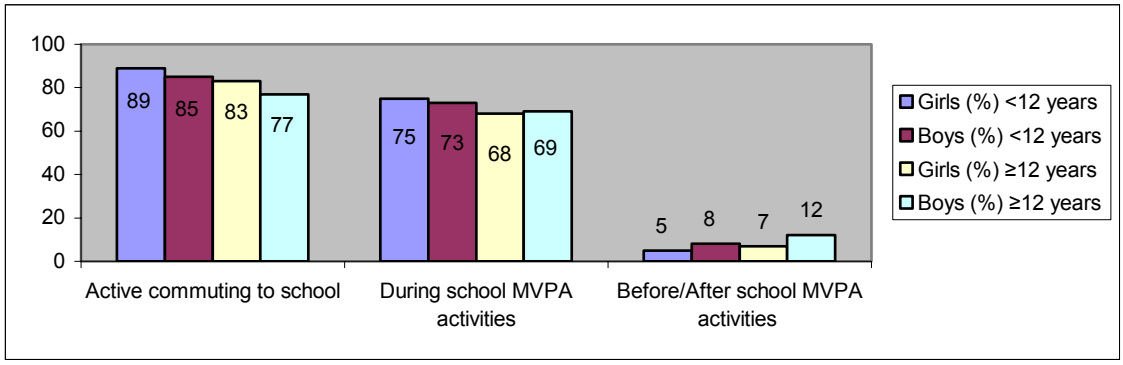


**Figure 1.** Proportion children reported doing/taking part of active commuting, MVPA at school and MVPA outside school (active commuting excluded).

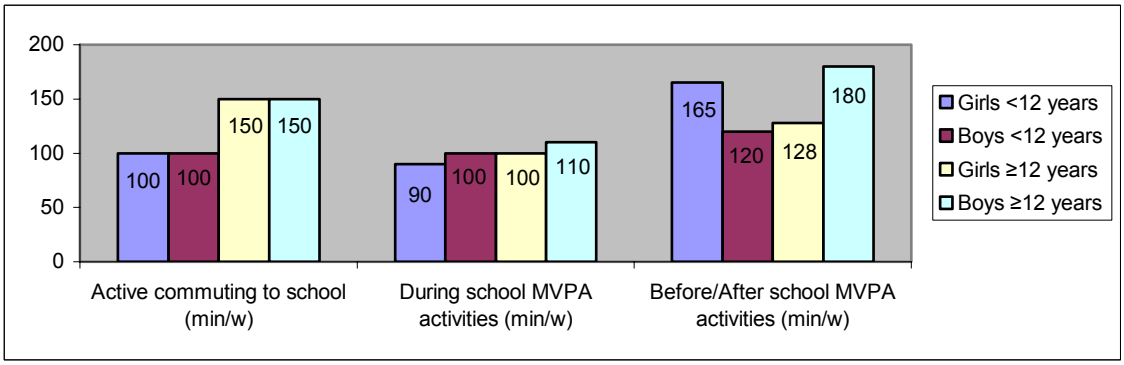


**Figure 2.** Median time spent on respectively activity. Before/after school activities are not including active commuting.

[113] Tudor-Locke C, Neff LJ, Ainsworth BE, Addy CL, Popkin BM. Omission of active commuting to school and the prevalence of children's health-related physical activity levels: the Russian Longitudinal Monitoring Study. Child Care Health Dev. 2002 Nov; 28(6):507-12.

***2.*** Gender and age differences occurred in children's PA at school. Fewer children ≥12 years took part of any PA in school compared to the younger ones. But, those who were engaged in school physical activities were spending significantly more time on these activities than younger children. Older male students were also more active in school than female subjects in the same age group. No significant gender difference in the younger age group.

***3.*** MVPA during leisure time is not usual among Chinese youth. Significantly more children ≥12 years are engaged in leisure time activities and gender difference occurs in both age groups. Less female students, no matter age group, are engaging in any leisure time PA. Gender and age have no relation to the time spent on these activities.

***4.*** Household TV ownership is more than 90% but, not more than 8% of the Chinese youth, no matter gender, is watching TV ≥2 hours per day and less than 1% are spending ≥4 hours per day on TV viewing.

Statistic significance between age groups in reporting duration of physical inactivities such as /reading/writing/drawing/TV and video viewing, older children spend more time on these activities.

Girls tend to spend more time on sitting games, but overall result is that few Chinese youth reported engaging in sitting games (video games are included).

15-17% of households own any motorized vehicle.

***5.*** Less than 2% are engaged in gardening/farming/gainful employment and less than 1% of the children have childcare duties.

**Authors' discussion**

***Re. 1*** Mode of commuting is likely influenced by following factors

- the distance to school
- the cost
- the household income
- the availability of motorized transportation
- age (the ability to ride a bicycle)

***Re. 2*** 72% of Chinese youth are engaging in school PA compared to 21-22% young people in the USA.

Even though reported time spent on PA in school seem to have been overestimated in the Chinese children, recall bias, it is likely that Chinese youth spend more time on PA during school than the American children. Data is compared with results from the study of Simons-Morton et al. 1993.[114] The study reported that the actual time, spent on MVPA during school education classes is less than 9% of class time among fifth-grade students in US schools.

[114] Simons-Morton BG, Taylor WC, Snider SA, Huang IW. The physical activity of fifth-grade students during physical education classes. Am J Public Health 1993, 83:262-64.

***Re. 4*** The low number of children watching TV may depend on the difference in viewing habits. 48% of the Filipino youth are spending more than 2 hours/day on watching TV. This can be compared to the habits of the US children; 65-67% is viewing TV at least 2 hours/day, who have greater access to satellite TV. TV viewing is related to the prevalence of obesity.[115, 116, 117] An increase of overweight and obesity is expected in the Chinese children, as the availability of satellite TV increase.

The children in China are expected to perform well in school and it is very typical that they get a lot of homework, which influence their leisure time. This might explain the habits of TV viewing.

***Re. 5*** The small proportion of Chinese youth having childcare duties is related to the national birth control polices, which have limited the family size.

## My reflections

***Re 1*** Active commuting to school is contributing with over 30% (in time) of MVPA to total daily MVPA in Chinese children and adolescents. This can be compared to the British,[118] Filipino[119] and Russian[120] children where active commuting is 9-10%, 21-52% and 13-18% of total daily MVPA, fig. 3.

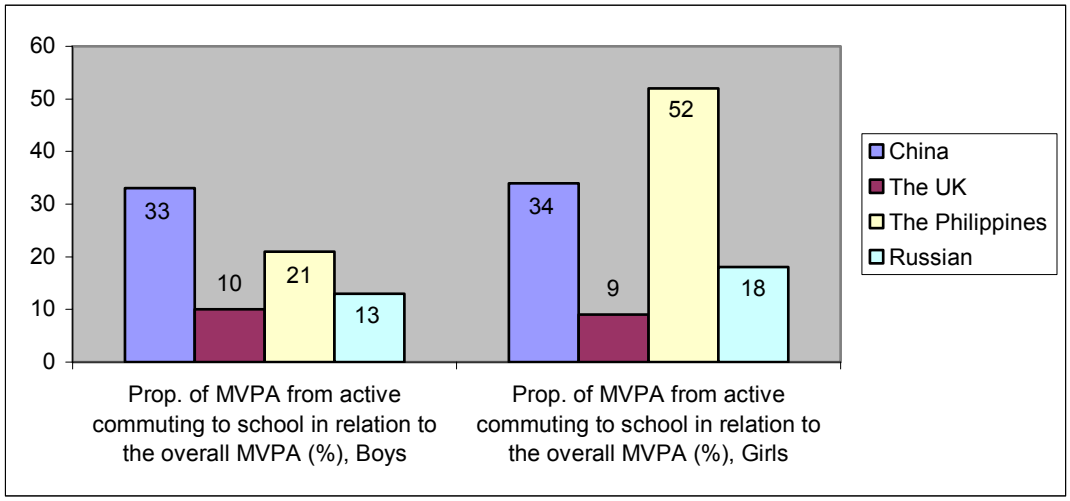


**Figure 3.** Proportion MVPA from active commuting (per child) in relation to the overall daily MVPA for the entire population between different countries.

[115] Anderson RE, Crespo CJ, Bartlett SJ, Cheskin LJ, Pratt M. Relationship of physical activity and television watching with body weight and level of fatness among children: results from the Third National Health and Nutrition Examination Survey. JAMA 1998;279:938-42.
[116] Crespo CJ, Smit E, Troiano RP, Bartlett SJ, Macera CA, Andersen RE. Television watching, energy intake, and obesity in US children: results from the Third National Health and Nutrition Examination Survey, 1988-1994. Arch Pediatr Adolesc Med. 2001;155:360-65.
[117] Eisenmann JC, Bartee RT, Wang MQ. Physical activity, TV viewing and weight in US youth: 1999 Youth Risk Behavior Survey. Obes Res. 2002;10:379-85.
[118] Cooper et al. 2003.
[119] Tudore-Locke et al. 2003.
[120] Levin S et al. 1999.

Few Chinese children are participating in after school sports (5-15%). But those who are engaged in sports after school are spending remarkably much time on these activities. This is the reason to why active commuting in the Chinese children contributes with 33-34% to the overall daily MVPA. If the time spent on after school activities from this group was excluded from the overall PA, contribution of active commuting would be more than 50%.

Active commuting is 35% of the recommended[121] 60 minutes per day and 70% of the lowest limit, 30 minutes (recommendation for very inactive children). The Russian study[122] showed that if active commuting was omitted from the daily PA, numerous of children would not have reached the minimum limit of PA recommendation (at least 30 minutes of PA per day five days per week). Instead they would have been classified as sedentary. If active commuting would be excluded from the Chinese children's daily PA, several more young people would have been classified as sedentary. This indicates that active commuting is of great importance in some cultures and countries of which the socio-economic circumstances are not as well as in the western countries.

Less than 18% of the children are passive traveller, but many of these are children younger than 12 years who are not allowed to ride a bicycle. Instead it is usual that children are riding on the back of their parents bicycle.

***Re. 2*** Because Chinese children do not have much spare time after school, when they have to spend lots of time making their huge amount of homework, school PA seem to be an important source of MVPA. As earlier mentioned, omitting these activities do also exclude a lot of children from meeting the lowest limit of PA guideline.

***Re. 3*** In this population active commuting to school does not seem to have any relationship to the leisure time PA and vice versa. No patterns of relationship between commuting mode and the overall PA have been found in earlier studies.

***Re. 4*** Proportion of Chinese people owning a motorized vehicle is less than 17%, while the possession of bicycles is 79%. In relation to the earlier studies, this implies that higher proportion of car ownership among the population is increasing passive commuting and decreasing active transportation to school, fig. 4.

[121] Biddle S, Cavill N & Sallis J. Policy framework for young people and health-enhancing physical activity. In Young and Active, Health Education Authority, London.
[122] Tudor-Locke et al. 2002.

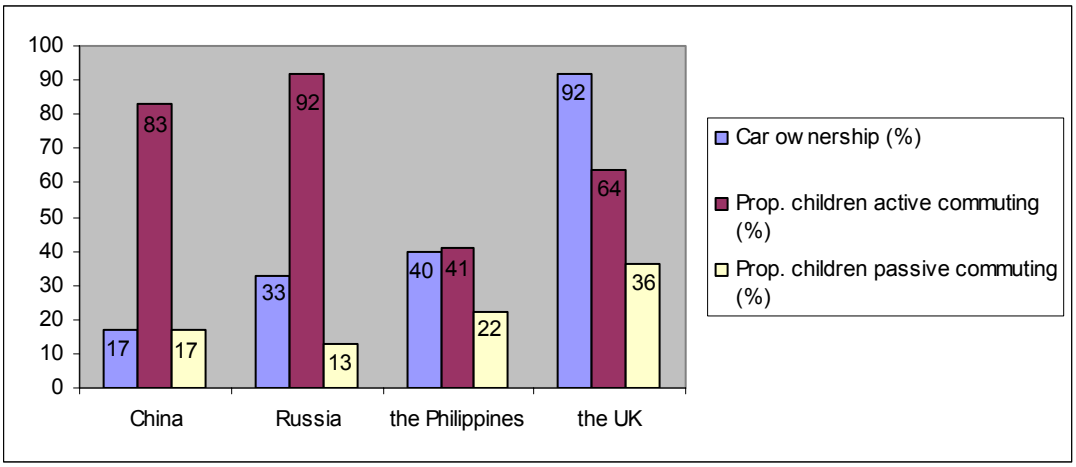


**Figure 4.** Comparison between car ownership and the proportion of active and passive commuting children in respectively country.
***The proportion of children active and passive commuting in Russia is including children using the both modes to commute to school.
**** There is a group of youths (37%) in the Philippines that are combining active and passive mode when commuting to school, which are not presented in this figure.

***Re. 5*** Very few Chinese children (11-20%) have to engage in the family household work after school, but are instead occupied with lots of homework. Comparing them with the Filipino youths, the most frequently reported activities after school in the Filipinos were household chores.[123] These obligations among the Filipinos might be, such as for the Chinese youths, a factor which decreases their opportunities to take part of any after school activities of moderate or vigorous level, especially among girls. Only 12% of the girls are engaging in any leisure time sports and the median duration of the activities are 12 minutes per day. A larger proportion of boys (74%) are participating in after school sports, but reported median duration is hardly 40 minutes every day.

The Russian children do also have household duties. But, as they are able to spend an average time of 73 minutes on daily PA after school, and less time on house hold chores, shows that Russian children do not have as much obligations in the households as the Filipino youths.

There is evidence that culture differences are key factors to children's opportunities to take part of any PA of moderate to vigorous levels in spare time.

[123] Tudor-Locke C, Ainsworth BE, Adair LS, Popkin BM. Physical activity in Filipino youth: the Cebue Longitudinal Health and Nutrition Survey. Int J Obes Relat Metab Disord. 2003 Feb;27(2):181-90.

## Review 6. An international study of the exposure of children to traffic[124]

*Roberts I et al.*

### Review

***The purpose***

The purpose of this study was to examine the extent of international differences in children's exposure to traffic as pedestrians or bicyclists.

***Methods***

By using a parent-child-proxy questionnaire, travel patterns in children from six cities in five countries were surveyed.

The cities were:

Melbourne (Australia)
Perth (Australia)
Montreal (Canada)
Auckland (New Zealand)
Umeå (Sweden)
Baltimore (the USA)

The questionnaire was handed out in school to the children. Parents and child had to answer the question about the child's transportation mode, the duration of transportation and the number and type of streets crossed on foot before school, to school and after school on the same day the questionnaire was handed out. As a socio-economic indicator parents were questioned about car ownership; how many cars the family had.

Children from age group 6 and 9 years were selected, because the pedestrian injury rates are highest between these ages. Totally 13423 children completed and returned the questionnaires. The respond rates differed between countries, table 1.

| City | Number of schools | Children | *Response rate (%)* |
|---|---|---|---|
| Melbourne | 72 | 3198 | *82* |
| Perth | 48 | 2781 | *65* |
| Auckland | 40 | 2871 | *85* |
| Montreal | 43 | 2501 | *61* |
| Umeå | 43 | 1211 | *46* |
| *Baltimore* | *24* | *861* | *29* |

Table 1. Proportion children responding the questionnaire.

[124] Roberts I, Carlin J, Bennett C, Bergstrom E, Guyer B, Nolan T, Norton R, Pless BI, Rao R, Stevenson M. An international study of the exposure of children to traffic. Inj Prev. 1997;3:89-93.

## Results

***1.*** Huge variations in travel patterns among children from different cities, fig. 1. More children in Australia and New Zealand were travelled by car to school, while walking was the most preferred mode of commuting to school in the other cities.

Some children were driven to school but walked home, which resulted in a smaller increase in proportion walking children.

Bicycling to school was a usual commuting mode in Sweden (31%) but not in the other countries. Generally more boys than girls bicycled and the use of bicycle increased with age.

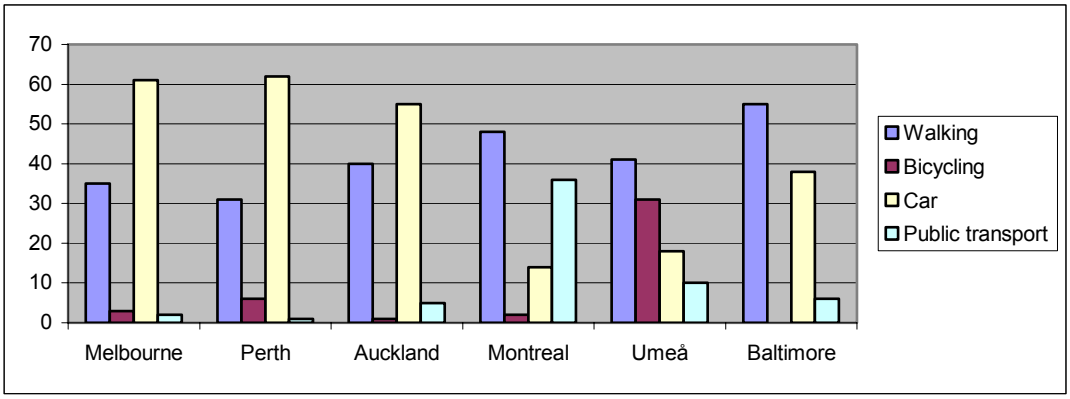


**Figure 1.** Comparison of commuting mode to school between cities.

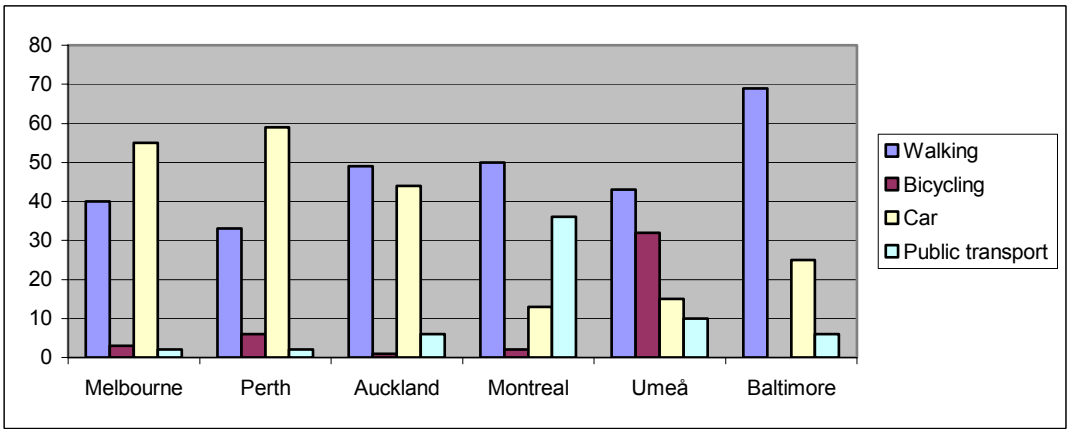


**Figure 2.** Comparison of commuting mode from school between cities.

Car ownership is also related to the choice of commuting mode. Availability of cars decreases the tendency of walking, table 2.

| City | No car in the household (%) | One car in the household (%) | *Two cars in the household (%)* |
|---|---|---|---|
| Melbourne | | | |
| Walking | 81 | 42 | *27* |
| Car | 11 | 52 | *69* |
| Perth | | | |
| Walking | 59 | 37 | *26* |
| Car | 20 | 55 | *68* |
| Auckland | | | |
| Walking | 80 | 50 | *28* |
| Car | 16 | 45 | *65* |
| Montreal | | | |
| Walking | 60 | 51 | *32* |
| Car | 2 | 13 | *27* |
| Umeå | | | |
| Walking | 67 | 44 | *30* |
| Car | 2 | 17 | *23* |
| *Baltimore* | | | |
| *Walking* | *88* | *48* | *39* |
| *Car* | *6* | *44* | *59* |

Table 2. Proportion of car ownership in the household in relation to walking and car travelling.

***2.*** The distribution of children walking less than 5 minutes respectively 15 minutes per day are presented in figure 3. Increasing proportion of children walking less than 5 and 15 minutes with increasing number of cars in the household.

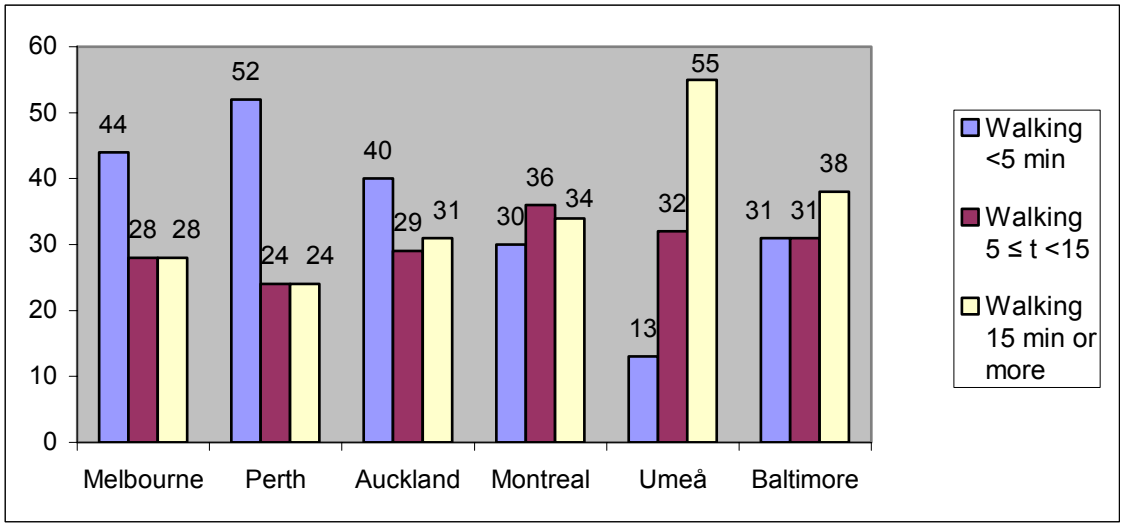


**Figure 3.** Proportion of children reported walking less than 5 minutes, 5 minutes or more but less than 15 minutes or 15 minutes or more.

**Authors' discussion**

***Re. methods***

The respond rate in Umeå and Baltimore was low and if the travel pattern of the non-respondents were substantially different to the respondents, bias exist. But, as seen in Umeå, children from households without cars were more likely to walk than children from households owning cars. If the majority of the respondents were low income families, then the effect of the low rate respondents would have underestimated the proportion of walking children, which in turn would not affect the interpretation of the results.

Self-reporting of pedestrian activity is usually under-reported,[125] depending on children forgetting details. In an attempt to avoid under-reporting, children were asked to finish the questionnaire at home together with parents.

***Re. 1*** Distinct differences occur in children's travel behaviour between countries. But the transportation patterns for chosen cities are not always representative for the country.

***Re. 2*** There are substantial differences between the proportion of car ownership and the exposure of risk in traffic. Children in families with cars do not cross as many streets as children from families without cars.

**My reflections**

***Re. results***

Because the aim of my study is about children's commuting behaviour, only relevant data (for my work) from the results of this study is presented and discussed.

***Re 1*** The largest proportion of active commuting children is in Umeå, while Melbourne and Perth have largest proportion passive commuter. As revealed, increased availability of cars decreases the tendency of active commuting and the tendency of walking longer trips than 15 minutes and also increases the use of cars. This can be compared to the earlier reviews, which showed how countries with small or smaller proportion of households owning cars also have large or larger proportion children active commuting to school. But, it has not, in any of the studies that have been reviewed, been described how far away from school the children lived, which could be one of many key factors for understanding children's choice of commuting mode.

[125] Routledge DA, Repetto-Wright R, Howarth CI. The comparison of interviews and observations to obtain measures of children's exposure to risk as pedestrians. Ergonomics 1974;17:623-38.

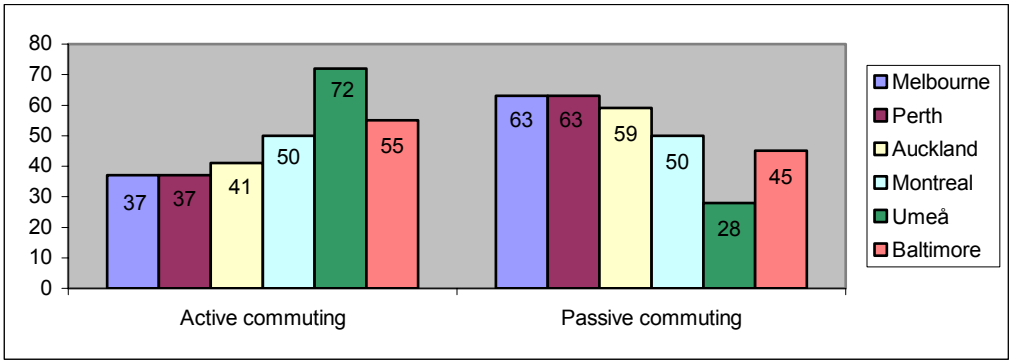


**Figure 4.** Proportion active and passive commuter to school in respective city.

***Re. 2*** A pattern can be discerned between the proportion of active commuter from the cities and the time children from each city spend on walking, see fig. 3 and 4. Those cities who contribute with most active commuter have also larger amount of children walking 15 minutes or longer per day and less proportion children walking for shorter time than 5 minutes. The opposite phenomenon occur for Melbourne, Perth and Auckland, which are those cities that contribute with largest proportion passive commuters and smallest rate of active commuting children, fig. 4. The majority of children from these three cities walk less than 5 minutes daily, fig. 3.

Comparing these results with the study by Cooper et al.[126] larger proportion of British children has more tendencies to walk for shorter time, even though a large proportion of them, totally 64%, walked to school. This might depend on that society structure, for example that proportionally more children lived within a walking distance to school, has some influence on the choice of mode and length of walking.

***Further.***

There are large variations between different places in the western world. But, as the authors mentioned some cities, such as Umeå are likely not representative for Sweden. This shows that large or small variations might occur in a country. Even though large variations exist between western cities, the majority of proportion walking children in this study reveals that young people in these parts of the world were cars are common in the society, are more likely to commute passively than actively compared to countries were cars in households are unusual.

[126] Cooper AR, Page AS, Foster LJ, Qahwaji D. Commuting to school. Are children who walk more pysically active? Am J Prev Med 2003; 25(4):273-76.

# A compilation of results

| | UK Bristol | Russia | Philippines The Cebu area | China | Australia Perth & Melbourne | NZ Auckland | Canada Montreal | Sweden Umeå | USA Baltimore |
|---|---|---|---|---|---|---|---|---|---|
| The year of the study | May/June 2002 | Spring 1995 | 1998-1999 | 1997 | Sept.-Nov. 1994 | Sept.-Nov. 1994 | May-June 1995 | May-June 1995 | May-June 1995 |
| 1. Age *(mean± 1 SD) | 10.4±0.8* | 11.8±3.6* | 14.5±0.5* | 11.5±3.3* | 6 & 9 | 6 & 9 | 6 & 9 | 6 & 9 | 6 & 9 |
| 2. Season | Summer | Spring | No info. | No info. | Spring | Spring | Spring | Spring | Spring |
| 3. Urban or Rural | U | U & R | U & R | U & R | U | U | U | U | U |
| 4a. Prop. walking & bicycling | 64% | 92% ** | 41% | 84% | 37% | 41% | 50% | 72% | 55% |
| b. Prop. using motorized vehicles | 36% | 13% ** | 22% | 16% *** | 63% | 59% | 50% | 28% | 45% |
| c. Prop. combining active & passive commuting | - | - | 37% | - | - | - | - | - | - |
| 5a. Time spent on active commuting/day (two ways) | 8-14 min. | 19 min. | 40-60 min. | 25 min. | - | - | - | - | - |
| 5b. Walking time to school (one way) | | | | | | | | | |
| % < 5 min. | 42% | | | | | | | | |
| % 5-15 min. | 39% | - | - | - | | | | | |
| % > 15 min. | 19% | | | | | | | | |
| 5c. Driving time to school (one way) | | | | | | | | | |
| % < 5 min. | 53% | | | | | | | | |
| % 5-15 min. | 44% | | | | | | | | |
| % > 15 min. | 3% | - | - | - | | | | | |
| 6. Daily waling time, before/after/ to/from school | | | | | | | | | |
| % < 5 min. | | | | | 48% | 40% | 30% | 13% | 31% |
| % 5-15 min. | | | | | 26% | 29% | 36% | 32% | 31% |
| % > 15 min. | | | | | 26% | 31% | 34% | 55% | 38% |
| 7. Quantity of total active commuting in relation to PA guideline **** | 18% | 32% | 35% | 35% | - | - | - | - | - |
| 8. Active commuting related to the overall PA | Not related | Not related | Not related | Not related | Not related | Not related | Not related | Not related | Not related |
| 9. Gender diff. in active com. time | Boys 18%> Girls | No diff. | Girls 33%> Boys | No diff. | No diff. | No diff. | No diff. | No diff. | No diff. |
| 10. Gender diff. in tot. daily MVPA B = boys G = girls | Walking group: B 51.3 min > G | Age group 12-16 y: B 84 min. > G | Walking group B 86.5 kcal >G Passive group B 75.5 kcal >G | B 5.4 min > G | - | - | - | - | - |
| 11. Prop. households owning cars in respective. country | > 90% ? | 33% | 40% | 15-17% | > 90% ? | > 90% ? | > 90% ? | > 90% ? | 92% |

** The proportion of children active and passive commuting in Russia is also including children using the both modes to commute to school.
*** Children under 12 years usually ride on the back of their parents bicycles.
**** 60 minutes of MVPA per day. Health Education Authority (Biddle, Sallis & Cavill, 1998): Sallis et al. 1999, p. 63.
? Data of proportion of households owning cars are missing, but is assumed comparable with data from the USA.

# Final reflections, discussions and conclusions

The purpose of this work was to learn more about the topic "active commuting to school" and search for questions and researchable queries in relation to the issue. The interest was also on the assessment method used for measuring active commuting.

The focus was on:

***1.*** in which kind of modes children and adolescents are commuting

***2.*** the prevalence of active and passive commuting and also the prevalence of the combination of these modes

***3.*** how long distances children are commuting (passive, active and a combination of both)

***4.*** time spent on active commuting

***5.*** the intensity of physically active commuting

***6.*** the contribution of PA by active commuting to the overall PA

***7.*** the contribution of active commuting to children in meeting existing guidelines for PA

***8.*** the relationship between active commuting and overall PA

***9.*** assessment methods in measuring active commuting

Other interesting issues in relation to active commuting, which emerged from the studies will be discussed further down:

***10.*** age in relation to active commuting

***11.*** gender differences in active commuting

***12.*** season variations and commuting modes

***13.*** settlements and active commuting

***14.*** the influence of socio-economic status

## Reflections and discussions

***Re. method***

Reported times of active commuting and of other physical activities have in the 6 articles been processed with different statistical methods. In this paper median time has been compared to arithmetic means and geometric means. Even though the statistical methods differ from each other, data from these articles can reasonably well be considered as comparable with one another.

***Re. 1*** Active commuting modes in children and adolescents:

Most children are walking or driven by parents to school. One can see that transportation by car is an unusual mode in China, Russia and in the Philippines than in the other countries.

Very low proportion of the children are bicycling, except for those in China and Umeå in Sweden where bicycling is a culture that has been existing for a long time.

The use of public transportation does also seem to be unusual, both in industrialized and developing countries. Only the children in Montreal, Canada, are using the public transports. If Montreal is representative for Canada is not known.

As earlier mentioned in the results of the Filipino study, one third of the Filipino youths are combining both walking and transportation by "jeepneys". It would be interesting to assess how much the walking session contributes to the total commuting distance.

***Re. 2*** The proportion (%) of children active and passive commuting to school:

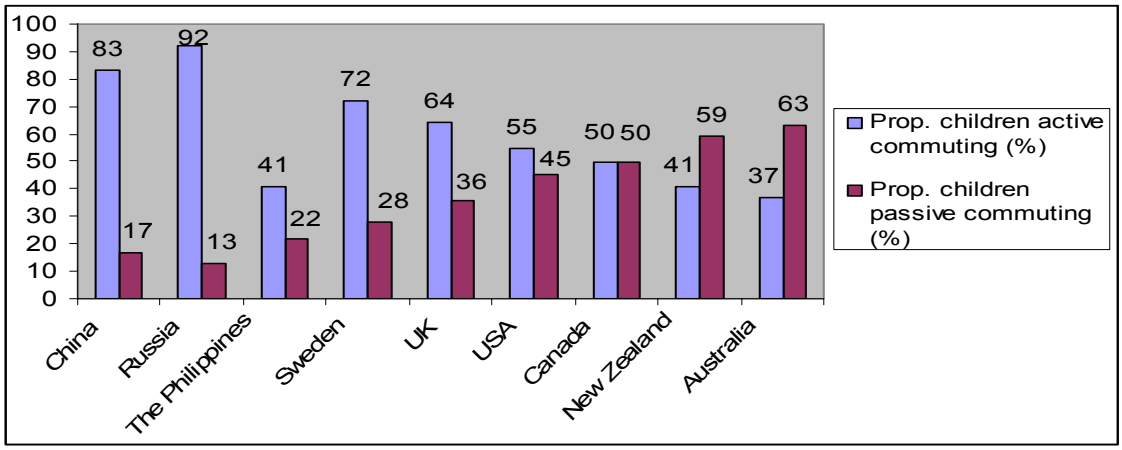


Fig. 1. Proportion of children active and passive commuting in different countries.
* Results from the Russian children are including those children who are both walking and passive commuting to school.
** Over 30% of the Filipino children are combining active and passive commuting.

Active commuting seems to be the most common way of commuting in China, Russia, the Philippines, Sweden, UK and in the USA. The inhabitants of Baltimore, USA, seem to commute more actively than passively. But, the response rate in this study was only 29% and if the commuting pattern of the non-respondents is the opposite of the respondents, bias exist. This could be assumed if comparing these results to data from the Health Styles Survey done by the Centres for Disease Control and Prevention, 1999.[127] The sample in this survey was selected as representative of the US population and the respondents reported that not more than 19% of primary school-aged children were walking to school while less than 6% were bicycling. Equal proportion secondary pupils cycled to school and only 20% of the secondary pupils reported walking to school. Furthermore, only 14% of all school trips were made by foot or by cycling.

Umeå is a small city with approximately 100000 inhabitants. The city is situated in the northern part of Sweden and is not likely a representative city for the country. Even though a majority of children are actively commuting to school, still Umeå is contributing with more passive commuters (28%) than China, Russia and the Philippines.

[127] From the Centre of for Disease Control and Prevention. Barriers to children walking and biking to school, United States, 1999. JAMA. 2002 Sep 18;288(11):1343-4.

According to Cooper et al. the results from the study in Bristol is comparable to British national data, but those who walk to school seem to walk short distances. This will be discussed further down.

Passive transportation in countries with fewer motorized vehicles, such as China, Russia and the Philippines is more likely done by public transportations (jeepneys in the Philippines) or by sitting on the back of parents' bicycles, because ownership of cars is unusual. The UK and other western countries contribute with proportionally most passive commuters and the car is the most used vehicle.

As seen in the study of Roberts et al. 1997[128], the number of active commuting children decreases with increasing numbers of cars in the household and the number of children passive commuting increases with the number of cars in the home. These results are suggesting that people's behaviour are adapting to the increasing availability of cars. Comparing the ownership of cars in the household with the proportion of passive commuters in each country, a pattern can be discerned. Increased availability of cars increases the passive transportation behaviour.

It seems as availability of cars in the households has influences on children's commuting mode. The number of cars is predicted to increase in developing countries such as China and the Philippines. A continuous observation of these countries would be of great importance for better understanding of the relation between commuting mode and the household possession of cars.

***Re. 3 & 4***

How much time is spent on active commuting and how long distances are walked?

Comparing the time spent on active commuting in children from China, Russia and the Philippines to the British ones, children from the first mentioned countries seem to have longer distances between home and school. But, the data can also be interpreted as Chinese, Filipino and Russian children are walking slower than the British ones, which is fairly improbable regarding the differences in figure 1. It is more likely that these children have long distances between home and school.

Over 60% of the British primary school-aged children are walking to school, but the majority of these children (81%) are walking for less than 15 minutes. Almost half of the children (42%) are having less then 5 minutes active journey to school every day.

Only 33% of the Russian households have cars and approximately 40% of the Filipino households own cars while less than 17% of the Chinese households are having any motorized vehicle. Because of these figures, differences in time spent on active commuting and walking distances between home and school could be related to the availability of cars in the family. As seen in the study of Roberts et al. 1997[129] households with cars have children walking shorter distances than children from families not owning any car.

Because of the economic circumstances in the family household and cars are not available, distance seems to be of less significance for Russian, Chinese and Filipino children's choice of commuting mode to school as in the children from the UK, where cars are more usual in the households. Studies of barriers to children actively

[128] Roberts et al. 1997, p.91.
[129] Roberts et al. 1997, p. 92.

commuting to school in the USA[130] and in Australia, [131] where cars are in almost every household, show that distance is one of the main reasons to way children prefer passive commuting to school.

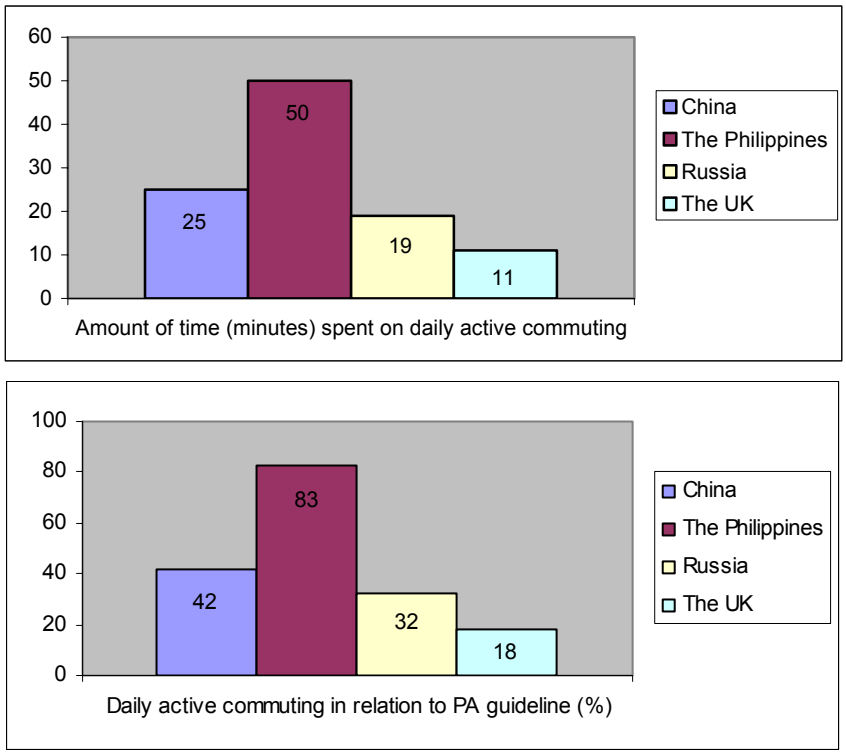


**Figure 1.** The amount of time, in minutes, spent on active commuting and active commuting compared to the international guideline for PA (mini. 60 minutes MVPA every day).

***Re. 5*** The intensity of physically active commuting:

None of the studies asked the children and adolescents about the commuting distance and speed of walking to school. But, all studies had set active commuting as a PA of at least moderate level.

***Re. 6& 7***

The contribution of PA by active commuting to the overall PA and the contribution of active commuting to children meeting existing guidelines for PA:

For many children, especially girls, active commuting plays a major role for their daily PA. E.g. Russian boys and girls, age 6-11, are equally engaged in daily PA of at least moderate intensity, but girls, 12 years and older, seem to have more household duties, which influences their time spent on PA in spare time.

It seems as the contribution of active commuting is of significance for children in several countries, especially for those who are not doing any PA during school or during leisure time, in meeting the guideline. Over 88% of the Filipino girls are not taking part of any after school MVPA, while >50% are not physically active in school

[130] From the Centre of for Disease Control and Prevention. Barriers to children walking and biking to school, United States, 1999. JAMA. 2002 Sep 18;288(11):1343-4.
[131] Ziviani J, Scott J, Wadley D. Walking to school: incidental physical activity in the daily occupations of Australian children. Occup Ther Int. 2004;11(1):1-11.

and 26% of the Filipino boys are not doing any MVPA during leisure time. The corresponding data for the Chinese boys and girls is >93%. More children in China and the Philippines are taking part of school education classes, but still it remains 26% of the Chinese children that are not participating in activities in school of moderate or vigorous intensity level. If active commuting was omitted in Russian children, 22% of them would not reach 30 minutes of MVPA per day, which indicates the importance of active commuting.

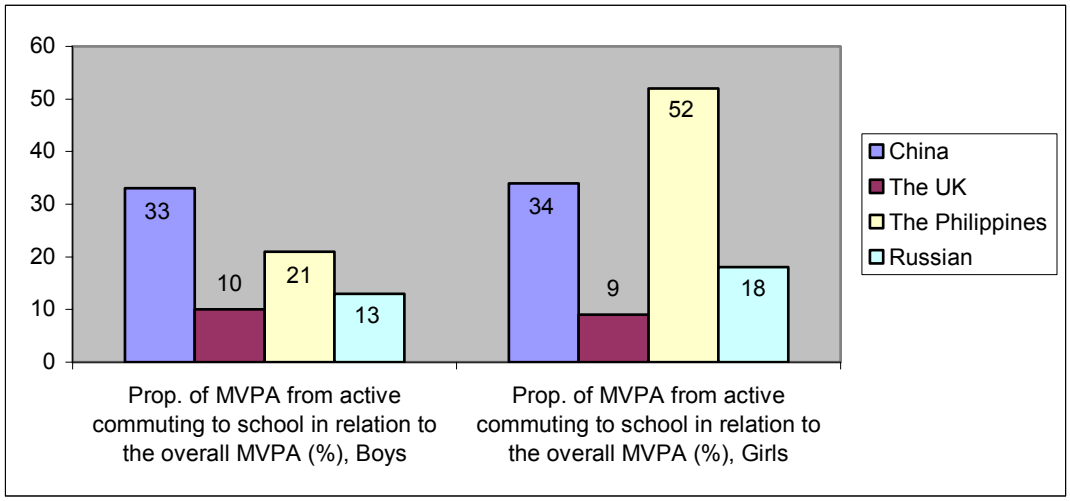


**Figure 3.** Proportion MVPA from active commuting in relation to the overall daily MVPA per child, between different countries.

As earlier mentioned a third commuting group exist among the Filipino youths, those who are combining walking and motorized vehicle. Because the chosen method of assessing PA could not identify how much walking contributed to the total commuting time, it is difficult to draw any conclusions what this kind of commuting can imply for the Filipino children. It could be that these children have long distances to walk to and from the jeepney stop then the walking would be of significance.

***Re. 8*** Relations between active commuting and the overall PA:

No general or distinct pattern has been found, which might signify that there are no relation between the overall PA in children and the choice of commuting mode to school.

***Re. 9*** Assessment methods in measuring active commuting:

It is difficult to say exact amount of time spent on active commuting because the methodology of assessing PA, which have been used in the reviewed studies, are not accurate enough to determine the exact time spent on active commuting.

Questionnaire surveys are simple and effective method of assessing PA in large samples. But, as mentioned in the reviews, over- and underestimations are not unusual, especially when children are estimating time and distances. With this method over- and underestimations can never be avoided but, it could be limited by good formulations of questions and specific answers. Careful instructions to participants are

also of importance and young children should have help from parents/adults to give a more correct answer.[132]

The accelerometer is an accurate and easy assessment method. Data is easy to collect and to download into the computer. But, when using the instrument one has to consider and be aware of what movements the accelerometer is measuring at given time.

In all 6 studies questionnaires have been used to examine the commuting behaviour in children. The Russian and younger age-group of Chinese children had their parents to answer the questions. Only Cooper et al.2003,[133] the British study and Tudor-Locke et al. 2003a,[134] the Filipino study combined the questionnaire with data from accelerometer assessments.

In the British study the accelerometer MTI/CSA 7164 was used to assess the PA minute by minute. Even though the instrument could measure PA every minute the authors could not estimate the exact time spent on commuting, because they did not have the information of when the children went to school. In addition, the authors did not know what the CSA 7164 actually measured between 8-9 am, if it was children's PA or PA and movements from the cars. It would have been easier for the authors to evaluate the results if a PA diary was included in the methodology.

The accelerometer Caltrac was used in the Filipino study. Because Caltrac is an instrument that assesses vertical movements and expresses the movements as activity-related EE and only can measure PA during a given time and, time spent on active commuting was difficult to evaluate. The authors presumed that the difference in Caltracderived EE between active and passive commuter corresponded the EE during active commuting, because this difference could not be explained by sports and exercise during and after school. The difference in EE was 44.2 kcal/day for the boys and 33.2 kcal/day for the girls. Reported time (PA questionnaire) on active commuting was 40 minutes/day from the boys and 60 minutes/day from the girls. By using the equation in the Compendium of physical activity by Ainsworth et al. 2000,[135] which was used in this study, the EE was calculated for these reported times, 134 kcal respectively 116 kcal (calculations can be found in Review 4). Comparison of these data to the differences from the Caltracderived EE shows that large differences occur. Using these two methods as complementary methods for assessing active commuting does not seem to facilitate the evaluation of results. Measurements of EE are not comparable with measurement in time.

***Re. 10*** Age in relation to active commuting:

Three of six studies compared active commuting with age groups. One is showing that the proportion of active commuting children increases with age.[136] A second one is telling that active commuting is decreasing with age[137], and a third one has results saying no significant differences in proportion children active commuting between age groups.[138] No conclusions can be made from these results.

[132] Armstrong et al. 1997.
[133] Cooper et al. 2003, p. 274.
[134] Tudor-Locke et al. 2003a, p. 466.
[135] Ainsworth et al. 2000, p. 498-504.
[136] Copper et al. 2003, p. 91.
[137]. Tudor-Locke et al. 2003b, p. 1096.
[138] Levin et al. 1999, p. 169

The same three studies are also comparing time spent on active commuting in relation to children's age. Two of three are saying that time spent on active commuting increases with age.[139, 140] If these results are representative for all children, the phenomenon might be able to be explained by factors such as:

- Older children have longer trip to school than younger ones.
- Older children are more physically capable of walking for longer time.
- Parents are less protective toward older children.

***Re. 11*** Gender differences in active commuting:

Results from Cooper et al.[141] is telling that boys are spending 18% more time on active commuting than girls, while Tudor-Locke et al. 2003a[142] is showing girls spending 33% more than boys (from the PA questionnaire). No differences in active commuting have been found between genders in Chinese and Russian children and the article of Roberts et al. 1997[143] did not study this issue.

No conclusion can be drawn from these results.

***Re. 12*** Season variations and commuting modes:

Variations in weather have effects on the commuting mode.[144, 145] Bad weather seem to have negative effect on active commuting.

***Re. 13*** The relation between urban/rural settlements and active commuting:

None of the studies described the surroundings where the children are living more than specifying if it was rural or urban cities/areas. The Filipino article found significant association between urban dwelling and mode of commuting in girls. None of the other discussed the relation even though data seemed to exist.

To understand the commuting behaviour it might be of importance to know how the community is structured and not of such importance if children are living in the urban or in the rural. All rural and urban areas are not identical.

In Sjolie et al. 2002[146] the conclusion of why rural youth were less active then urban ones was the lack of cycling tracks and walking trails in the rural area, which influenced the way of commuting. This might be true, but lack of cycling tracks and walking trails does not have to imply declining opportunities of active commuting to school. The traffic intensity and distance could as well as be the influencing factors. One has to look at the whole perspective of society structure before making any conclusions if different kinds of settlements have any relation to the commuting behaviour.

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[139] Tudor-Locke et al 2003b, p. 1096.
[140] Roberts et al. 1997, p. 92.
[141] Cooper et al, 2003, p. 275.
[142] Tudor-Locke et al. 2003a, p. 468.
[143] Roberts et al. 1997, p. 89-93.
[144] From the Centre for Disease Control and Prevention. Barriers to children walking and biking to school, United States, 1999. JAMA. 2002 Sep 18;288(11):1343-4.
[145] Loucaides CA, Chedozoy SM, Bennett N. Differences in physical activity levels between urban and rural school children in Cyprus. Health Educ Res. 2004 Apr;19(2):138-47.
[146] Sjolie AN, Thuen F. School journeys and leisure activities in rural and urban adolescents in Norway. Health Promot Int. 2002 Mar;17(1):21-30.

***Re. 14*** Socio-economic status indicated by car ownership:

Active commuting contributes with more PA in countries with lower proportion of car ownership.

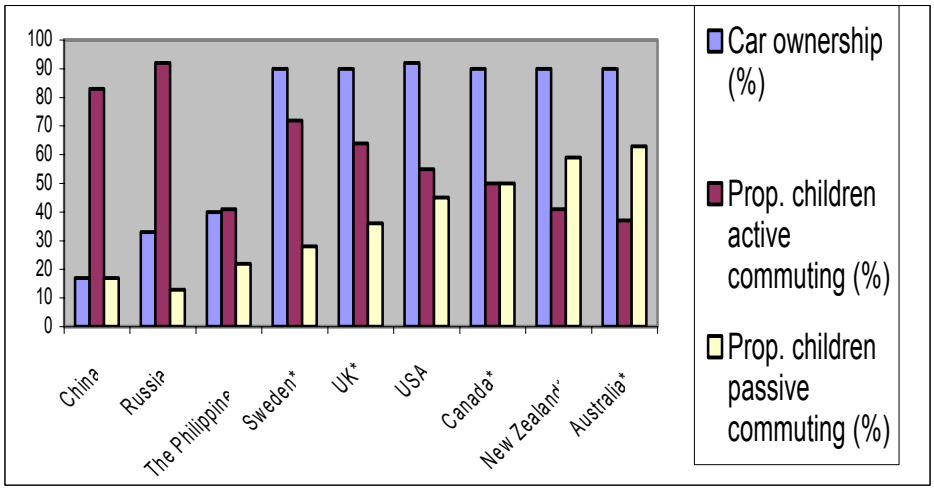


**Figure 4.** Comparison between proportion of households' car ownership and the proportion of active and passive commuting children in respective country.
*****Data of proportion of households owning cars are missing, but is assumed comparable with data from the USA.
******The proportion of children active and passive commuting in Russia is also including children using the both modes to commute to school.
******* There is a group of youths (37%) in the Philippines that are combining active and passive mode when commuting to school, which are not presented in this figure.

## Conclusions

Daily PA is of importance for children's physical, cognitive and psychosocial development[147] and the spontaneous PA seem to have importance for children meeting the PA guidelines. As evidence from this explorative study show, active commuting is a source that could contribute with much daily and regular PA in children. To those children who seldom participate in school PA education classes and structured sports and exercise in leisure time and/or have a relatively sedentary lifestyle, active commuting will be an important and huge possibility of daily regular PA of moderate level. Therefore, it is considered that it is reasonable to promote active commuting to school.

The impact of active commuting on health is not known. Research on this area is of importance. Another important topic that need more research on is the issue of determinants, factors that influence the choice of commuting modes. Such determinants could be the environment, availability of motorized vehicles, settlement conditions, season variations, culture differences etc.

As seen, no generalizations can be done from the results of the studies. The contribution of PA from active commuting differs from country to country and might also differ between cities in the same country. Similar data, such as the reviewed studies presented, has not been found for the Swedish children. "Skolprojektet 2001" was a project that had the purpose of

[147] WHO. Information sheet on obesity and overweight, 2004.

surveying Swedish children's PA.[148] Among many questions the children were asked about how much time they totally spent on daily walking or biking to school, friends and leisure time activities. The results revealed that 2/3 of 9-years-old children were spending maximum 10 minutes on daily walking or biking to school, friends and leisure time activities while 2/3 of the older children (12 rep. 14 years old) reported at least 20 minutes for the same activities. A master thesis, found on the database of Libris, done at the department of Samhällsbyggnadsteknik/Trafikteknik at Luleå tekniska universitet, 2003[149] is showing that more than 70% of all school children aged 6-8 years in the municipality of Mölndal were daily chauffeured, alone in the car, to school. Other Swedish reports of local surveys and investigations on children's school trip have been spotted on www.libris.se, www.transguide.net, www.vv.se (the library database). Because of the time limit of this work, these reports have not been reviewed, which should be done before further research in Sweden is implemented.

On the basis of these results, my reflections and conclusions, a proposal of research on the Swedish children is presented further down. The proposal is suggesting relevant researchable queries and which population that should be studied. It is also suggesting methodologies that are considered more accurate for each proposed research query compared to the assessment methods used in the reviewed studies. When choosing assessment methods one has to be careful and assure that it is the real time and distance of active commuting that is measured and chosen methods should limit bias, over- and underestimations. Regarding the methods, as mentioned in the discussion when using two methods to complement each other one has to consider what kind of results that are received, if the results are comparable and how the methods complement one another.

## Proposal to relevant researchable queries, population and methodology

*Objectives*:

A) Which is the prevalence of active commuting to school among children?
B) How long distances are children commuting?
C) How much time is spent on active commuting?
D) Contribution of active commuting to children in meeting PA guidelines?
E) Comparing active commuting with the overall PA and total daily PA

*Population*:

School children from grade 1-9, age 6-15 years.

*Geography*:

Sweden, the entire country or a representative part of the country

[148] Engström L-M. Hur fysiskt aktiva är barn och ungdomar? Svensk Idrottsforskning 2002;3:7-11.
[149] Stenson J. Skolvägar: studie av skolbarns sätt att ta sig till och från skolorna i Mölndals kommun. Examensarbete 20 p vid civilingenjörsutbildningen samhällsbyggnadsteknik på Luleå tekniska universitet i Luleå, 2003:259. http://epubl.ltu.se/1402-1617/2003/259/index.html.

*Methodology*:

Two conditions are described below, studies with large samples and with small samples.

To study large samples is simplified by using questionnaire surveys. As mentioned in the final reflections, one has to carefully specify the questions and answering alternatives to provide opportunities to be rather precise and to facilitate the comparison and evaluation of the data. An instructor should be present as a helping hand to the teachers and parents when children answering the questions.

A) Which is the prevalence of active commuting to school among children?
   Method: questionnaire
   Specify the usual mode: active (biking or walking), passive (car, moped or public transportation) or combining active and passive.
   Specify to and from school.

B) How long distances are children commuting?
   Method: questionnaire
   Estimate the distance you are travelling between home and school.

C) How much time is spent on active commuting?
   Method: questionnaire
   How many minutes to and from school?

D) Contribution of active commuting to children in meeting PA guidelines?

E) Comparing active commuting with the overall PA and total daily PA
   Methods: questionnaire
   How many minutes to and from school?
   Estimate the distance you are travelling between home and school.
   Do you participate in any sports/exercise and/or other activities at school and/or during leisure time?
   If you do participate in any of these activities, how much time do you spend?

When studying smaller samples using an accelerometer (MTI/CSA) will give more accurate description of time spent on different activities. By complement of a PA diary one can discern the activities from each other and specify what kind of PA was performed in a specific time. The following queries can be answered more specifically with this combination of methods.

A) Which is the prevalence of active commuting to school among children?

C) How much time is spent on active commuting?

D) Contribution of active commuting to children in meeting PA guidelines?

E) Comparing active commuting with the overall PA and total daily PA
   Methods: PA assessments with MTI/CSA during 7 consecutive days, which will be complement with a PA dairy in which the children continuously fill in every 5 minutes what kind of activities they have been performed.

To estimate the travel distances in small samples, measuring the real road is the best and most accurate way. But the method is very exacting, expensive and time demanding. The suggested method below could be considered as accurate as measuring the real road, but more convenient and less costly.

B) How long distances are children commuting?
Methods: Letting each child together with parents on a map mark the real road the child is walking/biking/chauffeured to school. The distance can then be measured by using a validated and calibrated map-reader.

## Acknowledgments

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