Pedestrian behaviour of 6th grade Estonian students: Implications of social factors and accident-prevention education at school

Airi Holm *, Juta Jaani, Diva Eensoo, Jaanika Piksööt

University of Tartu, Institute of Social Studies, Lossi 36, 51003 Tartu, Estonia

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ABSTRACT

Children as pedestrians are one of the most vulnerable groups of road users. Therefore factors associated with risky pedestrian behaviour should be carefully studied. The aim of this article is to clarify how the traffic behaviour of 6th grade students as pedestrians is associated with the behaviour of their traffic companions and prevention activities at school, also taking gender into consideration. The research was conducted based on a randomly-selected sample of 1033 6th-grade students with the mean age of 12.77 ± 0.38 (SD) years. The results showed that compared to girls boys take significantly more risks as pedestrians: they rarely use reflectors during periods of darkness and often cross the road against the red light. The most important role models for adolescents in traffic behaviour are their parents. The role model behaviour with the strongest effect on adolescent high-risk behaviour in traffic is the role model not using crosswalks to cross the street. The results also showed that higher-risk traffic behaviour by adolescent pedestrians is predicted by higher-risk behaviour on the part of their companions (parents, teachers), walking alone on the street, as well as by an adolescent’s lower involvement in the less active prevention activities in the classroom. To improve adolescent pedestrians’ traffic behaviour social environment and school-based factors should be considered more thoroughly in prevention work at school.

1. Introduction

Traffic accidents are a serious problem globally, causing injuries or even death. According to World Health Organization data (Peden et al., 2008), young people under the age of 25 have a particularly high risk of involvement in traffic accidents. Children tend to be involved in traffic as pedestrians: they walk along streets to go to school, sports training or home, and they also play outside. Adolescent pedestrians are more often alone in traffic than younger children, and therefore more vulnerable to traffic accidents. Different authors (Peden et al., 2008; Törö et al., 2011) have corroborated the findings that children are at higher risk in traffic compared to adults. According to the European Detailed Mortality Database (2015) the pedestrian standardised mortality rates per 100,000 in 10–14 year-old adolescents in selected post-Soviet countries (countries with lower socioeconomic status in Europa) in 2011 were higher (Poland 1.1, Estonia 1.6, Lithuania 1.8) than in selected European countries with higher social-economic status (Finland 0.3, Denmark 0.3, Sweden 0.2). Therefore the adolescents in

* Corresponding author.
E-mail addresses: airikas@msn.com (A. Holm), juta.jaani@ut.ee (J. Jaani), diva.eensoo@ut.ee (D. Eensoo), jaanika.piksoot@ut.ee (J. Piksööt).
post-Soviet countries are clearly more vulnerable to traffic accidents. Adolescents as pedestrians need to be taught how and why to use crosswalks, to follow traffic lights, to be visible in traffic, and to behave in a safe way.

Adolescent years are a tender age when adolescents experience emotional, physical and social changes and it is difficult to control their behaviour (Aasvee et al., 2012; Steinberg, 2007). Therefore at this age possible prevention activities to counter risk-taking behaviour should be carefully selected for traffic safety instruction. Adolescents spend a lot of time at school and there it is possible to influence their choices and behaviour but it is important to find the right methods and approaches.

Little is known about adolescent behaviour related to following traffic lights and using a reflector to be visible in traffic but road crossing behaviour has been researched more thoroughly. According to a study by Moussaid, Perozo, Garnier, Helbing, and Theraulaz (2010) people usually walk on streets in 2–5 person groups. Social environment (friends, parents, adult strangers) might influence adolescents' behaviour as pedestrians. Pressure by friends (Morroginello & Bradley, 1997; Simons-Morton, Lerner, & Singer, 2005; Toroyan & Peden, 2007) and positive attitudes towards risky behaviour as a road user (Evans & Norman, 2003) could increase children's risk-taking levels in traffic. Rosenbloom, Hadari-Carmi, and Sapir-Lavid (2012) researched the behaviour of 13-year-olds in crossing the road. They found that the children take more risks in road-crossing if they consider their friends’ road crossing behaviour unsafe. Other research revealed that people often follow other pedestrians when crossing the road, even if they are not convinced about their safety of doing so (Zhou & Horrey, 2010).

Children often walk on streets with their parents. Research on health-related behaviour has shown that children mostly pattern their own behaviour on parents' behaviour rather than their words (Daigle, Hebert, & Humphries, 2007; Morroginello, Corbett, & Bellissimo, 2008). The older the children get the more they copy their parents' behaviour (Morroginello et al., 2008). Some researchers have found that parents usually model safe traffic behaviour for their young children (Pfeffer, Fagbemi, & Stennet, 2010; Zeedyk & Kelly, 2003), however, children often take risks in road crossing (Pfeffer et al., 2010). The role models in traffic behaviour could be parents, friends or anyone else for the adolescents. We hypothesize that the role models of the students with low risk as pedestrians behave in a more safe way in traffic than the role models of the students with high risk as pedestrians.

Tabibi, Pfefferi, and Sharif (2012) found that 11-year-old children often walk alone in traffic because parents think that at that age they are more independent and can evaluate risks. However, Barton and Schwebel (2007) found that children take more risks alone than with parents. This is very dangerous because according to Tight (1996, referenced in Evans & Norman, 2003) 72% of pedestrian accidents involving children occur at a time when they are alone in traffic. Little is known about how adolescents behave as pedestrians with different companions. However, the social environment influences adolescents more than adults: the adolescent brain matures gradually and all the functions for making healthy decisions are not developed yet (Bergsma, 2011). Adolescents do not walk on streets only with parents as they did in childhood but also with friends, teachers, strange adults, and alone. Which group is the strongest role model for adolescents needs to be clarified. With this information it is possible to improve adolescents traffic safety education. We hypothesize that students with high risk in traffic take significantly more risks in traffic with companions and alone than the students with low risk in traffic.

Parents are the primary resource concerning health information for children but children spend a lot of time at school and they also acquire knowledge from school (Daigle et al., 2007). It is important, therefore, to teach traffic safety at school and choose effective teaching methods in order to achieve better learning process. Connections between traffic safety teaching methods and traffic behaviour have not been studied thoroughly. To improve health promotion at school we first need to know about factors related to pedestrian risk-taking in traffic and about the methods that are used at school for traffic safety education. With this knowledge we can improve traffic education at school. We set the hypothesis that the students with low risk in traffic report significantly more traffic related teaching methods used in the class than students with high risk in traffic. Steinberg (2007) suggests that in order to achieve healthy behaviour we need to encourage the development of self-regulation in adolescents. They need to understand the risks in traffic and how to make safe decisions in traffic.

The studies (Barton & Schwebel, 2007; Barton, Ulrich, & Lyday, 2010; Sullman, Thomas, & Stephens, 2012) have shown that boys tend to take more risks of various kinds in traffic (e.g. as cyclists and pedestrians). Statistical data (Peden et al., 2008; Törö et al., 2011) also show that compared to girls boys are more likely to be involved in traffic accidents. Therefore when studying risk-taking behaviour in traffic, gender factor should be taken into consideration.

The theoretical frame of this study is the PRECEDE-PROCEED model. It has been used as a basis for planning different health and injury prevention programs and it has been shown that working with this model is effective (Howat, Jones, Hall, Cross, & Stevenson, 1997). With the help of the PRECEDE-PROCEED model it is possible to chart the factors that affect peoples' health and make plans for the interventions to improve the health behaviour, for example changing health education or political regulations. In this study we also consider the reinforcing factors of the model: social support and peer influence (Green & Kreuter, 2005). As knowing the factors that affect students' behaviour as pedestrians it is possible to plan the prevention work at school, where the students spend a lot of time of their day.

The aim of this article is to clarify how the traffic behaviour of 6th grade students as pedestrians is associated with the behaviour of their traffic companions and prevention activities at school, also taking gender into consideration.
2. Materials and methods

2.1. Participants

In this study, the data from the study Promoting Health Effectiveness in Estonian Schools was used. The sample was a random selection of 6th-grade students from four of the largest counties that represent the northern, southern, eastern and western parts of Estonia. Stratified sampling was used to combine the sample from 12 subgroups (Estonian-based urban schools, Russian-based urban schools, and Estonian-based country schools in four counties). A two-stage sampling technique was implemented, with random selection of schools in the first stage as the primary sampling unit from each stratum. Then, in the second stage, one of all possible 6th-grade classes was sampled by simple random sampling. In total, 52 (66.7%) schools agreed to participate out of the 78 selected schools. In total, 1033 students answered the questionnaires (males = 50.1%; from Estonian schools = 67.7%; from urban schools = 81.1%). The response rate for subjects was 82.6% and the mean age was 12.77 ± 0.38 years.

2.2. Questionnaire

Participants reported on the traffic behaviour of their role model: how they follow traffic rules, whether they use the crosswalk, and reflectors and obey the traffic lights when crossing the road. They responded to questions concerning the frequency of each activity on a Likert 5-point scale, ranging from never (e.g. in the case of not having traffic lights in their local area) and these answers were excluded from the analyses. Participants identified who their role model was. They had the option of choosing the person from the list or naming their role model. Then they reported how the role model follows traffic rules. The variable was analysed in two groups: the role model follows traffic rules, meaning that the role model is a good example for them (yes), and the role model does not follow traffic rules (no), as well as the response I don't know.

Participants were asked about their traffic-safety class activities from the last three years: being given a poster or a brochure, making a poster or a brochure, participating in a campaign, speaking about traffic safety, engaging in a discussion/group work/role play, watching a film, participating in a training, participating in a competition/quiz. The variables were analysed in two groups: participating (counted as yes) and not participating (counted as no) in the activity.

2.3. Procedure

The data were collected in 2013. Lime Survey software for the web-based questionnaire was used. The respondents got their individual code of numbers and letters for filling in the questionnaires. The students and their parents gave their written consent. The Research Ethics Committee of the Tartu University approved this study.

For data analysis SPSS 20.0 was used. The Pearson Chi-square test, and simple and multiple logistic regression analyses were used. Level of risk-taking behaviour in traffic was the dependent variable. Independent variables were included to the model according to the hypothesis. First, simple logistic regression analyses were used. When statistically significant differences were found in the independent variables between the traffic risk groups, then these independent variables were included into the model of multiple logistic regression analysis. The associations were additionally adjusted by gender. Values of p < .05 were considered statistically significant.

3. Results

Table 1 gives an overview of the respondents’ pedestrian behaviour during the last 12 months. Significant differences between genders were found in reflector use during the darkness period (p = .004) and crossing the road against the red light (p = .016). Analysis revealed that compared to girls, boys take significantly more risks, rarely using reflectors during the dark hours and more often crossing the road against the red light.

In total 833 students answered the target questions on the 5-point scale. The highest point (5) was given to the safest behaviour. The pedestrian traffic-behaviour score was calculated by the mean value of at least one of the target questions.
The participants were divided into three risk groups, in accordance with the 25th and 75th percentile values (respectively 3.5 and 4.6) of the obtained traffic-behaviour scores: high-(n = 234; 28.1%), middle- (n = 352; 42.3%), and low-risk (n = 247; 29.7%) pedestrian group.

Subsequently, the association of children's behaviour with their role model's behaviour in traffic was studied. Most of the participants reported their role model was either their mother (67.9%) or father (22.2%). The other role models were friends, teachers or school personnel, siblings, and grandmother or grandfather. Simple logistic regression analyses revealed that if the role model does not set a good example in traffic, the odds for the child belonging to the high-risk group increase approximately 5–6 times, and to the medium-risk group approximately 2–3 times depending on the studied behaviour, when compared to the low-risk group. Using a multiple logistic regression analysis, when adjusting all studied behaviours of the role models in traffic (additionally adjusted by gender) the strongest predictor for high risk behaviour was the important family member not using the crosswalk. The important family member obeying traffic lights became non-significant (Table 2).

Analysing associations between risk groups and variables of following traffic rules alone and with other people (Table 3) by simple regression analysis, the results showed that if the students behave incorrectly in traffic with their companions or alone, the odds for belonging to the high-risk group increase approximately 5–6 times, and to the medium-risk group approximately 2–3 times when compared to the low-risk group. In multiple logistic regression analysis, when adjusting the behaviours with different companions in traffic (additionally adjusted by gender) the strongest predictor for high risk behaviour was behaving incorrectly alone, followed by behaving so with parents and with teachers. Behaving incorrectly with classmates, friends and adult strangers became non-significant.

For clarifying the association between children's behaviour as pedestrians and different teaching methods at school, students' reports on whether they have participated in different traffic safety activities were used for analysis (Table 4). By using simple logistic regression analyses, if the students did not report participation in traffic safety activities, the odds for belonging to the high-risk group increased between 1.5 to 3 times. The medium-risk group was differentiated from the low-risk group only by not having spoken about traffic and not watching a film (Table 4). In multiple logistic regression analysis the most consistent predictors for inclusion in the high-risk group were not speaking about traffic and not watching a film.

### Table 1
Students' behaviour as pedestrians.

<table>
<thead>
<tr>
<th>Behaviour</th>
<th>Never (1) n (%)</th>
<th>Mostly not (2) n (%)</th>
<th>Occasionally (3) n (%)</th>
<th>Almost always (4) n (%)</th>
<th>Always (5) n (%)</th>
<th>Total n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Using crosswalk on their way to school</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boys</td>
<td>9 (2.5)</td>
<td>24 (6.7)</td>
<td>65 (18.1)</td>
<td>119 (33.1)</td>
<td>142 (39.6)</td>
<td>359</td>
</tr>
<tr>
<td>Girls</td>
<td>11 (2.9)</td>
<td>15 (3.9)</td>
<td>60 (15.7)</td>
<td>139 (36.5)</td>
<td>156 (40.9)</td>
<td>381</td>
</tr>
<tr>
<td>Total</td>
<td>20 (2.7)</td>
<td>39 (5.3)</td>
<td>125 (16.9)</td>
<td>258 (34.9)</td>
<td>298 (40.3)</td>
<td>740</td>
</tr>
<tr>
<td>Using a reflector in periods of darkness period</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boys</td>
<td>23 (6.9)</td>
<td>32 (9.6)</td>
<td>58 (17.3)</td>
<td>115 (34.3)</td>
<td>107 (31.9)</td>
<td>335</td>
</tr>
<tr>
<td>Girls</td>
<td>6 (1.7)</td>
<td>23 (6.5)</td>
<td>59 (16.6)</td>
<td>130 (36.6)</td>
<td>137 (38.6)</td>
<td>355</td>
</tr>
<tr>
<td>Total</td>
<td>29 (4.2)</td>
<td>55 (8.0)</td>
<td>117 (17.0)</td>
<td>245 (35.5)</td>
<td>244 (35.4)</td>
<td>690</td>
</tr>
<tr>
<td>Crossing the road with green light</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boys</td>
<td>21 (7.6)</td>
<td>15 (5.4)</td>
<td>49 (17.8)</td>
<td>76 (27.5)</td>
<td>115 (41.7)</td>
<td>276</td>
</tr>
<tr>
<td>Girls</td>
<td>7 (2.6)</td>
<td>7 (2.6)</td>
<td>39 (14.7)</td>
<td>89 (33.5)</td>
<td>124 (46.6)</td>
<td>266</td>
</tr>
<tr>
<td>Total</td>
<td>28 (5.2)</td>
<td>22 (4.1)</td>
<td>88 (16.2)</td>
<td>165 (30.4)</td>
<td>239 (44.1)</td>
<td>542</td>
</tr>
</tbody>
</table>

* Significant difference between the genders, p < .05.

### Table 2
Likelihood for risk-taking behaviour as pedestrians by role models’ behaviour in traffic.

<table>
<thead>
<tr>
<th>Behaviour</th>
<th>Risk group</th>
<th>OR (95% CI)</th>
<th>Adjusted OR (95% CI)&lt;sup&gt;a&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Following traffic rules</td>
<td>High</td>
<td>4.78 (2.84–8.03)&lt;sup&gt;b&lt;/sup&gt;</td>
<td>2.90 (1.38–6.09)&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>No vs yes</td>
<td>Middle</td>
<td>1.97 (1.16–3.31)&lt;sup&gt;b&lt;/sup&gt;</td>
<td>1.55 (0.77–3.13)</td>
</tr>
<tr>
<td>Using a reflector in the darkness period</td>
<td>High</td>
<td>5.15 (3.12–8.52)&lt;sup&gt;b&lt;/sup&gt;</td>
<td>2.71 (1.44–5.10)&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>No vs yes</td>
<td>Middle</td>
<td>3.03 (1.89–4.86)&lt;sup&gt;b&lt;/sup&gt;</td>
<td>2.60 (1.50–4.56)&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Using a crosswalk</td>
<td>High</td>
<td>5.83 (3.70–9.20)&lt;sup&gt;b&lt;/sup&gt;</td>
<td>3.88 (2.16–7.00)&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>No vs yes</td>
<td>Middle</td>
<td>2.22 (1.44–3.43)&lt;sup&gt;b&lt;/sup&gt;</td>
<td>1.90 (1.11–3.23)&lt;sup&gt;b&lt;/sup&gt;</td>
</tr>
<tr>
<td>Following the traffic light</td>
<td>High</td>
<td>3.28 (1.98–5.42)&lt;sup&gt;b&lt;/sup&gt;</td>
<td>1.60 (0.83–2.94)</td>
</tr>
<tr>
<td>No vs yes</td>
<td>Middle</td>
<td>1.41 (0.86–2.33)</td>
<td>0.94 (0.52–1.68)</td>
</tr>
</tbody>
</table>

OR – odds ratio, CI – confidence interval.
Reference group is low risk group.

<sup>a</sup> Adjusted by variables included into the model and gender.

<sup>b</sup> Significant difference from the low risk group, p < .05.
The aim of this paper was to find out how the traffic behaviour of adolescents as pedestrians is associated with the behaviour of their traffic companions and prevention activities at school, taking gender into account. Taking the gender factor into account in the analysis was justified because the results revealed significant differences between the behaviour of boys and girls. In our study, on average, 13-year-old boys take more risks as pedestrians than girls, as demonstrated by non-use of reflectors and in crossing the road against the red light. Little is known about previous studies of adolescents' road crossing against the red light and traffic behaviour in the darkness period. Studying 15-year-old schoolchildren has shown that there were not significant difference between the genders in reflector use (Eensoo et al., 2007). There are more studies about children road crossing behaviour. Previous studies of children at younger ages have shown that boys take more risks than girls when crossing the streets (Barton & Schwebel, 2007; Sullman et al., 2012). The study of 15-year-old schoolchildren did not reveal significant difference between genders in crosswalk use (Eensoo et al., 2007). It seems possible that in older children significant differences between the genders in crosswalk use and in reflector use during the darkness period could disappear. However, international data analyses of traffic accidents (Peden et al., 2008) as well as analyses in separate post-Soviet countries (Törö et al., 2011) have show that boys are more vulnerable as pedestrians than girls. But by standardised mortality rates per 100,000 in 10–14 year-old adolescents in some countries (e.g. Denmark and Finland), girls are more vulnerable than boys (European..., 2015).

Two questions should be researched more thoroughly: (1) why in some traffic-related activities, do we not observe significant difference between boys and girls; and (2) why in some environmental conditions do girls take more risks than boys?

However, in line with what Eensoo et al. discovered in 2007 with students a few years older, the results of our study show better traffic behaviour in using the crosswalks and reflectors. In 2007 it was found that 18.3% of adolescent pedestrians never used the crosswalk but now that behaviour was down to 2.7%. Furthermore, 9.5% of these pedestrians never used

### Table 3
Likelihood for risk-taking behaviour as pedestrians by following traffic rules with different companions and alone.

<table>
<thead>
<tr>
<th>Companions</th>
<th>Risk group</th>
<th>OR (95% CI)</th>
<th>Adjusted OR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parents</td>
<td>High</td>
<td>11.94 (7.14–20.02)</td>
<td>4.80 (2.53–9.12)</td>
</tr>
<tr>
<td>No vs yes</td>
<td>Middle</td>
<td>4.66 (2.84–7.84)</td>
<td>2.24 (1.23–4.07)</td>
</tr>
<tr>
<td>Teachers</td>
<td>High</td>
<td>8.34 (5.22–13.33)</td>
<td>2.42 (1.34–4.38)</td>
</tr>
<tr>
<td>No vs yes</td>
<td>Middle</td>
<td>2.89 (1.84–4.52)</td>
<td>1.26 (0.73–2.19)</td>
</tr>
<tr>
<td>Classmates</td>
<td>High</td>
<td>7.88 (4.92–12.62)</td>
<td>1.25 (0.54–2.88)</td>
</tr>
<tr>
<td>No vs yes</td>
<td>Middle</td>
<td>4.11 (2.85–5.91)</td>
<td>1.31 (0.67–2.56)</td>
</tr>
<tr>
<td>Friends</td>
<td>High</td>
<td>6.86 (4.32–10.88)</td>
<td>1.04 (0.45–2.42)</td>
</tr>
<tr>
<td>No vs yes</td>
<td>Middle</td>
<td>4.19 (2.90–6.06)</td>
<td>1.34 (0.68–2.84)</td>
</tr>
<tr>
<td>Adult strangers</td>
<td>High</td>
<td>6.22 (4.09–9.45)</td>
<td>0.93 (0.52–1.66)</td>
</tr>
<tr>
<td>No vs yes</td>
<td>Middle</td>
<td>3.08 (2.15–4.42)</td>
<td>0.87 (0.53–1.41)</td>
</tr>
<tr>
<td>Alone</td>
<td>High</td>
<td>11.91 (7.55–18.78)</td>
<td>5.23 (2.80–9.77)</td>
</tr>
<tr>
<td>No vs yes</td>
<td>Middle</td>
<td>5.79 (3.99–8.40)</td>
<td>3.60 (2.18–5.93)</td>
</tr>
</tbody>
</table>

**OR** – odds ratio, **CI** – confidence interval.
Reference group is low pedestrian risk group.

*Adjusted by variables included into the model and gender.

**b** Significant difference from the low risk group, p < .05.

### Table 4
Likelihood for risk-taking behaviour as pedestrians by not participating in traffic-safety class activities.

<table>
<thead>
<tr>
<th>Class activities</th>
<th>Risk group</th>
<th>OR (95% CI)</th>
<th>Adjusted OR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Making a poster/a brochure</td>
<td>High</td>
<td>1.82 (1.17–2.84)</td>
<td>1.08 (0.66–1.78)</td>
</tr>
<tr>
<td>No vs yes</td>
<td>Middle</td>
<td>1.47 (1.00–2.16)</td>
<td>1.20 (0.79–1.84)</td>
</tr>
<tr>
<td>Speaking about traffic safety</td>
<td>High</td>
<td>2.89 (2.00–4.19)</td>
<td>1.96 (1.30–3.04)</td>
</tr>
<tr>
<td>No vs yes</td>
<td>Middle</td>
<td>1.43 (1.02–2.01)</td>
<td>1.08 (0.73–1.60)</td>
</tr>
<tr>
<td>Participating in a discussion/group work/role play</td>
<td>High</td>
<td>1.89 (1.27–2.83)</td>
<td>1.27 (0.80–2.02)</td>
</tr>
<tr>
<td>No vs yes</td>
<td>Middle</td>
<td>1.41 (0.99–2.01)</td>
<td>1.21 (0.82–1.80)</td>
</tr>
<tr>
<td>Watching a film</td>
<td>High</td>
<td>2.69 (1.86–3.90)</td>
<td>1.79 (1.15–2.78)</td>
</tr>
<tr>
<td>No vs yes</td>
<td>Middle</td>
<td>1.63 (1.17–2.27)</td>
<td>1.39 (0.93–2.05)</td>
</tr>
<tr>
<td>Participating in a training</td>
<td>High</td>
<td>1.66 (1.10–2.50)</td>
<td>0.91 (0.57–1.45)</td>
</tr>
<tr>
<td>No vs yes</td>
<td>Middle</td>
<td>1.29 (0.90–1.84)</td>
<td>0.99 (0.67–1.49)</td>
</tr>
</tbody>
</table>

**OR** – odds ratio, **CI** – confidence interval.
Reference group is low risk group.

*Adjusted by variables included into the model and gender.

**b** Significant difference from the low risk group, p < .05.

4. Discussion and conclusions

The aim of this paper was to find out how the traffic behaviour of adolescents as pedestrians is associated with the behaviour of their traffic companions and prevention activities at school, taking gender into account.

Taking the gender factor into account in the analysis was justified because the results revealed significant differences between the behaviour of boys and girls. In our study, on average, 13-year-old boys take more risks as pedestrians than girls, as demonstrated by non-use of reflectors and in crossing the road against the red light. Little is known about previous studies of adolescents’ road crossing against the red light and traffic behaviour in the darkness period. Studying 15-year-old schoolchildren has shown that there were not significant difference between the genders in reflector use (Eensoo et al., 2007). There are more studies about children road crossing behaviour. Previous studies of children at younger ages have shown that boys take more risks than girls when crossing the streets (Barton & Schwebel, 2007; Sullman et al., 2012). The study of 15-year-old schoolchildren did not reveal significant difference between genders in crosswalk use (Eensoo et al., 2007). It seems possible that in older children significant differences between the genders in crosswalk use and in reflector use during the darkness period could disappear. However, international data analyses of traffic accidents (Peden et al., 2008) as well as analyses in separate post-Soviet countries (Törö et al., 2011) have show that boys are more vulnerable as pedestrians than girls. But by standardised mortality rates per 100,000 in 10–14 year-old adolescents in some countries (e.g. Denmark and Finland), girls are more vulnerable than boys (European..., 2015).

Two questions should be researched more thoroughly: (1) why in some traffic-related activities, do we not observe significant difference between boys and girls; and (2) why in some environmental conditions do girls take more risks than boys?

However, in line with what Eensoo et al. discovered in 2007 with students a few years older, the results of our study show better traffic behaviour in using the crosswalks and reflectors. In 2007 it was found that 18.3% of adolescent pedestrians never used the crosswalk but now that behaviour was down to 2.7%. Furthermore, 9.5% of these pedestrians never used
reflector's in the darkness period in 2007 but now that figure has come down to 4.2%. This improvement could reflect the age differences, or the results of better traffic-safety work in last years in Estonia.

Analysing social-environment factors it revealed that the students selected their role models in traffic mostly from their family: mother and father, but also siblings and grandparents. There are no previous studies known where children report who is their role model in traffic. Some studies show how different social groups influence child traffic behaviour (Evans & Norman, 2003; Morroginello & Bradley, 1997; Simons-Morton et al., 2005; Toroyan & Peden, 2007) but our research shows that the most important role models for adolescents in traffic behaviour are their parents. Our findings support the hypothesis that the role models of low-risk group pedestrians behave in a more safe way in traffic than the role models of the high-risk group pedestrians. The strongest predictors among role models behaviour for adolescent high-risk behaviour as pedestrian were: the role model not using a crosswalks to cross the street; ignoring overall traffic rules; and not using a reflector in the darkness period. It has been found that predictors that tend to act in the same way in crossing the street as their parents and their role models do (Pfeffer et al., 2010; Zeedyk & Kelly 2003). In our study, obeying the traffic lights and using a reflector in the darkness period were also included as factors in pedestrian behaviour.

When analysing students' behaviour with different companions, it was discovered that the high-risk group of children differed from the low-risk group most consistently by obeying the traffic rules with their parents, teachers, adult strangers or alone. So the high-risk group students take more risks in traffic with some of the companions and alone than the low-risk group students, as hypothesized. However, when the companions are classmates, friends or adult strangers, significant difference does not appear between students with different risk levels in the model of the multiple logistic regression. It was found in the present study, and also in previous studies (Barton & Schwebel, 2007; Daigle et al., 2007; Morroginello et al., 2008; Pfeffer et al., 2010) that children take more risks alone than together with their parents. Hence, it is important to educate both parents and children regarding traffic matters. On the one hand the parents should know that it is they who set the example for their children regarding how to behave in traffic. On the other hand children should be educated to behave safely in traffic. Therefore it could be suggested that there should be trainings organised by the school or the state to remind the parents about traffic risks that pedestrians face, and, moreover, to impress upon them that they are the role models for their adolescent children. Different authors (Daigle et al., 2007; Morroginello et al., 2008) have found that children model their parents' behaviour, not just their words, so schools could organise traffic-orientated outdoor activities with parents and teachers to learn safe behaviour as pedestrians through experience and practice. Also cycling or walking on the streets with parents or teachers could help setting the right example for adolescents in safe traffic behaviour. For teachers it is extremely important to set the good example when having a excursion, outing or a museum visit with the class. It is also important to help the adolescents to develop their powers of self-regulation (Steinberg, 2007), so they can understand the risks and make better choices in traffic behaviour.

Comparing the odds that differentiate high-risk groups from the respective low-risk groups, there were lower odds for behaving correctly in traffic with friends (about 7–8) than for behaving correctly with parents and teachers (about 8–12). From these results it could be deduced that, depending on companions, low-risk group adolescents behave better with teachers and parents than with friends. This would be accord with the studies that have shown that children violate rules more often with friends (Simons-Morton et al., 2005; Steinberg, 2007; Toroyan & Peden, 2007) or older siblings (Morroginello & Bradley, 1997). It seems that adolescents, even the high-risk group students, behave better in traffic with parents and teachers than with friends. Walking together with parents or teachers could also help set a better model for traffic behaviour for adolescent pedestrians. Especially, it could be a positive influence to the high-risk students. This could be taken into consideration in traffic safety prevention. Steinberg (2007) suggests that limiting the possibility for risky behaviour is better than just teaching rules for healthy behaviour.

According to the national basic school curriculum, the topic “Health and Safety” should be covered as a cross-curricular theme (Põhikooli... , 2011). Teachers can select teaching methods according to their knowledge, the availability of materials, and possibilities for cooperation with traffic safety experts (Bergsma, 2011; Guercis & Markant, 2012). Students reported their participation in different traffic-orientated activities in the classroom. We hypothesized that the low-risk group students report significantly more traffic related teaching methods used in the class than the high-risk group students. We also wanted to know if there is a difference between risk groups, considering the methods they report/remember better. Then it could be possible to offer the students different and more influential teaching methods. Using simple logistic regression analyses, the high-risk group was significantly different from the low-risk group in terms of all reported traffic-safety class activities. We see from the model of multiple logistic regression analyses that the high-risk group students were more likely not to report the passive teaching methods (speaking about traffic safety and watching a film) compared to the low-risk group, and there were no longer any significant differences in active teaching methods between the risk groups. It could be that the high-risk group students did not report all of the classroom activities they took part in, or they simply did not remember speaking and watching films, although these two activities are often the most common in the classroom. Most probably the students did not remember those activities because these are passive teaching methods and therefore boring for the high-risk students. These findings emphasise the ongoing need for additional traffic education methods for students, and especially, methods to reach the high-risk group pedestrians that most probably want to learn actively to remember the information. As for watching a film, the teachers could use activating methods like answering questions, writing a summary, etc. about the film. This way the students that are not interested so much have to engage more effectively into the topic. At the same time, there are different learner types and passive teaching methods have the positive effect on the low-risk students. So these methods should not be forgotten in lessons. Actual traffic safety work done in classroom should be more...
thoroughly researched, with a view to clarifying the association between children's behaviour as pedestrians and different teaching methods at school. According to Guercis and Markant (2012), active teaching methods are more motivating, and can improve memory, attentiveness and ability to analyse different situations. Also Bergsma (2011) suggests that for achieving healthy behaviour we need to develop critical thinking in adolescents, and traditional teaching methods used at school do not work.

Shafto, Goodman, and Frank (2012) suggest it is important to involve different people who may be role models for students in the learning process to increase learning efficiency. It is important that parents and schools work together for the purpose of educating students about traffic matters. According to VanSchagen and Rothengatter (1997) both lecturing in the classroom and behavioural training are beneficial for students, although the latter gives slightly better results. It has been found that with active teaching methods there are many advantages related to achieving better results in the learning process (Guercis & Markant, 2012).

According to the framework of the PRECEDE-PROCEED model, we found out some factors that affect students’ behaviour as pedestrians—the reinforcing factors: parents and teachers’ behaviour, and the health education at school: using active teaching methods. Those factors should be considered when organising prevention work at school. The students’ behaviour should improve when taking these factors into consideration in prevention work.

In conclusion this article emphasizes the role of social and school-based factors in child traffic behaviour as a pedestrian. Adolescents at the age of 13 years take their parents as an example regarding traffic behaviour. They are more likely to behave in traffic like their role models do. If the role models do not obey traffic rules, the children are likely to act the same way. The school could emphasize that the parents are role models for their adolescent children. They should be educated more thoroughly about traffic behaviour, so they can model safe traffic behaviour for their (adolescent) children. Different traffic safety activities for both students and parents should be organised by school. Active teaching methods should be included in learning process because those methods are more memorable for students and help better than passive methods in improving adolescents' knowledge and behaviour connected with traffic.

4.1. Limitations

For ethical reasons, in filling out the questionnaires the students were not obligated to answer to these questions that they felt uncomfortable about. Several cases were excluded from the study because they had not answered to the target questions.

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