Pupil behaviour on school buses and potential risk factors for injury: an observational study

Sharon Goldman, a Kobi Peleg a

a The Gertner Institute for Epidemiology and Health Policy Research, Sheba Medical Center, Ramat Gan, Israel 52621.

Correspondence to Sharon Goldman (e-mail: sharong@gertner.health.gov.il).

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Abstract

Objective To observe pupil behaviour on school buses in Israel and identify hazards as a basis for improving school bus safety.

Methods Data on student, bus driver and chaperone behaviours and on hazards associated with school buses, bus loading zones and bus stops were collected during an observational study conducted on school buses in rural communities in Israel. This report focuses on observations of student behaviour during school bus rides. Future reports will discuss the other findings. Student behaviours were assessed by means of \( \chi^2 \) tests and logistic regression models.

Findings Observations were made on 362 rides on 125 buses on which 11 000 pupils travelled to and from school. Seatbelt use among the pupils was limited: on 23% of the rides all pupils fastened seatbelts, while on 42% none did. Seatbelt use was more frequent among primary school pupils than among older pupils. Pupil behaviours, such as rowdiness, noisiness, conflicts between pupils and not remaining seated were observed. These and other unsafe behaviours were more frequent on afternoon bus rides (odds ratio, OR: 3.2, 95% confidence interval, CI: 2.1–5.3), on routes with 5+ bus stops (OR: 4.1; 95% CI: 2.5–6.5) and on rides with primary school pupils (OR: 1.8; 95% CI: 1.2–2.9).

Conclusion Without enforcement, government regulations and seatbelt availability on school buses are not enough to ensure seatbelt usage among pupils. Bus drivers cannot be expected to enforce seatbelt use and deal with pupil misconduct while also driving safely. Innovative strategies for improving pupil behaviour on school buses are needed in order to increase pupil safety.

Introduction

In Israel, 90% of schoolchildren living in rural communities travel daily by school bus.1 Since 1 September 2006, seatbelts have been mandatory in all vehicles used for school transportation in Israel.2 The Ministry of Transportation introduced this seatbelt regulation following a tragic collision between a school bus and a jeep on the last day of the 2004 school year, which resulted in the death of 3 children and minor to severe injury of 50. The implementation of seatbelts in school buses was thus a
response to a single mass casualty rather than the outcome of research regarding day-
to-day bus-related injury risks.

Injury data from countries around the world have shown that bus travel is the
safest method for travelling to school. Data regarding bus-related injuries among
Israeli children show that the majority of casualties are not due to road crashes but
rather to outside events, such as children getting on and off the bus or pedestrians
crossing near the bus. Although information about injuries related to school
transportation in Israel has not been sufficiently recorded, data have been collected
from various sources. According to the Ministry of Education – which conducts
inquiries on school-related traffic injuries at its discretion, usually when fatalities are
involved – 67 students were injured while travelling on school transportation vehicles
from 2003 to 2006 (40 were injured in the above-mentioned crash in 2004) (Y. Shaul,
Department of Traffic Safety, personal communication, 2006). The Israel Trauma
Registry collects data on trauma-related hospitalizations. From 2002 to 2005, 75
children aged 6–17 years were hospitalized for bus-related injuries, although the
injuries were not specific to a school bus (the data include injuries to children riding
on both school and municipal buses, injuries incurred while boarding or disembarking
from a bus and injuries caused by a bus while children were crossing a road).

Most studies regarding school transportation safety and injuries have focused
on injuries occurring outside the bus, while few have observed pupil behaviour on
buses. Rowdiness, excessive noise and violence on the bus have been shown to
endanger passengers and interfere with bus driver concentration. One study
evaluating pupil behaviour measured suspension of bus-riding privileges, bus driver
referrals and teacher and bus driver questionnaire responses. A survey of bus drivers
found that noise outbursts (61%), out-of-seat activity (48%) and roughhousing (31%)
were among the most distracting pupil behaviours. It is both impractical and
dangerous to expect bus drivers to manage pupil behaviour and stop disruptions while
also ensuring that they are driving safely.

School bus transportation is challenging, in part because new safety measures
are continually being developed, modified and assessed. The initial aim of this study
was to examine seatbelt usage on school buses following the introduction of the
government regulation requiring seatbelts in all buses used for school transportation.
However, since on-bus observations were chosen as the most effective method for
measuring seatbelt usage, it was decided also to evaluate pupil and bus driver conduct as possible factors affecting school transportation safety.

Methods
An observational study was conducted on board vehicles used for school transportation in Israel between December 2006 and March 2007. The study population consisted of pupils enrolled in the general education system who lived in rural communities and travelled by means of school transportation to and from school in both the morning and the afternoon. The study sample was designed on the basis of 18 regional councils in a single geographic region in central Israel. The number of daily school transportation routes (over 1300); the number and type of schools (primary and secondary schools, over 100); route direction (to or from school); school bus category (private, public or regional council bus) and number of pupils studying in each regional council (approximately 31 000) were used to select the study sample. School transportation for children with special needs was excluded. Each observation began at the first bus stop and ended at the final destination. The final study sample included 16 regional councils (two regional councils were not included because they were not responsive in helping with technical needs for the study, such as providing routes and time schedules) and sampled over 20% of the school transportation routes in the designated area.

Nine observers received training from the principal investigator at the Israel National Center for Trauma and Emergency Medicine Research or from the observational coordinator. Observers travelled on buses without identifying themselves or explaining their purpose to the student passengers. Questions directed to drivers were asked either before or at the end of the ride.

The Ministry of Education approved the study and requested that the selected regional councils cooperate. In addition, each regional council traffic coordinator assisted by providing information regarding the number of pupils enrolled in school in each regional council, the number and types of schools, the number and types of buses used for school transportation and the bus routes and schedules.

A pilot study was performed to test the questionnaire, to identify routes and to test validity. Validity was substantiated both during the pilot and during some of the actual observations, in which a second observer was on the same bus. After the
observation, the questionnaires were compared for discrepancies. Prior to each
observation, transportation coordinators were contacted to ensure no schedule
changes. Individual-level variables were not collected.

The questionnaire was designed to identify risk factors for childhood injuries
associated with school transportation. The questionnaire covered four major topics:
(1) school and bus infrastructure: the area surrounding school bus loading zones and
the buses themselves; (2) bus ride: observations of pupil, bus driver and chaperone
behaviours; (3) hazards: risks associated with the bus ride or bus stops; and (4) bus
driver: experience, training and attitudes. This report focuses on pupils’ behaviour
during the school bus rides. Future reports will discuss the other findings.

Pupil behaviour was measured by observing the pupils during the bus ride.
The observed behaviours included: seatbelt use during the ride, remaining seated
while the bus was in motion; remaining seated until the bus came to a complete stop;
refraining from rowdiness and extreme noise; refraining from verbal or physical
conflict (including aggressive interaction such as wrestling, grabbing or hitting); and
not distracting or disturbing the driver. Behaviour was classified as positive if during
the ride all of the above behaviours were observed. Pupil behaviour was rated on a
scale of 1 to 4: 1 = during the entire ride, 2 = during most of the ride, 3 = during some
of the ride and 4 = none of the ride.

Excel and SAS (SAS Institute Inc., Cary, North Carolina, United States of
America) were used for data entry and assessment. Chi-square tests were performed
for comparison of student characteristics according to seatbelt use. Logistic regression
models assessing student behaviour during the bus ride were used to calculate odds
ratios (OR) and 95% confidence intervals (CI). The Hosmer and Lemeshow test was
used to measure the goodness of fit of the model.

Results
A total of 362 observations on buses used for school transportation were performed
between 17 December 2006 and 7 March 2007. Approximately 11,000 pupils were
observed – 35% of the pupils living in the geographical area of the sample population.
The observations took place on 125 different buses used for school transportation
(Table 1).
**Bus and bus ride**
The buses used for school transportation were manufactured between 1986 and 2007; 23% were manufactured between 2003 and 2007, while 33% were manufactured between 1986 and 1988. Buses manufactured before 1998 were 3.8 times more likely to have a hazard (e.g. protruding metal rods, broken seatbelts, torn seats or lack of arm rail by the door) than newer buses. Although seatbelts had been installed in almost all of the buses (97%), only 10% were equipped with lap–shoulder belts. Buses lacking seatbelts were at least 10 years old, and 85% of the buses with lap–shoulder belts were newer buses ($P < 0.0001$).

The length of the bus rides ranged from 5 to 80 minutes, with an average length of 26 minutes (standard deviation, SD: 12.6); 69% took up to half an hour. The number of bus stops ranged from 1 to 16, with a mean of 4. The maximum number of pupils on a bus was 55.

**Seatbelt use**
Seatbelt use was observed and recorded on 351 bus rides; on 23% of the rides all the pupils fastened seatbelts and on 42% none did (Table 2). School type (primary versus secondary school), presence or absence of an adult chaperone, seatbelt type (lap versus lap–shoulder belts) and length of ride (more or less than 25 minutes) were associated with seatbelt use. While seatbelt use varied with bus route (to or from school) and number of bus stops, these differences were not statistically significant. Primary school pupils (grades 1–6) were 5 times more likely to fasten seatbelts than secondary school pupils (middle and high school, grades 7–12). On rides in which a chaperone was present, pupils were 2.6 times more likely to fasten seatbelts; on 49% of the bus rides with a chaperone all the pupils fastened seatbelts, compared to 19% on rides without a chaperone ($P < 0.0001$). Interestingly, on buses with lap–shoulder seatbelts pupils were almost 3 times more likely to fasten seatbelts than pupils on buses with lap-only seatbelts (59.5% versus 19.3%).

**Pupil behaviour during the bus ride**
The following pupil behaviours were observed: not sitting while the bus was in motion, standing up before the bus came to a complete stop, being rowdy or extremely noisy, and engaging in physical or verbal conflicts. At least one of these behaviours was reported on 40% ($n = 218$) of the bus rides. Differences in the
frequency of unsafe behaviour were observed between bus rides to and from school (27.2% versus 51.3%), between primary and secondary pupils (46.2% versus 31%), and between routes with 1–4 stops and routes with 5 or more stops (27.5% versus 58.3%). The presence of a chaperone and the length of the bus route (in minutes) were not found to have a statistically significant association with these behaviours.

We found that on afternoon rides from school to home pupils were 2.3 times less likely to remain seated while the bus was in motion ($P < 0.0001$), 1.8 times more likely to stand up before the bus came to a complete stop at the bus stop ($P = 0.002$), 2.5 times more likely to be extremely noisy ($P = 0.003$) and 3.2 times more likely to engage in conflicts ($P = 0.005$). We also found that there was a twofold greater chance of observing at least 2 of the above behaviours in the afternoon compared to the morning (22% versus 10%, $P < 0.0001$).

On routes with 5 or more stops compared to 1–4 stops, pupils were less likely to remain seated (34% versus 14.7%; $P = 0.004$) and more likely to stand before the bus came to a complete stop (38.9% versus 11.9%; $P = 0.001$), be extremely noisy (21.5% versus 11.5%; $P = 0.002$) and engage in conflicts (15.3% versus 6.4%; $P = 0.001$). On 28% of the routes with 5 or more stops, at least 2 of the above behaviours were observed, compared to 9% on rides with up to 4 stops ($P < 0.0001$).

Primary school pupils were 2.3 times more likely to engage in at least 2 of the observed behaviours than middle and high school pupils (21.8% versus 9.6%; $P = 0.003$). On 25% of bus rides with primary school pupils, the pupils did not remain seated while the bus was in motion compared to 18.6% of rides with older pupils. Younger pupils were also more likely than older pupils to stand before the bus came to a complete stop (28.6% versus 14.7%; $P = 0.002$), to be rowdy and noisy (21.4% versus 7.7%; $P = 0.002$) and to engage in conflicts (12.1% versus 7.1%; $P < 0.0001$) (Fig. 1).

Logistic regression for positive pupil behaviour while travelling on the bus considered time of route, number of bus stops and type of school (Table 3). Positive behaviour was greater on the way to school (OR: 3.3, 95% CI: 2.1–5.3), on routes with fewer than 5 bus stops (OR: 4.0; 95% CI: 2.5–6.5) and among middle and high school pupils (OR: 1.8; 95% CI: 1.2–2.9).
Noise, conflicts between pupils, and pupils moving around on a travelling bus were all disruptive to the bus driver. On the basis of observations of pupil and bus driver behaviour and interviews with bus drivers, it was concluded that pupils disturbed the bus driver 4.5 times more on noisy bus rides (48.2%) compared to quiet ones (10.5%; $P < 0.0001$). Similarly, pupils disturbed the bus driver 6 times more on bus rides in which there were conflicts between pupils (66.7%) compared to rides without conflicts (10.7%; $P < 0.0001$).

**Discussion**

An important finding of this study is that seatbelt use among school-age children and adolescents is not dependent on seatbelt availability or on regulations requiring seatbelts in vehicles used for school transportation. In this study, seatbelts were found to be installed in 97% of the vehicles, yet in 42% of the observations none of the pupils fastened them. Among students in the higher grades, seatbelt use was even less frequent. Although seatbelt use was minimal, certain conditions increased it: use of seatbelts was greater when the bus was equipped with lap–shoulder belts, when a chaperone was present and when the pupils on the bus were primary school children. Hence, the use of better-fitting belts, such as lap–shoulder belts, and the presence of adult chaperones would appear to be more important than regulations or seatbelt availability for increasing seatbelt use, especially among middle and high school students.

While the use of seatbelts has proved to be an effective method for reducing traffic-related injuries and fatalities in private cars, controversy exists over the effectiveness of their use in school buses.\textsuperscript{10–12} If seatbelts are to be beneficial, it must be ensured that not only do all school bus passengers wear them, but that they wear them correctly.\textsuperscript{10}

Another major finding of this study is that pupil behaviour is highly dependent on other factors in the school bus environment. In general, morning bus rides (from home to school) were calmer, while rowdy behaviour and conflicts between pupils were more common on afternoon rides (from school to home). In addition, unsafe behaviour was more likely to occur on bus routes with 5 or more bus stops and on bus rides with primary school pupils. Pupil conduct not only affected the overall bus environment, but also bus driver concentration.
Bus drivers and transportation coordinators say that it is unrealistic to expect the bus driver to enforce seatbelt use and address misconduct while concentrating on driving safely (focus group with bus drivers and transportation coordinators, April 2007). The risk factors observed in this study, including out-of-seat activity, excessive noise and rowdiness, standing before the bus comes to a complete stop and distracting the bus driver, should therefore be addressed through strategies for improving behaviour and enhancing safety during school bus transportation.

The safety of children travelling by means of organized school transportation depends on many factors. In Israel, as in many developed countries, school transportation safety guidelines have been recommended, including codes of conduct for pupils; a “no standing” rule; specialized training and requirement of an outstanding driving record for bus drivers; measures to create a safe road environment, such as school zone speed limits and marked bus and pedestrian fences at waiting areas; and vehicle standards, such as seatbelts, flashing lights and maximum bus age limits.1,13–16 Initiatives to improve the school bus environment in the United States include assigned seating, surprise bus visits by school authority figures (e.g. school principals, teachers and policemen), stopping the bus to address rowdy behaviour, teaching appropriate bus behaviour throughout the school year and suspending misbehaved pupils from bus travel.18,19 While some of these recommendations and interventions are being implemented in Israel, others still need to be assessed and, if proved effective, implemented.

Limitations
The primary limitation of this study relates to bus drivers’ behaviours, which may have improved during the observation period (e.g. driving at a lower speed, taking more care to obey traffic laws). However, while we assumed that some of the bus drivers or bus companies might “put on a show” for the observers, we found that, in practice, the observers did not feel that the drivers, students or transportation coordinators altered their demeanour during the observations. Moreover, since misbehaviour was observed and reported by both drivers and pupils, we are confident that our results are reliable. In addition, observers travelled with the same driver on several rides, enabling repeated observation of the driver’s behaviour. Another limitation was that individual-level variables such as gender were not assessed.
Conclusion

This is the largest study of its kind of pupil on-bus behaviours based on observations of daily school bus travel to and from school. This study confirms that seatbelt availability and government regulations are not sufficient to ensure seatbelt usage. In order for laws and regulations to be effective they must be enforced. However, responsibility for enforcing seatbelt use and tackling pupil misconduct cannot be assigned solely to the bus driver, whose principle responsibility is to drive safely. Innovative methods for improving pupil conduct on school transportation vehicles should be designed, implemented and evaluated.

Acknowledgements

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Competing interests: None declared.

References


Table 1. **Study population, schools, buses and type of seatbelt in a study of seatbelt use on school buses in Israel, December 2006–March 2007**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Study population</strong></td>
<td></td>
</tr>
<tr>
<td>Pupils in the geographical area of the study</td>
<td>31 700 100</td>
</tr>
<tr>
<td>Observations of school transportation</td>
<td>362 100</td>
</tr>
<tr>
<td>Pupils in study sample</td>
<td>~11 000 34.7</td>
</tr>
<tr>
<td><strong>Total schools in sample</strong></td>
<td>88 100</td>
</tr>
<tr>
<td>Primary schools&lt;sup&gt;a&lt;/sup&gt;</td>
<td>50 56.8</td>
</tr>
<tr>
<td>Middle/high schools&lt;sup&gt;b&lt;/sup&gt;</td>
<td>28 31.8</td>
</tr>
<tr>
<td>Combined primary-secondary school</td>
<td>10 11.4</td>
</tr>
<tr>
<td><strong>Total buses in sample</strong></td>
<td>125 100</td>
</tr>
<tr>
<td><strong>Type of seatbelt in bus</strong></td>
<td></td>
</tr>
<tr>
<td>Lap belts</td>
<td>108 86.4</td>
</tr>
<tr>
<td>Lap–shoulder belts</td>
<td>13 10.4</td>
</tr>
<tr>
<td><strong>No seat belts</strong></td>
<td>4 3.2</td>
</tr>
</tbody>
</table>

<sup>a</sup> Primary school comprises grades 1–6 (ages 6–12).

<sup>b</sup> Middle and high schools comprise grades 7–12 (ages 12–18).
### Table 2. Seatbelt use on school buses among Israeli school pupils by selected variables, Israel, December 2006–March 2007

<table>
<thead>
<tr>
<th>Variable</th>
<th>Total rides&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Time of day</th>
<th>No. of bus stops</th>
<th>Route length</th>
<th>School type</th>
<th>Chaperone on bus</th>
<th>Seatbelt type</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>%</td>
<td>No.</td>
<td>%</td>
<td>No.</td>
<td>%</td>
<td>No.</td>
</tr>
<tr>
<td>Total rides&lt;sup&gt;a&lt;/sup&gt;</td>
<td>351</td>
<td>100</td>
<td>81</td>
<td>23.1</td>
<td>124</td>
<td>35.3</td>
<td>146</td>
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<tr>
<td>Time of day</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>To school (morning)</td>
<td>170</td>
<td>48.4</td>
<td>43</td>
<td>25.3</td>
<td>64</td>
<td>37.6</td>
<td>63</td>
</tr>
<tr>
<td>From school (afternoon)</td>
<td>181</td>
<td>51.6</td>
<td>38</td>
<td>21.0</td>
<td>60</td>
<td>33.2</td>
<td>83</td>
</tr>
<tr>
<td>No. of bus stops</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1–4</td>
<td>211</td>
<td>60.1</td>
<td>53</td>
<td>25.1</td>
<td>72</td>
<td>34.1</td>
<td>86</td>
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<tr>
<td>5+</td>
<td>140</td>
<td>39.9</td>
<td>28</td>
<td>20.0</td>
<td>52</td>
<td>37.1</td>
<td>60</td>
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<tr>
<td>Route length</td>
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<td></td>
<td></td>
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<tr>
<td>&lt; 25 minutes</td>
<td>181</td>
<td>51.6</td>
<td>37</td>
<td>20.4</td>
<td>61</td>
<td>33.7</td>
<td>83</td>
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<tr>
<td>&gt; 26 minutes</td>
<td>141</td>
<td>40.2</td>
<td>41</td>
<td>29.1</td>
<td>47</td>
<td>33.3</td>
<td>53</td>
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<td>29</td>
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<td>3</td>
<td>10.3</td>
<td>16</td>
<td>55.2</td>
<td>10</td>
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<tr>
<td>School type</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grades 1–6</td>
<td>200</td>
<td>56.9</td>
<td>70</td>
<td>35.0</td>
<td>83</td>
<td>41.5</td>
<td>47</td>
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<tr>
<td>Grades 7–12</td>
<td>151</td>
<td>43.0</td>
<td>11</td>
<td>7.3</td>
<td>41</td>
<td>27.2</td>
<td>99</td>
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<tr>
<td>Chaperone on bus</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Yes</td>
<td>44</td>
<td>12.5</td>
<td>22</td>
<td>50.0</td>
<td>16</td>
<td>36.4</td>
<td>6</td>
</tr>
<tr>
<td>No</td>
<td>307</td>
<td>87.5</td>
<td>59</td>
<td>19.2</td>
<td>108</td>
<td>35.2</td>
<td>140</td>
</tr>
<tr>
<td>Seatbelt type</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lap only</td>
<td>300</td>
<td>85.4</td>
<td>58</td>
<td>19.3</td>
<td>116</td>
<td>38.7</td>
<td>126</td>
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<tr>
<td>Lap–shoulder</td>
<td>37</td>
<td>10.5</td>
<td>22</td>
<td>59.5</td>
<td>7</td>
<td>18.9</td>
<td>8</td>
</tr>
<tr>
<td>No belt</td>
<td>14</td>
<td>4.1</td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

<sup>a</sup> On 11 rides (3%) seatbelt use was not reported.

### Table 3. Logistic regression analysis<sup>a</sup> for pupil behaviour on school bus, adjusted for time of ride, number of bus stops and type of school, Israel, December 2006–March 2007

<table>
<thead>
<tr>
<th>Variable</th>
<th>No.</th>
<th>% positive behaviour</th>
<th>OR&lt;sup&gt;b&lt;/sup&gt;</th>
<th>95% CI</th>
<th>P-value</th>
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<tbody>
<tr>
<td>Time of ride</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>To school (morning)</td>
<td>173</td>
<td>72.8</td>
<td>3.3</td>
<td>2.1–5.3</td>
<td>&lt; 0.0001</td>
</tr>
<tr>
<td>From school (afternoon)</td>
<td>189</td>
<td>48.6</td>
<td>1</td>
<td></td>
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<tr>
<td>No. of bus stops</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>1–4</td>
<td>218</td>
<td>72.5</td>
<td>4.0</td>
<td>2.5–6.5</td>
<td>&lt; 0.0001</td>
</tr>
<tr>
<td>5+</td>
<td>144</td>
<td>41.7</td>
<td>1</td>
<td></td>
<td></td>
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<tr>
<td>Type of school</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.01</td>
</tr>
<tr>
<td>Middle/high school</td>
<td>156</td>
<td>68.6</td>
<td>1.8</td>
<td>1.2–2.9</td>
<td></td>
</tr>
<tr>
<td>Primary school</td>
<td>206</td>
<td>53.8</td>
<td>1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Cl, confidence interval; OR, odds ratio.

<sup>a</sup> Hosmer and Lemeshow goodness-of-fit test P-value = 0.6.

<sup>b</sup> OR adjusted for other variables in model.
Fig. 1. Frequency of misbehaviour\(^a\) on school buses among Israeli schoolchildren, by grade level, Israel, December 2006–March 2007
\(^a\) Percentage of bus rides on which the behaviour was observed.