VTI konferens

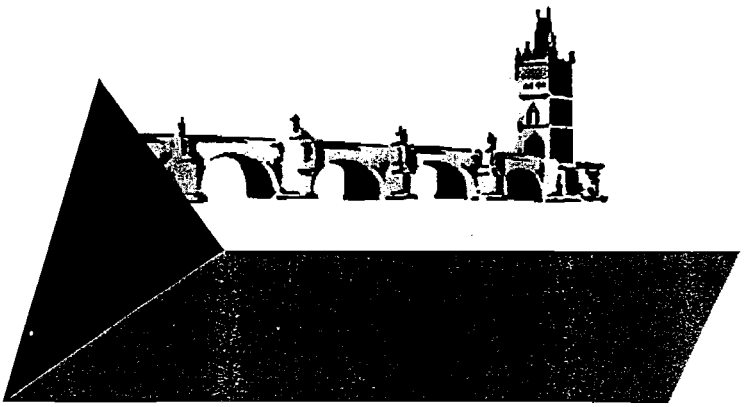
No. 4A, Part 2 • 1996

Proceedings of the Conference

Road Safety in Europe and Strategic Highway Research Program (SHRP)

Prague, the Czech Republic, September 20–22, 1995

– Traffic Engineering and Work Zones
– High Risks and Road User Groups



Swedish National Road and Transport Research Institute

Publisher:	Publication: VTI konferens 4A part 2	
Swedish National Road and Transport Research Institute S-581 95 Linköping Sweden	Published: 1996	Project code:
	Project:	

Title:
Proceedings of the Conference Road Safety in Europe and Strategic Highway Research Program (SHRP) Prague, the Czech Republic, September 20–22, 1995

Abstract (background, aims, methods, results) max 200 words:
Papers presented at the seminar were as follows:
Results of Speed and Accident Studies on Two-Lane Rural Roads in Germany (*Gerhard Schmidt*);
Behavioural Studies to Assist Safety Engineering Design (*Archie Mackie*);
Factors Influencing the Speed Choice of Drivers in Town (*I. Papp, T. Siska and P. Holló*);
Choosing a System to Control Level Crossing Signalling Devices (*A. Hakkert and B. Stepensky*);
Traffic Signal Systems from Central to Distributed Now Into the Future (*Fred Lantz and Miro Supitar*);
New Traffic Regulation in Relation to the Traffic Volumes and Safety in Workzones in the Netherlands (*Michel M. Kusters and Jan M. Boone*);
Designing and Operating Work Zones for Road Safety (*Karel Valík*);
Road Safety and Traffic Engineering (*Pavel Skládaný*);
Highway Agency Preliminary Implementation of Maintenance Work Zones Safety Drivers (*Fred R. Hanscom*);
Low Maintenance, Reusable Impact Attenuation Devices (*John F. Carney III*);
Applications of Video and Machine Vision Technologies to Traffic Safety and Transportation Planning in the United States and Great Britain (*Paul W. Shuldiner*);
Sustainable Traffic Safety Strategy (*Robert Methorst*);
Vulnerable Road Users, Societal Values and the Distribution of Power and Status – A Cross-County Analysis (*Keith Lehrer*);
Young Pedestrians and their Ability to Move Safely in the Traffic (*Kari Midtland*);
Analysis of Single Vehicle Accidents Caused by Young Passenger Car Drivers Based on Original Police Reports (*Tamás Siska*);
New Strategies to Increase Pedestrian Safety at Traffic Signals (*Klaus Schlabbach*);
Pedestrian – Vehicle Interactions on Roads in France (*Jaques Robin*);
Traffic Perception Attitude and Skills of School Children: Assessment of Contributing Elements (*Khaled El-Araby, Khaled Abbas and Ibrahim Mabrouk*);
Road Safety Concerning Schoolchildren and Adolescents (*Bojan Zlender, Niko Arneric, Marko Polic, Vlasta Zabukovec, Borut Kraigher and Marko Mis*);
Traffic Violations and the Highway Crash: The Etiology of High Risk Drivers (*Lawrence H. Nitz, Karl E. Kim and Edmund Leong*);
Driver's Risk and its Adaptation Function (*Antoni Wontorczyk*);
Young Drivers, the Relation Between Life Style, Motivation and Driving Behaviour (*Nils Petter Gregersen and Maj-Britt Wahlquist*);
"Pilot" – Implementation and Evaluation of Further Education of Young Drivers (*Sixten Nolén*);
Pedestrians' Problem and Safety (*Nocile Muhlard*);
Elderly Drivers, Guilty of Traffic Violations, Suffer from Selective Cognitive Impairment (*Catarina Lundberg, Kurt Johansson and Ove Almkvist*);
Neurodegenerative Alterations of Brain Tissue and Other Conditions Indicating Possible Cognitive Impairment Among Elderly Drivers, Dead in Connection with Car Crashes (*Kurt Johansson, Nenad Bogdanovic, Catarina Lundberg, Matti Viitanen and Hannu Kalimo*)

ISSN:	Language:	No. of pages:
1104-7267	English	286

PREFACE

The Swedish National Road and Transport Research Institute (VTI), the U.S. Transportation Research Board (TRB) together with the Forum of European Road Safety Research Institute (FERSI), Forum of European National Highway Research Instiute (FEHRL) and the Transport Research Centre (CDV) of Brno, the Czech Republic were jointly organising a three day conference in september 20–22 1995, in the Prague, the Czech Republic. Conference sessions covered the road with special emphasis on the Strategic Highway Research Program (SHRP) and drivers and vehicles as related to Highway Safety.

For the sessions on driver/vehicle/roadway safety there were presentations of special interest showing the differences that exist between the USA and between Northwestern Europe and Southern or Central and Eastern Europe in requirements, practice, performance and behaviour. Sessions covered the following topics:

- International Comparisons
- Safety Data and Models
- Methods for Estimating Safety
- Traffic Engineering and Work Zones
- High Risk and Road User Groups
- Alcohol and Drugs
- Social Aspects and Costs
- Road Safety Management
- Enforcement in Urban Areas
- Road and Roadside Design
- Hazardous Situations
- Pavement Properties and Distress
- Pavement Performance Studies
- Pavement Design and Performance
- Bituminous Binders and Mixtures
- Pavement Analysis
- DAWG

Linköping March 1996

Kenneth Asp

Proceedings of the Conference ROAD SAFETY IN EUROPE and STRATEGIC HIGHWAY RESEARCH PROGRAM (SHRP) in Prague, the Czech Republic, September 20–22, 1995.

VTI konferens 4A part 1
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Traffic Perception Attitude and Skills of School Children: Assessment of Contributing Elements

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(submitted for presentation at the International Conference Strategic Highway Research Program and Traffic Safety on Two Continents, Prague, the Czech Republic)

Abstract:

In recent years, many countries have been giving more attention to the traffic safety of children. Unfortunately in most developing countries, the situation is still relatively neglected. Of all factors contributing to children accidents in developing countries, the most significant are poor traffic behavior and non-compliance with traffic rules by children, particularly in developing countries, due to flawed traffic perception and attitudes, inadequate traffic knowledge and training, and lack of skills

In this research, a strong emphasis is given to analyzing the effect age, gender, socioeconomic background, and type of schooling differences have on children's traffic behavior in Cairo. Traffic behavior of children is known to be affected by traffic perception, attitude, skills, and knowledge. A stratified random sample of 1615 school children representing various degrees of affluence, age, gender, and type of schooling were surveyed and results were analyzed. In addition, traffic behavior of school children, in particular walking and crossing patterns, was videotaped to assess their actual traffic behavior and validate stated behavioral patterns

The research concludes that socioeconomic background is the leading factor affecting children's behavior followed by type and stage of school. Child gender was found to affect only traffic perception and attitude with no significant difference between boys and girls in traffic knowledge and skills. Of all children categories investigated, children in the primary school stage who live in less affluent districts and attend public schools were found to be the most exposed to traffic and exhibit the worst traffic behavior. The research concludes with a selected set of policy recommendations and countermeasures that could be investigated further to accommodate differences in age, gender, socioeconomic background, and type of schooling of children.

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TRAFFIC PERCEPTION, ATTITUDE, AND SKILLS OF SCHOOL CHILDREN: ASSESSMENT OF CONTRIBUTING ELEMENTS

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1. INTRODUCTION

Because of the relatively large numbers of children in developing countries coupled with high urban residential densities, children represent a much greater proportion of road accident fatalities than they do in developed countries. In Egypt, almost 45% of the population are under the age of 15 years (CAPMAS, 1992). Children under 15 years of age represent a significant proportion of road accidents' fatalities and injuries in developing countries (Jacobs and Sayer, 1977). In a study of 6 rural routes and 3 urban regions in Egypt, around 20% of pedestrian accidents were found to occur to children in the 5-15 years age group (ASRT, 1991). Several factors contribute to this situation, some are related to unsatisfactory design and layout of roads, sidewalks, and furniture, and others are related to poor condition of vehicles and non-compliance by drivers. However, more importantly is poor traffic behavior and non-compliance with traffic rules by children, particularly in developing countries, due to flawed traffic perception and attitudes, inadequate traffic knowledge and training, and lack of skills (Jacobs et al., 1981; Downing and Sayer, 1982; Sayer, 1989; Abbas et al., 1994).

According to 1986 census figures, more than 77% of school trips in Cairo were made on foot. Previous studies have shown that more than 20 percent of young pedestrian accidents occur during the school walking trip (Reiss, 1977; David and Rice, 1994). Since 87% of children in the 5-12 years age group and 74% of children in the 12-15 years age group go to school (CAPMAS, 1992), school children can be regarded as a good representation of the whole children population in Egypt. Based on the above, school children were chosen for the analysis of children traffic behavior in Egypt.

An in-depth investigation of school children behavior is thus needed to develop effective countermeasures aimed at improving the children road safety.

"In order to plan a comprehensive and integrated program of remedial measures, ... it is important that countries carry out in-depth investigation of pedestrian accidents so that the key patterns and contributory factors be determined.....", (Sayer, 1989).

The Transport Research Laboratory Overseas Unit has conducted a variety of traffic accidents' and safety studies in the developing world (Jacobs and Sayer, 1977; Jacobs et al., 1981; ASRT, 1991). A preliminary study of children road-crossing knowledge in Jamaica, Pakistan, and Thailand identified children's knowledge about crossing roads and how this knowledge was affected by factors such as gender, age, crossing experience, and advice given (Downing and Sayer, 1982). Age, experience and confidence, and parental advice, but not gender, were found to be significant factors affecting crossing performance. In case of Egypt, one of the main studies investigating the pedestrian problem, as part of the overall Traffic Accidents Research Program in Egypt, was conducted by Transport Research Laboratory Overseas Unit in collaboration with the Academy of Scientific Research and Technology (El-Hawary and Noureldin, 1985; ASRT, 1991). Sayer (1991) studied the pedestrian problem in Egypt and compared the road user characteristics, behavior, and knowledge with that of Pakistan and Botswana. In Egypt, only 2% of pedestrians interviewed thought there were any places where they had right-of-way over drivers and only about 7% mentioned using a crossing place or looking while crossing a street. Over 75% of pedestrians interviewed claimed they have no traffic safety education. However, in this study, apart from summary statistics and tabulations, no in-depth investigation of factors affecting pedestrian traffic behavior and attitude was conducted.

In an earlier paper, the authors investigated the overall traffic experience, perception, attitude as well as stated traffic behavior of school children in Cairo (Abbas et al., 1994). The majority of school children (91% of sample) were categorized as having imperfect and dangerous crossing behavior. However, no in-depth investigation of the contributing factors and their correlation with observed actual traffic behavioral patterns of school children was conducted.

As for the developed world, there has been a multitude of studies investigating elements contributing to traffic behavior of children. Sandels (1968) extensively examined the behaviors and cognitive abilities of children and concluded that the necessary degree of maturity for safe traffic behavior is reached between the ages of 9 and 12. Reiss (1977) conducted a school walking-trip study for young children in the 5 to 14 years age group. Significant differences by age groupings were noted for both pedestrian accident data and traffic knowledge responses. In two separate studies, Tight (1992) and Assailly (1992) investigated accident involvement patterns of child pedestrians in Britain and Europe. Regarding age and gender, boys were found to have a higher risk of accidents than girls in the age group 4 to 9 years. Children of low socioeconomic status were more involved in accidents than more affluent children Also, the majority of children's accidents were found to occur close to home and when the child was crossing the street or walking along the road. Tight (1992) concluded that emphasis on improving children's behavior will reduce accidents to an extent and that what is needed to change behavior across all road user groups is a coordinated approach that is not limited to engineering measures. Assailly (1992) concluded that improving behavior of school children through practical training in real traffic is more suitable than improving knowledge and attitudes. However, such an approach fails to realize that improving skills, knowledge, perception and attitude of school children is a precursory element towards the improvement of real traffic behavior. David and Rice (1994) conducted a study on the significance of physical environmental factors: pedestrian characteristics; accident location descriptors; and land use characteristics, on children pedestrian accidents in Montreal.

The main assumption in this research, as shown in Figure 1, is that traffic behavior of school children, as pedestrians, is a function of three elements (Brinks, 1990):

- School children traffic knowledge which in turn is a function of pedestrian traffic education and information;
- Children cognitive skills and abilities (i.e., anticipating traffic risk) as well as perceptual skills (i.e., reaction to anticipated risk and risk acceptance) which in turn is a function of traffic experience. Children traffic experience is mainly a function of the level of training, age, and traffic exposure);
- Traffic perceptions and attitude that are formed under the effect of the pedestrian environment, driver behavior, as well as enforcement.

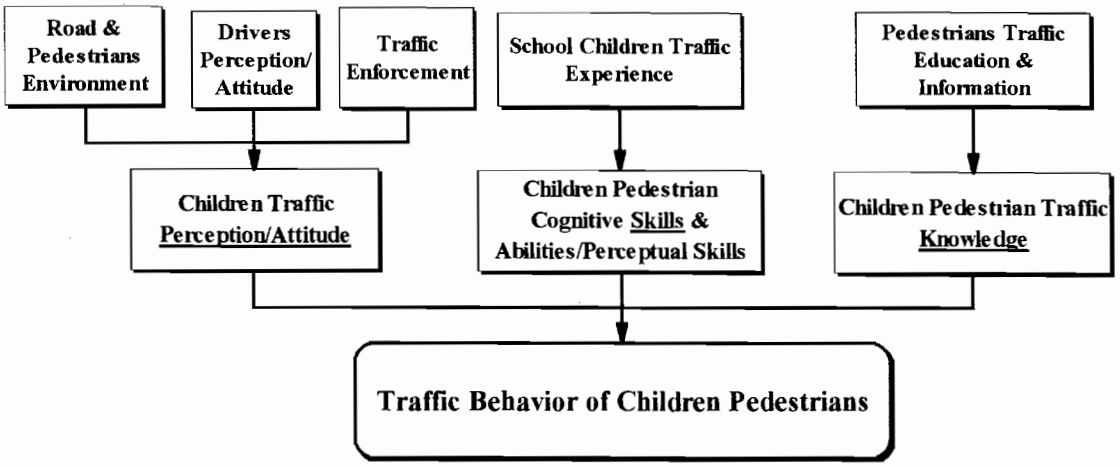

Figure 1. Framework for the Analysis of Child Pedestrian Traffic Behavior

In this research, an in-depth investigation of factors affecting school children's attitudes, skills, and knowledge is conducted in order to develop effective countermeasures aimed at improving the school children's safety in developing countries and aimed towards the most demanding of school children categories.

2. DATA COLLECTION

To fulfill the desired objectives, structured attitudinal questionnaires were used to collect relevant information about school children's knowledge, attitudes, and skills towards the traffic situation in Cairo. A stratified random sample of 1615 school children was chosen to represent different parameters such as affluence and physical planning of the districts where the schools are located, level of education (primary and preparatory), schooling system (public and private), and gender of school children. Two schooling districts were selected, namely Heliopolis and Helwan. The first represents a highly affluent well-planned residential district, while Helwan represents a relatively poor blue-collar area. In each district, a number of primary and preparatory schools representing different schooling systems, both public and private, were sampled. For more information on the survey, see Abbas et al., 1994.

In addition, traffic behavior of school children, in particular walking and crossing patterns, in the vicinity of schools was surveyed. A video camera was used to record child's traffic behavior. Data was collected during the morning and evening peaks at the study sites.

To aid in understanding the school children's safety problem and in determining the elements that contribute to school children's traffic behavior, the data were dealt in four categories: gender, affluence, type of schooling (public/private), and school stage (primary/preparatory).

3. ANALYSIS OF DATA

The primary emphases in previous analysis of accident data in developing countries involved tabulations and cross tabulations of two or more variables. Although this type of analysis is necessary, it promotes the theory of a single cause of accidents. Summary statistics, annual reports, and tabulations indicate the scope of the children pedestrian safety problem, rather than provide an adequate explanation. Studies have shown that there are many interrelated variables that contribute to children's traffic behavior that ultimately contribute to accidents. Thus, there is a need to apply the non-parametric statistical analysis methods that are congruent with a multiple causation theory of traffic safety. Statistical tests discussed in the following sections investigate the way differences in gender, type and stage of schooling, and socioeconomic levels affect the traffic skills, attitude, and/or knowledge of the school children. By determining such associations, a clearer understanding of the school children's safety problem can be achieved.

3.1 Nonparametric Statistical Analysis of the Questionnaire Responses

The questionnaire used in this research was designed to obtain the responses mainly in an ordinal and nominal form. Nonparametric statistical tests were utilized in analyzing questionnaire responses and inferring conclusions. These tests are well suited for analyzing nominal and ordinal data types. The purpose and applications of each of the tests used is described in detail in the following sections. All the tests undertaken in this research were performed using the Statistical Packages for Social Sciences (SPSS/PC$^+$ V2.0) software (Norusis, 1987).

3.1.1 Chi-Square Test for Significance in Correlation

The chi-square test was used to test for statistically significant association between children's traffic knowledge, skills, and attitudes on one hand and their gender, affluence, type of schooling, and education stage as indicated in their questionnaire responses. For each classification variable and for each questionnaire response regarding perception, attitude, skills, or knowledge, the number and percentage of school children that fall into each category were established and cast into a contingency table. A requirement of the chi-square test is that fewer than 20% of the categorized cells have an expected frequency of less than 5 and that no cell has an expected frequency of less than 1 (Seigel and Castellan, 1988). In several cases, these requirements were not met by the data in the form in which they were originally collected. In this case, the researchers combined several categories to meet the above requirement.

The chi-square test was applied to the modified data in order to test for correlation between the classification variables and the questionnaire responses. The rejection/confidence level, i.e., the level of significance of association is set at alpha = 0.05. The results of the chi-square analysis are summarized in Table 1.

3.1.2 The Cramer Coefficient Test to Assess Level of Association Between Parameters

The statistical investigations were pursued to a still higher level in an attempt to investigate the degree of association between the classification variables and the attitudes, skills, and knowledge of children using the Cramer coefficient C, in addition to testing for the existence of association as performed by the chi-square test. The Cramer coefficient C is an extremely useful measure of association because of its wide applicability. The coefficient C makes no assumptions about the shape of the population distributions, does not require underlying continuity in the variables, and it requires only categorical measurement of the variables as is the case in this research. In testing the significance of a measure of association as the Cramer coefficient, we are testing the null hypothesis that there is no correlation and that the observed value of the measure of association could have risen by chance in a random sample of school children in which the classification variable under study and the behavior of school children are independent. The alternative hypothesis is that there is a genuine relation between the variables. The results of the Cramer coefficient tests of significance supported the results of the chi-square analysis (see Table 1).

3.2 Observed Traffic Behavior of School Children

In addition, observations of school children traffic behavioral patterns, particularly crossing and walking patterns were video-taped and observations were categorized according to gender, stage and type of schooling, and region's affluence. Criteria were developed to mark good, fair, bad, and dangerous crossing and walking patterns. Those who used the sidewalks, looked both ways, and continued looking while crossing were given perfect marks. Those who ran across the roads and did not use the sidewalks were given low marks, and so on. This served as a validation check for the stated behavioral responses obtained from the questionnaires and added more credibility to the results.

3.3 Discussion of Results

Based on the statistical data analysis conducted, the following sections attempt to investigate and assess the elements contributing to school children's traffic exposure and behavior and attempts to explain their relation in view of the significantly distinctive characteristics of children in developing countries.

Table 1 Summary of Results from the Nonparamteric Analysis of Questionnaire Responses

Comparison Parameters / Question Responses	**Gender** (Boy/Girl)		**Stage** (Primary/Prep.)		**Type** (Private/Public)		**Region** (Affluent/Less Affluent)	
	Signif. Level	Chi-Square / Cramer Tests	Signif. Level	Chi-Square / Cramer Tests	Signif. Level	Chi-Square / Cramer Tests	Signif. Level	Chi-Square / Cramer Tests
1- Perception of Distance from School	**0.0000**	**Significant**	**0.0000**	**Significant**	**0.0361**	**Significant**	0.8400	N.S.
2- Preference of Travelling to School on Own	0.1742	N.S.*	**0.0027**	**Significant**	**0.0000**	**Significant**	**0.0000**	**Significant**
3- Ability to Deal with Traffic on Own	0.1354	N.S.	**0.0001**	**Significant**	0.2035	N.S.	**0.0015**	**Significant**
4- Fear of Traffic on Way to School	0.5672	N.S.	**0.0000**	**Significant**	**0.0000**	**Significant**	**0.0007**	**Significant**
5- Place to Stay on Early Arrival	**0.0000**	**Significant**	0.1755	N.S.	**0.0000**	**Significant**	**0.0000**	**Significant**
6- Place to Stay on Late Departure	**0.0001**	**Significant**	**0.0007**	**Significant**	**0.0000**	**Significant**	**0.0000**	**Significant**
7- Reasons for Staying Outside School Gates	**0.0000**	**Significant**	**0.0000**	**Significant**	**0.0000**	**Significant**	**0.0000**	**Significant**
8- Things Done Outside School Gates	**0.0000**	**Significant**	**0.0000**	**Significant**	**0.0000**	**Significant**	**0.0000**	**Significant**
9- Fear of Traffic in Front of School	0.7991	N.S.	**0.0000**	**Significant**	**0.0000**	**Significant**	**0.0000**	**Significant**
10- Ability to Cross Street on Own	0.4865	N.S.	**0.0000**	**Significant**	0.3515	N.S.	**0.0000**	**Significant**
11- Frequency of Crossing Streets on Own	0.3400	N.S.	**0.0000**	**Significant**	**0.0004**	**Significant**	**0.0323**	**Significant**
12- Actions Done When Crossing the Street	**0.0000**	**Significant**	**0.0000**	**Significant**	**0.0000**	**Significant**	**0.0000**	**Significant**
13- Street Crossing Places	0.3886	N.S.	0.1971	N.S.	**0.0000**	**Significant**	**0.0463**	**Significant**
14- Perception of Street Crossing	**0.0128**	**Significant**	**0.0000**	**Significant**	**0.0004**	**Significant**	**0.0500**	**Significant**
15- Holding Another Person's Hand on Crossing the Street	**0.0047**	**Significant**	**0.0000**	**Significant**	**0.0000**	**Significant**	**0.0036**	**Significant**
16- Source of Knowledge on Dealing with Traffic	**0.0000**	**Significant**	**0.0000**	**Significant**	**0.0000**	**Significant**	**0.0000**	**Significant**

* N.S. = Non-Significant

N.B.: Chi-Square Test was conducted to test the null hypothesis of independance in responses among the children groups at the the **5%** level
Cramer Coefficient Test was conducted to measure the degree of association (dependance) between the responses and the comparison parameters and its signifiance

Issue 1: Is School Children Traffic Exposure Significantly Dependent on Age and Gender of Child?
As seen in Figure 2, no significant differences existed in traffic exposure between boys and girls and between primary and preparatory school children. This implies that in developing countries, age is not an indication of traffic experience or that boys are exposed earlier to traffic. In fact, school children, both boys and girls, are exposed to traffic and are allowed to come and leave school on own at an early age. An earlier study by the authors established that age to be on the average 10 years old (Abbas et al., 1994). In case of school type and affluence of district, public school children and children in less affluent areas were significantly more exposed to traffic than private school and affluent districts' school children. This is expected due to the relatively higher socioeconomic status of private school children and the ability to ride a bus or come with parents.

From the above, it could be concluded that socioeconomic status and type of schooling, which in turn is dependent on socioeconomic status of the child's family, and not age and gender are major elements in traffic exposure in school children in Egypt. This contrasts with various studies conducted where age and gender were leading elements in the degree of traffic exposure for children, particularly in developed countries (Reiss, 1977; Assailly, 1992; Tight, 1992).

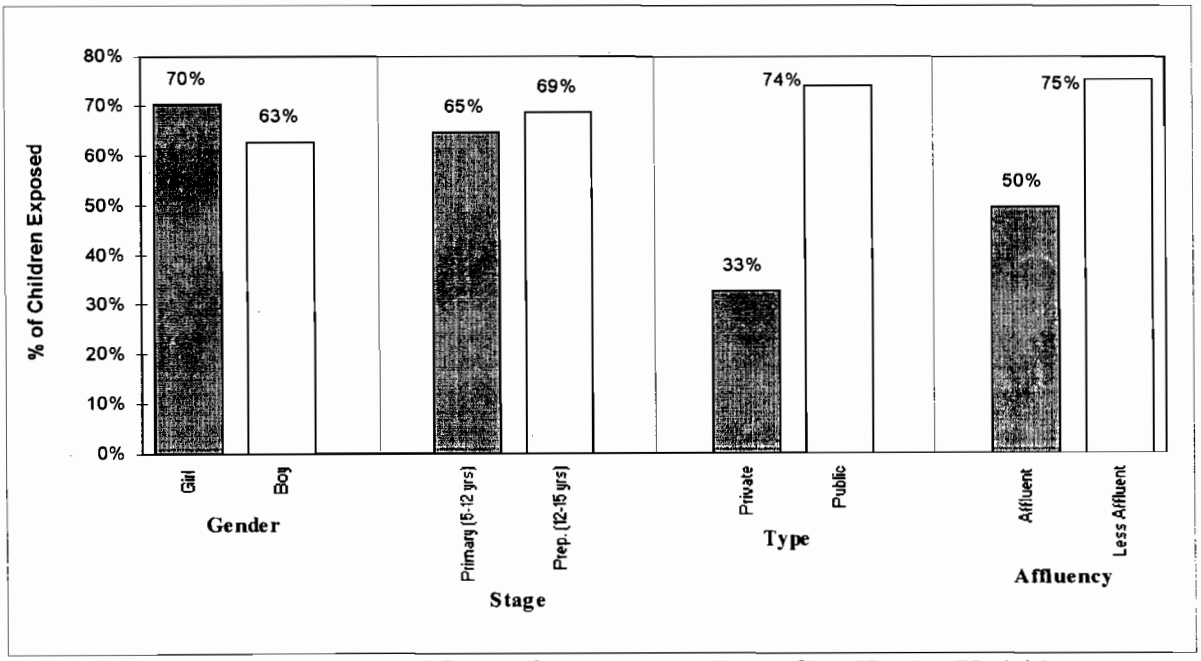

Figure 2. Traffic Exposure of School Children According to Classification Variable

Issue 2: Is School Children Traffic Behavior Significantly Affected by the Gender of the Child?
The results of the nonparametric analyses of the questionnaire responses indicated that school children's knowledge and attitudes are significantly affected by gender of child (at the 5% level). This is clearly seen in Table 1 and Figure 3 where there are significant differences between boys and girls, with boys having more positive behavior, in their attitudes towards holding another person's hand while crossing. In terms of street crossing knowledge, girls exhibited a greater percentage in dangerous street crossing knowledge than boys, although boys' knowledge was mainly imperfect. A very small percentage of boys and girls had perfect street crossing knowledge. More exposure by girls to traffic, as seen in Figure 2, can be used to explain some of these differences, but other factors such as sexual discrimination by parents in favor of boys, particularly in less affluent areas, play an important part. Behavioral differences (boys dash out and look less before crossing and play more frequently on streets) seem the cause for the imperfect crossing habits of boys. This implies the need for sexually selective educational and society-wide related safety programs that are tailored towards the need to enhance traffic knowledge and attitudes of school girls, and at the same recognizing the need to improve traffic knowledge of school boys.

However, as an indicator of perception, girls and boys were found to be not significantly different in their fear of traffic on their way to school and in front of school. In terms of skills, girls and boys were not significantly different in their ability to deal with traffic on own or their ability to cross street on own. This is clearly seen in Table 1 and Figure 3. This implies that girls and boys do not differ in skills or perceptive abilities and are both in need for traffic safety programs that go outside the classrooms into simulation of real-life traffic situations to enhance their skills. These results agree with findings by Downing and Sayer (1982) where gender was found to have no significant effect in street crossing performance of children in Jamaica, Pakistan, and Thailand.

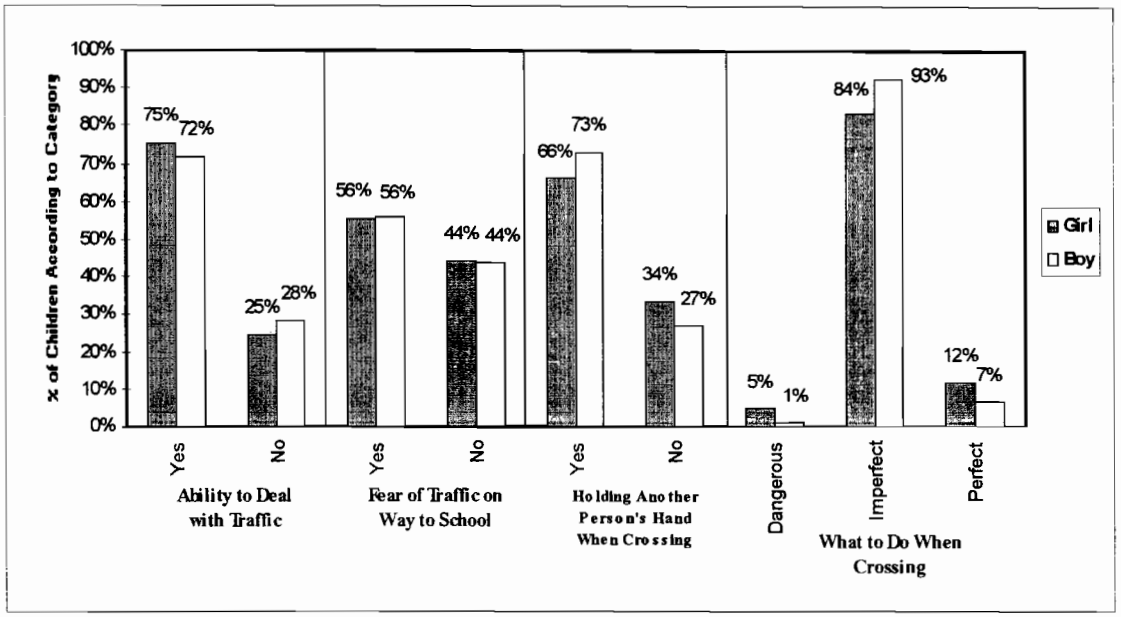

Figure 3. Traffic Skills, Perception, Attitude, and Knowledge According to Gender

These conclusions regarding gender were validated in the analysis of observed traffic behavior of school children. Girls and boys exhibited significantly different walking and crossing patterns with girls having a higher percentage in street walking and bad crossing behavior than boys (see Figure 4).

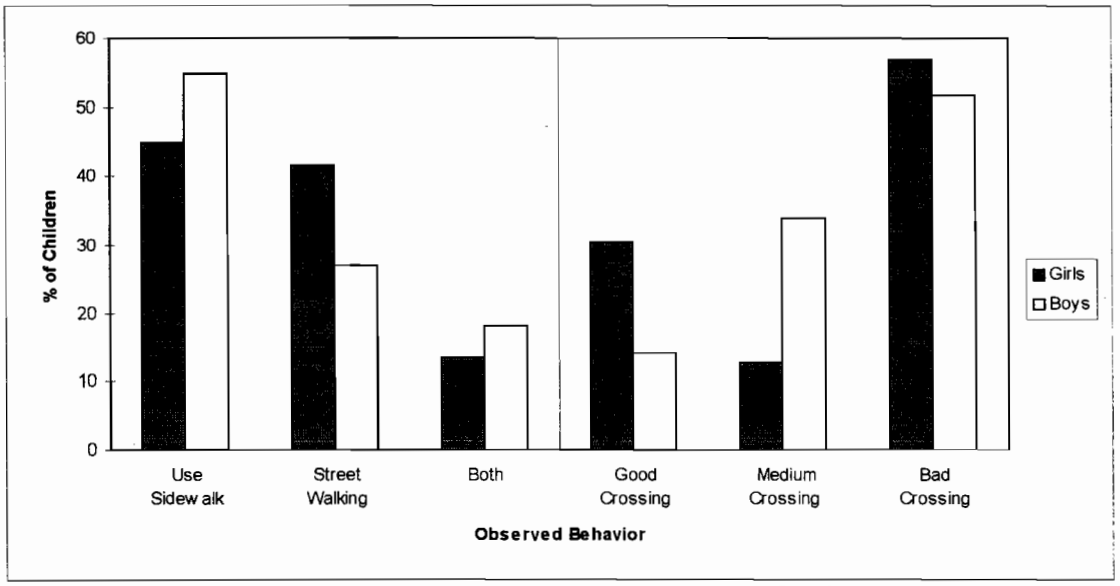

Figure 4. Observed Traffic Behavior According to Child Gender

Issue 3: Is School Children Traffic Behavior Significantly Affected by Stage of School?

The results of nonparametric analyses indicated that school children's perception, attitude, and skills are significantly affected by stage of schooling. Primary school children between the ages of 5 and 12 years

expressed less willingness to cross streets or deal with traffic on their own and were more afraid of traffic than children in the preparatory stage between the ages of 12 and 15 years. Details of the results are given in Figure 5. This implies that children, particularly in the age group 5 to 10 years old are at a high risk because they have not yet developed the perceptive, motor, and cognitive abilities necessary to deal with the traffic environment as older children have, although both primary and preparatory school children are highly exposed to traffic (see Figure 2). Thus, there is a need for safer traffic environments and special traffic control measures around primary schools in addition to special-purpose programs that enhance the perceptive abilities and skills of primary school children and that recognize their natural limitations. In case of knowledge, there was no significant differences in their knowledge of street crossing places, although, children in the preparatory stage performed better when asked about their street crossing knowledge (see Figure 5). This implies the fact that traffic knowledge of school children is inadequate across all school stages and hence the need for educational traffic programs.

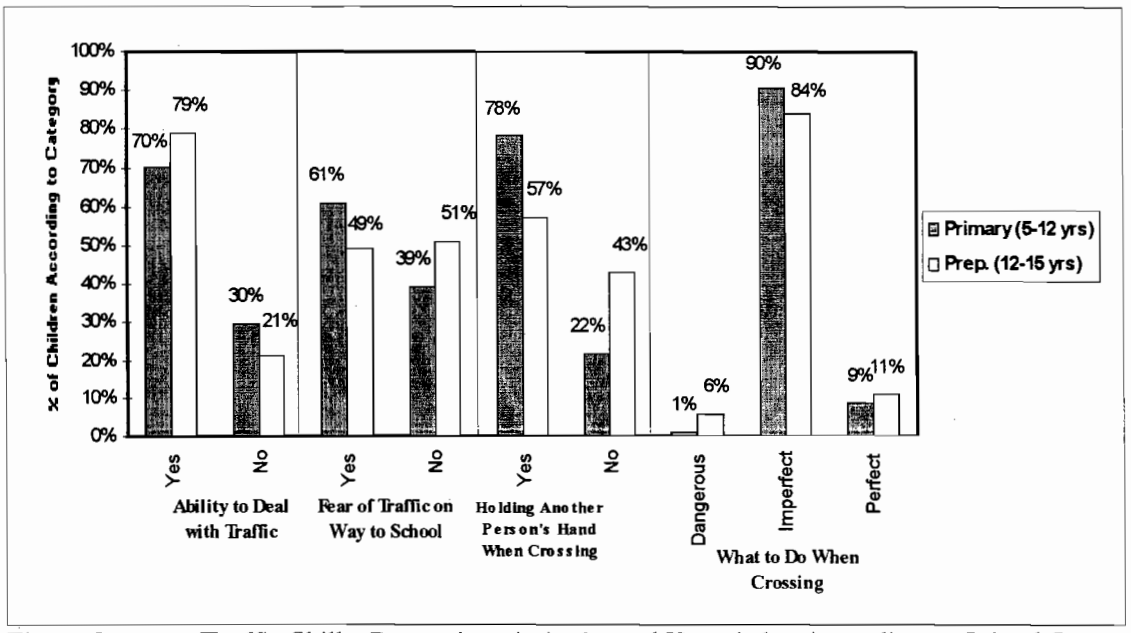

Figure 5. Traffic Skills, Perception, Attitude, and Knowledge According to School Stage

These conclusions were reinforced by analysis of observed traffic behavior of school children in front of schools. As seen in Figure 6, primary and preparatory stage school children exhibited different walking and crossing behavior, with primary stage children exhibiting the worse traffic behavior by street walking and bad street crossing.

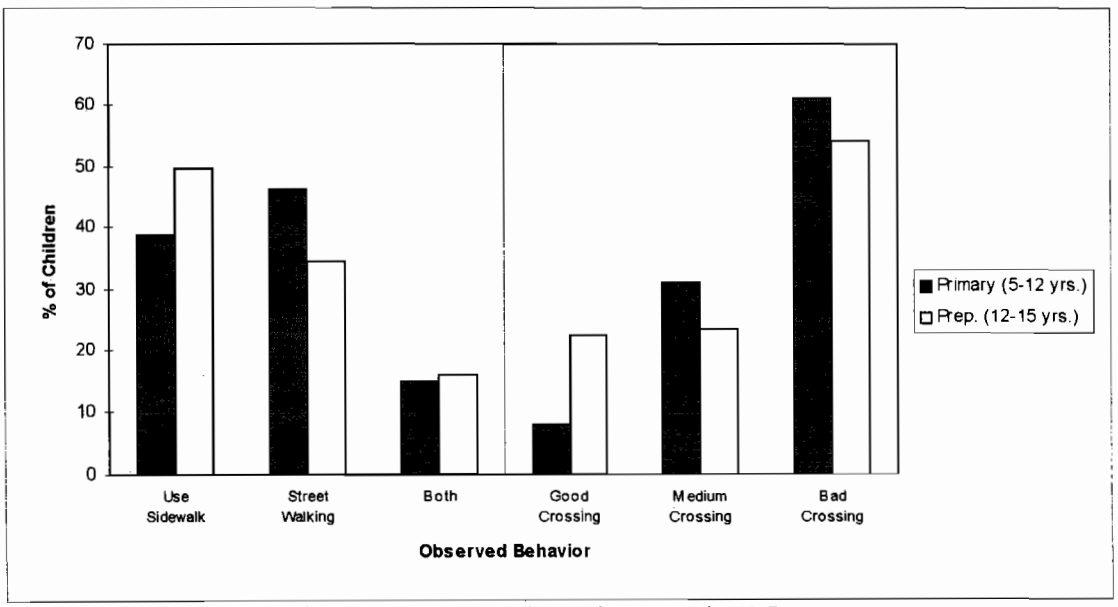

Figure 6. Observed Traffic Behavior According to School Stage

Issue 4: Is School Children Traffic Behavior Significantly Affected by Type of School?

The results of nonparametric analyses of questionnaire responses indicated that school children's attitude, perceptions, and knowledge are significantly affected by type of schooling. Private school children were less afraid of traffic and had a better attitude towards road crossing and had more knowledge of road crossing than public school children. However, in terms of skills, public and private school children were not significantly different in their ability to cross street or to deal with traffic on own (see Figure 7). These results imply that the overcrowding of classes and inadequate or non-existent playgrounds (more children playing outside school) and less extracurricular activities prevalent in public schools is a major factor in increasing the risk exposure of public school children and reducing their traffic perceptive abilities, attitudes, and knowledge. Thus, more care should be given to enhancing both the traffic environment around public schools and traffic safety programs tailored towards enhancing their perceptive and knowledge of traffic behavior. In terms of skills, traffic safety programs that simulate real-life traffic situations are needed for both public and private schools.

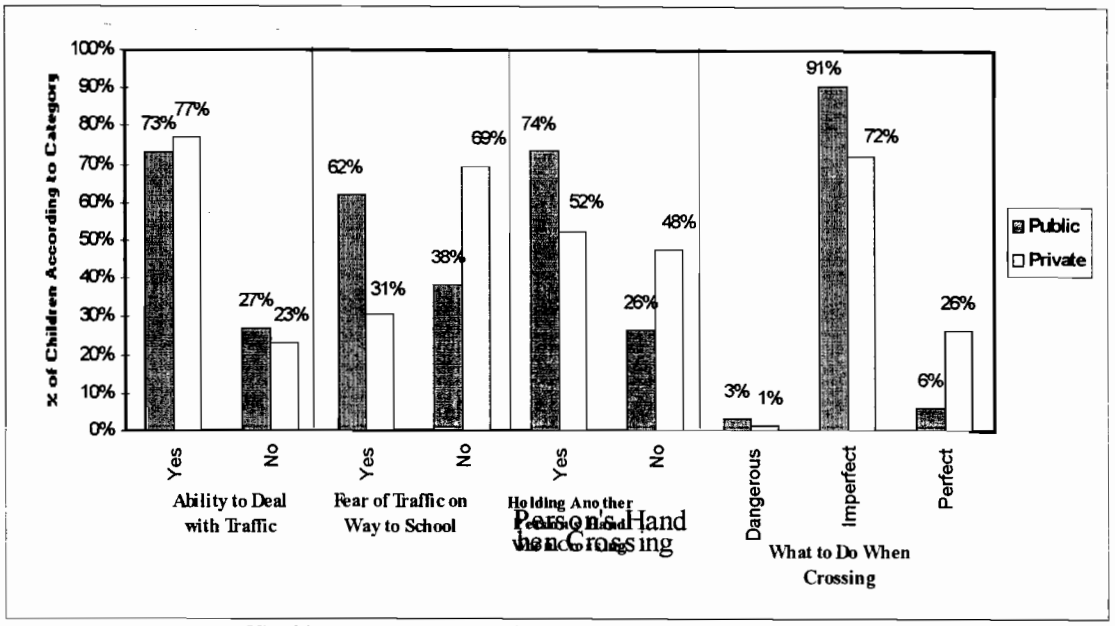

Figure 7. Traffic Skills, Perception, Attitude, and Knowledge According to School Type

The results were further validated by observing traffic behavior of public and private school children, where private school children exhibited better, although not perfect, walking and crossing road behavior than public school children (see Figure 8).

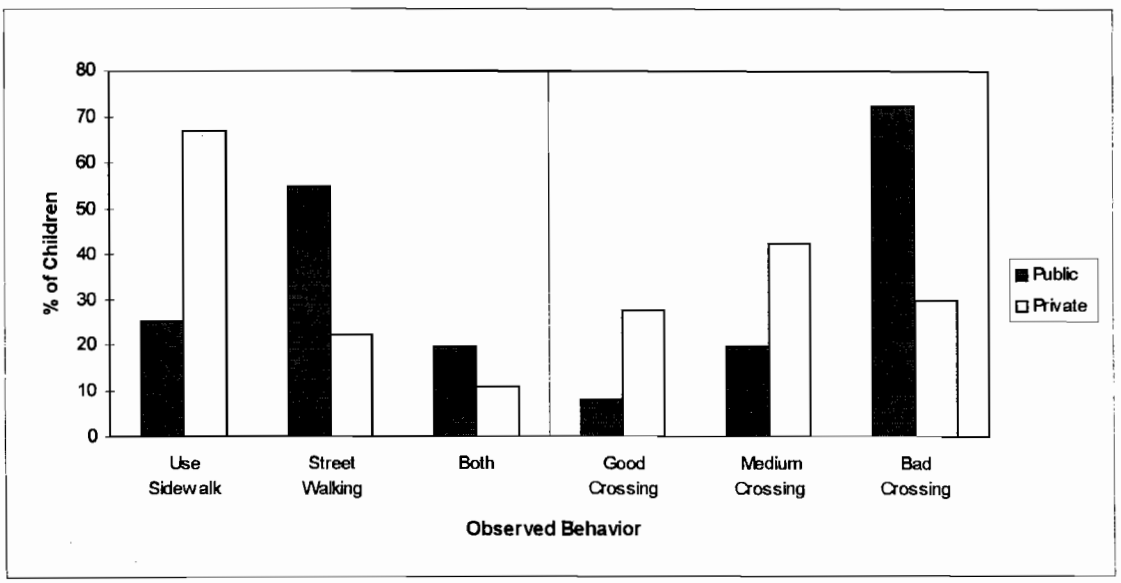

Figure 8. Observed Traffic Behavior According to Type of School

Issue 5: Is School Children Traffic Behavior Significantly Affected By Affluence of Area?

The nonparametric analyses results indicated there were significant differences in attitude, skills, perception, and knowledge between school children in affluent and less affluent areas. Children in affluent areas are more able to deal with traffic and cross street on own and had a better attitude and knowledge towards road crossing, although children in less affluent areas are more exposed to traffic. Details of the results are given in Figure 9.

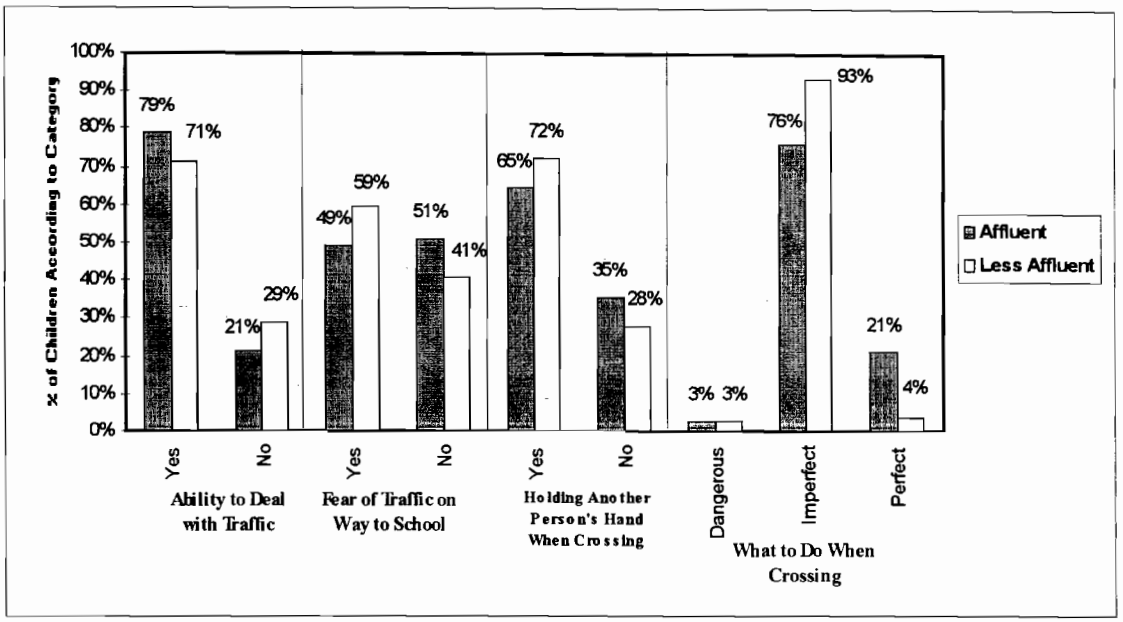

Figure 9. Traffic Skills, Perception, Attitude, and Knowledge According to Affluence

This shows that overcrowding in flats and on the streets, more exposure to traffic since more children walk to school, high traffic densities, lack of play areas, and deficiencies in parental supervision are major factors in these behavioral differences.

The results were validated by observed traffic behavior where school children in affluent areas exhibited better, although not perfect, walking and crossing patterns than children in less affluent areas (see Figure 10). A surprising observation was that school children in less affluent areas exhibited more good crossing, although not significantly large, behavior than children in affluent areas. This might be due to more traffic exposure and more street crossing in groups.

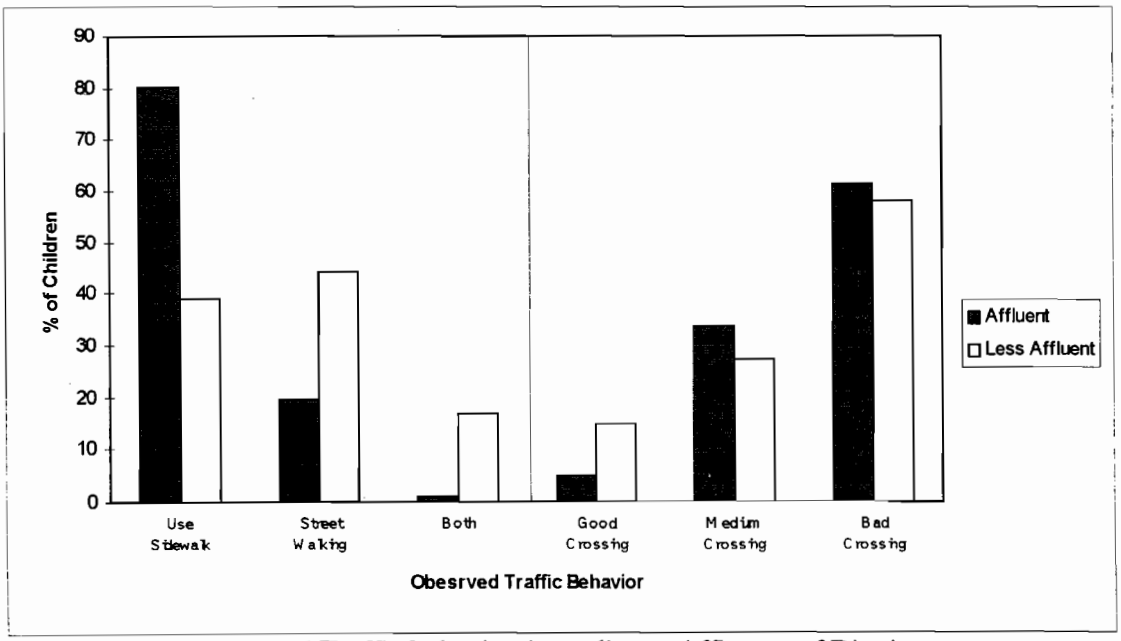

Figure 10. Observed Traffic Behavior According to Affluence of District

From the previous discussion, it could be concluded that child gender, type and stage of school, and affluence of district all affect by various degrees school children's traffic perception, attitude, skills, and knowledge and hence affect their traffic behavior. The results suggest that district affluence is the leading factor significantly affecting all of traffic perception, attitude, skills, and knowledge of school children. This is followed by type and stage of schooling. Child gender comes in last with no significant differences in traffic skills and knowledge between boys and girls. In terms of traffic exposure, affluence of district and school type were significant factors affecting traffic exposure of school children with girls being somewhat more exposed to traffic than boys.

It could be thus seen that although traffic behavior is imperfect across all school children's categories, children in the primary school stage living in less affluent districts are more exposed to traffic and exhibit the worse traffic behavior with respect other categories of children. This category should thus have priority for appropriate traffic safety polices and countermeasures. The relationship between the above contributing behavioral factors and actual pedestrian accidents could not be tested due to the unavailability of sufficient accident data.

4. SELECTED TRAFFIC SAFETY POLICY RECOMMENDATIONS

No effective traffic safety program can aim at complete coverage of traffic skills and knowledge of school children. Effective safety programs and policies for school children, particularly in financially constrained developing countries, should prioritize themselves to traffic safety tasks that are: 1) performed relatively frequently, and 2) relatively risky in terms of age, gender, affluence, and type of schooling, be it because certain categories of school children lack the required skill, attitude, and knowledge, or because their behavior in certain situations creates potential for accidents. Thus, there is a need for considerable research in the design and application of safety countermeasures packages compatible with the various children categories in the developing countries.

Based on the research results regarding factors contributing to traffic behavior of school children and based on studies involving the development of safety countermeasures for developing countries, particularly those by UNECA (1990) and TRRL (1991), the following information, though not an exhaustive list, could prove useful in the design of future safety programs, particularly for those programs that orient specific treatments (engineering, education, planning, etc.) for different children pedestrian audiences.

4.1 Urban and Transportation Planning Measures

The solution to the problem of preventing traffic accidents lies mainly in the better planning of cities and the adequate provision of transport infrastructure and facilities. However, this is sometimes difficult to attain in the existing urban areas, particularly in the overcrowded less affluent areas. Some useful planning guidelines are highlighted in the following points.

- Incompatible and mixed allocation of land use types common in developing countries, particularly in less affluent areas, should be avoided. School areas should be separated from industrial, commercial or office areas. Land-use and transport planners should allocate substantial space for school playgrounds. Almost all public schools in less affluent district have inadequate or no playgrounds.
- Urban and transportation planners should consider a functional classification and planning and design schemes for the road networks surrounding school areas, with priority given to primary schools. Examples include pedestrian segregation, urban footways, limiting car access, road narrowing, and cul-de-sacs schemes. Public schools that attract heavy pedestrians flows should be located on minor roads.

4.2 Traffic Education Measures

Points raised during meetings with headmasters/ headmistresses and teachers included: perception of the problem of traffic safety for school children specially in front of the schools, extent of safety education at school, if any, and school measures to reduce potential traffic hazards in front of their schools. It was concluded that the selection of educational objectives for traffic safety education programs should focus on the behavior that is both critical in terms of accidents and feasible for the child group involved. Since girls were found to exhibit worse traffic behavior than boys, there should be a careful consideration of girls' education programs, particularly in the primary school stage. The following set of policies and measures are examples of traffic education measures that could be adopted:

- Road safety should be a separate, graded subject at all schools. It should be noted that younger children in the primary stage should not have a large load of educational material. Traffic education for primary school children should aim at skill acquisition rather than knowledge acquisition (Michon, 1981). Only later, at the late primary and preparatory stage level, may knowledge complement skill.
- Parents' participation is a must and should be strongly encouraged, particularly for primary school children. Traffic safety education should be undertaken through community programs for adults (parents and especially those just arriving from rural areas).
- A strong broad commitment towards road safety education and training at schools is needed. Road safety teaching should cover topics such as: where to play safety, how to cross roads, understanding traffic signs and signals, getting to school safely, identifying local dangerous spots, seeing and being seen by traffic, judging distances and speeds, etc.,. Teachers' guidelines for instructing teachers on what and how to teach in terms of traffic safety should be developed with emphasis on accommodating age, gender, and child background differences.

4.3 Child Training Measures

Cognitive and perceptual skills as well as positive safe attitude towards road safety ought to be acquired and enhanced. This is specially true for primary school children where the child must do and observe doing traffic-related actions. Children in the primary school stage, particularly girls, require explicit training of every aspect of traffic behavior that is relevant for their age and school district. Road safety training should be compulsory in schools. Examples include:

- In traffic gardens, children can be trained, particularly older children through role play exercises, on how to deal with traffic situations.
- A more effective approach is to train children in real environment (Rothengatter, 1984). This is specially true in developing countries where actual traffic situations differ greatly from any sort of simulated traffic situation. It is of vital importance that children should be taken to suitable real road sites specially in the neighborhoods of their homes and schools to learn and experience road safety. Parent participation is necessary in any of these schemes.
- An interesting countermeasure that deals with the problem of children darting-out from the street common in front of schools was suggested by Snyder (1972). It consists of special training and curb markings in school crossing areas to condition children to look towards traffic as they approach the kerb. This is different from traditional training, since it is aimed at conditioning an automatic physical response - turning the head - rather than trying to get the child to think of what to do as he is running out into the street. This is effective to improving the school children's skills, particularly those of primary school children.

4.4 School Measures

Schools, particularly public schools, should attempt to choose their entrances to be at lightly trafficked side-roads as well as stagger off-peak traffic hours for the start and the end of the school day. Provision of adequate playgrounds should be emphasized when issuing a new school permit. Children should be prohibited to stay outside school premises before and after school hours, if arriving early or leaving

late. School patrol crossings and community assistance should be encouraged, particularly in front of primary public schools. On dropping children from school buses, bus drivers should ensure dropping children on the road off-side.

4.5 Road and Traffic Engineering Measures

The prevention and reduction of accidents should be included in the appraisal of new road schemes (whether new construction, or improvement or maintenance of existing roads) on the basis that these schemes consider in their design and implementation the relevant children road safety features. Priority for these measures should be given to schools in less affluent districts where roads and traffic conditions are less than satisfactory. Possible examples include

- One-way streets and non-intersection crossings to simplify child pedestrian crossings should be developed. Provision of formal pedestrian crossings to assist school children to cross busy roads. Most often, these crossings would be signal-controlled to achieve compliance. In many instances, school children do not cross at formal crossings. It may thus be necessary to restrict the opportunities of children to cross the road by the use of physical barriers or fences in front of schools. Also, location of pedestrian crossings mainly used by school children requires careful consideration as children were observed to dart-out and run in front of their schools and normally are impatient and take the shortest route. On wide roads, staging the crossing through central refuge islands allows child pedestrians to negotiate one traffic stream at a time. In locations of high child pedestrian and traffic concentrations, segregated crossing facilities (footbridges or underpasses) should be thoroughly evaluated and if found feasible should be implemented.
- Roads characterized by a dense pedestrian movement should be considered for full pedestrianisation and alternatives for re-routing traffic to other roads should be thought of. In addition, traffic calming measures should be adopted. These measures are meant to reduce the number and the severity of pedestrian/vehicle conflicts.
- Maintenance and surface treatment of sidewalks and road defects, improvement of skid resistance, and reconstruction of severely damaged roads all should be continuously and properly undertaken. Sidewalks should be wide enough specially in heavily pedestrian areas to allow for a more comfortable and easy movement for pedestrians. Kerbs should be dropped at children pedestrians' crossings to ease the crossing. Also, raised crossings should be considered where motorists do not give right-of-way to pedestrians, a very common case in developing countries.
- Management of parking in terms of designating parking spaces away from school areas so as to minimize the obstruction to child pedestrian's crossing view as well as not hindering their movement on sidewalks.

4.6 Legislative Measures

- To limit poorly defined and fragmented responsibilities prevalent in many developing countries, stronger inter-agency relationships and linkages are to be set up and enhanced to coordinate traffic safety countermeasures.
- Drivers applying for driving licenses should demonstrate their knowledge of pedestrian traffic rules and regulations. Instructions on how to drive in front of schools should be included in driving instruction booklets. Also, vehicles should be subject to regular safety inspection.
- The court system pertaining to traffic violations should be mainly looking at major cases of traffic accidents or traffic violations. Traffic police should be given more power to inflict on-the-spot traffic penalties, particularly in school areas. Low speed limits should be established in urban areas, specially in front of schools and areas characterized by heavy pedestrian movements.
- Legislation should consider the rural-to-urban migration phenomenon and the settlement of people in less affluent areas characteristic of most developing countries. Rules and regulations should be produced to reduce and prevent this phenomenon. The main issue should be to prevent the spread of unplanned dwellings and areas around cities. Also, legislation for road safety education to be compulsory at schools should be considered.

4.7 Enforcement Measures

Enforcement measures are fundamental in developing countries. Since, traffic behavior of drivers and pedestrians is a function of their traffic attitude, knowledge and experience, strict and continuous enforcement is one of the key factors that can bring change to negative traffic attitudes and hence improve the behavior of road-users. Strong and adequate enforcement of traffic laws in front of schools' entrances should be set up to ensure the safe crossing of children. This is particularly important for those primary schools whose entrances are on heavily trafficked roads. Illegal occupation of sidewalks whether by parked vehicle, stall holders, hawkers, petty-sellers, or ribbon development on densely trafficked roads should be penalized and prohibited.

4.8 Information and Mass Media Measures

Some measures include: promoting and raising the society awareness of the potential traffic hazards and problems encountered by pedestrian children, and promoting the awareness and courtesy of drivers towards pedestrians. An annual traffic week or a monthly traffic day could be introduced. This involves concentrated mass media campaigns on traffic safety aspects, press articles, exhibitions, school competitions, posters, leaflets and pamphlets. Media campaigns should concentrate on disseminating knowledge to the children regarding the safe use of the road, as well as attempting to change unsafe traffic attitudes.

4.9 Research Measures

- Most traffic safety research in developing countries ends up by a set of recommendations and measures to be implemented. If these are not implemented, even at a pilot scale, then the evaluation of the effectiveness and efficiency of remedial measures would remain unidentified.
- Specialized transport and traffic research institutes as well as universities should be constantly encouraged and supported. Special research grants to conduct traffic safety research in developing countries, particularly for children pedestrians, should be offered and consistency maintained.
- A reliable pedestrian accident data base is crucial for any safety research. Attention needs to be given to the whole process of accident data collection, storage, and analysis to ensure a systematic process and ensure that it is functioning in an adequate and efficient manner.

5. SUMMARY AND CONCLUSIONS

This paper summarizes the research undertaken to determine the significant factors affecting school children traffic behavior and their high vulnerability towards road accidents. The research involved the collection, reduction, and analysis of data pertaining to traffic perception, attitude, skills, and knowledge of school children. Using a variety of statistical tests and measurements, an in-depth investigation of the effect age, gender, socioeconomic background, and type of schooling differences on children traffic behavior was carried out.

Child gender, school type and stage, and affluence of district were found to have a significant, though varied, effect on school children knowledge, attitude, skills, and ultimately their traffic behavioral patterns. The research concludes that socioeconomic background is the leading factor affecting children's behavior followed by type and stage of school. Child gender was found to affect only traffic perception and attitude with no significant difference between boys and girls in traffic knowledge and skills. Of all children categories investigated, children in the primary school stage who live in less affluent districts and attend public schools were found to be the most exposed to traffic and exhibit the worst traffic behavior. The relationship between the contributing behavioral factors and pedestrian accidents could not be tested due to the unavailability of sufficient accident data. The research concludes with a selected set of policy recommendations and countermeasures that could be investigated further to accommodate differences in age, gender, socioeconomic background, and type of schooling of children.

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