Chapter 5
The Role of Elementary and Adult Education

James Thomson, PhD and Andrea Gielen, ScD, ScM

Educational programs have two target audiences: children and adults. Pedestrian safety education has existed for decades in the public school system, while skills-based pedestrian training is a more recent approach used in some schools. Programs for adults address the needs of parents and drivers, and are designed to help them learn to correctly anticipate the movements of young children. This chapter focuses on two issues: the key educational barriers, and the critical next steps needed in the domain of education and training to reduce child pedestrian injuries. We describe traditional road safety education concepts in relation to the developmental characteristics of young children, especially those ages 5 to 10 years (the highest risk group), noting how these challenge effective pedestrian education. We then describe a new, promising, skills-oriented training approach for children.

Traditional Road Safety Education

The entire road safety field is currently engaged in a strenuous re-examination of its aims and activities. At present, most road safety education takes place in the classroom, with the goal of increasing children's knowledge about traffic and improving their attitudes towards safety. Students are required to listen to presentations as they are being told *about* traffic, rather than actually practicing a skill. The assumption is that, by increasing their knowledge base and helping them develop a set of appropriate attitudes towards their own safety, children will be able to generalize from the classroom to real traffic situations. Many resources have been developed in an effort to do this (Thomson et al. 1996).

Such methods are not very effective. Although they do enhance children's knowledge about traffic, no evidence suggests that such knowledge improves behavior in real traffic. That is, children give more informed answers about traffic, but do not behave differently in the street. Numerous studies assessing road safety education have concluded that knowledge-based approaches do not result in safer or more skillful behavior in traffic (Rothengatter 1981; Thomson 1991).

Child safety villages are popular alternatives or supplements to classroom instruction. Typically, such facilities are child-sized models of communities, complete with streets, traffic lights, and buildings. In this setting, children receive instruction and practice skills, such as dialing 911 and safe street-crossing. We evaluated the impact of child safety village training on second-grade students' knowledge and the home safety behaviors of their parents using a paper-and-pencil test (Gielen et al. 1996). Students demonstrated a significant change in knowledge (increasing from 58% correct to 74% correct responses) and one-third of parents reported making a change in the home because their child participated in the safety village. However, evaluation studies to date have not indicated the degree to which street-crossing or other pedestrian behaviors have improved following exposure to training at a safety village. Accordingly, it is premature to recommend broad-scale adoption of child safety villages as a means to prevent child pedestrian injuries.

Developmental Characteristics of Children

Some authorities have suggested that the failure of traditional road safety education programs does not so much reflect shortcomings in educational practice, but inherent limitations in what children can learn. According to classic pioneer research conducted by Sandels in Sweden, "it is not possible to adapt fully

young children (under 10 years) to the traffic environment [because]...they are biologically incapable of managing its many demands" (Sandels 1975). Accordingly, she recommended that the principal aim of pedestrian safety should be to separate children from traffic altogether.

This outlook stemmed directly from early interpretations of Jean Piaget's enormously influential theory of development, in which he argued that development proceeds through four main stages that must be passed through in a fixed order without "jumping" ahead to the subsequent stage (Piaget 1955). He specified the age at which most children in Western societies would attain each developmental stage. From the road safety point-of-view, the concrete operational stage between about 7 and 11 years is critical to pedestrian safety because, according to Piaget, mental operations needed to make accurate judgments have not yet been developed. These include especially those tasks in which two or more variables need to be combined to make a decision. Piaget cites a two-train problem in which the child must judge which of two trains that start simultaneously from the same point but travel at different speeds over different routes will arrive at a destination first (Piaget 1969). This problem uncovers a child's inability to simultaneously relate speed and distance, a developmental skill usually acquired around 8 or 9 years of age. Before that age, distance is usually viewed as more important than velocity, so that child is apt to argue that the train closer to the destination will arrive first, even if the other train is traveling faster. Likewise, in traffic, younger children generally fixate on a single cue, ignoring the effect of others. As a result, younger children are more likely to make incorrect time-to-arrival (e.g., gap determination) judgments.

Skills-Based Training of Young Children

Can a child's judgment in traffic be improved through training? In the 1960s and 1970s, the answer to this question seemed to be "no." At that time, educators and others believed that Piagetian stages posed biological constraints on what children could comprehend at different ages. It was believed that, until that constraint was removed by increasing age, an educational intervention would have little, if any impact. In other words, children had to wait until they were developmentally ready to learn certain tasks. For traffic education, this was believed to occur around 9 years of age. The appropriate action to take with younger children was simply to protect them until "childhood has been matured out of them" (Sandels 1975).

This point-of-view implied that teaching children traffic safety skills was not very useful, and was supported by the poor results of traditional road safety education. However, this view is now considered overly pessimistic. Contemporary developmental psychologists are far less convinced about the inflexibility of the Piagetian stages. Research beginning in the mid-1970s demonstrated that children could frequently learn to solve problems, even long before they reach the supposed correct developmental stage. Their ability to accomplish this depends on a range of procedural, linguistic and other factors (Donaldson 1978; Boden 1994; Thomson et al. 1996), as well as the availability and proper use of appropriate training methods (Thomson et al. 1996).

The major shortcoming of road safety education now appears to be the educator's relatively poor understanding of which skills children need to develop to deal with traffic. This has resulted in unclear or nonspecific teaching objectives that do not indicate why they should be expected to make the child safer on the road (Rothengatter 1981; Thomson et al. 1996). A more scientific approach would be to establish objectives based on an analysis of problems posed by the traffic environment, the strategies an experienced pedestrian might use to solve such problems, and the underlying skills required to carry out that strategic behavior. Although seemingly obvious, competent pedestrian behavior involves a wide range of complex perceptual, cognitive and motor skills, making safe interaction with the traffic environment possible (Thomson et al. 1996). Adults demonstrate considerable competence in applying these skills as pedestrians, whereas children do not. Thus, a more credible aim of road safety education would be to promote the development of these skills and demonstrate their application properly in a variety of different traffic contexts. Appropriate skills training methods are required to do this.

Practical skills training methods have been the core of the most successful road safety education programs designed to improve children's traffic judgments and behavior. Pedestrian skills amenable to such training include crossing between parked cars and at intersections (Rothengatter 1981, 1984; van der Molen 1983); making sound roadside visual timing decisions (Lee, Young, and McLaughlin 1984; Young and Lee 1987; Demetre et al. 1993); developing safe route planning strategies (Thomson et al. 1992; Ampofo-Boateng et al. 1993); and reducing roadside impulsivity (Limbourg and Gerber 1981).

There are sound psychological reasons why practical approaches should be more successful than knowledge-based approaches, particularly among younger children (Thomson et al. 1996). On that basis we: developed a practical roadside training program for children between ages 5 and 7 years; administered it through parent instructors in a community with an exceptionally high child pedestrian accident rate (Thomson and Whelan 1996); and published the method in a manual for professional users (Thomson 1997). The results indicated that children exposed to the program had better traffic judgement and substantially safer behavior relative to the control group of children from the same classes. These improvements were robust, showing no deterioration when children were retested 2 to 3 months later. Moreover, the degree of improvement was similar to those achieved in earlier studies in which training had been administered by highly experienced trainers, rather than parents. We conclude that parent volunteers from ordinary backgrounds, if properly prepared, are capable of impressive results.

In a systematic review of childhood pedestrian injury prevention, the Harborview Injury Prevention and Research Center concluded that:

> "[pedestrian skills safety programs] do appear to improve child pedestrian crossing skills and can therefore be recommended. Programs that are multi-modal and programs which use parents are likely to be most successful in altering behavior. However, they are not panaceas and are not the complete answer to the pedestrian injury problem" (HIPRC 1997).

The fundamental advantage of such practical training is that it leads to measurable changes in children's behavior in traffic, not just an improvement in knowledge of road safety. This success in modifying behavior differs from that of traditional educational methods in which behaviors seldom change following training (Rothengatter 1981; Thomson 1991).

Education of Parents and Drivers

The role of parents and other caregivers in protecting child pedestrians has intuitive appeal. Parents can train their children or reinforce what is taught in school (Rivara et al. 1991; Thomson and Whelan 1996). Parents should also supervise young children and set an example for them in traffic by using rules, setting expectations, and modeling correct behaviors. Little research has been conducted concerning these various roles and their potential impact on protecting children in traffic. Rivara and others (1989) found that, although 94% of parents thought that children between ages 5 and 6 years were too young to cross residential streets unaccompanied, one-third of them allowed their kindergartners to do so, and 31% allowed their first-graders to walk home alone. Comparing a parent's estimate of their child's pedestrian skills with his/her actual ability, Dunne and others (1992) found that parents overestimated the capabilities of 5- and 6-year-olds and, to a lesser extent, that of 7- and 8-year-olds. Parents' assessment of children's skills were not accurate until the child was 9 to 10 years old. These results suggest that parents and other caregivers need to better understand the developmental and behavioral characteristics that put young children at increased risk for pedestrian injuries (Stevenson and Sleet 1997).

Interviews of 32 parents in the United Kingdom indicated that they restrict the distance their children are allowed to travel away from home independently (Dixey 1998). The principal concern of mothers was speeding traffic, such that most escorted their children to school. Each mother interviewed related stories of crashes or near-misses. The overall situation was described as "accidents waiting to happen."

Supervision was viewed as an expected and appropriate function of parenting small children, but did not replace the need to make the road a safer environment (Dixey 1998; Stevenson and Sleet 1997).

The principle of participation holds that a behavioral change program is more effective when those who are expected to change are involved in problem identification and program development (Green and Kreuter 1990). Rivara and others (1991) applied this principle to parents, involving them in the development of their children's training programs. To be successful, parents need to accurately understand the importance, dimensions, and determinants of the child pedestrian injury problem in their community. Even so, the extent of parents' knowledge and concern about child pedestrian safety and their interest in pedestrian advocacy is largely unknown. In a unique study, Roberts (1995c) found parents largely uninterested in advocating for such change, even when their child had been injured as a pedestrian. In a study of 715 parents who had been involved as cases or controls in that study, Roberts requested that the 715 parents involved in cases or controls in a previous pedestrian injury study, sign a petition to the transportation ministry supporting the prevention recommendations of the study. Only 31% of parents did so. Those who signed the petition were more likely than non-respondents to not have a child previously injured (19% of case-families versus 36% of control-families) and to have a higher socioeconomic status. These results indicate the low rates of citizen participation in child pedestrian safety advocacy, even among those at greatest risk.

In the United States, pedestrian safety has not been an issue of major importance in the minds of parents. In a survey of parents of children younger than 14 years of age, Eichelberger and others (1990) found that 47 percent thought that "kidnapping or harm by strangers" was the risk they were most worried might happen to their children, followed by "involvement with drugs" (43 percent) and "automobile accidents" (21 percent). Despite this, 55 percent of parents identified motor vehicle crashes and 20 percent identified pedestrian injuries as one of the two most frequent causes of "accidental" death among children. Fifty-one percent of parents felt they were least prepared for preventing pedestrian injuries to their children, even though 66 percent of the sample reported that they knew the rules for pedestrian safety.

Further, the extent or importance of parent involvement in child pedestrian safety organizations such as the National SAFE KIDS Campaign has not been systematically evaluated. The best ways to engage parents as community activists, or teachers, or role models for their children, needs further study. Caregivers might be reached through parenting and babysitter classes, injury prevention instruction given by health care professionals, or during parent-teacher association meetings, local coalitions, or other organizations.

Although a full review of driver behavior with regard to pedestrian collisions is beyond the scope here, one study does bear mentioning. Malefant and Van Houten (1989) evaluated a multifaceted community campaign designed to increase the proportion of motorists who yielded to pedestrians in crosswalks. Several techniques were used to change driver behavior, including public and school-based education, feedback signs reporting driver-yielding behavior, improved signage at crosswalks, and police enforcement. A greater proportion of drivers yielded to pedestrians in targeted crosswalks, and the number of pedestrians struck in crosswalks decreased 50 percent. Although the study design and statistical analysis used limit the conclusions that can be drawn, this study suggests that creative community-based educational approaches could effectively reduce child pedestrian injuries. Although the impact on pedestrian safety norms was not measured, media attention, corporate sponsorship, and use of these signs for at least two years after the program ended, all suggest that such an approach may have had a lasting effect on the public.

Recommendations

These issues must be addressed to advance the use of educational strategies for child pedestrian injury prevention. First, the road safety community needs to address the perceived and real potential of education and training. Second, objectives and methods used should be fundamentally reappraised. Third, educational roles and expectations need to be clarified, especially that of parents and community partners. The view that, for developmental reasons, children can only cope with the simplest traffic environments and are unable to assimilate several variables simultaneously needs to be reassessed. Evidence shows that the actions and decision-making capability of even young children can be improved to a more sophisticated level if appropriate training is provided (Thomson et al. 1996). In our opinion, the early pessimism of researchers towards road safety education is unfounded.

The key skills and competencies children need in order to interact safely with traffic need to be identified and a more comprehensive taxonomy of these skills needs to be developed. Research studies should be conducted to identify which of these skills can be acquired by training, and the optimal conditions needed for such training for children of each age and level of experience. Children with special needs, including those with hearing or visual impairments, learning difficulties, attention deficit-hyperactivity disorder, or physical disabilities, should be given special consideration, and special resources should be developed to help them. Presently, most special needs groups are poorly served by road safety education, despite declared commitments to maximize their well-being and independence.

Far more consideration should be given to assessing the behavior of all children in traffic. In particular, the child's behavior should be compared with that of an adult in traffic when formulating educational objectives. For example, examining strategies adults use to cross roads safely between parked cars or at intersections has been useful in developing educational strategies for children (Rothengatter 1981; Schagen 1985; Thomson and Whelan 1996).

Practical training is, by far, the most effective means of improving children's skill and judgment, especially among younger children. Despite this, oral communication concentrating on the acquisition of knowledge and attitudes is still used widely, even though it has not been proven effective in improving the behavior of children in real traffic. Further development of practical training programs is warranted.

Although the roadside seems to be the ideal context for training, practical problems do arise. Also, the number of traffic scenarios safely and conveniently found at any single roadside location is limited. For these reasons, we believe that simulating traffic problems may be important in road safety education. Interactive computer tasks or virtual reality technology should be explored to extend a child's traffic experience by offering a safe mode beyond traffic situations found near the school. Such new programs should undergo careful outcome evaluation.

Notwithstanding their effectiveness, practical training methods are time-consuming and labor-intensive, and relatively difficult to implement widely. Efficient methods of introducing practical training into a child's education should be developed. In Europe, such training may be conducted by parents with their own children. However, before we encourage parents to take a lead role in road safety, we need to demonstrate that the average parent is actually capable of doing so effectively. Parents may need training materials and preparation to be effective. Certain traffic skills might still be taught better by professionals. At present, several research programs in the United Kingdom are addressing these issues.

We also need to know more about parents' perceptions of their children's vulnerabilities in traffic and what they presently (albeit informally) teach their children. This will guide the development of materials parents need to help them correctly assess their child's competence in traffic and successfully train them.

In the end, education should have a broader audience than just parents and their children. The risk of child pedestrian injury is a function of many other factors of the physical and social environment that can help or hinder pedestrian safety. Within this context, educational approaches may be useful at many levels. They provide skills training for children and their parents, such as teach parents and novice drivers about high-risk circumstances, generate public awareness, and develop coalitions to initiate or support community interventions that reduce the likelihood of injury. Progress in each area will require considerable time and money for research and programs.

Additional Comments
Elementary and Adult Education

Andrea Gielen, ScD, ScM

I would first like to highlight conclusions from our literature search concerning educating parents and drivers, then address misperceptions about the role of education in child pedestrian safety. As noted, pedestrian safety educational needs go beyond targeting children's knowledge and skills. We lack sufficient information about parents' knowledge of injury risks and prevention, how they teach their children awareness of traffic hazards and street-crossing skills, and how they supervise them in traffic. Such basic information is needed before we make recommendations about what parents should learn. And beyond parents, what does the public at large understand about the problem and our proposed solutions? Finally, what price are people willing to pay to improve walkability in their communities? At the same time, we need to find the most effective strategies to communicate safety messages among various target populations. This research requires funding. We also need to develop a sound organizational framework that develops and supports a multifaceted approach designed to bring together many disciplines.

Applying a health-promotion perspective that considers behavioral and environmental determinants of the child pedestrian injury problem would be useful (Gielen and Girasek 2001). Others at this conference have addressed how the physical and social environment affects the behavior of children, their parents, and drivers. One approach is to consider what factors determine certain behaviors. Green and Kreuter (1990) developed the PRECEDE Model which includes a diagnostic step that categorizes all determinants as predisposing, reinforcing, or enabling factors. Identifying these factors helps set priorities and identify specific objectives and strategies for intervention. Predisposing factors are those that occur before the behavior occurs, and provide the motivation or reason behind it. These include knowledge, attitudes, cultural beliefs, and readiness to change. Enabling factors occur at the time of the behavior and make it possible for a motivation or behavior to be realized; in other words, they enable people to act. These include available resources, supportive policies and laws, assistance, and services. Reinforcing factors are those that provide continuing rewards or incentives after a behavior has begun, thereby contributing to the continuation or repetition of that behavior.

To maximize its usefulness, a behavioral model uses all three elements. In the realm of child pedestrian injury prevention, a child could be predisposed to have a pedestrian injury if the neighborhood lacks playground facilities (making street play more likely), or if he or she walks to school alone because his/her mother leaves for work earlier in the morning. Lack of knowledge by the parent concerning a child's true capabilities in traffic might also predispose the child to injury. Enabling factors would include traffic calming devices that affect driver or pedestrian behavior at the time and place of potential conflict. Reinforcing factors would include social support for working mothers through the walking school bus program, and praising and reassuring children who cross the street correctly.

Parents should be viewed as supervisors, exemplars, and advocates of child pedestrian safety. Their participation appears to enhance their child's pedestrian skills as shown in a study of children in Grades K-4 in which the use of a supplementary parent workbook increased children's looking behaviors as pedestrians (Rivara et al. 1991). Data concerning parents' tendency to overestimate their children's skills, especially those at five and six years of age, have already been noted. Further, the study by Roberts (1995c) indicated that parents are reluctant to advocate for pedestrian safety as individuals, even when it involves their own children who were previously injured while walking. Consequently, local advocacy groups such as the National SAFE KIDS Campaign may be needed to adopt this cause and reach out to parents as partners.

In terms of adult education, drivers are not only part of the problem, they are potentially part of the solution. Motorists involved in pedestrian crashes appear to drive less safely, but their behavior, especially in yielding to pedestrians, can be modified through comprehensive community intervention strategies. For example, a courtesy-promoting safety program in Canada effectively combined educational strategies, feedback, school programs, community education, and enforcement (Malenfant and Van Houten 1989). The effectiveness of such programs should be studied in other locations. Parents may not receive reinforcement for maintaining vigilant supervision or may have never had a pediatrician mention the potential problem of pedestrian injury to them. Drivers, similarly, want to avoid hitting pedestrians. Traffic calming devices and environmental interventions enable drivers to slow down. Active law enforcement can reinforce better driving behavior. A useful multifaceted model uses all elements of public health practice including education, enforcement, and engineering, the three "Es" of injury prevention.

Open Discussion
Elementary and Adult Education

Unidentified: *Are child pedestrian training programs looking at the depth of their programs? What percent of kids still have the wrong behavior? At the end of the day, are there still kids out there who are really doing something unsafe?*

J. Thomson: One of the questions we ask in our evaluation concerns the level we are hoping the child will attain. Looking at the distribution around the mean is often a lot more interesting than looking at the mean value itself. You may have noticed that, as children get older, not only does the mean knowledge and skill level of children in traffic increase, but the values become more consistent, that is, the standard deviation decreases. This is a measure of success in any training program for children.

Unidentified: *What is the bottom line? Are we at the point where we have a training program that we know enough about to implement nationwide for children, or would we just be making parents feel overconfident? Perhaps we should be educating parents about when not to let children cross the street.*

J. Thomson: We should train children and protect them at the same time. When we train our 5 or 6 year old children, we are not training them so they can go out on the streets alone next week. We say it is a part of a long-term educational process. Our educational programs involve the parents as active participants. In recent years though, we have done work that doesn't include parents as an element. We found that involving parents in the process helps them learn what their children can and can't do. We think they become more, rather than less realistic about their children's capabilities. In one study, we unobtrusively observed the number of children we had trained who were then permitted by their parents to walk to school alone. After our training ended, during eight weeks of observations, no such child was permitted to do so. Other researchers have also noticed this effect: when you involve parents in their children's learning process, the parents are more likely to reduce, not increase their child's exposure to traffic.

Unidentified: *I'm concerned about the focus on educating children. It seems the consensus is that children have a somewhat limited ability to negotiate the traffic environment, so I came up with a series of questions. What is taught to drivers about the pedestrian right-of-way? What do drivers know about how children behave in the road? What is the most common age and gender of drivers who hit pedestrians and how should we specifically target them? What programs can successfully instill a sense of responsibility among drivers, and do drivers understand the relationship between speed and fatality? Why isn't there more information about educating drivers?*

J. Thomson: These are not alternative strategies. Suggesting that children need to learn to deal with the traffic environment, like all environments they encounter, does not imply that poor driver behavior shouldn't be addressed. I'm very keen about the idea of empowering children because I have no faith that anyone is on the verge of developing a strategy that will significantly change driver behavior. Even if that was the case, children will certainly need educational experience. I can't imagine any traffic environment where the participants wouldn't need some kind of help learning to use it.

A. Gielen: I think you are right about how we need to know more about what the general driving public understands about pedestrian risk and how to drive safely where there is a high risk for pedestrian injury. Enhanced enforcement of speeding and road design changes also have great potential to modify driver behavior.

***L. Matusick**:* *It is not just money and time, though. Part of the problem, and a key player missing from this conference, is the public school system. Under the school system, less than $1 is spent on traffic safety per child up to 15 years of age, yet kids are expected to get to school safely and use that behavior all the time. The school system says reading, writing, and arithmetic are more important. We are having a hard time getting through to them the importance of traffic safety skills training. Plus, there is less teen driver education in the school systems today, as it is no longer a required program in many school districts. How do you suggest getting the schools to assist with traffic safety education?*

J. Thomson: Traffic safety is everyone's responsibility, but when you go to the schools and ask if they will get on board, they say "No thanks." That is a standard problem. We integrated a program into the school curriculum, but it only allows us to come in, take the children out of classes for training, and bring them back. Local police involved are rather keen on this because it promotes good relations between them and their school system. At the roadside, children learn to carefully observe, which is a skill development most teachers wish to promote for a variety of uses. The roadside is a good place to learn such skills. Should we try to point out to the schools how they can benefit beyond improving the children's safety? This seems to be a reasonably effective strategy. As an aspect of national strategy, it would be useful if roadside or other carefully selected training could be integrated into the curriculum.

A. Gielen: One strategy we are trying in Baltimore is to map child pedestrian injuries by neighborhood and approach schools in areas where these injuries cluster. Principals seem to care very deeply about this issue. The school administrators we are working with to enhance their school playground area, presently recognize that this is likely to result in more foot traffic, and raises some questions about the safety of the surrounding roads. To the extent that you can personalize the pedestrian safety problem for a particular geographic area, you can build more support with families and the school system.

P. Agran: *If the training program is designed around purposeful street crossing, how would you address the threat of injury to children who are not purposefully crossing the street?*

J. Thomson: A lot of research has been done focusing on school journeys and how children can develop strategies that will keep them safe. Safe trips to school are a major issue now in Europe, not just in the United Kingdom. Research suggests that, in 80 percent of the situations, the child is doing something other than paying attention to traffic at the time of the crash.

Unidentified: *Do you think the education learned in the street-crossing training programs you have discussed would also carry over to play situations?*

J. Thomson: Our hope is that as children increase their conceptual understanding of the issues, they would generalize their behavior to other circumstances. But we don't yet know whether this is happening.

I. B. Pless: *I'm frustrated because we seem to be incredibly parochial about not looking at what is being done in other countries. We are making little effort to identify good pedestrian programs. There can't be that many good pedestrian training programs out there. Once we've identified the best of the group, we should replicate them instead of trying to reinvent the wheel.*

[No Response]

I. Patterson: *I know we spoke yesterday regarding the adolescent age group as risk-takers. Do you have any ideas about how to reach that group educationally, since I'm sure that many younger children are emulating the unsafe actions of their older brothers and sisters?*

[No Response]

Chapter 6
A Research Agenda

Fred Rivara, MD, MPH and Ian Roberts, MD, PhD

A great body of research has been conducted during the past two decades concerning individual and environmental factors associated with pedestrian injury. The earlier chapter concerning individual factors by Christoffel and Peterson outlined many important issues. We now know a great deal about which children are at greatest risk. As a research agenda, it is less compelling to repeat or even extend risk factor research. Instead, we would be better served by putting such research findings to work, developing and implementing new programs, and using research methodology and funding to evaluate their impact.

At the outset, researchers must convince funding organizations that evaluation is an important and worthy pursuit. As described in the chapter by Thomson and Gielen, many studies have demonstrated that some gains can be achieved in children's pedestrian skills through intensive training programs. However, these gains are small and generally insufficient, with many children still exhibiting unsafe behavior after being taught or trained. The real challenge for the research community is to find out what interventions work well in most circumstances. This information is vital to program directors to help them determine whether the intervention is feasible and likely to be effective for their community. Such evaluation also provides them with a yardstick by which they can measure their progress, and indicates to the funding agency whether the project can be duplicated at other sites successfully and whether it resulted in unexpected positive or negative consequences (Thompson and McClintock 1998). Because such evaluations often have a complex design, they are relatively expensive to conduct.

How should community pedestrian programs be evaluated? Although several different methods exist, the randomized controlled trial (RCT) has come to be regarded as the gold standard in medical and public health research. The challenge for the evaluator is to assemble two or more comparable groups that have equal chances of experiencing the outcomes of interest, in which only one group will receive the pertinent intervention. Observed differences in outcome between the intervention and comparison groups can then be reasonably attributed to the intervention or to chance. The best way to achieve comparability between groups is to randomly allocate subjects to each group. A principal value of the RCT method is that study validity, or absence of bias, is far more readily assured by this method than with other study designs. Therefore, whenever possible, injury prevention evaluation studies should use a randomized, controlled design. While this methodology has been applied to other causes of injury, there have been few large-scale RCTs of urban pedestrian safety interventions. Studies of this nature require appropriate leadership, particularly from the Centers for Disease Control and Prevention, the National Highway Traffic Safety Administration, and the Federal Highway Administration.

Such methodologies should be directed to the small-to-moderate scale initiatives to build new roads or improve existing roadways. These are scheduled each year in most urban areas so that traffic flow is increased or risk decreased. The challenge is to orchestrate the implementation of these road improvements in such a way that their effectiveness and cost-effectiveness can be assessed and compared. Since the need for roadway improvements exceeds the resources allocated to them, random allocation of roadway improvements of differing costs (and thus different types) in different sites is arguably the fairest way of allocating resources. Simultaneously, such randomization meets the design needs of rigorous evaluation.

A wide range of environmental initiatives could be evaluated in this manner. These can be broadly categorized as traffic calming (discussed in Chapter 4) and "Home Zones." A Home Zone is a street or group of streets where pedestrians have priority and cars travel at little more than walking pace (Children's Play Council 1998). Home Zones have many features of the Dutch "Woonerf," existing on over 6,500 streets in the Netherlands, and can include physical features such as speed tables and bumps,

extended sidewalks, plantings, and play equipment, any of which slow traffic and emphasize the change in priority from vehicles to pedestrians. Prominent road signs and other entry features where Home Zones begin make drivers aware of the change in priority status. In the United Kingdom, efforts are underway to establish a number of pilot home zones; their effectiveness deserves evaluation.

Evaluations of such pedestrian injury prevention strategies should not be restricted to counting the number of collisions and injuries that occur. Other outcomes are also important and offer other dimensions to these solutions. Such outcome measures include levels of walking and cycling by children, adults, and the elderly; traffic noise; degree of social networking; and resident satisfaction and perceptions of safety.

A major challenge is to determine useful mechanisms to fund, coordinate, and conduct such research. Injury control is, by its nature, a collaborative process utilizing the expertise of individuals from different disciplines. Such evaluation might require collaboration on several levels. Collaboration needs to occur between researchers, program managers, and those with access to data, such as police for crash reports and health authorities for injury and vital statistics data. Collaboration will be needed between and within communities to conduct a randomized intervention. Finally, collaboration is needed among those who fund such research. Funds for road improvements are provided by federal and state Departments of Transportation, while funds for research and evaluation are provided by the Department of Transportation and the Department of Health and Human Services through its Centers for Disease Control and Prevention, Health Services Resources Administration, and the National Institutes of Health. Ideally, these organizations would blend funds together, rather than establish separate, independent research programs.

Response
A Research Agenda

Mark Stevenson, PhD, MPH

Let me begin by emphasizing that future gains in the prevention of child pedestrian injury will occur with a combination of educational and environmental strategies. It is our job to elucidate which components of these strategies work, and to do so, we will need to conduct research at the macro or community level.

I would like to address three key points that have been raised: the promotion of safe walking, use of randomized controlled trials to study the effectiveness of interventions, and the use of pedestrian skills training.

Concerning the promotion of safe walking, Drs. Rivara and Roberts have cleverly begun to tackle the difficult task of reducing childhood pedestrian injuries by dealing with the broader issue of promoting safe walking. By coupling the historical and social context of walking with its health benefits, we will be better able to harness support from a variety of partners. With this approach, reducing childhood pedestrian injuries by modifying the physical environment becomes almost a reality. I say "almost a reality," because we must not forget that the motor vehicle has become a cultural icon in many countries.

As Dr. Roberts has illustrated in recent studies, the decline in the injury rates for child pedestrian injury may be largely due to a decline in the amount children walk. The challenge is to reverse this decline, that is, to get more children walking again, while at the same time reducing their propensity for injury. Both factors need to be addressed simultaneously. Otherwise, the promotion of walking could increase children's potential for injury. Also, the American public is commonly concerned about the potential threat of violence to children as they walk. This should be addressed when advocating for children to walk more. Walking should be promoted, provided that the physical environment is conducive to safe walking. How can we accomplish more walking and safer walking at the same time? The risk of childhood pedestrian injury increases with increasing traffic volume, but it is threshold-dependent. One goal, then, might be to reduce traffic volume to the point below that threshold.

Let me turn now to the second key point–the use of randomized controlled trials of interventions. I fully endorse the position of Drs. Rivara and Roberts, provided that the difficulties encountered when undertaking such trials in childhood pedestrian injury are considered. Let's consider some of those difficulties. When proposing an intervention that changes the environment, for instance, it is difficult to randomly assign individuals or families within a community without having problems of contamination bias. In other words, a family randomly assigned to the intervention group might live near, or be good friends with, a family randomly assigned to the control group. If, during their normal interactions of daily life, the control group was exposed to the intervention, it would certainly contaminate the control group. To avoid this problem, it would be necessary to randomize entire communities, but to do so would require a substantial number of communities, which is not feasible given the bounds of most sources of research funds. For this and several other reasons, it is difficult to undertake a randomized controlled trial. As an alternative study design, we should consider undertaking community intervention trials. These are still controlled trials even though the communities are not randomized, and potential confounding influences can be taken into account.

As an example, I recently completed a community intervention trial of childhood pedestrian injuries and was able to detect favorable changes over time. The design followed that of a randomized controlled trial without the randomization. By establishing rigorous selection criteria for the communities, we obtained equivalence between the three communities on all of the outcome variables of interest at baseline

so that any changes associated with the intervention would be apparent. The community intervention trial, which included both school-based and environmental components, resulted in changes in behavior and knowledge (Stevenson et al. 1999; Cross et al. 2000).

A necessary aspect of any research design is the proper selection of the outcome to be measured. Because childhood pedestrian injuries are rare events, it may be difficult to show a reduction in injury morbidity and mortality over time, let alone one that can be directly attributed to the intervention. This is of concern because we know, based on experience in other public health areas, that a null result can adversely affect the likelihood of future funding for that topic. Therefore, we should seek outcomes other than injuries-averted outcomes for which change is easier to measure because it occurs more quickly or more broadly. Such alternative outcomes include change in knowledge and behaviors associated with an intervention. Some have criticized the use of these outcomes because changes in knowledge may not correlate with a reduction in injury. Nevertheless, in an imperfect world, these proximate measures have value. In this case, educational outcomes need to be validated by observations of subsequent behavior.

Not only do the results of a randomized controlled trial depend heavily on the study design used, they also depend greatly on the strength of the community coalition that supports and/or provides the intervention. Accordingly, we need to understand the factors that promote or inhibit the development of successful coalitions.

Turning now to the third key point, I would like to address the effectiveness of pedestrian skills training, or as some have noted, the lack thereof. Drs. Rivara and Roberts note that pedestrian skills training have, at best, resulted in only modest improvements in pedestrian behavior. Accordingly, they advocate emphasizing environmental initiatives over education and training for children. This is warranted, given the evidence that environmental strategies are likely to achieve measurable benefits. Although I am a supporter of environmental initiatives, I cannot dismiss the effectiveness of education and skills training in the prevention of child pedestrian injury.

There clearly needs to be a balance between legislative and environmental initiatives on one hand (the passive approach), and education and behavior change on the other (the active approach). For example, fluoridated water was introduced as a passive intervention to prevent dental caries and, as an intervention, has met with considerable success. At the same time however, children were not discouraged from brushing their teeth; instead, they continued to be educated about the importance of teeth brushing. Similarly, it is essential that any comprehensive plan to modify the physical environment and thereby enhance the child's safety, needs to be undertaken in tandem with well-directed pedestrian skills training.

To put this argument in another context, let's compare the use of smoke alarms with the installation of traffic calming. A smoke alarm sounds (ideally) in the event of a fire, thereby protecting the inhabitants by alerting them to the imminent presence of danger. Traffic calming, by contrast, does not directly protect children in the same manner. For example, an automobile might slow down in the presence of traffic calming devices when a pedestrian is present, but it cannot be determined whether the driver would have slowed down for the pedestrian in the absence of such road treatments. Indeed, there are no "quick fixes"—passive or active—that would prevent childhood pedestrian injuries in every case. Therefore, with the premise that environmental, educational, and behavioral programs need to co-exist, research must be conducted to determine which components of education and pedestrian skills training are the most efficacious and which programs work best.

In summary, the promotion of safe walking should contribute to community cohesion, long-term health benefits, and a decline in childhood pedestrian injury. However, we need to be cautious in promoting walking in the absence of pedestrian-friendly environments. Without the necessary changes to the physical environment, we may in fact place more children at risk of injury, particularly in the near-future. However, changes at a multitude of levels will help us reach our goal of allowing children to interact with their road environment with little or no risk of injury.

Chapter 7
Adopting a New Approach

Ian Roberts, MD, PhD and Fred Rivara, MD, MPH

In this chapter, we outline a new approach to the prevention of pedestrian injuries based on the benefits that individuals and the community derive from walking. Further, we recommend ways that communities might promote safe walking.

Walking and Personal Health

In England and Wales, pedestrian injuries account for approximately one third of all unintentional injury deaths among children between ages 0 and 14 years. Between 1985 and 1992, the pedestrian injury death rate in this age group there declined by 37% (DiGuiseppi, Roberts, and Li 1997). However, over the same time period for this age group, the average distance walked by this group in England and Wales decreased by 20%, from 247 miles to 197 miles. The death rate per mile walked decreased by only 24% between 1985 and 1992. Thus, changes in children's exposure to risk as pedestrians likely accounted for a large part of the decline in pedestrian death rates, while improvements in pre-hospital and medical care of seriously injured children accounted for much of the remainder (Roberts, Campbell et al. 1996).

Comparison data are not available in the United States because such exposure data are not collected. However, the Fatal Analysis Reporting System indicates that the pedestrian fatality rate of children younger than 15 years of age decreased 65% between 1975 and 1996 (NCSA 1997). Although it cannot yet be demonstrated, we suspect that much of this decline is caused by fewer children walking shorter overall distances (Roberts 1995b). Certainly no one is claiming that there has been any long-term upwards trend in walking.

Given that the most plausible explanation for the steep decline in child pedestrian death rates in the United States and the United Kingdom is a reduction in the amount of walking, what are the consequences? The public health consequences are likely to be considerable, but may not become fully apparent for decades. For example, it is estimated that one in four women in Great Britain living to age 90 will sustain a hip fracture (Law, Wald, and Meade 1991). A linear relationship exists between the risk of hip fracture and bone mineral density. Among women, bone density peaks in early adulthood, remains stable until menopause, and then declines. Bone density in these later years depends on peak density and subsequent rate of loss. Physical activity increases both peak density and reduces post-menopausal loss. The decline in walking has been proposed as a principal reason that hip fracture rates have doubled since the 1960s (Law, Wald, and Meade 1991). Unfortunately, this decline is ongoing. Since 1975, among British women ages 30 to 59, distance walked has decreased by 21% (Morris and Hardman 1997).

The decline in walking may also have important implications for other chronic diseases. Walking involves more than half of all skeletal muscle, the principal insulin sensitive tissue in the body. Walking increases the glucose uptake in skeletal muscle by enhancing insulin sensitivity. Insulin resistance is the main metabolic defect in Type II diabetes mellitus, a disease for which inactivity is an established risk factor (Morris and Hardman 1997). In a twelve-year follow-up study of 707 non-smoking retired men enrolled in the Honolulu Heart Program, the mortality rate among men who walked less than one mile per day was nearly twice that among those who walked more than two miles (Hakim et al. 1998). Similarly, the Harvard Alumni Study found that men who walked more than two km per day had a 13% lower risk of death than those who walked less (Paffenbarger et al. 1993).

Walking and Community Health

Walking may also be a critical indicator of societal health, with implications for community coherence and social support, levels of crime and violence, and the global environment. There is a large body of research literature about the relationship between social support and health (Berkman and Syme 1979). Social support has been proposed as directly promoting health and serving as a buffer that reduces the adverse health impact of social stresses. People with low levels of social support are at increased risk of mortality from all causes. Appleyard and Lintell (1972) studied the social networks of people living in three streets in San Francisco that were similar except for their levels of traffic volume. One street had 2,000 vehicles per day, another had 8,000 vehicles, and the third had 16,000 vehicles per day. There were striking differences in the extent to which residents had social contacts with friends and neighbors. Residents on the low volume street had an average of 3 friends and 6.3 acquaintances, while residents on the high volume streets had an average of 0.9 friends and 3.1 acquaintances. Social networks in the moderate traffic street fell between the two. These social networks are likely to have an important impact on the extent to which people feel safe in their neighborhoods.

At the macro level, the urban freeways in the United States have been accompanied by a depopulation of the inner city areas, particularly at night, which has implications for levels of crime and violence. In Great Britain, the demise of inner-city shopping facilities and the trend towards out-of-town supermarkets that cater to families with access to a car is believed to be an important contributor to social polarization. In this example, the less expensive, healthier foods available at supermarkets are only available to more affluent, car-owning families, whereas poorer families must rely on local shops, where food is more expensive.

In summary, the decrease in the amount of walking by residents of a community affects their personal health as well as the health of the community in which they live. While such a decrease in walking may be accompanied by a reduction in risk of pedestrian injury, particularly for children and the elderly, this trade-off comes at a considerable, and to many, an unacceptable price.

Pedestrian Training

The most common approach in the United States to decreasing pedestrian injuries among children is through pedestrian skills training programs. Several efforts have been evaluated. Using a controlled trial design, Rivara et al. (1991) evaluated pedestrian skills training of children ages 5 to 9 years. After exposure to the program, only 30% to 50% of children had safe street crossing behavior; the majority did not. van der Molen (1983) found similar effects among preschool children in the Netherlands, as did Limbourg and Gerber (1981) among preschool children in Germany. Rothengatter (1984) reported that skills training reduced incorrect crossing by approximately 50%.

Very few studies have reported the effects of the intervention program on injury frequency or rates. In a large-scale intervention in three cities in the United States for children in Grades K-6, Preusser and Blomberg (1984) found that watching a six-minute film and 60-second TV spot produced only modest changes in crossing behavior, yet was associated with an 18% to 36% reduction in pedestrian injuries in these three cities. Subsequently, Preusser and Lund (1988) studied the frequency of pedestrian crashes of those 9 to 12 years of age in Milwaukee and assumed that most were exposed to a pedestrian safety educational film and/or television commercial. Crash involvement decreased by 8% over a six-year period in Milwaukee, not significantly different from results in the contiguous counties or in Minneapolis-St. Paul, where no such program had been offered. Thus, although this program was viewed by the authors

as an educational success, the results were not strikingly so. Another public information and education campaign resulted in a reduction of pedestrian crashes by less than 20% (Blomberg et al. 1983). Given that educational and skills-training programs are not likely to eliminate all childhood pedestrian injuries, other approaches to preventing them should be developed and tested for effectiveness (please see Epilogue).

A New Approach to the Pedestrian Injury Problem

Although child pedestrian injuries are a leading cause of death and acquired disability in most motorized countries, focusing on preventing injuries may not be the most appropriate motivation for improving pedestrian safety. First, child pedestrian injuries, like all serious health events in childhood, are relatively rare. Second, the burden of injury falls disproportionately on the poor, who have little political power. In Great Britain, the pedestrian injury death rate for children in the lowest social class is five times greater than the most affluent children (Roberts and Power 1996). Third, the environmental context for walking, which is air pollution, noise, congestion and fear of traffic, is an everyday urban reality for nearly all families, both rich and poor. Rather than focusing solely on injury prevention, perhaps promoting safe walking to improve the quality of life, community coherence, and urban aesthetics would be a more effective way to convince decision-makers to change the urban landscape and promote pedestrian safety.

For example, a survey of 2,000 parents of school-age children in London showed that 90% of parents were (at least) very worried about traffic danger and feared the possibility of child abduction (DiGuiseppi, Roberts, Li, and Allen 1998). Although few children of these parents would likely be injured as pedestrians, their fear of traffic and strangers was pervasive. These concerns provide excellent levers with which to influence public opinion. Accordingly, community members would be more likely to broadly support improving the livability of the urban environment, reducing traffic noise, danger, congestion, and strengthening community social support networks rather than support child pedestrian safety per se.

An Agenda for the Future

Child pedestrian injury rates have fallen dramatically over the last two decades in most industrialized countries. However, evidence suggests that this has occurred because of a decrease in exposure, i.e. less walking. Our job is to continue to decrease the risk of pedestrian injury to children and to all people in the community while preserving walking as an important element of life to the individual and the community.

The suggested approach to reducing child pedestrian injuries, then, is to promote safe walking for individuals of all ages for the overall health benefits it renders to the individual and the community. Further, rather than rely solely on education and training to ensure children's safety, we should begin to change the physical environment, with priority given to the safe movement of pedestrians over the movement of motor vehicles. Prevention will entail slowing down traffic, decreasing density, decreasing on-street parking, and providing adequate play spaces and pedestrian paths, refuges, and sidewalks.

Epilogue

Richard A. Schieber, MD, MPH and Maria E. Vegega, PhD

During the conference, strong arguments were presented for and against the relative value of children's education and skills training in pedestrian safety. We have tried to capture the arguments made in these proceedings. Health educators and psychologists, particularly Drs. Andrea Gielen from the United States and James Thomson from Scotland, acknowledged that even though classroom education had not been particularly successful in improving pedestrian safety behavior among young children, skills training had strong merit. Crashes between child pedestrians and motor vehicles declined following classroom education, but the degree of pedestrian behavioral change was not significant. By comparison, correct behavior of certain road crossing skills had increased 40% to 70% among children exposed to skills training interventions in the United Kingdom, and up to 30% to 50% among K-4 students exposed to such training in the United States. This positive outlook could be described as "the cup being half-full." The other point of view ("the cup being half-empty") was presented by Drs. Ian Roberts from Great Britatin and Fred Rivara from the United States, who argued that no single educational program had demonstrated sufficient impact on the vast majority of students to merit endorsement and widespread dissemination. Indeed, a recent systematic review of community-based education studies aimed at reducing child pedestrian injuries concluded that such programs have modest and limited benefit, and that even after training, young children remain at substantial risk for pedestrian injuries. The natural consequence of this position is to abandon any future attempt to educate or train children in street crossing, and instead, to emphasize the institution of environmental (roadway) changes and the passage and enforcement of pro-pedestrian laws and ordinances, such as enforcement of speed laws.

This difference of opinion is critical because it is one of the most divisive among experts in this field. The problem arises because, for pedestrians, the margin of error is so small. When a vehicle strikes a child pedestrian, the child is likely to sustain an injury, whether severe or not, because the difference in momentum between the vehicle and the child is so great. Although relatively few injured children die, one might imagine that a non-fatal injury could have been fatal had the child been struck more directly instead, rolled under the car, or dragged. As traffic density and vehicle speed increase, so does the risk to any given child pedestrian, assuming other risk factors remain constant. Furthermore, children are frequently put at risk, because at some time during the day, all children are pedestrians, if only to walk through a parking lot to their parent's vehicle, or to chase a ball from the front yard. During such activities, children may not even think of themselves as pedestrians, because at such times, they are playing, not walking, when in fact they are doing both.

Given this enormous risk, to what extent does a child's behavior in traffic need to improve to judge a prevention program successful? Is a 20%, or even 50% improvement sufficient? And is such correctly-performed pedestrian behavior generalizable to every traffic environment the child is likely to encounter? What constitutes successful prevention via environmental change? For example, what reduction in speed from traffic calming measures is sufficient?

It is becoming increasing clear to the injury research community that merely learning about traffic has no certain bearing on a child's street-crossing behavior. For this reason, the vast number of pedestrian education classroom courses may not accomplish their objectives, and can even seem unnecessary unless accompanied by practical skills training. Even so, some classroom education may still be needed to give children the cognitive groundwork they need to master the skills training. In other words, classroom education may be necessary but not sufficient for safety. Once taught, the child must be helped to generalize such skills training, lest he or she be able to deal with only one traffic situation. This may be one reason that training at a miniature safety town may not be sufficient, although it might be a place to start.

The pedestrian safety field lacks the promise of a single magic bullet solution. The prevention of child pedestrian injuries is a multifaceted problem involving, at least, individual characteristics of the child, environmental design, and mutual dependence between the child and his or her environment. Indeed, during this conference, educators, traffic engineers, and planners all agreed that their own field did not presently provide the entire solution. Those advocating environmental interventions noted that educating adults to more closely supervise their children had merit, while those advocating for training acknowledged that their programs did not ensure safety for all children.

How then might this issue be resolved? First, we should honestly appraise all types of programs directed at pedestrian safety, whether they promote education, skills training, engineering, law enforcement, or a combination of these. All types of interventions should be held to the same standard of evaluation. One should not merely assume that engineering strategies will work because educational strategies do not. Second, cross-disciplinary discussions need to continue among experts to relate and compare findings, including strengths and limitations of each type of program, and to help improve them. Third, we should consider what would happen if we abandoned all attempts of any one approach. For example, the likely consequence of abandoning pedestrian safety education for young children in school is that parents and caregivers would, by default, bear more responsibility for such teaching, even though they may be poorly equipped to do so. Alternatively, children might teach themselves by trial-and-error, a potentially deadly means. Eventually, children must learn how to interact safely with traffic, including how to cross the street, just as they learn to ride a bicycle because such actions are an inevitable part of growing up. If pedestrian safety education and skills training begins at a later stage of childhood, would children by themselves, or through the instruction of caregivers, learn incorrect or incomplete safety strategies? Would important teachable moments be lost? Would teaching and training at a later stage of childhood be easier if children received certain types of instruction at a younger age? What proportion of our resources and energy should be devoted to teaching and training pedestrian skills, rather than teaching safety for other potential causes of injury? These issues need to be considered if injury prevention professionals around the world are to commit to developing a comprehensive, interdisciplinary approach to reduce pedestrian injuries among children.

An understandable concern is whether, in the ever-increasing competition for federal, state, and local funding, the “next dollar” should be spent on an engineering intervention versus an education and training program. One solution might be to spend some funding on each. This suits the position that, in the end, the best solutions are probably those that involve a mix of both environmental change and pedestrian skills training programs. However, serious attention needs to be spent on increasing the total amount of funding available, not just dividing up the same amount differently.

And finally, to what extent does such a debate apply to other areas of injury prevention, whether for children or adults? For many areas (e.g., bicycling safety, drowning prevention), public health professionals have long recognized that multidisciplinary efforts are likely to be more successful than any single type of effort alone (Klassen et al. 2000). Perhaps a multidisciplinary, multifaceted approach should be our standard for pedestrian injury prevention programs. This would also provide a more neutral tone for bringing experts with diverse professional backgrounds together. Consequently, it may help us achieve our goals, held in common by all experts, more quickly. In doing so, the complex societal problem of child pedestrian safety is more likely to acquire a long-lasting solution.

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Appendix A:
National Strategies For Advancing Child Pedestrian Safety

Reprinted from Schieber RA, Vegega ME (Editors). *National Strategies for Advancing Child Pedestrian Safety.* Atlanta, GA: Centers for Disease Control and Prevention, National Center for Injury Prevention and Control, 2001.

The recommendations presented here were generated during a meeting of diverse public and private organizations and agencies, as described in the body of these Proceedings. They do not necessarily represent the official policy of the Centers for Disease Control and Prevention, U.S. Department of Health and Human Services, nor the National Highway Traffic Safety Administration, U.S. Department of Transportation. Rather, they represent the priorities identified by an expert group convened by these two agencies.

Goals

To enhance the well-being and safety of children by:

1. Reducing their risk of injury while walking
2. Increasing their physical activity level
3. Creating a more pedestrian-friendly environment

Specific Recommendations

Recommendation #1:

Enhance public awareness about the need to improve safety for child pedestrians while promoting the health and environmental benefits of walking. Create coordinated national, state, and local public information campaigns that increase public awareness and understanding of:

1. The interdependent relationship among personal health, safety, community livability, and environmental protection;
2. Pedestrians are road-users who, like motorists and bicyclists, need to be safe in traffic;
3. The manner and degree to which engineering solutions can enhance pedestrian safety (e.g., traffic calming, separation of pedestrians from motor vehicle traffic, and better crosswalk controls);
4. The usefulness and cost-effectiveness of traffic law enforcement.

Recommendation #2:

Modify the behavior and attitudes of both pedestrians and drivers to improve road sharing.

1. Develop and encourage strategies that improve sharing the road, and increase mutual respect of pedestrians and motorists by teaching both groups the rules of the road.
2. Help the public understand the degree to which excessive speed increases stopping distances and thus increases the risk of pedestrian death.
3. Encourage the public to support enforcement of posted speed limits (especially in school zones and residential areas), laws that prohibit passing of school buses, and yield-to-pedestrian laws. Support the development and use of innovative technologies, such as red light cameras to help enforce traffic laws.
4. Develop, evaluate, and disseminate programs to educate parents and drivers about children's abilities and limitations as pedestrians in traffic. These programs should take into account different parenting styles and abilities. Encourage parents to supervise their children in traffic and to teach their children age-appropriate pedestrian safety rules.

Recommendation #3:

Modify the physical environment to better support pedestrian traffic.

1. At the national level:
   a. Establish transportation policies that encourage local communities to integrate pedestrian access and safety into every phase of transportation planning.
   b. Foster collaboration among federal agencies and national professional groups to help develop and promote public policy that leverages resources to achieve the most effective programs without duplicating efforts.
   c. Develop road construction standards that are more conducive to safe walking.
   d. Compile and disseminate local "best practices" that foster pedestrian safety, especially those that emphasize the use of low-cost solutions and new technologies.
   e. Help teach traffic engineers and engineering students how to retrofit streets and roads to make them safer. Develop and disseminate curricula, sponsor professional conferences, and assist with continuing education.

2. At the state and local levels:
   a. Encourage state and local officials to revise laws, ordinances, and practices to promote the construction of traffic-calming measures, such as roundabouts, speed humps and other road designs.
   b. Encourage city planners, engineers, real estate developers, and landscape architects to consider pedestrian safety, particularly for children and persons with disabilities when designing new communities or modifying existing ones.
   c. Encourage local officials, designers, and planners to enhance pedestrian accessibility and safety when building or remodeling schools, recreational sites, and businesses.

Recommendation #4:

Develop and conduct effective safe-walking programs.

1. Ensure that programs to prevent childhood pedestrian injuries receive sufficient public and private support as to provide programs in all states. This may require corporate and Congressional champions and a national spokesperson.
2. Encourage federal agencies responsible for road safety to make available effective pedestrian safety training activities for children. Encourage federal, state, and local departments of education to establish safe routes to school.
3. Encourage states to develop statewide pedestrian safety plans that reflect community needs. Encourage each state Department of Transportation to establish and adequately staff a pedestrian safety office to coordinate and conduct training programs, conduct public information and education campaigns, and develop local programs throughout the state.
4. At the community level, create multidisciplinary coalitions to develop programs that emphasize safety aspects and the health and environmental benefits of walking. Encourage parents, teachers, school administrators, pediatricians, and other child care providers to identify and creatively solve local pedestrian safety problems. Such coalitions should seek to enroll nontraditional partners.

Recommendation #5:

Conduct research to address gaps in knowledge and to translate research findings into effective programs and public policy.

1. Evaluate existing childhood pedestrian safety programs by using a systematic review process to determine which ones are effective and deserve widespread replication. Such programs include:
   a. Educational programs, such as Safe Routes to School, Walking School Bus, Willie Whistle, Keep on Looking, and others designed to reduce dart-outs and that help children cross streets safely.
   b. Traffic-calming strategies, such as roundabouts, speed humps, and other measures.
   c. Enforcement strategies, such as red light cameras and stricter ticketing of drivers who illegally pass school buses.
2. Where sufficient data do not exist, use randomized control trials where feasible to measure intervention effectiveness.
3. Conduct research to determine the cost-effectiveness of promising programs.
4. Fund research that links pedestrian safety to physical activity and a healthier environment.
5. Identify behavioral indicators to help determine when a child is ready to cross the street independently. Assess the chronologic and developmental age, skill patterns, and teachable moments when children are most receptive to interventions.
6. Determine what level of supervision children need at various levels of cognitive, social, skill, and behavioral development. Establish appropriate standards for such supervision.
7. Develop and test programs that use teens to mentor young children in pedestrian safety.

Recommendation #6:

Conduct surveillance to measure children's pedestrian injury rates, quantify the amount of walking children normally do, and identify risk factors for injury.

1. Identify and validate useful indirect measures that predict the occurrence of a child pedestrian injury. Use these to monitor program effectiveness.
2. Develop and test indicators of the prevalence of walking for transportation, the public's beliefs about the benefits and risks of walking, and the existence of environmental and social risks of walking.
3. Define children's exposure to risk of pedestrian injury that includes, but is not limited to, factors related to the time the child spends in the street; traffic density, speed, and complexity; and road features such as the number of lanes and existence of marked or signed crosswalks. Develop and implement methods of collecting data about such exposure.
4. Develop local risk factor surveillance systems to monitor how and why child pedestrians are injured, and to identify the environmental and behavioral modifications that could have prevented such injuries. Establish linkages to other data sources, particularly emergency department data and police crash reports.

Appendix B:
Glossary of Terms

Arterial Road: Roadways are typically classified by the way they are used. Streets serve residential neighborhoods, collectors "collect" the traffic from these streets, and arterials are used to move traffic at higher speeds between areas.

Bollard: A post, usually between three and four feet high and sometimes removable, placed in a manner that prevents motor vehicle access while allowing pedestrians and bicycles access.

Channelized right-turn slip lane: A right-turn lane located at an intersection, separated from other lanes by a pedestrian refuge island. If designed properly, this improves pedestrian safety by slowing speeds of right-turn vehicles and by providing a raised island for pedestrian refuge.

Chicane: A staggered curb extension or parking area that creates a curve or horizontal shift in the road for motor vehicles and slows traffic.

Choker: A pair of opposing curb extensions that narrow the street and may reduce the effective number of traffic lanes.

Curb extension: Spaces where the sidewalk has been extended, often at an intersection, to shorten crosswalk distance and provide better visibility for pedestrians. Curb extensions do not involve the loss of a lane, but narrow the overall width of the road.

E codes: A classification system used to identify the causes of injury or death based on the external (E) cause of injury, according to the International Classification of Disease, 10th Revision (ICD-10). These codes specify whether the pedestrian was struck by a motor vehicle, bicycle, or other type of vehicle, and whether the event occurred on a public road versus non-public road or place. National vital statistics tabulations by the National Center for Health Statistics, Centers for Disease Control and Prevention (CDC) use E codes for classification of injury.

Grade-separated crossing: A crossing that is either above-grade (an overpass or bridge) or below-grade (an underpass or tunnel) from the level of the roadway (at-grade).

Hospital discharge data: Many states now require E coding of all injury-related inpatient hospital visits which provide information about the cause of injury, yet little or no detail about the crash (see police crash report data). As these data become more readily available, they should provide more detail about the types of injuries that occur.

Large combination vehicle: A tractor-trailer. Because this is generally the largest vehicle that uses the street, it is the design vehicle whose dimensions are considered when designing new streets and intersections.

Left-turn pocket: A gap or indentation in a median designed to allow left-turning vehicles to move out of the flow of through-traffic and wait for a gap in traffic or a green left-turn signal to make a left-hand turn.

Level of service: Classification of density of vehicles in traffic lanes affecting vehicle speed. The highest level of service, Level A, has free-flow, unobstructed traffic flow. Level F has highly congested, predominantly stop-and-go traffic.

Living street: The rough translation of the Dutch word *woonerf*, describing a narrow street without sidewalks in which pedestrians, bicyclists, and motor vehicles all interact at low speeds.

Median barrier: A raised barrier (e.g., concrete New Jersey barrier) placed in the middle of the road to reduce head-on vehicle collisions and to discourage pedestrian mid-block street crossings.

Mid-block planter: Landscaping placed in the road, often as part of a chicane.

Mini-circle: Very small roundabouts, approximately 10 feet in diameter, placed at an intersection of residential streets to clarify right-of-way and to slow traffic. Some have raised centers, while others are just painted circles on the road. Seattle, WA currently has over 700 mini-circles.

Motor vehicle non-traffic accident (or crash): Any motor vehicle accident that occurs entirely in any place other than a public highway.

Motor vehicle traffic accident (or crash): Any motor vehicle crash occurring on a highway or street open to the use of the public for purposes of vehicular traffic as a matter of right or custom.

Multi-use path: Typically an off-road facility designed for use by pedestrians, runners, bicyclists, in-line skaters, and in some cases, equestrians. These can be located in urban or rural settings.

Partial or full street closure: A wide variety of road treatments that restrict access to streets, including full closures (such as cul-de-sacs), diagonal diverters, and curb extensions. These are designed to allow access by pedestrians, bicyclists, and occasionally emergency vehicles. Berkeley, CA has made extensive use of diverters.

Pedestrian mall: A road closed off entirely to motor vehicle traffic and available only for use by pedestrians. Pedestrian malls were used extensively in the 1960s and 1970s in the United States for downtown retail centers.

Pedestrian: Any person involved in a motor vehicle accident who was not at the time of the accident, riding in or on a motor vehicle, railroad train, streetcar, animal-drawn or other vehicle, or on a bicycle or animal. This group includes persons changing the tire of a vehicle, in or operating a pedestrian conveyance, (such as a baby carriage, wagon, roller skates, scooter, skateboard, wheelchair, skis, sled, or ice skates), making adjustments to a motor vehicle, and walking on foot.

Pedestrian refuge island: A small, concrete raised median built in the middle of a street or between travel lanes that allows pedestrians to cross part of the street, then pause while waiting for a break in traffic to cross the other part. These reduce the overall road width and may reduce the lane width.

Police crash report data: Police crash reports describe "who, what, when, where, how," and perhaps "why" a crash occurred. Nationally, such information is compiled in two databases. The first, the Fatal Analysis Reporting System (FARS) database, includes all deaths in the U.S. from motor vehicle crashes occurring on a trafficway or while the vehicle is still in motion after running off the trafficway that result in death within 30 days of the crash. The General Estimating System (GES) contains data from a national representative sample of crashes of all severities and is principally used to estimate the number and rate of non-fatal traffic injuries. Because both FARS and GES are based solely on crashes reported to or by the police, they may underestimate the true number of pedestrian injuries. This is due to underreporting to or by police of some traffic-related events, and exclusion of most events that occur in non-traffic locations, i.e. driveways and on private property.

Raised intersection: An intersection where the crosswalks and entire area encompassed by the crosswalks has been raised almost to the height of the sidewalk, with a ramp added on each side. This slows vehicle traffic, alerts drivers to the possible presence of pedestrians, and encourages pedestrians to cross only at the crosswalk. Such designs should incorporate pavement texture features to alert visually-impaired pedestrians.

Raised pavement marker: A raised, reflective device attached to the roadway to supplement lane lines, centerlines, or the edgeline of a roadway. These markers are usually made of hard rubber, plastic, or metal with a face that reflects the light from vehicle headlights back to the driver.

Randomized Controlled Trial (RCT): An epidemiologic experiment in which subjects in a population are randomly allocated into groups, usually called ìstudyî and ìcontrolî groups, to receive or not to receive an experimental preventive or therapeutic procedure, maneuver, or intervention. Randomized controlled trials are generally regarded as the most scientifically rigorous method of hypothesis testing available in epidemiology.

Roundabout: A circular form of an intersection designed to slow vehicle movement between streets. Modern roundabouts typically are used at the intersection of collector or arterial streets and are designed to force vehicles to slow upon entering. They often have only one lane for vehicles, generally considered safer than two-lane roundabouts.

Sight line: The line of sight between a pedestrian and a motor vehicle. An obstruction in the sight line increases the likelihood that a pedestrian and driver will not see each other.

Speed hump: A raised surface of the road over a short distance, though more gradual than a speed bump. Typically this includes a maximum height of roughly three inches over a distance of roughly 14 feet. They typically slow traffic to 20 to 25 miles per hour. In some countries, these are known as "sleeping policemen."

Speed table: A wider speed hump where the top of the hump is level for several feet. These often double as raised crosswalks.

T-intersection: An intersection where one street intersects perpendicularly with another street and dead-ends, forming the letter "T."

Textured crosswalk: A crosswalk constructed of brick, pavers, cobblestone, or some textured form of concrete or asphalt. This draws pedestrians to cross at the crosswalk and makes it more visible and audible to drivers.

Trafficway: Any road, street, or highway open to the public as a matter of right or custom for moving persons or property from one place to another.

Walkable community: A site where engineering and other measures encourage walking and improve pedestrian safety. Traffic calming measures and other pedestrian treatments (e.g., sidewalks) are a key part of making a community more walkable.

***Woonerf*:** See Living street.

Appendix C:
Meeting Participants:
Panel to Prevent Pedestrian Injuries

September 27–28, 1998
Atlanta, Georgia

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