



The pediatrician and traffic safety

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Abstract

Objective: To instruct children and teenagers about safe transportation and about their behavior as cyclists and pedestrians.

Sources of data: The MEDLINE and LILACS databases were searched, using the following terms, from 1995 to 2005: traffic accidents, child, adolescent, morbidity, mortality, age, and gender. Scientific articles on morbidity and mortality from traffic accidents, children in a pedestrian situation, as cyclists or as motor vehicle passengers, were selected.

Summary of the findings: More than 300 scientific articles were found, but only the studies that addressed those issues in a broad manner were selected.

Conclusions: Traffic-related mortality rates are still very high and show the necessity to intensify educational campaigns for community awareness, in addition to encouraging investments in effective pedestrian safety. The pediatrician's role is to decrease the number of children and adolescents who get involved in traffic accidents by providing them with traffic guidance and education.

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Introduction

Traffic kills more than one million people around the world every year and causes approximately 10 million disabling and permanent injuries.^{1,2}

Most of these accidents occur in poor countries, where pedestrians and children are more susceptible,²⁻⁴ however, the risks increase for motor vehicle passengers in adolescence

The incidence of traffic-related injuries in those countries tends to increase, and it is estimated that around the year 2020 they will be the third most common causes of death all over the world,^{5,6} determined according

to the disability-adjusted life year.

According to the data from the Department of Statistics of the Unified Health System, 5,538 children and adolescents aged between 0 and 19 years died in Brazil in 2002 from traffic accidents, 55% of whom were aged between 15 and 19 years, and of these 43% were male.⁷

This may be attributed to the growing increase in the number of circulating vehicles, to the growth of urban and industrial populations, to the lack of safety education, to impunity, to the lack of efficient laws, and to poor roadway maintenance.⁸

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Traffic-related mechanisms of injury may vary considerably from birth to the end of adolescence, due to either the gradual increase in body resistance, or to the several types of impact children are subject to at different ages. Accidents involving a motor vehicle and a pedestrian are not a risk to be considered during the first year of life just as falling off a motorcycle is not expected to occur at school age. Pediatricians should know about safety resources (e.g.: safety seats and helmets)⁸ used to minimize the effects of kinetic energy in different types of trauma.

In industrialized countries, deaths from traffic accidents have decreased substantially in the last 30 years and most studies point out that such decrease is due to changes in vehicle design, roadway improvements, increased use of seatbelts, and a reduction in the number of drunk drivers.⁹

By analyzing the Brazilian practice in traffic education, one notes that the way the change of behavior in traffic has been conducted has not yielded good results.^{10,11} Implementation of information systems about traffic accidents, educational measures regarding pedestrian crossing, and emergency care for the victims have been suggested for large Brazilian urban centers.¹⁰

Successful campaigns include educational strategies, environmental change and law enforcement.

The aim of the present study is to review the recent literature and provide some guidance for the safe transportation of children and adolescents and on their behavior as cyclists and pedestrians.

Traffic law

The Brazilian Traffic Code¹² determines that children younger than 10 years must be carried on the back seat (Article 64) and wear a seatbelt or equivalent restraint each (Resolution 15, Article 1).

Transportation of children that does not comply with safety rules is a very serious offense, which is punishable by fine (Article 168).

Carrying children younger than seven years on a motorcycle is also a very serious offense, which is punishable by fine and driver's license suspension (Article 244), and carrying them on bicycles is regarded as an average offense, which is punishable by fine (Article 244).

Pedestrian safety

Global statistics indicate that accidents involving a motor vehicle and a pedestrian account for nearly 50% of deaths, but they may exceed 70% in developing countries.^{13,14}

Several authors^{15,16} observed that under five-year-olds are more prone to backover accidents; two-year-olds are more likely to be run down at driveways; four-year-olds are usually run over in parking lots; six-year-olds fall

victim to these accidents in other places, such as in the middle of the block; and that finally, 10-year-olds are usually run down at road crossings.

Under five-year-olds are often run down at driveways and parking lots without even being seen by the drivers of high-end cars such as pickup trucks, SUVs and vans.¹⁶

Some factors that certainly contribute to the increased risk of accidents involving a motor vehicle and a pedestrian are the child's age, impact speed and vehicle design.^{10,17,18}

With regard to the drivers' attitudes, motor vehicle-pedestrian collisions occur due to excess speed, intoxication, insecure attitudes, noncompliance with traffic rules, lack of attention to pedestrians (especially children) and impunity.⁸ Accidents involving a motor vehicle and a child are usually caused by under-forty-year-old male drivers.^{18,19}

The factors related to a higher risk of motor vehicle-pedestrian collisions are:^{1,8,17,18} boys, ages 3 to 12 years, number of streets a child has to cross, midblock crossings, daylight hours, school hours, houses without a backyard or recreation area, strong association with alcohol consumption, underprivileged social classes, and unemployment.

For pedestrians to be safer in the street, they should always use the sidewalk, stay away from the curb, walk in a single line, contrary to the flow of vehicles (mandatory in case of no sidewalk).²⁰ The same applies to the highways, where the shoulder should be used.²⁰ They must cross the street in a crosswalk and obey the signs; if there is no crosswalk, they must cross the street perpendicularly to the sidewalks.²¹

Before crossing the street,²¹ pedestrian should keep away from the curb, stand in a visible place, pay attention to unmoving cars or objects that might hinder their view of oncoming traffic, look to the right and to the left, and make eye contact with the driver to make sure they are being seen,²⁰ in addition to always obeying the traffic signs.²²

Among the strategies for prevention of traumas in children and adolescents as pedestrians are educational strategies, street environment changes and other measures, such as organization of school hours.^{1,3,4,8,15,17,18}

Educational strategies should focus on the pedestrian's training and skills and should be related to a larger knowledge about the dangers of traffic, in addition to the behavioral changes imposed by this situation.¹

Pedestrian-oriented educational measures may change pedestrians' behavior when crossing the street, but it is still unknown whether they effectively reduce the risks of motor vehicle-pedestrian collisions.¹

Motor vehicle-pedestrian collisions may occur even under optimal lighting conditions, dry lanes and streets and good weather, but in zones densely populated with children, who lack knowledge and maturity to cross the streets, these accidents are very common; therefore, emphasis should be placed on providing children with a safe place where they can play and be supervised, and only be allowed to cross the streets if they have learned the technique properly.^{23,24}

Training should begin in preschool, indicating the appropriate and safer places for crossing the street,²⁴ always considering the child's attention development and highlighting its importance throughout school years.

Educational programs that include parents are often more successful, resulting in better supervision and attitudes as model of safe behavior, through good examples and transfer of knowledge.^{25,26} Awareness-raising and qualification programs for children's education yield as positive results as formal school education.^{1,25}

Educational interventions for drivers could include a comprehensive approach, focusing mainly on the importance to enhance drivers' attention in residential areas and at the higher-risk time periods.²⁶

These programs should also be sensitive in cultural and linguistic terms and be devised in a way that anyone can understand them. Since they have an educational purpose, they should use the language employed by the community and pay special attention to the families which have moved in recently so that they get to know the streets of the neighborhood and their risks, in addition to creating a friendlier and safer neighborhood. After the implementation of these measures, individual behavior will matter much less.^{8,27}

Traffic calming and improvement measures, which combine changes in traffic engineering, intense signage, barriers, restricted vehicle access, detours, and pedestrian refuge islands, may help reduce vehicle speed and increase drivers' attention.²⁷⁻³⁰

Traffic calming measures can reduce lethal and non-lethal injuries by around 11%.³⁰

Residential neighborhoods where families have many children and where there are many vehicles parked on the street and a large number of pedestrians are a priority for vehicle-pedestrian collision reduction programs. Measures such as parking prohibition and strategies for speed reduction enhance pedestrian visibility and considerably reduce vehicle-pedestrian collisions.^{31,32}

Initiatives to motivate walking and cycling habits help implement the effective measures and should be a priority in residential neighborhoods.^{1,27,33,34}

Other measures, such as the creation of student brigades to help control vehicle flow at school hours have been highly successful in short-term reduction of accidents involving personal injury and in raising the awareness of students regarding traffic safety.³⁵

In case of backover accidents at driveways involving children, strategies such as^{9,11} telling children to stay away from garages and parking lots or to play where they can be supervised by adults, enhancing drivers' attention to children in the surroundings and keeping vehicles parked in the garage^{16,33} proved effective.

Vehicle security technologies include back-up sensors and cameras that alert drivers to the presence of small children or to objects outside their field of vision, in addition to larger side mirrors.^{34,35}

Despite several studies in different countries, scant evidence exists on the effectiveness of safety education for children as pedestrians.¹

However, more than the increased awareness of the dangers posed by streets and behavioral changes, changes in the street environment and law enforcement regarding speed control are more effective in protecting children from traffic accidents.¹

Safe transportation of children and adolescents

A child safety seat should be used to transport the baby from the hospital to his/her home.^{36,37}

This recommendation should be reinforced in every well-child visit by recording, on the medical chart, how the child has been transported.

There are some important aspects that should be remembered, e.g., the safest place in a car for any child shorter than 1.45 m is in the middle of the backseat.³⁸⁻⁴³

Although a child must never be carried on someone's lap,⁴² even in the backseat, this is a common habit in Brazil. Based on classic physics, one may affirm that in a head-on crash at 50 km per hour into a hard object, a child weighing 10 kg may produce a force as heavy as half a ton against the arms of the person who is holding him/her.

Child transportation safety tips

Children must always get into or out of a car on the sidewalk side and parents should not allow unaccompanied children to approach the vehicle.⁴⁴

Proper child transportation should be encouraged.⁴⁵

Fastening two children or an adult and a child to the same seatbelt is not recommended; each passenger should wear his/her seatbelt.⁴⁶ As for the shoulder belt position, the harness should always cross the passenger's shoulder, and never be placed behind the child's back or under his/her arm.⁴⁴

Children mustn't be carried in the luggage area behind the rear seat, since this area is meant to absorb shocks and becomes easily deformed in case of an accident. Moreover, children will not be wearing any restraint system in this area. Besides hitting on interior elements of the vehicle, children may be thrown out and run over.⁴⁶

In safety education, setting an example is more important than any other type of action. If parents do not wear a seatbelt, their children won't either.⁴⁵

Choosing the best safety seat⁴⁴⁻⁴⁹

When buying a child safety seat, it is important to check the technical specification number of the country of origin. This warrants the quality of the product.

There is no specific safety seat brandname experts could recommend as being the safest or best. An ideal safety seat is one that suits the child's size and weight, one that adapts well to the vehicle seat and that will be used properly during transportation.

The manufacturer’s installation instructions must be strictly followed in order to guarantee safety.

Before buying the safety seat, it should be tried out to make sure it fits properly.

Before driving off, it is important to always check whether it has been installed in compliance with the manufacturer’s instructions and whether the child is properly buckled.

Special situations

Low birth weight and preterm newborn infants^{47,51,52} need to be constantly supervised; therefore, an adult should stay with them during transportation so as to readily detect respiratory problems that might be caused

by the half-inclined position of the safety seat. Before hospital discharge, the baby must be placed in the seat for a while and be observed.

If the preterm infant needs to be lying down, an appropriate Moses basket should be used for transportation (using the specification of the country of origin).

Babies under such circumstances should be placed in child safety seats or in reversible seats with five-point harnesses. This system allows belt harnesses to adjust properly to their bodies.

Reversible seats with fixed supports must be avoided. Since it is too large for the baby’s size, the support is placed away from his/her body and too close to his/her face, not allowing for proper use of the seatbelt.







| Group | Weight | Age | Features | Seats | |
|-------|--|--------------------------|---|---|---|
| 0 | Up to 10 kg. Approximate height: 72 cm. | Up to 1 year old. | Totally frail, not well-developed musculoskeletal structure. | Rear-facing seat since maternity discharge |  |
| 0+ | Up to 13 kg. Approximate height: 80 cm. | Up to 18 months | The same. | Rear-facing seat to at least 1 year of age. After 1 year, forward-facing seat. |  |
| 1 | From 10 to 20 kg. Approximate height: 1 m. | From 1 to 3 years old. | Frail backbone, not well-developed musculoskeletal structure. | Convertible forward facing model. |  |
| 2 | From 15 to 25 kg. Approximate height: 1.15 m. | From 3 to 6 years old. | The muscles are better developed, higher elasticity and limited arm-to-arm span. | Booster backless or high-back seat. |  |
| 3 | From 22 to 36 kg. Height below 1.45 m. | From 6 to 12 years old. | The muscles are better developed, feet flat on the floor. | Booster high-back seat, 3-point seat belt. |  |
| 4 | Height over 1.45 m. | From 11 to 12 years old. | Back against the vehicle seat, bent knees, feet flat on the floor and shoulder belt rested over the center of the shoulder. | 3-point seat belt, children and adolescents should be in the back seats up the age of 12. |  |

Figure 1 - How to transport children
Adapted and modified from the American Academy of Pediatrics⁴⁷ and NHTSA⁴⁸.

Note: Some seat models have already been certified by INMETRO⁵⁰, based on a Brazilian technical standard NBR 14.400:1999. The use of “children’s belts” is not recommended for not being adequately safe.

Consequences of inappropriate transportation

Out of negligence or lack of knowledge, most children are transported incorrectly in vehicles, even by those parents who have bought a safety seat.^{41,44,46,52,53}

The most common errors include models that are unsuitable to the child's size, inadequate installation on the vehicle seat, clearance between the seatbelt and the seat, inappropriate height of shoulder harnesses, unbuckled children, small children buckled to the vehicle's seatbelt, infants being transported on the front seat facing the dashboard and incorrect position of the seatbelt, which hinders the proper restraint of older children.

The use of safety equipment is essential to reduce the incidence of trauma, but under certain circumstances, these pieces of equipment themselves can be the cause of injury. Therefore, they should be used correctly.⁵³

As a result of inadequate transportation, traumas have dire consequences on children. If we consider body mass and surface, all children victimized by accidents possibly have a higher frequency of multiple organ injuries and a higher incidence of blunt trauma.

In children who are thrown out of a vehicle because they are not using a restraint system (seatbelt and child safety seat) or are using it incorrectly, head traumas are the major cause of death in all age groups.⁵⁴

Airbag⁵⁵⁻⁵⁸

An airbag is an efficient safety device in protecting children older than 12 years and adults, when combined with the use of a three-point seatbelt.

In case of younger children riding on the front seat, the airbag can cause severe injuries or even death.

In fatal cases, two were the predisposing factors:⁵⁵ small children in child safety seats placed on the front seat with their back to the dashboard, too close to where the airbag was installed. When the airbag deployed, at an extremely quick speed (1/20 secs), the back of the car seat shell, which is not designed to cushion such a strong impact, broke and caused injury to the child's brain and/or spinal column. Older children, who were either unbuckled or inappropriately restrained, were thrown against the dashboard at the airbag location during deceleration.

The Brazilian traffic laws¹² do not allow children younger than 10 years to ride on the front seat of a vehicle. If necessary, as in the case of vehicles containing only front seats, children should be carried in age-appropriate seats, a three-point seatbelt should be installed and worn, the front seat must be moved as far back from the dashboard as possible, babies must be carried in seats placed with their back facing the dashboard, in vehicles with passenger airbags (that cannot be disabled), and an airbag deactivation system should be installed. In addition, drivers must drive carefully so as to prevent the airbag from inflating.

Cyclist protection

Child cyclists are prone to falls, whose most severe consequences are head injury, brain contusion, severe deformation of the face and limb fractures.³⁰

Over 70% of bicycle accidents and deaths occur among boys aged less than 14 years, who have a fivefold greater risk of getting involved in this type of accident. In the evening and at night, the risk quadruples. Riding a bicycle without safety equipment remarkably increases the risk of head traumas. Fatal accidents are fourteen times more frequent among unhelmeted riders.⁵⁹⁻⁶¹

Children and/or adolescents must be provided with traffic education, learn about traffic signs and safety rules, and be able to put them into practice.

Helmets are a necessity not a simple accessory for cyclists,^{30,58,61,62} and their regular and appropriate use is provably capable of reducing mortality rates by up to 15% among motorbike riders. In cyclists, helmets may reduce the risk of head trauma by nearly 60%.^{30,58,62,63}

The Brazilian Traffic Code,¹² in article 105, paragraph VI, regards the following pieces of equipment as mandatory for cyclists: horn, front, rear and side reflectors, pedal reflectors, and left-side rear view mirror. The use of helmets is mandatory only for motorcycle riders.

A bicycle is suitable for a child when he/she is able to sit on the saddle with both feet flat on the ground and the knees slightly bent.⁶⁰

Cyclists should always ride on the right-hand side of the road and in the same direction as traffic, never against it.³⁰ Cycling should be practiced during daylight hours only (cycling in the evening and at night should be avoided), and children should wear brightly colored highly visible clothing;^{59,60} also, cycling in the evening and at night should be avoided.⁶¹ On top of that, traffic signs must be strictly obeyed.⁶¹

Conclusions

Statistical data show that, by using conventional age ranges, it is often difficult to define the ages at greater risks for accidents; some of them cross the age thresholds and are not shown in age-stratified analyses.^{1,32}

If we know the ages and skill acquisition of children, the application of prevention measures becomes easier.

For instance, after obtaining information about the number of deaths caused by vehicle-pedestrian collisions among U.S. children at three-month intervals, researchers found out that this number doubles at 12 to 14 and at 15 to 17 months of life, exceeding the number of accidents involving children as passengers at 15 to 47 months.³⁵ The authors concluded that vehicle-pedestrian collisions have not been given proper attention in programs for the prevention of accidents among children younger than four years and that they should be implemented earlier, during the first year of life.

The reduction in the number of traffic accidents, and consequently in the number of deaths and injured individuals, is still a challenge^{1,32,33} and, for enhanced efficiency, some aspects should be emphasized:

- Change in the behavior of children, adolescents and adults, drivers, pedestrians and cyclists through information, traffic education, and more drastically, through law enforcement, in addition to a more strict control by traffic authorities.⁴¹
- Children as pedestrians and cyclists are a priority for intervention measures aimed at reducing the deaths from traffic accidents.
- Improvement in the performance of active vehicle safety.⁴¹
- Safer use of existing roadways and better projects for future roadways.
- Reduction of energy transfers between vehicle occupants, and with the inner and outer environments. This reduction occurs with the use of safety devices (appropriate seats and three-point seatbelts), in addition to front airbag and neck protector.⁶⁵
- Proper use of devices, so that they can provide adequate safety at the time of an accident. An inadequately buckled seatbelt or an inappropriately-sized infant seat will cause injuries instead of avoiding them.

Rates are still high and show the need to intensify educational consciousness-raising campaigns for the community, and also the need to invest in effective measures for pedestrian safety.^{1,10,11}

Education serves to integrate individuals with their surrounding environment. As infants and children are inserted in the traffic context very early on, since their birth, traffic education should begin in infancy, in the family context, through the example of those people who live with them.

Pediatricians play a crucial role, since they know the stages of growth and development of children and adolescents and therefore are able to recommend preventive measures, by correlating accidents and their prevention in the context of development; the results would be even better if these recommendations were sorted out according to age ranges, predicting the periods in which risks are higher.^{40,41}

Having information about the epidemiological reality of traffic accidents, their victims, the environment and on how they occur, besides the risk factors, circumstances and time at which they occur, are important tools for the development of policies that can reduce morbidity and mortality.^{14,16}

Regional information about these accidents will allow changing the currently dire epidemiological situation.¹⁶

These data may also be used to complement preventive measures for families at high risk⁴¹ of maltreatment

(domestic violence); use of the mass media; publicity campaigns; and public health policies⁴⁹ – which are still in their infancy – so that strategic measures that benefit Brazilian children and adolescents can be jointly taken.

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