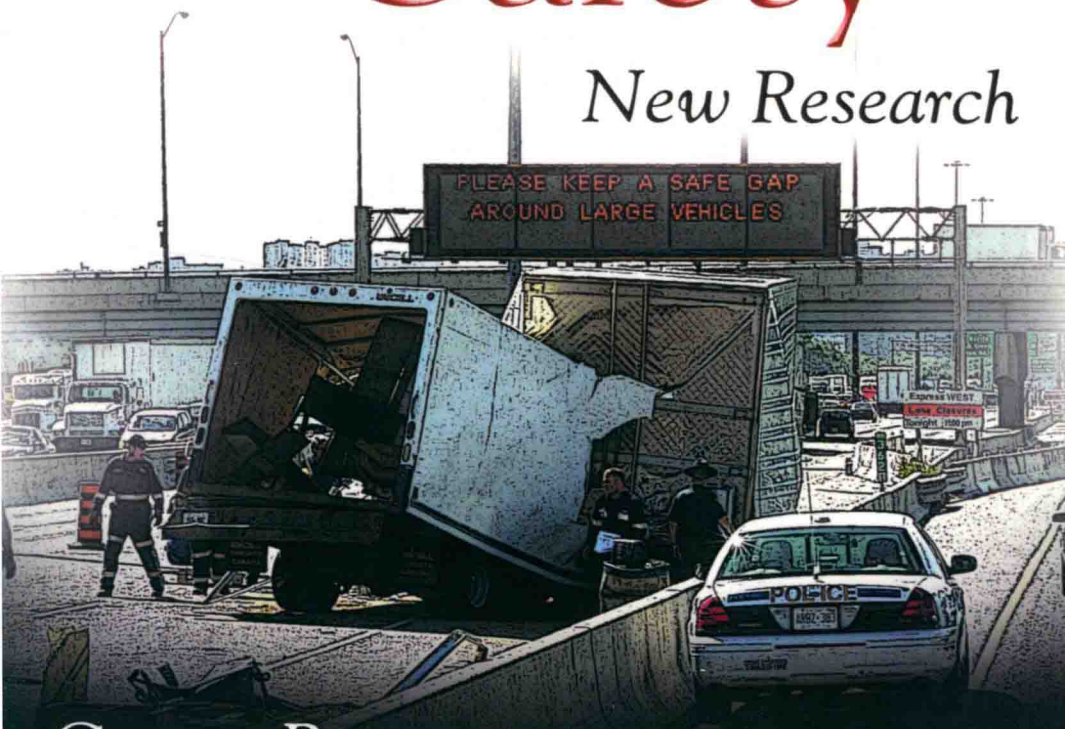


TRANSPORTATION ISSUES, POLICIES AND R&D

# Traffic Accidents *and* Safety

*New Research*



Garrett Bowman  
Editor

Novinka

**TRANSPORTATION ISSUES, POLICIES AND R&D**

**TRAFFIC ACCIDENTS  
AND SAFETY**

**NEW RESEARCH**

**GARRETT BOWMAN**  
**EDITOR**



*New York*

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**TRANSPORTATION ISSUES, POLICIES AND R&D**

**TRAFFIC ACCIDENTS  
AND SAFETY**

**NEW RESEARCH**

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## PREFACE

Traffic accidents (TAs) represent a significant public health issue and are associated with behavioral factors, vehicles safeties and conditions of the urban spaces. According to the Centers for Disease Control and Prevention, road crashes are one of the major causes of morbidity and mortality in the United States. There are many studies showing that children and adolescents may suffer significant and long-lasting psychosocial consequences following TAs. Countless research has been conducted during the last decades aiming to investigate the relationship between driver behavior and road features. This book provides new research on traffic accidents and safety.

Chapter 1 - Traffic accidents (TAs) are a leading cause of morbidity and mortality among children and adolescents in industrialized countries. There are many studies showing that children and adolescents may suffer significant and long-lasting psychosocial consequences following TAs. Most studies indicate that the prevalence of posttraumatic stress symptoms (PTSS)/disorder (PTSD) among children and adolescents is 12-46% in the first 4 months and 13-25% 4-12 months following TAs. Traffic accidents are also related to acute stress disorder (ASD), mood disorders, development of fears and negative impact on health related quality of life (HRQoL).

Although PTSD (sometimes with delayed onset) may significantly impede young people's development causing substantial subjective distress and resulting in impaired functioning, physicians often ignore or underestimate the likelihood of PTSD development and they are unaware of risk factors that predict its development and future persistence. Therefore young victims' psychological needs often remain unrecognized and unmet.

Most studies suggest that gender but not age is related to development of PTSD among children and adolescents following TAs. Findings regarding type

of accident as a risk factor have been inconsistent. The severity of body injury has been found to be unrelated to pediatric PTSD after TAs. However, the occurrence of brain injury after TAs has been reported to be correlated with PTSS, with mild brain injury predicting a higher risk of PTSD compared to no brain injury. Parental PTSS/PTSD, depression, endorsement of worry, and general family functioning have been found to increase the risk of developing PTSD among children.

Maladaptive appraisals have been associated with the development and maintenance of pediatric PTSD after TAs, whereas other cognitive processes, such as subjective threat and memory processes, have been shown to have a possible effect only in the acute phase.

In addition, initial biological responses to trauma as reflected by immediate posttraumatic alterations in neuroendocrine and/or inflammatory factors—increased plasma noradrenaline concentrations, increased or decreased cortisol levels, and increased serum IL-6 concentrations, increased urinary cortisol and epinephrine levels—have also been reported to be involved in subsequent PTSD development in children and adolescents.

Systematic screening of the potential psychological impact (peri-traumatic distress, ASD, post-traumatic stress symptoms, depression, anxiety, and other psychological symptoms) of TAs should receive the same priority as screening for physical injury, regardless of injury severity. Active management and referral for treatment as well as identification of children at risk and prevention of PTSD and other psychosocial consequences are also important. More studies of the psychobiology of physical trauma and PTSD in this pediatric population are needed.

Chapter 2 - Traffic accidents represent a significant public health issue and are associated with behavioral factors, vehicles safeties and conditions of the urban spaces.

Some studies characterizing the profile of accidents and their victims have pointed motorcycles as the most cited means of transportation.

The morbidity and mortality due to traffic accidents, is extremely high around the world. However, the proportion of deaths and injuries from motorcycle accidents is particularly high, often a result of higher exposure, a disregard of traffic laws and adoption of risk behaviors.

The social and health impact caused by traffic accidents has been extensively studied, since the hospitalization rate of accident victims is an indicator of the severity of the accidents and can be used to monitor trends and to quantify the event that represents a cost to health services, due to the high percentage of hospital admissions and high hospital care costs.

Strategies should be implemented to propose prevention and control of traffic accidents, also specifically directed to motorcyclists.

Chapter 3 - Countless research has been conducted during the last decades aiming to investigate the relationship between driver behavior and road features. The majority of the research is focused on passenger car speed, even though other modes of transport, for instance motorcycles, may be differently affected. In most of the cases researchers used pneumatic road tubes and video cameras to record vehicles' driving speeds and their vertical position. However, both pose risks to data validity due to human error and the inevitable effect of the equipment to drivers' behavior. The present investigation aims to bridge these gaps by evaluating motorcyclist's behavior and introducing a new methodology based on Global Positioning System (GPS). More specifically, the research is focused on the impact of curvature and road access to riding performance. Within the context of approaching riders' behavior, field measurements were conducted on two-lane rural roads with the use of instrumented with GPS equipment motorcycles. The planning of the experiments took into account various factors that potentially influence the driving behavior e.g., riding experience and presence of pillion. The conclusions drawn provide evidence that the riders' trajectory is correlated with the radius and the length of the curves and riding behavior is affected by the presence or not of a pillion. Finally, strong indications suggest that speed offences adjacent to junctions are more typical for experienced riders compared to inexperienced ones.

Chapter 4 - According to the Centers for Disease Control and Prevention, road crashes are one of the major causes of morbidity and mortality in the United States. The Healthy People 2020 has indicated that accidents are a major public health issue. Most motor-vehicle related events resulting in injury, disability, or death are predictable and preventable. Injuries are the leading cause of death for Americans aged 1 to 44 years and a leading cause of disability for all ages, regardless of sex, race/ethnicity, or socioeconomic status. Although motorcycles represent approximately 3% of all registered vehicles in the United States, motorcycling accounts for more than 13% of highway traffic fatalities. While fatalities normally represent a small percent of other motor vehicle occupants, fatalities can be as high as 40% for the motorcyclists when involved in accidents (or traffic crashes as typically referred to by transportation safety professionals). Motorcyclists are more vulnerable in crashes due to their lack of protection like enclosed vehicles do to motor vehicle occupants, so they are more likely to be severely injured or killed. Therefore, there is a motivation among stakeholders to decrease the



injury severity of motorcyclists. A clear understanding of the factors influencing injury severity levels due to motorcycle crashes and the related evidence prevention strategies is of paramount importance. When examining a topic of motorcycle injury severity, it is important to keep into consideration of different issues that include the definition and concept of injury severity, trends in motorcycle crashes, motorcycle-related policies and laws, knowledge of risk and protective factors. The main purpose of this chapter is to discuss the risk factors and protective factors related to injury severity of motorcycle crashes in the US. Important aspects related to motorcycle crashes' injury severity such as methodological challenges related to conceptual clarity and measurement are discussed. In addition, implications for education, research, practice and policy including laws and enforcement are highlighted so that the overall motorcycle safety situation could be improved.

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## *Chapter 1*

# **TRAFFIC ACCIDENTS: EPIDEMIOLOGY, RISK FACTORS, PSYCHOSOCIAL AND NEUROENDOCRINE IMPACT ON CHILDREN AND ADOLESCENTS**

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## **ABSTRACT**

Traffic accidents (TAs) are a leading cause of morbidity and mortality among children and adolescents in industrialized countries. There are many studies showing that children and adolescents may suffer significant and long-lasting psychosocial consequences following TAs. Most studies indicate that the prevalence of posttraumatic stress symptoms (PTSS)/disorder (PTSD) among children and adolescents is 12-46% in the first 4 months and 13-25% 4-12 months following TAs. Traffic accidents are also related to acute stress disorder (ASD), mood disorders, development of fears and negative impact on health related quality of life (HRQoL).

Although PTSD (sometimes with delayed onset) may significantly impede young people's development causing substantial subjective distress and resulting in impaired functioning, physicians often ignore or underestimate the likelihood of PTSD development and they are unaware of risk factors that predict its development and future persistence. Therefore young victims' psychological needs often remain unrecognized and unmet.

Most studies suggest that gender but not age is related to development of PTSD among children and adolescents following TAs. Findings regarding type of accident as a risk factor have been inconsistent. The severity of body injury has been found to be unrelated to pediatric PTSD after TAs. However, the occurrence of brain injury after TAs has been reported to be correlated with PTSS, with mild brain injury predicting a higher risk of PTSD compared to no brain injury. Parental PTSS/PTSD, depression, endorsement of worry, and general family functioning have been found to increase the risk of developing PTSD among children.

Maladaptive appraisals have been associated with the development and maintenance of pediatric PTSD after TAs, whereas other cognitive processes, such as subjective threat and memory processes, have been shown to have a possible effect only in the acute phase.

In addition, initial biological responses to trauma as reflected by immediate posttraumatic alterations in neuroendocrine and/or inflammatory factors—increased plasma noradrenaline concentrations, increased or decreased cortisol levels, and increased serum IL-6 concentrations, increased urinary cortisol and epinephrine levels—have also been reported to be involved in subsequent PTSD development in children and adolescents.

Systematic screening of the potential psychological impact (peritraumatic distress, ASD, post-traumatic stress symptoms, depression, anxiety, and other psychological symptoms) of TAs should receive the same priority as screening for physical injury, regardless of injury severity. Active management and referral for treatment as well as identification of children at risk and prevention of PTSD and other psychosocial consequences are also important. More studies of the psychobiology of physical trauma and PTSD in this pediatric population are needed.

## INTRODUCTION

Traffic accidents are a leading cause of morbidity, disability and mortality among young people, aged 15–29 years in industrialized countries. Globally, TAs resulted in 1,2 million deaths and 50 million injuries across the age range

during 2002. The burden of disease attributed to road safety is comparable with malaria and tuberculosis. The global burden of tuberculosis is increasing at a rate of 1% per year, while the global burden of TA injuries is predicted to increase by more than 65% by 2020 (Commission for Global Road Safety 2006).

Car deaths on Europe's roads have halved over the last decade, but campaigners say tougher EU laws could prevent many more people from dying needlessly. Ninety percent of the world's fatalities on the roads occur in low- and middle-income countries, even though these countries have approximately half of the world's vehicles. Half of those dying on the world's roads are "vulnerable road users": pedestrians, cyclists and motorcyclists. The newly adopted 2030 Agenda for Sustainable Development's has set an ambitious road safety target of halving the global number of deaths and injuries from road traffic crashes by 2020. Without interventions, TAs will rank third between all causes of morbidity and mortality globally by 2020 (Peden et al. 2004).

## **TRAFFIC ACCIDENTS AND IMPACT ON MENTAL HEALTH**

Children and adolescents may suffer significant and long-lasting psychosocial consequences following TAs. Traffic accidents are related to development of post-traumatic stress symptoms (PTSS) and disorder (PTSD), acute stress disorder (ASD), mood disorders, travel anxiety, specific phobias, alcohol abuse; they may also have a negative impact on young victims' health related quality of life (HRQoL). The psychological consequences for parents of children have also been documented (e.g., Kassam-Adams 2009). Nevertheless, less than half of the parents of affected children sought help of any form (including from friends) for their child and only 20% of affected parents sought help for themselves (De Vries et al. 1999).

## **DEVELOPMENT OF PTSD AND ITS PREVALENCE**

Most studies indicate that PTSD is relatively common among children and adolescents following RTAs. Its prevalence varies between studies due to various reasons (e.g., different methodologies used, time since the accident, measures used, definitions), but it is estimated to be between 12-46% in the

first 4 months and 13-25% 4-12 months after the TA (Kolaitis et al. 2011, Landolt et al. 2005, Mehta and Ameratunga 2012, Mirza et al. 1998, Olofsson et al. 2009, Pervanidou et al. 2007a, Stallard et al. 2004). Although PTSD, sometimes with a delayed onset, may significantly impede young people's normal development, causing substantial subjective distress and impaired functioning, physicians often ignore or underestimate the likelihood of PTSD development and are unaware of risk factors that predict its development and future persistence. Therefore, young victims' psychological needs often remain unrecognized and unmet. Special attention should also be paid to the common occurrence of subsyndromal psychological disturbances and more complex syndromes (Schäfer et al. 2006).

More recently, Williams et al. (2015) reporting on a large representative sample of adolescents, as part of the 2005 National Survey of Adolescents-Replication (NSA-R) study, found that 10.2% of adolescents reported having at least 1 serious TA. The prevalence of current PTSD and depression among adolescents having a TA was 7.4% and 11.2%, respectively. A TA among those aged 15 years and younger was independently associated with depression and alcohol abuse while among adolescents aged 16 years and older, a TA was associated only with alcohol abuse.

While most studies agree on the high rates of PTSS/PTSD following TAs, Brand et al. (2014) found that the overall incidence of PTSD after TAs was very low (0.78% in a total of 32,807 collected data sets). The reason for this very low incidence of PTSD in their patient sample is attributed by the researchers to possible underestimation of the psychophysiological impact of traffic accidents on patients.

According to Meiser-Stedman et al. (2007), it is suggested that children should be directly interviewed as they are significantly more likely to meet criteria for ASD, as well as other ASD and PTSD symptom clusters, based on their own report than on their parent's report. Lastly, it is interesting to note that adolescent witnesses, as well as direct victims, may be at risk for posttraumatic reactions Tierens et al. (2012).

## **RISK FACTORS RELATED TO DEVELOPMENT OF PTSS/PTSD**

Certain factors have been found to predict development of PTSD/PTSS following TAs. One of them is gender: girls show greater risk for developing

PTSD than male victims of TAs (Kassam-Adams and Winston 2004, Mirza et al. 1998, Olofsson et al. 2008, Stallard et al. 2004). Acute stress disorder and general psychopathology such as anxiety and depression in young victims also predict the development of PTSS/PTSD (Bryant et al. 2004, Dalgleish et al. 2008, Mather et al. 2003, McDermott and Cvitanovich 2000, Mirza et al. 1998). Perceived threat has also been documented by some studies as being a predictor of PTSD (Bryant et al. 2004, Di Gallo et al. 1997, McDermott and Cvitanovich 2000, Stallard et al. 1998).

Age and socioeconomic status are not related to PTSD development among children and adolescents following TAs (Olofsson et al. 2009). Findings regarding type of TA and the severity of body injury as risk factors have been inconsistent (Keppel-Benson et al. 2002, Olofsson et al. 2009). However, the occurrence of brain injury after TAs has been correlated with PTSS, with mild brain injury predicting a higher risk of PTSD than no brain injury. Mather et al. (2003) have also found that the presence of mild TBI did not influence the likelihood of experiencing PTSS following a TA.

Maladaptive appraisals have been associated with the development and maintenance of pediatric PTSS/PTSD 6 months after TAs, whereas other cognitive processes, such as subjective threat and memory, may have a possible effect only in the acute phase (Meiser-Stedman et al. 2009). Stallard and Smith (2007) also found that the theoretically determined appraisals and cognitive coping styles of young victims of TAs were associated with chronic post-traumatic reactions; these authors also suggest the need to develop trauma-focused interventions for children that directly address these key cognitions during therapy.

Other predictors of PTSS among school-aged children include peri-traumatic distress, a robust predictor according to Bui et al. (2010) and posttraumatic nightmares--especially exact replicative ones (Wittmann et al. 2010).

Parental PTSS, depression, worry, vigilance, and general family functioning increase the risk of developing PTSD among children (De Vries et al. 1999, Keppel-Benson et al. 2002, Kolaitis et al. 2011, Landolt et al. 2005). This also suggests that parents should be actively involved in family prevention and treatment interventions of their children's PTSS/PTSD.



## PTSD AND BIOLOGICAL MARKERS

In one of the few existing studies, Kassam-Adams et al. (2005) have identified association between early physiological arousal (i.e., elevated heart rate defined as  $\geq 2$  SDs higher than the normal resting heart rate for their age and sex) and the development or persistence of PTSD symptoms in injured children and point to the importance of better understanding the interplay between physiological and psychological functioning after a traumatic stressor.

## NEUROENDOCRINE PERSPECTIVES OF PTSD AFTER TAS

During the last 30 years, a variety of published studies in trauma survivors have elucidated the role of the Hypothalamic-Pituitary-Adrenal (HPA) Axis and the Sympathetic Nervous System (SNS) in the pathophysiology of PTSD (Chrousos 2009, Pervanidou and Chrousos 2010). The HPA Axis and the SNS are the main components of the Stress System, via which the brain regulates the complex responses to threatening stimuli. The activation of the stress system by everyday stressors results in adaptive endocrine, metabolic, behavioral and cardiovascular changes that help maintain homeostasis. However, the experience of traumatic stressors, such as accidents, natural disasters, violent attacks, terrorism, or witnessing such exposures can lead to excessive and prolonged activation of stress mediators or, in a subgroup of individuals, to chronic hypoactivation of the stress system, which is equivalent to a state of dyshomeostasis with a variety of psychological and biological consequences (Pervanidou and Chrousos 2010, Chrousos 2009).

## Summary of Studies in Adults with PTSD

The majority of studies in adults with PTSD have shown increased CRH centrally and decreased cortisol in the periphery, with elevated catecholamine concentrations. More specifically, the research has shown elevated basal cerebrospinal fluid (CSF) CRH levels, as indicated both by using a single lumbar puncture and serial CSF sampling (Bremner et al. 1997, Kasckow et al. 2001,) and low urinary cortisol concentrations (Yehuda et al. 1995, Yehuda 2001) and reduced blood cortisol concentrations, several times during the