



# Injury protection and accident causation parameters for vulnerable road users based on German In-Depth Accident Study GIDAS

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## ARTICLE INFO

### Article history:

Received 14 June 2010

Received in revised form

26 November 2010

Accepted 3 December 2010

### Keywords:

Pedestrian

Bicyclist

Motorcyclist

Injury severity

Injury causes

Accident causation

## ABSTRACT

Within a study of accident data from GIDAS (German In-Depth Accident Study), vulnerable road users are investigated regarding injury risk in traffic accidents. GIDAS is the largest in-depth accident study in Germany. Due to a well-defined sampling plan, representativeness with respect to the federal statistics is also guaranteed. A hierarchical system ACASS (Accident Causation Analysis with Seven Steps) was developed in GIDAS, describing the human causation factors in a chronological sequence. The accordingly classified causation factors – derived from the systematic of the analysis of human accident causes (“7 steps”) – can be used to describe the influence of accident causes on the injury outcome. The bases of the study are accident documentations over ten years from 1999 to 2008 with 8204 vulnerable road users (VRU), of which 3 different groups were selected as pedestrians  $n = 2041$ , motorcyclists  $n = 2199$  and bicyclists  $n = 3964$ , and analyzed on collisions with cars and trucks as well as vulnerable road users alone. The paper will give a description of the injury pattern and injury mechanisms of accidents. The injury frequencies and severities are pointed out considering different types of VRU and protective measures of helmet and clothes of the human body. The impact points are demonstrated on the car, following to conclusion of protective measures on the vehicle. Existing standards of protection devices as well as interdisciplinary research, including accident and injury statistics, are described. With this paper, a summarization of the existing possibilities on protective measures for pedestrians, bicyclists and motorcyclists is given and discussed by comparison of all three groups of vulnerable road users. Also the relevance of special impact situations and accident causes mainly responsible for severe injuries are pointed out, given the new orientation of research for the avoidance and reduction of accident patterns.

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## 1. Introduction

Traffic participants without outer protective cells are called “vulnerable road users (VRU)”. This encompasses pedestrians, bicyclists and motorcyclists. These different types of VRU have different protection options. Thus, motorcyclists have a crash helmet, which protects the whole head in case of an impact and frequently even wear protective clothing with special protectors, which are aimed at protecting the body from impact injuries. Compared to this, bicyclists frequently wear special bicycle helmets and using no special protection clothes, while pedestrians number amongst the road users the lowest grade of protection.

The number and incidence of the different groups of road users in the individual countries characterize the economic accident consequences due to the general traffic accident events and the number of casualties and fatalities recorded in doing so. Under-

standably bicycles and motorized two-wheelers are very frequent in Asian countries, and their numbers cannot be compared to accident events in Europe or the US. In the so-called “low and middle income countries” the behavior of mixed traffic and the velocity behavior of the individual road user can be called particularly conflict-fraught (WHO, 2009). Vehicle factors, such as insufficient brakes and frequently inadequate driving abilities of the drivers as well as poor design and layout of roads, frequently render traffic in a country unsafe and influence the accident events. In China nearly 1/10 of all traffic fatalities are bicyclists, in India approximately 4%. In India 69% of all motorized vehicles are motorized two-wheelers and 27% of all fatalities number amongst the group of users of motorized two-wheelers. In the European Union approximately 40,000 persons die in traffic annually (ETSC, 2008) of which 8000 are unprotected road users, such as pedestrians and riders of two-wheelers. Riders of motorized-two wheelers represent 16% of all road deaths, whereas they only account for 2% the total mileage/kilometers traveled.

As technical causes for accidents have become infrequent due to technically high quality automotive engineering and road design,

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