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Characteristics of bicycle crashes in an adolescent population in Flanders (Belgium)

Jef Vanparijs[a], Luc Int Panis (Prof.)[b,c], Romain Meeusen (Prof.)[a,*], Bas de Geus (Prof.)[a]

[a] Research group of Human Physiology, Faculty of Physical Education and Physical Therapy, Vrije Universiteit Brussel, Belgium
[b] Flemish Institute for Technological Research (VITO), Mol, Belgium
[c] Transportation Research Institute (IMOB), Hasselt University, Diepenbeek, Belgium

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ABSTRACT

Introduction: In regions where transportation is mainly motorized, air pollution and traffic congestion are rife. Active transportation such as cycling might be a solution but safety is a major concern. An efficient science based safety policy is needed. The aim of this paper is to analyze in depth the bicycle crash causes and characteristics in an adolescent population (14–18 yr).
Methods: By using questionnaires for self-reported bicycle crashes, bicycle crash data were collected from insurance companies (January 2014–June 2015) and from schools (November 2013–March 2014). Six bicycle crash causes were predefined and possible differences between schools and insurance companies were analyzed.
Results: Eighty-six school and 78 insurance registered crashes were analyzed. "Distraction of the cyclist" and "third party crossing a bicycle path failing to see the cyclist" are the main causes of bicycle crashes (both 29%). Bad (maintained) infrastructure accounted for 21% of the crash causes. Bicycle crashes reported at insurance companies needed significantly more medical attention and led to high absenteeism (57% at least one day of absenteeism). Only 21% of the bicycle crashes reported at insurance companies were also reported in the official police database.
Conclusion: The human factor was the main cause accounting for 79% of the crashes. Bicycle crashes involving a car accounted for 42% and single bicycle crashes accounted for 31% of the total number of crashes. From the bicycle crashes registered at insurance companies 21% was also registered in official police statistics. A combination of information, education and changing the bicycle specific environment might reduce the consequences of human errors more efficiently.

1. Introduction

Exposure to noise and air pollution and traffic jams are important drawbacks in regions where transportation is mainly motorized. Policy makers are seeking solutions such as a modal shift from motorized to active transportation (cycling and walking) in order to reduce congestion and environmental pollution. Additionally, when replacing car trips by bicycle trips the increased physical activity has the potential to improve public health since physical inactivity is a major cause of several health issues like obesity and cardiovascular diseases (Dill, 2009; Gordon-Larsen et al., 2009; Oja et al., 2011). These health benefits far outweigh the small health risk associated from increased air pollution exposure (Buekers et al., 2015; Rabl and de Nazelle, 2012; de Hartog et al., 2010; Rojas-Rueda, 2012). Despite the many advantages of cycling for transportation, the limited distance that can be overcome, the weather and safety are some serious drawbacks cited for not (taking up) cycling for daily transportation. The weather and distance cannot be influenced by policy makers, but some other factors such as the crash risk (perception) can be decreased with effective policies. Safety is for many people (adults and parents who decide for their children) a reason for not (taking up) cycling (Ghekiere et al., 2014). Therefore, policymakers should invest in increasing the safety, by decreasing the prevalence and severity of crashed cyclists. This will have a positive influence on the health of those who already cycle and those who would like to take up cycling. Devising efficient and effective safety policies requires a good collection of data and sound analysis of cycling crashes.

Multiple approaches are used specifically to analyze bicycle crashes. Each method focuses on different aspects of bicycle safety.

* Corresponding author.
E-mail address: Rmeeusen@vub.ac.be (R. Meeusen).

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Studies analyzing bicycle crashes using hospital data often focus on the risk factors for serious injury (Thomas et al., 1994; Macpherson et al., 2002; Depreitere et al., 2004; Rivara et al., 2015; Nyberg et al., 1996; Mehan et al., 2009). Whatever the outcome of these studies, they are based on incomplete bicycle crash data (Elvik and Mysen, 1999; Juhra et al., 2012) since only a small fraction are registered in hospital databases. Hospital registered events and injuries are biased towards more serious, major (crashes leading to a hospitalization of more than 24 h) and fatal bicycle crashes. Additionally, these studies are more focused on the consequences of the crash rather than the cause and circumstances of these crashes. By understanding the causes and circumstances of bicycle crashes, policy makers can take appropriate steps to improve bicycle safety and reduce bicycle crash prevalence.

Studies using officially registered bicycle crash data (data that is used for policy guidelines such as police databases) contain wide age ranges because each bicycle crash victim that is registered through this instance will be recorded no matter the age of the victim. In contrast, the available studies that use self-reported bicycle crashes in a bicycling population are mostly done in a working population (Vanparijs et al., 2015) (e.g. asking employees whether or not they were involved in a bicycle crash), meaning adults between 18 years and 65 years are overrepresented in the available studies. There are no studies focusing on self-reported bicycle crash characteristics in an adolescent population (Vanparijs et al., 2015). However, in Belgium between 2000 and 2007, 1713 adolescents (12–17 yrs) were involved in officially registered bicycle crashes compared to 831 young adults (18–24 yrs) or 1284 adults aged 25–39 yrs (Martens and Nuyttens, 2009).

The self-reported method gives a more accurate representation of the crashes within an bicycling population regardless of the severity of the crashes and in addition it gives access to detailed information on the crash circumstances. However, this method registers a very small number of major crashes and therefore focuses more on minor crashes (de Geus et al., 2012; Poulos et al., 2015). We suggest here that a combination of self-reported bicycle crashes and officially registered bicycle crashes could contain enough data for the analysis of both, minor and major bicycle crashes.

Therefore, the aim of this study was to analyze in depth the bicycle crash causes and characteristics in an adolescent population. By using self-reported bicycle crashes, detailed information on crash circumstances could be collected. Also aspects of subjective safety were taken into consideration (Cho et al., 2009; Carver et al., 2010; Chaurand and Delhomme, 2013; Noland, 1995). For this study, we collected bicycle crash data from insurance companies and from schools. We hypothesize that the self-reported crashes and injuries are less severe on average than those reported by insurance companies.

2. Methods

2.1. Definitions

A crash (Davis and Pless, 2001) was defined as either a collision or single bicycle crash. A collision was a crash with a third party involved regardless of fault. A single bicycle crash was a crash with no third party involved (including a collision with a fixed or stationary object) (Schepers et al., 2015).

The term “self-reported” indicates that a questionnaire was filled out by the victim of a bicycle crash.

Bicycle crashes needed to comply with all of the following inclusion criteria: (i) crash occurred during commuter cycling (cycling for transportation); (ii) acute crash; (iii) crash with material and/or physical damage; (iv) victims aged between 14 and 18 years at the time of the crash and (v) victims were riding a bicycle at the time of the crash. An acute crash was defined as a crash with a sudden etiology (e.g. slipping on a wet surface), as opposed to gradual or progressive etiology (e.g. pain in the knee from an overuse injury).

Bicycle crashes were excluded when the questionnaires were not filled out by the victims themselves or when the description of the bicycle crash circumstances was lacking.

2.2. Study design

In order to collect data of bicycle crashes in an adolescent population, this study combined bicycle crash data collected through eight schools and bicycle crashes registered at two insurance companies. In Belgium, students are insured by the school during the trips from and to school. Therefore, if a student is involved in a crash with medical and/or material consequence, the school will report it to their insurance company. For the insurance registered bicycle crashes, insurance companies were asked to participate in the study.

Their crash database was screened by the research team for relevant crashes from January 2014 to June 2015. Subsequently, a letter with a link to an online questionnaire was sent to the victims of all relevant cases (N = 527).

For the bicycle crashes collected through schools from November 2013 to March 2014, a total of 1600 adolescents were personally contacted and asked whether they were involved in a bicycle crash in the past 12 months. When they were involved in a bicycle crash, the same questionnaire used for the insurance companies was filled out. Although adolescents could report more than one crash in the past 12 months, no one reported more than one crash. Before analysis, all questionnaires were screened for duplicates between insurance and school registered crashes. One duplicate in insurance and school registered crashes was excluded. After exclusion, we looked at both data sources separately since we expected the insurance registered crashes to be more severe.

The Vrije Universiteit Brussel ethical committee approved the study (B.U.N. 143201318030).

2.3. Questionnaires

For this study, recent literature on adolescents (Ghekiere et al., 2014; Schoeppe et al., 2014; Schepers and Wolt, 2012) was used to adapt the questionnaire used by de Geus et al. (2012) to the specific adolescent population. The questionnaire from de Geus et al. (2012) was inspired by existing national official registration systems for traffic crashes and recent literature (Kim et al., 2007). The questionnaire was designed to collect detailed information on the (i) context and circumstances of the crash, (ii) cause of the crash, (iii) presence and cause of possible physical injuries or material damage, (iv) type of injury, (v) protective and preventive measures taken at the time of the crash, (vi) medical care, (vii) reporting by police, insurance or hospital. The first two questions were open questions: “Where were you cycling, what were the circumstances?” and “How did the crash happen, what went wrong?”. Those two first questions were used to define the cause of the crash. The remaining questions were multiple choice. If the victims could not answer the question (couldn’t remember) they were asked to choose the “unknown” option.

2.4. Injury severity

Information about injury severity was retrieved by several questions. For the first question, a detailed dummy figure showing 23 body parts was shown. Crash victims were asked to indicate each body part that was injured. In the second question the type of injury (eg, fractures, deep cuts, abrasions, contusion, sprain, muscle injury, burns) for each body part was asked. These two questions were used to identify the International Classification of Diseases (ICD-9-CM)