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Motorcycle riders' perception of helmet use: Complaints and dissatisfaction

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ABSTRACT

In accidents which involve two-wheeled vehicles the helmet plays a life-saving role, but very little is known about the motorcycle rider's perception of the helmet. We evaluated the relationships between having been involved in an accident and dissatisfaction with the helmet, and between the perception of motorcycle riders and the objective features of the helmet. This was a case–control study: riders of motorized two-wheelers who had been involved in accidents (accident cases) were compared against a similarly interviewed sample of riders that had not been in accidents (control cases). Information about the driver, the vehicle and the helmet was collected in all interviews. To evaluate the relationships, logistic regressions were carried out. The majority of drivers were dissatisfied with their helmets, but no evidence was found to link this dissatisfaction with having been involved in an accident. The two most common complaints related to noisiness, followed by the helmet visor. Complaints did not seem to be statistically associated with physical features of the helmet.

1. Introduction

About 43,000 people die and 1.8 million people are injured every year in the European Union as a direct result of road accidents (European Road Safety Observatory, 2008). Two-wheeled motor vehicles are involved in 14% of all traffic accidents in the European Union. The associated number of fatalities is over 6000 per annum (EU Injury Database, 2007).

Riding motorized two-wheeled vehicles carries a higher risk of being involved in a fatal traffic accident than from using any other common mode of transport. It has been estimated that, per 100 million person travelling hours, 440 motorized two-wheeled vehicle rider fatalities occur, compared to 75 and 25 fatalities for bicyclists and car drivers, respectively (Koornstra et al., 2003). Half of these accidents are caused by collision participants other than the motorcycle riders while approximately 40% are caused by the motorized two-wheeled vehicle riders, and the remainder are attributable to factors associated with the vehicle or the road. Drivers and passengers of cars are better protected than riders of motorized two-wheeled vehicles, whose survival of an accident is most strongly guaranteed by wearing a helmet, especially a full-face motorcycle helmet. Cognitive failures on the part of motorized two-wheeled vehicle riders are known to cause 34% of these accidents (ACEM, 2004; Magazzù et al., 2006).

Several studies have shown that a helmet can be a life saver in an accident and can protect against severe head injuries, particularly integral helmets with full facial protection (Branas and Knudson, 2001; Christian et al., 2003; Cui et al., 2009; Deutermann, 2004; Eastridge et al., 2006; Forero Rueda et al., 2009, 2010; Houston and Richardson, 2008; Hundley et al., 2004; Keng, 2005; Lin et al., 2001; Liu et al., 2008; Nakahara et al., 2005; Norvell and Cummings, 2005; Ouellet and Kasantikul, 2006; Sauter et al., 2005). However, little is known about whether helmets can be optimised to improve a rider's perception of the helmet. In fact, the rider's perception can actually be influenced by some features of the helmet (noisiness, temperature, ventilation, field of vision, and size), as the following authors have found.

With regards to noisiness, Carley et al. (2010) conducted a study of helmet noise mechanisms using measurements inside and outside a helmet during on-road riding; they presented evidence of the inability of a helmet to protect against hearing damage at low frequencies and its tendency to attenuate acoustic signals, such as speech, at high frequencies. In another study on the attenuation of noise by motorcycle helmets, Młynski et al. (2009) found simi-

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lar results with no attenuation of sound below about 500 Hz. Since aerodynamically generated noise is worst in the frequency range up to about 1 kHz, this means that helmets offer no noise protection in the range where it is most needed. This combination of no attenuation at low frequency and large attenuation at high frequency poses a risk of hearing damage from the low frequency aerodynamic noise and also to difficulty in understanding speech because of the high frequency attenuation.

With regards to ventilation and temperature problems, a 2007 study indicated that sound pressure and ventilation aspects of helmet design contributed substantially to the well-being of a motorcycle rider; it also found no causal link to accidents from these ergonomic factors (BAST, 2007). Bogerd and Brühwiler (2009) examined 27 modern full-face motorcycle helmets (9 flip-up and 18 integral models) from 13 manufacturers by using a thermal manikin head-form. They found that most motorcycle helmets offered some ventilation, although the heat transfer away from the head and the scalp ventilation was relatively poorly controlled. In another study, the same authors investigated the relationship between perception and heat loss among other parameters, with a focus on vent-induced effects. They found that subjects were able to systematically perceive effects caused by changing the vent configuration of motorcycle helmets, under simulated riding conditions (Bogerd and Brühwiler, 2009). Deetjen et al. (2005) conducted experiments on 12 different protective helmets and found maximum inside temperatures of 20–37 °C for measured outside temperatures of 15–36 °C, and they found room for improvement because of functional and design errors (a temperature of 24–27 °C is classified as comfortable).

With regards to the visor, Buyan et al. (2006) evaluated radiant warming through four visor configurations, ranging from a standard clear visor to an aluminium covered visor. They found that the clear visor transmitted the most radiant heating, and the aluminium covered visor the least; an electrochromic foil transmitted intermediate amounts of heat. Subjective examinations indicated a perceptible difference between the clear visor and the electrochromic foil visor, but no perceptible difference between two different electrochromic foil visors. Thus, while tinted helmet visors improved the optical quality for a wearer, they could also lead to an adverse heat gain.

Despite these previous investigations, a rider's subjective feelings of comfort or discomfort when wearing a helmet remain unknown, as does a rider's perception of whether a helmet contributes to traffic accidents. These factors are important as they could indicate potential design improvements that are unrelated to impact protection and the energy absorption characteristics of a helmet. In order to provide knowledge on how motorcycle helmets should be improved to reduce a rider's discomfort and to facilitate the avoidance of accidents we conducted the present work, with the following specific objectives:

- to evaluate the relationship between having been involved in an accident and the perception of discomfort from wearing the helmet,
- to evaluate the relationship between a riders' perception of their motorcycle helmet and the objective design features of the helmet.

2. Materials and methods

2.1. Study background

The present study was carried out within the European project COST 357 – PROHELM (Accident Prevention Options with Motorcycle Helmets). COST 357 – PROHELM was a 4-year (2006–2009) multi-centre international research study, that was conducted across several European countries in order to increase knowledge of how motorcycle helmets could be improved and thus facilitate avoiding accidents. The activities of COST 357 – PROHELM were divided into 10 tasks, which were implemented by four working groups (WG) (Bogerd et al., 2010). This present study was undertaken by WG 1, composed of Germany, Greece, Ireland, Italy, Portugal, and Turkey; this group was charged with studying riders' subjective feelings of discomfort when using helmets and how their perceptions of helmets influence accidents involving motorcyclists (Orsi et al., 2009; Otte et al., 2008).

2.2. Study design and population

The study design was in the form of a case–control study. The accident cases were motorized two-wheeled vehicle riders who had been involved in accidents; the control cases were a sample of motorized two-wheeled vehicle riders from the same geographical regions but who had not been involved in accidents. Control cases were not matched precisely according to age, sex, engine size or location, however the possible confounding effect of these factors was accounted for in the statistical analysis. The inclusion criteria for selecting these motorcycle riders depended on them either (a) having a history of at least one road traffic accident (crash) while using a helmet and still possessing the helmet or (b) having no history of being involved in a road traffic accident. In contrast, the exclusion criterion related to motorcyclists who had been wearing a helmet while they were involved in a road traffic accident but who had since disposed of the helmet.

Every country collected a sample of accident cases and a sample of control cases. A similar data sampling process was used in all countries. However, the precise methodology differed depending on the research activities and procedures in the individual countries. Germany and Italy had in-depth-investigation teams with access to the scene of the event directly after an accident; Greece surveyed riders retrospectively in their homes; Ireland, Portugal and Turkey carried out their activities by following the same methodology of other national research sources, i.e., police surveys, accident reports and forensic expert activities. The control cases were obtained by trained staff during predefined time intervals at petrol stations, during police checkpoints, and by surveys of motorcycling enthusiasts. The test subjects were asked to participate in the survey and to allow their helmets to be examined and measured. Motorcyclists who gave their informed consent were included in the study.

Each Investigation Centre had to log all the cases and control cases consecutively as they occurred during the study period. No proportional distribution was established among the different countries. Most of the Investigation Centres were ready to implement the methodology and to commence investigations by March 2007. The scheduled deadline for completing data collection was the end of September 2008.

2.3. Data collection

The variables concerned information about the motorcycle rider, their vehicle and helmet, and their perceptions and use of the helmet and accident circumstances (only for cases). Gathering information involved administering a questionnaire to the motorcycle rider and quantitatively examining the helmet using custom designed and standardized measurement tools.

2.3.1. The questionnaire

A suitable questionnaire was developed to collect data. This included personal data as well as general helmet data, and data on helmet features, conditions, sensations and usage. People from