EVOLUTION IN MOTORCYCLE CRASHES AND CURRENT CRASH CHARACTERISTICS IN THE OECD COUNTRIES

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ABSTRACT

The objective of this paper is to characterise the safety of powered two wheelers in terms of recent crash and fatality trends, typical injuries and crash characteristics in the OECD countries. Traffic fatality data presented in this paper are mainly based on the following sources: the IRTAD database of the OECD/ITF (aggregate data for 32 countries), the CARE database of the European Commission (disaggregated data for EU countries), and national databases (e.g. FARS for the US). This data is analysed in relation to user, vehicle and road characteristics, and are combined with exposure data (e.g. vehice-kilometres of travel) where possible, in order to provide risk estimates. Moreover, the motorcycle crash scenarios are summarised on the basis of in-depth studies. The results suggest that, in OECD countries, motorcyclists are clearly overrepresented in road traffic casualties and are around 20 times more at risk in traffic than a car occupant. PTW trends are not following the overall fatalities decrease; in fact, PTW is the only mode of transport for which the number of fatalities has increased, significantly in some countries. The average age of motorcyclist killed has increased. However, being young, male and lacking experience is still associated with increased PTW fatality risk. The severity of injuries is usually correlated with power of the engine. Almost one third of all PTW fatalities occur at junctions - a proportion notably higher compared to other road users' - out of which about half at crossroads. Finally, better weather conditions, resulting in more use of motorcycles, from April to October, result in a large proportion of PTW fatalities.

Keywords: Powered Two Wheelers, Safety, Crash evolution, Crash characteristics.

BACKGROUND AND OBJECTIVES

In recent years, some countries have experienced rapid growth in the variety, sales, registrations, and activity of powered two wheelers (motorcycles, scooters, mopeds), with concomitant growth in crashes, injuries, and fatalities involving them. Such growth is likely to accelerate as world populations grow and more people recognize the potential economic, mobility, and environmental sustainability benefits of powered two wheelers. But these benefits must be weighed against societal costs to establish powered two wheelers as viable transportation alternatives in an increasingly more health-conscious world.

The present research analyses the safety of powered two wheelers in terms of recent crash, injury and fatality trends, typical injuries, and crash characteristics.

DATA ISSUES

Fatality and injury data

Crash data presented in this chapter are mainly based on the following fatal data from the following sources:

- The IRTAD database, which presents aggregated data for 32 countries
- The CARE database, which gathers disaggregated data for most EU countries
- National databases, such as FARS for the United States

Analysing serious injuries is also essential to understand safety issues of motorcyclists, because motorcyclists are more exposed to very serious injuries, due to their lower mass and occupant protection, which are significantly different from injuries of other road users. In addition, recent work (IRTAD, 2011) has shown that reducing the number of seriously injured may require a different approach than reducing the number of fatal crashes. However, one must be aware of the challenge of analysing injury data because:

- There is no common definition of serious injuries among countries.
- Data on injuries are largely underreported and biased in the source of information described above.

Only a very limited number of countries have systematic exchange of information between police and health data to allow a more complete picture of the situation. motorcyclists' injuries are more often underreported (Amoros et al. 2006; Brougton at al., 2007)

Exposure data

Understanding motorcycles crashes require analysing crash and relating them to several exposure data. Without detailed PTW exposure information, it is difficult to determine risk trends from the available fatality and injury data. There are various indicators to measure exposure to asses to risks of transport modes: vehicle –kilometres, passenger-kilometres, the number of motorized vehicles, the time spent in transport etc.

Using the number of veh-km performed by PTW gives a good proxy of their actual exposure to assess the level of risk. However, very few countries collect on a regular basis this type of data.

RELATIVE RISK OF MOTORCYCLISTS

In 2009, there were more than 11,000 PTW fatalities in OECD countries (excluding Chile, Estonia, Slovak Republic, Mexico, Turkey), representing between 6% and 29% of total fatalities. This percentage has to be compared with the percentage of PTW in the motorized fleet. For example, PTW represent 1% of the motorized fleet in Ireland and 4% in France, but respectively 14% and 21% of total fatalities.

Figure 1 shows the evolution in the share of PTW fatalities in relation to total fatalities for the period 1999 – 2008. For all countries examined, except Portugal, the share of PTW fatalities in relation to total fatalities have increased, with most significant increase for Luxembourg (possibly largely due to the small sample size) and France. But it must be noted that the increased percentage of PTW fatalities relative to total fatalities since 1999 may reflect increases in PTW fatalities, decreases in other motor vehicle fatalities or both.

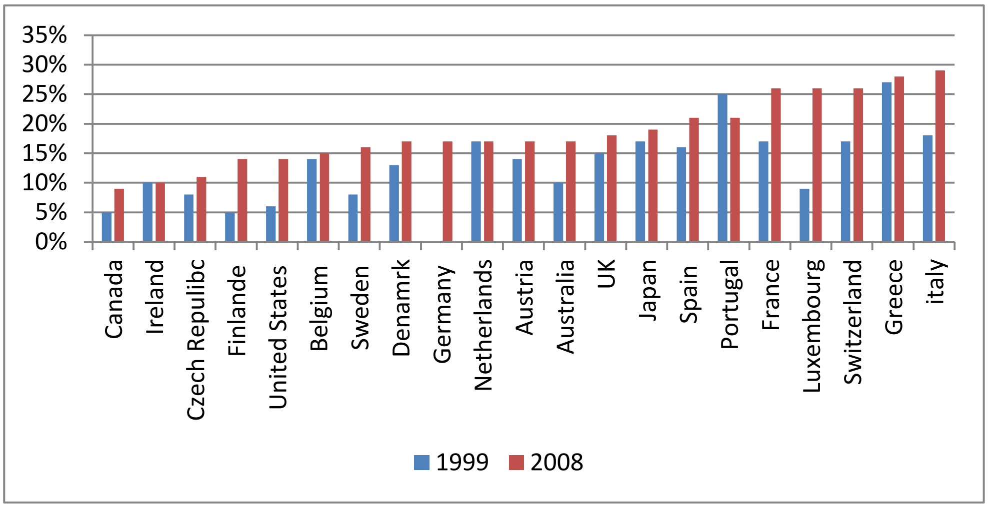


Figure 1. Share of PTW fatalities in total fatalities in the OECD countries on 1999 and 2008

When related to the number of kilometres travelled, a motorcyclist is between 8 to 40 times more likely to be killed in a traffic crash than car drivers (see Table 1).

Table 1. Deaths per billion veh-km in 2009 for motorcyclists and car occupants

	Car Occupant	**Motorcyclists**	**Mopeds (when distinction is available)**	**Relative risk of motorcyclists vs car occupants**
Australia				37 for serious injuries
Austria	6.6	98	113	15 for motorcyclists 17 for mopeds
Belgium (2008)	6.4	81.9		12.8
Czech Republic (2008)	14	382		27
Denmark	5	38	41	7.6 for motorcyclists 8.2 for mopeds
France	6	125	135	21 for motorcyclists 22.5 for mopeds
Greece (2004)*	8	77.8	40.1	10 for motorcyclists 5 for mopeds
Ireland	3.8	84.3		22
Netherlands (2004-08)	3.0	64	63	21
New Zealand	7.9	146		19
Slovenia	5	170		34
Sweden (2004-09)	3.9	75.7	39.8	19 for motorcyclists 10 for mopeds
Switzerland	2.6	34.4	60.2	13 for motorcyclist 30 for mopeds
United States	5.8	227.9		40

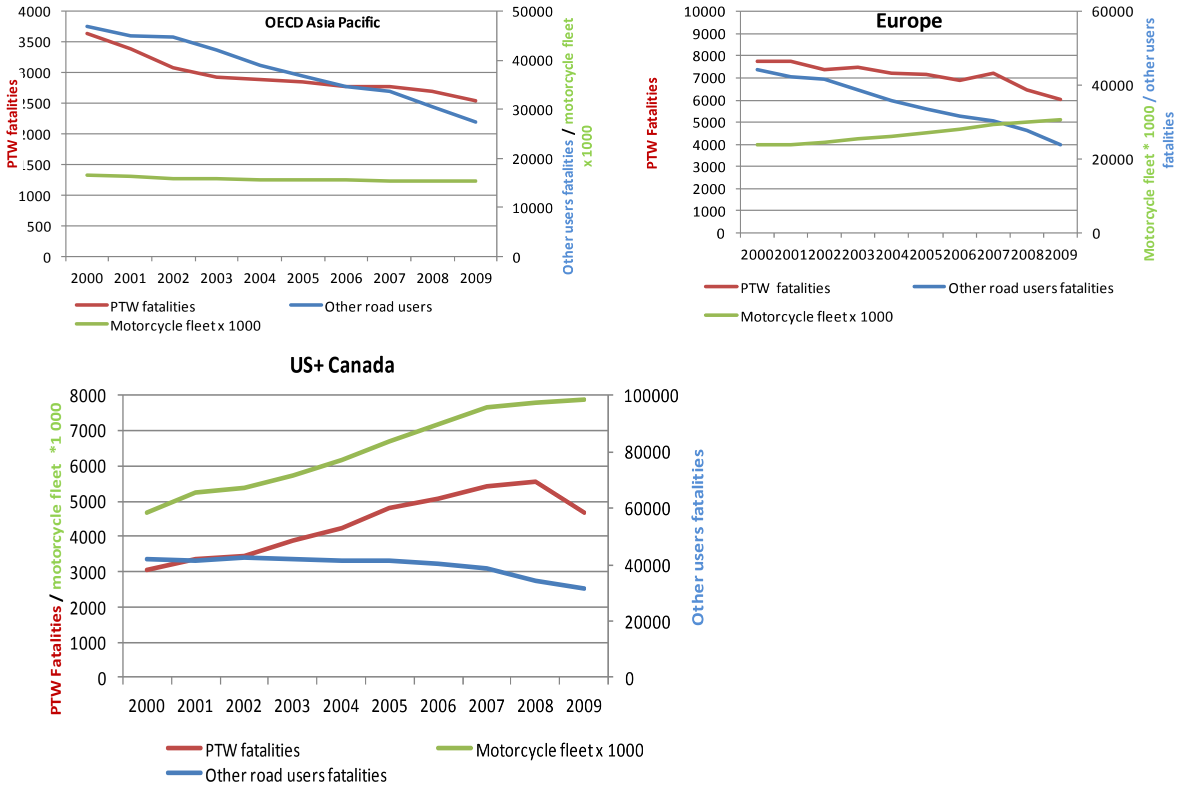
* Year: 2004, Drivers only
Source: IRTAD 2010 Annual report

TRENDS IN PTW FATAL CRASHES

Figure 2 illustrates the recent relative trends in the number of motorcyclists killed and other road users killed in the three main regions of the OECD. A sharp increase in the number of motorcyclists killed is observed in North America and a moderate decrease in the other regions. While on average, OECD countries have seen a reduction by around 27% in the number of persons killed in a traffic accident in 2000-2009, the number of motorcyclists killed increased by 1% in total. The discrepancy is particularly obvious in North America.

In the United States, the number of motorcyclists killed increased by 83% between 2000 and 2008, while the number of passenger car occupants decreased by 29% (NHTSA, 2009). The relative deterioration of motorcyclist's safety in North America has to be seen in the context of an important increase in the PTW fleet during the same period, which has almost doubled. From 2008 onwards, however, a sharp 17% decrease was observed, most likely due to decreased motorcycling mobility associated with economic recession.

Figure 2: Motorcyclists and other road users killed in the three main regions of the OECD, and evolution of the fleet



Source: IRTAD
Note: OECD Asia Pacific includes: Australia, Japan, Korea and New Zealand

Figure 2 shows the increasing trend for motorcycle user fatalities compared to trends for other modes of transport. The difference is sharper in Europe, the US, Australia and Canada: other road users' fatalities exhibit sharper decrease.

PTW CRASH CHARACTERISTICS

Effect of gender

In most countries, the share of male or female riders killed follows the share of females and males in the motorcyclists' population. As PTW becomes more popular among females, one can also observe an increasing trend in the percentage of female victims of a PTW crash. In the United States, for example, female were 9.6% of all motorcycle riders killed in 2000 and 9.8% in 2009. Among only motorcycle drivers killed, however, females were 3.2% in 2000 and 3.9% in 2009, a 21.9% increase.

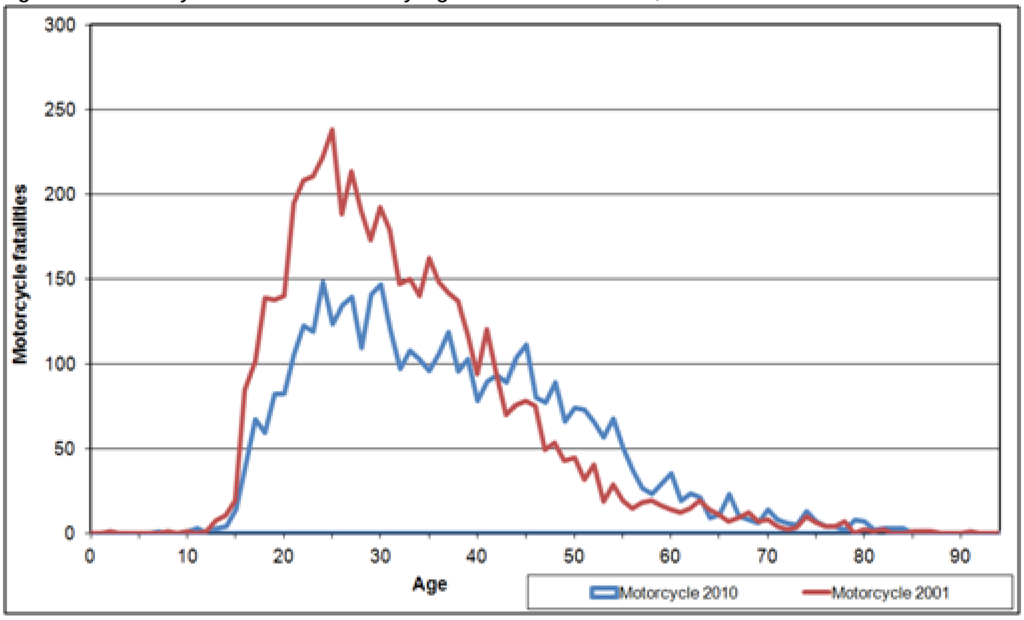
Results of epidemiologic studies on impact of gender on occurrence or severity of crashes are heterogeneous. One study found a higher crash risk for women than for men (Chang et al. 2007), some studies showed the opposite (Lardelli-Claret et al. 2005; Lin et al. 2003b), and other studies did not observe any relationship between gender and crash risks (Mullin et al. 2000). One study did adjust crash risk with the distance travelled and found the same crash risk for male and female (Harrison et al. 2005).

Effect of rider age

In most countries, during the last decade, the number of motorcycle fatalities among 40-60 year old riders has significantly increased. It appears that there has been a shift in fatalities from the youngest age groups to middle-aged riders. This is to be linked to the increasing popularity of PTWs among this age group.

In Europe, 30% of motorcyclists killed are less than 25 years old. However, the average age of motorcyclist killed tend to increase (38 in 2007 compared to 30 years in 1995). The number of motorcycle rider fatalities decreased between 1997 and 2006 only for those under the age of 25, while it increased for most ages over 30 (Figure 3). During the decade, the number of motorcycle fatalities among 40-60 year old riders has doubled (SafetyNet 2010). The same patterns are observed in the United States, Canada and Australia.

Figure 3 - Motorcycles rider fatalities by age in 2001 and 2010, both EU-20



Most epidemiological studies show a higher crash risk for the youngest age groups (Chang et al. 2006; Evans 2004; Harrison et al. 2005; Lardelli-Claret et al. 2005; Lin et al. 2003b; Mullin et al. 2000; Reeder et al. 1995; Rutter et al. 1996; Ryan et al. 1998; Skalkidou et al. 1999; Yannis et al. 2005).

Effect of experience

Inexperienced riders are often over-represented in motorcycle fatalities. It is important to make a distinction between novice rider and young riders. Novice riders are not necessarily young. Crash involvement depends on age *and* experience. In most cases, the increased crash risk is due to the combined effect of age and inexperience. Some studies suggest that the age of the rider is a more influential factor than the lack of experience (Mullin et al. 2000; Rutter et al. 1996), i.e. even if a share of crashes among young people is attributed to the lack of experience, the mere fact of being young is in itself a more important risk factor.

Monthly, Weekday, and Hourly Periodic Trends

PTW rider crashes, injuries, and fatalities are strongly correlated with periodic factors such as seasons, months, day of week, and time of day. These periodicities reflect both environmental and socio-cultural factors, e.g., monthly patterns associated with prevailing climate and weather conditions in the region, weekly patterns associated with the typical five-day work week from Monday to Friday, and hourly patterns associated with work and other activities and the circadian day-night cycle.

PTW crashes reflect the motorcycling activity associated with season and weather. In most countries, there are relatively few fatalities in the winter, and relatively many in the summer, reflecting the seasonal pattern of use of mopeds and motorcycles. The impact of season is however less marked for mopeds (Dacota, 2011).

As with other crashes, the number of PTW crashes increases during the week end. While there are many crashes every day of the week, these numbers increased on week-ends.

Road Type, Area type and Junctions

In Europe, the majority of PTW fatalities in all countries occur on non-motorway road network (Dacota, 2011). In case of mopeds, this can be explained by the fact that mopeds are not allowed to circulate on motorways in most European countries. The existence of medians, separating opposite traffic flows on motorways, results in fewer fatal motorcycle accidents.

In most European countries, the majority of PTW fatalities occur outside urban areas, and particularly on the non-motorway rural roads. However, in Greece, Italy, Portugal, Poland,Slovenia and Romania, more than 50% of PTW fatalities occur inside urban areas, most probably due to increased PTW mobility inside urban areas compared to the other European countries.
Moreover, almost one third of all PTW rider fatalities occur at a junction (28,6%), whereas for car occupants fatalities, only 14% occur at junctions. Nearly 50% of the total number of motorcycle/moped rider fatalities recorded at a junction occurred at crossroads, possibly due to the increased number of crossing traffic flows at crossroads. Furthermore, Table 2 shows that in Europe for all transport modes most fatalities occur away from junctions. However, the highest shares of fatalities at junctions are found among bicycles and powered two-wheelers.

Table 2 -Fatalities by road user type and junction, 2010

	Not at junction	At junction	Not defined
Pedestrian (EU)	74%	19%	7%
Bicycle (EU)	59%	33%	8%
Moped (EU)	67%	29%	4%
Motorcycle (EU)	67%	27%	6%
Car + taxi (EU)	77%	14%	9%
Lorry, under 3.5 tonnes (EU)	76%	13%	11%
Heavy goods vehicle (EU)	71%	7%	23%
EU-23 all modes	73%	19%	8%
Motorcycle (NZ)	81%	19%	0%

Source: CARE Database / EC
Date of query: October 2012

Impact of engine displacement

Several epidemiological studies focused on the relation between engine displacement and crash occurrence and severity. Some studies suggest that users of PTW with higher displacement have a higher risk of crash (Kraus et al. 1975; Nairn et al. 1993) and a higher risk of being seriously injured (Hurt et al. 1981; Namdaran et al. 1988; Pang et al. 2000; Quddus et al. 2002). Other studies have not found any association (Chang et al. 2006; Langley et al. 2000; Lin et al. 2003b; Yannis et al. 2005; Zambon et al. 2006).

Studies taking into account the exposure show that riders of high displacement PTW drive more km every year than those riding small motorbikes (Broughton 1988; Carre et al. 1994; ONISR 2005; Yannis et al. 2007). One study estimated that riders of PTW>500 cc on average make 4 times as much kilometres than those driving 50 cc (Broughton 1988).

Table 3 illustrates the evolution in the number of motorcyclists killed based on the power of the engine for Belgium and Greece. In 2007, 90% of motorcyclists killed were riding a motorbike above 400 cc in Belgium. Between 1998-2000 and 2007, the number of riders of bikes over 400 cm3 killed increased by 15%, while those riding bikes under 400 cc decreased by 40%. A similar, and even more pronounced pattern is observed in Greece, where, between 1998-2000 and 2010, while the number of riders of PTW of less than 270 cc decreased by 93%, the number of riders of PTW of more than 270 cc increased by 24%.

A recent study in Greece showed that motorcycle power is strongly associated with accident severity, especially when taking into account the age of the motorcycle driver. More specifically, it was found that accident severity decreases with motorcycle engine size, whereas the highest severity is observed for motorcyclists aged less than 21 years riding mopeds (Yannis et al. 2005). This result may be attributed to more risk-taking behaviour and inexperience of young drivers, together with the poor driving performance of mopeds at demanding conditions.

Table 3 - Evolution of the share of PTW fatalities per engine size in Belgium and in Greece

Belgium – PTW fatalities by engine power

Année	Motos de < 400cc	Motos de >=400cc	Tous types de motos
1991	25	89	114
1995	20	96	116
2000	16	102	118
2001	21	126	147
2002	16	148	164
2003	14	110	124
2004	16	104	120
2005	16	107	123
2006	16	114	130
2007	11	125	136
Evolution entre la moyenne 98-2000 et 2007	-40%	+15%	+7%

Greece – PTW fatalities by engine power

Year	Motorcycles < 270 cc	Motorcycles >=270 cc	Total
1996	436	171	607
2000	426	129	555
2001	406	146	552
2002	302	123	425
2003	279	119	398
2004	319	148	467
2005	286	203	489
2006	317	215	532
2007	280	209	489
2008	276	200	476
2009	271	190	461
2010	234	196	430
Evolution between average of 1998-2000 and 2010	**-93%**	**24%**	**-40%**

Serious injuries among motorcyclists

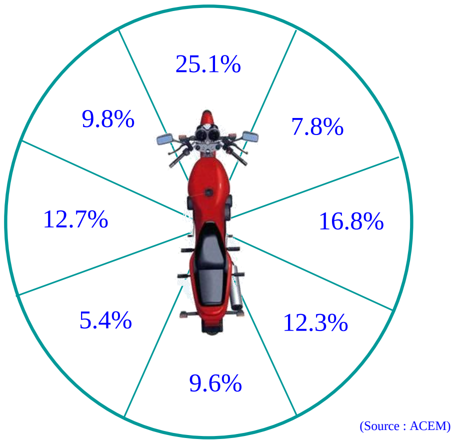
Most of the information above is based on fatal crashes, because they are in most countries easily available. However, understanding the nature and extent of serious injuries among motorcyclists is essential in the perspective of a safe system approach. It is also very important from an economic and health perspective, given the high costs associated with the most severe injuries.

Compared to other road users, motorcyclists sustain much more severe injuries. As an example, in France in 2006, motorcyclists represented 23,5% of fatalities, but 30,6 % of injured road users and 30% of injured road users with long term handicap (Amoros et al. 2008; ONISR 2007). In Sweden, of all road-users (2010) that got at least a 10% disability, bikers were 8% and moped riders were 6%.

Figure 4 illustrates the impact location of motorcyclists. Most frequent injuries concern the « limbers », lower limbs in particular, and then head injuries. Spine injuries are less frequent but can have severe long term consequences. Colon, head and limb injuries are the main causes of long term handicap. The percentage of severe head injuries remains high, despite the use of helmet. Head and trunk injuries are the main causes of death (Moskal 2009).

In France, in 1996-2004, 24% of head injuries, 44% of spine injuries and 38% of leg injures leading to severe handicap concerned motorcyclists (Amoros et al. 2008). In 2004, there were as many motorcyclists severely injured than car occupants. The risk for a motorcyclist to suffer from a major handicap is higher than the risk of dying. In the United States in 2009 half of all injuries were to the head/face/neck or shoulder/trunk regions, while almost three in ten were to the leg/knee/ankle/foot region.

Figure 4 – Impact locations of motorcyclists
Les configurations de choc chez les motocyclistes



CRASH SCENARIOS

Table 4 summarises the various types of crashes (Van Elslande, 2008), which are detailed in the sections below.

Table 4 – Motorcycle crash types

Single vehicle crashes (typically 20 to 45% of fatal crashes)	With an obstacle on the roadside
	With an obstacle on the road
	Without obstacles
Multi vehicle crashes (typically 30-50% of fatal crashes)	Chain collision
	Frontal collision
	Rear collision
	Lateral collision
Crash with a pedestrian (estimated less than 10 % of fatal crashes)	

The first harmful event in a PTW crash is typically the event whereby substantial crash energy transfer occurs rapidly or is precipitated imminently. As shown in Table 5, almost one-half (49.2%) of fatal PTW crashes in the United States from 2000 to 2009 involved collision with another motor vehicle in transport on the same roadway. About 30% of fatal crashes involved collisions with fixed objects; 17.0 % involved non-collisions, such as overturn/rollover, fell/jumped from vehicle, and other; and 3.8% involved unknown and/or unrecorded first harmful events.

Table 5 - Fatal Powered Two Wheeler Crashes in the U.S. by First Harmful Event, 2000-2009. Source: Fatality Analysis Reporting System, 2011.

First Harmful Event	Fatal Crashes	Percentage
Collision with Motor Vehicle in Transport on Same Roadway	19793	49,2
Non-Collision - Overturn/Rollover	5980	14,9
Collision with Curb	2247	5,6
Collision with Guardrail Face or End	1785	4,4
Collision with Pole, Post, Sign Support, Etc.	1594	4,0
Collision with Standing Tree	1302	3,2
Collision with Ditch	1118	2,8
Collision with Embankment	956	2,4
Collision with Live Animal	806	2,0
Collision with Concrete Traffic Barrier	499	1,2
Collision with Other Fixed Object	489	1,2
Collision with Fence	461	1,1
Non-Collision - Fell/Jumped from Vehicle	432	1,1
Other Noncollision	419	1,0
Collision with Culvert	411	1,0
Collision with Parked or Stopped Motor Vehicle Off Roadway	406	1,0
Other/Unknown	1518	3,8
Total	**40216**	**100,0**

Single-vehicle crashes

The prevalence of single vehicle PTW crashes ranges among 20% and 45%. The UK Department for transport reports 25% of motorcycle fatalities and 24% of casualties attributable to single vehicle crashes. In France (ONISR, 2010) on 2009, 36% of motorcycle fatalities and 34% of moped fatalities were in single vehicle accidents, these crashes taking up 19% of motorcycle injury crashes and 18% of moped injury crashes. Results from the 2BESAFE project suggest that single vehicle crashes are 25% of all PTW crashes in Italy, 38% in Greece and 44% in Finland and Sweden.

These can be distringuished into crashes with loss of control, or other single vehicle crashes. According to the UK Department for Transport, nearly half of single vehicle accidents of motorcycles were recorded as being originated by a loss of control. This loss of control can be due to several identified causes, as mentioned in the literature:

- Loss of control in curve due to an excessive speed (exceeding speed limitation or too high speed for the situation)
- Loss of control due to the influence of alcohol (in France, in 2009, 20% of motorcycle fatalities involve a positive alcohol level, with a higher rate in single vehicle accidents (ONISR 2008)
- Loss of control due to overbraking
- Loss of control due to a mechanical problem (6% of PTW crashes in the MAIDS study)
- Loss of control due to bad road conditions (< 4% for MAIDS)
- Other type of loss of control

Other single vehicle crashes

This second category of single vehicle accidents does not, strictly speaking, refers to a loss of control initiating the problem but the sudden meeting of an unexpected obstacle (which doesn't consist in a road user) on the carriageway. The following configurations can be distinguished:

- PTW is confronted to an animal who crosses suddenly the carriageway (0.3% according to MAIDS study)
- PTW hits an obstacle on the carriageway (stone fell down from a hill, or any object fell down from a truck, etc.)
- Other

Multi-vehicle crashes

At junction

Crashes at junctions cover a large proportion of crashes involving a PTW and another vehicle (principally a passenger car). According to the MAIDS project, 50% of PTW crashes occur at junctions; however, as shown previously, this proportion largely varies between countries or settings. The following crash scenarios can be considered (Van Elslande, 2008):

- the scenario in which a PTW overtakes and a passenger car turns left represents 11% of the accidents, and in 9% the passenger car makes a U-turn Safetynet (2008). Based on the MAIDS study, PTW overtakes another vehicle while the other vehicle is turning left or right at 6,1% and 1,2% of crashes respectively.
- the configuration with passenger car turning left hits oncoming motorcycle represents 26% of motorcycle accidents Safetynet (2008). In the MAIDS study, the configuration in which another vehicle turns in front of PTW in the same direction impacting PTW represents 2,6% of their database, while 8,6% respectively concerns turning in opposite direction.
- the accident configuration where the PTW is on a prioritized road while a passenger car crosses or turn on his way represents 46% of the accident cases Safetynet (2008). Based on ONISR (2005): 32,8% of injury accidents between a motorcycle and a car occur at junctions where the motorcyclist has the right of way (34,4% for fatal accidents).

Not at junction

According to the UK Department for Transport 37% of motorcycle fatalities and 24% of motorcycle casualties occurred out of an intersection. ONISR (2005) established that 44,3% of injury accidents between a motorcycle and a passenger car occur out of intersections (51,8% for fatal accidents). 2BESAFE project gives the following percentages for motorcycle vs passenger car fatal crashes out of a junction (2006-2007):

- Finland = 14% (no data for urban area)
- France = 28,9%

- Greece = 23,2%
- Italy = 23%
- United Kingdom = 14,1%

A number of different configurations can be considered (Van Elslande, 2008):

- changing lane or overtaking,
- rear-end accident: another vehicle impacts the rear of PTW in 2,2% of the MAIDS database accidents, while in 6,4 the PTW impacts the rear of another vehicle
- aberrant manoeuvre of PTW (wheeling, go the wrong way along a street, go the wrong way in a roundabout, sudden acceleration…): 1,5% of injury accidents and 1,4% of fatal accidents (ONISR, 2005).
- Aberrant manoeuvre of other vehicle (U-turn, door opening etc.): 6,5% of injury accidents (ONISR, 2005)
- With several PTWs
- Other

Crashes with pedestrians

In MAIDS study accidents involving a pedestrian constitute less than 2% of PTW accidents. According to ONISR (2005), 5,5% of PTW injury accidents involve a pedestrian (3,1% for fatal accidents).

CONCLUSIONS

On average, in OECD countries, motorcyclists count for 14% of all road fatalities, while only representing 5% of the fleet. Motorcyclists are clearly overrepresented in the road traffic casualties. They are around 20 times more at risk in traffic than a car occupant. This is due to their greater vulnerability and lack of protection in the case of collision. When involved in a crash, PTW riders are exposed to a significantly higher risk of severe injuries, entailing long-term disabilities.

The situation of motorcyclists has deteriorated in the past decade if one compares with the significant progress with other road users. PTW trends are not following the overall fatalities decrease in the OECD countries; this may be explained by the high increase in PTW fleet and respective mobility, as PTW have been steadily gaining in popularity in recent years, with large gains seen in PTW ownership and ridership. PTW is the only mode of transport for which the number of fatalities has increased, significantly in some countries, over the last decade, which stresses the importance of taking immediate appropriate counter measures.

Many countries face similar patterns: with the average ago of motorcyclist killed having increased. In Europe the number of motorcyclists killed in the 40-60 has doubled in 10 years. The fatality rates for moped riders aged 15-19 and motorcycle riders aged 20-30 are notably high. It appears that being young, male and lacking experience is associated with increased PTW fatality risk.

More men than women die each year in PTW road accidents. Men typically drive more than women, especially as regards PTW. Almost one third of all PTW fatalities occur at junctions – a proportion notably higher compared to other road users' – out of which about half at crossroads; this stresses the importance of taking specific counter measures for junction safety improvement for PTWs.

As regards seasonality, the better weather conditions, resulting in more use of motorcycles, from April to October, results in a large proportion of PTW fatalities, especially as regards motorcycles. The majority of PTW fatalities occur on Friday, Saturday or Sunday, when increased PTW mobility is expected, and most often between 3pm and 9pm.

The severity of injuries is usually correlated with power of the engine.

A wide majority of crashes are single vehicles crashes occurring on rural roads, followed by crashes at intersections.

Most of the data presented in this paper and in other research publications are based on fatal data because they are easily available and usually reliable. It is however essential to gain more information on serious injuries, because this represents a main challenge in improving road safety; and because, and maybe more for motorcyclists, measures and equipment can help to reduce the severity of serious injuries. Some countries now have experience in linking police and health database in order to have a more complete picture of the consequences of crashes.

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