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REVIEW
ΑΝΑΣΚΟΠΗΣΗ

Message 1: "Be a safe driver"

Message 2: "Be a safe road user"

Road traffic accidents constitute the first cause of unintentional injury death in the European Union (EU). In EU-25, an estimated 43,000 people die every year due to motor vehicle crashes. Nevertheless, road traffic injuries can be prevented and their consequences can be alleviated if the appropriate practices, policies, strategies and road safety regulations are adopted. This paper aims: (a) to describe the magnitude and the socio-economic burden of road traffic injuries in the countries of the EU, (b) to outline underlying risk factors and, (c) to present evidence based preventive practices that reduce the likelihood of road traffic injuries occurrence. Some of these measures are therefore included in the European Code Against Injuries (ECAI) aiming to raise public awareness regarding injury prevention.

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ΑΡΧΕΙΑ ΕΛΛΗΝΙΚΗΣ ΙΑΤΡΙΚΗΣ 2008, 25(Συμπλ 1):11–18

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Μήνυμα 1: «Οδηγείτε με ασφάλεια» και Μήνυμα 2: «Φροντίστε για την ασφάλειά σας ως χρήστης του δρόμου»

Περίληψη στο τέλος του άρθρου

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1. DEFINITION

According to the World Health Organisation (WHO), a road traffic injury (RTI) is any injury due to crashes, originating terminating or involving a vehicle partially or fully on a public highway.[1] Specifically injury due to motor vehicle car crashes is always associated with a sudden exchange of mechanical energy reaching people at rates that involve forces in excess of their injury thresholds.[2]

2. MAGNITUDE OF THE PROBLEM

Worldwide, an estimated 1.2 million people are killed in road traffic accidents (RTAs) and approximately 50 million get injured every year.[1] Projections indicate that these figures are likely to increase by about 65% over the next 20 years unless there is a change in traffic related injury prevention (tab. 1).[1] In EU-25, 43,000 lives are lost annually due to RTAs.[3] This corresponds to 21% of the total deaths due to injuries in Europe, placing RTAs as the second, after suicide, cause of death due to external injuries in EU. Moreover, 1.8 million people were injured in these crashes, representing an estimated cost of 160 billion Euros, which is the consequence of the 1.25 million of accidents that occur at the European roads.[3]

People aged 15–24 years are at higher risk for road traffic mortality compared to people aged 25–44 years old. The World Report on road traffic injury prevention indicates that

Table 1. Predicted road traffic fatalities by region (in thousands), adjusted for underreporting, 1990-2020.[3]

Region	Countries (N)	1990 (N)	2000 (N)	2010 (N)	2020 (N)	% Change 2000–2020	Fatality Rate (deaths/100,000 persons) 2000	2020
East Asia and Pacific	15	112	188	278	337	79	10.9	16.8
East Europe and Central Asia	9	30	32	36	38	19	19.0	21.2
Latin American and Caribbean	31	90	122	154	180	48	26.1	31.0
Middle East and North Africa	13	41	56	73	94	68	19.2	22.3
South Asia	7	87	135	212	330	144	10.2	18.9
Sub-Saharan Africa	46	59	80	109	144	80	12.3	14.9
Sub-total	121	419	613	862	1123	83	13.3	19.0
High-income countries	35	123	110	95	80	-27	11.8	7.8
Total	156	542	723	957	1203	67	13.0	17.4

there are notable differences in the way users are affected by road traffic collisions.[1] More than half of all road traffic deaths globally occur among youngsters and adults aged 15 to 44 years old with 73% of all road traffic fatalities affecting males. Vulnerable road users – pedestrians, cyclists and motorcyclists – account for a much greater proportion of RTAs in low-income and middle-income countries.[4] In addition vulnerable road users, children and older people, are at high risk to die from RTAs.[5] Approximately 34,000 of those people involved in RTAs are aged 0–14 or above 60 years old, representing about 5% of the total estimated deaths from RTI every year.

Pedestrians and cyclists represent 33% of victims of road crashes, which accounts for about 40,000 deaths per year. Pedestrians, cyclists and motorcyclists usually suffer the most severe injuries as a result of a RTA, and report more frequently remaining health problems that require further assistance. On average, pedestrians and cyclists account for about 20% of people involved in serious accidents in the WHO European Region, but they are at disproportionate risk of death or injury compared to car users.

The European Association for Injury Prevention and Safety Promotion[6] reports more than 56,000 deaths in EU-27 associated with RTAs. Hospital admissions (860,000), hospital outpatients (1,800,000) and patients requiring other types of medical treatment (1,200,000) make road traffic related injuries to account for approximately 6.5% of all the medical treated cases in the EU-27.[6]

The decreasing trend in road traffic injuries and fatalities that have been observed during the last years in the EU-25 (fig. 1),[1] gives an encouraging message about the existing preventive initiatives. Yet, the diversity in the estimations of deaths and injuries in Europe due to different types of existing data sources (some sources analyze traffic injuries as a system whereas some others as a health issue) makes the development of an integrated system that allows precise estimation of the burden of RTIs in Europe, as an issue of high priority.

3. RISK FACTORS

In the late 60's, Haddon proposed a framework to categorize risk factors according to two different criteria: the temporal stage of the crash combined with the classical epidemiologic model for infectious diseases (vehicle-subject-environment).[2] This matrix has been used since then to identify different injury risk factors along with strategies aiming to prevent the occurrence of injury.[1] An example of such a matrix specified for the case of RTIs is presented in table 2.

3.1. Demographic risk factors

Worldwide, road traffic deaths occur more frequently among males with males accounting for approximately 73% of the road traffic deaths and 70% of DALYs lost.[7] Although the number of fatalities between males is strongly associated with age, this is not actually the case for females. According to figure 2, younger men die more frequently due to RTIs and this trend seems to decrease with increasing age.[1]

The highest death rates are observed in the age group of 15–29 in high-income countries, and in people over 60 years in low and middle-income countries. Children in low and middle-income countries have much higher death rates due to RTIs, than children in high-income countries.[7] According to the transport mode, a person on a two-wheel motorized vehicle is 20 times more likely to be killed for

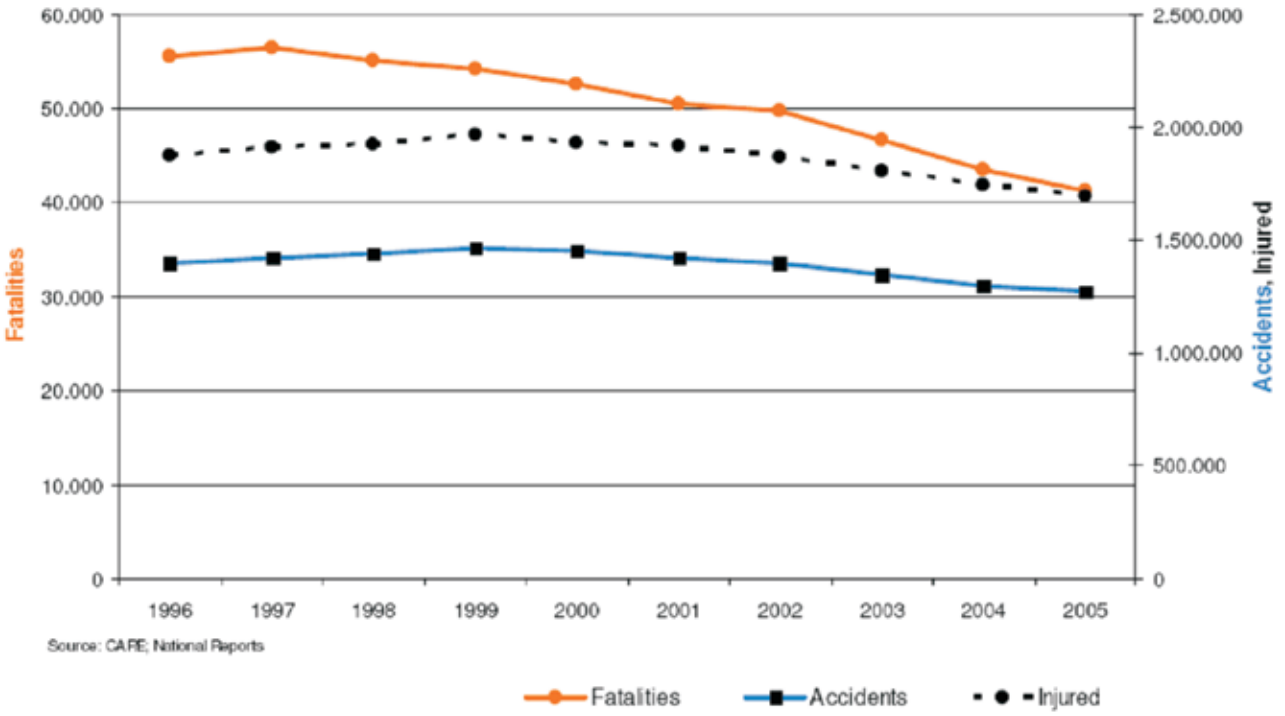

Figure 1. Annual figures of road traffic fatalities, accidents and injured people (EU-25), 1996-2005.[3]

Table 2. The Haddon Matrix.[1,2]

Phase	Factors	Vehicle	Environment
Pre-crash	Information	Roadworthiness	Speed management
	Attitudes	Lighting	Police enforcement
	Impairment	Braking	Pedestrian-friendly design facilities
		Handling	Road layout
Crash	Use of restraints	Restraints (seatbelt, airbag, CRS)	Hazards removal
	Gender and age influence on injury tolerance levels	Helmet use	Road design
	Impairment	Crashworthiness	Barriers
Post-crash	First aid skills	Ease of access	Rescue facilities
	Access to medics	Fire risk	Traffic management to ease the access

each kilometer traveled, whereas a pedestrian is 9 times more likely and a person riding on a bicycle is 8 times more likely, all compared to a person in a car. Other means of transport like rail or air seem to be safer.[8] Relevant data are shown in table 3.

3.2. Environmental risk factors

There is a variety of environmental risk factors that can lead to RTIs such as road design, correct maintenance, type and conditions of the road. Driving at excess speed reduces driver's reaction, can produce loss of vehicle control and at the same time increases the kinetic energy involved in the crash. Thus, roadsides should be designed to avoid an excessive amount of energy being transmitted to the occupant in case of a crash. Special attention must be paid to the diversity of road users and their needs, since effective measures suitable to protect a specific group of road users can be extremely harmful to others.[9]

Pedestrian and cyclist friendly infrastructure designs should be always considered when a new road is designed. Vulnerable road users' limited conspicuity (also applicable to powered two-wheelers) as well as poor lighting conditions have been identified as factors contributing to RTAs.[9]

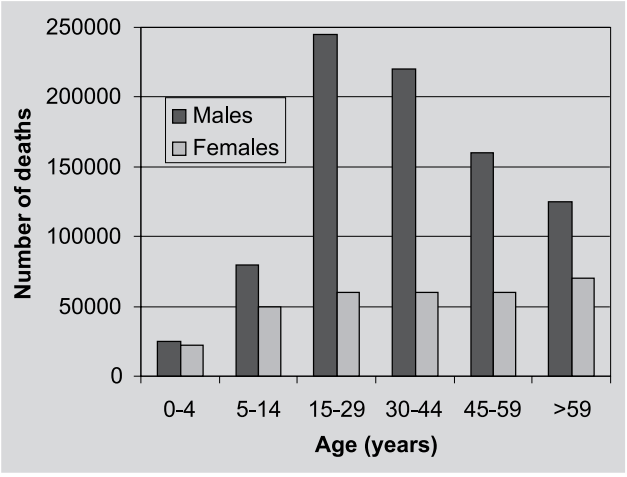

Figure 2. Road traffic deaths by gender and age group. World, 2002.[1]

3.3. Behavioral risk factors

Alcohol consumption increases the likelihood for both the occurrence of a crash and the causation of severe injuries or even death. A number of studies showing these effects have been reported.[1] Drivers with Blood Alcohol Levels around 0.02–0.05 g/100 ml were found to be 3 times more likely to be killed in a single vehicle crash than drivers who have not consumed alcohol. Interestingly when alcohol levels reach 0.08–0.10 g/100 ml, notably three cans of beer, especially among males 16–20 years old, then the chances to have a RTI increase to 52.[10] Medicines for somatic illnesses do not seem to be associated with increase in crash involvement although medicines intake for the treatment of mental illnesses and narcotics were found to increase the likelihood of involvement in a crash.[9]

Table 3. Deaths per 100 million passenger-kilometers versus passenger-travel hours in European Union countries for the period 2001-2002.[1]

	Deaths per 100 million passenger-kilometers[a]	Deaths per 100 million passenger-travel hours[b]
Roads (total)	0.95	28
Powered two-wheelers	13.8	440
Foot	6.4	75
Cycle	5.4	25
Car	0.7	25
Bus and coach	0.07	2
Ferry	0.25	16
Air (civil aviation)	0.035	8
Rail	0.035	2

a Passenger-kilometers is the total distance covered by all the individuals travelling on that mode.

b Passenger-travel hours is the total time spent by all the individuals travelling on that mode.

4. EFFECTIVE PREVENTIVE PRACTICES

Reduction in the number of RTAs can be achieved through the prevention of underlying risk factors in four different stages:[1]

- Reducing the exposure, namely the amount of movement, or travel, within the system by different users or a given population density.
- Decreasing the probability of a crash, given a particular exposure.
- Diminishing the probability of injury, given a crash.
- Reducing the severity of injury and the eventual impairment.

According to Haddon,[11] there is no logical reason why the most effective countermeasures must parallel the sequence of causes contributing to injuries. This is particularly true for RTIs since the most effective practices were those focusing on reducing the likelihood of injury occurrence and/or injury severity. A review of the literature suggests that the most effective and cost-effective interventions to prevent RTIs are those countermeasures that combine both engineering and enforcing policies. Nevertheless, recent investigations are suggesting that the protective effectiveness of these interventions is increased only when behavioral aspects of the driver/road user are also taken into consideration.[12]

The following recommendations have been proposed by WHO[1] and are strongly supported by scientific evidence. Though there are many other effective interventions to reduce RTIs (such as safer road and traffic management designs, enforcement and regulation done by the Authority), these recommendations have not been included here. We have limited ourselves to describe good practices that can be put in place by every user of the road traffic system.

- Helmets

Helmets are intended to protect against head injuries or reduce the severity of such injuries since riders of motorcycles and mopeds as well as cyclists are exposed to a higher risk of death due to traffic crashes.[1] The effectiveness of this countermeasure is shown to be high as helmets reduce the number of head injuries amongst moped-riders and motorcyclists by approximately 45%. This effect is even larger for more serious injuries. There

is evidence that the enforcement of the use of helmets prevents the increase of fatalities.[9]

Bicycle helmets**:** Bicycle helmets prevent serious injuries and even death.[13,14] State helmet laws significantly increase helmet use by children and play an important part in any comprehensive effort designed to achieve this goal.[15] The most cost-effective approach for increasing helmet use is legislation, combined with community education and helmet promotion campaigns.[16,17]

Motorcycle helmets: Motorcycle helmet use appears to reduce the risk of mortality leading to an estimated 72% reduction of head injuries.[18]

- Seat belts and airbags

Seat belts protect people travelling in cars from colliding with the interior of the vehicle and from being throwing out of the vehicle. In other words, seat belt helps the management of the mechanical energy that is transmitted to the occupants in case of impact. Most of the newer vehicles are also equipped with frontal airbags for driver and front passenger. The combination of seat belt and airbag is even more effective for preventing serious injuries. The effectiveness of seat belts is completely unquestionable regardless sitting in the front or in the rear seats of the vehicle: the use of seat belts reduces the probability of being killed almost by 40–50% for drivers and passengers in the front seat and by 25% for rear seat occupants. They also show an important effect in the prevention of serious injuries (with similar estimations of protection) and slightly lower effect in the protection against less severe injuries (though always significant).[9]

All the occupants in the vehicle must have the seatbelt appropriately fastened. It has been reported that a rear passenger not wearing the seatbelt can increase 5 times the probability of death for frontal occupants.[19] A systematic review found strong evidence for the effectiveness of safety belt laws in general and for the incremental effectiveness of primary safety belt laws relative to secondary laws.[20] Strong evidence for the effectiveness of enhanced enforcement programs for safety belt laws was also found.[21,22]

Airbags in vehicles: A cohort study found that the average risk of driver death was reduced by 8% (95% CI: 4% – 12%) by an air bag.[23] Benefit was similar for belted and unbelted drivers and was slightly greater for women. However, seat belts offered much more protection than air bags.

- Child restraint systems

Child restraint systems work in the same way with seatbelts; however they are specifically designed to meet the different requirements in terms of size and injury tolerance of children. Children are always better protected in the rear seat and they must use the adequate restraint system according to their size. For children in the age group 0–4 years, the correct use of child seats reduces the probability of injury by around 50% for forward facing seats and around 80% for rearward facing seats.[9]

There is strong evidence that child safety seat laws reduce fatal and nonfatal injuries and increase child safety seat use.[20,24] Rear seating is recommended for children under the age of 13 years as the use of age-appropriate restraints, including child safety seats and belt-positioning booster seats is an evidence based effective measure.[25] Multifaceted community booster seat education campaigns can significantly increase the use of child booster seats.[26–29]

- Improving visibility of road users

Seeing and being seen are fundamental prerequisites for the safety of all road users. A great deal of studies have shown that fluorescent materials in yellow, red and orange colours improve detection and recognition in the daytime, while during night-time visibility, lamps, flashing lights and retro reflective materials in red and yellow colours are recommended.[22,30,31] Retro reflective materials arranged in a 'biomotion' configuration also enhance recognition. Increasing the use of reflective or fluorescent clothing, white or light coloured helmets, and daytime headlights[32] are simple, cheap interventions that could considerably reduce motorcycle crash related injury and death.[9]

- Drinking and driving

Impairment by alcohol is an important factor influencing both the risk of RTIs, as well as the severity of those injuries. The scientific literature and national road safety programmes concur that a package of effective measures is necessary to reduce alcohol related accidents and injuries.[1] Blood alcohol limits of 0.05 g/dl for the general driving population and 0.02 g/dl for young drivers are generally considered to be the best practice at present. Laws that establish a lower legal limit for blood alcohol content for younger or inexperienced drivers than for older, more experienced drivers is also recommended.[32] There is a statistically significant reduction of 9% in the number of

fatal crashes where these policies are implemented and of 7% in all kind of accidents. Alcohol not only increases the chances to be involved in a crash but also the probability of sustaining more severe injuries.

- Speeding

There is strong evidence showing that people exceeding the speed limits have more chances to be involved in severe road traffic crashes. There is a statistically significant increase in the number of fatal crashes of about 26% (CI: 24% – 28%) with a mean change of 15 km/h in the speed limit. Speed limits are an indicator of the adequate speed to negotiate a particular segment of the road.[9]

The control of vehicle speed via speed detection devices can prevent crashes. In recent years, speed cameras have been extensively introduced for speed enforcement, since they create the perception that police can be everywhere. Speed cameras, radars and laser devices are effective interventions in reducing road traffic collisions and related casualties.[33] As far as the use of mobile speed cameras,[34] it was found that the route-based method is the best way to measure effectiveness at distances up to 500 meters and this method demonstrates a 51% reduction in crashes due to injuries.

Information and education of road users can improve knowledge about the rules of the road, the purchase of safer vehicles and equipment, as resulted from the implementation of community or school based related programs.[35–38]

According to available scientific evidence[39] pedestrian safety education can result to improvement of children's knowledge and can enhance observed road crossing behavior; still it is unknown whether this approach reduces also the risk of pedestrian motor vehicle collisions and injury occurrence. Moreover, there is evidence that safety knowledge and observed behavior decline with time, suggesting that safety education must be repeated at regular time intervals. In general, most programs providing highway safety education do not work in isolation – they need to be linked or used in combination with other measures.

5. CONCLUSION

RTIs constitute the first cause of unintentional injury death in the European Union (EU). Nevertheless, research has shown that a large number of effective measures aiming to reduce the risk of RTIs, implemented not only at a national or community level but also at an individual level, already exist. Some of the practices that according to the literature are found to be effective and therefore strongly recommended are the following:

- For drivers

- Minimize distractions while driving: avoid using a mobile phone, drinking, smoking, or eating.
- Drinking and driving don't mix. After drinking alcohol, use public transport or have a designated driver. If you go out with others, decide beforehand who will drink non-alcoholic beverages and make sure everyone gets home safely.
- Bear in mind that fatigue and lack of sleep slow your reactions and increase your risk of injury. On long trips, take regular breaks, at least a 15-minute break every two hours.
- Follow road traffic rules, adapt your speed to given circumstances and maintain a safe distance from the vehicle in front of you. Remember that you are in charge of a powerful machine that can injure and kill vulnerable road users (e.g. pedestrians, motorcyclists, cyclists, horse riders).
- Stay calm and don't let yourself be provoked by other road users, don't drive aggressively.
- Adapt your driving to the road and weather conditions.
- If you are a new driver, consider taking a more experienced driver with you.

- For road users

- Make sure you know and follow all road traffic rules.
- Wear your seat belt on all trips, including short trips. Make sure that everyone wears a seat belt in your car, both in the front and rear seats and remember that seat belts must be used even if your vehicle has airbags.
- Always put children in the back. Learn the regulations applying to children – they need an age- and size-appropriate car restraint or booster seat that is properly fitted in the vehicle. Read the instructions provided by the manufacturer.
- Always wear a helmet when you ride a motorcycle, bike, or horse. Make sure that it meets safety standards. Helmets might be useless if they are not the correct size and worn in the correct position. Make sure your children's helmets are properly adjusted.

- Wear light coloured, fluorescent or reflective clothing when you ride a motorcycle, bike or horse. Use your lights to be seen as well as to see.
- As a pedestrian, try also to be visible. Walk on pavements and use zebra/pelican crossings if available. Face oncoming traffic when walking on the side of the road.
- Teach your children how to cross the road safely and practice with them in real life situations. Bear in mind that you are a model for your children.

ΠΕΡΙΛΗΨΗ

Μήνυμα 1: «Οδηγείτε με ασφάλεια»
Μήνυμα 2: «Φροντίστε για την ασφάλειά σας ως χρήστης του δρόμου»

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Τα τροχαία ατυχήματα αποτελούν την πρώτη αιτία θανάτου από ακούσιο τραυματισμό στην Ευρωπαϊκή Ένωση. Στην Ευρώπη των 25, περίπου 43.000 άτομα πεθαίνουν ετησίως από τροχαία ατυχήματα. Παρόλα αυτά, τα τροχαία καθώς και οι συνέπειες αυτών μπορούν να προληφθούν εάν υιοθετηθούν κατάλληλες πρακτικές, πολιτικές, στρατηγικές και κανόνες οδικής ασφάλειας. Αυτή η εργασία στοχεύει: (α) να περιγράψει την έκταση του προβλήματος και τις κοινωνικο-οικονομικές επιπτώσεις των τροχαίων ατυχημάτων στις χώρες της Ευρωπαϊκής Ένωσης, (β) να επισημάνει τους υποκείμενους παράγοντες κινδύνου, και (γ) να παρουσιάσει τις επιστημονικά αποδεδειγμένες πρακτικές που μειώνουν την πιθανότητα τροχαίων ατυχημάτων. Μερικές από αυτές τις πρακτικές έχουν συμπεριληφθεί στον Ευρωπαϊκό Κώδικα Κατά των Ατυχημάτων, προκειμένου το κοινό να ενημερωθεί σχετικά με την πρόληψη των ακούσιων τραυματισμών.

Λέξεις ευρετηρίου: Ευάλωτοι χρήστες του δρόμου, Ευρωπαϊκός Κώδικας Κατά των Ατυχημάτων, Οδηγοί, Οδική ασφάλεια, Πεζοί, Πρόληψη, Τροχαία ατυχήματα

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