



RSA

Review of Pre-crash Behaviour in Fatal Road Collisions Report 1: Alcohol

Research Department
Road Safety Authority
September 2011

Údarás Um Shábháilteacht Ar Bhóithre
Road Safety Authority

Contents

Executive Summary	3
Introduction.....	4
Road Traffic Fatality Collision Data in Ireland.....	4
Road Safety Strategy 2007-2012	7
Alcohol	9
Methodology	10
Results	11
Profile of drivers and motorcyclists	16

Executive Summary

Alcohol has played a significant role as a causal factor in road traffic collisions in Ireland as well as around the world. Previous research in Ireland indicates that alcohol had been a factor in 36.5% of alcohol related fatal crashes in 2003, 28.4% in 2004 and 28.9% in 2005. Differences between years were not statistically significant.

The Road Safety Authority, as part of an overall study into the pre-crash behaviour of road users, analysed the role alcohol played in fatal collisions over the period 2005 to 2007. This is the latest period that closed investigation files are available for analysis. The period of this study was relevant to establish some effectiveness measure of the introduction of Mandatory Alcohol Testing (MAT) which was legislated for in July 2006. This provision allowed the Gardaí to breath- test a driver without the requirement that the Garda had formed an opinion that the driver had already consumed alcohol. This provision allowed the Gardaí to test a greater number of drivers than had been permitted before. The study also analysed the cases in which a breath-test was administered in the case of a fatal collision by the Gardaí¹. Such testing was carried out in approximately 10% of all the fatal collisions analysed.

The result of the analysis shows that there has been a reduction in the role alcohol has played in fatal collisions over the period and that the reduction was statistically different.

In order to verify the analysis of the fatal collisions was valid, a robust statistical methodology was used in this study. Following the method used in previous studies in Ireland, this study shows that the percentage of road traffic collisions where alcohol was a factor decreased to 15.53% in 2007, from 28.33% in 2005 and 20.87% in 2006. This reduction is significant and would appear to be as a result of the introduction of MAT in 2006.

The more robust analysis (the Case Deletion method and a Multiple Imputation method) verified that the reduction found in the method used previously was valid and that the reduction of alcohol related fatal collisions over the period was significant.

¹ It should be noted that there was no compulsion of a Garda to take a breath test at the scene of a fatal collision during the period on this study. The Garda has discretion in the matter. This discretion has now been removed under the Road Traffic Act 2011.

Introduction

The Research Department of the Road Safety Authority (RSA) was given access to Garda (Police) investigation files for fatal road traffic collisions for the years 2005, 2006 and 2007. These files were stored at the Garda National Traffic Bureau at Garda Headquarters. In all cases, where a road user is killed, the Gardaí carry out a comprehensive investigation and a file is prepared. These files fulfil two regulatory requirements:

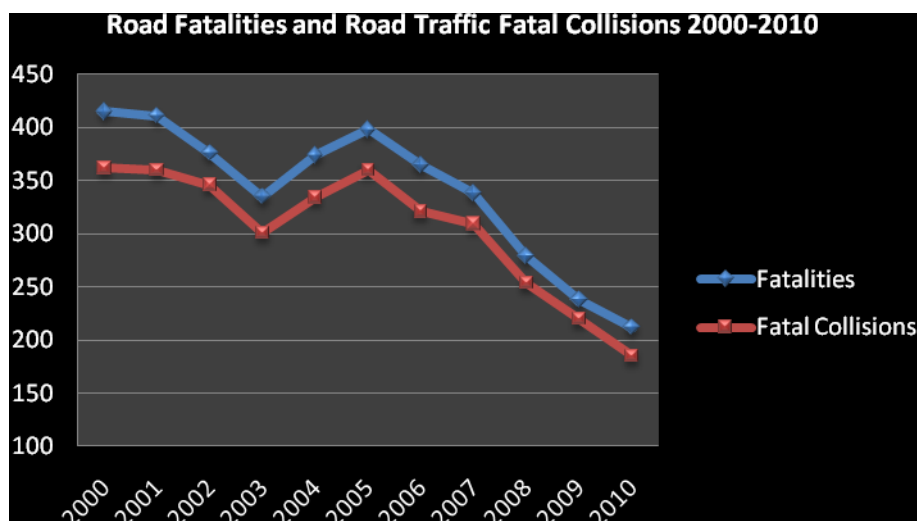
- In cases where a person died as a result of a road traffic collision, the Coroner must be informed and an inquest held;
- In such cases where a person is to be prosecuted as a result of a fatal road traffic collision, the decision to take the prosecution rests with the Director of Public Prosecutions.

These fatal road traffic collision files were retained at the Garda National Traffic Bureau for a period of five years and then archived. However, since 2007, the Garda National Traffic Bureau no longer seeks a complete file and now receives a summary of the file.

The fatal road traffic collision investigation files, created by the Gardaí, are to gain evidence for the regulatory requirements above. They usually contain eye-witness statements, forensic collision reports, vehicle examination reports, medical evidence, inquest results, toxicology reports, map reports and a covering report. They are based primarily on fact and would contain little opinion or perception content.

Road Traffic Fatality Collision Data in Ireland

The RSA published the Road Safety Strategy 2007-2012 in 2007, with the ambitious target to reduce road traffic collision fatalities to 60 per million/population or lower within the timeframe of the strategy. The strategy contained 126 specific actions to achieve this target. At the end of 2010, this target of 60 per million/population had been reached and improved on. Road traffic collision fatalities were 47 per million/population in 2010.



Collision data in Ireland is collected by the Research Department in the Road Safety Authority. This is a statutory function of the Authority under its enabling legislation, the Road Safety Authority Act 2006. The data is gathered by An Garda Síochána who is the investigatory authority for road traffic collisions in the state. Data is collected by the Gardaí on a form - C(T)68 - which is completed within three days of the collision and forwarded to the Road Safety Authority. The C(T)68 form is designed to collect data for statistical use only and is not part of any future investigation file. In the case of fatal and injury collisions, the data is comprehensive, but where only material damage is the outcome of the collisions, the data is less specific. In the case of fatal collisions, the C(T)68 is forwarded by the Gardaí to the Garda National Traffic Bureau at Garda Headquarters who send it to the Research Department at the Road Safety Authority.

The data collated by the Gardaí and forwarded to the Research Department in the Road Safety Authority is collated, quality checked and analysed. The aggregate information is disseminated annually by the Road Safety Authority with the publication of the Road Collision Facts.

There are other sources of collision data available such as that received by the National Roads Authority (NRA) and the Health Service Executive (HSE). The National Roads Authority receives data on road traffic collision fatalities from Local Authority road engineers on an LA16 form, while the Health Service Executive collects hospital data on some fatalities that die in hospital and all patients with road related injuries that are admitted to hospital. The

Review of Pre-crash Behaviour in Fatal Road Collisions
Report 1: Alcohol

hospital data is contained in a database called HIPE (Hospital In Patient Entry)².

² HIPE data only refers to persons injured who are admitted and detained in hospital. There is no general database for those who are dealt with in accident and emergency departments.

Road Safety Strategy 2007-2012

An ounce of prevention is worth a pound of cure.

Henry de Bracton, *De Legibus in 1240*

The Road Safety Strategy 2007-2012 seeks to achieve 'A change in focus to prioritise prevention of a collision in addition to planning to contain the consequences and recovery / rehabilitation of the injured'. This emphasis on prevention is highlighted further where the strategy states that as part of its evaluation objective, it will:

"Apply cost-benefit analysis and evaluation techniques in all decisions relating to the commitment of public funds in the prevention of and response to collisions, deaths and injuries and in follow up recovery and rehabilitation of the people injured in a collision."

In order to evaluate road safety interventions that will have a preventative effect, it is important to the Road Safety Authority that information on the pre-crash behaviour of road users involved in road traffic collisions is attained. Therefore the Road Safety Strategy 2007-2012 has as one of its actions (no.110) to:

"Review and research the outputs from collision analysis, including pre-crash behaviour of those involved in fatal and serious injury collisions."

There is very little pre-crash information in the Road Safety Authority's collision database or in the other sources of collision data held by the NRA or the HSE. Therefore the best available source of information on pre-crash behaviour would be contained in the Garda investigation files. Over the period 2005 to 2007, 990 fatal collisions occurred in Ireland. The Road Safety Authority sought permission from the Garda Commissioner to gain access to these files for research purposes to gain some insight into the pre-crash behaviour of the participants in such collisions. The Garda Commissioner agreed to allow such access to all files that were closed. Therefore, 778 files were available for analysis. Agreement from the Commissioner was based on three conditions:

1. The files would be examined at Garda National Traffic Bureau only;

Review of Pre-crash Behaviour in Fatal Road Collisions

Report 1: Alcohol

2. No personal information would be recorded;
3. A copy of all the data collected would be left with the Superintendent in the Bureau.

The Research Department analysed the files to extract information that was not contained in the C(T)68 forms for each file and also to update the C(T)68 forms where the data was not available when the form was originally completed.

The data collected related to the:

- Vehicles – make, model, registered number (age), tax and insurance;
- Individuals – drivers, passengers, pedestrians, cyclists etc;
- Medical and forensic information (alcohol levels, presence of drugs, top level summaries of autopsies etc);
- Behavioural information (use of seatbelts, hi-visibility clothing, details from witnesses and Gardaí);
- Purpose of the trip.

Data was collected on 2,145 individuals of whom:

- 880 were fatalities;
- 179 were seriously injured;
- 469 received minor injuries;

Review of Pre-crash Behaviour in Fatal Road Collisions

Report 1: Alcohol

Alcohol

This first report is the findings of the study regarding the role that alcohol plays in these collisions. The first report focuses on alcohol for a number of reasons:

- The study follows a similar methodology to a previous study for the three preceding years, 2003, 2004 and 2005 (Bedford, McKeown, O'Farrell, & Howell, 2008);
- The Road Safety Authority was anxious to see the effect that the introduction of Mandatory Alcohol Testing (MAT) in 2006 would have on the role of alcohol in road traffic collisions that resulted in a fatality;
- It is assumed that alcohol plays a significant role in pre-crash behaviours by many of the participants in the collisions;
- The requirement of the Gardaí to perform a mandatory alcohol test on all drivers involved in fatal/injury collisions is now passed into legislation. There is a requirement to examine what the previous record for testing at collisions was in the past. (It should again be noted that this study only pertains to collisions that resulted in a fatality and only includes information on injured persons where a fatality had occurred as part of the collision.)

Other subsequent reports will examine other causal factors that play a role in pre-crash behaviour in fatal collisions and will be published later in 2012.

Methodology

In order to gain more comprehensive information on the pre-crash behaviour of road users in road traffic collisions, the Road Safety Authority was given access to Garda investigation files on fatal road collisions for the period 2005-2007. The Research Department of the Road Safety Authority reviewed 778 files over this period. The Road Safety Authority did not have access to all investigation files from the period, the total of which was estimated to be 990. The review and analysis of the available files was carried out in 2010. The databases developed as part of the review captured the full range of information concerning:

- Vehicles (make, model, registration, tax and insurance);
- Individuals (details of drivers, passengers, vulnerable road users such as cyclists, pedestrians and motorcyclists);
- Medical/forensic information (alcohol levels, drugs, autopsy summaries);
- Behavioural information (use of seatbelts, hi-visibility clothing, witness and Garda reports);
- The purpose of the trip.

Information was available on 2,145 individuals, broken down as follows:

- 880 fatalities;
- 179 serious injuries;
- 469 minor injuries in the 778 files reviewed;
- Forensic files were available for 1,167 vehicles.

This method of reviewing fatal collision files was used in two previous studies to assess the role of alcohol in such collisions (D Bedford, 2006),(Bedford, et al., 2008). While the purpose of the Road Safety Authority study was to examine a wide range of pre-crash behaviours in road traffic collisions, this report will focus on alcohol. Other reports will be published on other road traffic pre-crash behaviours later this year.

Review of Pre-crash Behaviour in Fatal Road Collisions

Report 1: Alcohol

In Ireland, the current legal driving limit for alcohol in blood samples is 50 mg/100ml referred to as the Blood Alcohol Concentration (BAC); for urine it is 67mg/100ml. The legal limit for breath testing for alcohol undertaken by the Gardaí is 22microgrammes/100ml of breath. In Ireland, the current legal driving limit for alcohol for professional and learner drivers in blood samples is 20 mg/100ml; for urine this is 27mg/100ml. The breath test alcohol limit for professional and learner drivers is 9microgrammes/100ml of breath. International research indicates that a person's ability to drive is affected by alcohol if there is a level of alcohol in the blood of 20mg/100ml or greater. In this study, a crash was considered to be alcohol-related if the driver's BAC was $\geq 20\text{mg}/100\text{ml}$ (or the equivalent in urine and breath tests). Whether alcohol was considered to be a contributory factor in a pedestrian death was based on the circumstances of the crash and either the driver or pedestrian or in certain cases both BAC. This criterion was the same as used in the previous Bedford studies in 2005 and 2008.

Results

The Road Safety Authority collision data comprised 990 motor vehicle road traffic collisions where a fatality occurred in Ireland from 2005 to 2007. The information obtained from the Garda investigation files was used to update the collision database and provide information on the BAC which was not included in the original C(T)68 forms. Each collision record was matched to the BAC, age and sex of the driver, and the time of the incident. 62% of the investigation files had no recorded BAC.

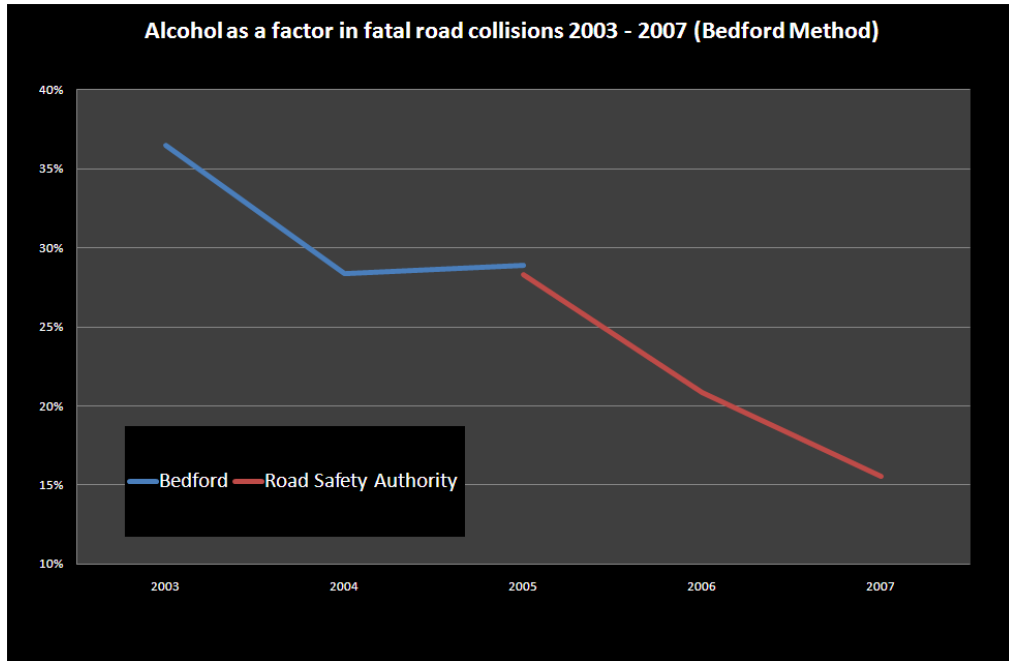
In the investigation files that were analysed, a preliminary results of the data showed that alcohol was a factor in fatal collisions for the three years as follows:

Table A

Year	% BAC $\geq 20\text{mg}/100\text{ml}$
2005	28.33%
2006	20.87%
2007	15.53%

These initial findings were arrived at by using the methodology that was used in both the previous Bedford studies (D Bedford, 2006)(Bedford, McKeown, O'Farrell, & Howell, 2008). The results indicated that there was a significant decrease in alcohol as a factor in fatal collisions in each year.

Review of Pre-crash Behaviour in Fatal Road Collisions
Report 1: Alcohol



The analysis also revealed that alcohol was not a factor in the following percentage of cases:

Table B

Year	% BAC < 20mg /100ml
2005	15.56%
2006	14.64%
2007	18.77%

However, a more correct approach in addressing this data would be to combine the cases where alcohol was a factor (**Table A**) and the cases where it was not (**Table B**) which is the total cases where alcohol information is known. Then, take a percentage of cases where alcohol was a factor from all cases where information about alcohol is known. This is referred to as "**case deletion**" method which is robust statistical method used to evaluate the data and to factor in information where definite data is available, that there were investigation files, which indicated that there was no evidence of any alcohol involved in the collision.

Review of Pre-crash Behaviour in Fatal Road Collisions
Report 1: Alcohol

The results are as follows:

Table C

Year	Alcohol a factor	Alcohol not a factor	% Alcohol factor (BAC \geq 20mg /100ml) using case deletion method
	a	b	a as a percentage of (a+b)
2005	28.33%	15.56%	64.56%
2006	20.87%	14.64%	58.77%
2007	15.53%	18.77%	45.28%

The results using the case deletion method are significantly higher than the simple method in Table A but more importantly demonstrate that alcohol as a factor in fatal collisions has decreased significantly over the three years examined.

In **Table D** (c-(a+b)), cases where no information on alcohol was found accounted for a substantial numbers of cases. These are referred to as "missing data". In statistics, **missing data**, or **missing values**, occur when no data value is stored for the variable in the current observation. Missing data is a common occurrence and can reduce the representativeness of the sample, and therefore distort inferences about the population. In situations where missing data is likely to occur, it is advisable to use methods of data analysis methods that are robust to missingness. An analysis is robust when it is capable that mild to moderate violations of the technique's key assumptions will produce little or no bias or distortion in the conclusions drawn about the population. If it is known that the data analysis technique which is to be used isn't content robust, it is a good idea to consider imputing the missing data.

Table D

Year	Alcohol a factor	Alcohol not a factor	Cases where information about alcohol is known		Cases containing no information on alcohol
	a	b	a+b	c	c-(a+b)
2005	28.33%	15.56%	43.89%	100%	56.11%
2006	20.87%	14.64%	35.51%	100%	64.49%
2007	15.53%	18.77%	34.30%	100%	65.70%

In order to remedy the missing BAC values, this study uses **multiple imputation** to estimate the BAC in the Garda investigation files (Li, et al 1991), (Rubin, 1987), (Rublin, 1996). Multiple imputation replaces missing values with multiple sets of simulated values to complete the data, applies standard analyses to each completed data set, and adjusts the obtained parameter estimates for missing-data uncertainty. The objective of multiple imputation is to handle missing data in a way that results in valid statistical inference.

Multiple imputation provides a useful strategy for dealing with data sets with missing values. Instead of filling in a single value for each missing value, Rubin's (1987) multiple imputation procedure replaces each missing value with a set of plausible values that represent the uncertainty about the right value to impute. These multiple imputed data sets are then analysed by using standard procedures for complete data and combining the results from these analyses. No matter which complete data analysis is used, the process of combining results from different imputed data sets is essentially the same. This results in valid statistical inferences that properly reflect the uncertainty due to missing values.

The imputation method used in this study follows the two-stage model approach developed by Rubin et al. (1998) for the U.S. Department of Transport National Highway Traffic Safety Administration (NHTSA). The two-stage model consists of a first-stage conventional loglinear model to determine BAC as a binary indicator, i.e., if BAC=0 or BAC>0. The second stage of this is a conventional linear regression model used to predict the actual level of BAC given that BAC>0.

Table E below demonstrates the results of the usage of the multiple imputation method to deal with the missing values issue. It once again shows a significant decline in alcohol-related fatal collisions over the period

Review of Pre-crash Behaviour in Fatal Road Collisions
Report 1: Alcohol

examined. It again shows that there was a significant decline in alcohol-related fatal collisions after the introduction of mandatory alcohol testing which was introduced in mid 2006.

Table E

Year	% BAC \geq 20mg /100ml	% Alcohol factor (BAC \geq 20mg /100ml) using case deletion method	% Alcohol factor (BAC \geq 20mg /100ml) using imputation method
2005	28.33%	64.56%	65%
2006	20.87%	58.77%	64%
2007	15.53%	45.28%	57%

Review of Pre-crash Behaviour in Fatal Road Collisions
Report 1: Alcohol

Profile of drivers and motorcyclists

The table below shows the number of drivers and motorcyclists who were involved in a fatal road traffic collision in the years 2005-2007 and identifies the presence or not of alcohol. The table is indicative of the age of the person concerned.

Table F

Age group of drivers and motorcyclists involved in a fatal road traffic collision in the years 2005-2007

Year			BAC limit		Total	% above legal limit
			Within legal limit or no alcohol present	Over the legal limit		
2005	Age group	0-9	2	0	2	0.0
		10-16	4	0	4	0.0
		17-24	33	63	96	65.6
		25-34	27	47	74	63.5
		35-49	25	45	70	64.3
		50-64	17	16	33	48.5
		65 +	6	8	14	57.1
		unknown	14	17	31	54.8
	Total		128	196	324	60.5
2006	Age group	10-16	1	0	1	0.0
		17-24	24	52	76	68.4
		25-34	30	42	72	58.3
		35-49	27	42	69	60.9
		50-64	17	15	32	46.9
		65 +	14	6	20	30.0
		unknown	5	10	15	66.7
	Total		118	167	285	58.6
2007	Age group	0-9	1	0	1	0.0
		10-16	3	0	3	0.0
		17-24	28	47	75	62.7
		25-34	25	37	62	59.7
		35-49	34	32	66	48.5
		50-64	19	11	30	36.7
		65 +	12	3	15	20.0

Review of Pre-crash Behaviour in Fatal Road Collisions
Report 1: Alcohol

	unknown	9	6	15	40.0
Total		131	136	267	50.9

Testing of drivers at scene/Garda station/hospital

Information was collected on the testing of drivers/motorcyclists involved in fatal collisions over the three years and the relevant files were studied. The number of individuals where information was collected is as follows: 518 in 2005, 477 in 2006 and 421 in 2007. In the vast majority of cases, no information was available as to whether a breath test was administered to the driver(s)/motorcyclist(s) - 80.8% in 2005, 76% in 2006 and 62% in 2007.

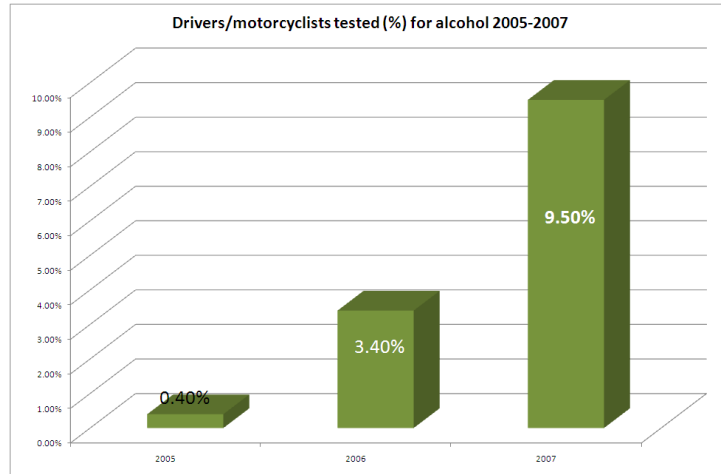
Table G

	2005	%	2006	%	2007	%
Tested	2	0.4%	16	3.4%	40	9.5%
No Information	420	81.1%	373	78.2%	288	68.4%
Failed test	0	0.0%	0	0.0%	1	0.2%
Passed test	2	0.4%	15	3.1%	39	9.3%
Refused test	0	0.0%	1	0.2%	0	0.0%
Unknown	96	18.5%	88	18.4%	93	22.1%
Total	518	100.0%	477	100.0%	421	100.0%

Table contains both vehicles where forensic files were available and ones where no forensic files were available .

However, over the period of the study, there was more than a nineteen fold increase in the percentage of cases where a test was administered. It is worth noting that this increase in testing coincided with the introduction of mandatory alcohol testing which was permitted by legislation in the summer of 2006.

Review of Pre-crash Behaviour in Fatal Road Collisions Report 1: Alcohol



Reference

1. Li, K.-H., T. E. Raghunathan, and D. B. Rubin. 1991. Large-sample significance levels from multiply imputed data using moment-based statistics and an F reference distribution. *Journal of the American Statistical Association* 86: 1065—1073.
2. Marchenko, Y. V. and J. P. Reiter. 2009. Improved degrees of freedom for multivariate significance tests obtained from multiply imputed, small sample data. *Stata Journal*. Forthcoming.
3. Rubin, D. B. 1987. *Multiple Imputation for Nonresponse in Surveys*. New York: Wiley.
4. Rubin, D. B. 1996. Multiple imputation after 18+ years. *Journal of the American Statistical Association* 91: 473—489.
5. Schafer, J. L. 1997. *Analysis of Incomplete Multivariate Data*. Boca Raton, FL: Chapman & Hall/CRC.
6. van Buuren, S., H. C. Boshuizen, and D. L. Knook. 1999. Multiple imputation of missing blood pressure covariates in survival analysis.

Working To Save Lives

Údarás Um Shábháilteacht Ar Bhóithre Road Safety Authority

Páirc Ghnó Ghleann na Muaidhe, Cnoc an tSabhaircín, Bóthar Bhaile Átha Cliath, Béal an Átha, Co. Mhaigh Eo
Moy Valley Business Park, Primrose Hill, Dublin Road, Ballina, Co. Mayo
local: 1890 50 60 80 fax: (096) 25 000 email: info@rsa.ie website: www.rsa.ie