



MONASH University

Accident Research Centre

Victorian Injury Surveillance Unit (VISU)

Off-road motorcycling injury in Victoria

Mary O'Hare
Erin Cassell
Melinda Congiu

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Summary

This report provides data and information on off-road motorcycling injury in Victoria at three levels of severity: deaths, hospital admissions and emergency department (E.D) presentations (non-admissions). A comparative analysis with on-road motorcycling injury was also undertaken. The data were extracted from three injury databases held by the Victorian Injury Surveillance Unit (VISU) at Monash University Accident Research Centre:

1. The Australian Bureau of Statistics Death Unit Record File (ABS-DURF) for deaths
2. Victorian Admitted Episodes Dataset (VAED) for hospital admissions
3. Victorian Emergency Minimum Dataset (VEMD) for emergency department presentations (non-admissions)

The latest available three years of data were extracted from each dataset for analysis: January 1, 2001 to December 31, 2003 for fatalities; July 1 2001 to June 30 2004 for hospital admissions; and July 1, 2002 to June 30, 2005 for emergency department presentations (non-admissions).

Key definitions:

On-road: injuries incurred by motorcyclists from a traffic accident.

Off-road: injuries incurred by motorcyclists from a non-traffic accident.

1. Off- and on- road motorcycling fatalities (ABS-DURF)

- Over the three-year period 2001-2003, there were 187 motorcycling deaths in Victoria, 86% (n=161) of which occurred on-road and 14% (n=26) off-road.
- In this period there was an overall reduction of 49% in motorcycling fatalities, with a 45% decrease in those occurring on-road and a 70% decline in those occurring off-road.
- Males were over-represented in both on-road and off-road motorcycling fatalities, accounting for 94% of on-road fatalities and 88% of off-road fatalities.
- The peak age group for off-road fatalities was 15-24 years (62%, all males). The pattern for on-road fatalities was different as they were concentrated across a wider range of 10-year age groups from age 15-54 years. One third of off-road fatalities (32%) were aged 20-29 years.
- For both on-road and off-road motorcycling, more fatalities occurred in December than in any other month of the year, although the number of on-road fatalities was also high in May. Seasonal variations in the frequency of fatalities were evident for on-road motorcycling with more deaths occurring in summer and autumn compared with winter and spring.
- The major cause of on-road motorcycling fatalities was collision with other motor vehicles such as cars, vans, pick-up trucks, heavy vehicles or buses (54%). By contrast, only 12% of off-road motorcyclists died from injuries

received in collisions with other motor vehicles (most commonly another motorcycle). Off-road fatalities were mostly caused by the driver being thrown off or falling off the motorcycle (27%), or being killed in the course of driving an all-terrain vehicle or other off-road motorcycle (27%). Approximately one-quarter of both off-road and on-road fatalities were caused by collisions of the motorcycle with a fixed object.

- Due to coding and classification issues, data on location (place of occurrence), detailed cause of death, and the activity at the time of injury did not provide any meaningful information.

2. Off- and on-road motorcycling hospitalisations (VAED)

There were 7,706 hospital admissions for motorcycling injuries recorded on the VAED over the 3-year period 2001/02 to 2003/04. Of these, 3,428 (45%) were related to off-road motorcycling, 4,023 (52%) to on-road motorcycling and the remaining cases (n=255, 3%) were assigned to 'other and unspecified' codes.

Off-road motorcycling injury hospital admissions

- A total of 3,428 off-road motorcycling hospital admissions occurred over the 3-year period 2001/02 to 2003/04. There was a small increase (2%) in the annual frequency of motorcycling hospitalisations over this period.
- Seventy-one percent of off-road motorcycling hospital admissions were aged 10 – 34 years and 92% were male.
- Although fractures were the most common injury (59%), intracranial injuries (8%) were the most serious with 61% of brain-injured cases requiring a length of hospital stay of 8 or more days.
- The two most commonly injured body sites were knee and lower leg (25%) and the head (14%).
- Just over half of the off-road injury cases (53%) were discharged after a hospital stay of less than two days.

Combined off-road and on-road motorcycling injury hospital admissions

- More than 90% of the 7,706 hospitalisations for motorcycling injuries were males, overall and for both off-road and on-road motorcyclists.
- Off-road motorcycling hospital admissions peaked in age group 15–19 years, whereas on-road motorcycling hospital admissions peaked in age group 25–29 years.
- Fractures were the most common injury for both off-road and on-road motorcyclists, accounting for 59% and 54% of injuries respectively.
- On-road motorcycling injury hospitalisations were more likely to be caused by collisions with other vehicles, whereas off-road cases were more likely to be caused by non-collision events such as being thrown off or falling off the motorcycle.

3. Off- and on-road hospital ED presentations (non-admissions) (VEMD)

- A total of 9,553 ED presentations for motorcycling injury were made to hospital Emergency Departments in Victoria over the three-year period 2002/3 to 2004/5.
- Almost half (47%) of these occurred on-road and 37% occurred off-road. Over the three-year period there was a 66% increase in the number of ED presentations for off-road motorcycling injuries.
- Data on the type of bike involved were limited. Available evidence indicated that dirt bikes and trail bikes were the bikes most frequently involved in motorcycling injury ED presentations.
- Males were injured far more frequently than females (89% vs 10%). A higher proportion of females were injured during on-road riding than off-road riding (19% vs 10%).
- The age pattern of ED presentations for on-road and off-road motorcycling was similar except that off-road ED presentations peaked at an earlier age (10-14 years) than on-road ED presentations (15–19 years).
- Both on- and off-road motorcycle ED presentations were lowest in winter (21% and 19% respectively). ED presentations peaked in summer for on-road motorcyclists (27%) and in autumn for off-road motorcyclists (28%)
- Both on-road and off-road motorcyclist ED presentations increased over the weekend and peaked on Sunday.
- The major proportion (88%) of off-road injuries were sustained in the course of leisure and sports pursuits and occurred at recreational, athletics and sports venues. All on-road motorcycle accidents, by definition, occurred on roads, streets or highways.
- The top four injuries sustained by on-road and off-road motorcyclists were identical: fractures, sprains and strains, superficial injuries, and open wounds.
- The most commonly injured body sites for on-road and off road motorcycle injuries were the same although they were ranked differently. The top five injured body sites for on-road motorcycling ED presentations were: multiple injuries (15% of cases); shoulder (13%); knee (9%); ankle (6%); and wrist (6%). The top five injured body regions for off-road motorcycle ED presentations were: shoulder (16% of cases); knee (10%); wrist (9%); ankle (8%) and multiple injuries (7%).

Table 1: Summary table of off- and on-road motorcycle injury cases, Victoria

Characteristics	Deaths			Hospital Admissions			Emergency Dept Presentations (non-admissions)		
	Off-road n=26	On-road n=161	All n=187	Off-road N=3,428	On-road n=4,023	All** n=7,706	Off-road n=3,564	On-road n=4,508	All*** n=9553
Gender									
Male	23 (88%)	151 (94%)	174 (93%)	3140 (92%)	3663 (91%)	7034 (91%)	3158 (89%)	3613 (80%)	8099 (85%)
Female	3 (12%)	10 (6%)	13 (7%)	288 (8%)	360 (9%)	672 (9%)	361 (10%)	861 (19%)	1337 (14%)
Age group in years									
0-4 years	1 (4%)	2 (1%)	3 (2%)	21(<1%)	5 (<1%)	28 (<1%)	27 (<1%)	17(<1%)	50 (<1%)
5-9 years	1 (4%)	0 (0%)	1 (<1%)	166 (5%)	44 (1%)	221 (3%)	215 (6%)	48 (1%)	316 (3%)
10-14 years	1 (4%)	2 (1%)	3 (2%)	463 (14%)	173 (4%)	653 (9%)	596 (17%)	132 (3%)	882 (9%)
15-19 years	10 (39%)	14 (9%)	24 (13%)	609 (18%)	395 (10%)	1047 (14%)	759 (21%)	543 (12%)	1,571 (16%)
20-24 years	6 (23%)	24 (15%)	30 (16%)	533 (16%)	647 (16%)	1217 (16%)	579 (16%)	856 (19%)	1,740 (18%)
25-29 years	0 (0%)	27 (17%)	27 (14%)	421 (12%)	666 (17%)	1118 (15%)	423 (12%)	764 (17%)	1,418 (15%)
30-34 years	0 (0%)	20 (12%)	20 (11%)	371 (11%)	600 (15%)	1011 (13%)	367 (10%)	673 (15%)	1,227 (13%)
35-39 years	1 (4%)	18 (11%)	19 (10%)	239 (7%)	480 (12%)	746 (10%)	245 (7%)	458 (10%)	830 (9%)
40-44 years	1 (4%)	16 (10%)	17 (9%)	223 (7%)	385 (10%)	623 (8%)	156 (4%)	353 (8%)	591 (6%)
45-49 years	0 (0%)	15 (9%)	15 (8%)	129 (4%)	263 (7%)	407 (5%)	91 (3%)	273 (6%)	397 (4%)
50-54 years	0 (0%)	11 (7%)	11 (6%)	95 (3%)	169 (4%)	268 (4%)	49 (1%)	176 (4%)	244 (3%)
55-59 years	2 (8%)	3 (2%)	5 (3%)	50 (2%)	89 (2%)	143 (2%)	525 (<1%)	77 (2%)	108 (1%)
60-64 years	0 (0%)	5 (3%)	5 (3%)	29 (<1%)	33 (<1%)	63 (<1%)	11 (<1%)	53 (1%)	67 (<1%)
65-69 years	0 (0%)	0 (0%)	0 (0%)	21 (<1%)	27 (<1%)	50 (<1%)	8 (<1%)	30 (<1%)	40 (<1%)
70-74 years	3 (12%)	3 (2%)	6 (3%)	24 (<1%)	25 (<1%)	51 (<1%)	6 (<1%)	21 (<1%)	30 (<1%)
75-79 years	0 (0%)	0 (0%)	0 (0%)	12 (<1%)	8 (<1%)	21 (<1%)	2 (<1%)	18 (<1%)	20 (<1%)
80+ years	0 (0%)	1 (<1%)	1 (<1%)	22 (<1%)	14 (<1%)	39 (<1%)	5 (<1%)	15 (<1%)	20 (<1%)

Injury cause (top 4)	<ul style="list-style-type: none"> - MC driver non-collision (throw/fall): 7 (27%) - Driver ATV or other off-road MC: 7 (27%) - MC driver collision (fixed object): 6 (23%) - MC driver collision (other MC): 3 (12%) 	<ul style="list-style-type: none"> -MC driver * collision (car, van): 68 (42%) -MC driver * collision (fixed object): 43 (27%) -MC driver * collision (HV, bus): 19 (12%) -MC driver* non-collision (throw/ fall): 8 (5%) *All MC riders rode motor scooters, mopeds or motorised bicycles. 	<ul style="list-style-type: none"> -MC driver* collision (car, van): 68 (36%) -MC driver * collision (fixed object) = 43 (23%) -MC driver* collision (HV, bus): 19 (10%) -MC driver* non-collision (throw/ fall): 8 (4%) *All MC riders rode motor scooters, mopeds or motorised bicycles & were on-road. 	<ul style="list-style-type: none"> -MC driver non-collision eg throw/fall (motor scooter, moped or motorised bicycle): 638 (19%) -MC driver non-collision eg throw/fall: 523 (15%) -MC driver non-collision eg throw/fall (ag-bike, dirt bike, trail bike): 332 (10%) -MC rider (any) in unspecified accident: 311 (9%) 	<ul style="list-style-type: none"> -MC rider (any) in unspecified accident: 702 (17%) -MC driver non-collision accident (motor-scooter, moped or motorised bicycle): 357 (9%) -MC driver collision with car, van (motor-scooter, moped or motorised bicycle): 334 (8%) 	<ul style="list-style-type: none"> -MC rider (any) in unspecified accident: 702 (9%) (on-road) -MC driver non-collision eg throw/fall (motor scooter, moped or motorised bicycle): 638 (8%) (off-road). -MC driver non-collision accident: 523 (7%) (off-road). -MC driver non-collision accident (motor-scooter, moped or motorised bicycle): 357 (5%) (on-road) 	<ul style="list-style-type: none"> - MC Driver: 3230 (91%) - MC Passenger = 161 (5%) - Fall (up to 1 metre) = 102 (3%) - MC rider or pillion: 37 (1%) 	<ul style="list-style-type: none"> -MC Drive: 3935 (87%) -MC Passenger = 538 (12%) -Fall (up to 1 metre) = 2 (<1%) -Collison with person = 3 (<1%) 	<ul style="list-style-type: none"> -MC Driver: 8504 (89%) -MC Passenger: 789 (8%) -Fall (up to 1 metre): 149 (2%) -MC rider or pillion: 55 (<1%)
Nature of main injury (top 4)	<i>Unavailable</i>	<i>Unavailable</i>	<i>Unavailable</i>	<ul style="list-style-type: none"> -Fracture: 2038 (59%) -Open wound: 290 (8%) -Intracranial injury: 261 (8%) -Other/unspecified injury: 227 (6%) 	<ul style="list-style-type: none"> -Fracture: 2191 (54%) -Other/unspecified injury: 347 (9%) -Open wound: 312 (8%) -Dislocation/sprain/strain: 285 (7%) 	<ul style="list-style-type: none"> -Fracture: 4394 (57%) -Open wound: 617 (8%) -Other/unspecif.: 589 (8%) -Intracranial injury =536 (7%) 	<ul style="list-style-type: none"> -Fracture: 1041 (29%) -Sprain / strain: 807 (23%) -Superficial injury: 368 (10%) -Open wound: 361 (10%) 	<ul style="list-style-type: none"> -Fracture: 1012 (22%) -Sprain/strain: 988 (22%) -Superficial injury: 714 (16%) -Open wound: 361 (8%) 	<ul style="list-style-type: none"> - Fracture: 2444 (26%) - Sprain/strain: 2147 (23%) - Superficial injury: 1285 (14%) - Open wound: 851 (9%)

Body region injured (top 4)	<i>Unavailable</i>	<i>Unavailable</i>	<i>Unavailable</i>	-Knee & lower leg: 856 (25%) -Head: 471 (14%) -Elbow & forearm: 458 (13%) -Shoulder & upper arm: 440 (13%)	-Knee & lower leg: 919 (23%) -Elbow & forearm: 490 (12%) -Shoulder & upper arm: 478 (12%) -Head: 448 (11%)	-Knee & lower leg: 1843 (24%) -Elbow & forearm: 991 (13%) -Shoulder & upper arm: 950 (12%) -Head: 931 (12%)	-Shoulder: 578 (16%) -Knee: 359 (10%) -Wrist: 309 (9%) -Ankle: 280 (8%)	-Multiple injuries: 680 (15%) -Shoulder: 596 (13%) -Knee: 420 (9%) -Ankle = 284 (6%)	-Shoulder: 426 (15%) -Multiple injuries: 1,071 (11%) -Knee = 939 (10%) -Ankle: 666 (7%)
Season of year									
Spring	5 (23%)	28 (17%)	33 (18%)	868 (25%)	1,028 (26%)	1,959 (25%)	933 (26%)	1,168 (26%)	2,478 (26%)
Summer	7 (27%)	50 (31%)	57 (31%)	946 (27%)	1,088 (27%)	2,103 (27%)	903 (25%)	1,219 (27%)	2,535 (27%)
Autumn	6 (19%)	52 (32%)	58 (31%)	941 (27%)	1,112 (28%)	2,118 (28%)	1,043 (29%)	1,182 (26%)	2,627 (28%)
Winter	8 (31%)	31 (19%)	39 (21%)	673 (20%)	795 (20%)	1,526 (20%)	685 (19%)	939 (21%)	1,913 (20%)
Length of hospital stay	<i>Unavailable</i>	<i>Unavailable</i>	<i>Unavailable</i>				<i>Not applicable</i>	<i>Not applicable</i>	<i>Not applicable</i>
<2 days				1830 (54%)	2014 (50%)	3979 (52%)			
2 – 7 days				1322 (39%)	1373 (34%)	2804 (36%)			
8 - 30 days				257 (8%)	554 (14%)	821 (11%)			
31+ days				19 (<1%)	82 (2%)	102 (1%)			
Location of injury	<i>Unavailable</i>	<i>Unavailable</i>	<i>Unavailable</i>	-Unspecified: 1300 (38%) -Other specified: 738 (22%) -Sports & athletic areas: 415 (12%) -Farm: 407 (12%)	-Road, street, highway: 2853 (71%) -Unspecified: 927 (23%) -Other specified: 107 (3%) -Sports & athletic areas: 43 (1%)	-Road, street, highway: 3307 (43%) -Unspecified: 2,347 (31%) -Other specified: 874 (11%) -Sports & athletic areas: 480 (6%)	- Recreation place: 1370 (38%) - Home: 856 (24%) - Farm: 780 (22%) - Athletics/ sports area: 459 (13%)	- Road, street or highway: 4508 (100%)	Road, street or highway = 4,508 (47%) Recreation place = 1,370 (14%) Home = 856 (9%) Farm = 780 (8%)

Activity at time of injury	- Other specif /unspecif ed: 21 (81%) - Sports: 2 (8%) - Leisure: (4%) - Work (paid): 1 (4%) - Work (other): 1 (4%)	-Other specified/ unspecif./ unavailable : 160 (99%) -Leisure: 1 (<1%)	- Other specified/ unspecif./ unavail.: 181 (97%) - Sports:2 (1%) - Leisure: 2 (1%)	- Sports: 1,034 (30%) - Unspecified : 999 (29%) - Other specified: 918 (27%) - Leisure: 355 (10%)	- Unspecified : 1888 (47%) - Other specified: 1798 (45%) - Sports: 217 (5%) - Working for income: 49 (1%)	- Unspecified: 2982 (39%) - Other specified: 2805 (36%) - Sports: 1307 (17%) - Leisure: 414 (5%)	- Leisure: 2653 (74%) - Sports: 485 (14%) - Other specif /unspecif: 278 (8%) - Working for income: 79 (2%)	- Leisure: 2610 (58%) - Other specified /unspecified: 1482 (33%) - Vital activity: 194 (4%) - Working for income: 128 (3%)	- Leisure: 6184 (65%) - Other specified /unspecified: 2242 (23%) - Sports: 599 (6%) - Vital activity: 232 (2%)
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Notes: **Total admissions includes other and unspecified as well as off- and on-road figures; ***Total ED presentations includes 117 motorcycle injury cases with some data missing as well as off- and on-road figures.

Abbreviations: MC = motorcycle; Unspec. occup. = unspecified occupant; MV = motor vehicle; non-MV = Non-motor vehicle such as animal-drawn vehicle, animal being ridden; HV = heavy transport vehicle; Ped = pedestrian

Off-road motorcycling injury in Victoria

Introduction

This report provides data and information on off-road motorcycling injury in Victoria at three levels of severity: deaths, hospital admissions and emergency department (E.D) presentations (non-admissions). A comparative analysis with on-road motorcycling injury was also undertaken. The data were extracted from three injury databases held by the Victorian Injury Surveillance Unit (VISU) at Monash University Accident Research Centre:

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The latest available three years of data were extracted from each dataset for analysis: January 1, 2001 to December 31, 2003 for fatalities; July 1 2001 to June 30 2004 for hospital admissions; and July 1, 2002 to June 30, 2005 for emergency department presentations (non-admissions).

The Australian Bureau of Statistics Death Unit Record File (ABS-DURF)

This file contains information supplied by the State Registrar of Births, Deaths and Marriages from death certificates to the Australian Bureau of Statistics (ABS). Each death registered in Australia is classified according to the World Health Organisation (WHO) International Classification of Diseases (ICD), Version 10 (ICD-10). Death data for the calendar years 1970, 1975, 1980, and 1990–2003 are held by VISU. The current file consists of 141,949 injury-related death records, 32,487 of which are Victorian. Year 2003 data may be underestimated by 5–10% due to a delay in registration of some deaths that occurred late in the year. Timeliness of data is an issue. The ABS provides VISU with a unit record file of data annually, usually in the December of the following year. The unit record file of deaths data for 2004 (which would contain additional cases that occurred in 2003 but which were not registered in that year) were provided to VISU in December 2005 but the file was called back due to technical issues. It was reissued in March 2006 but, due to VISU staffing issues, the data will not be integrated into the VISU ABS-DURF dataset until August 2006.

The Victorian Admitted Episodes Database (VAED)

The VAED is a state-wide collection of data on all admissions to Victorian hospitals (both public and private) compiled by the Department of Human Services. The injury surveillance subset is supplied annually to VISU. Injury data are coded to the WHO International Classification of Diseases Version 10 with Australian Modifications (ICD10-AM) by trained hospital personnel utilising information recorded by medical and ancillary staff in patient records (paper-based and electronic).

When integrating the injury data onto the VEMD dataset held by VISU, cases readmitted to the same hospital within 30 days are excluded to minimise the possibility

of double counting. Each record in the database represents an episode of care, and not necessarily one incident. A patient may be transferred within and between hospitals for various episodes of care and these transfers cannot be tracked so that they may be represented by more than one record. This double counting is estimated to account for 10% of cases on the database.

The VAED (Injury Surveillance) subset held by VISU contains in excess of 2 million records for the 17-year period 1987/88 to 2003/04. Data for 2004/5 are delayed. The file has not yet been received from DHS but should be available in July.

The Victorian Emergency Minimum Dataset (VEMD)

The VEMD records details of injury cases treated at hospitals with 24-hour Emergency Department services in Victoria compiled by the Department of Human Services and supplied quarterly to VISU. Data are supplied to DHS from the participating hospitals. At the hospital level, injury surveillance data are entered onto an electronic database by Emergency Department medical staff or clerks at triage when the patient explains the reason for presentation or later based on the information on the presenting problem recorded electronically at triage or in the paper-based patient record. A validation study conducted by VISU has shown that 80% of injury cases are captured on the VEMD but data quality varies by hospital and by individual staff member.

Both admitted and non-admitted cases are recorded on the dataset but only non-admissions were analysed for this report (admissions data for this report were extracted from the VAED). Currently, 38 hospitals contribute data to the VEMD (Injury Surveillance). From January 2004 onwards, 100% statewide coverage applied. The total number of cases on the VISU-held VEMD dataset is in excess of 2,115,000 records. In addition to the standard injury surveillance variables —age, sex, injury cause, location, activity, nature of main injury, body region injured, and human intent— the VEMD also contains a free text description (narrative) describing the injury event in more detail. The quality of narrative data varies between hospitals and ranges from poor to excellent.

1. Fatalities

Fatalities were extracted from the Australian Bureau of Statistics (ABS) death unit record file (DURF) file for the 3-year period 2001-3.

1.1 Case selection procedure

- Cases were selected for analysis utilising ICD-10 broad external cause of injury codes V20-V29, '*Motorcycle rider injured in transport accident*'. Within these broad codes, subcategories were selected that separated non-traffic from traffic cases.

Non-traffic: (V20.0 – V28.0) '*driver injured in nontraffic accident*' and (V20.2 – V28.2) '*unspecified motorcycle rider injured in nontraffic accident*'. (V29.0) '*driver injured in collision with other and unspecified motor vehicles in nontraffic accident*' and (V29.3) '*motorcycle rider [any] injured in unspecified nontraffic accident*'.

Traffic: (V20.4 – V28.4) '*driver injured in traffic accident*' and (V20.9 – V28.9) '*unspecified motorcycle rider injured in traffic accident*'. (V29.4) '*driver injured in collision with other and unspecified motor vehicles in traffic accident*'; (V29.5) '*passenger injured in collision with other and unspecified motor vehicles in traffic accident*'; (V29.6) '*unspecified motorcycle rider injured in collision with other and unspecified motor vehicles in traffic accident*' and (V29.9) '*motorcycle rider [any] injured in unspecified traffic accident*'.

- In addition, the external cause code V86 '*Occupant of special all terrain or other motor vehicle designed primarily for off-road use, injured in transport accident*' was also interrogated. All codes covering three- and four-wheeled motorcycles were excluded. The codes retained were:

Non-traffic: (V86.5) '*driver of all-terrain or other off-road motor vehicle injured in non-traffic accident*' and (V86.9) '*unspecified occupant of all-terrain or other off-road motor vehicle injured in nontraffic accident*'.

Traffic: (V86.0) '*driver of all-terrain or other off-road vehicle injured in traffic accident*' and (V86.3) '*unspecified occupant of all-terrain or other off-road vehicle injured in traffic accident*'.

These codes were further broken down into these sub-classifications: '*two-wheeled special all-terrain or other off-road vehicle*' and '*special all-terrain or other off-road motor vehicle, unspecified number of wheels*'. The latter category may contain some three- and four-wheeled motorcycle cases but all cases were retained to capture eligible injury cases that occurred on two-wheeled motorcycles.

- Extracted cases were aggregated and assigned to four groups: off-road (‘non-traffic’), on-road (‘traffic’), other (‘cases in which injuries were sustained whilst *boarding or alighting* the motorcycle’, ICD10 code V20.3 – V29.3 and V86.4) and unspecified (all cases coded to ‘unspecified’).

1.2 Definitions

Definitions were extracted from the ICD-10 manual:

Motorcycle rider: ‘any person riding on a motorcycle or in a sidecar or trailer attached to such a vehicle’. A motorcycle was defined as any road bike, dirt bike (or trail bike), moped, motorscooter or minibike. Excluded, as far as possible, were cases involving three-wheeled and four wheeled all-terrain vehicles.

Transport accident: ‘any accident involving a device designed primarily for, or being used at the time primarily for, conveying persons or goods from one place to another’.

Public highway [trafficway] or street: ‘the entire width between property lines (or other boundary lines) of land open to the public as a matter of right or custom for purposes of moving persons or property from one place to another. A roadway is that part of the public highway designed, improved and customarily used for vehicular traffic’.

Traffic accident: ‘any vehicle accident occurring on the public highway (or originating on, terminating on, or involving a vehicle partially on the highway]. A vehicle accident is assumed to have occurred on the public highway unless another place is specified, except in the case of accidents involving only off-road motor vehicles, which are classified as nontraffic accidents unless the contrary is stated’.

Non-traffic accident: ‘any vehicle accident that occurs entirely in any place other than a public highway’.

Using the above definitions, all injury data included in the analyses below were assigned to one of these two groups:

On-road: cases of motorcycling injury that occurred in a traffic accident.

Off-road: cases of motorcycling injury that occurred in a non-traffic accident.

1.3 Results

A total of 187 motorcycling fatalities (excluding most 3 and 4-wheel vehicle-related deaths) occurred over the three-year period 2001 to 2003 in Victoria (Table 2). Most fatalities occurred on-road (86%). All deaths were classified as unintentional.

Table 2 On- and off-road motorcycling fatalities, Victoria 2001-3

on or off road transport			
		Frequency	Percent
Valid	Off-road	26	13.9
	On-road	161	86.1
	Total	187	100.0

1.3.1 Off-road motorcycling fatalities

Over the three-year period 2001-3 there were 26 off-road motorcycling fatalities, 14% of all motorcycling fatalities that occurred in Victoria over this period. There was a sharp decrease in the frequency of deaths between 2002 and 2003 (Table 3). A small proportion of the decrease (around 2 deaths) may be explained by late notification of deaths that occurred in December 2003 as data on missed cases in the previous year are supplied by the ABS with the next year's data file. Nonetheless, the annual frequency of off-road motorcycling fatalities needs to be monitored over a longer time period to see whether the sharp downturn observed between 2002 and 2003 is an aberration.

Table 3 Off-road motorcycling fatalities by year of registration, Victoria 2001-3

Year of Death Registration			
		Frequency	Percent
Valid	2001	10	38.5
	2002	13	50.0
	2003	3	11.5
	Total	26	100.0

Seasonal variation

Off-road motorcycling deaths peaked in December (6 deaths or 23%), and no deaths occurred in January in any of the three years (Table 4). Overall, there was no obvious seasonal variation: winter (8 deaths); summer (7 deaths); autumn (6 deaths); and spring (5 deaths).

Table 4 Off-road motorcycling fatalities by month of year, Victoria 2001-3

Month of Death Registration		Frequency	Percent
Valid	February	1	3.8
	March	1	3.8
	April	2	7.7
	May	3	11.5
	June	3	11.5
	July	2	7.7
	August	3	11.5
	September	2	7.7
	October	1	3.8
	November	2	7.7
	December	6	23.1
	Total	26	100.0

Gender and age

Males accounted for 88% of off-road motorcycling fatalities, most likely because of their higher motorcycling participation rate (Table 5). Because of the small number of female deaths, detailed analysis by gender was not undertaken.

Table 5 Off-road motorcycling fatalities by age and gender, Victoria 2001-3

Age in groups * Gender Crosstabulation				
Count		Gender		Total
		Male	Female	
Age in groups	0-4yrs	1	0	1
	5-9yrs	1	0	1
	10-14yrs	1	0	1
	15-19yrs	10	0	10
	20-24yrs	6	0	6
	35-39yrs	1	0	1
	40-44yrs	1	0	1
	55-59yrs	1	1	2
70-74yrs	1	2	3	
Total		23	3	26

Young males and older females appear over-represented in the fatalities data but participation and exposure data are not available. Males aged 15–24 years accounted

for 16 of the 26 off-road motorcycling deaths (62%) (Table 5). The peak age group for fatalities was 15-19 year olds (all males). Research indicates that inexperience as well as the smaller stature (height and weight) of younger riders may cause child and adolescent motorcyclists to be at higher risk of injury (Van Muiswinkel, 1994; Rodgers & Adler, 2001).

Location and activity

Analyses by location (place of occurrence) and activity (at the time of injury) were not undertaken because of data quality and classification issues. For both variables, only a small amount of the data was coded to meaningful categories, with the majority of cases labelled as 'unspecified', 'unavailable', or 'other'. For the 'activity' code, only 5 (19%) of the fatalities were classified into a meaningful category. Of these, three deaths occurred in leisure or sports, and two were work-related (paid and unpaid).

Cause of injury

The major causes of fatal injury, accounting for 89% of off-road motorcycling deaths, were:

- Motorcycle driver injured in a non-collision accident (e.g. throw, fall or overturned motorcycle accident) - 7 deaths (27% of cases).
- Motorcycle or all-terrain vehicle (ATV) driver injured in a non-traffic accident – 7 deaths (27% of cases).
- Motorcycle driver injured in a collision with a fixed or stationary object – 6 deaths (23% of cases).
- Motorcycle driver injured in a collision with another motorcycle – 3 deaths or 12% of cases.

1.3.2 Comparison of off-road and on-road motorcycling fatalities

Of the 187 motorcycling fatalities over the three-year period 2001-2003, 82% occurred on-road (Table 6). There was a consistent downward trend in the frequency of on-road motorcycling fatalities over the 3-year period, whereas off-road fatalities increased in 2002 then declined sharply in 2003. There was a 45% reduction in the frequency of on-road motorcycling fatalities over the 3-year period compared with a 70% reduction in off-road fatalities. As previously mentioned, off- and on-road fatality data may not be complete for 2003 because a small proportion of deaths that occurred late in 2003 may not be recorded due to late notification.

Table 6 Frequency of off- and on-road motorcycling fatalities, Victoria 2001-3

Year of Death Registration * On or Off Road Crosstabulation				
		Off-road	On-road	Total
Year of	2001	10	66	76
Death	2002	13	59	72
Registration	2003	3	36	39
Total		26	161	187

Seasonal variation

Figure 1 depicts the frequency of off-road, on-road, and overall motorcycling fatalities by month of year for the three-year period 2001-3. On-road motorcycling fatalities peaked in May and again in December but there is less variation in off-road fatalities with a single peak in December. Seasonal analysis revealed that there were more deaths of on-road motorcyclists in autumn (52 deaths) and summer (50 deaths) compared with winter (31 deaths) and spring (28 deaths). This is probably related to exposure.

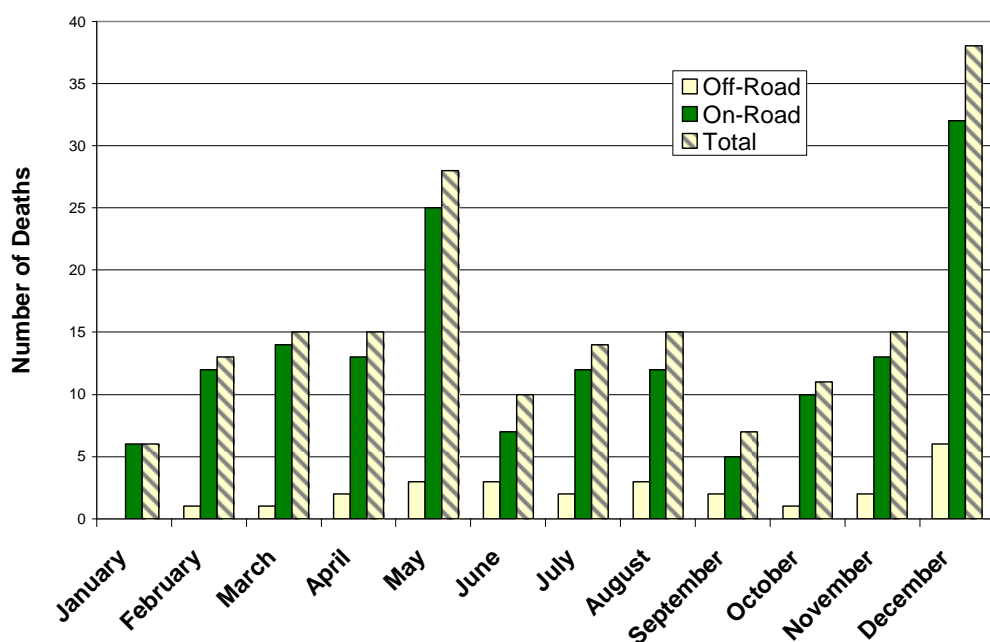


Figure 1: Frequency of on- and off-road motorcycling fatalities by month of year, Victoria 2001-3

Males were over-represented in both on-road and off-road motorcycle fatalities, accounting for 86% of fatalities overall, 94% of on-road fatalities and 88% of off-road fatalities (Table 7). No exposure data (including time-at-risk) are available for either on- or off-road motorcycling, so rates cannot be calculated.

Table 7 Frequency of on- and off-road motorcycling fatalities by gender, Victoria 2001-3

Gender * On or Off Road Crosstabulation				
		Off-road	On-road	Total
Gender	Male	23	151	174
	Female	3	10	13
Total		26	161	187

The licensing age for recreational and on-road motorcycle riding is 18 years. Among off-road motorcycling fatalities, 38% (n=10 deaths) occurred in the 15 - 19 year age band. Nearly two-thirds of off-road fatalities occurred in age group 15-24 years (Figure 2).

A different age pattern was apparent for on-road motorcycling fatalities. Deaths peaked in 25-29 year olds, with the highest number of deaths recorded for 23 year olds (9 fatalities or 6%). There were more than ten fatalities in all 5-year age groups from adolescence through until late middle age (i.e. from 15-19 years of age until 50-54 years of age). This pattern is likely a reflection of the different exposure levels of the age groups for each motorcycling category.

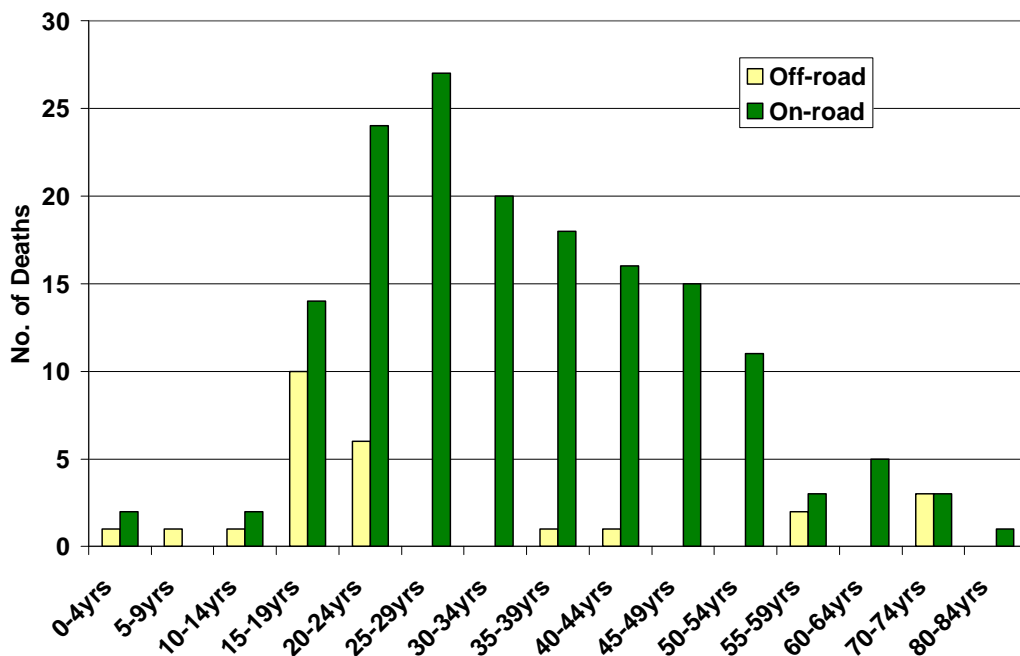


Figure 2: Comparison of on-road and off-road motorcycle deaths by age group, Victoria 2001

Cause of injury

Most on-road motorcycling fatalities (54%) were caused by collisions with other motor vehicles such as cars, vans, pick-up trucks, heavy vehicles or buses. By contrast, only 12% of off-road motorcyclists suffered fatal injuries from a collision with another motor vehicle (mostly another motorcycle).

The four major causes of fatal injury, accounting for 86% of on-road motorcyclist deaths, were:

- Motorcycle driver injured in a collision with a car, van or pick-up truck – 68 deaths (42% of cases).

- Motorcycle driver injured in a collision with a fixed or stationary object – 43 deaths (27% of cases).
- Motorcycle driver injured in a collision with a heavy vehicle or bus – 19 deaths (12% of cases).
- Motorcycle driver injured in a non-collision accident (e.g. throw, fall or overturned motorcycle accident) - 8 deaths (5% of cases).

2. Hospital admissions

Data on hospital admissions were extracted for the Victorian Admitted Episodes Dataset (VAED) for the three-year period 2001/02 to 2003/04.

2.1 Case selection procedure

The case selection process was the same as that used to extract fatality data from the ABS-DURF as hospital admissions data are also classified to ICD-10. To avoid double counting, all deaths were excluded from the VAED dataset before analysis.

2.2 Results

There were 7,706 hospital admissions for motorcycling injury in Victoria over the three-year period 2001/02 to 2003/04 (Table 8). Over half (52%) of hospitalisations occurred on-road, 44% occurred off-road and the remaining 4% were classified to 'other specified' or 'unspecified' codes. Cases coded to 'unspecified' and 'other' were included in all analyses. All motorcycling hospitalisations were unintentional (accidental).

Table 8 Frequency of on- and off-road motorcycling hospital admissions, Victoria 2001/2 to 2003/4

On or Off Road Motorcycling Injury			
		Frequency	Percent
Valid	On-road	4,023	52.2
	Off-road	3,428	44.5
	Unspecified	244	3.2
	Other	11	0.1
	Total	7,706	100.0

2.2.1 Off-road motorcycling hospital admissions

The annual frequency of hospital admissions for off-road motorcycling injury was fairly similar over the 3-year period (Table 9) with only a small increase in the number of off-road motorcycling injury hospitalisation recorded over the study period (2%).

Table 9 Frequency of off-road motorcycling hospital admissions, Victoria 2001-3

Financial Year of Patient Admission			
		Frequency	Percent
Valid	2001/02	1,146	33.4
	2002/03	1,112	32.4
	2003/04	1,170	34.1
	Total	3,428	100.0

Seasonal variation

Date of discharge was used for seasonal variation analyses. A comparatively smaller proportion of discharges occurred in winter (20% of discharges) than summer (27%). Hospital discharges for motorcycling injury cases peaked in January (11%).

Gender and age

Males accounted for 92% (n=3,140) of off-road motorcycling hospital admissions (Table 10). As found for fatalities, the largest proportion of admitted cases was in the 15-19 year age group (18%). Seventy percent of all off-road motorcycling hospital admissions were aged 10-34 years. Female hospitalisations peaked in 10-14 year-olds (16% of all female admissions) and male cases peaked in 15-19 year olds (18% of all male admissions). Surprisingly, 11 persons in the 80+ age group were hospitalised for off-road motorcycle riding, but these could be related to powered mobility scooter riding.

Table 10: Off-road motorcycling hospital admissions by age and gender, Victoria 2001/2 to 2003/4

		Sex of patient		Total
		male	female	
Age group	0-4yrs	13	8	21
	5-9yrs	131	35	166
	10-14yrs	416	47	463
	15-19yrs	570	39	609
	20-24yrs	510	23	533
	25-29yrs	402	19	421
	30-34yrs	351	20	371
	35-39yrs	220	19	239
	40-44yrs	211	12	223
	45-49yrs	114	15	129
	50-54yrs	76	19	95
	55-59yrs	43	7	50
	60-64yrs	26	3	29
	65-69yrs	18	3	21
	70-74yrs	18	6	24
	75-79yrs	10	2	12
	80-84yrs	5	6	11
	85+ yrs	6	5	11
Total		3,140	288	3,428

Activity at the time of the injury

Coding for activity at time of injury was poor; 56% of off-road motorcycling hospital admissions were coded to either the 'unspecified' or 'other specified' variable (Table 11). As would be expected, sports (30%) and leisure (10%) were the most common activities being engaged in at the time of injury. A small number of cases (3%) were work-related.

Table 11 Off-road motorcycling injury hospital admissions by activity, Victoria 2001/2 to 2002/3.

Grouped activity		Frequency	Percent
Valid	Sports	1,034	30.2
	Unspecified	999	29.1
	Other specified	918	26.8
	Leisure	355	10.4
	Working for income	93	2.7
	Other types of work-unpaid	25	0.7
	Vital activities, resting, eating, sleeping	4	0.1
	Total	3,428	100.0

Location (place of occurrence) of injury

Location data were also poorly coded, with 59% of cases coded as occurring in 'unspecified places' or 'other specified places' (Table 12). The most common location of injury was sports and athletic areas (12%), followed closely by farms (11%).

Table 12 Off-road motorcycling hospital admissions by location, Victoria 2001/2-2003/4

Grouped location		Frequency	Percent
Valid	Unspecified places	1,300	37.9
	Other specified places	738	21.5
	Sports & athletic areas	415	12.1
	Farm	407	11.9
	Road, street & highway	381	11.1
	Home	165	4.8
	Trade & service area	10	0.3
	Industrial & construction area	6	0.2
	School, public buildings	4	0.1
	Residential Institution	2	0.1
	Total	3,428	100.0

Cause of injury

The major causes of off-road motorcycling injury hospitalisations were:

- Motorcycle driver injured in a non-collision accident such as being thrown, falling, or from an overturned motor scooter, moped or motorised bicycle – 638 cases (19%).
- Motorcycle driver injured in a non-collision accident such as being thrown, falling, or from an overturned motorcycle - 523 cases (15%).
- Motorcycle driver injured in a non-collision accident (i.e. being thrown, falling, or overturning) an off-road motorcycle e.g. ag-bike, dirt bike or trail bike - 332 cases (10%).
- Motorcycle rider (any) injured in an unspecified accident - 311 cases (9%).

Length of hospital stay

The length of stay in hospital can be used as a proxy for injury severity (Table 13). More than half of off-road motorcycle injury cases (53%) were discharged after a hospital stay of less than two days, indicating a low level of injury severity. Thirty-nine percent of injury cases had a length of stay of 2-7 days and these could be classified as moderately severe injuries. Eight percent of cases were in hospital for 8 or more days, the most serious level of injury.

Table 13 Off-road motorcycling hospital admissions by length of stay, Victoria 2001/2 to 2003/4

Grouped Length of Stay (days)			
		Frequency	Percent
Valid	< 2 days	1,830	53.4
	2-7 days	1,322	38.6
	8-30 days	257	7.5
	31+ days	19	0.6
	Total	3,428	100.0

Injury type and site

The most common injury was fracture (60%), followed by open wound (9%) and intracranial injury (8%) (Table 14). When injury types with a total frequency in excess of 15 cases were analysed separately, then the most severe injuries were intracranial injuries (61% of cases that required a hospital stay of 8 or more days), open wounds (48%); injury to nerves and spinal cord (39%); injury to internal organs (20%); and traumatic amputation (19%). Although 180 fracture cases required a hospital stay of 8+ days, these cases accounted for only 9% of the serious injury category.

Motorcyclists aged 10–19 years had the highest frequency of the two most serious injury categories (intracranial injuries and open wounds), as well as the highest proportion of fractures (30%). The pattern of injury was similar among males and females.

Table 14 Off-road motorcycling injuries by type of injury, Victoria 2001/2 to 2003/4

Nature of injury * Grouped Length of Stay (days) Crosstabulation		Grouped Length of Stay (days)				Total
		< 2 days	2-7 days	8-30 days	31+ days	
Nature of injury	fracture	921	937	173	7	2,038
	open wound	193	83	14	0	290
	intracranial injury	198	47	14	2	261
	other & unspecified injury	170	52	4	1	227
	dislocation, sprain & strain	151	47	4	1	203
	superficial injury	109	35	6	0	150
	injury to internal organs	22	79	24	1	126
	injury to muscle & tendon	17	17	1	0	35
	injury to nerves & spinal cord	12	7	5	7	31
	burns	9	6	4	0	19
	missing injury code	13	4	1	0	18
	traumatic amputation	8	5	3	0	16
	early and other complications of trauma	1	2	1	0	4
	eye injury- excl foreign body	2	1	0	0	3
	injury to blood vessels	1	0	2	0	3
	crushing injury	3	0	0	0	3
	complications of surgical & med care NEC	0	0	1	0	1
Total		1,830	1,322	257	19	3,428

Table 15 shows the frequency of off-road motorcycling injury hospitalisations by body site injured. The four most commonly injured sites were knee and lower leg (25% of injury cases); head (14%); elbow and forearm (13%); and shoulder and upper arm (13%). There was no gender difference in the pattern of injury by body site.

Table 15 Off-road motorcycling hospital admissions by body site injured, Victoria 2001/2 to 2003/4

Body region injured		Frequency	Percent
Valid	knee & lower leg	856	25.0
	head	471	13.7
	elbow & forearm	458	13.4
	shoulder & upper arm	440	12.8
	abdomen, lower back, lumbar spine & pelvis	253	7.4
	thorax	243	7.1
	wrist & hand	188	5.5
	hip & thigh	188	5.5
	ankle & foot	167	4.9
	neck	92	2.7
	unspecified body region	25	0.7
	missing injury code	18	0.5
	burn- lower limb	16	0.5
	multiple body regions	5	0.1
	body region not relevant	5	0.1
	burn- upper limb	3	0.1
	Total	3,428	100.0

2.2.2 Comparison of off-road and on-road motorcycling injury hospital admissions

Of the 7,706 motorcycling hospitalisations over the period 2001/2 to 2003/4, 52% occurred on-road and 44% occurred off-road. Overall, there was a negligible increase (0.03%) in the total number of motorcyclist injuries leading to hospitalisation in Victoria over this period. Comparing data for 2001/02 with 2003/04 there was a small increase in the number of off-road (2%) motorcyclist hospitalisations and a small decrease (4.5%) in the number of on-road motorcyclist hospitalisations (Table 16).

Table 16 Off-road and on-road motorcycling hospital admissions by year of admission, Victoria 2001/2 to 2003/4

Financial Year of Patient Admission * On or Off Road Crosstabulation						
		Off-road	On-road	Other	Unspecified	Total
Financial Year	2001/02	1,146	1,370	2	53	2,571
	2002/03	1,112	1,344	3	97	2,556
	2003/04	1,170	1,309	6	94	2,579
Total		3,428	4,023	11	244	7,706

Gender and age

Around 90% of on-road and off-road motorcycling hospital admissions were male (Table 17).

Table 17 Off-road and on-road motorcycling hospital admissions by gender, Victoria 2001/2 to 2003/4

Gender of patient * On or Off Road Crosstabulation						
		Off-road	On-road	Other	Unspecified	Total
Sex of patient	Male	3,140	3,663	8	223	7,034
	Female	288	360	3	21	672
Total		3,428	4,023	11	244	7,706

Among off-road motorcycling hospitalisations, cases were predominantly in the 15-19 year age group (18%), whereas 25-29 year olds predominated in on-road motorcycling hospitalisations (17%) (Table 18). A higher proportion of off-road motorcycling hospitalisations were children (aged <15 years) compared with on-road cases (19% vs 6%). It is not known if the injured children were motorcycle drivers or passengers.

Table 18 Off-road and on-road motorcycling hospital admissions by 5-year age group, Victoria 2001/2 to 2003/4

Age group * On or Off Road Crosstabulation						
		Off-road	On-road	Other	Unspecified	Total
Age group	0-4yrs	21	5	0	2	28
	5-9yrs	166	44	1	10	221
	10-14yrs	463	173	1	16	653
	15-19yrs	609	395	1	42	1,047
	20-24yrs	533	647	1	36	1,217
	25-29yrs	421	666	0	31	1,118
	30-34yrs	371	600	2	38	1,011
	35-39yrs	239	480	2	25	746
	40-44yrs	223	385	0	15	623
	45-49yrs	129	263	1	14	407
	50-54yrs	95	169	0	4	268
	55-59yrs	50	89	1	3	143
	60-64yrs	29	33	0	1	63
	65-69yrs	21	27	0	2	50
	70-74yrs	24	25	1	1	51
	75-79yrs	12	8	0	1	21
	80-84yrs	11	3	0	1	15
85+ yrs	11	11	0	2	24	
Total		3,428	4,023	11	244	7,706

Location and activity when injured

In total, 75% of motorcycling injury hospitalisations (47% of on-road cases and 29% of off-road cases) were not coded to a specific activity variable (Table 19). ‘Sports’ and ‘leisure’ were the most common specific activities being undertaken at the time of injury.

Table 19 Off-road and on-road motorcycling hospital admissions by activity at the time of injury, Victoria 2001/2 to 2003/4

Grouped activity * On or Off Road Crosstabulation						
		Off-road	On-road	Other	Unspecified	Total
Grouped activity	Unspecified	999	1,888	4	91	2,982
	Other specified	918	1,798	5	84	2,805
	Sports	1,034	217	1	55	1,307
	Leisure	355	49	1	9	414
	Working for income	93	53	0	1	147
	Other types of work-unpaid	25	3	0	3	31
	Vital activities, resting, eating, sleeping	4	7	0	1	12
	Activity code not required	0	1	0	0	1
Total		3,428	4,016	11	244	7,699

Forty-two percent of motorcycling injury cases were not coded for location. As would be expected, the road/street/highway was the most common location of on-road motorcycling injury (71%) (Table 20). Data on location of off-road hospitalised cases were too unreliable to analyse (60% lacked specificity).

Table 20 Off-road and on-road motorcycling hospital admissions by location of injury event, Victoria 2001/2 to 2003/4

Grouped location * On or Off Road Crosstabulation						
		Off-road	On-road	Other	Unspecified	Total
Grouped location	Road, street & highway	381	2,853	4	69	3,307
	Unspecified places	1,300	927	6	114	2,347
	Other specified places	738	107	1	28	874
	Sports & athletic areas	415	43	0	22	480
	Farm	407	41	0	8	456
	Home	165	38	0	3	206
	Trade & service area	10	7	0	0	17
	Residential Institution	2	4	0	0	6
	Industrial & construction area	6	0	0	0	6
	School, public buildings	4	1	0	0	5
	Y35-Y98 Legal intervention & medical cause codes	0	1	0	0	1
Total		3,428	4,022	11	244	7,705

Cause of injury

The major causes of off-road motorcycling hospitalisations are described above. The major causes of on-road motorcycling hospitalisations were:

- Motorcycle rider (any) injured in an unspecified accident - 702 cases (17%).

- Motorcycle driver injured in a non-collision accident such as being thrown, falling, or from an overturned motor scooter, moped or motorised bicycle – 357 cases (9%).
- Motorcycle driver injured in a collision with a car, van or pick-up truck - 356 cases (9%).
- Motorcycle driver (motor-scooter, moped or motorised bicycle) injured in a collision with a car, van or pick-up truck – 334 cases (8%).

Length of hospital stay

A comparison of the relative severity of on-road and off-road motorcyclist hospitalisations, measured by length of hospital stay) reveals that around half of hospital admissions in each of the motorcycling categories were discharged from hospital in less than two days (50% of on-road cases and 53% of off-road cases). A higher proportion (39%) of off-road cases remained in hospital for 2-7 days compared with on-road cases (34%). On-road motorcyclists were twice as likely to be seriously injured (defined by a length of stay of 8 days or more) than off-road motorcyclists (16% vs 8%) (Table 21).

Table 21 Off-road and on-road motorcycling hospital admissions by length of hospital stay, Victoria 2001/2 to 2003/4

Grouped Length of Stay (days) * On or Off Road Crosstabulation						
		t				
		Off-road	On-road	Other	Unspecified	Total
Grouped Length	< 2 days	1,830	2,014	7	128	3,979
of Stay (days)	2-7 days	1,322	1,373	4	105	2,804
	8-30 days	257	554	0	10	821
	31+ days	19	82	0	1	102
Total		3,428	4,023	11	244	7,706

Injury type and site

The type and site of injuries sustained by on-road and off-road motorcyclists were broadly similar, indicating that similar injury mechanisms may apply (Table 22). Fractures were the most frequent injury (59% of on-road cases and 54% of off-road cases), followed by open wounds (8% for both). Additional analyses of the more severe injury cases showed that similar proportions of on-road and off-road cases sustained intra-cranial injuries (7% vs 8%) but that the proportion of injuries to the nerves or spinal cord was higher in off-road than on-road motorcycling hospitalisations (2% vs 1%).

Table 22 Off-road and on-road motorcycling hospital admissions by nature of injury, Victoria 2001/2 to 2003/4

Nature of injury * On or Off Road Crosstabulation						
		Off-road	On-road	Other	Unspecified	Total
Nature of injury	fracture	2,038	2,191	5	160	4,394
	open wound	290	312	1	14	617
	other & unspecified injury	227	347	1	14	589
	intracranial injury	261	266	1	8	536
	dislocation, sprain & strain	203	285	2	14	504
	superficial injury	150	240	1	9	400
	injury to internal organs	126	158	0	7	291
	injury to nerves & spinal cord	31	75	0	4	110
	injury to muscle & tendon	35	47	0	2	84
	burns	19	22	0	1	42
	missing injury code	18	20	0	2	40
	traumatic amputation	16	11	0	7	34
	early and other complications of trauma	4	25	0	2	31
	injury to blood vessels	3	16	0	0	19
	crushing injury	3	3	0	0	6
	eye injury- excl foreign body	3	2	0	0	5
	sequelae of injuries, poisoning & ext cause	0	3	0	0	3
	complications of surgical & med care NEC	1	0	0	0	1
Total		3,428	4,023	11	244	7,706

The knee and lower leg, elbow and forearm, shoulder and upper arm, and the head were the four most commonly injured body sites for both off-road and on-road cases (Table 23). However, head injuries formed a higher proportion of all injuries to off-road motorcyclists than to on-road motorcyclists (14% vs 11%).

Table 23 Off-road and on-road motorcycling hospital admissions by injury site, Victoria 2001/2 to 2003/4

		Body region injured * On or Off Road				Total
		Off-road	On-road	Other	Unspecified	
Body region	knee & lower leg	856	919	3	65	1,843
	elbow & forearm	458	490	2	41	991
	shoulder & upper arm	440	478	1	31	950
	head	471	448	2	10	931
	abdomen, lower back, lumbar spine & pelvis	253	372	0	17	642
	thorax	243	301	0	14	558
	wrist & hand	188	334	0	26	548
	hip & thigh	188	243	2	11	444
	ankle & foot	167	191	1	14	373
	neck	92	145	0	9	246
	unspecified body region	25	27	0	1	53
	missing injury code	18	20	0	2	40
	body region not relevant	5	28	0	2	35
	burn- lower limb	16	12	0	1	29
	multiple body regions	5	5	0	0	10
	burn- upper limb	3	5	0	0	8
	burn- trunk	0	5	0	0	5
Total		3,428	4,023	11	244	7,706

3. Emergency department presentations (non-admissions)

Data on emergency department presentations were extracted from the Victorian Emergency Minimum Dataset (VEMD). Only non-admissions were included in analyses.

3.1 Case selection procedure

- Cases were selected if the cause of injury was coded as 3 ('motorcycle driver') or 4 ('motorcycle passenger').
- Cases were then assigned as on-road or off-road using the location (place of occurrence of injury) variable. All cases in which the location of the injury event was coded to 'road, street or highway' were assigned to the 'on-road' category. Cases with other locations ('place for recreation', 'athletics and sports area', 'farm' etc) were assigned to the 'off-road' category.
- As there were large groups of cases coded under the location variable as 'other specified' and 'unspecified', a check of each case narrative was made for information on place of occurrence. If information on location was given, the case was re-assigned accordingly.
- In addition, a text search was made of all other case narratives on the VEMD for the study years using the words "dirt bike", "trail bike", "mini bike", "motocross", "enduro bike", and "off-road bike" and spelling variations of these search words. Cases where the bikes were described as three- and four-wheeled motorcycles were excluded from the sub-set by a hand search. Identified eligible cases were added to the off-road data sub-set.

3.2 Definitions

- *On-road*: if the motorcycle injury case occurred on a 'road, street or highway'.
- *Off-road*: if the motorcycle injury case occurred at any other location – 'place for recreation', 'athletics and sports area', 'farm' 'home', 'residential institution', 'school, day care centre, public administration area', 'medical hospital', 'trade or service area', 'industrial or construction area', 'mine or quarry' and 'other specified place'. According to the VEMD manual, the category 'other specified place' includes such locations as mountain, beach, prairie, parking lot etc.

3.3 Results

There were 9,553 motorcycling injury E.D. presentations (non-admissions) in Victoria recorded on the VEMD for the 3-year period 2002/3 to 2004/5, 47% of which occurred off-road and 37% on-road (Table 24). For the remaining cases (16%), the location of the motorcycle injury event could not be identified.

Table 24 Off-road and on-road motorcycling hospital E.D. presentations (non-admissions), Victoria 2002/3 to 2004/5

Motorcycle Category		Frequency	Percent
Valid	on road	4,508	47.2
	off road	3,564	37.3
	other specified/ unspecified	1,481	15.5
	Total	9,553	100.0

3.3.1 Off-road motorcycling ED presentations (non-admissions)

The narratives were searched for type of off-road motorcycle being ridden at the time of the injury event. The vast majority of the narratives provided no additional information. These cases were assigned to the 'Motorcycle – other' category and comprised 84% of the 3,564 injury cases that presented to a participating ED (Table 25). Of the cases that included a description of the type of off-road motorcycle in the narrative, dirt bikes and trail bikes were the most frequently ridden motorcycle at the time of the injury (15% of ED presentations).

Table 25 Off-road motorcycling hospital E.D. presentations (non-admissions), Victoria 2002/3 to 2004/5

Off-Road Motorcycles		Frequency	Percent
Valid	Motorcycle - other	2,979	83.6
	dirtbike	280	7.9
	trail bike	244	6.8
	mini bike	31	0.9
	motocross	25	0.7
	off road	4	0.1
	enduro bike	1	0.0
	Total	3,564	100.0

Between 2002/03 and 2003/04 there was a 28% increase in ED presentations in off-road motorcycle injuries and a further 30% in the following year (Table 26). Only 6% of this increase was due to additional hospitals contributing data to the VEMD over this period. However, annual frequency data would need to be monitored over a longer time period to ascertain whether there is genuine upward trend.

Table 26 Off-road motorcycling hospital E.D. presentations (non-admissions) by year of presentation, Victoria 2002/3 to 2004/5

Year		Frequency	Percent
Valid	2002/03	904	25.4
	2003/04	1,155	32.4
	2004/05	1,505	42.2
	Total	3,564	100.0

Male presentations increased by 59% (from 812 cases to 1,288 cases) and female presentations by 87% (from 92 cases to 172 cases). Every 5-year age group (except persons aged 65-69 and 80+) showed increases in the frequency of ED presentations over the study period. Of those age groups with over 50 ED presentations, increases ranged from 35% (30-34 year olds) to 98% (10 – 14 year olds) (Table 27).

Table 27 Off-road motorcycling hospital ED presentations (non-admissions) by age group and year of registration, Victoria 2002/3 to 2004/5

Age groups * Financial Year Commenced Crosstabulation					
		Financial Year Commenced			Total
		2002	2003	2004	
Age groups	0-4	4	6	17	27
	5-9	60	68	87	215
	10-14	130	209	257	596
	15-19	196	237	326	759
	20-24	139	208	232	579
	25-29	111	138	174	423
	30-34	114	99	154	367
	35-39	66	83	96	245
	40-44	36	51	69	156
	45-49	24	31	36	91
	50-54	12	12	25	49
	55-59	2	7	16	25
	60-64	3	1	7	11
	65-69	4	1	3	8
	70-74	1	3	2	6
	75-79	0	0	2	2
	80+	2	1	2	5
Total		904	1,155	1,505	3,564

Seasonal variation

Off-road motorcycling ED presentations (non-admissions) peaked in April (11%) and were lowest in July (6%) (Figure 3). Analysis by season revealed the frequency of ED presentations (non-admissions) was lowest in winter (685 cases or 19%) and highest in autumn (1043 cases or 29%). Without exposure data, it is not possible draw any conclusions about the relative risk of riding in the different weather/surface conditions related to season of the year.

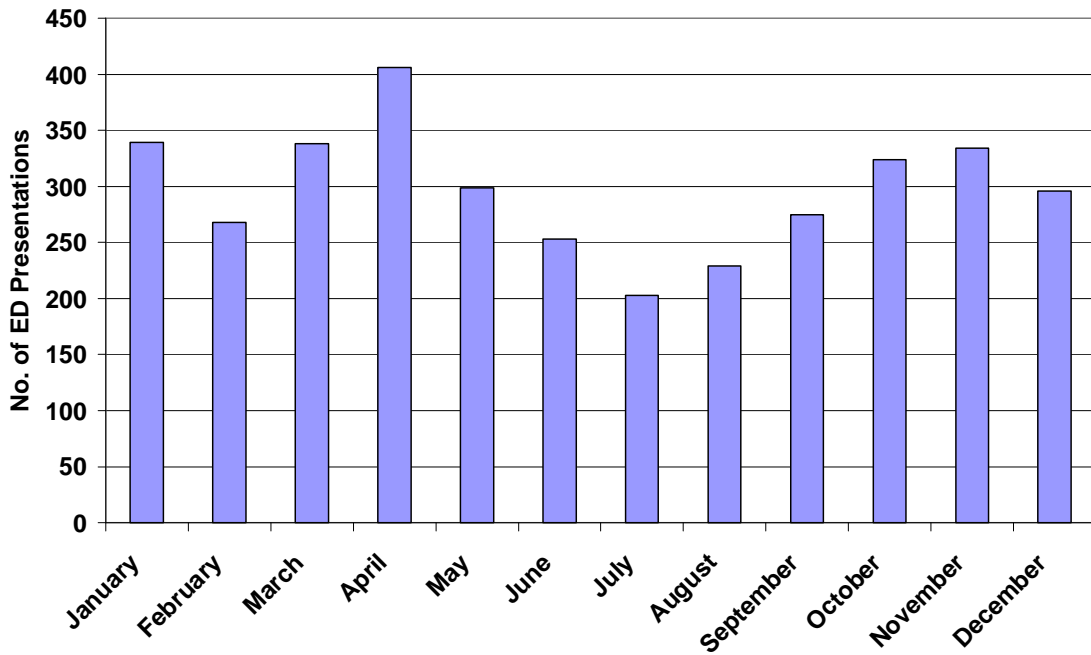


Figure 3: Off-road motorcycling ED presentations (non-admissions) by month of year, Victoria 2002/3 to 2004/5

Most ED presentations for off-road motorcycling injury occurred over the weekend (56%), with a large upsurge on Sunday (35% of all presentations) (Figure 4). Following the peak on Sunday, off-road motorcycle injury presentations declined until Thursday, then increased.

Nearly three-quarters (73%) of off-road presentations to ED were made between 11am and 7pm, with the highest proportion occurring at 5pm (10%).

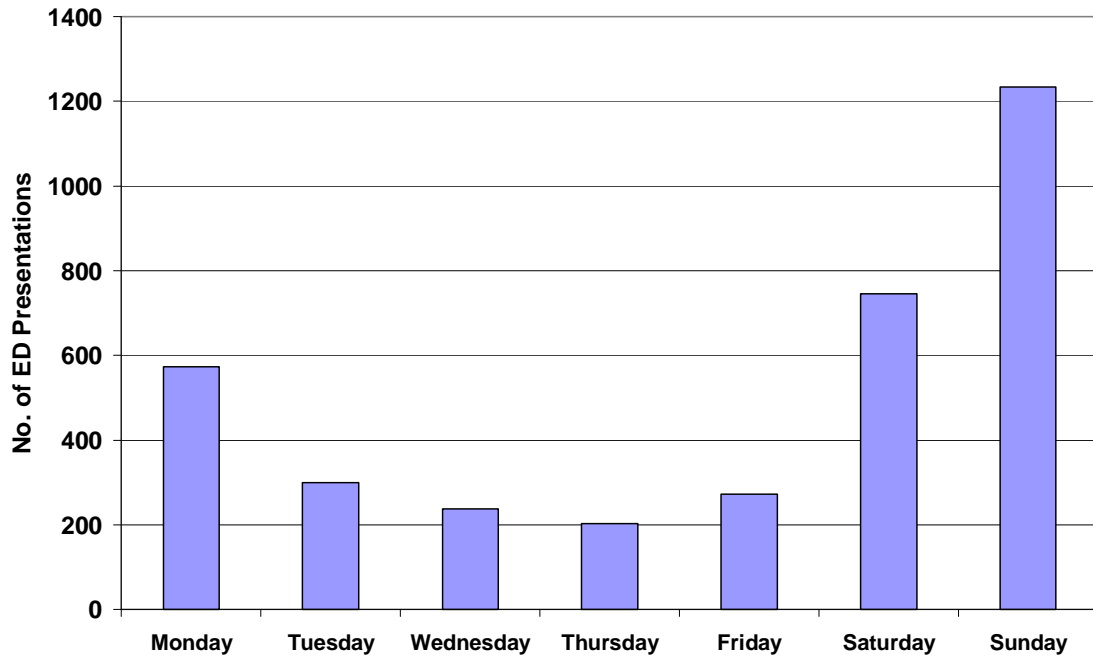


Figure 4: Off-road motorcycling ED presentations (non-admissions) by day of the week, Victoria 2002/3 to 2004/5

Gender and age

Off-road motorcycling ED presentations were predominantly male (89% of cases) (Table 28). Among males, the highest frequency of presentations (21%) was in motorcyclists aged from 15–19 years, while for females those aged 10-14 years presented most frequently (23%). The young age of child presentations is a cause for concern. Twenty-seven cases were 0–4 year olds and 215 were 5–9 year olds. Among children aged 0-4, 11 cases (41%) were coded as the motorcycle driver at the time of the injury. Among children aged 5-9 years, 186 cases (87%) were coded as the motorcycle driver.

Table 28 Off-road motorcycling hospital ED presentations (non-admissions) by 5-year age group, Victoria 2002/3 to 2004/5

Age groups * Gender Crosstabulation					
		Sex			Total
		Missing	Male	Female	
Age groups	0-4	3	18	6	27
	5-9	1	162	52	215
	10-14	11	501	84	596
	15-19	18	674	67	759
	20-24	4	532	43	579
	25-29	4	391	28	423
	30-34	1	343	23	367
	35-39	0	224	21	245
	40-44	2	146	8	156
	45-49	0	82	9	91
	50-54	1	40	8	49
	55-59	0	19	6	25
	60-64	0	10	1	11
	65-69	0	8	0	8
	70-74	0	5	1	6
	75-79	0	2	0	2
	80+	0	1	4	5
Total		45	3,158	361	3,564

Activity and location

A total of 74% of off-road motorcyclist injury presentations occurred whilst the person was engaged in either leisure (74%) or sports (14%) (Table 29). Only 8% of cases were coded to 'unspecified' or 'other specified' which compares very favourably with VAED data in which almost 60% of cases were coded to these two categories.

Table 29 Off-road motorcycling hospital ED presentations (non-admissions) by activity when injured, Victoria 2002/3 to 2004/5

Activity when injured		Frequency	Percent
Valid	Leisure	2,653	74.4
	Sports	485	13.6
	Other specified activity	157	4.4
	Un-specified activity	121	3.4
	Working for income	79	2.2
	Other work	35	1.0
	Vital activity, resting, sleeping or eating	29	0.8
	Education	4	0.1
	Missing	1	0.0
	Total	3,564	100.0

Over one-third of off-road motorcyclists who presented to ED were injured at a place for recreation (38%). The home, farm and athletics and sports area were also common places where injuries occurred (Table 30).

Table 30 Off-road motorcycling hospital ED presentations (non-admissions) by place of occurrence of injury, Victoria 2002/3 to 2004/5

Type of place injury occurred		Frequency	Percent
Valid	Place for recreation	1,370	38.4
	Home	856	24.0
	Farm	780	21.9
	Athletics and sports area	459	12.9
	School, day care, public admin	21	0.6
	Residential institution	20	0.6
	Trade or service area	17	0.5
	Other specified place	15	0.4
	Mine or quarry	14	0.4
	Industrial/construction area	10	0.3
	Medical hospital	2	0.1
	Total	3,564	100.0

Cause of injury

Most off-road motorcycling injury cases were coded to the transport injury codes, 'motorcycle driver' or 'motorcycle passenger' (95% of cases) which provides no information on the mechanism of injury (Table 31). Only 4% were coded to the remaining transport injury codes (these cases did not specify whether the injured person was the driver or a passenger). The free text narrative may contain additional information but the quality of narratives is variable. The most commonly described mechanisms of injury for cases coded to the cause 'Motorcycle driver' were falls and collisions. Cases coded to cause 'Motorcycle passenger' were most frequently described as falls. Cases coded to the falls cause code 'Fall up to 1 metre' (3% of cases), commonly referred to the person falling off the motorcycle, whereas cases coded to 'Fall over 1 metre' usually described that the person flipped over the handlebars. The 'animal-related' case was caused when the motorcycle hit a kangaroo. Thirty-seven cases (1%) were classified as 'motorcycle rider or pillion' because it could not be ascertained from the narrative whether the injured person was the driver or passenger.

Table 31 Off-road motorcycling hospital ED presentations (non-admissions) by cause of injury, Victoria 2002/3 to 2004/5

Injury Cause		Frequency	Percent
Valid	Motorcycle driver	3,230	90.6
	Motorcycle passenger	161	4.5
	Pedestrian injured by motorcycle	1	0.0
	Fall up to 1 metre	102	2.9
	Fall over 1 metre	7	0.2
	Submersion drown other	1	0.0
	Cutting, piercing object	5	0.1
	Other animal related	1	0.0
	Struck by collision with person	1	0.0
	Struck by collision with object	18	0.5
	Motorcycle rider or pillion	37	1.0
	Total	3,564	100.0

Injury type and site

The four most frequently occurring injuries were fractures (29% of cases); sprains or strains (23%); superficial injuries (10%) and open wounds (10%) (Table 31). The four most commonly injured body sites were the shoulder (16%), knee (10%), wrist (9%) and ankle (8%) (Table 32).

As only non-admitted cases were included in the dataset 99% of cases were discharged to their homes. The remaining cases (1%) either left at their own risk after treatment commenced (0.6%) or left before being seen by a doctor (0.2%).

Table 32 Off-road motorcycling hospital ED presentations (non-admissions) by injury type, Victoria 2002/3 to 2004/5

Nature of Main Injury		Frequency	Percent
Valid	Fracture, excludes tooth	1,041	29.2
	Sprain or strain	807	22.6
	Superficial, excludes eye	368	10.3
	Open wound, excludes eye	361	10.1
	Injury to muscle or tendon	243	6.8
	Injury of unspecified nature	179	5.0
	Dislocation	130	3.6
	Other specified nature of injury	130	3.6
	Multiple injuries	122	3.4
	Intracranial injury	65	1.8
	Burn or corrosion	37	1.0
	Crushing injury	29	0.8
	Foreign body	19	0.5
	Injury to blood vessel	9	0.3
	Missing	5	0.1
	Eye injury	4	0.1
	Dental injury	4	0.1
	No injury detected	4	0.1
	Injury to nerve	2	0.1
	Injury to internal organ	2	0.1
	Traumatic amputation	1	0.0
	Electrical injury	1	0.0
	Bite (non-venomous)	1	0.0
	Total	3,564	100.0

3.3.2 Comparison of off-road and on-road motorcycling ED presentations (non-admissions)

Nearly half (47%) of motorcycling injury cases presenting to the ED were on-road and a further 37% were off-road (Table 33). In total 143 of the cases classified to the 'on-road' category (because they were assigned to the location code 'road, street and highway') involved bikes that are generally associated with off-road use. Emergency Department staff members (medical and/or clerical) enter the VEMD injury surveillance data and the variable 'road' is not clearly defined. Cases were assigned using the location code if the narrative did not provide sufficient information to support re-classification.

Table 33 Motorcycling hospital ED presentations (non-admissions), Victoria 2002/3 to 2004/5

		Motorcycle Class				Total
		on road	off road	other specified	other unspecified	
offroad	Motorcycle - other	4,365	2,979	696	575	8,615
	dirtbike	76	280	71	32	459
	trail bike	58	244	52	39	393
	mini bike	8	31	3	10	52
	motocross	0	25	1	0	26
	off road	1	4	2	0	7
	enduro bike	0	1	0	0	1
Total		4,508	3,564	825	656	9,553

Seasonal variation

The analysis revealed that the smallest number of presentations occurred during winter for both on-road (n= 939, 21% of cases) and off-road (n=685, 19% of cases), motorcycling, probably reflecting a seasonal downturn in motorcycling in wet and cold conditions. On-road motorcycling ED presentations were highest in summer (n=1219, 27% of cases), whereas off-road motorcycling presentations were most frequent over autumn (n=1012, 28 % of cases).

There was a marked upsurge in both on-road and off-road motorcycling ED presentations at the weekend followed by a decline until mid-week (Table 34). Of the weekdays, both on and off-road motorcyclists were more likely to present to ED on Mondays but some of these cases may be delayed presentations for injuries that occurred on the weekend.

Table 34 Motorcycling hospital ED presentations (non-admissions) by day of presentation, Victoria 2002/3 to 2004/5

		Motorcycle Category				Total
		on road	off road	other specified	other unspecified	
Day of Presentation	Monday	649	573	135	139	1,496
	Tuesday	504	300	95	52	951
	Wednesday	497	238	50	42	827
	Thursday	579	202	51	40	872
	Friday	507	272	63	50	892
	Saturday	762	745	171	143	1,821
	Sunday	1,010	1,234	260	190	2,694
Total		4,508	3,564	825	656	9,553

Activity when injured

A large proportion (23%) of on-road and off-road motorcyclist ED injury presentations were coded to the 'other specified activity' or 'unspecified activity' categories (33% for on-road and 8% for off-road). Leisure/sports pursuits were the most common activities engaged in at the time of injury by both off-road (88%) and on-road (59%) motorcyclists presenting to ED (Table 35).

Table 35 Motorcycling hospital ED presentations (non-admissions) by activity when injured, Victoria 2002/3 to 2004/5

Activity when injured * Motorcycle Category Crosstabulation						
		<u>Motorcycle Category</u>				Total
		on road	off road	other		
Activity when injured				specified	unspecified	
	Leisure	2,610	2,653	622	299	6,184
	Other specified / unspecified activity	1482	278	152	330	2,242
	Sports	58	485	34	22	599
	Vital activity, resting, sleeping or eating	194	29	6	3	232
	Working for income	128	79	3	2	212
	Other work	27	35	5	0	67
	Education	6	4	2	0	12
	Being nursed, cared for	3	0	1	0	4
	Missing	0	1	0	0	1
Total		4,508	3,564	825	656	9,553

Gender and age

Overall, males accounted for 85% of ED presentations for motorcycling injuries. A higher proportion of females were injured whilst riding on-road (19%) compared to off-road (10%), which probably reflects their lower participation in off-road motorcycling. For males, the corresponding figures were 80% for on-road riding and 89% for off-road riding (Table 36). In the absence of exposure data, which would provide accurate denominator data to enable the calculation of injury rates, it is impossible to determine whether males are at higher risk of ED presentation for motorcycling injury per se than females.

Table 36 Motorcycling ED presentations by gender, Victoria 2002/3 to 2004/5

Sex * Motorcycle Category Crosstabulation						
		<u>Motorcycle Category</u>				Total
		on road	off road	other		
Sex				specified	unspecified	
	Male	3,613	3,158	731	597	8,099
	Female	861	361	58	57	1,337
	Missing	34	45	36	2	117
Total		4,508	3,564	825	656	9,553

As shown in Figure 5, the pattern of ED presentations for on-road and off-road motorcycling by five-year age groups was very similar. The major difference was that off-road ED presentations peaked at an earlier age than on-road presentations.

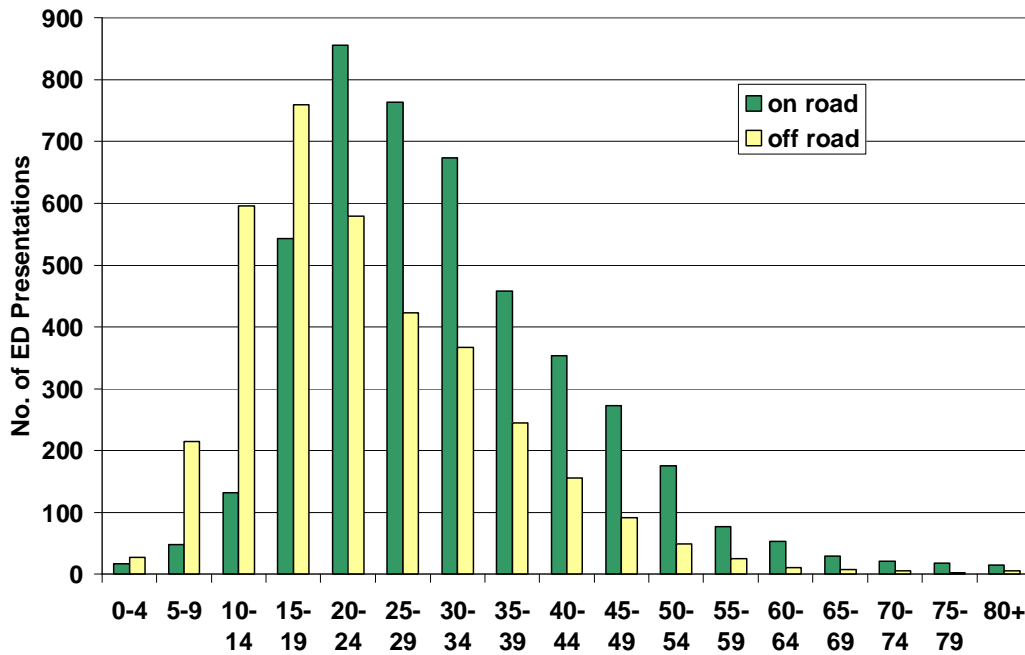


Figure 5: Comparison of on-road and off-road ED presentations by 5-year age group, Victoria 2002/3 to 2004/5

Data were analysed to determine the proportion of injured motorcyclists who were apparently driving under the age limit for a learners' permit (17 years). Twenty-nine percent of off-road motorcyclists aged less than 17 years were coded as the motorcycle driver at the time of the injury (n=1,040). By comparison, only 4% of on-road motorcyclists coded as the driver were aged less than 17 years.

Injury type and site

The type and nature of injuries were similar in on- and off-road motorcyclists. The rank order of the top four types of main injury sustained by on-road and off-road motorcyclists were identical (Table 37). The four most frequently occurring injuries for both on-road and off-road motorcycling were: fractures (22% vs 29% of injuries respectively); sprains and strains (22% vs 23%); superficial injuries (16% vs 10%); and open wounds (8% vs 10%).

Table 37 Motorcycling ED presentations by type (nature) of main injury, Victoria 2002/3 to 2004/5

		Motorcycle Category				Total
		on road	off road	other specified	other unspecified	
Nature of Main Injury	Fracture, excludes tooth	1,012	1,041	202	189	2,444
	Sprain or strain	988	807	207	145	2,147
	Superficial, excludes eye	714	368	101	102	1,285
	Open wound, excludes eye	361	361	77	52	851
	Injury to muscle or tendon	324	243	58	28	653
	Other specified nature of injury	301	130	39	18	488
	Multiple injuries	302	122	29	25	478
	Injury of unspecified nature	194	179	50	51	474
	Dislocation	116	130	33	23	302
	Intracranial injury	46	65	9	9	129
	Crushing injury	37	29	4	4	74
	Burn or corrosion	13	37	4	5	59
	Foreign body	15	19	5	2	41
	No injury detected	34	4	0	2	40
	Injury to blood vessel	11	9	2	1	23
	Missing	13	5	2	0	20
	Injury to internal organ	13	2	0	0	15
	Eye injury	4	4	1	0	9
	Dental injury	2	4	0	0	6
	Injury to nerve	3	2	0	0	5
Poisoning, toxic effect (excludes bites)	3	0	1	0	4	
Traumatic amputation	1	1	0	0	2	
Bite (non-venomous)	1	1	0	0	2	
Electrical injury	0	1	0	0	1	
Bite (venomous)	0	0	1	0	1	
Total	4,508	3,564	825	656	9,553	

The five most common body sites injured in on-road and off-road motorcycle injury cases presenting to ED were the same, but ranking by frequency was different (Table 38). The top five injury sites for on-road motorcycling ED presentations were: multiple injuries (15% of cases); shoulder (13%); knee (9%); ankle (6%); and wrist (6%). For off-road motorcycling ED presentations, the top five body sites were: shoulder (16% of cases); knee (10%); wrist (9%); ankle (8%) and multiple injuries (7%).

Table 38 Motorcycling ED presentations by body site injured, Victoria 2002/3 to 2004/5

		Body Region * Motorcycle Category Crosstabulation				Total
		on road	off road	other		
Body Region				specified	unspecified	
	Shoulder	596	578	141	111	1,426
	Multiple injuries	680	265	71	55	1,071
	Knee	420	359	87	73	939
	Wrist	275	309	80	60	724
	Ankle	284	280	46	56	666
	Hand, includes fingers	244	243	67	50	604
	Foot, includes toes	208	230	58	30	526
	Lower leg	195	231	49	46	521
	Thorax	253	142	42	32	469
	Neck	297	59	19	12	387
	Forearm	115	184	33	19	351
	Elbow	119	114	22	19	274
	Unspecified body region	154	57	17	11	239
	Face, excludes eye	100	102	16	12	230
	Lower back	124	70	21	11	226
	Head, excludes face	110	76	12	19	217
	Body region code not required	82	71	11	8	172
	Thigh	49	61	9	6	125
	Upper arm	49	54	2	7	112
	Hip	57	28	8	8	101
	Abdomen	48	21	2	6	77
	Pelvis	21	6	5	3	35
	Missing	16	11	2	0	29
	FB in soft tissues	8	10	4	1	23
	FB in eye	2	2	1	1	6
	FB in ear	1	1	0	0	2
	FB in genitourinary tract	1	0	0	0	1
Total		4,508	3,564	825	656	9,553

4. Discussion

The foregoing analyses provide a useful exploration of the VISU-held injury surveillance data on the frequency and pattern of off-road and on-road motorcycling fatalities and hospital-treated injuries. Over the 3-year period(s) studied, off-road motorcycling contributed 14% of all motorcycling fatalities, and 45% and 37% of all hospital admissions and ED presentations (non-admissions) for motorcycling injuries, respectively. This is a sizeable and costly injury problem that has been largely unaddressed due to a lack of clarity about 'ownership' of off-road motorcycling safety by government departments/agencies.

The major difference between the two motorcycling activities in terms of injury causation is that off-road motorcyclists were more likely to be killed or injured in single vehicle (non-collision) events such as falls/thrown from/overtakes and less likely to be injured in collisions with other vehicles than their on-road counterparts. Another difference is that injured off-road motorcyclists tend to be younger than their on-road counterparts, particularly for fatalities, which were concentrated in the 15-24 year age group. Of grave concern is the number of injured off-road and, to a lesser extent, on-road motorcycle drivers who were under the minimum age for obtaining a motorcycle licence or learner's permit. It is also probable that the motorcycles the unlicensed drivers were using were unregistered because the registration requirement for a recreational motorbike in Victoria is that the owner is at least 18 years of age and the holder of a full motorcycle licence or a learner's permit. In response to the growing problem of off-road motorcycle injuries among children and teens in the U.S., the American Academy of Pediatrics recommended in 2000 that parents not allow children aged less than 16 years to ride off-road motorcycles, and that states prohibit their use by children and teens in that age group (AAP, 2000).

Severe injuries (defined as those requiring eight or more days hospital stay) were more frequently seen in hospitalised on-road motorcyclists than their off-road counterparts. However, intracranial (brain) injuries, which were more likely than other types of injuries to require eight or more days hospital stay, were more common among off-road motorcyclists than on-road. There were no useable data on helmet use in the two groups of injured motorcyclists as protective equipment wear was only reported in a small number of VEMD case narratives. Research indicates that requiring riders of off-road vehicles to wear helmets can reduce the risk for fatal injury (Keenan et al., 2004; Rodgers, 1990).

Apart from these differences, the profile of injured off- and on-road motorcyclists was similar. Injured motorcyclists were overwhelmingly male and driving the vehicle at the time of injury. In both kinds of motorcycling, the major types of injury were fractures, open wounds and sprains/strains and the most vulnerable body sites for injury were the knee and lower leg, elbow and forearm and shoulder and upper arm.

Because there are no participation and exposure data for off-road motorcycle riding, injury rates and the relative risk of injury in the two motorcycle modes could not be calculated and compared. The Australian Sports Commission surveys the participation in exercise, recreation and sport by Australian adults (defined as persons aged 15 years and over) annually, but published results aggregate motorcycling participation under 'motor sports'. The ASC may hold disaggregated participation data for 'off-road'

motorcycling for Australia and Victoria (contact ASC Research and Corporate Planning (02) 6214 1111; website: www.ausport.gov.au).

There are obvious differences in the injury hazards faced by off-road and on-road motorcyclists (Newstead & Cameron, MUARC report, undated; CDC, 2006). For example, although off-road motorcyclists generally travel at lower speeds they negotiate rugged and unpredictable terrain strewn with obstacles on trails that are generally poorly maintained and susceptibility to deterioration in bad weather conditions, and they execute inherently risky manoeuvres such as jumping over obstacles. Conversely, on-road motorcycles must share the road with many and much larger vehicles, such as cars and trucks, increasing the possibility of adverse mass ratio accidents. There is no or sparse information in the injury surveillance datasets on both the contributory factors to injury (such as protective gear wear, motorcycle speed, driver experience and alcohol and drug use) and the specific mechanisms of injury. More detailed information on all motorcycling fatalities that occur in Victoria is available from the National Coronial Information System (NCIS) based at and managed by the Victorian Institute of Forensic Medicine (Phone: 9684 4414). The Queensland Injury Surveillance Unit (QISU) collects injury data from the Emergency Departments of 15 Queensland hospitals at a more detailed level than collected in Victoria on the VEMD, and these data should provide more information on contributory factors to off-road motorcycling injury (phone: 07 3840 8569).

The less stringent safety requirements for registration of recreational motorcycles in Victoria may be a contributory factor to off-road motorcycling injury. However, riding of these vehicles is restricted to certain areas such as roads located outside "built up areas" as defined by speed zones of less than 100 km/h or training and assessment areas for motorcycle riders with a learner permit. Also, passengers cannot be carried on recreational motorcycles.

Data strengths and limitations

Strengths

The three databases utilised for this analysis provide a statewide compilation of injury data that cover three levels of injury severity: deaths, hospital admissions and emergency department presentations (non-admissions). These datasets provide the most comprehensive surveillance data on off-road motorcycle injury in Australia because Victoria is the only Australian state that has an Emergency Department injury surveillance system that covers all hospitals with 24-hour staffed emergency services (from 2004).

Limitations

Completeness of data

ABS-DURF (fatalities data): Fatalities data are complete for 2001 and 2002 but are underestimated by 5-10% in 2003 due to non-registrations of some deaths that occurred late in that year. The 2004 file will include the late registrations for 2003. (VISU has received the 2004 file from the ABS but data have not yet been merged into the VISU dataset.)

VAED: Injury case capture on the VAED is not known as no validation study of VAED (injury surveillance) has been undertaken. A small validation study of VEMD conducted in four hospitals in the late 1990s found that, on average, injury case ascertainment was 83%. All injury hospital admissions are processed through hospital emergency departments. It is estimated that 10% of injury admissions recorded on the VAED are double counted due to the transfer of patients within and between hospitals for various episodes of care.

Trained hospital medical records staff members enter data on the VAED (coded to ICD-10AM) utilising information recorded in the patient's medical record (electronic and paper). There may have been some misclassification of cases to the on- and off- road categories as there was an apparent lack of consistency in the coding of off-road cases by cause and location. For this study, all off-road cases were defined as such by their assignment to a 'non-traffic' transport injury cause (i.e. they were caused by a vehicle accident that occurred in a place other than a public highway) yet 11% of the off-road motorcycling hospital admissions selected using the 'non-traffic' cause codes were assigned the location code 'road/street/highway'. ICD-10AM has no specific code for dirt trails/tracks so if these injury cases occurred off-road they should have been assigned to the location code 'other specified location'. Another limitation of the VAED data is that the usefulness of the location and activity codes was affected by lack of specificity – in 30% of off-road cases the activity at the time of injury was unspecified and in 38% of cases the place where the injury happened (location) was unspecified.

VEMD: VEMD data are entered by untrained ED medical and clerical staff at triage and/or later from patient self-reports, electronically recorded information and/or patient medical records. Only public hospitals that offer a 24-hour ED service contribute to the VEMD dataset so the frequency of motorcycling injury hospital ED presentations reported here may be an underestimate as some private hospitals and rural public hospitals provide limited daytime ED services. The number of hospitals contributing data to the VEMD progressively increased between 1995 (when 19 major hospitals contributed data) and 2004 when 100% statewide coverage was achieved (37 hospitals). As previously mentioned, injury case ascertainment on the VEMD is estimated at 83%. As for hospital admissions, there may be some misclassification of on- and off-road motorcycling injury cases as some ED presentations were coded as occurring on a 'road, street or highway' yet information in case narratives indicated that the injury occurred on a dirt bike track.

5. Research recommendations

- Ongoing monitoring and surveillance of off-road motorcycle injury utilising VISU-held databases
- Study of off- and on-road motorcycling fatalities in Victoria utilising data from the National Coroners Information System (NCIS)
- Telephone call-back study of hospital-treated off-road motorcycling injury cases to investigate the circumstances and contributory factors to injury, safety practices of riders and injury sequelae and personal and societal costs.
- Off-road motorcycling exposure and safety telephone or internet-based survey: a study to determine injury rates and risk and the safety practices in off-road motorcycling

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Appendix: Comparison of ABS-DURF and VAED datasets to RCIS (police reported) deaths and hospitalisations for motorcycle injury cases

Table Comparison of motorcyclist fatalities on ABS-Death Unit Record File held by VISU and the Road Crash Information System (RCIS) held by VicRoads, Victoria 2001-3

	Fatalities (RCIS)	Fatalities (ABS- DURF)
2001	64	66
2002	56	59
2003	39	36
Total	159	161

Table Comparison of frequency of motorcycling injury cases hospital presentations (admissions) as recorded on the Victorian Admitted Episodes Dataset (VAED) and the Road Crash Information System (VicRoads)

	'Taken to hospital' (RCIS)	Hospital admissions (VAED)
2001/02	918	2571
2002/03	856	2556
2003/04	833	2576
Total	2,607	7,706*

Note: * Total does not include an estimated 9,500 motorcycling injury ED presentations (non-admissions) over the same period.