

Seasonal variation in hospital admission for road traffic injuries in England: analysis of hospital statistics

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ABSTRACT

Objective: To report on seasonal variation in hospital admissions for traffic injuries to car and truck occupants, motorcyclists, cyclists, and pedestrians.

Methods: Descriptive study of hospital admission statistics in England, 1999–2004. Main outcome measures: national average monthly admissions for injury; severity of injury, defined as death in hospital or a hospital admission lasting four days or more.

Results: Admissions for car occupants were highest in the winter months but seasonal variation was not great (highest and lowest months: December, 16% above monthly average; June, 5% below). There was a summer peak and winter trough in admissions for adult cyclists (June, 34% above average; December, 27% below) and motorcyclists (August, 33% above average; January, 43% below). Admissions for child pedestrians were highest in late spring and lowest in mid-winter (May, 24% above average; December, 28% below). By contrast, admissions for adult pedestrians were higher in winter than summer (December, 33% above average; July, 17% below). From April to September, there were more admissions for pedestrians and cyclists in England (44 875 in the six years of the study) than for car occupants (34 582). For cyclists, proportionally more injuries in the winter months were severe. Severity of injuries to car occupants did not show seasonal variation.

Conclusions: The public health “toll” of traffic injuries, measured as total numbers of people injured, varies substantially by season. Although it is important to reduce all injuries, the safety of pedestrians and cyclists, as unprotected road users, needs particular attention.

The Department for Transport in England has recently published guidance on speed limits.¹ It states that limits should be “evidence-led”, and should better reflect the needs of all road users, not just motorists. Much national road safety advice about seasonal effects is based on an assumption that injuries are concentrated during winter, when there is less daylight, worse weather, and wet and icy roads.^{2–4} We analysed data on hospital admissions by type of road user and month of the year.

METHOD

Nationwide data on hospital admissions for 1999–2004 in England were analysed using the Department of Health’s hospital episode statistics (HES) system. HES includes data about all people who go through a formal process of admission to hospital, including people who do not stay in hospital overnight but excluding people who attend the emergency department without formal

admission. We selected codes from the International Classification of Diseases, 10th revision, for transport injuries, excluding admissions for non-traffic injuries (see Appendix for codes used). Traffic injuries are defined as those coded as having occurred on the public highway.

We divided the year into spring (March to May), summer (June to August), autumn (September to November), and winter (December to February). We divided the analysis into all injuries, and severe injuries, defining severe as injuries that resulted in either death in hospital or a length of hospital stay of four days or more. Children were defined as those aged 15 years or less.

RESULTS

There was significant month-by-month variation in admissions for every individual group of road user (table 1).

Admissions for car and truck drivers were higher in the winter months than in spring or summer but month-by-month variation was not nearly as substantial in amplitude as that for other road users.

Admissions for motorcyclists and pedal cyclists showed a substantial summer peak and much lower levels in winter (table 1). Admissions for adult cyclists in June were a third more than the monthly average, and those in December were about a quarter of average. Admissions for child cyclists in August were almost double the monthly average and those in December were about one-fifth of average (table 1).

Admissions for child pedestrians were relatively high in April, May, June, September, and October, with relatively low months in December and January. By contrast, admissions for adult pedestrians were highest in winter and lowest in the summer months (table 1). Figure 1 compares the month-by-month profile of injuries to non-motorised road users, the cyclists and pedestrians, with that of car and truck occupants.

In general, the percentage of injuries that were severe did not vary greatly by season (table 2). For car occupants, the percentage of injuries that were severe was significantly but only slightly higher in winter than summer; that for cyclists and pedestrians was also significantly higher in winter than summer. The smallest percentage of injuries that were severe were those to child cyclists, and the largest were those to adult pedestrians.

HES includes a code for whether or not the road traffic injuries to cyclists and pedestrians involved “collision with” a motor vehicle. Of all road traffic

Table 1 Month of admission for road traffic injuries: observed number (n) of admissions*; percentage of admissions in each month, compared with the monthly average across the year for the road user category†; and χ^2 test for seasonal variation‡

	All	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	χ^2
Car occupants														
n	71099	5751	5244	5192	5455	5820	5575	5791	6132	5809	6551	6786	6993	345
% of average		95%	96%	86%	93%	96%	95%	96%	102%	99%	109%	116%	116%	
Truck occupants														
n	4527	355	343	316	340	404	350	410	393	420	421	423	352	24
% of average		92%	98%	82%	91%	105%	94%	107%	102%	113%	110%	114%	92%	
Motorcyclists														
n	35473	1713	1892	2468	3108	3681	3704	3891	3996	3701	3012	2486	1821	2544
% of average		57%	69%	82%	107%	122%	127%	129%	133%	127%	100%	85%	60%	
Adult cyclists														
n	18257	1177	1049	1196	1358	1805	2006	2058	2023	1787	1407	1261	1130	976
% of average		76%	74%	77%	91%	116%	134%	133%	131%	119%	91%	84%	73%	
With MV§	5850	467	379	431	379	479	547	578	571	587	480	520	432	
Without MV	11006	633	587	679	854	1194	1307	1337	1295	1065	798	644	613	
Child cyclists														
n	16395	378	496	816	1485	2136	2186	2304	2713	2175	1015	399	292	6273
% of average		27%	39%	59%	110%	153%	162%	166%	195%	161%	73%	30%	21%	
With MV§	3035	108	136	158	291	355	385	386	405	346	246	126	93	
Without MV	12428	244	337	633	1105	1659	1685	1760	2149	1721	700	250	185	
Adult pedestrians														
n	25756	2426	2027	2039	1959	1921	1857	1805	1922	2020	2304	2569	2907	458
% of average		111%	102%	93%	93%	88%	88%	83%	88%	95%	105%	121%	133%	
With MV§	23621	2255	1891	1882	1777	1750	1656	1637	1716	1830	2111	2389	2727	
Without MV	649	41	34	45	48	49	69	63	77	73	49	55	46	
Child pedestrians														
n	16818	1093	1153	1458	1582	1770	1591	1486	1354	1572	1529	1206	1024	261
% of average		77%	89%	102%	114%	124%	115%	104%	95%	114%	107%	87%	72%	
With MV§	15753	1045	1102	1357	1467	1654	1471	1371	1232	1454	1454	1148	998	
Without MV	480	12	17	39	44	62	60	60	72	58	31	15	10	

*Data on episodes for the same hospitalised injury were linked together to count each injury once only. Analysis was restricted to emergency admissions to ensure that the date of admission was close to the date of incident.

†Monthly average calculated taking account of difference between months in the number of days in them.

‡Month by month variation was assessed by modelling the observed monthly counts, allowing for the number of days in each month, using Poisson regression. The peak (the time of year when maximum number of admissions occurred) and the ratio of the number of admissions to the overall average was estimated from the fitted model and significance assessed by a χ^2 statistic. The total χ^2 for heterogeneity with 11 degrees of freedom (df) is partitioned into a χ^2 with 2 df to test significance of seasonality and a χ^2 with 9 df to assess significance of deviations from the fitted model ie goodness of fit. Every group of road users shows significant seasonal variation (the χ^2 value for $p = 0.01$, on 11 degrees of freedom, is 24.7)

§Coded as involving collision with a motor vehicle (MV) or not coded as such.

injuries in each group, there was a code to indicate that the injury resulted from a collision with a motor vehicle in 94% of injuries of child pedestrians (15753/16818), 92% of older pedestrians (23621/25756), 19% of child cyclists (3035/16395), and 32% of injuries to older cyclists (5850/18257). These are minimum percentages of vehicle involvement because, in 5% of pedestrian injuries and 7% of cyclist injuries, the statistical record did not specify whether a vehicle was involved or not. Much of the summer excess of injuries to adult cyclists was in the coded category that did not involve collision with a motor vehicle (table 1). Nonetheless, for child cyclists there was a four-fold increase in the peak summer month, compared with the lowest winter month, in injuries caused by collision with a motor vehicle.

DISCUSSION

Principal findings

Seasonal variation in road traffic injuries is much greater for child pedestrians, cyclists, and motorcyclists than for car occupants. In the months from April to September, there were more admissions for injuries to pedestrians and cyclists in England (44875 in the six years of the study) than for injuries to car occupants (34582). Even after excluding injuries that apparently did not involve collision with motor vehicles, the

number of hospital admissions for pedestrians and cyclists injured by vehicles throughout the period of the study (48259) was about two-thirds as high as those for injured car occupants (71099). Put another way, for every 100 injuries to car occupants, motorists injured 68 pedestrians and cyclists. Given that there was no code for the circumstances of the injury in 6% of pedestrian and cyclist injuries, the true figure is probably higher than 68.

Interpretation, public health "toll" of injuries, and individual traveller risk

The most obvious explanation for the substantial peak of summer injuries to motorcyclists and pedal cyclists is that many more people use bikes during the summer months. The child pedestrian peaks are in April, May, and June (school summer term), and in September and October (start of school autumn term), which may reflect an increase in walking during term time. A greater proportion of the injuries to cyclists in the winter than summer were severe. Possible explanations include the effects of winter weather and less daylight which, in scale, more than offset the effects of injury to "occasional" (ie, summer only) cyclists. Another explanation is that, even at relatively low rates of cycling use, there may be an effect of "safety in numbers"—notably increased awareness of cyclists

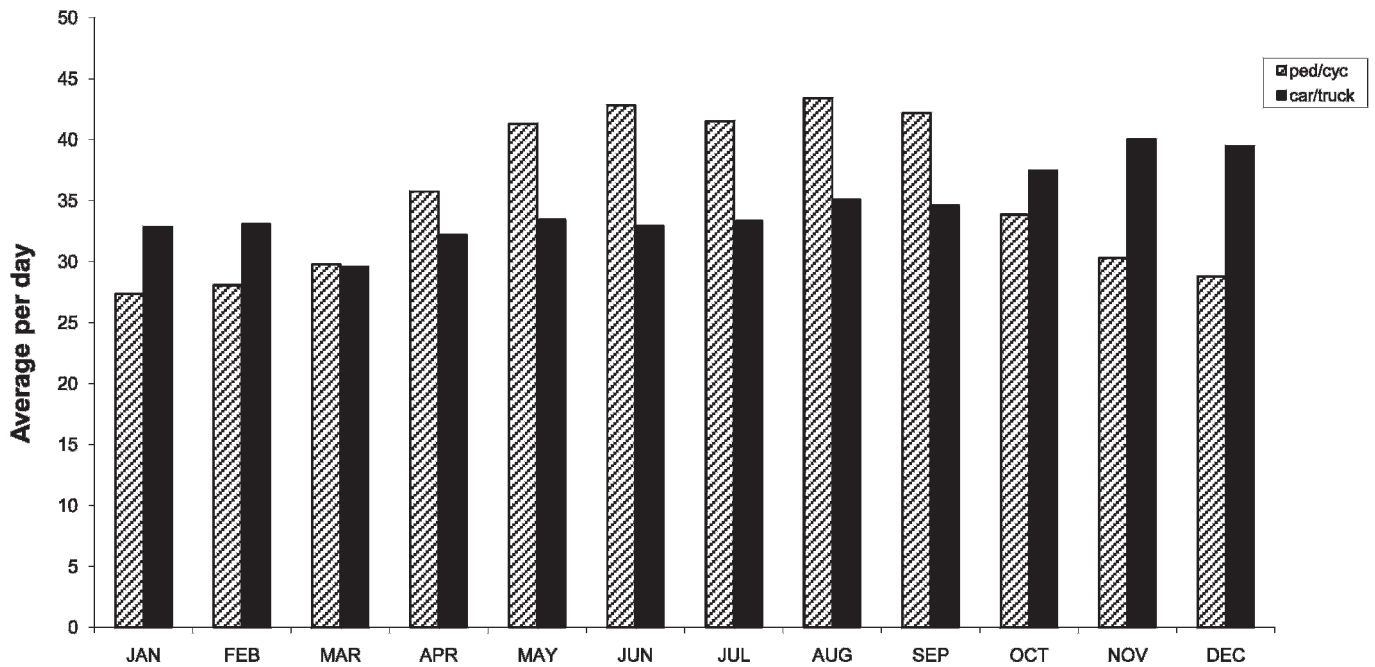


Figure 1 Monthly variation in admissions, expressed as average admissions per day (to take account of differing numbers of days in each month), showing data for: pedestrians and cyclists; and car and truck occupants.

by car drivers—when the use of cycling increases in the spring and summer.^{5,6}

There is an important distinction between the public health “toll” of injury, at different times of the year, and risk to the

individual traveller. The public health “toll” is unequivocally higher for pedestrians and cyclists, considered together, than for motorists in summer (table 1, fig 1). It is harder to estimate whether the risk at the individual level—injury per journey or

Table 2 All categories of injury by season, the percentage that were severe, and odds ratios (with 95% CI) for the percentages of all injuries that were severe, comparing seasons

Road user	Season	Total	Severe	% severe	Odds ratio (95% CI)
Car occupant	Spring	16467	5599	34.0	1.03 (0.98 to 1.08)
	Summer*	17498	5838	33.4	1
	Autumn	19146	6692	35.0	1.07 (1.03 to 1.12)
	Winter	17988	6343	35.3	1.09 (1.04 to 1.14)
Truck occupant	Spring	1060	381	35.9	0.90 (0.76 to 1.08)
	Summer*	1153	442	38.3	1
	Autumn	1264	517	40.9	1.11 (0.94 to 1.32)
	Winter	1050	384	36.6	0.93 (0.78 to 1.11)
Motorcyclist	Spring	9257	4260	46.0	0.98 (0.92 to 1.03)
	Summer*	11591	5403	46.6	1
	Autumn	9199	4324	47.0	1.02 (0.96 to 1.07)
	Winter	5426	2457	45.3	0.95 (0.89 to 1.01)
Adult cyclist	Spring	4359	1302	29.9	1.04 (0.95 to 1.13)
	Summer*	6087	1772	29.1	1
	Autumn	4455	1424	32.0	1.14 (1.05 to 1.25)
	Winter	3356	1188	35.4	1.33 (1.22 to 1.46)
Child cyclist	Spring	4437	382	8.6	1.15 (1.00 to 1.13)
	Summer*	7203	547	7.6	1
	Autumn	3589	318	8.9	1.18 (1.02 to 1.37)
	Winter	1166	138	11.8	1.63 (1.33 to 2.00)
Adult pedestrian	Spring	5919	3096	52.3	1.06 (0.98 to 1.14)
	Summer*	5584	2844	50.9	1
	Autumn	6893	3691	53.6	1.11 (1.03 to 1.19)
	Winter	7360	4097	55.7	1.21 (1.13 to 1.30)
Child pedestrian	Spring	4810	1269	26.4	1.17 (1.07 to 1.30)
	Summer*	4431	1035	23.4	1
	Autumn	4307	1100	25.5	1.13 (1.02 to 1.24)
	Winter	3270	863	26.4	1.18 (1.06 to 1.31)

*Reference category.

per mile travelled—differs across the seasons because of limitations in denominator data about trips made by mode of travel by month. Many more journeys are made by pedal cyclists and motorcyclists in summer than in winter. It is possible, and indeed likely, that injuries per trip for cyclists and motorcyclists are lower in summer, in clement weather conditions, than winter. Seasonal denominator data currently available for cyclists and pedestrians in England—journeys made, and miles travelled, by month of the year⁷—are not robust enough to compare seasonal risk accurately at the level of the individual road user. However, annual data are available. In the years covered by our study, the average number of trips made by car drivers and occupants (637 per person per year) was over 40 times higher than those made by bicycle (average 15 per person per year).⁸ If car and bicycle journeys were equally safe or hazardous, trip for trip, one would expect 40 times fewer admissions for injuries to cyclists than to car occupants. Scrutiny of the data in table 1 reveals no monthly injury ratio of “cyclists to car occupants” that is even close to 1:40. Per trip, cycling is more risky, as measured by hospital admission, at any time of the year than journeying by car.

Much of the seasonal variation for cyclists, and of the summer excess of injuries to cyclists and pedestrians over those to car occupants, comprises non-fatal injuries. It is well documented that deaths following road traffic injury—most of which occur before reaching hospital⁹—are more numerous among car occupants than cyclists.

Strengths, weaknesses, and unanswered questions

Strengths of the study are that, at least in this time period, data on hospital admissions for road traffic injuries are more complete than those from police statistics.⁹ ¹⁰ This is particularly true for adult cyclists: the hospital admission data shows a ten-fold seasonal difference, compared with a less than two-fold difference published in the STATS19 police statistics in 2006 (the only year in which monthly data have been published⁷).

Privacy regulations preclude seeking original records and checking coding. A potential weakness of the study is that the hospital statistics do not provide insights into the circumstances of the injuries. For example, many injuries to cyclists are coded as not involving collision with a motor vehicle. However, these non-collision injuries are likely to include some injuries caused when cyclists take avoiding action when, say, a car passes too closely or a car door is opened as they pass. Injuries to cyclists are also caused, to an undocumented extent, by road surfaces that are unsuitable for cycles such as uneven or steeply sloping cambers, humps, and potholes in road surfaces. Cyclists may also, independently of collision or road surface, wobble and fall. Drivers need to be constantly aware of the presence of cyclists, to give them wide berth and to pass them with caution and at appropriate speed, to minimise injury to cyclists who may themselves be prone to error. An area for further research is the study of the extent to which injuries to cyclists are caused by errors by the cyclist or by drivers.

Policy implications

As long as road traffic injury is so exposure-dependent—dependent on the mode, number, and duration of journeys—it may be wrong to interpret relatively low levels of road traffic injury as evidence of safe roads. For example, the fact that there are many fewer injuries to cyclists and child pedestrians in winter than summer may well result from rational decisions made by them to stay off the roads in winter. Similarly, declines

What is already known on the subject

- ▶ There are more road traffic deaths in the winter than in the summer months.
- ▶ Road traffic injuries kill more car occupants and motorcyclists than pedal cyclists and pedestrians.

What this study adds

- ▶ There is substantial seasonal variation in hospital admissions for road traffic injuries to motorcyclists and cyclists, with much higher numbers of admissions in the summer than in the winter months.
- ▶ Non-fatal injuries account for much of the substantial summer excess of injuries to cyclists.
- ▶ Nonetheless, cycling is more risky than travelling by car, whether danger is measured by hospital admissions or as deaths, particularly once allowance is made for the many fewer trips made by cycle than by car.
- ▶ In this study, for every 100 injuries to car occupants, drivers of motorised vehicles injured at least 68 pedestrians and cyclists.

in injury rates for pedestrians and cyclists over time may, at least in part, reflect decisions to make more journeys by car.¹¹

There is considerable current interest in obesity and in encouraging people to take more exercise, including making journeys on foot or cycle rather than by car. There is also an obvious environmental case for increasing the number of journeys made by non-motorised modes. However, in some circumstances, when people feel that it is unsafe to cycle or walk they may be right. Encouragement of walking and cycling needs to be accompanied by serious efforts to ensure that safe traffic environments are established for pedestrians and cyclists. Better separation of pedestrians and cyclists from motorists, and greater awareness among the latter of the risks faced by pedestrians and cyclists, are important. International comparison shows that both injury and death rates per distance travelled by cyclists in the UK are more than three times those found in the Netherlands or Denmark.⁵ This scale of variation between countries, and our findings of substantial seasonal variation, underline the scope for prevention of unnecessary injury.

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APPENDIX: CODES USED FROM THE ICD, 10TH REVISION FOR CATEGORY OF ROAD USER AND CIRCUMSTANCE OF INJURY

Pedestrian: ICD10 codes V01 to V06 if decimal point is .1 or .9; V09 if decimal point is .2, .3 or .9
 Cyclist: ICD10 codes V10 to V18 if decimal point is .3 through to .9; V19 if decimal point is .4 to .9
 Motorcyclist: ICD10 codes V20 to V28 if decimal point is .3 through to .9; V29 if decimal point is .4 to .9
 Three-wheeler: ICD10 codes V30 to V39 if decimal point is .4 to .9
 Car occupant: IDC10 codes V40 to V49 if decimal point is .4 to .9
 Truck occupant: IDC10 codes V50 to V59 if decimal point is .4 to .9
 Heavy goods vehicle occupant: GV IDC10 codes V60 to V69 if decimal point is .4 to .9
 Pedestrian injuries were further subdivided by code as: (1) collision with motor vehicle, V02 to V04, V09.2; (2) not in collision with motor vehicle, V01, V05, V06; (3) nature of collision not specified, V09.3, V09.9.
 Cyclist injuries were further subdivided by code as: (1) collision with motor vehicle, V12 to V15, V19.4 to V19.6; (2) not in collision with motor vehicle, V10, V11, V16, V18; (3) nature of collision not specified, V19.8, V19.9.

Lacunae

I TOLD YOU SO DEPARTMENT

Some while ago, editor emeritus Barry Pless wrote an editorial that suggested that one of the most effective injury prevention strategies was to reduce speeding. In the case of Montrealers, who are notoriously bad drivers, cutting speeds had to be coupled with controlling stop light violations. The combination of speed cameras and red light cameras has now ended after a 3-month pilot study. As reported in the *Montreal Gazette*, “After a three-month grace period, during which drivers caught speeding or running red lights on one of the 15 cameras throughout the province were issued with more than 11 000 warning letters, guilty parties will now be receiving tickets in the mail for anywhere from \$154 for running a red to as much as \$1,255 for speeding.” The article notes that “in France, officials say photo radars led to a 40 per cent drop in the traffic fatality rate, saving more than 7000 lives in five years.... In Montreal, speeding in the targeted areas has dropped by 44 per cent, excessive speeding of 40 to 60 kilometres an hour over the speed limit has dropped by 94 per cent, and the running of red lights dropped by 77 per cent. Driving speeds dropped an average of 9 kilometres an hour where cameras were placed. Signs warn drivers the cameras are coming up, along with government campaigns and media coverage.” The article concludes with this amazing statement: “According to a survey conducted by the Transport Department in July, 83 per cent of drivers are “completely” or “mostly” in favour of the pilot project.” (Contributed by Barry Pless)

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