FALL AND INJURY INCIDENCE RATES OF JOCKEYS WHILE RACING IN IRELAND, FRANCE, AND BRITAIN

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RUNNING TITLE

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ABSTRACT

This paper presents and analyses injury incidence rates for amateur and professional racing jockeys in Ireland, France and Britain by means of a retrospective study and review of published data.

Amateur jump racing was seen to have the highest fall risk in these three countries (between 115 and 140 falls/1000 rides). Jump racing also had the highest rates of injury/ride amongst both amateur and professional jockeys. Flat racing, however, had the highest rates of injuries/fall (34-44%). 15% of all injuries in both jump and flat racing populations of amateur and professional jockeys were concussive head injuries and more than half of these involved loss of consciousness. Professional jump jockeys in Ireland fell less frequently than those in France or Britain. Their injury/fall rate and injury/ride rate were highest in Britain. Professional flat racing jockeys in France had the lowest rates of injuries/fall and injuries/ride while those in Ireland had the highest.

INTRODUCTION

Horse racing is a particularly risky sport[1, 3, 7-10, 13, 15, 17, 21, 24, 26] in which the rider's position and height above the ground, and the unpredictability, power, speed, mass of the horse and the likelihood of being kicked or trampled in the event of a fall all contribute to the incidence and severity of jockeys' injuries. Two thirds of jockey fatalities between 1975 and 2000 in Britain were from head injury[32]. Jump racing was seen to have a greater fall/ride incidence than flat racing, while flat racing had a higher concussion/fall incidence in both Britain and Ireland. Point-to-point jockeys were seen to fall more frequently and have a higher injury/ride incidence than National Hunt jockeys[2]. It has also been reported[29] that racing jockeys, despite always wearing helmets, have a concussion rate of 13%, which is higher than reported in American football and boxing. Injury risks for professional jockeys are higher than in other sports, at 0.88% per competitor per event[28], compared to 0.24% and 0.14% in professional motorcycle and car racing, respectively[6].

In Ireland, France and Britain, there are three main types of equestrian racing. Flat racing is performed on closed tracks without jumps. National Hunt races are also held on closed tracks but over jumps. Point-to-point racing in Britain and Ireland also involves jumps but takes place in open fields. Amateur jockeys participate in point-to-points while almost exclusively professional jockeys participate in flat and National Hunt racing. Amateur jump races in France, however, do not take place in open fields: these are held on closed tracks.

There is a lack of worldwide equestrian injury data and a lack of uniformity in the data that is available. The objective of the present paper is to provide quantitative

details regarding the frequency and severity of injuries, focussing especially on head injuries, sustained by jockeys while racing. This could help to motivate future efforts into designs for personal protective equipment including helmets, reconstructions of documented falls involving injury, and identifying fundamental differences between head injuries arising from jump or flat racing.

METHODS

Sufficient epidemiological data was needed to categorise and prioritise the different types of injury involved in equestrian racing and to compare collected data with already published figures. Relevant literature was found through the PubMed, Medline and Sport Discus databases and Google and Google Scholar, during 2006 and 2007. Keywords used for searches included equestrian injury, horse racing injury, jockey injury, head injury, sports injury, horse injury, brain injury and concussion.

Ireland, France and Britain were the three countries for which the most detailed data on jockeys' injuries have been available to the authors and consequently no data from other racing jurisdictions have been included in this paper. All available epidemiological injury data were collected and provided to the authors for the racing seasons of 1999-2006 by the senior Medical Officers of both the Irish Turf Club and France Galop. Corresponding data have also been collated and published previously by the medical personnel of the British Horseracing Authority[2, 23]. In each jurisdiction, broadly similar procedures were followed by the three professional racing authorities: qualified medical personnel assessed all injured jockeys immediately at the scene of each accident. No ethics approval was required for this

research as it involved neither contact with jockeys nor intervention in the treatment of any injured jockeys.

While there are many clinical forms of head injury including concussion, loss of consciousness (LOC), skull fracture, contusion, haematoma and haemorrhage, the level of on-course medical assessment is not identical in each country and reported head injuries are, at best, only categorised in terms of concussion or LOC. The evaluation of this is always done by qualified medical personnel although this is done differently in each country. In Ireland, concussion severity is related to LOC[31]: following minor concussion, a jockey is not permitted to race for two days, while a jockey is not permitted to race for one week following LOC, amnesia or hospitalisation. The most severe level of concussion relates to "prolonged" LOC and a jockey with such an injury is stood down from racing for at least three weeks. British authorities used the same classifications prior to 2003, following which they introduced different guidelines where concussion severity is determined retrospectively after all concussion symptoms are cleared[22]. All jockeys in Britain now undergo baseline neuropsychological evaluation before being granted a racing licence and they are reassessed after a concussive incident. A jockey is not permitted to return to race riding until the repeat test results return to normal. In France, a jockey who is concussed must be certified as medically fit to race again before they are permitted to do so; this cannot happen for at least 72 hours after having being concussed[14]. In order to permit the most meaningful comparison possible, concussion was defined in this paper as a mild traumatic brain injury (MTBI), the severity of which was categorised according to the period of LOC[31]. The concussion severity grading for Britain is available for years prior to 2003. Other reported forms

of head injury, i.e., skull fracture, and fatalities are negligibly rare occurrences (c.f. annualised data of Tables A1 and A2) and consequently were ignored in this paper.

Incidence rates were compared by calculating incidence rate ratios (IRR)[30]. 95% confidence intervals were provided for the IRR. Poisson regression was done using R v. 2.7.2[20] software to determine if incidence rates changed during the years for which the data was collected. Overdispersion was tested by using a Chi-Square goodness of fit test with an alpha value of 0.05. The data analyzed through Poisson regression was not seen to be overdispersed. Proportions were compared using a two-tailed-two-proportion z-test with a significance of 0.05.

RESULTS

Ireland

Eight years of jockey injury data for jump, point-to-point and flat racing were summarised in Table 1a, compared in Table 1b and presented in detail on an annualised basis in Table A1. All injuries associated with these data led to jockeys being "stood down" from riding for various periods of time.

**** TABLE 1a NEAR HERE ****

From the Poisson regression it was seen that the yearly incidence rates for concussions/ride, falls/ride and injuries/ride did not change significantly. An exception for this was for jump racing, where it was observed that the injury/ride rate showed a slight increase from 1999 to 2006 (Year coefficient of 0.053; 95% CI [0.03, 0.08]). Table 1b shows the comparison results between the incidence rates and

proportions between the main forms of Irish racing. Point-to-point racing was seen to have significantly higher rates of falls/ride, injuries/ride and concussions/ride than either jump or flat racing. The higher injury/ride rate was a consequence of the higher fall/ride rate. Jump racing had higher rates of injury/fall and concussion/fall than point-to-point racing. The difference in the concussion/injury proportion between point-to-point and jump racing was not significant.

**** TABLE 1b NEAR HERE ****

It is also seen from Table 1b that flat racing had significantly higher injury/fall and concussions/fall rates than either point-to-point racing or jump racing. There was no significant difference in the proportions of concussions/injury between flat and point-to-point racing. Jump racing, on the other hand, had considerably higher rates of falls/ride, injuries/ride and concussions/ride than flat racing. The difference in proportions of concussions/injury between jump and flat racing was not significant.

There was no significant difference in the proportions of concussions either with LOC (i.e., stood down for at least 7 days) or without LOC for the various forms of racing. While less severe concussions (2 and 7 days off racing) were more frequent than more severe concussions (77% Vs. 23%), LOC was more commonly associated with concussion (95% confidence interval is [54%, 66%]) than not (60% Vs 40%).

France

French data were summarised in Table 2a for the period 2000-2006 for amateur and professional jockeys, compared in Table 2b and presented on an annualised basis in Table A2. In all cases, these data included the total number of injuries during racing,

including those that led to time off work (TOW). Information on injuries leading to time off riding was only available for the professional racing population. Less serious injuries which did not lead to TOW were recorded in France but not in Ireland or Britain. Head injury data was only available for combined populations: professional, amateur, flat and jump. LOC information was only available for all combined jockey groups.

*** TABLE 2 NEAR HERE ****

A small decrease in the falls/ride rate and the injuriesTOW/ride rate was observed for professional jump jockeys in France over the years 2000 to 2006 (falls/ride: Year coefficient of -0.01, 95% CI [-0.019, -0.0017]. InjuriesTOW/ride: Year coefficient of -0.04, 95% CI [-0.07, -0.01]). Similarly, a small decrease in the concussions/ride rate was observed for the combined populations of amateur and professional jump jockeys (Year coefficient of -0.09, 95% CI [-0.14, -0.04]). For flat jockeys, the concussion/ride rate did not seem to change significantly throughout the years. Professional and amateur jump racing had a significantly higher falls/ride rate than flat racing (Table 2b). Professional jump racing had higher rates of injuries leading to TOW/ride than flat racing. Professional and amateur jump racing had higher total injuries/ride than flat racing. Professional and amateur flat racing exceeded jump racing in the rates of injuries/fall, while professional flat racing exceeded professional jump racing in injuries leading to TOW/fall. Professional flat racing also had a slightly higher proportion of injuries leading to TOW/injury.

Injury data for amateur jockeys did not report or quantify injuries leading to TOW. Amateur jump and flat racing jockeys seem to have fallen more frequently than their

professional counterparts. Professional jump jockeys, however, showed a higher injuries/ride rate and a higher injuries/fall rate and professional flat jockeys show a higher injuries/fall rate than flat amateur jockeys, with the exception that amateur flat racing jockeys seem to have been injured more per ride.

**** TABLE 3 NEAR HERE ****

Jump racing had a significantly higher concussion/ride rate than flat racing, while flat racing had a higher concussion/fall rate (Table 3a summarizes the data and Table 3b shows the comparisons results). The difference in the proportion of concussions over total injuries between jump and flat racing was found to be not significant. The differences between the rates of concussion/ride and concussion/fall in professional and amateur racing in France were also seen from Table 3b to be insignificant. Amateur racing, however, had a higher proportion of concussions/injury than professional racing.

When the annualised French data were examined (Table A2), it was seen that the number of concussions with LOC did not decrease over time, unlike the overall number of head injuries/ride: the level of more serious injuries remained relatively constant.

Great Britain

British data over a sixteen year period were obtained from published literature and is presented in Table 4[2, 23]. These describe general fall and injury incidence rates; detailed yearly data were not available.

**** TABLE 4 NEAR HERE ****

Point-to-point racing had the highest rates of falls/ride and injuries/ride. The injury/fall rate of point-to-points was similar to that of jump racing, while that of flat racing was more than double. The concussion severity distribution was based on the number of days off riding, as calculated prior to 2003 and as is currently calculated in Ireland. For jump and point-to-point racing the distribution was very similar, the majority of concussions being relatively minor. In Britain, point-to-point racing had the highest number of concussions/ride and /fall. Flat racing had the fewest concussions/ride, but had more concussions/fall than jump racing.

Comparison between Ireland, France and Britain

Available information for incidences of injury in professional racing is shown in Table 5a. Corresponding comparison results are shown in Table 5b. For professional jump racing, France had the highest falls/ride rate while Ireland had the lowest. Britain and Ireland had the highest injury/fall rate and France had the lowest. There was no significant difference in the injuries/ride rate between Ireland and France; that of Britain was some 40% higher. For professional flat racing, France had the lowest rates of falls/ride and injuries/ride. There was no significant difference between Ireland and Britain in the injuries/fall rate; France had the lowest of the three. Concussion data for France were only available for combined populations of professional jump and flat racing jockeys. Therefore, French concussion data were compared to the Irish and British data by combining the jump and flat data for Ireland and for Britain. From this comparison, it was seen that the difference in the

concussions/ride rate between France and Ireland was not significant, while the French concussion/ride rate was higher than the British one. The concussion/ride rate for Ireland was slightly higher than for Britain. The concussion/fall rate for France was higher than that in Ireland and Britain. Amateur jump racing in Ireland had a slightly higher falls/ride rate than in either France or Britain.

**** TABLE 5a NEAR HERE ****

**** TABLE 5b NEAR HERE ****

Table 6 compares the incidence rates of concussion and LOC in the three countries. For France, LOC data were available only for a combined population of all jockeys; therefore, they were compared with the combined data from all jockeys in Ireland. LOC data for Ireland and Britain were available for separate amateur and professional jump populations. France had higher rates of concussion than Ireland and Britain for most cases (Table 5). The rates of concussion/fall and /ride in jump racing were similar in France and Britain although they were 50% higher than in Ireland. On the other hand, the proportion of concussions which involve LOC was slightly higher in Ireland than in either France or Britain. This difference could have been influenced by the lack of separate amateur flat jockey data in Ireland[*], since French data included amateur flat jockeys.

**** TABLE 6 NEAR HERE ****

[*] Included in National Hunt figures since such races are governed by National Hunt rules.

DISCUSSION

Ireland, France and Britain were the three racing jurisdictions around the world for which detailed levels of accident and injury data were available. Unfortunately, this information was neither reported nor presented uniformly: the severity of concussion was defined using different criteria after 2003 for the British data, the time off work arising from an injury was characterised differently and not every country presented annual injury rates. Presenting such data annually in a harmonised manner across a greater number of countries could provide insight into why injury rates might be lower in any given country and consequently might help to inform the policies of different racing regulatory authorities.

The present analysis only served to identify differences in injury incidence rates that exist between the three countries and the different types of racing. It did not address additional modifiable risk factors which could also give rise to different injury incidence rates. Many of the more successful jockeys actually compete in all three countries and around the world and do not restrict their activities solely to one country.

Of all the forms of racing considered in this study, it is amateur jump jockeys who fell most frequently in each of the three countries although their injury rate from a fall was essentially the lowest (Tables 1, 2 and 4). Differences in fall rates between amateur jump jockeys from different countries could be due to different racing environments: Irish and British amateur jump races are in open fields while in France they are over closed tracks. Professional jump racing ranks second in the rates of falls/ride; this was expected, since the presence of jumps increases the risk of falling

from a horse when compared to flat racing. Jump racing also had the highest rates of injury/ride although it was flat racing that had the highest rates of injuries/fall (Tables 1, 2 and 4).

With respect to the incidences of concussion (Tables 1, 3 and 4), amateur jump jockeys were concussed more than twice as frequently in Britain than in Ireland, whereas flat racing jockeys in Ireland or France were concussed more than twice as frequently than their counterparts in Britain. These differences were most likely to be due to differences in classification of concussion in the three countries. Even though concussions seldom occurred, they only occurred following a fall and were neither the only injury nor the injury with the greatest incidence. Nevertheless, approximately 15% of all injuries involved concussion (Tables 1 and 3). More than half of all concussions in each country involved LOC (Table 6), while less severe concussions were considerably more frequent than more extreme ones (Tables 4 and A1). This means that a jockey would have had a high chance of having LOC whenever concussed, but the chance of it being a very severe concussion was relatively low. Over the period 2000-2006 in Ireland (2003-2006 in France), the absolute number of concussions involving LOC remained relatively high (Tables A1 and A2). No annualised data were available for Britain. The frequency of concussion/ride in both Ireland, France and Britain was far greater in jump racing than it is in flat racing (Tables 1, 3 and 4), although this is a reflection of the fact that the likelihood of falling in jump racing far exceeded that in flat racing. It is more important to recognise that, in the event of a fall, the likelihood of being concussed in flat racing is more than three times greater than it is in jump racing, with the exception of in Britain (Tables 1 and 3). Even though there is a low risk of falling in

flat racing, in the event of a fall happening, there is a high risk of suffering head and other injuries.

Why there were relatively high incidences of concussion in equestrian racing is not clearly known. So too is any causative link unknown between head injuries and repetitive sub-concussive impacts[11] or impacts against different stiffness ground[12, 19, 25, 27]. Rotational acceleration and blunt impacts against soft surfaces may be contributory factors but this is not certain[18, 33, 34]. It is clear that the safety performance of equestrian helmets has improved considerably since they were introduced[16], and the low incidences of fatalities and extreme head injuries suggests that helmets do perform well. It may actually be that cases of concussion that are associated with current helmet designs[4] would have been manifest as more serious head injuries in a previous era. Nevertheless, the prevalence of mildly concussive injuries to professional jockeys and the high chances of LOC in the event of a concussion suggest that the performance of current helmet designs would merit future investigation.

CONCLUSIONS

Horse racing is a high risk sport with high incidence rates of concussion and head injury amongst flat and jump racing jockeys. Of all jockeys, it is amateur jump racing jockeys that fell most frequently in Ireland, France and Britain. Jump racing also had the highest rates of injury/ride amongst both amateur and professional jockeys. Flat racing, however, had the highest rates of injuries/fall (34 to 44%). While there is a paucity of worldwide equestrian injury data and a lack of uniformity

in the data that are available, it would appear that 15% of all injuries in both jump and flat racing populations of amateur and professional jockeys are concussive and more than half of these involve LOC.

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CONFLICT OF INTEREST

The authors have no conflict of interest in this work.

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APPENDIX

Tables A1 and A2 provide annualised incidences of jockey falls and injury over the period 1999 – 2006 in Ireland and France, respectively.

**** TABLE A1 NEAR HERE ****

**** TABLE A2 NEAR HERE ****

Table 1: Rates for jump, point-to-point and flat racing in Ireland 1999-2006.

Category	Jump Professional	Point-to-point	Flat Professional
Falls/1000 rides	50.99	138.89	3.72
Injuries/1000 falls	169	84	439
Injuries/1000 rides	8.62	11.68	1.64
Concussions/1000 rides	1.08	1.75	0.28
Concussions/1000 falls	21	13	75
Concussions/injury proportion (%)	12.5	15.0	17.2

Table 2: Incidence rates for professional jump, professional flat, jump amateur and flat amateur racing in France 2000-2006.

Category	Professional		Amateur	
	Jump	**Flat**	**Jump**	**Flat**
Falls/1000 rides	85.27	2.68	115.40	5.11
Injuries TOW/1000 falls	100	340	NA	NA
Injuries TOW/1000 rides	8.59	0.91	NA	NA
Total injuries/1000 falls	200	587	111	425
Total injuries/1000 rides	17.06	1.57	12.86	2.17
Injuries TOW/injury proportion (%)	50	57.6	NA	NA

NA: Not Available.

Table 3: Incidences of head injury in France 2000-2006.

Incidence Rate	Jump Prof. + Amat.	Flat Prof. + Amat.	Professional Jump + Flat	Amateur Jump + Flat
Concussions/1000 rides	2.46	0.27	0.94	1.03
Concussions/1000 falls	28	91	32	39
Concussions/1000 injuries	146	164	143	242

Table 4: Injury rates for professional jump and flat racing and for point-to-point (amateur) racing in Britain 1991-2006[2, 23].

Incidence Rate	Jump Professional	Point-to-point	Flat Professional
Falls/1000 rides	68	127.3	4.4
Injuries/1000 falls	180	182.2	398
Injuries/1000 rides	12.2	23.2	1.8
2 day concussion/1000 total concussions	484.3	443.3	NA
6 day concussions/1000 total concussions	295.8	326.7	NA
20 day concussion/1000 total concussions	219.9	230	NA
Concussions/1000 rides	1.256	4.1582	0.116
Concussions/1000 falls	18	32.7	28

NA: Not Available.

Table 5: Comparative incidence rates of LOC and concussion amongst amateur and professional jockeys in France, Ireland and Britain.

Proportion	**France**	**Ireland**	**Britain**
All Jockeys: LOCs/1000 Concussions	510	600	NA
Professional jump jockeys: LOCs/1000 Concussions	NA	590	515.7
Amateur jump jockeys: LOCs/1000 Concussions	NA	600	556.7

Professional & Amateur Jump Jockeys	**France**	**Ireland**	**Britain**
Concussions/1000 rides	2.5	1.4	2.7
Concussions/1000 falls	28	17	25

Table A1: Incidences of jockey injury in Ireland 1999-2006.

Jump Ireland	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**Total (1999-2006)**
Total Starters	16137	16995	16822	17531	17644	18720	20117	20110	**144076**
Falls	838	893	756	877	871	1018	1079	1015	**7347**
Total Injuries	119	129	132	127	156	171	205	203	**1242**
Fatal Head Injury	0	0	0	0	1	0	0	0	**1**
Total Concussions	18	10	20	23	29	19	25	11	**155**
Concussion, 2 days	NA	4	7	6	14	10	11	4	**56**
Concussion, 7 days	NA	5	9	5	10	4	11	5	**49**
Concussion, 21 days	NA	1	3	11	4	4	3	2	**28**
Concussion, 3+ months	NA	0	1	1	1	1	0	0	**4**

Point-to-Point Ireland	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**Total (1999-2006)**
Total Starters	7901	7142	3900	6915	7839	7376	9827	9730	**60630**
Falls	1097	1076	632	929	752	1180	1250	1505	**8421**
Total Injuries	85	109	52	60	73	100	108	121	**708**
Fatal Head Injury	0	0	0	0	0	0	0	1	**1**
Total Concussions	14	19	8	7	12	19	12	15	**106**
Concussion, 2 days	NA	7	3	2	1	11	6	7	**37**
Concussion, 7 days	NA	6	5	3	7	6	4	6	**37**
Concussion, 21 days	NA	2	0	2	4	1	2	1	**12**
Concussion, 3+ months	NA	4	0	0	0	1	0	1	**6**

Flat Ireland	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**Total (1999-2006)**
Total starters	7862	8670	9786	10658	11193	10985	11279	11477	**81910**
Falls	24	34	32	33	30	51	58	43	**305**
Total Injuries	7	11	17	24	17	17	21	20	**134**
Fatal Head Injury	0	0	0	0	1	0	0	0	**1**
Concussions	2	2	3	6	4	1	3	2	**23**
Concussion, 2 days	NA	1	1	3	1	0	0	1	**7**
Concussion, 7 days	NA	0	1	2	1	0	2	1	**7**
Concussion, 21 days	NA	0	1	1	1	1	1	0	**5**
Concussion, 3+ months	NA	1	0	0	1	0	0	0	**2**

NA: Not available

Table A2: Incidences of jockey injury in France 2000-2006.

All Jockeys	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**Total (2000-2006)**
Total starters	69276	69476	70464	70640	72527	70561	70205	**493149**
Falls	2131	2133	2017	2012	2095	1970	1916	**14274**
Total injuries	447	424	430	428	465	473	459	**3126**
Concussions	80	69	102	55	55	47	58	**466**
Concussions with LOC	25	26	43	33	35	35	42	**239**

Professional Jockeys	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**Total (2000-2006)**
Total starters	62834	62886	64075	64369	66061	64439	64604	**449268**
Falls	1981	1927	1845	1853	1929	1826	1754	**13115**
Total injuries	414	397	403	400	441	449	436	**2940**
Concussions	69	61	94	50	50	43	54	**421**
Injuries TOW	253	219	305	224	215	195	192	**1603**

All Flat Jockeys	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**Total (2000-2006)**
Total starters	47125	47704	48238	49101	50108	49242	48928	**340446**
Falls	146	152	148	125	136	153	137	**997**
Total injuries	82	80	74	75	79	88	78	**556**
Concussions	17	10	19	7	11	13	14	**91**

Professional Jump	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**Total (2000-2006)**
Total starters	20915	20549	20925	20384	21237	20143	20075	**144228**
Falls	1859	1804	1723	1757	1821	1692	1643	**12299**
Total injuries	343	332	339	335	372	372	368	**2461**
Injuries TOW	211	178	NA	174	191	147	158	**1059***

Professional Flat	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**Total (2000-2006)**
Total starters	41919	42337	43150	43985	44824	44296	44529	**305040**
Falls	122	123	122	96	108	134	111	**816**
Total injuries	71	65	64	65	69	77	68	**479**
Injuries TOW	42	41	NA	50	24	48	34	**239***

*** Excludes 2002 data; subsequent analysis ignores individual 2002 data.**

NA: Not available.