Journal of Outdoor Recreation, Education, and Leadership 2017, Vol. 9, No. 3, pp. 314–324
https://doi.org/10.18666/JOREL-2017-V9-I3-8193

What to Do With 15 Years of Injury Data From a College Guide Training Diploma Program?

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Abstract

The outdoor leadership field is maturing in its understanding of activity safety and objective measures of risk exposure. Patterns of injury, relative exposure between related activities, and risk profiles per user group are only just beginning to accumulate academic findings from which a collective understanding of managing adventure-based risk can grow. But how much relative understanding can be ascertained from a specific data set? This paper presents 15 years of injury data from a college guide training diploma program and examines the issues that arise when a researcher tries to compare one data set to another. This paper argues that any one data set is most valid when compared only to itself. The further a data set strays from its contextual factors, the less valid such comparisons become. Recommendations are offered to improve comparability of data.

KEYWORDS: risk management; outdoor leadership; safety; outdoor education; injury rates

The outdoor leadership field is still maturing in its understanding of activity-based safety and objective measures of exposure to risk. Patterns of injury, relative exposure between related activities, and risk profiles per user group are only just beginning to accumulate academic findings from which a collective understanding of managing adventure-based risk can grow. But how much relative understanding can be ascertained from a specific data set?

Over the past several decades, sporadic outdoor recreation or adventure tourism injury data have appeared in the literature. These data are typically activity specific and often anchored in one locale. As a cross section of the many examples available, whitewater rafting and kayaking injury data have been reported in the United States (Fiore, 2003; Whisman & Hollenhorst, 1999) and United Kingdom (Wilson, McDermott, Munir, & Hogervorst, 2013). Rock climbing injuries have been reported (Jones, Asghar, & Llewellyn, 2008; Schöffl, 2010), as have skiing and snowboarding injuries (Langran, 2012; National Ski Areas Association [NSAA], 2015). Reports from New Zealand, for example, have aggregated many adventure tourism activity injury statistics based on hospital data (Bentley, Meyer, Page, & Chalmers, 2001). These works appear in journals with topics as varied as sports medicine, tourism, and industrial safety. This large body of work—beyond the scope of this article—is sporadic and disjointed, with little in the way of continuity, comparison, or elements of theory building. The data are activity or sport related, and much of the data does not deal specifically with supervised outdoor programs or skills instruction, the focus of this paper.

Specific to supervised outdoor programs, wilderness education expeditions received the earliest academic injury data attention, based primarily upon incident data from the National Outdoor Leadership School (NOLS; Gentile, Morris, Schimelpfenig, & Bass, 1992; Leemon & Schimelpfenig, 2003; McIntosh, Leemon, Visitacion, & Schimelpfenig, 2007). Offshoots or specific data from this sector have emerged, such as outdoor education fatality rates in Australia (Brookes, 2011). Gaudio, Greenwald, and Holton (2010) made a significant contribution to the outdoor field by comparing a college outdoor education program to mainstream collegiate sport, finding that outdoor activities present substantially fewer injuries per student day than do collegiate sports.

This study offers an alternative perspective, examining the pattern of injury in a Canadian career college professional adventure guide training diploma program. More conceptually, the relative value of using this data for comparison purposes is examined.

As context, this college program has been training novice adventure guides in a 2-year diploma format since 2000. An average of 101 guide trainees per year spend half of their course hours in field-based technical training and certification courses. The students' mean age is 20 years old. Approximately 7,000 field days per year are distributed across training such as river rescue, kayak, and canoe instructor certification, climbing and vertical rescue, mountain biking, and backpack guiding, plus winter activities such as alpine skiing and snowboarding, cross-country skiing, ice climbing, and winter camping. Courses travel to locations across eastern Canada, the Northeast United States, and parts of Central America.

This sample group represents a unique opportunity to examine injury patterns among dedicated outdoor students as aspiring guides, who are required to perform above the level of a supervised recreational participant. More specifically, though, what is to be done with the 15 years of injury data from this college guide training diploma program?

Method

The first portion of this study examined 15 years of injury data from 2000 to 2015—the full tenure of this college program. Instructional staff documented injuries, illness, and near-miss events during all field training courses and expeditions. A recordable incident threshold was established in 2000 to align with that endorsed by the Wilderness Risk Management Committee and the Association of Experiential Education (Wilderness Risk Managers Committee [WRMC], 2008). Incident data were annually entered into an Excel database and retrieved for this study. The college's Research Ethics Board granted this study an exemption from review based on the secondary use of historical data.

A practice has emerged in the study of outdoor injury rates to measure incidents relative to student days in the field and to express aggregated rates per 1,000 student days in the field (Gaudio et al., 2010). To provide context, within a typical student field day in the program under study, students participated in activity (i.e., exposure to activity risk) between as little as 2 hr/day and up to 7 hr/day. The remainder of the day involved logistics, camp setup, theory sessions, or rest periods. As established by Gaudio et al. (2010), instructor days were not included in total field day calculations. Only one instructor injury was reported during this period.

Events categorized as injuries are the focus of this study. Assessed against firsthand experience managing this program, the injury data set appeared complete and accurate. Near-miss data were not included, as upon review this data set appeared to be inconsistently recorded and variable in completeness of the individual incident reports. Illness data were deemed less useful given the day trip or single overnight trip orientation of this program, in which students may have brought their illness with them rather than developed an illness while training and under supervision while in the field.

The database entries were compiled, stripped of personal identifiers, and examined for accuracy and completeness. The data were then sorted by several factors to isolate injury type, course type, and injury severity, among others. These results were then entered into tables, and confidence intervals were established for relevant values. This data manipulation was done in Excel.

Results

Over this 15-year period, 390 injuries were recorded. A total of 92,610 field days were accumulated during this period, establishing an overall injury rate of 4.21/1,000 field days (FD), with a corresponding 95% confidence interval (CI) of 3.35 to 4.70. Actual recorded injuries varied per year from two to 46, with injury rates varying per year from 0.84 to 6.23/1,000FD (Figure 1). There were no fatalities during this period.

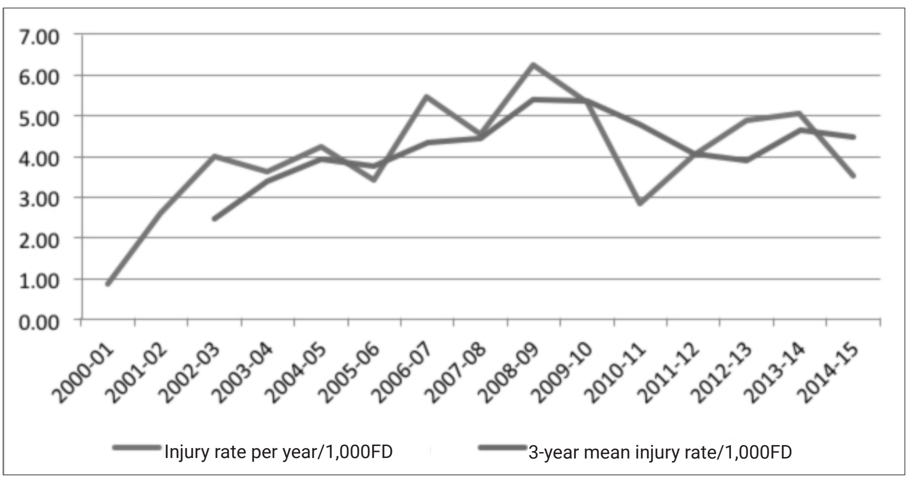

Figure 1. Injury rate/1,000FD/year, 2000–2015. Three-year mean calculated by summing the present year plus previous two, divided by 3.

Of the 390 injuries, 342 occurred during course hours. Forty-eight occurred outside of supervised course hours, but still on program location. As an example of injuries outside of course hours, students had unsupervised ski practice time in the evenings during alpine ski and snowboard courses, which generated 24 of the 48 injuries for that activity.

A small number of injury types made up the majority of reported injuries. The most common injuries reported over the study were (in order, from most prominent) ligament sprains, contusions, and head injuries with no loss of consciousness (resulting in concussion symptoms). The top five injury types accounted for 72% of all injuries reported (Table 1).

Twenty-five percent of reported injuries necessitated evacuation from the field and proceeded directly to a hospital emergency room (ER) for formal medical examination (some of which required further medical attention from a doctor and some of which were released after examination). The majority of injuries (75% of total injuries) were managed by the instructors in the field using wilderness first aid skills, or via evacuation from the field but requiring no further medical follow-up. Female students received disproportionately more injuries than males did (41% of the injuries, while making up 26% of the population).

Table 1
Incidence of Injury Type

Injury type	Total	Rate/1,000FD	95% CI
Ligament sprain	88	0.95	[.54, 1.13]
Contusion	84	0.91	[.57, 1.02]
Head injury no loss of consciousness	47	0.51	[.39, .62]
Muscle strain	34	0.37	[.16, .45]
Dislocation	29	0.31	[.10, .38]
Laceration	28	0.30	[.17, .45]
Fracture	16	0.17	[.06, .20]
Blister(s)	6	0.06	[0, .15]
Skin abrasions	6	0.06	[.02, .11]
Tendonitis	5	0.05	[0, .09]
Burn	4	0.04	[.01, .06]
Eye injury	3	0.03	[0, .06]
Head injury with loss of consciousness	3	0.03	[0, .06]
Dental or tooth-related	2	0.02	[0, .05]
Frostbite	1	0.01	[0, .03]
Near drowning or other submersion	1	0.01	[0, .03]
Sunburn	1	0.01	[0, .03]
Other	32	n/a	n/a

Snowboarding generated the most injuries (33% of all injuries); however, per 1,000 field days, it fell to fifth most injury producing. A 2-day cross-country skiing skate technique course, a 4-day introduction to whitewater kayaking, and a 5-day introductory raft guide course all had relatively high injury rates compared to other course types (Table 2).

Table 2
Injury Rate, Evacuation, and ER Visits per Activity Type, Ranked

Injury/course type	Injury rate /1,000FD	Total	95% CI	Injuries requiring evacuation from field	Injury requiring evacuation + ER visit	ER visit rate as % of injuries
WW Kayak Inst Cert Course	10.94*	5	[0, 4.8]	2	2	40
XC Ski – Skating Technique	10.32	13	[2.85, 17.66]	4	0	0
WW Kayak Skills I	10.09	36	[6.47, 15.08]	11	4	11
Cycle Touring	9.52	4	[0.62, 13.02]	0	0	0
Rafting Skills I	7.57*	27	[3.58, 6.74]	5	4	15
Snowboard I or II	7.06	129	[5.26, 8.32]	54	32	25
Backpacking Guide	5.56*	1	[0, 2.96]	0	0	0
Mountain Bike Guiding	5.17	6	[5.16, 12.16]	5	2	33
River Rescue I	5.04	9	[1.53, 8.75]	2	2	22
Graduate Expedition	4.94	28	[1.42, 6.76]	10	4	14
Mountain Bike Skills 1	4.48	8	[2.12, 6.99]	3	2	25
Raft Guide Cert	4.31	10	[3.95, 11.06]	2	1	10
Sea Kayak Expedition	3.97*	5	[0.20, 1.43]	3	3	60
XC Ski Classic	3.36	6	[0.77, 6.85]	3	3	50
Winter Snowshoe Expedition	2.62	7	[0.58, 5.13]	0	0	0
Rock Climbing II	2.46	5	[0, 7.19]	2	2	40
Ice Climbing II	2.38	3	[2.32, 8.10]	0	0	0
Intro to Mountain Travel	2.38*	3	[4.66, 9.73]	0	0	0
Rock Climbing Intro	2.24	4	[0, 3.65]	2	2	50
Alpine Ski I and II	1.86	34	[1.25, 2.37]	12	7	21
Raft Expedition	1.49	8	[0.82, 3.21]	2	2	25
Ice Climbing I	1.12*	2	[2.32, 8.10]	0	0	0
Canoeing Flatwater	0.84	3	[0, 2.00]	0	0	0
Other, Accumulated	n/a	34	n/a	0	0	0

*injury rate falling outside of 95% confidence interval, lacking statistical validity.

Snowboarding generated by far the most injuries necessitating an ER visit; however, those injuries accounted for 25% of total snowboarding injuries. Sixty percent of reported sea kayak (9 days) expedition injuries required evacuation to an ER (often camp-related injury such as a knife cut), 50% of rock climbing and cross-country classic ski injuries required an ER visit, 40% of whitewater kayak instructor course injuries required an ER visit, and 33% of mountain bike course injuries required an ER visit (Table 2).

Comparing College Guide Training Data to Published Outdoor Data

The obvious use of the college guide training injury data is to compare it to other data sets. Suitable outdoor program and recreation or participant-oriented injury data were retrieved from several published sources. Comparison between data sets proved difficult (detailed in the Discussion section), a situation that echoes findings by Wilson et al. (2013). The comparisons that follow utilize data that most align with the present data set.

At a program level, the injury rate of the college guide training program was 4.21/1,000FD, notably higher than other published outdoor program data. Cornell's outdoor education data showed a combined injury and illness rate of 1.24/1,000FD (Gaudio et al., 2010). Data from NOLS wilderness expedition programs showed an injury rate of 1.18/1,000FD (McIntosh et al., 2007).

Injury type in the college guide training program aligned with NOLS data, which showed similar distribution of injuries (Leemon & Schimelpfenig, 2003). NOLS found that "athletic injuries" (defined as sprains and strains) made up 50% of all injuries, followed by soft tissue injuries at 30% (soft tissue injury is undefined in the NOLS data). The guide training data found 22% of injuries were ligament strains (i.e., athletic injuries) and a further 30% were soft tissue related (contusion, laceration, and abrasion combined).

Wright and Islas (2014) found that concussions represented 6.5% of outdoor-related ER visits. Similarly, the college program data indicated 21 of the 50 reported head injuries/concussions were deemed serious enough to visit an ER, which represented 5% of all program injuries and 30% of total ER visits. Wright and Islas also found that concussions represented 9.6% of all injuries to alpine skiers and 14.7% of all injuries to snowboarders. Comparatively, Langran (2012) found that 4.4% of ski injuries and 5.1% of snowboard injuries were concussions. Within the college guide training data, concussions represented 2.9% of ski injuries and 23.2% of snowboard injuries. From this perspective, college guide training ski-induced concussions were half that of other published rates, but the snowboarding-induced concussions were significantly higher. College students wore helmets during all snow courses.

From an activity perspective, recreational ski and snowboard injury data are the most widely tracked. The NSAA safety data showed injury rates of 2.5/1,000FD for alpine skiing and 6.1/1,000FD for snowboarding (NSAA, 2015). Langran (2012) estimated injury rates of 1 to 2/1,000FD and 2 to 4/1,000FD for skiing and snowboarding, respectively. The college program data indicate 1.86 and 7.06/1,000FD for skiing and snowboarding, respectively. For skiing and snowboarding, the guide training data aligned with mainstream recreation injury rates. The distribution of injuries in these two activities (Table 3) is similar between Langran's findings and college data, with the college data showing substantially fewer fractures and more incidents of concussions than recreation data.

Table 3

Comparison of Injury Type for Ski and Snowboard Between College Guide Training and General Public Participation Data

Injury type for ski and snowboard	% of ski injuries		% of snowboard injuries	
	Langran (2012)	College	Langran (2012)	College
Fracture	18.9	0	35	8.5
Sprain	47.7	47.1	25.6	22.5
Contusion	12.1	23.5	12.7	23.2
Concussion	4.4	2.9	5.1	23.2
Laceration	10.4	0	11.4	0

Similar comparisons can be made between the college guide training injury data and related outdoor programs and recreation data (Table 4). There is variation as to when the college guide training program aligns with (e.g., for mountain biking and cross-country skiing), is above (whitewater kayaking and rafting), or is typically below (rock and ice climbing) other published rates. For certain activities, such as the whitewater kayaking, the variation in injury rates was dramatically broad (0.03/1,000FD to 10.09/1,000FD).

Table 4
Comparison of Injury Rates per Activity Type Between College Guide Training, Cornell Outdoor Program, WRMC, and Recreation Data

Activity	College guide training rate/1,000FD	Cornell rate/1,000FD (Gaudio et al., 2010)	WRMC Adv Program data rate/1,000FD (Leemon, 2013)	Recreation rate/1,000FD
Alpine ski	1.86	n/a	5.15	2.5[a]
Snowboard	7.06	n/a	16.77	6.1[a]
Whitewater kayak	10.09	4.38	0.92	0.03–0.06[b]
Rock climbing	2.24	5.00	0.49	n/a
Ice climbing	1.12	3.41	2.91	2.87–4.07[c]
Rafting	7.57/4.31	n/a	0.57	0.02[b]
Mountain biking	5.17	7.45	2.92	7.00[d]
Backpacking	5.56* outside 95% CI	4.66	0.77	n/a
XC ski classic	3.36 (classic ski)	2.65 (unspecified)	n/a	n/a

[a]NSAA, 2015. [b]Fiore, 2003. [c]Schöffl, Morrison, Schwarz, Schöffl, & Küpper, 2010. [d]Jackson, 2013.

Discussion

The college guide training program data showed a higher overall injury rate than related published data from outdoor programs, and in some cases higher or on par with recreation rates. This highlights the importance of context in interpreting and drawing conclusions from isolated or comparative injury data.

In comparative data sets, industrial and to some extent recreational data often used the metric of injury per 1,000 hr of participation (for recreation) or per 1,000 hr of exposure (for industry) or per 100,000 population. These various measures do not equate to each other. A participation hour is difficult to reconcile against the outdoor program measure of injuries per 1,000 field days. As indicated earlier, a program day may include anywhere from 2 to 7 hr of actual exposure to the inherent risks in the activity, and for any activity, this exposure time likely varies day to day as a course progresses. Compared to most individual-based recreational activities, a structured, supervised instructional program likely meters out challenge and exposure to hazards differently. An individual recreationally challenging him- or herself on a mountain bike ride is quite different in context than students in guide training who are learning how to lead a mountain bike group or tour.

Less visible in the data sets are inherent differences in the risk tolerance of a given supervised program. A career-oriented guide training program will by necessity expose participants to more risk and therefore potential injury than a wilderness expedition program or even a front-country recreation-based outdoors club. This is evident in college guide training injury rates for whitewater kayaking and rafting, which are higher than comparators (Table 4), but does not exhibit itself as evident compared to ice climbing or downhill skiing. This indicates an even finer view of context, as variance within course types, goals and outcomes, locations, and procedures might influence injury rates, even if the activity is shared by comparators. For whitewater rafting data in particular, the recreation data refers to commercially guided participants (with injuries as low as 0.2/1,000FD (Fiore, 2003) on an unknown grade of river. The college guide training data involve high grade (i.e., difficult) rapids and inevitable error and failure given a training context. This failure carries consequence indicated in the injury data. Without contextual information, these two rafting statistics may create misleading conclusions when compared with each other.

Another context difference within the data is that the college guide training does top rope and top rope protected lead climbing only (a second top rope offers redundant protection to the lead gear and belay). Gaudio et al. (2010) did not indicate if the Cornell climbing data are top rope only or lead. Schöffl, Morrison, Schwarz, Schöffl, and Küpper (2010) pointed to lead falls and athletic-grade climbing as key indicators of injury, neither of which is programmed into the college guide training courses, yet there is still dramatic difference between the college rock climbing injury rates (2.24/1,000FD) and the WRMC wilderness climbing data (0.49/1,000FD (Leemon, 2013). Risk tolerance, goals and outcomes, locations, and procedures may play some role in explaining these discrepancies.

The nature of reporting injuries deserves some commentary in light of these comparisons. What gets noted as an injury is subject to organizational risk tolerance and therefore likely has some variation between data sets. The parameters of any given program create limitations in reporting. As recreation-based participants are not bound by programmatic structure, reporting of injuries is survey based or relies upon hospital ER admittance data, both of which have limitations, especially given an unknown user day count. Within supervised programs, short-term outdoors club programs such as the Cornell program (Gaudio et al., 2010) potentially omit injuries that are not reported during program hours but eventually manifest into symptoms or an ER visit sometime after the program has ended. The college guide training program, on the other hand, given 2 academic years, deals with delayed onset and repeat injuries. In 2007–2008, there were eight joint dislocations, for example, but these were attributed to just three students, each with recurring injuries over the year.

Including not only evacuation rates from the field data but also visits to an ER presents a threshold of sorts to assess the severity of injury (a rating otherwise absent from injury data). As outdoor instructors possess limited medical diagnosis skills, any formal medical severity scale use would be inappropriate. ER visits creates a de facto severity threshold for injury and evacuation data.

This brings to light details such as in introductory rock climbing there were few injuries (four over 15 years), but half of those required an ER visit (Table 2). Additionally, sea kayaking is seen as a lower risk activity; however, 60% of all injuries necessitated an ER visit. The incidence of injury for these course types was low, but the severity was relatively high. In contrast, the high-level college raft guide certification course saw substantially more injuries than the previously listed activity/course types, but only 10% of these injuries required an ER visit. A cross-country skiing skate technique course ranked highest in injury rate, 10.32/1,000FD, 95% CI [2.85, 17.66], but generated zero ER visits—an example of an activity with high frequency yet low severity of injury.

Within a single longitudinal data set such as the college guide training data presented here, it could be anticipated that over time reporting practices evolve and capture more injuries than previously recognized. This could be one explanation for the rise in injury rates over the first decade of the college program (Figure 1). More specifically, as a particular injury type comes under scrutiny, it possibly sees more attention and therefore more reporting. It would be difficult to isolate an increasing occurrence of an injury such as concussions, taken from the college guide training data (Figure 2), from an increasing sensitivity to the injury and more thorough reporting by instructors and awareness training delivered to students.

Further, relative to context in the comparison of data, Gaudio et al. (2010) found in their Cornell data an even distribution between male and female injuries (51% vs. 49%), equal to their population on course. The guide training distribution shows females with a much higher proportion of injuries relative to their population (41% of the injuries, but only 26% of the population). There is no immediately obvious explanation for this.

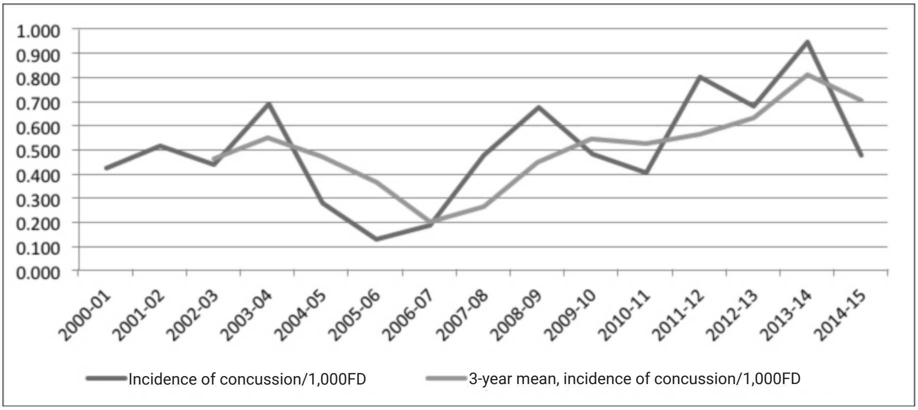

Figure 2. Rate of concussion injuries in college guide training data. 3-year mean calculated by summing the present year plus previous two, divided by 3.

Limitations

This article draws attention to the limitations inherent in comparing injury data between or across contexts. Data collection within a program carries certain assumptions not immediately evident in tables, rates, and a 95% CI. Caution needs to be applied when anchoring rates to any particular comparator.

Although the aggregated field days may be substantial, it is important to note that the number of injuries per activity is still very low (i.e., four injuries for introductory rock climbing over 15 years). Statistical significance values are provided with this data set, with some relationships showing significance and others potentially occurring by chance—not surprising given the low number of injuries in certain cases.

Supervised program adventure activity may or may not be comparable to unsupervised participant recreation (e.g., comparing instructor-level ski training data to public ski injury data), likewise for the closer relationship between led wilderness expeditions and guide-oriented training programs. Measures provided by any one data set will vary in exposure to activity inherent risk, dependent upon hours per day of actual activity time, program risk tolerance related to reporting, activity goals and outcomes, difficulty of activity locations and routes, and safety procedures.

Conclusion

The guide training injury patterns in this data are similar to and sometimes higher than recreation patterns and are typically higher than wilderness expedition injury patterns. There are exceptions to this general finding. That guide training students may perform in higher difficulty locations may explain some of this pattern, but how it should be offset by higher degrees of student competence and higher levels of expert supervision is not clear. There is not an immediate explanation for why some activities show higher injury rates than comparators (i.e., snowboarding) and others lower (i.e., ice climbing).

Future data analysis would do well to expand upon the context of the data, to aid in further academic comparisons. Recreation versus supervised training, different tolerance for risk between specific programs, the relative competence of the individuals involved, variance within course types, goals and outcomes, locations, and safety procedures might influence injury rates, even if the activity is shared by comparators. The standards of what constitutes a reportable injury and how those reporting standards evolve over time will also likely influence findings.

The reporting of hospital ER rates beyond evacuation would be beneficial, as visiting an ER presents a threshold of sorts for generically categorizing severity of injury. As data sets grow, the statistical validity of particular rates will be enhanced, with the expectation that someday complex regression analysis may be possible to isolate and examine the variables that influence any one activity's injury patterns.

What is to be done with 15 years of injury data from a college guide training diploma program? Given this discussion, any one data set is most valid when compared only to itself. The further a data set strays from its contextual factors, the less valid such comparisons become.

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