


# Survey of American university coaches: injuries in the pole vault

 © by IAAF  
22:2; 57-65, 2007

By Sean D. Turbeville, Linda D. Cowan, Charles B. Pasque and Tom Williams

*This survey was designed to assess and summarise the opinions and safety practices of university level pole vault coaches in the United States. An anonymous, web-based survey was sent to coaches and the information collected included demographic data, coaching experience, coaching techniques, vaulting equipment, and injury/safety information. One hundred and thirty-one completed questionnaires were returned from the estimated 233 universities that include the pole vault in their programmes. While the vast majority of the responding coaches considered the pole vault to be a "safe sport", nearly all reported having observed injuries that required medical attention, including fractures and head trauma. In addition, nearly all respondents had observed a pole break during competition, and nearly one-quarter of these incidents had led to injury. These results suggest that the perception of risk among NCAA coaches may not be consistent with their own personal experience as a competitor or coach.*

## ABSTRACT

*Sean D. Turbeville, Ph.D., works in the Department of Biostatistics and Epidemiology, College of Public Health at the University of Oklahoma Health Sciences Center in Oklahoma City, Oklahoma, USA.*

*Linda D. Cowan, Ph.D., works in the Department of Biostatistics and Epidemiology, College of Public Health at the University of Oklahoma Health Sciences Center in Oklahoma City, Oklahoma, USA.*

*Charles B. Pasque, M.D., works in the Department of Orthopedic Surgery & Rehabilitation, College of Medicine at the University of Oklahoma Health Sciences Center in Oklahoma City, Oklahoma, USA.*

*Tom Williams, M.Ed., is a former coach and now works in the Department of Athletics at the University of Oklahoma in Norman, Oklahoma, USA.*

## AUTHORS

## Introduction

**W**hile the pole vault has increased in popularity in the United States, media attention has focused on several catastrophic deaths among high school and university athletes.<sup>3</sup> Such stories

have left the public with a bad impression of the safety of the event. Many within the athletics community do not share the same concerns and consider the mishaps to be unfortunate accidents. Others think that the safety of the event can be improved with the use of evidence-based prevention methods.<sup>6,7,9</sup> These comments are anecdotal however and no systematic survey of coaches has been made. The current survey was designed to assess and summarise the opinions and practices of university level pole vault coaches concerning safety.

## Methods

An anonymous, web-based survey was sent by email to a stratified random sample of 50% of the track and field programmes at universities belonging to the three divisions of the NCAA (National Collegiate Athletic Association) (Division I, N = 96; Division II, N = 73; Division III, N = 156). The sampling frame for selection of universities was obtained from the listing of all track and field programmes on the NCAA website.<sup>5</sup> The e-mail addresses for the sample were then identified from the website for each institution.<sup>5</sup> If no e-mail address was available for the pole vault coach, the head track and field

coach was contacted. The NCAA does not have available a separate listing of those programmes that include the pole vault as a track and field event and thus it was not possible to target the emails specifically to pole vault coaches. Because of this, some surveys were inadvertently sent to programmes that did not include the event.

We considered that at least part of the initial non-response to the survey was a result of the fact that the mailings could not be targeted. In order to estimate the proportion of institutions chosen for the survey that actually had pole-vaulting programmes, a strati-

Table 1: Survey data reported by NCAA coaches

	NCAA Division			
	Division I	Division II	Division III	Combined
Responses	N = 56	N = 23	N = 52	N = 131
Years Coaching Pole Vault, Median (Range)	8 (1-41)	5.5 (2-13)	9 (1.5-41)	8 (1-41)
Vaulted Competitively (% Yes)	62%	61%	61%	62%
Years in Competition, Median (Range)	8 (1-35)	5.5 (1-20)	7 (1-34)	8 (1-35)
<u>Level of Competition (% Yes)</u>				
Beginner	27%	21%	32%	29%
High School	60%	43%	68%	60%
College	81%	79%	81%	80%
Division I	61%	9%	22%	39%
Division II	12%	46%	37%	14%
Division III	18%	36%	63%	38%
NAIA	3%	18%	15%	10%
Junior College	6%	0%	4%	4%
Open	60%	36%	52%	53%
Masters	24%	14%	13%	18%
Elite	19%	7%	3%	12%
<u>Source of Pole Vaulting Education (% Yes)</u>				
Track and Field Coach	84%	80%	84%	83%
Camp/Clinic	76%	80%	80%	79%
Instructional Video	67%	75%	78%	73%
Private Pole-Vaulting Coach	36%	30%	28%	32%
Family Member	9%	20%	8%	10%
Personal Experience	66%	50%	62%	62%
Other	16%	20%	18%	18%

fied random sample of the survey institutions was selected and the presence of the event in the programme confirmed by either visiting the website for the track and field programme or contacting the coach by e-mail. The results of this second sampling allowed for adjustment of the number of institutions to which the survey was relevant. Of the initial 325 sampled institutions, an estimated 233 (72%; 95% CI = 67% to 76%) of universities offered the pole vault. The estimated numbers by NCAA division were: Division I – 81 (84%; 95% CI = 73% to 91%), Division II – 47 (64%; 95% CI = 52% to 77%), and Division III – 105 (67%; 95% CI = 54% to 78%).

Completed surveys were returned via e-mail and stored in a secure, password-protected database. All demographic information was evaluated as grouped data only. The survey consisted of 76 open- and closed-ended questions dealing with a variety of topics. It required approximately 25 minutes to complete. Information collected included individual data (i.e. coaching level (division), years of coaching experience, years of competition experience, state and city in which the university is located), coaching techniques (i.e., foot dominance, average take-off point, use of standard positions), pole vault equipment (i.e., dimensions of current landing pits, landing pit surfaces, use of box collars, poles, pole vault shoes, etc.), and injury/safety information (i.e., padding surrounding landing pits, type of surfaces surrounding landing pit, helmet use and acceptance, use of "spotters" and suggestions on how to make the sport safer).

No incentive was provided for completion of the survey. This study was approved by the Institutional Review Board of the University of Oklahoma Health Sciences Center.

Statistical analyses were performed with the NCSS Statistical Analysis and Data Analysis Software (Number Cruncher Statistical Systems. Kaysville, Utah 2003). Descriptive statistics included median and range. The percent distribution of response for each question was assessed using the following statistical proce-

dures: The one-sample proportion test was used to test all dichotomous responses (i.e. Yes/No). This test evaluates whether or not the observed proportion is significantly different from 0.50. The Wilson Score method was used to calculate 95% confidence intervals. The chi-square test of goodness of fit was used to test for differences among responses when there were more than two levels (e.g., Yes/No/No opinion). All statistical tests were two-tailed, using a p-value of .05 to define statistical significance.

## Results

Three hundred and twenty-five web-based surveys were successfully sent via e-mail. Of these, an estimated 233 (72%) of the programmes included the pole vault. One hundred and thirty-one completed surveys were returned for an overall response percentage of 40% (131/325) and an adjusted response of 56% (131/233) based on the proportion of NCAA universities estimated to have the pole vault. Adjusted response proportions were significantly different by NCAA division, with the highest being from Division I (69%, 49%, 50% for Division I, II, III respectively;  $p < .05$ ). The respondents were predominantly male, although a few female coaches also participated.

### Coaching demographics

The respondents have considerable experience in coaching the pole vault (median coaching experience = 8 years, range 1-41 years, (Table 1)). Sixty-two percent of the coaches had themselves competed in the pole vault with a median number of 8 years of competitive experience (range <1-35 years). Among those coaches who personally competed in the event, 80% (66/83) did so at the collegiate level and 8% (11/131) of coaches continue to compete in the pole vault at the master's level (data not provided in Table). Most of the coaches learned how to teach the pole vault through more than one method, the most common of which was from their own track and field coach (83%, 104/126). As part of the survey, coaches were asked to rate their own ability to teach pole vault on a scale from

Table 2: Responses to questions on injuries, equipment and safety

<b>Injury</b>
Have you ever sustained an injury from pole vaulting that required you to see a doctor?
Have you ever witnessed an injury to another pole-vaulter where medical attention was needed?
If yes, do you know the injury sustained? (N = 69)
Fracture
Concussion/Head Trauma
Sprain/Strain
Contusion/Laceration
Dislocation
What "major injury" do you think is the most common in pole vaulting? (N = 59)
Concussion/Head Injury
Fractures
Sprain/Strain
Spinal Cord Injury
Other
Contusion/Laceration
Dislocations
What "minor injury" do you think is the most common in pole vaulting? (N = 71)
Sprain/Strain
Contusion/Laceration/Abrasion
Dislocations
<b>Poles</b>
Have you ever witnessed a pole breaking during practice?
Have you ever witnessed a pole breaking during competition?
Was the athlete injured?
What type of injury(s) did the athlete receive? (N = 30)
Fracture
Sprain/Strain
Contusion/Laceration/Abrasion
Head Injury
Do you allow your athletes to exceed the recommended body weight on the poles they use?
Do you ever have your athletes place their hands higher than the maximum top handhold position?
<b>Shoes</b>
Do your athletes wear shoes specifically made for pole-vaulting?
Do you think pole-vaulting shoes improve performance?
<b>Spotters</b>
Do you support the use of spotters?
Do you think using spotters increases the safety of vaulting?
Do you think pole-vaulting is a safe sport?
Have any parents or athletes expressed concerns about safety issues in pole vaulting?

\*Pd.05

N (% Yes)	95% CI
96 (35.4%)*	27%-45%
101 (88.1%)*	80%-93%
25 (36%)	---
17 (25%)	---
14 (20%)	---
11 (16%)	---
2 (3%)	---
N (%)	---
20 (34%)	---
16 (27%)	---
12 (20%)	---
6 (10%)	---
3 (5%)	---
1 (2%)	---
1 (2%)	---
N (%)	---
55 (77%)	---
15 (21%)	---
1 (1%)	---
N (% Yes)	---
89 (84%)*	76%-90%
100 (95.2%)*	89%-98%
24 (23.8%)	---
N (%)	---
7 (23%)	---
2 (7%)	---
20 (67%)	---
1 (3%)	---
105 (69.5%)*	60%-78%
105 (21%)*	14%-30%
105 (71.4%)*	62%-79%
87 (60.9%)	50%-71%
106 (49%)	38%-57%
104 (47.2%)	40%-59%
101 (96%)*	90%-98%
101 (44.6%)	---

1 to 10, with 10 being the best. Eighty percent of respondents reported a coaching competency of 7 or greater.

### Injury history

Because most respondents competed competitively in the pole vault (and some coaches continue to compete at the masters level) as well as having significant coaching experience, the coaches were thought to be reliable reporters concerning the basic types and mechanisms of injuries observed in the pole vault. Thirty-five percent of NCAA coaches had themselves incurred an injury that required medical attention while pole vaulting (anytime in their career) (Rate = 2.42 injuries per 100 coaching years).

Eighty-eight percent of coaches said they had observed an injury to another vaulter, either during competition or practice, for which medical attention was needed (Rate = 6.47 per 100 coaching years). Coaches observed fractures (36%) more often than sprains or strains (20%), contusions (16%), or dislocations (3%) (Table 2). Most of the observed fractures occurred to the hand, wrist, or ankle. Twenty-five percent of coaches also reported having observed an athlete sustain head trauma or a concussion while pole vaulting. It is unclear if multiple coaches observed the same injury or if the observations represent different occurrences.

Respondents were also asked about their attitudes regarding the safety of the pole vault ("Do you think pole vaulting is a safe sport", Table 2). Ninety-six percent of respondents indicated they felt the event to be safe. On the other hand, over 44% had been approached at some time by either a parent or an athlete concerning safety issues. Respondents were also asked to name what they consider the most common "major" and "minor" injuries in the pole vault. The most common "major" injuries were concussions/head injury (34%), fractures (27%) and sprains/strains (20%). The most common

“minor” injuries were sprains/strains (77%) followed by contusion/laceration/ abrasion (21%) (Table 2).

### Injury Mechanisms

Those coaches who observed an injury to a vaulter that required medical attention were asked to provide a reason for why they

thought the injury occurred. The injuries are categorised by potential mechanisms in Table 3. Respondents often reported more than one mechanism for an observed injury.

Eighty-four percent and 95% of the coaches observed a pole break during practice or competition, respectively. Over 23%

Table 3: Reported mechanisms of injury in pole vaulting

	N = 106
Coaching Error	3 (3%)
Inexperience	5 (5%)
Poor Pole Selection	
Too big	13 (12%)
Too small	3 (3%)
Unspecified	2 (2%)
Plant Error	8 (8%)
Take-off Error	5 (5%)
Failed/Aborted Jump	7 (7%)
Improper Landing	
Feet First	9 (9%)
Head First	2 (2%)
Unspecified	5 (5%)
Broken Pole or Equipment Failure	9 (9%)
Padding	
Inadequate (not enough)	7 (7%)
Inadequate (athlete fell between pads)	4 (4%)
Poor/Inadequate Warm-up	1 (1%)
Failure in Technique	9 (9%)
Poor Weather	
Rain	1 (1%)
Strong Cross wind	1 (1%)
Unspecified	1 (1%)
Accident	2 (2%)
Dangerous Vaulting	1 (1%)
Improper Speed/Running Down Runway	1 (1%)
Bar fell on them	1 (1%)
Poor Body Awareness	1 (1%)
Tapped during warm-up	1 (1%)
Poor Conditioning	1 (1%)
Pilot error	1 (1%)
Hesitancy by the Vaulter	1 (1%)

of the respondents indicated that the athlete received an injury as a result of the broken pole. The types of injuries observed included contusions and lacerations ( $n = 20$ ), followed by fractures ( $n = 7$ ), strains or sprains ( $N = 2$ ) and head injury ( $N = 1$ ). Most of the injuries occurred to the wrist, hand or fingers, and, in some cases, the athlete received more than one injury (directly or indirectly) as a result of the broken pole. In 10% of the injuries associated with a broken pole, respondents reported that the athlete's weight exceeded the manufacturer's maximum weight recommendations (Data not shown). When a pole did break, it was more likely to break into two pieces rather than splinter in multiple pieces (49.5% v. 24.8%,  $p < .05$ ).

### Poles

In almost every instance, the institution furnishes the equipment for the pole vault. Most coaches take it upon themselves to "periodically" check for defects during the regular season but require their athletes to check for defects on a regular basis (i.e. daily or before each use). When travelling, a hard-shell case was more likely to be used for carrying poles than a soft-wrap case (53.8% v. 34.6%,  $p < .05$ ). (Data not shown)

There was considerable variation in the criteria used by coaches when helping an athlete choose a pole for vaulting: An athlete's size, speed, strength, experience, technique, the length of the approach, weather conditions, minimum pole requirements, planting technique, and hand positions were variables often reported by respondents for pole selection. In general, the size, speed, and experience of the athlete were most often reported as factors that influenced the choice of an appropriate pole for an athlete. Most coaches (79%) do not allow their athletes to place their hands higher than the maximum top handhold position. A few respondents indicated that they start an athlete on a smaller pole before moving them to a larger one. Interestingly, most coaches allow their athletes

to exceed the manufacturers maximum weight recommendations for the poles (69.5% v. 30.5%;  $p < .001$ ).

### Spotters

The responding coaches were nearly equally divided in the acceptance of "spotters" as a safety measure in the pole vault (49% v 51%;  $p > .05$ ). The dominant reasons given for favouring the use of spotters were: 1) The area to protect is too large and a spotter would likely increase the risk of injury to both the athlete and the spotter; 2) A spotter would probably provide a false sense of security for the vaulter; and 3), There is no evidence to suggest spotters would be effective in reducing the risk of injury to the vaulters.

### Shoes

Over 71% of the responding coaches have their athletes wear shoes specifically designed for the pole vault. Most respondents felt they improve performance (60.9% v 39.1%;  $p < .05$ ) by providing the athlete with better stability during the approach and take-off.

### Discussion

This is the first systematic survey of the opinions and practices of NCAA pole vault coaches, and is, to our knowledge, the first web-based survey sent to NCAA coaches via email. The initial percent response was 40% but when adjusted to account for universities that actually offer the pole vault, improved to 56%. How much this non-response reflects blocking of emails by anti-Spam software used by individual institutions versus refusals is unknown. Unfortunately, we were unable to characterise the non-responders beyond the NCAA division they represented.

There is a paucity of data on the epidemiology of non-catastrophic injuries in pole-vaulters. The present survey, although not designed to obtain prevalence rates of injury, can nevertheless be used to identify the rank order of types of injuries that have been observed in pole vaulters. As noted,



the most frequently observed injuries were fractures (36%), concussions/head trauma (25%) and strains/sprains (20%). The only epidemiological study of pole vaulting injuries comes from the study of WALLGREN (1965), which reported the types, incidence, and mechanisms of pole vault injuries in Finnish children (mean age 12 years) who were treated at a children's hospital between 1957 and 1964.8 The author also collected information from 14 of Finland's top pole vaulters (mean age not reported) during the 1962 season. The types of injuries among children were fractures (N = 62, 57%) and contusions (N = 21, 19%), followed by lacerations (N = 13, 12%), dislocations (N = 9, 8%), and concussions (N = 3, 3%). In the study, the landing pit (44%), pole (26%) and planting box (15%) were the three most common sources of injury. In only a third of the cases did the landing pit meet the minimum safety requirements for that time. In 24 of the 39 cases (62%), a failure of technique at some phase of the vault was the underlying reason for the injury, the most common being improper landing (50%) and improper planting of the pole (21%). In the 14 elite Finnish vaulters, a total of 53 injuries occurred during competition. The most common injuries were sprained ankles (45%) followed by a tendon or muscle injury (29%). Very few fractures were reported (< 4%). Again, a failure in proper landing technique was the most common mechanism cited as responsible for the injury (64%).

In the present study the most common mechanism responsible for an injury was related to poor pole selection (i.e. too large of a pole) followed by a failure in technique (i.e. improper landing) or equipment failure (i.e. broken pole).

Certainly, the pole vault has evolved since 1965 - particularly with respect to equipment - and one could argue that the injuries reported by WALLGREN do not reflect the types of injuries vaulters experience today. On the other hand, results from the present sur-

vey suggest that fractures are the injury most often observed by coaches, similar to the report of WALLGREN for young vaulters.

Fracture and head injury occur in other university sports as well. According to the 2003-2004 NCAA Injury Surveillance Systems (ISS), spring football had the highest rate of fractures per sport exposures of any university sport (0.60 per 1000 AE; 7.9% of all injuries). NCAA female hockey has the highest rate of concussion in university sports (1.03 per 1000 AE; 24% of all female hockey injuries).4 There is currently no NCAA injury information available on the types and frequencies of injuries for track and field events with which to compare the data of WALLGREN, the results of this survey, or those for other sports. However, track and field event will be included in the NCAA ISS as of 2005 (Personal communication Randy Dick, Associate Director Research / Injury Surveillance System NCAA).

Since 1982, there have been 35 catastrophic injuries in pole vaulters reported to the National Center for Catastrophic Sport Injury Research (Personal communication, Dr. Fred Mueller 2005). BODEN et al. (2001) assessed the circumstances, mechanisms, and injury characteristics of 32 of these catastrophic injuries that occurred between the years 1982 and 1998.2 The average age of the injured athletes was 17.5 years (range, 14 to 23). The mechanism of injury in 17 cases (53%) involved landing on the edge of the pad followed by the head whipping off the pad and striking the surrounding hard surface. In eight cases, the injury occurred when the athlete prematurely released the pole and landed in the vaulting box. The remaining five athletes landed on the surrounding hard surface missing the pad entirely. Thirty-one of the 32 catastrophic injuries (97%) were a result of head injuries. Whether or not a helmet would have prevented these injuries is unknown.

While the vast majority of coaches in our study considered the pole vault to be a



"safe sport", nearly all of them reported having observed injuries that required medical attention and reported significant types of injuries, including fractures and head trauma. In addition, nearly all respondents had observed a pole breaking during competition, and nearly 25% of these cases resulted in injury. These results suggest that the perception of risk among NCAA coaches may not be consistent with their own personal experience as a competitor or coach. The fact that questions elicited information on lifetime prevalence of injuries and not those observed within the past year may explain the differences between risk perception and observations of injury. It is not possible to determine whether or how recent advances in safety devices and equipment have influenced the rate of injury occurrence.

Recently the American Society for Testing and Materials (ASTM) proposed standards

to increase the safety of the pole vault.<sup>1</sup> The proposals included larger landing pits, padding on the planting box and cross-bar uprights, and padding for the back area of the pit, and the bases. The absence of systematically collected data on pole vaulting injuries makes it difficult to evaluate the impact of these interventions. The NCAA has taken the first step by incorporating track and field as a component of its injury surveillance system (ISS). The results will hopefully provide important information on the injury incidence in the sport (i.e. we'll know what the baseline risk is). Once we know the basic epidemiology of pole vaulting injuries, efforts can be focused on further appropriate injury prevention methods.

*Please send all correspondence to:*

*Sean D. Turbeville, Ph.D.*

*Sean-Turbeville@ouhsc.edu*

## REFERENCES

1. American Society for Testing and Materials. Committee F08.67 on Pole Vault Available at <http://www.astm.org/cgi-bin/SoftCart.exeCOMMIT/SUBCOMMIT/F0867.htm?L+mystore+yben6569>. Accessed March 24, 2005
2. BODEN, B.; PASQUINA, P.; JOHNSON, J. et al. (2001): Catastrophic injuries in pole vaulters. *Am. J. Sports Med.* 29 (1): 50-54.
3. GOLDMAN, T.: Pole vaulting proves lethal to some athletes. Available at <http://www.npr.org/programs/atc/features/2002/apr/polevault/index.html>. Accessed March 24, 2005.
4. NCAA Injury Surveillance System. Available at [http://www1.ncaa.org/membership/ed\\_0utreach/health-safety/iss/index.html](http://www1.ncaa.org/membership/ed_0utreach/health-safety/iss/index.html)
5. NCAA Men's Outdoor Track & Field. Available at [http://www2.ncaa.org/sports/spring/track\\_and\\_field/mens/index.html](http://www2.ncaa.org/sports/spring/track_and_field/mens/index.html). Accessed December 12 2005.
6. NIELSON, D. (2002): Education is the key to pole vault safety. *The NCAA News.* April 29, 2002.
7. SCHNIRRING, L. (2002): Pole vault deaths spur safety concerns. *Phys. Sports Med.* 30 (6) 1-3.
8. WALLGREN, G. (1965): Pole vaulting injuries to young persons and top-ranking athletes. *J. Sports Med.Phys.Fitness* 5 (3):156-162
9. WEIR, K: High risk: a series of pole-vaulting deaths has spurred efforts to make the sport safer. Available at [http://www.findarticles.com/p/articles/mi\\_m0BFU/is\\_3\\_89/ai\\_108476885](http://www.findarticles.com/p/articles/mi_m0BFU/is_3_89/ai_108476885). Accessed March 24, 2005.