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Epidemiology of National Collegiate Athletic Association men's and women's swimming and diving injuries from 2009/10 to 2013/14

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Abstract

Background/Aim—Recent injury data for collegiate-level swimming and diving is limited.

Previous data is limited to single seasons, elite and national team athletes, or emergency department data. This study describes the epidemiology of men's and women's swimming and diving injuries reported by the National Collegiate Athletic Association (NCAA) Injury Surveillance Program (ISP) during the 2009/10–2013/14 academic years.

Methods—Injuries and athlete-exposure (AE) data reported within nine men's and 13 women's swimming and diving programs were analyzed. Injury rates, injury rate ratios (IRR), and injury proportions by body site, diagnosis, and mechanism were reported with 95% confidence intervals (CI).

Results—The ISP captured 149 and 208 injuries for men's and women's swimming and diving, respectively, leading to injury rates of 1.54/1000AEs and 1.71/1000AEs. Among females, divers had a higher injury rate (2.49/1000AEs) than swimmers (1.63/1000AEs; IRR=1.53; 95%CI: 1.07, 2.19). Injury rates for male divers (1.94/1000AEs) and swimmers (1.48/1000AEs) did not differ (IRR=1.33; 95%CI: 0.85, 2.31). Most injuries occurred to the shoulder and resulted in strains. Many injuries were classified as overuse or non-contact. Female swimmers had a higher overuse injury rate (1.04/1000AEs) than male swimmers (0.66/1000AEs; IRR=1.58; 95%CI: 1.14, 2.19). Overuse injury rates for female divers (0.54/1000AEs) and male divers (0.46/1000AEs) did not differ (IRR=1.16; 95%CI: 0.40, 3.34).

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Conclusions—Shoulder, strain, and overuse injuries were common in collegiate men's and women's swimming and diving. In addition, divers may have higher injury rates than swimmers, although small reported numbers in this study warrant additional research.

Keywords

incidence; epidemiology; sport; injury surveillance; swimming and diving

INTRODUCTION

The National Collegiate Athletic Association (NCAA) has sanctioned championship events in men's swimming and diving since 1937[1] and women's swimming and diving since 1982.[2] In the 2013/14 academic year, 9,630 men and 12,333 women participated in NCAA swimming and diving.[3] Collegiate swimmers compete in events ranging from 50 to 1,500 meters, utilizing at least one of four strokes: freestyle, backstroke, breaststroke, or butterfly. Collegiate divers compete in one-meter springboard, three-meter springboard, and/or platform diving (Division I only). Points are awarded for all events based on placement. The sum of the swimming and diving points yields the total swimming and diving team score.

The preparation for swimming involves a high training volume and exertion[4, 5] This coupled with the repetitive nature of swimming coupled have previously been asserted as major risk factors for overuse injury.[6-8] Previous studies[5-13] have also found high frequencies of shoulder injuries, with shoulder pain being a major cause of missed practices and poor performance.[14] However, these studies are limited in that they utilize small sample sizes generally from one season and/or one swimming program.

There is also a dearth of research that utilizes large populations of divers over a substantial period of time. Instead, most data originates from case studies,[15, 16] case series,[17] and observations from a single championship competition.[18-20] One surveillance study utilized National Electronic Injury Surveillance System (NEISS) data to examine diving-related injuries of individuals <20 years old presenting at United States emergency departments. This study found large proportions of injuries to the head/face/neck, that resulted in lacerations and soft tissue injuries, and were caused by collision with the diving board or platform.[21] Another study found that Junior Olympic divers had injury histories including fractures and strains.[22] More specifically, due to repetitive hyperextension of the back, diving has been associated with lumbar spondylolysis and low back pain.[22-24] Also, concussion research in diving is limited, although they are hypothesized to occur from deceleration upon entering the water.[25]

Given the large number of athletes involved in swimming and diving, understanding the patterns, mechanisms, and risk factors of injury in this population is critical. The NCAA Injury Surveillance Program (ISP) has monitored all injuries occurring in a sample of men's and women's swimming and diving varsity teams. This study utilizes data from the NCAA ISP to describe the epidemiology of men's and women's swimming and diving injuries occurring within the NCAA competition level during the 2009/10-2013/14 academic years.

METHODS

Data from the 2009/10-2013/14 academic years were obtained from the NCAA ISP, a prospective surveillance program that is managed by the Datalys Center for Sports Injury Research and Prevention (hereafter known as the Datalys Center), an independent, nonprofit research organization. This study was approved by the [name removed for blind review], with student-athletes from participating teams providing consent at the beginning of each academic year.

Sample

Men's swimming and diving data originated from nine varsity programs that contributed 23 team-seasons. Each team-season included an average 22.8 swimmers and 3.5 divers. Women's swimming and diving data originated from 13 varsity NCAA women's swimming and diving programs that contributed 30 team-seasons. Each team-season included an average 22.4 swimmers and 3.2 divers.

Data collection

The methodology of the NCAA ISP during the 2009/10-2013/14 academic years has been previously described.[26] The ISP utilized a convenience sample of NCAA varsity sport teams with athletic trainers (ATs) reporting injury data. These ATs worked with these participating teams and attended school-sanctioned practices and competitions. When injuries occurred, the ATs reported them in real-time through the electronic health record application used by the team medical staff throughout the academic year. In addition to musculoskeletal injuries, the surveillance system captured other sports-related adverse health events such as illness, heat-related conditions, general medical conditions, and skin infections. Only varsity level practice and competition events and team conditioning sessions were included in the ISP data sets. Individual weight lifting and conditioning sessions were excluded.

For each event, the AT completed a detailed event report on the injury or condition (e.g., site, diagnosis) and the circumstances (e.g., activity, mechanism, event type [i.e., competition or practice]). For swimming events, the AT specified which stroke was being performed. The ATs were able to view and update previously submitted information as needed during the course of a season. In addition, ATs also provided the number of student-athletes participating in each practice and competition.

From the electronic health record application, common data elements that included injury and exposure information were stripped of any identifiers and personally identifiable information and retained only relevant variables and values.[26] The frequency of export or submission of data varied slightly among vendors providing the electronic health record applications to team medical staff. This common data element standard allows ATs to document injuries as they normally would as part of their daily clinical practice, as opposed to having them separately report injuries for injury surveillance program purposes. All electronic health record applications must have successfully complete a data-validation process to be certified.

Exported data passed through an automated verification process that conducted a series of consistency checks. Data were reviewed and flagged for invalid values. The AT and data quality assurance staff were notified and worked together to resolve the issue. Data that passed the verification process were then placed into the men's and women's swimming and diving aggregate datasets.

Definitions

A reportable injury in the ISP was defined as an injury that: occurred as a result of participation in an organized intercollegiate practice/competition and required attention from an AT or physician. Multiple injuries occurring from one injury event could be included.

A reportable athlete-exposure (AE) was defined as one student-athlete participating in one NCAA-sanctioned practice or competition in which he or she was exposed to the possibility of athletic injury, regardless of the time associated with that participation. Only athletes with actual playing time in a competition were included in competition exposures.

Body parts were categorized as: head/face, neck, shoulder/clavicle, arm/elbow, hand/wrist, trunk (including chest, abdomen, upper back, and lower back), hip/groin, thigh/upper leg, knee, lower leg (including the Achilles), ankle, foot, and other. Injuries were also categorized by the number of days in which athletes were restricted from participation. First, non-time loss injuries were those injuries that resulted in restriction of participation less than 24 hours; however, this excluded concussions, fractures, and dental injuries, which were considered time loss injuries, regardless of reported time loss. The inclusion of these injuries as time loss is typical in injury surveillance.[27, 28] Second, severe injuries were those injuries that resulted in time loss over three weeks.[29] These severe injuries may have also resulted in the student-athletes prematurely ending their season (i.e., season-ending injury).

Classifying injuries and athlete-exposures by swimming versus diving

Student-athletes were grouped either swimmers or divers. If a student-athlete's injury record did not include their sport, we contacted ATs from their school to obtain such information. For AEs, we consulted historical team rosters for participating programs to decipher the ratio of swimmers to divers. The AEs documented for that school for that year were then distributed based upon these ratios. This distribution assumes that swimmers and divers participated in the same number of practices and competitions across a season. Thus, if a school's men's swimming and diving program had 27 swimmers and 3 divers (i.e., 9:1 ratio), and 200 competition AEs in the 2011/12 academic year, then we would assume that swimmers and divers had accounted for 180 and 20 of the competition AEs, respectively. ATs from participating programs confirmed our methodology that swimmers and divers participated in approximately the same number of practices and competitions across a season.

Statistical analysis

Data were analyzed to assess rates and patterns of college men's and women's swimming and diving injuries. Data were analyzed using SAS-Enterprise Guide software (version 4.3; SAS Institute Inc., Cary, NC). Statistical analyses included calculation of rate ratios (IRRs),

injury proportion ratios (IPRs), and chi-square tests (χ^2) tests. The overall injury rate was calculated as the ratio of injuries per 1,000 total AEs. Injury rates were also calculated as the ratio of practice injuries per 1,000 practice exposures and the ratio of competition injuries per 1,000 competition exposures. The following is an example of an IRR comparing competition and practice injury rates:

$$IRR = \frac{\left(\frac{\sum \text{competition injuries}}{\sum \text{competition athlete-exposures}} \right)}{\left(\frac{\sum \text{practice injuries}}{\sum \text{practice athlete-exposures}} \right)}$$

The following is an example of an IPR comparing the proportion of shoulder injuries sustained in male and female divers:

$$IPR = \frac{\left(\frac{\sum \text{shoulder injuries in men's diving}}{\sum \text{total injuries in men's diving}} \right)}{\left(\frac{\sum \text{shoulder injuries in women's diving}}{\sum \text{total injuries in women's diving}} \right)}$$

All 95% confidence intervals (CIs) not containing 1.00 were considered statistically significant. Because of statistical power concerns in time trends, we grouped years as 2009/10-2011/12 and 2012/13-2013/14. Also, due to the small number of injuries, the majority of analyses utilize the overall count of injuries, as opposed to stratifying by competition and practice.

RESULTS

Overall frequencies and rates

Men's swimming and diving—The ATs reported 149 injuries during 2009/10-2013/14 in college men's swimming and diving, of which 124 (83.2%) and 25 (16.8%) occurred to swimmers and divers, respectively. A total of 133 (89.3%) occurred during practice; 16 occurred during competition (10.7%). Most injuries occurred in the regular season (61.7%); 36.2% and 2.0% occurred in the preseason and postseason, respectively. In addition, 77.2% were non-time loss and 2.7% were severe. Four injuries (2.7%) required surgery.

These 149 injuries occurred during 96,745 AEs, for an injury rate of 1.54/1000AEs (95%CI: 1.29, 1.79; Table 1). No difference existed between the injury rates for practice (1.50/1000AEs) and competition (1.93/1000AEs; IRR=0.78; 95%CI: 0.46, 1.30). When injury rates were stratified by athlete-type, injury rates for male divers (1.94/1000AEs) and swimmers (1.48/1000AEs) did not differ (IRR=1.33; 95%CI: 0.85, 2.31).

Women's swimming and diving—The ATs reported 208 injuries during 2009/10-2013/14 in college women's swimming and diving, of which 171 (82.2%) and 37 (17.8%) occurred to swimmers and divers, respectively. A total of 190 (82.2%) occurred during practice; 18 occurred during competition (17.8%). Most injuries occurred in the regular season (62.0%); 35.6% and 2.4% occurred in the preseason and postseason,

respectively. In addition, 72.6% were non-time loss and 2.9% were severe. Four injuries (1.9%) required surgery.

These 208 injuries occurred during 121,719 AEs, for an injury rate of 1.71/1000AEs (95% CI: 1.48, 1.94; Table 1). No difference existed between the injury rates for practice (1.72/1000AEs) and competition (1.61/1000AEs; IRR=1.07; 95% CI: 0.66, 1.73). When injury rates were stratified by athlete-type, divers had a higher injury rate (2.49/1000AEs) than swimmers (1.63/1000AEs; IRR=1.53; 95% CI: 1.07, 2.19).

Comparison of rates—There were no gender differences in men's and women's swimming and diving injury rates overall (Males vs females IRR=0.90; 95% CI: 0.73, 1.11), for practices (IRR=0.87; 95% CI: 0.70, 1.09), or for competitions (IRR=1.20; 95% CI: 0.61, 2.36). Injury rates did not differ between male and female swimmers (IRR=0.91; 95% CI: 0.72, 1.15) or divers (IRR=0.78; 95% CI: 0.47, 1.29).

Time trends—In men's swimming and diving, there were no differences in injury rates for men's swimmers or divers between the two time periods (2009/10-2011/12 and 2012/13-2013/14) (Figure 1). However, in women's swimming and diving, there was a 30% reduction in the swimming injury rate from 2009/10-2011/12 to 2012/13-2013/14 (IRR=0.70; 95% CI: 0.52, 0.95). There was also a 44% reduction in the diving injury rate, although this change was not significant (IRR=0.56; 95% CI: 0.30, 1.08).

Body sites injured and diagnoses

Most injuries occurred to the shoulder in men's swimming, (34.7%), men's diving (32.0%), and women's swimming (31.3%) (Table 2). However, in women's diving, the trunk comprised the largest proportion of injuries (37.8%). There were no gender differences in body part-specific injury rates among swimmers or divers. However, male divers sustained a greater proportion of shoulder injuries (32.0%) than female divers (5.4%; IPR=5.92; 95% CI: 1.37, 25.59).

The most common injury diagnosis was strains in men's swimming (21.8%), men's diving (20.0%), women's swimming (17.0%), and women's diving (16.2%) (Table 3). In addition, swimmers had large proportions of entrapment/impingement (men: 14.5%; women: 11.1%) and tendonitis (men: 13.7%; women: 15.8%). There were no gender differences in diagnosis-specific injury rates or proportions among swimmers or divers.

Table 4 summarizes common injuries for men's and women's swimming and diving and the percentage of time-loss injuries. For the three concussions in women's diving, two occurred from contact with the water and one occurred from contact with the diving board. In addition, zero cases of spondylolysis and four cases of lower back pain were reported.

Mechanism of injury and activity

The majority of injuries were classified as overuse (men's swimming: 44.4%; men's diving: 24.0%; women's swimming: 63.7%; women's diving: 21.6%) and non-contact (men's swimming: 25.0%; men's diving: 28.0%; women's swimming: 17.0%; women's diving: 27.0%; Table 5). Contact with water also accounted for large proportions of injuries in

men's and women's diving (32.0% and 16.2%, respectively). Female swimmers had a higher rate of overuse injuries (1.04/1000AEs) than male swimmers (0.66/1000AEs; IRR=1.58; 95%CI: 1.14, 2.19). No gender differences in injury mechanism existed among divers. Among swimmers, the largest proportion of injuries occurred while swimming the medley (men: 45.2%; women: 45.6%). There were no gender differences in activity-specific injury rates or proportions among swimmers or divers.

DISCUSSION

Swimming and diving are treated as one NCAA team although they are two discrete sports. Our study utilized injury surveillance data to describe the epidemiology of men's and women's swimming and diving at the NCAA level over the past five years. The study adds to the literature on men's and women's swimming and diving injuries, using data that has been thoroughly checked for errors prior to landing in data sets.[26] This study also captured both time loss and non-time loss injuries in an effort to optimally summarize the types of injuries managed and treated by team medical staff. Such data can help identify areas for prevention and health care related to injuries in swimming and diving.

Previous studies have utilized varying methods to report swimming injuries, leading to disparate reported rates. Mountjoy et al.[19, 20] estimated that the injury rate per 100 swimmers at the 2009 and 2013 world championship events were 2.7 and 6.1, respectively. At the 2008 and 2012 Summer Olympics, Junge et al.[30] and Engebretsen et al.[31] found that 3.4% and 5.4% of swimmers were injured, respectively. Studies with college-level student-athletes are available, but considered injuries sustained outside of practice and competitions (e.g. strength training, non-swimming-related activities). Across five seasons of men's and women's swimming at a Division I university, Wolf et al.[11] reported injury rates of 4.00 and 3.78 injuries per 1000 exposures in men's and women's swimming, respectively. Across seven seasons within a Division I women's swimming team, 2.12 injuries per 1000 exposures were reported.[12] In these studies, activities outside of swimming contributed to 55%-62% of injuries. A smaller study[10] of 34 NCAA Division I male and female swimmers across one season restricted injuries to those sustained during school-sanctioned practices and competitions, yielding an overall rate of 5.55 injuries per 1000AEs. Our study utilized data from 22 programs and 53 seasons and yielded smaller swimming injury rates (men: 1.48/1000AEs; women: 1.63/1000AEs). The NCAA ISP currently does not collect injury data occurring during individual strength training and cross training sessions. Nevertheless, given the larger sample size and inclusion of all injuries from school-sanctioned practices and competitions (time loss and non-time loss), our rates may better estimate the true burden of injury during school-sanctioned practices and competitions than previously reported.

The low reported injury rate in swimmers may be indicative of the swimming culture more so than of the true incidence of injury. In a sample of youth/adolescent swimmers, 95% believed that mild shoulder pain was normal and should be tolerated.[32] However, only 14% reported an injury to team medical staff and 72% reporting using pain medication in order to participate.[32] These findings suggest that swimmers may not associate shoulder pain with injury and rather than seeking care from team medical staff, may self-medicate

with pain medication. Within the context of the NCAA ISP, it is only when an athlete discloses the pain, or when an AT notices the pain, that the injury would be reported.

This need for disclosure is further highlighted by our study and previous studies[5-10] finding large proportions of shoulder and overuse injuries. In addition, female swimmers were more likely to suffer an overuse injury than male swimmers. Previous research has suggested that anatomical, physiological, and psychological differences between male and female athletes may contribute to increased risk of overuse injury in females.[33] Despite the possible gender differences in overuse injuries, the cause of overuse injuries among swimmers of both genders should be further explored. In particular, future studies should examine the adverse effects of rapid increases in the frequency and intensity of training, and the protective effects of adequate recovery time. Because swimming heavily relies upon the upper extremity to propel the body forward,[34] such research should also examine whether proper form also mitigates shoulder injuries.[35]

Research related to divers is limited. At the 2008 and 2012 Summer Olympics, Junge et al. [30] and Engebretsen et al.[31] found that 2.1% and 8.1% of divers were injured, respectively. In our study, divers had a higher injury rate than swimmers, although the finding was only significant in females. Diving injuries were mostly strains and to the shoulder and trunk. This was similar to findings in Junior Olympic divers,[22] but dissimilar to emergency department data,[21] although such data may exclude less severe injuries. In addition, although previous research[23, 24] has highlighted the cases of spondylolysis, lower back pain, and concussions among divers, ISP data reported zero, four, and three cases, respectively. Our sample of 25 male and 37 female diving injuries may not represent the true incidence of these injuries among all NCAA swimming and diving programs. Future research needs to better estimate the incidence of these rarer injuries.

Limitations

Our findings may not be generalizable to other swimming and diving programs within the NCAA or from other levels of competition. The NCAA ISP also does not collect data related to activities outside of school-sanctioned practices and competitions, as did previous studies [11, 12]. Because AEs were unit-based rather than time-, event-, or distance-based, we were unable to report injury rates by the number of minutes/hours of practice/competition, the number of specific events in which athletes participated per competition, or the number of meters swam. This recording method reduces reporting burden for participating ATs and provides consistency for comparisons across various sports injury surveillance research outcomes. Because the NCAA places swimmers and divers on the same team, we had to estimate the distribution of AEs between swimmers and divers. As a result, caution must be taken when interpreting rate-based results specific to swimmers and divers. We utilized historical rosters that identified swimmers and divers on university websites as well as guidance from ATs on how to distribute AEs between both types of student-athletes. However, these assumptions may not be valid among other collegiate programs.

Conclusions

Although swimming and diving are two discrete sports, we found shoulder and overuse injuries comprised large proportions of injuries among these NCAA student-athletes. As a result, future research should examine the causes of overuse injuries among swimmers. Collegiate divers may have higher injury rates than swimmers; however, our small sample of diving injuries highlights the need for larger samples to better understand the factors that contribute to the frequency and severity of injuries sustained by collegiate divers.

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WHAT ARE THE NEW FINDINGS

- The study adds to the literature on men's and women's swimming and diving injuries, using data that has been thoroughly checked for errors prior to landing in data sets
- Divers had a higher injury rate than swimmers, although the finding was only significant in females
- Female swimmers were more likely to suffer an overuse injury than male swimmers

HOW MIGHT IT IMPACT ON CLINICAL PRACTICE IN THE NEAR FUTURE

- By capturing both time loss and non-time loss injuries, current findings may better summarize the types of injuries that are sustained by student-athletes and managed and treated by team medical staff
- The large proportions of overuse injuries reported in swimming and diving highlight the need to emphasize proper technique and avoid rapid increases in the frequency of training to avoid overuse shoulder injuries

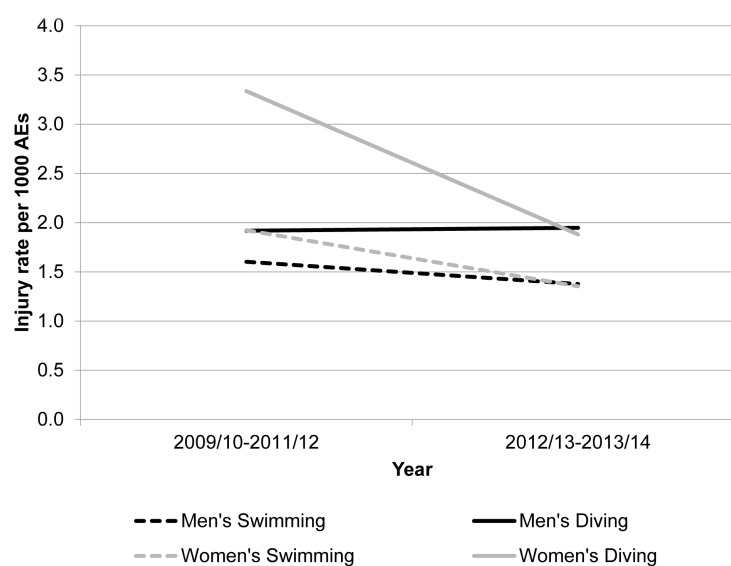


Figure 1. Injury rates per 1,000 athlete-exposures by academic year, men's and women's swimming and diving, 2009/10-2013/14

Table 1

Injury rates and 95% confidence intervals (CI), by type of athlete and type of athlete-exposure (AE) in NCAA Men's and Women's Swimming and Diving^a, 2009/10-2013/14

Athlete type	Exposure type	Men's Swimming and Diving			Women's Swimming and Diving		
		# injuries in sample	AEs	Rate and 95% CI (per 1000 AE)	# injuries in sample	AEs	Rate and 95% CI (per 1000 AE)
Swimmers	Practice	110	76676	1.43 (1.17 , 1.70)	157	96888	1.62 (1.37 , 1.87)
	Competition	14	7153	1.96 (0.93 , 2.98)	14	8233	1.70 (0.81 , 2.59)
	Total	124	83829	1.48 (1.22 , 1.74)	171	105121	1.63 (1.38 , 1.87)
Divers	Practice	23	11800	1.95 (1.15 , 2.75)	33	13630	2.42 (1.60 , 3.25)
	Competition	2	1116	1.79 (0.00 , 4.28)	4	1221	3.28 (0.07 , 6.49)
	Total	25	12916	1.94 (1.18 , 2.69)	37	14851	2.49 (1.69 , 3.29)
Total	Practice	133	88476	1.50 (1.25 , 1.76)	190	110518	1.72 (1.47 , 1.96)
	Competition	16	8269	1.93 (0.99 , 2.88)	18	11200	1.61 (0.86 , 2.35)
	Total	149	96745	1.54 (1.29 , 1.79)	208	121719	1.71 (1.48 , 1.94)

^aData originates from NCAA ISP data, 2009/10-2013/14. Injuries are defined as injuries that: (1) occurred during a sanctioned practice or competition; and (2) were evaluated and/or treated by an athletic trainer, physician, or other healthcare professional.

Table 2

Number of injuries and injury rates with 95% confidence intervals (CI) by body part in NCAA Men's and Women's Swimming and Diving^a. 2009/10-2013/14

	Men's		Women's	
	# injuries in sample, n (%)	Rate and 95% CI (per 1000 AE)	# injuries in sample, n (%)	Rate and 95% CI (per 1000 AE)
Swimmers				
Head/face	5 (4.0)	0.06 (0.01 , 0.11)	4 (2.3)	0.04 (0.00 , 0.08)
Neck	0 (0.0)	0.00	2 (1.2)	0.02 (0.00 , 0.05)
Shoulder/clavicle	43 (34.7)	0.51 (0.36 , 0.67)	63 (36.8)	0.60 (0.45 , 0.75)
Arm/elbow	6 (4.8)	0.07 (0.01 , 0.13)	4 (2.3)	0.04 (0.00 , 0.08)
Hand/wrist	11 (8.9)	0.13 (0.05 , 0.21)	4 (2.3)	0.04 (0.00 , 0.08)
Trunk	20 (16.1)	0.24 (0.13 , 0.34)	30 (17.5)	0.29 (0.18 , 0.39)
Hip/groin	6 (4.8)	0.07 (0.01 , 0.13)	10 (5.9)	0.10 (0.04 , 0.15)
Thigh/upper leg	6 (4.8)	0.07 (0.01 , 0.13)	6 (3.5)	0.06 (0.01 , 0.10)
Knee	11 (8.9)	0.13 (0.05 , 0.21)	19 (11.1)	0.18 (0.10 , 0.26)
Lower leg	2 (1.6)	0.02 (0.00 , 0.06)	6 (3.5)	0.06 (0.01 , 0.10)
Ankle	2 (1.6)	0.02 (0.00 , 0.06)	5 (2.9)	0.05 (0.01 , 0.09)
Foot	7 (5.7)	0.08 (0.02 , 0.15)	9 (5.3)	0.09 (0.03 , 0.14)
Other	5 (4.0)	0.06 (0.01 , 0.11)	9 (5.3)	0.09 (0.03 , 0.14)
Total	124 (100.0)	1.48 (1.22 , 1.74)	171 (100.0)	1.63 (1.38 , 1.87)
Divers				
Head/face	1 (4.0)	0.08 (0.00 , 0.23)	5 (13.5)	0.34 (0.04 , 0.63)
Neck	2 (8.0)	0.15 (0.00 , 0.37)	3 (8.1)	0.20 (0.00 , 0.43)
Shoulder/clavicle	8 (32.0)	0.62 (0.19 , 1.05)	2 (5.4)	0.13 (0.00 , 0.32)
Arm/elbow	1 (4.0)	0.08 (0.00 , 0.23)	1 (2.7)	0.07 (0.00 , 0.20)
Hand/wrist	2 (8.0)	0.15 (0.00 , 0.37)	6 (16.2)	0.40 (0.08 , 0.73)
Trunk	5 (20.0)	0.39 (0.05 , 0.73)	14 (37.8)	0.94 (0.45 , 1.44)
Hip/groin	1 (4.0)	0.08 (0.00 , 0.23)	0 (0.0)	0.00
Thigh/upper leg	1 (4.0)	0.08 (0.00 , 0.23)	0 (0.0)	0.00
Knee	1 (4.0)	0.08 (0.00 , 0.23)	1 (2.7)	0.07 (0.00 , 0.20)
Lower leg	1 (4.0)	0.08 (0.00 , 0.23)	1 (2.7)	0.07 (0.00 , 0.20)
Ankle	2 (8.0)	0.15 (0.00 , 0.37)	2 (5.4)	0.13 (0.00 , 0.32)
Foot	0 (0.0)	0.00	1 (2.7)	0.07 (0.00 , 0.20)
Other	0 (0.0)	0.00	1 (2.7)	0.07 (0.00 , 0.20)
Total	25 (100.0)	1.94 (1.18 , 2.69)	37 (100.0)	2.49 (1.69 , 3.29)

^aData originates from NCAA ISS data, 2009/10-2013/14. Injuries are defined as injuries that: (1) occurred during a sanctioned practice or competition; and (2) were evaluated and/or treated by an athletic trainer, physician, or other healthcare professional.

Table 3

Number of injuries and injury rates with 95% confidence intervals (CI) by diagnosis in NCAA Men's and Women's Swimming and Diving^a. 2009/10-2013/14

	Men's		Women's	
	# injuries in sample, n (%)	Rate and 95% CI (per 1000 AE)	# injuries in sample, n (%)	Rate and 95% CI (per 1000 AE)
Swimmers				
Concussion	5 (4.0)	0.06 (0.01 , 0.11)	1 (0.6)	0.01 (0.00 , 0.03)
Contusion	4 (3.2)	0.05 (0.00 , 0.09)	3 (1.8)	0.03 (0.00 , 0.06)
Entrapment/Impingement	18 (14.5)	0.21 (0.12 , 0.31)	19 (11.1)	0.18 (0.10 , 0.26)
Fracture	3 (2.4)	0.04 (0.00 , 0.08)	0 (0.0)	0.00
Inflammation	2 (1.6)	0.02 (0.00 , 0.06)	6 (3.5)	0.06 (0.01 , 0.10)
Sacroiliac Joint Dysfunction	0 (0.0)	0.00	6 (3.5)	0.06 (0.01 , 0.10)
Spasm	5 (4.0)	0.06 (0.01 , 0.11)	4 (2.3)	0.04 (0.00 , 0.08)
Sprain	6 (4.8)	0.07 (0.01 , 0.13)	9 (5.3)	0.09 (0.03 , 0.14)
Strain	27 (21.8)	0.32 (0.20 , 0.44)	29 (17.0)	0.28 (0.18 , 0.38)
Subluxation	1 (0.8)	0.01 (0.00 , 0.04)	5 (2.9)	0.05 (0.01 , 0.09)
Tendonitis	17 (13.7)	0.20 (0.11 , 0.30)	27 (15.8)	0.26 (0.16 , 0.35)
Other ^b	36 (29.0)	0.43 (0.29 , 0.57)	62 (36.2)	0.59 (0.44 , 0.74)
Total	124 (100.0)	1.48 (1.22 , 1.74)	171 (100.0)	1.63 (1.38 , 1.87)
Divers				
Concussion	0 (0.0)	0.00	3 (8.1)	0.20 (0.00 , 0.43)
Contusion	2 (8.0)	0.15 (0.00 , 0.37)	3 (8.1)	0.20 (0.00 , 0.43)
Entrapment/Impingement	1 (4.0)	0.08 (0.00 , 0.23)	0 (0.0)	0.00
Fracture	0 (0.0)	0.00	2 (5.4)	0.13 (0.00 , 0.32)
Inflammation	2 (8.0)	0.15 (0.00 , 0.37)	0 (0.0)	0.00
Sacroiliac Joint Dysfunction	2 (8.0)	0.15 (0.00 , 0.37)	2 (5.4)	0.13 (0.00 , 0.32)
Spasm	3 (12.0)	0.23 (0.00 , 0.50)	5 (13.5)	0.34 (0.04 , 0.63)
Sprain	3 (12.0)	0.23 (0.00 , 0.50)	4 (10.8)	0.27 (0.01 , 0.53)
Strain	5 (20.0)	0.39 (0.05 , 0.73)	6 (16.2)	0.40 (0.08 , 0.73)
Subluxation	0 (0.0)	0.00	1 (2.7)	0.07 (0.00 , 0.20)
Tendonitis	2 (8.0)	0.15 (0.00 , 0.37)	0 (0.0)	0.00
Other ^b	5 (20.0)	0.39 (0.05 , 0.73)	11 (29.7)	0.74 (0.30 , 1.18)
Total	25 (100.0)	1.94 (1.18 , 2.69)	37 (100.0)	2.49 (1.69 , 3.29)

^a Data originates from NCAA ISS data, 2009/10-2013/14. Injuries are defined as injuries that: (1) occurred during a sanctioned practice or competition; and (2) were evaluated and/or treated by an athletic trainer, physician, or other healthcare professional.

^b "Other" injuries includes injuries with counts <5 among swimmers or divers in men's or women's swimming and diving. Injuries in this category with multiple reports included: bursitis (Men: n=2; Women: n=2), cysts (Women: n=2), infectious disease (Men: n=3; Women: n=4), and nervous system (Women: n=4). In addition, "Other" injuries included injuries coded for diagnosis as "miscellaneous."

Table 4Common injuries in NCAA Men's and Women's Swimming and Diving^a. 2009/10-2013/14

Injury	Men's Swimming and Diving		
	# injuries in sample, n (%)	% non-time loss injuries ^b	Most common mechanisms of injury for this injury
Men's Swimming			
Shoulder entrapment/impingement	18 (14.5)	100.0%	Overuse (88.9%)
Shoulder tendonitis	9 (7.3)	100.0%	Overuse (66.7%)
Men's Diving			
Shoulder strain	4 (16.0)	75.0%	Contact with water (75.0%)
Women's Swimming			
Shoulder entrapment/impingement	19 (11.1)	84.2%	Overuse (100.0%)
Shoulder tendonitis	16 (9.4)	87.5%	Overuse (87.5%)
Women's Diving			
Concussion	3 (8.1)	0.0%	Contact with water (66.7%)
Trunk spasm	3 (8.1)	100.0%	Non-contact (66.7%)

^aData originates from NCAA ISS data, 2009/10-2013/14. Injuries are defined as injuries that: (1) occurred during a sanctioned practice or competition; and (2) were evaluated and/or treated by an athletic trainer, physician, or other healthcare professional.

^bIncludes injuries that resulted in time loss less than one day; does not include any concussions, fractures, or dental injuries, regardless of time loss

Table 5

Number of injuries and injury rates with 95% confidence intervals (CI) by mechanism of injury and activity in NCAA Men's and Women's Swimming and Diving^a. 2009/10-2013/14

	Men's		Women's	
	# injuries in sample, n (%)	Rate and 95% CI (per 1000 AE)	# injuries in sample, n (%)	Rate and 95% CI (per 1000 AE)
Swimmers				
Mechanism of injury				
Contact with other athlete	4 (3.2)	0.05 (0.00 , 0.09)	1 (0.6)	0.01 (0.00 , 0.03)
Contact with ground/surface	15 (12.1)	0.18 (0.09 , 0.27)	9 (5.3)	0.09 (0.03 , 0.14)
Contact with water	4 (3.2)	0.05 (0.00 , 0.09)	3 (1.8)	0.03 (0.00 , 0.06)
Contact with timing pad/ side of pool/starting block	4 (3.2)	0.05 (0.00 , 0.09)	4 (2.3)	0.04 (0.00 , 0.08)
Non-contact	31 (25.0)	0.37 (0.24 , 0.50)	29 (17.0)	0.28 (0.18 , 0.38)
Overuse	55 (44.4)	0.66 (0.48 , 0.83)	109 (63.7)	1.04 (0.84 , 1.23)
Illness/Infection	5 (4.0)	0.06 (0.01 , 0.11)	8 (4.7)	0.08 (0.02 , 0.13)
Other	6 (4.8)	0.07 (0.01 , 0.13)	8 (4.7)	0.08 (0.02 , 0.13)
Activity				
Backstroke	12 (9.7)	0.14 (0.06 , 0.22)	25 (15.6)	0.24 (0.14 , 0.33)
Breast stroke	10 (8.1)	0.12 (0.05 , 0.19)	14 (8.2)	0.13 (0.06 , 0.20)
Butterfly	16 (12.9)	0.19 (0.10 , 0.28)	22 (12.9)	0.21 (0.12 , 0.30)
Freestyle	13 (10.5)	0.16 (0.07 , 0.24)	13 (7.6)	0.12 (0.06 , 0.19)
Medley	56 (45.2)	0.67 (0.49 , 0.84)	78 (45.6)	0.74 (0.58 , 0.91)
Team conditioning	2 (1.6)	0.02 (0.00 , 0.06)	7 (4.1)	0.07 (0.02 , 0.12)
Other	15 (12.1)	0.18 (0.09 , 0.27)	12 (7.0)	0.11 (0.05 , 0.18)
Divers				
Mechanism of injury				
Contact with ground/surface	2 (8.0)	0.15 (0.00 , 0.37)	3 (8.1)	0.20 (0.00 , 0.43)
Contact with water	8 (32.0)	0.62 (0.19 , 1.05)	6 (16.2)	0.40 (0.08 , 0.73)
Contact with board/platform	1 (4.0)	0.08 (0.00 , 0.23)	3 (8.1)	0.20 (0.00 , 0.43)
Non-contact	7 (28.0)	0.54 (0.14 , 0.94)	10 (27.0)	0.67 (0.26 , 1.09)
Overuse	6 (24.0)	0.46 (0.09 , 0.84)	8 (21.6)	0.54 (0.17 , 0.91)
Illness/Infection	0 (0.0)	0.00	2 (5.4)	0.13 (0.00 , 0.32)
Other	1 (4.0)	0.08 (0.00 , 0.23)	3 (8.1)	0.20 (0.00 , 0.43)
Activity				
Diving	21 (84.0)	1.63 (0.93 , 2.32)	30 (81.1)	2.02 (1.30 , 2.74)
Team conditioning	2 (8.0)	0.15 (0.00 , 0.37)	4 (10.8)	0.27 (0.01 , 0.53)
Other	2 (8.0)	0.15 (0.00 , 0.37)	3 (8.1)	0.20 (0.00 , 0.43)

^aData originates from NCAA ISS data, 2009/10-2013/14. Injuries are defined as injuries that: (1) occurred during a sanctioned practice or competition; and (2) were evaluated and/or treated by an athletic trainer, physician, or other healthcare professional.