Epidemiology of Injuries in National Collegiate Athletic Association Men’s Swimming and Diving: 2014–2015 Through 2018–2019

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Context: The National Collegiate Athletic Association (NCAA) has sponsored men’s swimming and diving since 1937. In recent years, participation has continued to grow, with an estimated 444 sponsored teams and 9800 athletes competing in 2018–2019. Despite the large number of NCAA student athletes and steady increases in membership over the years, few studies have explored the epidemiology of collegiate swimming- and diving-related injuries. An updated investigation is needed to appraise the overall health and safety of this population and to assess temporal patterns in injury incidence within this group.

Routine examination of injury incidence in this population is necessary to highlight areas that may warrant further attention and to inform the implementation of targeted interventions aimed at injury prevention. As such, the purpose of this study was to describe the epidemiology of sport-related injuries among men’s swimming and diving student-athletes in a sample of NCAA teams recorded in the NCAA ISP during the 2014–2015 through 2018–2019 academic years.

METHODS

Study Data

Men’s swimming and diving exposure and injury data collected in the NCAA ISP during the 2014–2015 through
Classifying Injuries and Athlete-Exposures by Swimming Versus Diving

Injured athletes were identified as either swimmers or divers when injury records were submitted by the AT. For injury records with unknown athlete type, it was assumed that the athlete was a swimmer if the corresponding activity at the time of injury was reported as backstroke, breaststroke, butterfly, freestyle, or medley. The athlete was assumed to be a diver if the corresponding activity was breaststroke, butterfly, freestyle, or medley. The athlete at the time of injury was reported as backstroke, breaststroke, freestyle, or medley. That the athlete was a swimmer if the corresponding activity was breaststroke, butterfly, freestyle, or medley. For injury records with unknown athlete type, it was assumed divers when injury records were submitted by the AT. For injury records with unknown athlete type, it was assumed divers when injury records were submitted by the AT.

Statistical Analysis

Injury counts and rates per 1000 AEs for each athlete type (swimmers, divers) were examined by event type (practice, competition) and time lost (time lost [TL], non–time loss [NTL]). Poststratification sample weights by sport, year, and division were established within the surveillance system to compute national estimates of injury events on the basis of the sampled teams. An AE was defined as 1 athlete participating in 1 exposure event. Weighted and unweighted rates were estimated; however, results have been presented in terms of unweighted rates (unless otherwise specified) due to low frequencies of injury observations across levels of certain explanatory variables. Temporal trends in injury rates (pooled for practices and competitions) across the study period were evaluated using rate profile plots stratified by athlete type. Injury counts and proportions were examined by body part injured, mechanism of injury, injury diagnosis, and activity at the time of injury. Respiratory infections (n = 40) were not included in analyses due to reporting inconsistencies (by program and year) across the study period. Injury rate ratios were used to examine differential injury rates across event types. The injury rate ratios with associated 95% confidence intervals (CIs) excluding 1.00 were considered statistically significant. All analyses were conducted using SAS version 9.4 (SAS Institute).

RESULTS

A total of 339 men’s swimming and diving injuries (swimmers: 296; divers: 43) from 218 050 AEs (swimmers: 189 704; divers: 28 346) were reported to the NCAA ISP during the 2014–2015 through 2018–2019 athletic seasons (rate: swimmers = 1.56/1000 AEs; divers = 1.52/1000 AEs). This equated to a national estimate of 296 050 injuries overall (swimmers: 10 956; divers: 2 565; Table 1). Across the study period overall, there were no significant differences in swimming injury rates by event type (practice, competition). Differences in diving injury rates by event type were not examined due to a low number of

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Table 1. Reported and National Estimates of Injuries, Athlete Exposure (AEs), and Rates per 1000 AEs by Athlete Type and Event Type*

| Athlete Type | Overall | Practices | Competitions |
|--------------|---------|-----------|--------------|
|              | Reported | National Estimate | Reported | National Estimate | Reported | National Estimate |
| Swimmers     | 296      | 10 956    | 274        | 10 040        | 22       | 917              |
|              | 189 704  | 7 740 041 | 169 885    | 6 863 653     | 19 818   | 876 388          |
|              | 1.56 (1.38, 1.74) | 1.42 (1.24, 1.9) | 1.61 (1.42, 1.80) | 1.46 (1.27, 1.65) | 1.11 (0.65, 1.57) | 1.05 (0.58, 1.51) |
| Divers       | 43       | 2565      | 34         | 2137          | 9        | 428              |
|              | 28 346   | 1 156 558 | 25 385     | 1 025 603     | 2961     | 130 954          |
|              | 1.52 (1.06, 1.97) | 2.22 (1.76, 2.67) | 1.34 (0.89, 1.79) | 2.08 (1.63, 2.53) | 3.04 (1.05, 5.03) | 3.27 (1.28, 5.25) |
| Overall      | 339      | 13 521    | 308        | 12 176        | 31       | 1345             |
|              | 218 050  | 8 896 599 | 195 270    | 7 889 257     | 22 780   | 1 007 342        |
|              | 1.55 (1.39, 1.72) | 1.52 (1.35, 1.69) | 1.58 (1.40, 1.75) | 1.54 (1.37, 1.72) | 1.36 (0.88, 1.84) | 1.34 (0.86, 1.81) |

* Data presented in the order of reported number, followed by athlete exposures (AEs), estimated injury rates, and associated 95% Confidence Intervals (CIs). Data pooled association-wide are presented overall, and separately for practices and competitions. National estimates were produced using sampling weights estimated on the basis of sport, division, and year. All CIs were constructed using variance estimates calculated on the basis of reported data. A reportable injury was one that occurred due to participation in an organized intercollegiate practice or competition, and required medical attention by a team Certified Athletic Trainer or physician (regardless of time lost). Only scheduled team practices and competitions were retained in this analysis.
Injuries to the shoulder (27.0%) and trunk (16.2%) accounted for the largest proportions of all men's swimming injuries reported during the study period (Table 2). Among shoulder injuries, nearly half (47.5%) were NTL, approximately a third (30.0%) were TL, and roughly a quarter (22.5%) had missing TL data. Similarly, a greater proportion of trunk injuries involved NTL (50.0%; TL: 33.3%; missing TL data: 16.7%). The most commonly reported mechanisms of injury were overuse (42.6%) and noncontact (18.9%) injuries. Overuse injuries accounted for a larger proportion of competition injuries (73.3%) than practice injuries (18.3%). Most men's swimming injuries reported during 2014–2015 through 2018–2019 were strains (19.6%) and inflammatory conditions (18.6%). Strains were more prevalent among reported competition injuries (36.4%) than practice injuries (18.3%), whereas inflammatory conditions were more prevalent among reported practice injuries (19.0%) than competition injuries (13.6%). The most commonly reported specific injuries during the study period were biceps tendinitis (shoulder) (7.8%; Rate = 1.21 per 10000 AE), shoulder impingement (4.7%; Rate = 0.74 per 10000 AE), rotator cuff tear (partial or complete) (3.4%; Rate = 0.53 per 10000 AE), and rotator cuff tendinitis (3.4%; Rate = 0.53 per 10000 AE).

Injuries to the shoulder (23.3%) and trunk (23.3%) accounted for the largest proportions of all men's diving injuries reported during the study period (Table 3). Injuries were most commonly attributed to surface contact (32.6%), noncontact (30.2%), and overuse (20.9%) mechanisms. Most men's diving injuries reported during the study period were strains (18.6%) and inflammatory conditions (16.3%); no specific injury was observed to be notably prevalent among all reported diving injuries.

**Injuries by Swimming- and Diving-Specific Activities**

Most injuries in men's swimming between 2014–2015 and 2018–2019 occurred during freestyle swim (34.1%), conditioning (16.9%), and breaststroke swim (10.8%). Injuries occurring during freestyle and breaststroke events were more prevalent among reported competition injuries than practice injuries (Table 4). Most injuries in men's divers during the study period occurred during unspecified diving activities (44.2%).

**SUMMARY**

This study aimed to describe the epidemiology of NCAA men's swimming- and diving-related injuries reported to the NCAA ISP between the 2014–2015 and 2018–2019 academic years. Injury rates in men's swimming remained relatively stable and low during the first 3 years of the study.
period before fluctuating during the final years of the study. The observed fluctuations in the final 2 years of the study may be reflective of changes in training patterns. HIIT has been shown to both increase muscular performance and improve athletic performance in swim, cycling, and running times. However, the observed fluctuations in the final years of the study may also be reflective of changes in training patterns. HIIT has been shown to both increase muscular performance and improve athletic performance in swim, cycling, and running times.

Table 2. Distribution of Swimmer Injuries by Body Part, Mechanism, and Injury Diagnosis; Stratified by Event Type

| Body Part | Injuries | National Estimate | Injuries | National Estimate | Injuries | National Estimate |
|-----------|----------|------------------|----------|------------------|----------|------------------|
| Head/face | 20 (6.76) | 838 (7.65)       | 1 (4.55) | 38 (4.14)        | 19 (6.93) | 801 (7.98)       |
| Neck      | 3 (1.01)  | 148 (1.35)       | 0 (0.0)  | 0 (0.0)          | 3 (1.09)  | 148 (1.47)       |
| Shoulder  | 80 (27.03)| 3269 (29.84)     | 5 (22.73)| 408 (44.49)      | 75 (27.37)| 2860 (28.49)    |
| Arm/elbow | 19 (6.42) | 543 (4.96)       | 4 (18.18)| 97 (10.58)       | 15 (5.47) | 446 (4.44)       |
| Hand/wrist| 7 (2.36)  | 222 (2.03)       | 1 (4.55) | 30 (3.27)        | 6 (2.19)  | 192 (1.91)       |
| Trunk     | 48 (16.22)| 2349 (21.44)     | 4 (18.18)| 132 (14.39)      | 44 (16.06)| 2217 (22.08)    |
| Hip/groin | 19 (6.42) | 626 (5.71)       | 4 (18.18)| 113 (12.32)      | 15 (5.47) | 513 (5.11)       |
| Thigh     | 7 (2.36)  | 208 (1.90)       | 1 (4.55) | 43 (4.69)        | 6 (2.19)  | 166 (1.65)       |
| Knee      | 15 (5.07) | 392 (3.58)       | 0 (0.0)  | 0 (0.0)          | 15 (5.47) | 392 (3.90)       |
| Lower leg | 5 (1.69)  | 114 (1.04)       | 1 (4.55) | 19 (2.07)        | 4 (1.46)  | 96 (0.96)        |
| Ankle     | 8 (2.70)  | 233 (2.13)       | 0 (0.0)  | 0 (0.0)          | 8 (2.92)  | 233 (2.32)       |
| Foot      | 8 (2.70)  | 215 (1.96)       | 0 (0.0)  | 0 (0.0)          | 8 (2.92)  | 215 (2.14)       |
| Other     | 57 (19.26)| 1799 (16.42)     | 1 (4.55) | 38 (4.14)        | 56 (20.44)| 1761 (17.54)    |
| Mechanism |          |                  |          |                  |          |                  |
| Player contact | 7 (2.36)  | 197 (1.80)       | 1 (4.55) | 38 (4.14)        | 6 (2.19)  | 159 (1.58)       |
| Surface contact | 19 (6.42) | 554 (5.06)       | 3 (13.64)| 86 (9.38)        | 16 (5.84) | 468 (4.66)       |
| Water     | 6 (31.58)| 222 (40.07)      | 1 (33.33)| 38 (44.19)       | 5 (31.25)| 185 (39.53)      |
| Deck      | 10 (52.63)| 265 (47.83)      | 2 (66.67)| 49 (56.98)       | 8 (50.00)| 216 (46.15)      |
| Other     | 3 (15.79) | 67 (12.09)       | 0 (0.0)  | 0 (0.0)          | 3 (18.75)| 67 (14.32)       |
| Other apparatus contact | 8 (2.70)  | 164 (1.50)       | 3 (13.64)| 54 (58.99)       | 5 (1.82)  | 110 (1.10)       |
| Noncontact | 56 (18.92)| 2690 (24.55)     | 6 (27.27)| 402 (43.84)      | 50 (18.25)| 2286 (22.79)    |
| Overuse   | 126 (42.57)| 4777 (43.60)     | 7 (31.82)| 268 (29.23)      | 119 (43.43)| 4509 (44.91)    |
| Other/unknown | 80 (27.03)| 2574 (23.49)     | 2 (9.09) | 68 (7.42)        | 78 (28.47)| 2505 (24.95)    |
| Diagnosis |          |                  |          |                  |          |                  |
| Abrasion/laceration | 6 (2.03)  | 142 (1.30)       | 0 (0.0)  | 0 (0.0)          | 6 (2.19)  | 142 (1.41)       |
| Concussion | 5 (1.69)  | 133 (1.21)       | 1 (4.55) | 38 (4.14)        | 4 (1.46)  | 95 (0.95)        |
| Contusion  | 1 (0.34)  | 19 (0.17)        | 1 (4.55) | 19 (2.07)        | 0 (0.0)  | 0 (0.0)          |
| Dislocation/subluxation | 11 (3.72)| 808 (7.37)       | 2 (9.09) | 289 (31.52)      | 9 (3.28)  | 518 (5.16)       |
| Entrapment/impingement | 18 (6.08)| 519 (4.74)       | 0 (0.0)  | 0 (0.0)          | 18 (6.57)| 519 (5.17)       |
| Fracture   | 3 (1.01)  | 86 (0.78)        | 0 (0.0)  | 0 (0.0)          | 3 (1.09)  | 86 (0.86)        |
| Illness/infection | 12 (4.05)| 394 (3.60)       | 0 (0.0)  | 0 (0.0)          | 12 (4.38)| 394 (3.92)       |
| Inflammatory condition | 55 (18.58)| 1966 (17.94)     | 3 (13.64)| 128 (13.96)      | 52 (18.98)| 1839 (18.32)    |
| Spasm     | 19 (6.42) | 1133 (10.34)     | 2 (9.09) | 68 (7.42)        | 17 (6.20)| 1065 (10.61)    |
| Sprain    | 11 (3.72) | 302 (2.76)       | 2 (9.09) | 60 (6.54)        | 9 (3.28)  | 242 (2.41)       |
| Strain    | 58 (19.59)| 1943 (17.73)     | 8 (36.36)| 213 (23.23)      | 50 (18.25)| 1730 (17.23)    |
| Other     | 97 (32.77)| 3512 (32.06)     | 3 (13.64)| 102 (11.12)      | 94 (34.31)| 3410 (32.96)    |

aData presented in the order of reported number, followed by the proportion of all injuries attributable to a given category. Data pooled across event types are presented overall, and separately for practices and competitions. National estimates were produced using sampling weights estimated on the basis of sport, division, and year. A reportable injury was one that occurred due to participation in an organized collegiate practice or competition, and required medical attention by a team Certified Athletic Trainer or physician (regardless of time loss). Only scheduled team practices and competitions were retained in this analysis.
The prevalence of NTL shoulder injuries in swimming may be of particular concern. In a previous study of actively competing competitive swimmers, 91% reported a history of shoulder pain and 80% reported pain during activity on a constant, daily, weekly, or monthly basis.15 Given the prevalence of shoulder pain as opposed to acute injury presentations,16 researchers alike may seek to identify cases of chronic prevalence of shoulder pain in this population. When documenting only the cases that required medical attention associated with cycles of remission and exacerbation, even be greater than that observed in the present study. Because overuse injuries are often chronic and may be associated with cycles of remission and exacerbation, documenting only the cases that required medical attention and intervention by an AT may not fully capture the prevalence of shoulder pain in this population. When addressing overuse and chronic pain, clinicians and researchers alike may seek to identify cases of chronic shoulder pain as opposed to acute injury presentations.16 Similarly, the observed distribution of swimming injuries across body parts may be expected when considering the dynamics of the sport. Given that swimmers use their upper extremities to propel themselves through the water, it is not surprising that injuries were mostly attributed to the extremities (eg, hand and wrist, elbow, foot, ankle, knee). Notably, most swimming injuries were attributed to noncontact or overuse mechanisms. These types of mechanisms have been known to lead to the development of inflammatory conditions such as bicep tendonitis, rotator cuff tendonitis, or bursitis.13 Given the physical demands of

| Body part       | Overall Injuries Reported (%) | National Estimate (%) | Overall Injuries Reported (%) | National Estimate (%) | Overall Injuries Reported (%) | National Estimate (%) |
|-----------------|-------------------------------|-----------------------|-------------------------------|-----------------------|-------------------------------|-----------------------|
| Head/face       | 3 (6.98)                      | 311 (12.12)           | 1 (11.11)                     | 30 (7.01)             | 2 (5.88)                      | 281 (13.15)           |
| Neck            | 1 (2.33)                      | 30 (1.17)             | 0 (0.0)                       | 0 (0.0)               | 1 (2.94)                      | 30 (1.40)             |
| Shoulder        | 10 (22.63)                    | 720 (28.07)           | 2 (22.22)                     | 48 (11.45)            | 8 (23.53)                     | 672 (31.45)           |
| Hand/wrist      | 5 (11.63)                     | 128 (4.99)            | 2 (22.22)                     | 49 (11.45)            | 3 (8.82)                      | 79 (3.70)             |
| Trunk           | 10 (22.63)                    | 671 (26.16)           | 4 (44.44)                     | 300 (70.09)           | 6 (17.65)                     | 371 (17.36)           |
| Hip/groin       | 2 (4.65)                      | 61 (2.38)             | 0 (0.0)                       | 0 (0.0)               | 2 (5.88)                      | 61 (2.85)             |
| Thigh           | 1 (2.33)                      | 50 (1.95)             | 0 (0.0)                       | 0 (0.0)               | 1 (2.94)                      | 50 (2.34)             |
| Knee            | 3 (6.98)                      | 91 (3.55)             | 0 (0.0)                       | 0 (0.0)               | 3 (8.82)                      | 91 (4.26)             |
| Lower leg       | 3 (6.98)                      | 110 (4.29)            | 0 (0.0)                       | 0 (0.0)               | 3 (8.82)                      | 110 (5.15)            |
| Ankle           | 1 (2.33)                      | 50 (1.95)             | 0 (0.0)                       | 0 (0.0)               | 1 (2.94)                      | 50 (2.34)             |
| Foot            | 2 (4.65)                      | 282 (10.99)           | 0 (0.0)                       | 0 (0.0)               | 2 (5.88)                      | 282 (13.20)           |
| Other           | 2 (4.65)                      | 60 (2.34)             | 0 (0.0)                       | 0 (0.0)               | 2 (5.88)                      | 60 (2.81)             |

| Mechanism       | Overall Injuries Reported (%) | National Estimate (%) | Overall Injuries Reported (%) | National Estimate (%) | Overall Injuries Reported (%) | National Estimate (%) |
|-----------------|-------------------------------|-----------------------|-------------------------------|-----------------------|-------------------------------|-----------------------|
| Surface contact | 14 (32.56)                    | 409 (15.95)           | 3 (33.33)                     | 79 (18.46)            | 11 (32.35)                    | 330 (15.44)           |
| Water           | 11 (27.57)                    | 310 (11.79)           | 3 (100.00)                    | 79 (100.00)           | 8 (72.73)                     | 231 (70.00)           |
| Other           | 3 (21.43)                     | 99 (24.21)            | 0 (0.0)                       | 0 (0.0)               | 3 (27.27)                     | 99 (30.00)            |
| Other apparatus contact | 2 (4.65) | 269 (10.49) | 1 (11.11) | 19 (4.44) | 1 (2.94) | 251 (11.75) |
| Noncontact      | 13 (30.23)                    | 907 (35.36)           | 2 (22.22)                     | 144 (33.64)           | 11 (32.35)                    | 752 (36.56)           |
| Overuse         | 9 (29.30)                     | 609 (23.74)           | 3 (33.33)                     | 186 (43.46)           | 6 (17.65)                     | 423 (19.79)           |
| Other/unknown   | 5 (11.63)                     | 372 (14.50)           | 0 (0.0)                       | 0 (0.0)               | 5 (14.71)                     | 372 (17.41)           |

| Diagnosis       | Overall Injuries Reported (%) | National Estimate (%) | Overall Injuries Reported (%) | National Estimate (%) | Overall Injuries Reported (%) | National Estimate (%) |
|-----------------|-------------------------------|-----------------------|-------------------------------|-----------------------|-------------------------------|-----------------------|
| Abrasion/laceration | 1 (2.33) | 19 (0.74) | 1 (11.11) | 19 (4.44) | 0 (0.0) | 0 (0.0) |
| Concussion       | 3 (6.98)                      | 311 (12.12)           | 1 (11.11)                     | 30 (7.01)             | 2 (5.88)                      | 281 (13.15)           |
| Contusion        | 1 (2.33)                      | 19 (0.74)             | 0 (0.0)                       | 0 (0.0)               | 1 (2.94)                      | 19 (0.89)             |
| Dislocation/subluxation | 3 (6.98) | 91 (3.55) | 0 (0.0) | 0 (0.0) | 3 (8.82) | 91 (4.26) |
| Entrapment/impingement | 3 (6.98) | 299 (11.66) | 2 (22.22) | 49 (11.45) | 1 (2.94) | 251 (11.75) |
| Fracture         | 2 (4.65)                      | 282 (10.99)           | 0 (0.0)                       | 0 (0.0)               | 2 (5.88)                      | 282 (13.20)           |
| Illness/infection | 0 (0.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) | 0 (0.0) |
| Inflammatory condition | 7 (16.28) | 452 (17.62) | 0 (0.0) | 0 (0.0) | 7 (20.59) | 452 (21.15) |
| Spasm | 3 (6.98) | 114 (4.44) | 0 (0.0) | 0 (0.0) | 3 (8.82) | 114 (5.33) |
| Sprain | 4 (9.30) | 141 (5.05) | 1 (11.11) | 30 (7.01) | 3 (8.82) | 110 (5.15) |
| Strain | 8 (18.60) | 523 (20.39) | 1 (11.11) | 126 (29.44) | 7 (20.59) | 397 (18.58) |
| Other | 8 (18.60) | 314 (12.24) | 3 (33.33) | 175 (40.89) | 5 (14.71) | 139 (6.50) |

Table 3. Distribution of Diver Injuries by Body Part, Mechanism, and Injury Diagnosis; Stratified by Event Type

Data presented in the order of reported number, followed by the proportion of all injuries attributable to a given category. Data pooled across event types are presented overall, and separately for practices and competitions. National estimates were produced using sampling weights estimated on the basis of sport, division, and year. A reportable injury was one that occurred due to participation in an organized intercollegiate practice or competition, and required medical attention by a team Certified Athletic Trainer or physician (regardless of time loss). Only scheduled team practices and competitions were retained in this analysis.
competitive swimming and the typical nature of injuries reported in men’s swimming, it is unsurprising that the 3 most reported specific injuries were in fact biceps tendonitis (shoulder), shoulder impingement, and rotator cuff tendinitis.17,18 It is important to note that swimming athletes may also experience concomitant shoulder injuries due to the multifactorial etiology (strength imbalances, glenohumeral joint laxity, scapular dyskinesia) of overuse shoulder pain.18–20 On the basis of the existing literature surrounding the prevalence of shoulder injury,13 the necessary stress and strain on the shoulder to be competitive—and the difficulty in implementing injury prevention programs for a multifactorial injury that is often overuse—may involve multiple anatomical structures and involve individualized muscular imbalances and form variations. It may be reasonable to suggest that in addition to screening for risk factors such as range of motion deficits, muscular imbalances, and history of injury, clinician and research focus should be aimed towards secondary injury prevention strategies. This may include monitoring fatigue and recovery as well as addressing the cycle of remission and exacerbation within overuse injuries.16

Given that whole-body movement and coordination is necessary in swimming, it is important to identify that injury to the shoulder may be a functional manifestation of underlying core weakness.24,28–30 This observation in previous literature (in both swimming24,28 and overhead31,32 athletes) may be further supported by the finding that after the shoulder, the trunk and the hip and groin were also prevalently injured structures in the current study. Therefore, the observed distribution of injuries along the kinetic chain among NCAA men’s swimming athletes in the present study point to the importance of the interaction among the shoulder, trunk, and hip and groin and may indicate a relationship between the inherent risks of injury within these structures.28,30,33

The overall men’s diving injury rate in the present study was lower than previously reported in this population.4 Given the observed frequencies of diving injuries reported across the study period, it is difficult to contextualize these findings. The most commonly reported injuries among men’s diving occurred in the shoulder and trunk, which is consistent with previous reports within this population.4 It is important that the biomechanics of diving during takeoff (contact with the surface of the diving board or platform), flight, and entry are inherent factors that contribute to injury.34 During takeoff, flight, and entry, divers perform complex extension, flexion, and rotational movements within the trunk.34 Just before entering the water, divers’ shoulders are uniquely abducted and flexed in a vulnerable position whereby glenohumeral joint stability may be compromised.34 During entry, divers’ shoulders (abducted and flexed) and wrists (dorsiflexed, pronated, and radially deviated) bear significant gravitational force of impact, breaking the surface tension of the water while being placed in an unstable position.34 The competitive nature of the sport demands that athletes consistently practice and

### Table 4. Distribution of Injuries by Injury Activity; Stratified by Athlete Type and Event Type

| Athlete Type | Activity | Overall | Competitions | Practices |
|--------------|----------|---------|--------------|-----------|
|              | Injuries Reported (%) | National Estimate (%) | Injuries Reported (%) | National Estimate (%) | Injuries Reported (%) | National Estimate (%) |
| Swimmers     | Swim–backstroke | 14 (4.73) | 366 (3.34) | 1 (4.55) | 34 (3.71) | 13 (4.74) | 332 (3.31) |
|              | Swim–breast | 32 (10.81) | 1117 (10.20) | 5 (22.73) | 155 (16.90) | 27 (9.85) | 962 (9.58) |
|              | Swim–butterfly | 15 (5.07) | 652 (5.95) | 3 (13.64) | 325 (35.44) | 12 (4.38) | 328 (3.27) |
|              | Swim–freestyle | 101 (34.12) | 3663 (33.43) | 12 (54.55) | 365 (39.80) | 69 (32.48) | 2998 (32.85) |
|              | Swim–medley | 7 (2.36) | 236 (2.15) | 0 (0.00) | 0 (0.00) | 7 (2.55) | 236 (2.35) |
|              | Diving–not specified | 1 (0.34) | 34 (0.31) | 0 (0.00) | 0 (0.00) | 1 (0.36) | 34 (0.34) |
|              | Conditioning | 50 (16.89) | 2606 (23.79) | 0 (0.00) | 0 (0.00) | 50 (18.25) | 2606 (25.96) |
|              | Weights | 9 (3.04) | 253 (2.31) | 0 (0.00) | 0 (0.00) | 9 (3.28) | 253 (2.52) |
|              | Other or unknown | 67 (22.64) | 2030 (18.53) | 1 (4.55) | 38 (4.14) | 66 (24.09) | 1992 (19.84) |
| Divers       | Dive–1.0-m board | 8 (18.60) | 547 (21.33) | 3 (33.33) | 186 (43.46) | 5 (14.71) | 361 (16.89) |
|              | Dive–1.0-m platform | 1 (2.33) | 19 (0.74) | 1 (11.11) | 19 (4.44) | 0 (0.00) | 0 (0.00) |
|              | Dive–3.0-m board | 5 (11.63) | 128 (4.99) | 1 (11.11) | 19 (4.44) | 4 (11.76) | 110 (5.15) |
|              | Dive–3.0-m platform | 1 (2.33) | 30 (1.17) | 0 (0.00) | 0 (0.00) | 1 (2.94) | 30 (1.40) |
|              | Dive–5.0-m platform | 0 (0.00) | 0 (0.00) | 0 (0.00) | 0 (0.00) | 0 (0.00) | 0 (0.00) |
|              | Dive–7.5-m platform | 1 (2.33) | 19 (0.74) | 0 (0.00) | 0 (0.00) | 1 (2.94) | 19 (0.89) |
|              | Dive–10.0-m platform | 1 (2.33) | 30 (1.17) | 1 (11.11) | 30 (7.01) | 0 (0.00) | 0 (0.00) |
|              | Diving–not specified | 19 (44.19) | 1615 (62.96) | 2 (22.22) | 156 (36.45) | 17 (50.00) | 1459 (68.27) |
|              | Weights | 2 (4.65) | 37 (1.44) | 0 (0.00) | 0 (0.00) | 2 (5.88) | 37 (1.73) |
|              | Other or unknown | 5 (11.63) | 140 (5.46) | 1 (11.11) | 19 (4.44) | 4 (11.76) | 121 (5.66) |

**a** Data presented in the order of reported number, followed by the proportion of all injuries attributable to a given category. Data pooled across event types are presented overall, and separately for practices and competitions. National estimates were produced using sampling weights estimated on the basis of sport, division, and year. A reportable injury was one that occurred due to participation in an organized intercollegiate practice or competition, and required medical attention by a team Certified Athletic Trainer or physician (regardless of time loss). Only scheduled team practices and competitions were retained in this analysis.
develop complex aerial movements, putting them at risk of developing both strains through noncontact mechanisms and inflammatory conditions through overuse mechanism. It may be noted that over half of all reported injuries in the present study were attributed to these mechanisms. Therefore, the findings of the present study are largely consistent with expectations given the biomechanical demands of diving activities.

In considering the results of the present study, there exist limitations applicable to both swimming and diving injuries that warrant targeted attention and discussion. First, NCAA ISP participation among men’s swimming and diving programs was notably low throughout the study period. Despite the similarity in participation with previous surveillance-based investigations of NCAA men’s swimming, the limited participation among NCAA men’s swimming programs in the current study not only limits the analytical flexibility of the data collected (as noted throughout the present study), but also the external validity of the findings. Whereas sports injury surveillance is an effective tool to examine temporal patterns in injury incidence, healthy participation in surveillance programs is needed to facilitate such investigations. As such, it is critical to continue efforts aimed at increasing ISP participation among men’s swimming and diving programs. Second, in considering the injury rates reported in the present study, it is imperative to acknowledge that exposure-time ascertainment remains a challenge in sports injury surveillance, particularly for individualized sports with nontraditional athletic seasons, such as swimming and diving. Swimming and diving are unique sports, and therefore, swimmers and divers are subjected to inherently different degrees of injury risk. As one example, swimmers perform repetitive movements at varying intensities, whereas divers are tasked with performing highly technical aerial maneuvers at a comparatively lesser volume. These differences notwithstanding, swimming and diving are typically recognized as 1 team within member institutions. As such, computation of position-specific at-risk exposure time is particularly challenging, and although AEs may be estimated on the basis of roster sizes (as done herein), this practice remains far from ideal. Incorporating wearable health instruments to capture athletes’ time spent practicing, distance and strokes swum, number and type of dives, or cardiovascular and muscular exertional indices may more precisely describe and quantify at-risk exposure time in this population. The NCAA ISP in its current form is not well positioned to accommodate such measures, and such nuanced measurement may require adaptations in sports injury surveillance (separately capturing at-risk exposure time for swimmers and divers) or small-sample studies.

Routine surveillance of collegiate men’s swimmers and divers allows researchers to describe and highlight injury patterns, which in turn are disseminated to provide the sports medicine community with current and practical information. As discussed above, this critical process will be more effective with more robust participation in sports injury surveillance programs. Our findings demonstrate unique injury characteristics in NCAA men’s swimming and diving. The results observed in this study, coupled with the inferential limitations discussed above, highlight the need for further study of men’s swimming and diving injuries yet also offer avenues for additional data collection and targeted examination.

ACKNOWLEDGMENTS

The NCAA Injury Surveillance Program was funded by the NCAA. The DataLytics Center is an independent nonprofit organization that manages the operations of the NCAA ISP. The content of this report is solely the responsibility of the authors and does not necessarily represent the official views of the funding organization. We thank the many ATs who have volunteered their time and efforts to submit data to the NCAA-ISP. Their efforts are greatly appreciated and have had a tremendously positive effect on the safety of collegiate student-athletes.

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