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# High School Competitive Diving Injuries: National Athletic Treatment Injury and Outcomes Network (NATION)

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# High school competitive diving injuries: National athletic treatment injury and outcomes network (NATION)

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## ABSTRACT

**Purpose:** Elite diving coaches and USA diving officials have become increasingly concerned about injury prevention among adolescent divers. However, little is known about such injuries. The purpose of this study was to describe the injuries among high school students who participated on high school diving teams.

**Subjects:** High school students who participated on the diving teams of high schools that were included in the National Athletic Treatment, Injury and Outcomes Network (NATION) for 2011–2014.

**Methods:** Descriptive epidemiology using injury exposure data on 56 boys' Swimming and Diving teams and 55 girls' Swimming and Diving teams from the National Athletic Treatment, Injury and Outcomes Network (NATION) for 2011–2014.

**Results:** Only 12 injuries were reported, and 8 (67%) were concussions. The incidence of concussions was the same between boys and girls.

**Conclusion:** Concussions are the highest reported injury among high school divers in the NATION data. Student athletes who had minor injuries may not have been evaluated by an athletic trainer. Researchers need better injury surveillance data for high school divers.

**Key words:** sports injuries, injury surveillance, and springboard diving

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## INTRODUCTION

Recently, elite diving coaches and USA diving officials have become increasingly concerned about injury prevention among adolescent divers. To address injuries, USA Diving

developed education classes for age group diving coaches on injury prevention techniques. However, little is known about injuries among adolescent divers. In fact, few studies have investigated the injuries specific to diving in any age group (7,9).

Data on injuries specific to diving is limited at this time. Research conducted utilizing the National Collegiate Athletic Association Injury Surveillance Program, which recorded data from 22 swimming and diving programs, concluded that a large proportion of injuries in both men and women had been sustained from contact with the water, 32.0% and 16.2%, respectively (7). Specific identification of the division of the programs was not included in this research. Information on division is important because the difficulty of dives performed varies between Division I, Division II, and Division III, and only Division I divers perform from the platform. One study on diving-related injuries examined reports from emergency departments for patients under 20 years old (5). However, many divers who sustain minor injuries or acquire overuse injuries may not be evaluated in the emergency department, therefore limiting this study's findings to only severe injuries that required immediate attention. Another study investigated elite divers who attended the 15<sup>th</sup> FINA World Aquatic Championships in 2013. This study found divers were the most injured athletes during the championship (9). Two other research articles focused on back injuries of elite junior divers (1,10) Baranto et al. (1) found 53% of elite divers studied had some type of deterioration abnormality on MRI, and Narita et al. (10) found 37.3% of elite divers studied reported back pain.

Studies have examined rates of injuries among adolescent athletes in other sports, including track and field, rowing, ice hockey, rugby, soccer, gymnastics, baseball, and football (2, 3, 4 and 13). However, the data on injuries to adolescent divers is limited, and the studies that have been done focused on the elite adolescent diver (1,10). Additionally, female adolescent athletes have been reported to sustain more overuse injuries compared to male adolescents, and the type of injuries differ by sex and sport (2, 3, 4, 7, 11, 12 and 13). No study has investigated the injuries in high school adolescent divers from a national database. The aim of this study was to describe the injuries and timing (practice/competition and pre-, during, or post-season) by sex in adolescent high school divers.

## **METHODS**

### **Data Source**

This study utilizes data collected by the National Athletic Treatment, Injury and Outcomes Network (NATION). The methods have been published previously (6). NATION is an injury surveillance program that collected comprehensive information on sports injuries among high school student-athletes from 2011–2014 in the United States. The program used a rolling recruitment model and a convenience sample of 147 high schools across 26 states. The data collected was from high school athletic trainers who agreed to participate in the program.

Recruitment increased over the surveillance period, with 30 schools providing data across all three years (6). Data was collected for academic years 2011–2014.

Injuries reported in NATION were evaluated and/or treated by an athletic trainer, physician, or other health care provider. Time loss required that the student athlete be restricted from participation for a minimum of 24 hours past the day of injury occurrence. The injury must have occurred during practice or competition for a school-sponsored sport. In these data, diving and swimming were combined in one sport of record, and the injury event was indicated at the time of injury.

### **Population**

The population for this study was male and female high school divers representing their high school.

### **Variables**

The variables of interest are sex, competition/practice, pre- or during season, grade, time loss, type of injury, and concussion symptoms.

### **Statistical Analysis**

The NATION data recorded only 12 injuries for divers; therefore, only summary statistics are reported. Concussion data was reported separately since it was the most frequent injury among divers. STATA 8.0 (StataCorp LP, College Station, TX) was used to calculate summary statistics.

### **Human Subjects**

This study was reviewed and approved by the Old Dominion University Institutional Review Board (approval number 1040893-1).

## **RESULTS**

In high school diving, only 12 injuries were reported for 56 boys' swimming and diving team seasons and 55 girls' swimming and diving team seasons. Information on whether an athlete is a swimmer or diver is not reported for the total number of athletes; only when an athlete sustained an injury did data indicate whether he/she was a swimmer or a diver. Therefore, the total number of divers could not be determined. High school swimming and diving meets consist of 11 swimming events and 1 diving event, consequently leading to a small number of divers per team. Only 12 injuries were reported among high school divers. However, the most common injury for divers, 8 out of 12 (67%), was concussion from hitting the board. The other injuries were 1 shoulder injury, 1 back injury, 1 neck/cervical spine injury, and 1 headache without concussion. The mean for total time loss among all injuries was 28 days with a median of 32.5. The mean time loss for a concussion was 27 days. Incidence of concussions among males and females was the same. The preseason had 3 concussions, and the regular season had 5 concussions. All other injuries occurred during the regular season. The symptom prevalence for

concussions is reported in Table 1. The range of time loss from a concussion was 7 days to 77 days with a mean time loss of 35 days and a median of 37 days.

## **DISCUSSION**

Few published studies have investigated injuries among competitive divers at the national or international level, and none have investigated injuries among competitive high school divers. Our findings differ from those studies that investigated injuries at the college and international level. In high school diving, we found that most injuries are from direct contact with the diving board resulting in a concussion that leads to significant time loss before returning to the sport and that boys and girls were equally affected. However, a study that included college diving found a difference in the types of injuries men and women sustained, and these injuries occurred from contact with the water. Male divers had more shoulder injuries, and female divers had injuries to the trunk (7). Only 3 (8%) concussions were reported, and 2 of the concussions involved contact with the water; all were sustained by women divers (7). At the international level, a study investigated the injuries athletes were competing with during the 2013 FINA Aquatic World Championships. Fifty-five percent of divers reported an injury or physical complaint. This was the highest among any of the aquatic sports. The most reported injuries were to the arm and shoulder (9). According to this study, most divers competed though injured.

Our study did not find many injuries, but those that we found had a mean loss from participation of 28 days. This indicates that though there were a small number of injuries in high school diving, those that did occur were severe. There are reasons that there is a difference between high school, college, and international diving injuries. High school divers only compete on the 1-meter springboard, and the level of competitiveness in high school diving is lower compared to that of USA Diving and AAU Diving sanctioned events. Lower competitiveness results in the performance of easier dives. In addition, limiting diving to 1 meter reduces the potential impact from contact with the water. Many high school divers are new to the sport and have not been diving for many years, reducing the chances of having an overuse injury. In the NCAA, divers compete at 1 meter and 3 meters, and at the better Division I diving programs, divers will compete on 5-, 7.5-, or 10-meter platforms. The level of diving competition will influence the difficulty of the dives. Additionally, divers in college have been typically diving for many years, increasing the potential for overuse injuries. At international competitions, divers perform at an elite level and execute the most difficult dives. The athlete who dives at this level has been diving for many years, and this dramatically increases the odds of an overuse injury.

## **LIMITATIONS**

The number of reported injuries is small, and the actual number of divers could not be determined, limiting the ability to establish the injury rates among divers. Diving is unique in that it is paired with swimming, which is a completely different sport, and some divers compete

in swimming events. The athletic trainers' documentation practices include swimmers and divers as one team versus creating separate sports for each within their electronic medical records, thus limiting the ability to track exposures separately for divers and swimmers. Examining these two sports together makes monitoring injuries in diving difficult. Additionally, the data in this study is from a convenience sample of high schools and may not be generalizable to high school diving throughout the US (8). Considering the small number of injuries reported, one might possibly conclude that not all injuries that occurred were reported in the NATION data.

## **CONCLUSIONS**

Our findings suggest that most diving injuries, though small in number, are severe, resulting in substantial time lost from play. The most common injury is concussion from hitting the diving board. Both the number of injuries and concussions were equal among boys and girls. The very limited availability of data on diving injuries highlights the need for better monitoring and investigation. The injuries to adolescent divers from high school teams may be different from injuries to adolescent divers who compete at USA Diving and AAU Diving sanctioned events. High school teams will have some divers that compete at non-high school meets but also will have divers that strictly dive for the high school team. Since there is a difference in competitiveness between high school and non-high school meets, and non-high school meets will include 3-meter and platform events, the injuries encountered may be very different. Understanding the injuries among adolescent divers who compete in high school and USA Diving and AAU Diving sanctioned events can help develop training programs so that coaches can improve diving techniques and reduce or even prevent such injuries as concussion and overuse in college and international diving.

## **APPLICATION IN SPORT**

Surveillance for injuries among adolescent divers has been understudied. Diving injuries may be underreported, and only the most serious injuries, like concussions, are being reported. Better surveillance among adolescent divers is needed, and specific studies investigating concussions among divers will be important to help improve the safety of the sport.

## **ACKNOWLEDGMENTS**

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## **REFERENCES**

1. Baranto A., Hellstrom M., Nyman R., Lundin O., & Sward L. (2006). Back pain and degenerative abnormalities in the spine of young elite divers — a 5-year follow-up magnetic

- resonance imaging study. *Knee Surgery, Sports Traumatology, Arthroscopy*, 14, 907–914. <https://doi.org/10.1007/s00167-005-0032-3>
2. Bostrom A., Thulin K., Fredriksson M., Reese D., Rockborn P., & Hammar, M. L (2016). Risk factors for acute and overuse sport injuries in Swedish children 11 to 15 years old: What about resistance training with weights? *Scandinavian Journal of Medicine & Science in Sports*, 26, 317–323. doi: 10.1111/sms.12432
  3. Caine D., Caine C., & Maffulli, N. (2006). Incidence and distribution of pediatric sport-related injuries. *Clinical Journal of Sports Medicine*, 16, 500–513. doi: 10.1097/01.jsm.0000251181.36582.a0
  4. Cuff S., Loud K., & O’Riordan MA. (2010). Overuse injuries in high school athletes. *Clinical Pediatrics*, 49, 731–736. doi: 10.1177/0009922810363154
  5. Day, C., Stolz, U., Mehan, T. J., Smith, G. A., & McKenzie, L. B. (2008). Diving-related injuries in children < 20 years old treated in emergency departments in the United States: 1990–2006. *Pediatrics*, 122, E388–E394. doi:10.1542/peds.2008-0024
  6. Dompier, T. P., Marshall, S. W., Kerr, Z.Y., & Hayden, R. (2015). The National Athletic Treatment, Injury and Outcomes Network (NATION): Methods of the surveillance program, 2011–2012 through 2013–2014. *Journal of Athletic Training*, 50, 862–869. <https://doi.org/10.4085/1062-6050-50.5.04>
  7. Kerr, Z. Y., Baugh, C. M., Hibberd, E. E., Snook, E. M., Hayden, R., & Dompier, T. P. (2015). Epidemiology of National Collegiate Athletic Association men’s and women’s swimming and diving injuries from 2009/2010 to 2013/2014. *British Journal of Sports Medicine*, 49, 465–471. <http://dx.doi.org/10.1136/bjsports-2014-094423>
  8. Kerr Z. Y., Dompier T. P., Snook, E. M., Marshall, S. W., Klossner, D., Hainline, B., & Corlette, J. (2014). National Collegiate Athletic Association Injury Surveillance System: Review of methods for 2004–2005 through 2013–2014 data collection. *Journal of Athletic Training*, 49, 552–560. <https://doi.org/10.4085/1062-6050-49.3.58>
  9. Mountjoy, M., Junge, A., Benjamin, S., Boyd, K., Diop, M., Gerrard, D., van den Hoogenband, C-R., ... & Marks, S. (2015). Competing with injuries: Injuries prior to and during the 15th FINA World Championships 2013 (aquatics). *British Journal of Sports*, 49, 37–43. <http://dx.doi.org/10.1136/>
  10. Narita, T., Kaneoka, K., Takemura, M., Sakata, Y., Nomura, T., & Miyakawa, S. (2014). Critical factors for the prevention of low back pain in elite junior divers. *British Journal of Sports Medicine*, 48, 919–923. <http://dx.doi.org/10.1136/bjsports-2012-091875>



11. Pierpoint, L. A., Williams, C. M., Fields, S. K., & Comstock, R. D. (2016). Epidemiology of injuries in United States high school track and field. *American Journal of Sports Medicine*, 44, 1463–1468. <https://doi.org/10.1177/0363546516629950>
12. Schroeder, A. N., Comstock, R. D., Collins, C. L., Everhart, J., Flanigan, D., & Best, T. M. (2015). Epidemiology of overuse injuries among high-school athletes in the United States. *Journal of Pediatrics*, 166, 600–606. <https://doi.org/10.1016/j.jpeds.2014.09.037>
13. Weir, M. A., & Watson, A. W. S. (1996). A twelve month study of sports injuries in one Irish school. *Irish Journal of Medicine*, 165:165–169. <https://doi.org/10.1007/BF02940243>