

Athletic Training Service Characteristics for Patients With Ankle Sprains Sustained During High School Athletics

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Context: Limited information exists on the amount and type of care provided by athletic trainers (ATs) treating athletes who sustained ankle sprains in the high school setting.

Objective: To describe AT services provided for patients with ankle sprains injured in high school athletics.

Design: Descriptive epidemiology study.

Setting: Athletic training facility (ATF) visits and AT services collected from 147 high schools in 26 states.

Patients or Other Participants: High school student-athletes participating in 13 boys' and 14 girls' sports who sustained a diagnosed ankle sprain during the 2011–2012 through 2013–2014 academic years. The ATs documented 3213 ankle sprains.

Main Outcome Measure(s): Number of ATF visits and individual AT services and mean ATF visits (per injury) and AT services (per injury) were calculated by sport and for time-loss injuries (participation-restriction time of at least 24 hours) and non-time-loss injuries (participation-restriction time <24 hours).

Results: During the 3-year period, 19 925 ATF visits were reported, with an average of 6 (interquartile range = 1–7) ATF

visits per ankle sprain. Most ATF visits were for non-time-loss injuries (65.1%). Football accounted for the largest proportions of ankle sprains (27.3%) and ATF visits (35.0%). In total, 71 404 AT services were provided for ankle sprains. Therapeutic activities or exercise were the most common AT services (47.4%), followed by neuromuscular reeducation (16.6%), strapping (14.2%), and modalities (11.5%). An average of 22 (interquartile range = 4–28) AT services were reported per ankle sprain. The average number of AT services per injury was higher among patients with time-loss than non-time-loss injuries (35 versus 19; $P < .001$).

Conclusions: The ATs provided a variety of services to treat high school athletes who had sustained ankle sprains, including therapeutic exercises and neuromuscular reeducation, which were supported by research. However, ATs should consider using manual therapy (use supported by grade B evidence) and therapeutic exercise more (use supported by grade A evidence).

Key Words: NATION, injury surveillance, medical care

Key Points

- Athletic trainers provided a variety of services to treat ankle sprains that reduced health care costs by limiting the number of referrals to other health care providers.
- A majority of ankle sprains were non-time loss, and these patients received at least 1 athletic training service.
- Rapid return to play may lead to an increased risk of recurrent sprains.

Athletic training is a fairly young profession that is slowly expanding. In 1994, only 35% of all US high schools had access to athletic training services.¹ In a survey conducted by the National Athletic Trainers' Association in 2009, only 42% of high schools employed athletic trainers (ATs).² However, a more recent survey,³ conducted in 2015, illustrated that access to athletic training services had increased, and 70% of respondents from public secondary schools indicated that they provided ATs at sports games or practices. However, only about one-third of all public secondary schools had full-time ATs.³ When secondary schools lack athletic training services, they may have to rely on coaches or administrators or immediate referral to emergency services when an injury occurs.⁴ The former may not have the

proper medical education to appropriately treat musculoskeletal injuries, and use of the latter considerably increases the health care cost and burden to patients, parents, and the community.⁵

More than 7.8 million high school students participate in organized sports in the United States each year.⁶ An estimated 12 million athletes between the ages of 5 and 22 years sustain a sport-related injury annually, leading to 20 million lost days of school⁷ and approximately \$33 billion in health care costs.⁸ The majority of sport-related orthopaedic injuries are to the lower extremity, and more than 40% involve the knee or ankle.⁹ Ankle sprains are highly prevalent, and approximately 600 000 patients with ankle sprains are seen in emergency department visits per year in the United States,¹⁰ costing about \$2 billion.¹¹

However, only 33% of individuals with an ankle sprain seek treatment at an emergency department, indicating that more than 1 million ankle sprains may occur each year in the United States, with treatment costs well surpassing the \$2 billion that was previously reported. The majority of researchers who addressed the documentation of injury focused on epidemiology instead of the care being provided to treat injuries.

Epidemiologic studies offered plentiful information regarding the occurrence and rates of injury between the sexes,¹² in various sports,¹³ and across various levels of play.¹⁴ Unfortunately, these examinations have often excluded many of the tasks performed by the athletic medical staff, such as treatment and rehabilitation, which are fundamental components of high-quality medical care. The inclusion of factors beyond injury incidences and rates is important for determining suitable levels of medical care, including preventive measures and the treatment of both time-loss (TL) and non-time-loss (NTL) injuries. Despite the importance of this information, very few authors have attempted to quantify AT services in high school,^{15–17} collegiate,¹⁸ and traditional health care settings.¹⁹ To combat this gap, the National Athletic Treatment, Injury and Outcomes Network (NATION) project aims to provide a comprehensive examination of all TL and NTL injuries and the associated AT services in the high school setting.²⁰ Using NATION data, previous investigators have detailed the methods for documenting injuries and the overall AT services provided.^{17,20} Comparing TL and NTL ankle sprains is important as clinical theories postulated that most ankle sprains were NTL. Evaluating which AT services are supplied to patients with TL and NTL ankle sprains may highlight deficiencies in the treatment of these injuries. Additionally, determining if a majority of AT services are spent on NTL injuries may provide a better understanding of how resources are being used. Therefore, the purpose of this article is to describe the care given to athletes with ankle sprains in 27 high school sports as reported to NATION.

METHODS

During the 2011–2012 through 2013–2014 school years, NATION captured injury and AT service data for 27 high school sports during preseason, regular season, and postseason practices and competitions.²⁰ The 27 sports consisted of 13 boys' sports (baseball, basketball, crew, cross-country, football, golf, indoor track, lacrosse, outdoor track, soccer, swimming and diving, tennis, and wrestling) and 14 girls' sports (basketball, crew, cross-country, field hockey, golf, gymnastics, indoor track, lacrosse, outdoor track, soccer, softball, swimming and diving, tennis, and volleyball). Participating ATs, who were responsible for covering practices and competitions that occurred both at home and away, were employed at 147 high schools in 26 states. These ATs were either full or part time and were either hired internally or contracted from nearby clinics or university graduate programs. Most of the high schools were public (84.4%), coeducational (98.6%), and set in nonurban areas (75.5%; rural = 37.4%, suburban = 38.1%), and they enrolled fewer than 1000 students (51.0%).

The NATION data-collection tools were embedded within commercially available electronic medical record applications,²⁰ which enables data collection to be seamlessly integrated into routine record keeping. Software vendors participating in NATION modified their software and underwent annual certification using benchmarking transmission datasets developed by the Datalys Center for Sports Injury Research and Prevention, Inc (Indianapolis, IN). They also embedded secure data-transmission protocols that sent deidentified records to secure Datalys Center servers on an ongoing and routine basis.²⁰ This process is compliant with the Health Insurance Portability and Accountability Act. The ATs completed detailed reports for each ankle sprain, including condition (site, diagnosis, severity) and circumstances (activity, mechanism, event type [competition or practice], and playing surface). The ATs were able to view and update previously entered information as needed. The data collection also captured the number of athletic training facility (ATF) visits and the number of AT services provided for each injury. Detailed methods for collecting injury information and AT services have been previously documented.^{17,20} An injury reported to NATION must have occurred during a school-sponsored sport activity and must have been evaluated or provided care (or both) by an AT, physician, or other health care professional. A *TL injury* was defined as a student-athlete restricted from participation for at least 24 hours past the day of injury. An injury restricting participation for less than 24 hours was considered an *NTL injury*. An *ATF visit* was defined as a student-athlete seeking an AT service for an ankle sprain. An *AT service* was defined as the application of any type of manual therapy, modality, exercise and evaluation, test, or skill session that the player received due to an ankle sprain via interaction with the AT.¹⁷ For example, if the student-athlete was provided with a cold pack, stretching exercises, and range-of-motion (ROM) exercises, those counted as 3 AT services. If the time spent by the AT was less than 2 minutes, the AT service was not documented.¹⁸

Statistical Analysis

Descriptive statistics (mean, median, and interquartile range [IQR]) were calculated for the AT services and ATF visits data for all school-sanctioned activities. These provided a complete image of all AT services provided. All data went through quality checks in which the data were deidentified and passed through an automated verification process of consistency checks.²⁰ The NATION database was queried for the injury diagnosis *ankle sprain*. All ATF visits and AT services for each ankle sprain were compiled into a new dataset. Services provided by ATs were examined by categories based on previous research.^{15,17} We calculated the average number of ATF visits per ankle sprain (Average ATF visit = Σ ATF visits/ Σ Ankle sprains) and the average number of AT services per ankle sprain (Average AT services = Σ AT services/ Σ Ankle sprains). These statistics were calculated overall and separately for TL injuries, for NTL injuries, and by sport for all ankle sprains. Statistics for TL and NTL injuries by sport were compared using independent-samples *t* tests.²¹ To analyze specific AT services for TL and NTL ankle sprains, χ^2 or Fisher exact *t* tests were calculated to compare the

Table 1. Athletic Training Facility (ATF) Visits for High School Student-Athletes Sustaining Ankle Sprains by Sport, NATION, 2011–2012 Through 2013–2014

Sports	Ankle Sprains, No.	ATF Visits, No.	ATF Visits for Non-Time-Loss Injuries, %	Average No. ATF Visits per Injury (Median; Interquartile Range)			
				Total	Time Loss ^a	Non-Time Loss ^b	P Value ^c
Boys' sports							
Baseball	60	337	68.3	6 (4; 2–8)	9 (6; 5–11)	5 (3; 1–7)	.01 ^d
Basketball	342	1932	47.5	6 (3; 1–6)	10 (6; 4–11)	4 (2; 1–4)	<.001 ^d
Crew	8	14	100.0	2 (2; 1–2)	0	2 (2; 1–2)	NA
Cross-country	72	308	69.2	4 (2; 1–4)	7 (3; 1–7)	4 (2; 1–4)	.25
Football	878	6972	62.2	8 (4; 2–10)	13 (9; 4–19)	6 (3; 1–7)	<.001 ^d
Golf	0	0	0	0	0	0	NA
Indoor track	78	350	90.0	4 (2; 1–6)	7 (5; 5–10)	4 (2; 1–5)	.26
Lacrosse	126	522	83.7	4 (2; 1–6)	5 (4; 2–6)	4 (2; 1–6)	.45
Outdoor track	77	299	89.3	4 (2; 1–4)	8 (8.5 4–12)	4 (2; 1–4)	.23
Soccer	174	907	68.9	5 (3; 1–7)	9 (7; 3–13)	4 (2; 1–5)	.002 ^d
Swimming and diving	3	6	100.0	2 (1; 1–4)	0	2 (1; 1–4)	NA
Tennis	12	29	44.8	2 (1; 1–2)	8 (8; 3–13)	1 (1; 1–2)	.40
Wrestling	80	380	62.4	5 (3; 1–6)	10 (6; 3–10)	4 (3; 1–5)	.048 ^d
Total	1910	12056	63.2	6 (3; 1–7)	11 (7; 4–15)	5 (3; 1–6)	<.001 ^d
Girls' sports							
Basketball	266	1647	64.2	6 (4; 1–8)	9 (6; 3–13)	5 (3; 1–7)	.002 ^d
Crew	16	98	93.9	6 (1.5; 1–5)	6 (6; 6–6)	6 (1; 1–4)	.99
Cross-country	86	483	79.7	6 (3; 1–7)	8 (5; 3–7)	5 (3; 1–7)	.23
Field hockey	87	490	67.8	6 (3; 1–8)	12 (8; 4–17)	4 (3; 1–5)	.02 ^d
Golf	0	0	0	0	0	0	NA
Gymnastics	38	127	63.0	3 (1; 1–5)	9 (5; 3–17)	2 (1; 1–3)	.12
Indoor track	76	363	77.7	5 (3; 1–7)	12 (12; 5–13)	4 (3; 1–6)	.02 ^d
Lacrosse	110	635	76.5	6 (3.5; 2–8)	11 (9; 2–15)	5 (3; 2–7)	.04 ^d
Outdoor track	74	342	89.2	5 (3; 1–5)	4 (4; 3–6)	5 (3; 1–5)	.58
Soccer	251	1649	71.7	7 (4; 2–10)	9 (6.5; 3–16)	6 (3; 2–8)	.002 ^d
Softball	55	299	92.0	5 (4; 2–8)	2 (2; 1–2)	6 (5; 2–9)	.001 ^d
Swimming and diving	4	14	100.0	4 (3; 2–6)	No injuries	4 (3; 2–6)	NA
Tennis	27	130	66.2	5 (4; 2–5)	6 (5; 2–7)	4 (4; 3–5)	.30
Volleyball	213	1592	49.4	7 (4; 2–9)	13 (7; 3–14)	5 (3; 1–7)	.001 ^d
Total	1303	7869	68.2	6 (3; 1–8)	10 (6; 3–13)	5 (3; 1–7)	<.001 ^d
Overall	3213	19925	65.1	6 (3; 1–7)	10 (7; 3–14)	5 (3; 1–6)	<.001 ^d

Abbreviation: NA, not applicable; NATION, National Athletic Treatment, Injury and Outcomes Network.

^a Time-loss injuries were those injuries resulting in participation-restriction time of at least 24 hours.

^b Non-time-loss injuries were those injuries resulting in participation-restriction time of less than 24 hours.

^c P value was for the independent-samples *t* test comparing the average number of ATF visits per injury between time-loss and non-time-loss injuries.

^d Denotes statistical significance (*P* < .05).

proportion of AT services used. The main categories for AT services were AT evaluation/reevaluation, physical performance test or measurement, therapeutic activities or exercise, neuromuscular reeducation, manual therapy techniques or massage, modalities, strapping, gait training or crutch fitting, and wound care. All *t* tests, χ^2 tests, and Fisher exact *t* tests with *P* values <.05 were considered statistically significant. All data were analyzed using SAS Enterprise Guide software (version 4.3; SAS Institute Inc, Cary, NC).

RESULTS

Athletic Training Facility Visits

In total, 19 925 ATF visits were reported for patients with 3213 ankle sprains (Table 1). Football players had the highest number of ATF visits (*n* = 6972; 35.0% of all ATF visits) and accounted for the largest proportion of ankle sprains (878; 27.3%). Among girls' sports, soccer had the highest number of ATF visits (1649; 8.3%).

The majority of ATF visits were for NTL injuries (65.1%), and most of the ankle sprains were NTL (2551; 79.4%). Similar percentages of ATF visits for NTL ankle sprains were seen in boys' (63.2%) and girls' (68.2%) sports. Thirty patients with ankle sprains (<1.0%) did not receive any form of AT services; 1 of those 30 sustained a TL injury.

Athletic Training Facility Visits per Ankle Sprain

The 19 925 ATF visits led to an average of 6 (IQR = 1–7) ATF visits per ankle sprain (Table 1). Football players had the highest number of ATF visits per ankle sprain (8) overall, whereas volleyball and soccer players had the highest numbers of ATF visits per ankle sprain (7 each) among girls' sports. The average number of ATF visits per ankle sprain was higher for TL ankle sprains than for NTL ankle sprains and overall. This trend was replicated (a higher number of ATF visits per ankle sprain for TL than for NTL injuries) in the following sports: football, wrestling, baseball, boys' basketball, boys' soccer, girls'

Table 2. Types of Athletic Trainer (AT) Services for High School Student-Athletes Sustaining Ankle Sprains by Type of AT Service, NATION, 2011–2012 Through 2013–2014

Type of AT Service	Current Procedural Terminology Code	Ankle Sprains, n (%)			P Value ^c
		Total	Time Loss ^a	Non-Time Loss ^b	
AT evaluation or reevaluation	97005, 97006	6819 (9.5)	4654 (9.6)	2165 (9.4)	.44
Consultation		6031 (8.4)	4152 (8.6)	1879 (8.2)	.08
Functional evaluation		788 (1.1)	502 (1.0)	286 (1.2)	.01 ^d
Physical performance test or measurement	97750	2 (<0.1)	0	2 (<0.1)	NA
Therapeutic activities or exercise	97110, 97530	33905 (47.5)	23558 (48.6)	10347 (45.1)	<.001 ^d
Independent ROM		10475 (14.7)	7273 (15.0)	3202 (13.9)	<.001 ^d
Isotonic strength		8201 (11.5)	5583 (11.5)	2618 (11.4)	.62
Tubing strength		10091 (14.1)	7295 (15.1)	2796 (12.2)	<.001 ^d
Passive ROM		1450 (2.0)	948 (2.0)	502 (2.2)	.04 ^d
Bike ROM		641 (0.9)	451 (0.9)	190 (0.8)	.17
Bike conditioning		836 (1.2)	541 (1.1)	295 (1.3)	.05
Isometric strength		589 (0.8)	368 (0.8)	221 (1.0)	.01
Manual resistance exercise		1079 (1.5)	827 (1.7)	252 (1.1)	<.001 ^d
Treadmill conditioning		135 (0.2)	68 (0.1)	67 (0.3)	<.001 ^d
Proprioceptive neuromuscular facilitation ROM		72 (0.1)	39 (<0.1)	33 (0.1)	.01 ^d
Stair climber		170 (0.2)	100 (0.2)	70 (0.3)	.01 ^d
Isokinetic strength		166 (0.2)	65 (0.1)	101 (0.4)	<.001 ^d
Neuromuscular reeducation		11882 (16.6)	8235 (17)	3647 (15.9)	<.001 ^d
Proprioception with device	97112	9478 (13.3)	6839 (14.1)	2639 (11.5)	<.001 ^d
Basic proprioception		2404 (3.4)	1396 (2.9)	1008 (4.4)	<.001 ^d
Manual therapy techniques or massage		224 (0.3)	132 (0.3)	92 (0.4)	.01 ^d
Massage	97140, 97124	158 (0.2)	85 (0.2)	73 (0.3)	<.001 ^d
Mobilization		66 (0.1)	47 (0.1)	19 (<0.1)	.55
Modalities		8246 (11.5)	5139 (10.6)	3107 (13.5)	<.001 ^d
Hot or cold packs		5387 (7.5)	3490 (7.2)	1897 (8.3)	<.001 ^d
Ice bag	97010	4022 (5.6)	2564 (5.3)	1458 (6.3)	<.001 ^d
Hot pack		660 (0.9)	473 (1.0)	187 (0.8)	.03 ^d
Ice massage		43 (0.1)	32 (<0.1)	11 (<0.1)	.35
Cryo/Cuff (DJO, LLC, Vista, CA)		662 (0.9)	421 (0.9)	241 (1)	.019 ^d
Whirlpool		2179 (3.1)	1253 (2.6)	926 (4)	<.001 ^d
Slush bath	97022	1517 (2.1)	862 (1.8)	655 (2.9)	<.001 ^d
Hot whirlpool		409 (0.6)	293 (0.6)	116 (0.5)	.09
Cold whirlpool		253 (0.4)	98 (0.2)	155 (0.7)	<.001 ^d
Electrical stimulation		312 (0.4)	226 (0.5)	86 (0.4)	.08
Electrical stimulation	97014	308 (0.4)	224 (0.5)	84 (0.4)	.06
Electric modality (other)		4 (<0.1)	2 (<0.1)	2 (<0.1)	.59
Ultrasound		61 (0.1)	31 (<0.1)	30 (0.1)	.01 ^d
Vasopneumatic devices	97035	222 (0.3)	94 (0.2)	128 (0.6)	<.001 ^d
Paraffin bath	97016	0	0	0	NA
Contrast bath	97018	84 (0.1)	44 (<0.1)	40 (0.2)	.01 ^d
Iontophoresis/phonophoresis	97034	1 (<0.1)	1 (<0.1)	0	NA
Strapping	97033	10107 (14.2)	6650 (13.7)	3457 (15.1)	<.001 ^d
Taping	29280, 29260,	8875 (12.4)	6036 (12.5)	2839 (12.4)	.71
Wrap	29240, 29540,	954 (1.3)	499 (1.0)	455 (2.0)	<.001 ^d
Padding	29520, 29230,	119 (0.2)	59 (0.1)	60 (0.3)	<.001 ^d
Splint	29550	159 (0.2)	56 (0.1)	103 (0.4)	<.001 ^d
Gait training or crutch fitting		174 (0.2)	61 (0.1)	113 (0.5)	<.001 ^d
Wound care	97116	45 (0.1)	11 (<0.1)	34 (0.1)	<.001 ^d
Total	97597, 97598, 97602	71404 (100.0)	48440 (100.0)	22964 (100.0)	

Abbreviations: NA, not applicable; NATION, National Athletic Treatment, Injury and Outcomes Network; ROM, range of motion.

^a Time-loss injuries were those injuries resulting in participation-restriction time of at least 24 hours.

^b Non-time-loss injuries were those injuries resulting in participation-restriction time of less than 24 hours.

^c P value was for the χ^2 or Fisher exact *t* test comparing the proportion of AT services used between time-loss and non-time-loss injuries.

^d Denotes statistical significance ($P < .05$).

basketball, field hockey, girls' indoor track, girls' lacrosse, girls' soccer, softball, and girls' volleyball.

Athletic Trainer Services

In total, 71 404 AT services were provided for all patients with ankle sprains (Table 2). Therapeutic activities or exercises were the most common type of AT service

(47.4%), followed by neuromuscular reeducation (16.6%), strapping (14.2%), modalities (11.5%), and AT evaluation or reevaluation (9.5%). The most frequent specific AT services were independent ROM (14.7%), tubing strength (14.1%), proprioception with device (13.3%), taping (12.4%), and isotonic strength (11.4%). The majority of AT services were for TL ankle sprains (48 440; 67.8%).

Table 3. Average Number of Athletic Trainer Services per Injury for High School Student-Athletes Sustaining Ankle Sprains by Sport, NATION, 2011–2012 Through 2013–2014

Sports	Average No. Athletic Trainer Services per Injury (Median; Interquartile Range)			P Value ^c
	Total	Time Loss ^a	Non-Time Loss ^b	
Boys' sports				
Baseball	25 (1; 6–37)	40 (24; 14–62)	21 (10; 3–31)	.03 ^d
Basketball	19 (8; 4–22)	30 (20; 6–39)	14 (6; 3–14)	<.001 ^d
Crew	5 (4; 3–6)	0	5 (4; 3–6)	NA
Cross-country	17 (6; 3–14)	26 (8.5; 2–22)	15 (5.5; 3–13)	.31
Football	28 (13; 5–32)	43 (23; 7–52)	24 (11; 4–28)	<.001 ^d
Golf	0	0	0	NA
Indoor track	17 (7; 3–24)	30 (19; 17–52)	17 (5; 3–24)	.21
Lacrosse	17 (8; 3–20)	23 (16; 7–26)	16 (7; 3–18)	.28
Outdoor track	13 (5; 2–14)	36 (33; 14–58)	12 (5; 2–13)	.01 ^d
Soccer	20 (9; 4–24)	33 (16; 8–48)	17 (8; 4–22)	.03 ^d
Swimming and diving	9 (6; 4–16)	0	9 (6; 4–16)	NA
Tennis	12 (4; 3–7)	53 (53; 16–90)	4 (4; 3–5)	.41
Wrestling	17 (10; 4–22)	39 (32; 6–56)	13 (9; 4–18)	.02 ^d
Total	23 (10; 4–26)	37 (21; 7–48)	19 (8; 4–22)	<.001 ^d
Girls' sports				
Basketball	22 (8; 4–28)	30 (12; 6–47)	19 (9; 4–25)	.02 ^d
Crew	22 (5; 3–20)	32 (32; 32–32)	21 (5; 2–17)	.84
Cross-country	18 (8; 3–24)	17 (12; 8–24)	18 (6; 3–22)	.80
Field hockey	21 (10; 3–30)	48 (40; 20–50)	17 (7; 3–22)	.02 ^d
Golf	0	0	0	NA
Gymnastics	10 (3; 1–10)	33 (18; 11–59)	7 (3; 1–8)	.01 ^d
Indoor track	18 (11; 4–27)	41 (40; 27–52)	15 (9; 3–21)	.01 ^d
Lacrosse	23 (11; 4–30)	47 (29; 12–77)	20 (9; 3–29)	.03 ^d
Outdoor track	16 (8; 3–21)	14 (8; 3–19)	16 (8; 3–21)	.76
Soccer	25 (14; 5–35)	33 (17; 8–44)	23 (13; 4–32)	.05
Softball	24 (15; 6–32)	10 (6; 1–15)	27 (18; 7–42)	.01 ^d
Swimming and diving	12 (7; 3–21)	0	12 (7.5; 3–21)	NA
Tennis	21 (15; 5–29)	26 (21; 5–40)	19 (14.5; 6–28)	.50
Volleyball	22 (11; 4–32)	30 (19; 8–40)	19 (9; 4–28)	.01 ^d
Total	21 (11; 4–29)	31 (18; 7–42)	19 (9; 4–27)	<.001 ^d
Overall	22 (10; 4–28)	35 (20; 7–46)	19 (9; 4–23)	<.001 ^d

Abbreviations: NA, not applicable; NATION, National Athletic Treatment, Injury and Outcomes Network.

^a Time-loss injuries are those injuries resulting in participation-restriction time of at least 24 hours.

^b Non-time-loss injuries were those injuries resulting in participation-restriction time of less than 24 hours.

^c P value was for the independent-samples t test comparing the average number of athletic trainer service visits per injury between time-loss and non-time-loss injuries.

^d Denotes statistical significance ($P < .05$).

Overall, 78.2% of all TL injuries and 76.4% of NTL ankle sprains received therapeutic activities or neuromuscular reeducation.

Athletic Trainer Services per Ankle Sprain

Overall, an average of 22 (IQR = 4–28) AT services were reported per ankle sprain (Table 3). The largest numbers of AT services per ankle sprain in boys' and girls' sports were for football (28) and soccer (25) players, respectively. The average number of AT services per ankle sprain was higher among TL injuries than among NTL injuries, overall and when comparing TL injuries with NTL injuries for baseball, boys' basketball, football, boys' outdoor track, boys' soccer, wrestling, girls' basketball, field hockey, girls' gymnastics, girls' indoor track, girls' lacrosse, softball, and girls' volleyball. When we compared the average number of AT services per ankle sprain between TL and NTL injuries, the findings by AT service type were similar (Table 4). The greatest differences for the average number of AT service visits per injury between TL and

NTL ankle sprains were related to the number of therapeutic activities or exercise (16 versus 9, $P < .001$), neuromuscular reeducation (6 versus 3, $P < .001$), strapping (5 versus 3, $P < .001$), and modality services (5 versus 2, $P < .001$) provided.

DISCUSSION

Previous researchers have documented AT services for all injuries.^{15–18} However, we are the first, to our knowledge, to document AT services for patients with ankle sprains in the high school setting. Specifically examining ankle sprains is important because of their high frequency and resulting cost.¹¹ In our study, ATs provided a variety of AT services, including evaluation, therapeutic activities or exercise, modalities, and strapping. Many high schools do not have access to an AT, but earlier authors^{15–17} and we have shown a variety of services provided by ATs that ultimately reduced health care expenditures by reducing referrals to other health care providers for therapy.⁴

Table 4. Average Number of Athletic Trainer (AT) Services per Injury and per Athletic Training Facility Visit for High School Student-Athletes Sustaining Ankle Sprains by Type of Service, NATION, 2011–2012 Through 2013–2014

Type of AT Service	Total	Average No. AT Services per Injury (Median; Interquartile Range)		
		Time Loss ^a	Non-Time Loss ^b	<i>P</i> Value ^c
AT evaluation or reevaluation	2 (1; 0–2)	3 (1; 0–4)	2 (1; 0–2)	<.001 ^d
Physical performance test or measurement	<1 (0; 0–0)	<1 (0; 0–0)	<1 (0; 0–0)	.15
Therapeutic activities or exercise	11 (4; 1–13)	16 (7; 1–21)	9 (4; 1–11)	<.001 ^d
Neuromuscular reeducation	4 (1; 0–4)	6 (2; 0–7)	3 (1; 0–4)	<.001 ^d
Manual therapy techniques or massage	<1 (0; 0–0)	<1 (0; 0–0)	<1 (0; 0–0)	.001 ^d
Modalities	3 (1; 0–3)	5 (3; 1–6)	2 (1; 0–2)	<.001 ^d
Hot or cold packs	2 (1; 0–2)	3 (2; 0–3)	1 (1; 0–2)	<.001 ^d
Whirlpool	<1 (0; 0–0)	1 (0; 0–1)	<1 (0; 0–0)	<.001 ^d
Electrical stimulation	<1 (0; 0–0)	<1 (0; 0–0)	<1 (0; 0–0)	.28
Ultrasound	<1 (0; 0–0)	<1 (0; 0–0)	<1 (0; 0–0)	.06
Vasopneumatic devices	<1 (0; 0–0)	<1 (0; 0–0)	<1 (0; 0–0)	<.0001 ^d
Paraffin bath	<1 (0; 0–0)	<1 (0; 0–0)	<1 (0; 0–0)	Not applicable
Contrast bath	<1 (0; 0–0)	<1 (0; 0–0)	<1 (0; 0–0)	.001 ^d
Iontophoresis/phonophoresis	<1 (0; 0–0)	<1 (0; 0–0)	<1 (0; 0–0)	.31
Strapping	3 (1; 0–4)	5 (2; 0–6)	3 (1; 0–3)	<.001 ^d
Gait training or crutch fitting	<1 (0; 0–0)	<1 (0; 0–0)	<1 (0; 0–0)	<.001 ^d
Wound care	<1 (0; 0–0)	<1 (0; 0–0)	<1 (0; 0–0)	.10

Abbreviation: NATION, National Athletic Treatment, Injury and Outcomes Network.

^a *Time-loss injuries* were those injuries resulting in participation-restriction time of at least 24 hours.

^b *Non-time-loss injuries* were those injuries resulting in participation-restriction time of less than 24 hours.

^c *P* value was for the independent-samples *t* test comparing the average number of AT service visits per injury between time-loss and non-time-loss injuries.

^d Denotes statistical significance (*P* < .05).

Coupled with numerous systematic and narrative reviews,^{22,23} as well as clinical practice guidelines highlighting evidence-based recommendations for the management and rehabilitation of patients with ankle sprains, our findings provide insight into the actual treatment of ankle sprains as performed by ATs. Ankle sprains are perceived to be a minor injury, and 50% of patients with ankle sprains did not seek care from a medical professional, supporting this erroneous perception.²⁴ In our study, the majority (79.4%) of ankle sprains reported in the high school setting were NTL injuries, with most resulting in at least 1 AT service (30 patients with ankle sprains did not receive any AT service). With an emerging body of literature detailing the long-term consequences of ankle sprains,²⁵ it is paramount that patients with ankle sprains be managed with high-quality care in an attempt to prevent recurrent sprains and long-term disability. Recommendations for acute care after an ankle sprain include protection, optimal loading, ice, compression, and elevation.²⁶ Recovery appears to be improved for mild or moderate ankle sprains when patients are prescribed ankle braces for support during acute and subacute recovery,²⁷ whereas casting may be more appropriate for those with more severe sprains.²⁸ However, a small percentage of AT services included the prescription of some form of external support or medical device to assist in protection and ambulation. Unfortunately, we do not know whether this low percentage of external-device treatment is a result of patients already having external support, a lack of supplies, or factors such as a failure to adhere to best practices.

Deficits in ROM, strength, and static and dynamic balance have been identified^{29,30} as potential risk factors for recurrent sprains. Progressive strengthening and balance training are equally effective in restoring normal strength, balance, and self-reported function in patients with an ankle

sprain.³¹ Thus, the high percentage of patients with ankle sprains who were treated with therapeutic activities or neuromuscular reeducation, which include ROM, strengthening, and proprioception (TL injuries: 78.2%; NTL injuries: 76.4%), aligns with current clinical recommendations for rehabilitation.³² Specifically, 64.1% of the AT services provided were therapeutic activities or exercise for strength, ROM, balance, gait, and functional limitations. However, a small percentage (0.2%) of AT services were manual therapy interventions (eg, joint mobilizations, manipulations, or soft tissue massage). These manual therapies have been documented to improve ROM after an ankle sprain.³³

A similar percentage of AT services focused on ankle taping (12.4%), proprioception with device (13.3%), independent ROM (14.7%), isotonic strength (11.5%), and tubing strength (14.1%). It is possible that everyone who received ankle taping also received neuromuscular training. However, we would expect that all patients with ankle sprains should receive treatment that is based on current evidence, so the percentage of AT services focused on proprioception, ROM, and strengthening should be higher. Proprioception, ROM, and strengthening interventions have been supported in the literature for the treatment of ankle sprains with grade A evidence according to the National Athletic Trainers' Association position statement.^{31,32} However, only grade B evidence supported ankle taping for the treatment of ankle sprains.³² Specifically, after a person sustained an ankle sprain, it was estimated that an AT would need to tape 26 people to prevent an ankle sprain,³⁴ whereas to prevent 1 recurrent ankle sprain, 4 to 5 patients with a history of an ankle sprain would need to complete rehabilitation training.³⁵ A recent overview³¹ of systematic reviews supported the use of therapeutic activities, neuromuscular re-education, and taping, but the

evidence to support therapeutic interventions appears to be of higher quality.³²

In our study, the majority of ATF visits and AT services were for patients with NTL ankle sprains, although this may reflect the larger number of ankle sprains that were NTL injuries. However, the numbers of ATF visits and AT services per TL ankle sprain were higher than those for NTL ankle sprains. Specifically, more ATF visits and AT services per ankle sprain occurred for TL injuries overall, and for baseball, boys' basketball, football, boys' soccer, wrestling, girls' basketball, field hockey, girls' indoor track, girls' lacrosse, girls' soccer, softball, and girls' volleyball ($P < .05$). Therefore, athletes with a TL injury would have more ATF visits per TL injury because they were not participating in sport. However, for 10 sports, ATF visits per injury did not differ for TL and NTL injuries. Additionally, 5 sports did not have a TL ankle sprain (crew, golf, and swimming and diving for boys and golf and swimming and diving for girls). The 12 sports whose athletes had more ATF visits for TL injuries were collision and contact sports, and the associated ankle sprains may have been more severe, thereby requiring more treatment and days of treatment. Specifically, TL injuries were associated with more therapeutic activities or exercise, neuromuscular reeducation, strapping, and AT evaluation and reevaluation. These findings may indicate the severity of injuries that result in TL, which may require further examination and more extensive rehabilitation than NTL injuries.

One third of all AT services provided and 65.1% of ATF visits were for patients with NTL ankle sprains, which highlights the amount of care that ATs provided to manage patients with ankle sprains that did not result in TL. It is concerning that a majority (2551; 79.4%) of ankle sprains in our sample were NTL injuries. Even though this group received AT services, the rapid return to play may lead to an increased risk of recurrent sprains. A history of a previous ankle sprain is the most consistent risk factor for sustaining a future ankle sprain, and the risk of a subsequent sprain is nearly doubled in the first 12 months after sustaining an ankle sprain.³⁶ Coupled with the fewer AT services associated with NTL injuries, ATs may be unconsciously increasing the risk of recurrent ankle sprains.²⁴ Unfortunately, due to the limitations of these data, we were unable to assess those who had recurrent ankle sprains.

LIMITATIONS

Our data-collection method relied on preexisting electronic medical record systems that ATs used as part of their daily clinical practice to acquire data on AT services provided for ankle sprains, but it is possible that some injuries were missed. For example, an athlete may not have considered his or her injury severe enough to warrant attention. For the 30 patients who did not receive any treatment, the ATs may not have entered any data because ATs do not bill for services, so they might not have thought of an evaluation as reportable (ie, billable). At the same time, the documentation of AT services may have missed aspects of the care or management provided to injured athletes, such as any services that occurred outside the high school setting or that was provided by anyone other than the

AT or team medical staff. Our results are not generalizable to high schools without access to ATs. We did not account for the type of AT coverage (eg, full time, part time, outreach, graduate assistant), which may be associated with the quantity and type of AT services provided.³⁷ Lastly, like the authors of recent epidemiologic studies, we were unable to compare treatments by ankle-sprain type (ie, medial, lateral, or syndesmotic). Even with these limitations, our data illustrate the volume of care and management ATs provided to treat ankle sprains, the most common musculoskeletal injury sustained during sports. Future researchers should focus on high schools with and without access to ATs, barriers to providing ideal ankle-sprain management, and differences in care based on AT coverage.

CONCLUSIONS

A variety of AT services were used to care for athletes who sustained ankle sprains. Although the quantity of AT services varied by sport and between TL and NTL injuries, our results suggest that NTL ankle sprains accounted for approximately one third of all documented AT services. These data also suggested that when ATs provided care for patients with ankle sprains, they were primarily using therapeutic activities or exercise and neuromuscular reeducation, which are supported in the literature. However, the treatment of ankle sprains could be improved in 2 main areas: (1) very few AT services focused on manual therapy despite the empirical evidence supporting its use and (2) a large portion of AT services should focus on therapeutic exercise, which is supported by grade A evidence.

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