

Injury and Treatment Characteristics of Middle School-Aged Patients Under the Care of Athletic Trainers From 2010 to 2022: A Report From the Athletic Training Practice-Based Research Network

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Context: Exploring sports-related musculoskeletal injuries and treatment characteristics in middle school sports may help inform patient care decisions such as appropriate medical coverage.

Objective: To describe injury and treatment characteristics of middle school-aged athletes receiving care from athletic trainers within the Athletic Training Practice-Based Research Network (AT-PBRN).

Design: Descriptive study.

Setting: Middle school.

Patient or Other Participants: Middle school-aged athletes (n = 1011; male = 503, female = 506, 2 declined to answer) with sports-related musculoskeletal injuries.

Main Outcome Measures: Electronic patient records were analyzed from the AT-PBRN from 59 athletic trainers across 14 states between 2010 and 2022. Summary statistics (frequency, percentages, median, and interquartile ranges [IQR]) were used to describe injury (age at injury, sex, sport, body part, and diagnosis) and treatment characteristics (type of treatment, number of visits, and number of procedures per visit).

Results: Football (17.7%, n = 179), basketball (17.6%, n = 178), and soccer (14.9%, n = 151) reported the highest number of injuries. The ankle (17.2%, n = 174), knee (16.5%, n = 167),

and head (14.1%, n = 143) were the most common injury locations. Concussion (13.0%, n = 131), ankle strain/sprain (12.4%, n = 125), and thigh/hip/groin sprain/strain (11.1%, n = 112) were the most reported diagnoses. Therapeutic exercise or activities (27.6%, n = 1068), athletic trainer evaluation or re-evaluation (24.7%, n = 957), and hot/cold packs (19.8%, n = 766) were the most common services, with a median of 2 visits (IQR = 1 to 4) and 2 procedures (IQR = 1 to 2) per visit.

Conclusions: Football, basketball, and soccer reported the most musculoskeletal injuries for middle school-aged athletes. Concussions were the most frequent diagnosis, followed by ankle sprains/strains. Our findings are similar to prior investigations at the high school and collegiate levels. Treatments at the middle school level were also similar to those that have been previously reported at the high school level with therapeutic exercise/activity, athletic trainer evaluation or re-evaluation, and hot/cold packs being the most common treatments. This information may be useful for informing patient care decisions at the middle-school level.

Key Words: medical coverage, musculoskeletal injuries, youth athlete

Key Points

- Football, basketball, and soccer had the highest number of injuries with concussions, ankle sprains/strains, and thigh/hip/groin sprains/strains being the highest reported injury diagnoses.
- Treatment patterns in middle school athletes were similar to prior reports for high school athletes, with therapeutic exercise/activities, athletic trainer evaluation or re-evaluation, and hot/cold packs being the most common forms of treatment.

Sport participation is popular among children, and more than 26 million children in the United States participated in an individual or team sport in 2019.¹ Athletic activities have become increasingly rigorous over time, and youth athletes are expected to begin training and participating in their sport of choice at an early age, typically between the ages of 11 and 14.² Although sport participation offers many benefits, such as increased physical activity levels, social development, improved self-image, and personal enjoyment, there is also an

increased risk for injury due to rapid growth and maturation of the musculoskeletal system during adolescent years.^{2–5} Injury during this period may have long-term health consequences that extend into adulthood and result in repetitive injury, pain, and dysfunction.⁶ Understanding sport-related musculoskeletal injuries and treatment characteristics in this setting may help in identifying necessary medical coverage, which has been an important topic within the sports medicine community in the secondary school and collegiate settings.⁷

Despite the importance of this topic, few studies have been conducted assessing injuries at the middle school level. Existing research has primarily focused on specific injuries, a specific sport, or 1 sex or only included data from a single school. One study of middle school athletic injuries from a single school found that football accounted for the highest injury rate for all injuries, followed by girls' track, girls' cross-country, and boys' wrestling.⁸ The most common injury locations were the ankle, knee, thigh, shin/calf, and wrist/hand/finger, with strains, sprains, and tendinitis being the most common injury types.⁸ This study provides the most comprehensive injury data to date in middle school athletes across multiple sports; however, this study may not be generalizable as it contains information from only 1 school.

Several other studies conducted on injury in middle school athletes focus on a single sport or a specific injury. In a study assessing cross-country athletes, girls had a higher prevalence of injury than boys, with the most common injuries being ankle sprain, patellofemoral pain, and medial tibial stress syndrome, whereas boys more frequently reported plantar fasciitis, Osgood-Schlatter disease, and iliotibial band syndrome.⁹ In middle school girls' basketball, soccer, and volleyball athletes, the knee was the most commonly injured body part, with patellofemoral pain, Osgood-Schlatter disease, and patellar tendinosis being the most commonly diagnosed injuries.¹⁰ In elite youth soccer players, a systematic review revealed that the ankle, knee, and groin were the most commonly injured locations, with sprains, strains, and contusions being the most common injury types.¹¹ Across these sports, it appears that injury to the lower extremity tends to be the most common.⁹⁻¹¹ When considering upper extremity injuries, a recent systematic review of youth sport-related shoulder injuries demonstrated that baseball was the sport with the highest injury rate for the shoulder.¹² Although these studies enhance our knowledge of sport-related injury in middle school-aged athletes, no information was available on treatments provided to the injured athletes. There has been limited exploration involving a comprehensive range of sports, injuries, and treatments for athletes at this level, although several studies exist at the high school and collegiate levels.

A variety of epidemiological studies involving multiple sports have been conducted in the high school and collegiate athletic settings that may provide insight for injuries at the middle school level.¹³⁻¹⁸ In high school and collegiate athletics, football has been reported to have the highest injury rate.^{14,16-18} The most common injuries at the high school and collegiate level are sprains or strains to the lower extremity and concussions.^{13,14,16-18} Female athletes at both levels report a greater amount of overuse injuries than their male counterparts.^{14,15,18} Although there are many similar injury findings between high school and collegiate sports, the rate of overuse injuries is over 3 times higher in collegiate athletes than in high school athletes, and these injuries typically result in more time loss and increased surgical intervention.¹⁵ These similarities and differences between high school and collegiate settings justify further exploration into injury characteristics in the middle school setting as each setting is unique.

Investigations into injury characteristics often exclude information about treatments and tasks carried out by athletic training or sports medicine staff. Information about injury assessment, treatment, and management are all essential components for determining appropriate medical coverage

for athletes at any level.⁷ Within the middle school population, no study has comprehensively examined a diverse range of sports, injuries, and treatments administered. Addressing this gap in the literature is essential to better inform injury prevention and treatment strategies in this age group. Therefore, the objective of this study was to describe the injury and treatment characteristics of middle school-aged patients receiving care reported by athletic trainers within the Athletic Training Practice-Based Research Network (AT-PBRN).

METHODS

Design

This was a retrospective analysis of patient data collected via electronic medical records (EMRs) within the AT-PBRN. Clinical data were recorded within the AT-PBRN, which has been previously described in the literature.¹⁹ Patient records were completed by 59 athletic trainers (sex: male = 23, female = 36; years certified = 4.9 ± 9.4 ; years employed at site = 2.3 ± 5.1) practicing in 36 athletic training clinics (middle school/high school grades combined = 17; preparatory = 9; middle school = 4; sports medicine clinic = 2; sports walk-in clinic = 1; performance clinic = 1) across 14 states that represented the West ($n = 17$), Midwest ($n = 8$), Northeast ($n = 6$), and South ($n = 3$) regions of the United States, as classified by the US Census Bureau between 2010 and 2022.²⁰ This study was approved by the university's institutional review board.

Patients

Patients were middle school-aged athletes under the care of an athletic trainer within the AT-PBRN. Middle school was considered to be the intermediate school between elementary and high school, which typically includes grades 6 to 8 and children between the ages of 10 and 13. This age range was selected because some schools included within the AT-PBRN are combined middle school/high school settings, and information about grade level was unavailable. This age range is reflective of other studies involving middle school athletes.^{9,21} To be included in the current study, patients met the following criteria: aged 10 to 13 years, experienced an injury or condition that was diagnosed by an athletic trainer or primary care physician, and visited the athletic training clinic for an athletic training service (eg, evaluation, ice/heat, and therapeutic exercises). All athletes were diagnosed with a sport-related injury or condition by either an athletic trainer or primary care physician.

Procedures

Data were collected using a web-based EMR service by an athletic trainer. We followed data extraction procedures previously described by Marshall et al to ensure data quality and integrity.²² Patient cases were extracted and reviewed by a member of the AT-PBRN team. For this study, we first identified patient cases by identifying patients who reported their age as between 10 and 13 years at intake. We then used the unique injury identification number associated with each patient case to identify and extract the remaining variables.

For our study, we obtained data from various forms in the EMR. We extracted variables related to patient characteristics from the demographics form, which included sex, type of

Table 1. Participant Age and Sex

	Total, n (%)
Age, y	
10	45 (4.5)
11	135 (13.4)
12	273 (27.0)
13	558 (55.2)
Sex	
Female	506 (50.0)
Male	503 (49.8)
Decline to answer	2 (0.2)
Total	1011

sport, activity during injury (ie, practice and competition), and injury diagnosis (using International Classification of Disease [ICD] diagnostic codes).^{22,23} The study period included the transition period from version 9 to version 10 of the ICD coding system, which occurred in 2015. During this transition, ICD codes were cross-referenced between the 2 coding versions in the EMR. Therefore, we presented the ICD codes as version 10. In cases where data were similar or fell under the same category code, the data were combined. For example, ICD-10 codes for concussion included the following: S06.0X0XA-concussion, S06.0X9A-concussion with loss of consciousness, and S06.0X0A-concussion mental confusion without loss of consciousness.

We extracted treatment-related variables from the evaluation and discharge forms in the EMR.^{22,23} These variables included the type of service (identified by Current Procedural Terminology [CPT] codes), amount of care (number of visits and number of services per visit), and duration of care (number of days between intake and discharge). A *service* refers to any type of care provided and categorized according to a CPT code. On the other hand, a *visit* was defined as 1 encounter at the athletic training clinic. We calculated the number of visits (sum of visits divided by the sum of patient cases) and number of services per visit (sum of services divided by the sum of visits) based on calculations reported in previous studies.^{16,22–26} In cases where data were similar or fell under the same category code, the data were combined. For example, therapeutic exercise (CPT code 97110) and therapeutic activities (CPT code 97530) were combined.

Instrumentation

The CORE-AT EMR (www.core-at.com) is a patient documentation system that adheres to the guidance of the Health Insurance Portability and Accountability Act of 1996. It is a web-based system and incorporates standard documentation forms, patient-oriented outcome forms, and an injury surveillance feature. Detailed information about the features and functions of CORE-AT EMR has been reported in previous research.^{19,27,28}

Statistical Analysis

Descriptive statistics (frequency, percentages, median, and interquartile ranges [IQRs]) were used to describe injury (age at injury, sex, sport, body part, and diagnosis) and treatment characteristics (type of treatment, number of visits, and number of procedures per visit). Diagnosis and type of treatment were recorded, respectively, using the ICD-10 and CPT codes. All analyses were conducted using SPSS (version 27; IBM Corp).

Table 2. Sport in Which Injury Occurred

Sport	Male, n (%)	Female, n (%)	Total, N (%)
Football	175 (34.8)	4 (0.8)	179 (17.7)
Basketball	91 (18.1)	87 (17.2)	178 (17.6)
Soccer	51 (10.1)	100 (19.8)	151 (14.9)
Volleyball	5 (1.0)	126 (24.9)	131 (13.0)
Track ^a	39 (7.8)	66 (13.0)	106 (10.5)
Cross-country	33 (6.6)	34 (6.7)	67 (6.6)
Wrestling	61 (12.1)	5 (1.0)	66 (6.5)
Other	23 (4.6)	13 (2.6)	36 (3.6)
Softball	1 (0.2)	21 (4.2)	22 (2.2)
Cheerleading	0 (0.0)	19 (3.8)	19 (1.9)
Baseball	16 (3.2)	1 (0.2)	17 (1.7)
Field hockey	1 (0.2)	14 (2.8)	15 (1.5)
Swimming ^a	2 (0.4)	6 (1.2)	9 (0.9)
Lacrosse	2 (0.4)	2 (0.4)	4 (0.4)
Hockey	0 (0.0)	3 (0.6)	3 (0.3)
Recreational athlete	2 (0.4)	1 (0.2)	3 (0.3)
Tennis	0 (0.0)	3 (0.6)	3 (0.3)
Gymnastics	1 (0.2)	1 (0.2)	2 (0.2)
Total	503	506	1011

^a Indicates that an injury occurred in that sport, but the athlete declined to report their sex.

RESULTS

Injury Characteristics

A total of 1011 middle school-aged athletes reported musculoskeletal injuries (Table 1), with a total of 121 different injuries and illnesses being reported (see Supplemental Table, available online at <https://dx.doi.org/10.4085/1062-6050-0359.23.S1>). Of the athletes, 506 were female, 503 were male, and 2 declined to answer. Football (17.7%, $n = 179$), basketball (17.6%, $n = 178$), and soccer (14.9%, $n = 151$) reported the highest number of injuries (Table 2). Injuries occurred most frequently during practice (52.7%, $n = 533$), followed by games (25.8%, $n = 261$), nonsport injuries (17.3%, $n = 175$), and conditioning injuries (4.2%, $n = 42$). The most common sites of injury were the ankle (17.2%, $n = 174$), knee (16.5%, $n = 167$), and head (14.1%, $n = 143$; Table 3). Among specific injury classifications, concussion (13.0%, $n = 131$), ankle strain/sprain (12.4%, $n = 125$), and sprain/strain of the thigh/hip/groin (11.1%, $n = 112$) were the most reported diagnoses (Table 4).

Treatment Characteristics

A total of 3870 treatments were recorded. All treatments were performed by a licensed/certified athletic trainer. The most common treatments provided were therapeutic exercise or activities (27.6%, $n = 1068$), followed by athletic trainer evaluation or re-evaluation (24.7%, $n = 957$), hot or cold packs (19.8%, $n = 766$), and manual therapy techniques (9.5%, $n = 369$; Table 5). The sports that reported for treatments the most were soccer (24.1%, $n = 931$), basketball (18.9%, $n = 731$), and volleyball (14.0%, $n = 540$; Table 6). Across all injuries, patients attended a median of 2 visits (IQR = 1 to 4; range, 1 to 5). The median number of procedures per visit was 2 (IQR = 1 to 2; range, 1 to 2).

DISCUSSION

Our findings for injury characteristics were similar to those from prior reports at various athletic levels; however,

Table 3. Injury Location

Body Part	Male, n (%)	Female, n (%)	Total, N (%)
Ankle	76 (15.1)	98 (19.4)	174 (17.2)
Knee	83 (16.5)	84 (16.6)	167 (16.5)
Head	87 (17.3)	56 (11.1)	143 (14.1)
Back	28 (5.6)	31 (6.1)	59 (5.8)
Foot	24 (4.8)	34 (6.7)	58 (5.7)
General medical	24 (6.8)	23 (4.5)	57 (5.6)
Shoulder	26 (5.2)	29 (5.7)	55 (5.4)
Thigh ^a	24 (4.8)	29 (5.7)	54 (5.3)
Calf ^a	20 (4.0)	32 (6.3)	53 (5.2)
Hip	24 (4.8)	27 (5.3)	51 (5.0)
Finger	12 (2.4)	15 (3.0)	27 (2.7)
Wrist	15 (3.0)	12 (2.4)	27 (2.7)
Thumb	8 (1.6)	11 (2.2)	19 (1.9)
Elbow	12 (2.4)	5 (1.0)	17 (1.7)
Chest	4 (0.8)	6 (1.2)	10 (1.0)
Hand	7 (1.4)	3 (0.6)	10 (1.0)
Forearm	6 (1.2)	3 (0.6)	9 (0.9)
Neck	6 (1.2)	3 (0.6)	9 (0.9)
Toe	5 (1.0)	1 (0.2)	6 (0.6)
Trunk	2 (0.4)	3 (0.6)	5 (0.5)
Upper arm	0 (0.0)	1 (0.2)	1 (0.1)
Total	503	506	1011

^a Indicates that an injury occurred in that sport, but the athlete declined to report their sex.

our study adds new information about treatments and services provided by athletic trainers for athletes in the middle school setting. The sports with the highest number of reported injuries were football, basketball, and soccer, with concussions and lower extremity injuries being the most common. The most frequent treatments for these injuries were therapeutic exercises or activities, athletic trainer evaluation or re-evaluation, and hot or cold packs. This information may be beneficial for determining the allocation of resources for athletic trainers and school administrators involved in decision-making regarding medical coverage for athletics in the middle school setting.

Football, basketball, and soccer accounted for the highest number of injuries reported in our study. Football is commonly reported to have the highest injury rate among studies at the middle school, high school, and collegiate levels.^{8,14,16–18} When separated into boys' and girls' sports, male athletes reported the highest number of injuries in football (34.8%), basketball (18.1%), wrestling (12.1%), and soccer (10.1%), whereas

Table 4. Most Common Injury Diagnoses

Diagnosis	ICD-10 Code(s)	Total, n (%)
Concussion	S06.0X0XA, S06.0X9A, S06.0X0A	131 (13.0)
Ankle sprain/strain	S93.401A, S93.429A, S93.439A	125 (12.4)
Thigh/hip/groin sprain/strain	S73.109A, S76.119A, S83.90XA	112 (11.1)
Patellar tendonitis	M76.50	42 (4.2)
Knee pain	M25.569	35 (3.5)
Back sprain/strain	S23.9XXA, S33.8XXA, S33.6XXA	29 (1.9)
Hand/finger sprain/strain	S63.90XA	27 (2.7)
Knee contusion	S80.00XA	21 (2.1)
Foot sprain/strain	S96.919A	20 (2.0)
Foot contusion	S90.30XA	18 (1.8)
Low back pain	M54.5	18 (1.8)

Abbreviation: ICD, International Classification of Disease.

Table 5. Treatment Procedure and Frequency

Procedure Name	CPT Codes	Total, n (%)
Therapeutic exercise or activities	97110, 97530	1068 (27.6)
Athletic trainer evaluation or re-evaluation	97005, 97006	957 (24.7)
Hot or cold packs	97010	766 (19.8)
Manual therapy techniques	97140	369 (9.5)
Strapping: lower extremity (hip, knee, ankle/foot, toes)	29520, 29530, 29540, 29550	251 (6.5)
Massage	97124	176 (4.5)
Electrical stimulation	97014	119 (3.1)
Strapping: upper extremity (shoulder, elbow or wrist, hand or finger)	29240, 29260, 29280	89 (2.3)
Whirlpool	97022	24 (0.6)
Physical performance test or measurement	97750	20 (0.5)
Ultrasound	97035	13 (0.3)
Contrast bath	97034	8 (0.2)
Neuromuscular reeducation	97112	5 (0.1)
Infrared	97026	3 (0.1)
Gait training	97116	2 (0.1)
Total		3870

Abbreviation: CPT, Current Procedural Terminology.

female athletes reported the highest number of injuries in volleyball (25.1%), soccer (19.7%), and basketball (17.2%). Similar results are reported at the high school level, with football (58.6%), wrestling (8%), and soccer (7.2%) accounting for the most injuries in boys' sports and soccer (21.1%), basketball (18.1%), and volleyball (14.3%) accounting for the most injuries in girls' sports.¹⁶ Although there are increased risks for injury when participating in contact sports, such as football, basketball, soccer, and wrestling, high school athletes participating in contact sports have reported fewer symptoms of anxiety and depression than those participating in limited- or no-contact sports.^{29,30} Athletes and parents should weigh the risks and benefits before sport participation and determine the best fit for each individual athlete.

Table 6. Treatments Performed by Sport

Sport	Male, n (%)	Female, n (%)	Total, n (%)
Soccer	271 (18.5)	660 (27.5)	931 (24.1)
Basketball	358 (24.4)	373 (15.5)	731 (18.9)
Volleyball	9 (0.6)	531 (22.1)	540 (14.0)
Football	463 (31.6)	9 (0.4)	472 (12.2)
Track ^a	67 (4.6)	210 (8.8)	279 (7.2)
Cross-country	112 (7.6)	147 (6.1)	259 (6.7)
Other	29 (2.0)	160 (6.7)	189 (4.9)
Softball	12 (0.8)	122 (5.1)	134 (3.5)
Baseball	75 (5.1)	0 (0.0)	75 (1.9)
Wrestling	63 (4.3)	0 (0.0)	63 (1.6)
Tennis	0 (0.0)	49 (2.0)	49 (1.3)
Cheerleading	0 (0.0)	47 (2.0)	47 (1.2)
Swimming ^a	6 (0.4)	35 (1.5)	43 (1.1)
Field hockey	0 (0.0)	34 (1.4)	34 (0.9)
Gymnastics	0 (0.0)	16 (0.7)	16 (0.4)
Hockey	0 (0.0)	3 (0.1)	3 (0.1)
Lacrosse	0 (0.0)	3 (0.1)	3 (0.1)
Recreational athlete	0 (0.0)	1 (0.0)	1 (0.0)
Total	1465	2400	3869

^a Indicates that a treatment was performed on an athlete who declined to report their sex.

The most common injury locations were the ankle, knee, and head in our middle school-aged athletes, which are similar to locations reported in prior studies in the middle school, high school, and collegiate settings.^{8–11,13,14,16–18} When considering specific injury diagnoses, concussion was the most common injury (13.0%), followed by ankle sprains and strains (12.4%), thigh/hip/groin sprains and strains (11.1%), and patellar tendinitis (4.2%). Sports that involve activities such as running, jumping, and fast changes in direction such as football, basketball, and soccer may put the lower extremities at higher risk of injury even in middle school-aged athletes.^{2,8–10}

A variety of treatments were administered by athletic trainers to the middle school-aged athletes in this study. The most common services included therapeutic exercise or activities (27.6%), athletic trainer evaluation or re-evaluation (24.7%), hot or cold packs (19.8%), and manual therapy techniques (9.5%). Similarly, at the high school level, athletic trainer evaluation or re-evaluation and therapeutic activities or exercise have been the most reported services.^{16,24} The sports receiving the most treatments in our study were soccer (24.1%), basketball (18.9%), volleyball (14.0%), and football (12.2%). Football received the most treatments among boys' sports (31.6%), and soccer received the most treatments among girls' sports (27.5%). Sports receiving the most treatments differ slightly between middle school, high school, and collegiate settings. In the high school setting, girls' soccer, boys' track and field, and girls' track and field report the highest number of services per injury.¹⁶ In the collegiate setting, football, baseball, basketball, and soccer account for the highest services among male sports, and basketball, soccer, and volleyball account for the highest number of services among female sports.³¹ Regardless of the setting, it is clear that athletic trainers play an important role in providing a variety of key services to injured athletes.

Our study has several limitations to be considered. The data are collected by athletic trainers within a clinical setting, which can be very busy, and every injury that occurs may not be recorded. Our data may not be fully representative of what occurs in the clinic setting. Data about athlete-exposures were not available within the EMR, so injury rates could not be calculated. Additionally, some athletes may not report injuries to an athletic trainer at their middle school. Finally, data were collected from multiple different athletic trainers who may have different documentation habits, which could limit the data.

CONCLUSIONS

Our study contributes valuable insights about injuries sustained and treatments provided in the middle school setting, where access to athletic training services may be limited. Injury characteristics were similar to those previously reported at the high school and collegiate levels. Middle school-aged athletes who participated in football, basketball, and soccer reported the most musculoskeletal injuries. Ankle, knee, and head were the most injured locations, with concussion, ankle sprains/strains, and thigh/hip/groin sprains/strains being the most frequent injury diagnoses. Treatments most often consisted of therapeutic exercise or activities, athletic trainer evaluation or re-evaluation, and hot or cold packs. Soccer, basketball, and volleyball received the highest number of services among the sports teams. This information may

provide useful insight for patient care decisions at the middle school level.

REFERENCES

1. National Survey of Children's Health. Data Resource Center for Child and Adolescent Health. Accessed August 3, 2023. <https://www.childhealthdata.org/browse/survey/results?q=8071&r=1&g=829>
2. Atay E. Prevalence of sport injuries among middle school children and suggestions for their prevention. *J Phys Ther Sci*. 2014;26(9):1455–1457. doi:10.1589/jpts.26.1455
3. Malina RM. Children and adolescents in the sport culture: the overwhelming majority to the select few. *J Exerc Sci Fit*. 2009;7(2 suppl): S1–S10. doi:10.1016/S1728-869X(09)60017-4
4. Harrison PA, Narayan G. Differences in behavior, psychological factors, and environmental factors associated with participation in school sports and other activities in adolescence. *J Sch Health*. 2003;73(3):113–120. doi:10.1111/j.1746-1561.2003.tb03585.x
5. Visek AJ, Achrafi SM, Mannix H, McDonnell K, Harris BS, DiPietro L. The fun integration theory: toward sustaining children and adolescents sport participation. *J Phys Act Health*. 2015;12(3):424–433. doi:10.1123/jpah.2013-0180
6. Merkel DL. Youth sport: positive and negative impact on young athletes. *Open Access J Sports Med*. 2013;4:151–160. doi:10.2147/OAJSM.S33556
7. Courson R, Goldenberg M, Adams KG, et al. Inter-association consensus statement on best practices for sports medicine management for secondary schools and colleges. *J Athl Train*. 2014;49(1):128–137. doi:10.4085/1062-6050-49.1.06
8. Beachy G, Rauh M. Middle school injuries: a 20-year (1988–2008) multisport evaluation. *J Athl Train*. 2014;49(4):493–506. doi:10.4085/1062-6050-49.2.19
9. Wu AC, Rauh MJ, DeLuca S, et al. Running-related injuries in middle school cross-country runners: prevalence and characteristics of common injuries. *PM R*. 2022;14(7):793–801. doi:10.1002/pmrj.12649. Retracted in: *PM R*. 2023;15(11):1511. doi:10.1002/pmrj.13096
10. Barber Foss KD, Myer GD, Hewett TE. Epidemiology of basketball, soccer, and volleyball injuries in middle-school female athletes. *Phys Sportsmed*. 2014;42(2):146–153. doi:10.3810/psm.2014.05.2066
11. Pfirrmann D, Herbst M, Ingelfinger P, Simon P, Tug S. Analysis of injury incidences in male professional adult and elite youth soccer players: a systematic review. *J Athl Train*. 2016;51(5):410–424. doi:10.4085/1062-6050-51.6.03
12. Gibson ES, Cairo A, Räisänen AM, Kuntze C, Emery CA, Pasanen K. The epidemiology of youth sport-related shoulder injuries: a systematic review. *Transl Sports Med*. 2022;2022:e8791398. doi:10.1155/2022/8791398
13. Rechel JA, Yard EE, Comstock RD. An epidemiologic comparison of high school sports injuries sustained in practice and competition. *J Athl Train*. 2008;43(2):197–204. doi:10.4085/1062-6050-43.2.197
14. Ritzer EE, Yang J, Kistamgari S, Collins CL, Smith GA. An epidemiologic comparison of acute and overuse injuries in high school sports. *Inj Epidemiol*. 2021;8(1):51. doi:10.1186/s40621-021-00344-8
15. Roos KG, Marshall SW, Kerr ZY, et al. Epidemiology of overuse injuries in collegiate and high school athletics in the United States. *Am J Sports Med*. 2015;43(7):1790–1797. doi:10.1177/0363546515580790
16. Lam KC, Snyder Valier AR, Valovich McLeod TC. Injury and treatment characteristics of sport-specific injuries sustained in interscholastic athletics. *Sports Health*. 2015;7(1):67–74. doi:10.1177/1941738114555842
17. Hootman JM, Dick R, Agel J. Epidemiology of collegiate injuries for 15 sports: summary and recommendations for injury prevention initiatives. *J Athl Train*. 2007;42(2):311–319.
18. Yang J, Tibbetts AS, Covassin T, Cheng G, Nayar S, Heiden E. Epidemiology of overuse and acute injuries among competitive collegiate athletes. *J Athl Train*. 2012;47(2):198–204. doi:10.4085/1062-6050-47.2.198

19. Valovich McLeod TC, Lam KC, Bay RC, Sauers EL, Snyder Valier AR. Practice-based research networks, part II: a descriptive analysis of the Athletic Training Practice-Based Research Network in the secondary school setting. *J Athl Train*. 2012;47(5):557–566. doi:10.4085/1062-6050-47.5.05
20. Census regions and divisions of the United States. US Census Bureau. Accessed August 8, 2023. https://www2.census.gov/geo/pdfs/maps-data/maps/reference/us_regdiv.pdf
21. Watson A, Post E, Biese K, Kliethermes S, Brooks MA, Bell D. Decreased physical activity and sleep, not sport specialization, predict illness in middle school athletes. *Sports Health*. 2020;13(1):25–30. doi:10.1177/1941738120927599
22. Marshall AN, Kikugawa TM, Lam KC. Patient, treatment, and cost characteristics associated with sport-related ankle sprains: a report from the Athletic Training Practice-Based Research Network. *Athl Train Sports Health Care*. 2019;12(4):173–180. doi:10.3928/19425864-20190521-01
23. Lam KC, Marshall AN, Welch Bacon CE, Valovich McLeod TC. Cost and treatment characteristics of sport-related knee injuries managed by athletic trainers: a report from the Athletic Training Practice-Based Research Network. *J Athl Train*. 2021;56(8):922–929. doi:10.4085/1062-6050-0061.20
24. Kerr ZY, Dompier TP, Dalton SL, Miller SJ, Hayden R, Marshall SW. Methods and descriptive epidemiology of services provided by athletic trainers in high schools: the National Athletic Treatment, Injury and Outcomes Network study. *J Athl Train*. 2015;50(12):1310–1318. doi:10.4085/1062-6050-51.1.08
25. Simon JE, Wikstrom EA, Grooms DR, Docherty CL, Dompier TP, Kerr ZY. Athletic training service characteristics for patients with ankle sprains sustained during high school athletics. *J Athl Train*. 2019;54(6):676–683. doi:10.4085/1062-6050-449-16
26. Grooms DR, Simon JE, Dalton SL, Dompier TP, Kerr ZY. High school athletic trainer services for knee injuries. *J Athl Train*. 2018;53(10):956–964. doi:10.4085/1062-6050-48-17
27. Valovich McLeod TC, Kostishak N II, Anderson BE, Welch Bacon CE, Lam KC. Patient, injury, assessment, and treatment characteristics and return-to-play timelines after sport-related concussion: an investigation from the Athletic Training Practice-Based Research Network. *Clin J Sport Med*. 2019;29(4):298–305. doi:10.1097/JSM.0000000000000530
28. Lam KC, Valier AR, Anderson BE, McLeod TC. Athletic training services during daily patient encounters: a report from the Athletic Training Practice-Based Research Network. *J Athl Train*. 2016;51(6):435–441. doi:10.4085/1062-6050-51.8.03
29. Rice SG; American Academy of Pediatrics Council on Sports Medicine and Fitness. Medical conditions affecting sports participation. *Pediatrics*. 2008;121(4):841–848. doi:10.1542/peds.2008-0080
30. Howell DR, Kirkwood MW, Laker S, Wilson JC. Collision and contact sport participation and quality of life among adolescent athletes. *J Athl Train*. 2020;55(11):1174–1180. doi:10.4085/1062-6050-0536.19
31. Powell JW, Dompier TP. Analysis of injury rates and treatment patterns for time-loss and non-time-loss injuries among collegiate student-athletes. *J Athl Train*. 2004;39(1):56–70.

SUPPLEMENTAL MATERIAL

Supplemental Table. All Injury Diagnoses (ICD-10 code).
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