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Competitive Swimming-Related Injuries in the Adolescent Athlete: A Retrospective Analysis

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Abstract

***Introduction:** Competitive swimmers exert repetitive stress on their bodies and this may contribute to injury development among these athletes. Prior research has demonstrated high rates of shoulder pathologies in swimmers, however, to date, the most common swimming-associated diagnoses in adolescent patients have not been well delineated.*

***Methods:** A retrospective review of our institution's medical record system was performed to identify pediatric and adolescent patients who were seen in our clinic for swimming injuries. Following chart review, injury-related data were then compiled for each patient including aggravating factors, diagnosis, diagnostic workup, and treatment protocol.*

***Results:** Among our cohort of 90 patients (mean age: 14.4 years) with swimming-related injuries, patellofemoral dysfunction (17), shoulder impingement (14), and rotator cuff pathology (14) were the most common diagnoses. Physical therapy was the most regularly prescribed treatment for swimming-associated injuries as well as rest from swimming and non-steroidal anti-inflammatory drugs. Surgery is rarely indicated for swimming-associated injuries in this population (5 patients).*

***Conclusions:** Common injury locations for pediatric and adolescent swimmers include the shoulder, knee, and lower back. Providers should be aware of the common diagnostic evaluation modalities (x-rays and MRI) and treatment options (physical therapy, rest from swimming) for patients with swimming-associated injuries.*

Keywords: overuse; pediatric; sports medicine; shoulder.

Introduction

Injury prevention in competitive swimming is critically important to athletes of all ages and abilities. Swimmers compete in four strokes – freestyle, backstroke, butterfly, and breaststroke – each of which put unique demands on athletes' bodies. Competitive swimming events range from 50 meters to 1500 meters in length and can take anywhere from 20 seconds to 20 minutes to complete, depending on the athlete and the specific event. While athletes may specialize in any of the four strokes, swimmers predominantly train by swimming freestyle during practice sessions as it is the fastest and most efficient stroke. Swimming training is particularly rigorous with elite teenage athletes often training 7 or more practices a week at 6,000-7,000 yards per session [1]. The repetitive motion of swimming training can put significant cumulative stress on one's joints and may lead to overuse injuries [2-5]. In addition, there is growing evidence that early sport specialization predisposes pediatric and adolescent athletes to increased injury risk and burnout. Early sport specialization is especially common in swimming as well other individual-athlete sports such as tennis, gymnastics, and diving [6].

Because swimming is not a weight-bearing sport, the associated injury risks may differ from those of land-bound sports. Unlike running or bicycling, much of the power that swimmers generate comes from the arms [7]. Additionally, factors that increase performance such as greater range of motion of the shoulder, increased internal rotation strength and increased adduction strength may be associated with instability of the joint [2]. As a result, shoulder injuries are particularly common among swimmers, with estimates of the prevalence of shoulder pathology as high as 91% [3]. It is commonplace in competitive swimming to continue training despite shoulder pain and many swimmers believe that this is a normal part of the sport [1]. In fact, the term "swimmer's shoulder" has been used to describe anterior shoulder pain resulting from rotator cuff tendonitis and subacromial impingement [8]. Other common sites of injury include the neck, back, and knee [9-10].

However, while there are data regarding the risk factors for and prevalence of injuries associated with competitive swimming, there is limited literature describing the management of swimming injuries in the pediatric and adolescent populations; a population which is susceptible to over-use injuries. The present study aims to report on the medical work-up, diagnosis and treatment of swimming-associated pathologies in youth athletes.

Materials & Methods

Data Acquisition

This study was a retrospective review of our institution's medical record database. We used Structured Query Language (SQL) code to program the data extraction from Epic's Clarity database (Epic Systems Corporation, Madison, WI). We then identified 149,188 visits for 36,226 patients to orthopedic surgeons and sports medicine physicians at our institution from January 1st, 2016 to June 15th, 2021. We included only patients who were 18 years of age or younger at the time of the visit and those who had at least one History and Physical (H&P) or Progress Note. We extracted 508,825 provider notes. We then narrowed the set of notes to 12,206 notes for 4,130 patients that mentioned the words "swim," "swimming," "butterfly," "backstroke," "breaststroke," "freestyle," "competitive swim," "swim team," or related terms "water polo" and "diving." We created indicators for each of these key words to mark in which notes they occurred. We then excluded notes that contained phrases that we identified as not being relevant to the patient's injury. Examples of these would be standard "smart texts" often used by physicians for recommending pool exercise such as "Begin swimming and closed chain kinetic exercises," "Recommended activities: swimming," or "Recommend low impact activities such as cycling and swimming." Other examples were standard smart texts used for cautioning the patient against certain activities such as "No hot tubs or swimming." We excluded patients with only the positive indicator for the word "swim" due to the high rate of false hits with that key word. The final group included for chart review involved 2,943 notes for 920 patients. The Oakland Committee of the University of California, San Francisco Institutional Review Board (IRB) approved the project design prior to data extraction including waiving the need for informed consent from subjects.

Chart Review

The previously described keywords identified in association with each patient were searched within the patients' charts in order to find the notes from orthopedic surgeons and sports medicine physicians that led these patients to be initially included for chart review. Each note with a keyword was read by the study authors in order to evaluate the mechanism of injury for each patient. Patients were included for final analysis in the study if the injuries that led them to seek the care of an orthopedic surgeon or sports medicine faculty member were directly related to swimming. Patients were not included when their pathologies arose from ambiguous causes or when their injuries were definitively not linked to swimming. Three hundred ninety-one patients were excluded because their injuries were caused by sports other than swimming. Four hundred thirty-nine patients were excluded because they sought care due to concerns or injuries not associated with a sport (such as a fracture from a fall or a scoliosis evaluation).

Patient demographic data including age at the time of first visit to the orthopedic surgeon or sports medicine physician and gender were obtained from provider notes. Physician notes, were used to obtain information on aggravating factors and/or causes of the injury as well as the time course of the presenting problem. Provider notes also contained information on the location of the injury (classified as upper

extremity, lower extremity, or other for the purposes of this study), specific diagnoses given, which diagnostic testing modalities were employed, and the subsequent management plan. Patient charts contained data on whether or not the patient ultimately received surgical intervention and whether or not the patient was seen again by the provider to follow-up on the patients' presenting complaint. These data were catalogued using REDCap (Research Electronic Data Capture) database software [11-12].

Analysis

Data analysis was performed using Stata MP 16 analytical software (StataCorp, LLC, College Station, Texas). Patients were divided into one of three groups based on the location of their injury: upper extremity, lower extremity, and other. Mean values for age were calculated for the full cohort of patients as well as each group of injury-specific patient entries. The distribution of patient gender, injury location, specific diagnosis, diagnostic workup technique, management protocol, and follow-up appointments were compiled as well for each group of injury location-grouped patients.

Results

Eighty-nine pediatric and adolescent swimmers were included in our data analysis. One patient sought care for two swimming-associated injuries, thus we analyzed 90 patient injuries. Patients were 14.4 years old (SD: 1.96 years, range: 8-18) on average when they first sought care. Seventy-three patients were female (81.1%) with one female patient having two injuries (Table 1).

Table 1. *Demographics*

		Upper extremity (n=49)	Lower extremity (n=27)	Other (n=14)	Total (n=90)
Gender					
	Male	10	4	2	16
	Female	39	23	12	74
Mean age (standard deviation)		14.6 (1.4)	13.4 (2.4)	15.7 (1.9)	14.4 (2.0)

Upper Extremity Injuries

Demographics

Forty-nine of the eighty-nine patients included in the current study sought care for an upper extremity concern (54.4%). These patients were a mean age of 14.6 years old (SD: 1.39, range: 12-17) and thirty-nine of the patients were female (79.6%) (Table 1).

Aggravating Factors

A number of aggravating factors (movements that cause pain) or causes of injury were described by patients. The most common factors specifically listed included other overhead activity such as putting on a shirt or throwing a ball (14/49 patients), a recent increase in yardage or intensity of swim practices (9/49 patients), and cross-training or lifting weights (8/49 patients) (Table 2).

Injury Time Course, Location, and Specific Diagnoses

Forty-three of the forty-nine injuries (87.8%) were described by patients as being chronic in nature. Six injuries were acute in nature (12.2%) (Table 3). Forty-eight of the patients presented to clinic due to shoulder pathologies (98.0%) with three of the patients complaining of bilateral shoulder pain (6.1%), and one patient presented with scapular pain (2.0%). Many patients received multiple diagnoses from providers. The most common diagnoses included impingement (14 patients), rotator cuff tendinopathy (14 patients), muscle strains (10 patients), shoulder instability (8 patients), and biceps tendinopathy (7 patients) (Table 4a).

Diagnostic Evaluation

Twelve patients were diagnosed based on history and physical exam only (24.5%). Eleven of forty-nine patients (22.5%) underwent an x-ray in addition to a history and physical exam, while three patients (6.1%) received an MRI as well as a physical exam. Twenty-three patients (48.9%) had a more extensive workup for their injuries including both an MRI and x-rays in addition to a history and physical exam (Table 5).

Treatment protocol and Follow-Up

A number of treatment modalities were suggested for the swimmers seeking care. The most common recommendations included physical therapy (46/49 patients), taking time off from swimming (16/49 patients), lowering the intensity of swimming workouts until symptoms improve (14/49 patients), and non-steroidal anti-inflammatory medications (NSAIDs) (13/49 patients) (Table 6).

Three patients underwent surgical treatment for upper extremity swimming-associated injuries (6.1%). These operations included arthroscopic stabilization following an acute dislocation while swimming butterfly, a labral tear repair following an acute dislocation while swimming backstroke, and a subacromial decompression procedure for a patient with chronic subacromial bursitis (Table 6).

Twenty-nine patients (59.2%) followed up in orthopedics or sports medicine clinics (Table 6).

Lower Extremity Injuries

Demographics

Twenty-seven competitive swimmers visited an orthopedic surgeon or sports medicine physician for a concern related to their lower extremities. These patients were a mean of 13.4 years old (SD: 2.4, range 8-18). Twenty-three of the twenty-seven (85.2%) were female patients (Table 1).

Aggravating Factors

Patients described a number of aggravating factors related to their injuries. The most commonly mentioned factors included swimming breaststroke specifically (10/27 patients), pushing off of the wall or diving into the pool (8/27 patients), walking (5/27 patients), and a recent increase in yardage or intensity of swimming workouts (5/27 patients) (Table 2).

Injury Time Course, Location, and Specific Diagnoses

Twenty patients described their injuries as being chronic in nature (74.1%) while 7 patients had injuries due to acute events (25.9%) (Table 3). The most common locations of injuries were the knee (20/27 patients) and hip (5/27 patients). The most common diagnosis given was patellofemoral dysfunction (17 patients) with muscle strains being the next most frequently represented (4 patients) (Table 4b).

Diagnostic Evaluation

Six patients received only a physical exam and history during their visit (22.2%). Thirteen patients underwent an x-ray and history/physical exam (48.1%), one received an MRI and history/physical exam (3.7%), and seven received an x-ray, MRI, and history/physical exam (25.9%) (Table 5).

Treatment protocol, Surgeries and Follow-Up

Physicians recommended a range of treatment strategies for these competitive swimmers with lower extremity injuries. The most common recommendations were physical therapy (26/27 patients), decreasing the intensity of swimming workouts (10/26 patients), NSAIDs (9/27 patients), and conservative measures such as icing, stretching, or taping the affected area (8/27 patients) (Table 6).

Two patients underwent operations for lower extremity-related pathologies. One patient underwent a Fulkerson osteotomy and medial patellofemoral ligament (MPFL) repair for patellar instability and another underwent a medial meniscus repair with chondroplasty for a chronic meniscus tear due, in part, to a significant amount of breaststroke swimming specifically (Table 6).

Thirteen of the twenty-seven patients went to a follow-up appointment following their initial evaluation (Table 6).

Other Injuries

Demographics

Fourteen swimmers visited orthopedic surgeons or sports medicine doctors for primary concerns not related to the upper or lower extremities. These included injuries to the head, back, and trunk. This cohort of patients was a mean age of 15.7 years old at the time of their first visit (SD: 1.9, range: 12-18). Twelve of the fourteen patients were female (85.7%) (Table 1).

Aggravating Factors

The most common aggravating factors for this group of patients included swimming butterfly specifically (6/14 patients), swimming breaststroke specifically (4/14 patients), and doing flip turns (3/14) (Table 2).

Injury Time Course, Location, and Specific Diagnoses

Eleven of the fourteen patients sought care for chronic injuries (78.6%) while three visited a physician for

acute concerns (21.4%) (Table 3). The most common injury location for this group of patients was the back (10/14 patients) with the lower back being an especially common site of injury (7/14 patients). Two patients suffered injuries to the head (both concussions due to collisions during practice) and two suffered injuries to the chest or chest wall. The most common diagnosis was muscle strains or generalized low back pain (3 patients). Two patients were diagnosed with each of disc herniation, facet arthropathy, concussion, and scoliosis (Table 4c).

Diagnostic Evaluation

As in the medical workup for upper and lower extremity injuries, the evaluation for this cohort of patients included a history and physical examination, x-ray, and MRI. The most common workup protocol included a physical examination, x-ray, and MRI (42.8%). Only one patient did not receive imaging and thus only underwent evaluation with a history and physical exam (7.1%) (Table 5).

Treatment protocol, Surgeries and Follow-Up

The most common treatment modality for this cohort was physical therapy (12/14 patients). Other common recommendations included NSAIDs (4/14 patients), conservative measures such as icing, stretching and taping the affected area (4/14 patients), decreasing the intensity of swimming workouts (3/14 patients), and rest completely from swimming (3/14 patients). No patients received surgical treatment for their injuries in this cohort (Table 6). The majority of patients attended a follow-up visit (12/14 patients) (Table 6).

Table 2. *Aggravating Factors*

	Upper extremity (n=49)	Lower extremity (n=27)	Other (n=14)	Total (n=90)
Overhead activity (i.e., putting on shirt, throwing ball)	14	0	0	14
Acute increase in workload	9	5	1	15
Cross-training	8	2	2	12
Freestyle	6	1	1	8
Butterfly	7	2	6	15
Backstroke	5	0	0	5
Breaststroke	6	10	4	20
Positional changes	1	0	2	3
Walking & running	0	5	2	7
Push-offs & dives	0	8	0	8
Flip turns	0	0	3	3

Table 3. *Time course*

	Upper extremity	Lower extremity	Other	Total
Acute	6	7	3	16
Chronic	43	20	11	74

Table 4(a). *Upper Extremity Diagnoses*

Diagnosis	Patients
Impingement	14
Rotator cuff pathology	14
Muscle strain or undiagnosed pain	10
Shoulder instability (including dislocation)	8
Biceps tendon pathology	7

Labral pathology	7
Bursitis	3
Thoracic Outlet Syndrome	2
Salter-Harris Physeal Fracture of Proximal Humerus	1
AC joint pathology	1
Scapular dyskinesia	1

Table 4(b). *Lower Extremity Diagnoses*

Diagnosis	Patients
Patellofemoral dysfunction	17
Muscle strain or undiagnosed pain	4
Patellar instability	2
Impingement of hip	2
Sprain of great toe	1
Hip avulsion fracture	1
Osgood-Schlatter Disease	1
Labral pathology of hip	1
Meniscus tear	1
Patellar tendonitis	1

Table 4(c). *Other Diagnoses*

Diagnosis	Patients
Muscle strain or undiagnosed pain	3
Scoliosis	2
Disc herniation	2
Concussion	2
Facet arthropathy	2
Costochondritis	1
Slipping rib syndrome	1

Table 5. *Medical Workup*

	Upper extremity	Lower extremity	Other	Total
History & physical exam	12	6	1	19
H&P + x-ray	11	13	3	27
H&P + MRI	3	1	2	6
H&P + x-ray + MRI	23	7	6	36
H&P + CT[1]	0	0	1	1
H&P + Ultrasound + x-ray	0	0	1	1

[1]CT scan followed a head injury (concussion) resulting from a collision at practice

Table 6. *Treatment recommendations and follow-up*

	Upper extremity (n=49)	Lower extremity (n=27)	Other (n=14)	Total (n=90)
Physical therapy	46	26	12	84
Limit swimming intensity	14	10	3	27
NSAIDs	13	9	4	26
Complete rest from swimming	16	3	3	22
Conservative measures – icing, stretching, taping, etc.	10	8	4	22
Sling/Boot/Brace	1	6	1	8
Steroid Injection	3	0	2	5
Work on technique with coach	2	0	0	2
Cognitive rest, sleep	0	0	2	2
Surgery	3	2	0	5
Any follow-up visit	29	13	12	54
1 follow-up visit	20	7	8	35
2 follow-up visits	5	2	2	9
3 or more follow-up visits	4	4	2	10

Discussion

This retrospective cohort study investigated the most common pediatric and adolescent competitive swimming-related injuries as well as their associated diagnostic evaluation methods and treatment protocols. Of the 90 patient injuries we analyzed, 74 occurred in female patients. Prior research in collegiate swimmers has shown no relationship between gender and injury rates [10, 13]. However, Kerr et al. found that injuries to collegiate women swimmers were more likely to be related to overuse [13]. The large discrepancy in gender representation in our cohort of patients is thus thought-provoking. It may be the case that pediatric and adolescent swimmers have different rates of swimming-associated injury based on gender. We may hypothesize that if these differences do in fact exist, they may result from developmental differences and the age at which patients become skeletally and hormonally mature. However, we are unable to make any casual assertions based on the present study design. Future research should further investigate the relationship between swimming-associated injuries and gender in adolescent athletes.

The most common site of injury was the shoulder (48 of 90 studied injuries). This is consistent with numerous studies indicating the high incidence of shoulder pain and pathologies among swimmers [2, 3, 5, 7, 9, 10, 13-20]. Lower extremity injuries were most often localized to the knee (20 of 90 studied injuries). Other common injury sites included the back and hip. Across all injury locations, the majority of injuries analyzed were chronic in nature (74 of 90 injuries). It is likely that these injuries are the result of the chronic stress placed on athlete's joints from the repetitive motions associated with swimming training. While we are not able to make a definitive assertion of causality for these chronic injuries based on the current data alone, past research has indicated that overuse injuries are particularly common among swimmers [2, 5, 13]. Repeated stress on the joints creates cycles of inflammation which may predispose athletes to subluxation, pain and further injury [2]. In addition, many attributes that make swimmers athletically successful may make them susceptible to injury such as increased shoulder range of motion [2].

Particularly common upper extremity diagnoses among our patient cohort included shoulder impingement,

rotator cuff pathology, shoulder instability, and muscle strains (Table 4a). The term "swimmer's shoulder" has been used to describe shoulder pain associated with inflammation of the rotator cuff associated with impingement [21]. Notably, Sein et al. found that among the 80 swimmers whom they analyzed, 84% had positive impingement signs and 69% of those who underwent MRI had radiographic evidence of supraspinatus tendinopathy [3]. The study also found that the weekly yardage output of the swimmers correlated with supraspinatus tendinopathy [3]. Thus, it is perhaps not surprising that we found impingement and rotator cuff tendinopathy to be among the most commonly diagnosed conditions among our cohort of athletes.

Notably, nine of the 49 patients specifically reported a recent increase in the intensity and/or frequency of their workouts as well. This is consistent with findings from Feijen et al. who found that an increased acute to chronic workload ratio was predictive of shoulder pain development among competitive swimmers [22]. Similarly, Yoma et al. found that athletes' shoulder active external rotation range of motion was diminished following especially intense training sessions, which they hypothesized may make athletes susceptible to injury in subsequent practices [23]. As such, it is possible that chronic stress is put on the body by the repetitive motions of swimming and an acute increase in workload causes increased inflammation and increased susceptibility to injury. Wolf et al. found that among 94 Division 1 collegiate swimmers, freshmen were the most likely to suffer injuries [10]. It is possible that these first-year collegiate swimmers were at highest risk for injury due to a similar mechanism involving the body not being able to safely make the acute adjustment to the increased physical demands that come with collegiate athletics. In addition, the present data may suggest a need for guidelines regarding training volume and intensity for young swimmers. This may include descriptions of the number of practices per week based on age as well as the total yardage swum per practice. Future work is needed to better describe how these parameters may be determined. However, the relatively high prevalence of patients in our cohort who suffered upper extremity injuries as a result of recent increases in training intensity (9/49 patients) suggest that the development of such guidelines may be of value to coaches and athletes alike.

Among lower extremity injuries, the most common diagnosis given was patellofemoral dysfunction. Patellofemoral syndrome most often presents as anterior knee pain and is frequently associated with overuse related to running or other activities in which repetitive knee flexion occurs [24]. The most frequent aggravating causes of lower extremity pain in our cohort of 27 patients included swimming breaststroke specifically (10 patients) and wall push-offs and dives (8 patients). It is likely that the repeated knee flexion associated with pushing off of the wall each lap as well as the specific motion of kicking required in certain strokes, especially breaststroke, may contribute to the development of this condition. In fact, Kenal et al. note that this is a common lower extremity diagnosis among swimmers, particularly those who frequently swim breaststroke [25]. In addition, Grote et al. demonstrated that breaststroke specialists are more likely to have groin and hip related pain [26]. As such, our finding that swimming breaststroke was a commonly reported aggravating factor for lower extremity swimming-associated injuries is in line with prior research. Notably, five of the twenty-seven patients reported a recent increase in swimming workload during the initial evaluation of their lower extremity injury. As with upper extremity injuries, it is possible that an acute increase in physical stress on the body may cause a chronically overused joint to become symptomatic. However, future research is needed to better validate this hypothesis.

Among injuries to other parts of the body, the most common area of concern was the back and particularly the low back (10 of 14 patients and 7 of 14 patients, respectively). A number of diagnoses were given to patients with chronic low back pain associated with swimming with the most common being muscle strains, disc herniation, facet arthropathy, and scoliosis. Note that patients were not included in the study for asymptomatic scoliosis evaluations. However, those with swimming-associated pain and a scoliosis diagnosis were included for analysis. Prior research has demonstrated that back pain is a common presenting complaint for swimmers [9, 10, 27]. Nyska studied four swimmers with low back pain and found that three specialized in "short-axis" swimming strokes – butterfly and breaststroke. The authors hypothesized that the patients' back pain may be due to the repetitive hyperextension that is necessary for performance in these swimming disciplines [27]. We

found that six of the fourteen patients cited swimming butterfly as an aggravating factor associated with their pain and four of fourteen listed breaststroke as causing discomfort. Thus, our data support the limited literature that has suggested that low back pain among swimmers is associated with short-axis swimming strokes.

The most common medical workup across all injury locations was a history and physical exam in addition to x-ray and MRI studies (Table 5). The combination of x-ray and MRI allows for maximal evaluation of bony and soft tissue structures, respectively. Thus, it is logical that this combination of imaging modalities would be employed for the diagnosis of swimming-associated pathologies which include a range of both bony and soft tissue-associated conditions.

Finally, the treatment recommendations across all injury locations showed a significant preference for physical therapy (84 of 90 injuries). Additionally, rest from swimming, limiting swimming intensity, NSAIDs, and conservative measures including icing and stretching were commonly recommended treatments. As many swimming injuries may be related to soft tissue imbalances and inflammation, strengthening exercises through physical therapy is a logical first-line treatment plan for many swimmers [2]. Additionally, the concept of a holistic approach, including physical therapy, icing, massage, and muscle stimulation, to treating swimming injuries has been previously recommended [28]. Few patients required surgical intervention for their swimming-associated injuries (5 of 90 injuries). As such, it is likely that first-line therapies should continue to include non-invasive approaches such as those previously discussed.

Limitations

There are certain limitations inherent to the nature of retrospective chart review studies. First, we cannot be certain that the patient notes analyzed are comprehensive sources of data. For example, a patient may have mentioned to their physician that swimming freestyle causes shoulder discomfort, but this aggravating factor may not appear in the patient chart. Similarly, treatment recommendations verbalized by the provider, such as a suggestion to take off time from swimming, may not have been formally written in the patient note. As such, it is possible that certain variables are underreported. In addition, many notes did not have information regarding the exact time course of patient injuries nor the return to play interval following treatment. Therefore, the variable of time course was grouped as acute or chronic and return to play data were not included. In addition, we are not able to make causal assertions regarding the specific mechanisms of injury development given the retrospective nature of the study. Because patients may not have followed up with their provider once their symptoms resolved, we are further unable to comment on the efficacy of the treatment protocols or outcomes for patients such as return to play timelines. Future research should thus include longitudinal follow-up with patients in order to assess the course of swimming-associated injuries. It is also possible that our data acquisition process did not capture all swimmers who sought care from orthopedic surgeons and sports medicine physicians at our institution if the patient notes did not use the keywords for which we searched. Finally, it is possible that patients sought care from primary care providers or other physicians not included in this study design for swimming-associated injuries.

Conclusions

Common injury locations for pediatric and adolescent competitive swimmers include the shoulder, knee, and lower back. Treatment for swimming-associated injuries in this population often includes physical therapy, NSAID medications, and limiting swimming training intensity. However, surgical treatment is uncommonly indicated.

While most injuries among the cohort of swimmers studied were chronic in nature, many patients noted that a recent increase in workload may have contributed to the worsening of their symptoms. As such, providers may recommend diversifying sporting activity among this patient population in order to promote longevity in sports, enhance performance, and decrease burnout [29].

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