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Comparison of Shoulder Injury in Collegiate- and Master's-Level Swimmers

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Abstract: The need to investigate shoulder injury in swimmers other than the young and elite is evident, as all ages and levels are represented in the 100 million Americans who classify themselves as swimmers. To investigate the differences between young, highly competitive collegiate swimmers and older, less elite swimmers, a survey questionnaire was distributed to 100 collegiate and 100 master's swim teams. Questions regarding swimming routines, performance standards, and several possible predisposing factors associated with "swimmer's shoulder," as implicated in the literature, were investigated. As expected, the results revealed that the collegiate group swam the higher yardage, with considerably faster times in both the 50- and the 1,000-yd freestyle, and more than double the number of workouts per week. However, the collegiate and master's group reported similar percentages, 47 and 48%, respectively, experiencing shoulder pain lasting 3 weeks or more, despite the lesser distances and intensities associated with the latter group. Chi-square analysis revealed no association between shoulder pain and perceived level of flexibility, hand paddle usage, or breathing side for either group. However, over 50% of the swimmers with shoulder pain in both groups perceived that increased intensities and/or distance provoked shoulder pain, indicating that fatigue may be the issue to avoid and on which to focus. Strengthening the muscles of the shoulder, specifically those shown to have a propensity to fatigue, provides a strong defense against injury, as fatigue of the shoulder muscles may be the initial antecedent to swimmer's shoulder. These results give the swimmer, coach, and medical practitioner feedback to consider for a swimmer of any age or level. **Key Words:** Master's athlete—Overuse—Shoulder injuries. *Clin J Sport Med* 1995;5(1):4-8.

The term "swimmer's shoulder" is typically used to describe any type of shoulder discomfort in the swimmer. It is also the most common orthopedic complaint among swimmers. The cause and the possible factors associated with swimmer's shoulder have been extensively investigated in the elite- and collegiate-level swimming population (3,7,11,12,18).

Since all ages and levels are represented in the 100 million Americans who classify themselves as swimmers (9), the need to investigate the incidence of shoulder pain in swimmers other than the young and very elite is evident.

Three unavoidable factors influencing swimmer's shoulder for any age or level swimmer are that (a) swimming demands an extremely high repetition rate of shoulder revolution, (b) swimming will take the shoulder to extremes of range of motion (ROM), and (c) swimming requires the generation of high muscular forces on the shoulder to sustain the forward propulsive effort.

Other factors related to swimmer's shoulder and associated training regimes have been implicated in the literature on shoulder injury. Breathing side, lack of flexibility or hyperlaxity, hand paddle usage, and increased intensities and/or distances all have been linked to swimmer's shoulder (3-6,12,14,18).

The purpose of this survey study was to compare the swimming profiles of young, elite, collegiate swimmers versus older, less elite master's swimmers, as well as to assess the correlation between previously described risk factors and swimmer's shoulder.

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	Collegiate	Master's
Average age (yr)	19.5	41.5
Average age at entry into swimming (yr)	9.1	22.1
Average age at entry into swimming (yr) for swimmers with shoulder pain	8.8	25.1
Total years of consistent swimming	10.1	12.1
Swim sessions per week	8.6	4.0
Estimated wk/yr of 6,000 + yd	40.6	42.0

TABLE 1. Descriptive data on collegiate and master's swimmers

Five hundred thirty-two collegiate swimmers and 395 master's swimmers returned the survey, making the response rate slightly >18%. The average age of the collegiate swimmer was 19.5 years, and the average age of the master's swimmer was 41.5 years. The age at entry into swimming was 9.1 years for the collegiate group and 22.1 years for the master's group. The total number of years of consistent swimming was 10.1 years for the college population and 12.1 years for the master's group. The average age at starting swimming for the collegiate swimmer with shoulder pain was 8.8 years and the average age at starting swimming for the master's swimmer with shoulder pain was 25.1 years (Table 1). Hand dominance percentages were 90% right dominant, 9% left dominant, and 1% ambidextrous in the college group and 88% right dominant, 11% left dominant, and 1% ambidextrous in the master's group. Breathing side revealed that, of the college group,

RESULTS

The last two questions in the first half of the survey asked if they had ever had swimming-related shoulder pain that lasted 3 weeks or more and if the swimmer responded with a "yes" to both questions, the individual was defined as injured and was asked to continue with the additional questions on the following page. A "no" to either or both of those questions signaled completion of the survey. Page 2 of the survey further delineated the group with painful shoulders by asking their side of shoulder pain and the side they breathed from during swimming at the time of pain occurrence. They were asked if the pain was provoked by an increase in distance and/or intensity and whether they used hand paddles during swim sessions immediately prior to the injury. The final questions related to their actions based upon discomfort, such as if they obtained medical intervention and prescribed medical treatment, if any. Descriptive statistics were utilized to summarize the data. The chi-square test of association was used to compare the two populations.

METHODS

This study utilized a two-page questionnaire that was sent to 100 collegiate and 100 master's swim teams surveying their incidence of shoulder pain and the possible factors predisposing them to injury. A modified random sample was used to incorporate all 50 of the United States for both the collegiate and the master's group. All collegiate swimmers competed under National Collegiate Athletic Association (NCAA) division I, II, or III guidelines. The demographic data collected on the latter group validate swimmers belonging to United States Masters Swimming (USMS) as the group representative of the older, less elite, swimmer. Included in each of the mailings to the 200 teams were 25 individual surveys and a letter to each coach that clarified instructions and stated the purpose, as well as requesting support and assistance. A self-addressed, stamped envelope was included to accommodate the survey return.

Prior to mass mailing, two pilot surveys were administered to two swim teams to ensure the clarity and validity of the questions. Based upon responses in the pilot surveys, further alterations in the questions and format were made. The beginning portion of the survey hosted demographic data such as current age, age at entry into swimming, total number of years of consistent swimming, and hand dominance. The survey continued with questions regarding their swimming routines, such as breathing side, use of hand paddles, number of swim sessions per week, and estimates of how much of their swimming routine was dedicated to the freestyle stroke. Estimated weekly yardage was queried and divided into eight possible selection categories, starting at 0-10,000 yd as the lowest category and >70,000 yd as the highest selection category. Each category between the lowest and the highest had a range of 10,000 yd. The swimmers performance profile was determined by asking questions regarding their current race times for 50 and 1,000 yd, to accommodate both the short- and the long-distance swimmer. Performance times for 50 yd of freestyle swimming were broken into eight intervals: <20, 20-22, 23-24, 25-26, 27-28, 29-30, 31-40, and ≥40 s. One thousand-yard times were divided into the following seven categories: <9, 9-11, 12-13, 14-15, 16-17, 18-19, and ≥20 min. They were asked to estimate the number of weeks per year they swam over 6,000 yd as well. An additional question asked whether they considered their body joints to be flexible, tight, or average.

31% breathed from their right side, 14% breathed from their left side, and 55% were bilateral breathers. In the master's group, 42% breathed from their right side, 26% breathed from their left side, and 32% breathed bilaterally.

Distribution of estimated weekly yardage in 1,000-yd categories revealed that the largest percentage (26%) of collegiate swimmers swam between 40,000 and 50,000 yd per week. The largest percentage (48%) of the master's population swam between 10,000 and 20,000 yd per week (Table 2).

The collegiate group reported 8.6 workouts per week, while the master's group reported 4.0. Reported weeks of the year at $\geq 6,000$ yd were 40.6 for the college group and 42.0 for the master's group (Table 1).

Forty-six percent of the collegiate group reported incorporating paddles in their workouts, while 28% of the master's group incorporated paddles. Seventy-nine percent of the collegiate group who used hand paddles did so for $\geq 3,000$ yd per week, while only 17% of the master's group used them for $\geq 3,000$ yd.

Performance time breakdown for 50 yd of freestyle swimming revealed that the largest percentage (30%) of collegiate swimmers were capable of swimming that distance in 23–24 s, while the largest percentage of master's swimmers (33%) fell in the 31- to 40-s category (Table 3).

Nearly half, and the largest percentage (47%), of the collegiate swimmers claimed the ability to swim 1,000 yd of freestyle in 9 to 11 min. The largest percentage of master's swimmers (31%) claimed the ability to swim that distance in 12 to 13 min (Table 3).

Sixty percent of the college swimmers reported dedicating $\geq 70\%$ of their workout to the freestyle stroke, while the master's swimmers reported 59% dedicating $\geq 70\%$ of their workout to freestyle.

The response to the joint flexibility inquiry indicated similar distribution patterns of tight, average, and flexible subjective joint flexibility across both groups (Table 4).

Both groups reported that nearly 50% of the swimmers sustained a swimming-related shoulder injury. Forty-seven percent of the college and 48% of the master's swimmers claimed to have experienced shoulder pain lasting 3 weeks or more that, in

TABLE 2. Distribution of estimated weekly yardage

Yd	Collegiate (%)	Master's (%)
0–10K	0	42
10K–20K	2	48
20K–30K	15	9
30K–40K	20	1
40K–50K	26	0
50K–60K	23	0
60K–70K	10	0
70K+	4	0

TABLE 3. Performance time distribution for 50 and 1,000 yd of swimming

	Collegiate (%)	Master's (%)
50 Yd		
Seconds		
<20	1	0
20–22	28	2
23–24	30	10
25–26	25	18
27–28	11	14
29–30	4	16
31–40	1	33
40>	0	7
1,000 yd		
Minutes		
<9	23	0
9–11	47	22
12–13	26	31
14–15	3	19
16–17	0	15
18–19	1	7
20>	0	6

turn, forced them to cease or alter their swimming routines.

When swimmers with shoulder pain were delineated from the entire group, the percentages of subjective joint flexibility varied only slightly from those reported by swimmers without shoulder pain (Table 4).

Fifty-five percent of the college swimmers with shoulder pain opted to seek medical intervention, versus 39% of the master's swimmers. Of the six treatment recommendations [rest, exercise, ice, nonsteroidal antiinflammatory drugs (NSAIDs), surgery, or other] advised by a health professional, ice was the most frequently prescribed treatment for the college swimmers (92%). Rest and NSAIDs were the most frequently prescribed treatment in the master's group, with both treatments having a 76% recommendation rate.

Chi-square analysis revealed no statistically significant probability of breathing side having an association with shoulder pain ($p < .05$).

Another chi-square analysis, executed on those with shoulder pain, revealed no statistically significant probability of an association between shoulder pain and subjective level of joint flexibility ($p < .05$).

Respectively, 71 and 73% of the college and master's swimmers with shoulder pain reported that

TABLE 4. Reported flexibility for college and master's swimmers

	College	Master's	College with pain	Master's with pain
Flexible	221 (42%)	144 (37%)	108 (43%)	73 (38%)
Tight	79 (15%)	70 (18%)	37 (15%)	45 (24%)
Average	226 (43%)	175 (45%)	104 (42%)	72 (38%)

It is common for competitive swimmers to use paddles to strengthen and improve their stroke. It is thought that the paddles increase the kinesthetic awareness (the "feel" for movement) as well as increase the muscular power (9).

No statistically significant probability of association emerged when analyzing hand paddle usage and shoulder pain, immediately after their use; however, the additional strain on the shoulder imposed by hand paddles may further fatigue an already susceptible shoulder, therefore, one would be wise to limit the use of paddles as well as avoid using paddles late in a swim session, when the muscles are most prone to fatigue.

The higher percentage of collegiate swimmers who opted to seek medical intervention may be due to the generally higher stakes involved. A collegiate swimmer may have scholarships and team pressures encouraging a rapid recovery.

Percentages revealed ice as the number one treatment for the college group and rest and NSAIDs as the number one treatment for the master's group. It is quite possible that rest is not frequently advised for the college group because, once again, team, peer, or scholastic pressures may discourage periods of rest.

This study did not differentiate current versus past pain and therefore may not identify the master's swimmer whose injury may have been sustained in college. However, since in the master's group, the average age at starting swimming for those with shoulder pain (25.1 years) is commonly the age at which most collegiate swimmers have graduated from college, it is quite likely that the shoulder pain sustained by the master's swimmer was in fact sustained during the master years, as opposed to the collegiate swimming years. Therefore, the percentages reported in this survey should be closely representative of two distinct populations.

These results give the coach and medical practitioner feedback on factors to consider when encountered with a swimmer, of any age or level, with the common complaint of "swimmer's shoulder."

SUMMARY

Responses to a two-page questionnaire sent to 100 collegiate and 100 master swim teams provided insight into training routines, shoulder injury rates, and possible predisposing factors.

Information collected on each group's performance time revealed the collegiate group to be swimming much higher weekly yardage and more than double the amount of workouts per week.

The similar percentages of collegiate and master's swimmers (47 and 48%, respectively) who ex-

perienced shoulder pain lasting 3 weeks or more, however, indicate that "swimmer's shoulder" is not a condition unique to the young, more competitive swimmer, despite the lesser intensities and distances associated with the master's group.

No association was found between shoulder pain and perceived level of flexibility, hand paddle usage, or breathing side for either group.

Over 50% of those with shoulder pain in both groups reported provocation following an increase in swimming intensity and/or distance. This information, backed by current EMG data, supports the notion that fatigue may be the major issue.

Implementing a strengthening program, with particular emphasis on the subscapularis and serratus anterior, the muscles most prone to fatigue, may be the swimmer's best defense against shoulder injury.

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