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# Prevalence of musculoskeletal disorders in swimming athletes

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**Abstract**
Musculotendinous injuries and disorders are very common among sports personnel's. It involves injuries of soft tissues supporting posture and alignment of posture. Swimming athletes tend to develop musculoskeletal disorder due to repetitive movements in particular direction. Musculoskeletal pathologies arise as a result of prolonged working in awkward posture. In sports due to excessive continuous strain in soft tissues lead to development of soft tissue disorder.
**Aims and objective**: To study the prevalence of Musculoskeletal Disorders in Swimming Athletes.
**Methodology:** A total of 120 athletes participated in the research, 30 freestyle stroke athletes, 30 breaststroke athletes and 30 backstroke athletes, 30 butterfly athletes. The Nordic Questionnaire was used to determine the prevalence of musculoskeletal disorders in swimming athletes.
**Results:** The major findings of this study demonstrated that there is highly significant prevalence of shoulder pain constituting 67.33% of athletes in freestyle, butterfly and backstroke. The breaststoke constituted about 28.66% of knee joint disorder.
**Conclusion:** From this study, it is concluded that the prevalence of shoulder joint is significantly higher in athletes performing freestyle stroke and butterfly stroke. Knee pain was significantly very high among swimmers who practice breaststroke.

**Keywords:** swimming athletes, competitive swimming, swimming strokes, nordic questionnaire

## Introduction
Swimming is a sport which involves participation of young athletes/ generation in competitive events. In swimmers, shoulder pain is the most common musculoskeletal complaint and is usually due to supraspinatus or biceps tendinitis. Modern training techniques are producing steady improvements in world record times for competitive swimming but may also be placing the competitive swimmer at greater risk for injury [1]. Swimming is an organized, fast growing sport with competitive swimmers found in abundance in all age group. Most injuries and complaints encountered in swimming athletes occur because of repetitive micro trauma or overuse, with many injuries originating from faulty technique and poor swimming biomechanics. Swimming is unique in that it provides upper and lower body strength and cardiovascular training, which is performed in a non-weight bearing environment. However the highly repetitive motion of swimming may predispose overuse injury [2].
Swimmers perform highly repetitive motions that can lead to overuse injuries, specifically to the shoulder and back (Kenal *et al*, 1996). Back injuries in swimmers include disc degeneration, hyperextension, or myofascial involvement (Kenal *et al*, 1996).
Swimmers who frequently participate in the breast stroke and butterfly continually hyperextend their backs in order to perform the movement, and studies have shown that this element is related to spondylolysis (Nyska *et al*, 2000)[3]. Swimming is one of the safest sports. Still there are few injuries. One of the biggest injury types is shoulder injuries and other upper part chronic overuse injuries [4]. Swimming ranks above both hiking and jogging in the number of participants in the United States. Competitive swimming is a demanding and time-consuming sport. During 1 year of practice, the average top-level swimmer may perform over 500,000 strokes per arm [5, 6]. Most successful competitive swimmers in the United States swim for 10 to 11 months each year in a career that often begins by age 6 years and may last continuously for 10 to 15 years. Many swimmers engage in two swim practices daily, 5 to 7 days per week, and often average 8,000 to 20,000 yards per day, depending on the season. Application of a four-to-one ratio proposed by Counsilman shows that this distance is equivalent to running 32,000 to 80,000 yards per day—or more than 45 miles per day. This enhanced intensity of activity put competitive swimmers at enhanced risk of development of musculoskeletal disorders [1].
Swimming is a kind of sport which involves combination of whole body strength exercises along with cardiovascular training. Most common stokes in swimming are freestyle stroke, backstroke, butterfly stroke and breast stroke. Swimmers mostly spent lot of time in performing free style swimming and because of repetitive movement of upper extremity and lower extremity it lead to development of musculoskeletal disorders most commonly shoulder, spine, and knee joint [7].
Musculoskeletal disorders MSD are disorders observed in the joints and supporting soft tissues which includes ligaments, nerves, and tendons. MSD can develop due to various reasons it could be sudden twisting activity, lifting of heavy weight or may be due to repetitive activity or may be working in awkward posture for longer duration. Musculoskeletal disorder can arise due to various reasons and can affect any part of the skeletal system [6].

## Procedure
150 subjects were approached for the study A total number of 120 subjects (including male and female) who fulfilled the inclusion criteria were included in the study.

After the selection of the subjects, consent forms were given to the subjects. A signed consent was collected from the subjects. Questionnaires were then distributed to the participants, with verbal instructions to fill the questionnaire. The questionnaire, once filled, was collected personally from the participants. The instrument used in this study is Nordic questionnaire [10].

## Results

**Table 1:** Have you at any time during the last 12 months had any trouble (such as ache, pain, discomfort, numbness) in

| Body Region | Total No. of Patients | Yes | | No | |
|---|---|---|---|---|---|
| | | No. Of Patients | Percentage of Patients | No. of Patients | Percentage of Patients |
| Neck | 120 | 44 | 36.67% | 76 | 63.33% |
| Shoulders | 120 | 95 | 79.17% | 25 | 20.83% |
| Upper back | 120 | 48 | 40.00% | 72 | 60.00% |
| Elbows | 120 | 26 | 21.67% | 94 | 78.33% |
| Wrist/hands | 120 | 27 | 22.50% | 93 | 77.50% |
| Lower back | 120 | 34 | 28.33% | 86 | 71.67% |
| Hips/thighs | 120 | 10 | 8.33% | 110 | 91.67% |
| Knees | 120 | 29 | 24.17% | 91 | 75.83% |
| Ankles/feet | 120 | 31 | 25.83% | 89 | 74.17% |

**Table 2:** During the last 12 months have you been prevented from carrying out normal activities (e.g. Job, housework, hobbies) because of this trouble in

| Body Region | Total No. of Patients | Yes | | No | |
|---|---|---|---|---|---|
| | | No. of Patients | Percentage of Patients | No. of Patients | Percentage of Patients |
| Neck | 120 | 108 | 90.00% | 12 | 10.00% |
| Shoulders | 120 | 13 | 10.83% | 107 | 89.17% |
| Upper back | 120 | 3 | 2.50% | 117 | 97.50% |
| Elbows | 120 | 7 | 5.83% | 113 | 94.17% |
| Wrist/hands | 120 | 10 | 8.33% | 110 | 91.67% |
| Lower back | 120 | 16 | 13.33% | 104 | 86.67% |
| Hips/thighs | 120 | 5 | 4.17% | 115 | 95.83% |
| Knees | 120 | 6 | 5.00% | 114 | 95.00% |
| Ankles/feet | 120 | 17 | 14.17% | 103 | 85.83% |

**Table 3:** During the last 7 days have you had trouble in

| Body Region | Total No. of Patients | Yes | | No | |
|---|---|---|---|---|---|
| | | No. of Patients | Percentage of Patients | No. of Patients | Percentage of Patients |
| Neck | 120 | 53 | 44.17% | 67 | 55.83% |
| Shoulders | 120 | 103 | 85.83% | 17 | 14.17% |
| Upper back | 120 | 55 | 45.83% | 65 | 54.17% |
| Elbows | 120 | 24 | 20.00% | 96 | 80.00% |
| Wrist/hands | 120 | 4 | 3.33% | 116 | 96.67% |
| Lower back | 120 | 23 | 19.17% | 97 | 80.83% |
| Hips/thighs | 120 | 11 | 9.17% | 109 | 90.83% |
| Knees | 120 | 17 | 14.17% | 103 | 85.83% |
| Ankles/feet | 120 | 36 | 30.00% | 84 | 70.00% |

### Stroke wise tabular & graphical representation

### Free Style Stroke

**Table 4:** Have you at any time during the last 12 months had any trouble (such as ache, pain, discomfort, numbness) in

| Body Region | Total No. of Patients | Yes | |
|---|---|---|---|
| | | No. Of Patients | Percentage Of Patients |
| Neck | 30 | 12 | 40.00% |
| Shoulders | 30 | 26 | 86.67% |
| Upper back | 30 | 16 | 53.33% |

**Table 5:** During the last 12 months have you been prevented from carrying out normal activities (e.g. Job, housework, hobbies) because of this trouble in

| Body Region | Total No. of Patients | Yes | |
|---|---|---|---|
| | | No. of Patients | Percentage of Patients |
| Neck | 30 | 3 | 10.00% |
| Shoulders | 30 | 6 | 20.00% |
| Upper back | 30 | 1 | 3.33% |

| | | | |
|---|---|---|---|
| Elbows | 30 | 0 | 0.00% |
| Wrist/hands | 30 | 0 | 0.00% |
| Lower back | 30 | 1 | 3.33% |
| Hips/thighs | 30 | 0 | 0.00% |
| Knees | 30 | 0 | 0.00% |
| Ankles/feet | 30 | 0 | 0.00% |

**Table 6:** During the last 7 days have you had trouble in

| Body Region | Total No. of Patients | Yes | |
|---|---|---|---|
| | | No. of Patients | Percentage of Patients |
| Neck | 30 | 19 | 63.33% |
| Shoulders | 30 | 29 | 96.66% |
| Upper back | 30 | 19 | 63.33% |
| Elbows | 30 | 6 | 20.00% |
| Wrist/hands | 30 | 1 | 3.33% |
| Lower back | 30 | 10 | 33.30% |
| Hips/thighs | 30 | 2 | 6.66% |
| Knees | 30 | 3 | 10.00% |
| Ankles/feet | 30 | 2 | 6.66% |

## Butterfly Stroke

**Table 7:** Have you at any time during the last 12 months had any trouble (such as ache, pain, discomfort, numbness) in

| Body Region | Total No. of Patients | Yes | |
|---|---|---|---|
| | | No. Of Patients | Percentage Of Patients |
| Neck | 30 | 14 | 46.66% |
| Shoulders | 30 | 16 | 53.33% |
| Upper back | 30 | 10 | 33.33% |
| Elbows | 30 | 10 | 33.33% |
| Wrist/hands | 30 | 13 | 43.33% |
| Lower back | 30 | 18 | 60.00% |
| Hips/thighs | 30 | 14 | 46.66% |
| Knees | 30 | 10 | 33.33% |
| Ankles/feet | 30 | 5 | 16.66% |

**Table 8:** During the last 12 months have you been prevented from carrying out normal activities (e.g. Job, housework, hobbies) because of this trouble in

| Body Region | Total No. of Patients | Yes | |
|---|---|---|---|
| | | No. of Patients | Percentage of Patients |
| Neck | 30 | 2 | 6.66% |
| Shoulders | 30 | 5 | 16.66% |
| Upper back | 30 | 0 | 0.00% |
| Elbows | 30 | 0 | 0.00% |
| Wrist/hands | 30 | 3 | 10.00% |
| Lower back | 30 | 6 | 20.00% |
| Hips/thighs | 30 | 2 | 6.66% |
| Knees | 30 | 1 | 3.33% |
| Ankles/feet | 30 | 0 | 0.00% |

**Table 9:** During the last 7 days have you had trouble in

| Body Region | Total No. of Patients | Yes | |
|---|---|---|---|
| | | No. of Patients | Percentage of Patients |
| Neck | 30 | 1 | 3.33% |
| Shoulders | 30 | 3 | 10.00% |
| Upper back | 30 | 0 | 0.00% |
| Elbows | 30 | 2 | 6.66% |
| Wrist/hands | 30 | 2 | 6.66% |
| Lower back | 30 | 8 | 26.66% |
| Hips/thighs | 30 | 1 | 3.33% |
| Knees | 30 | 1 | 3.33% |
| Ankles/feet | 30 | 1 | 3.33% |

## Backstroke

**Table 10:** During the last 12 months have you been prevented from carrying out normal activities (e.g. Job, housework, hobbies) because of this trouble in

| Body Region | Total No. of Patients | Yes | |
|---|---|---|---|
| | | No. of Patients | Percentage of Patients |
| Neck | 30 | 1 | 3.33% |
| Shoulders | 30 | 1 | 3.33% |
| Upper back | 30 | 0 | 0.00% |
| Elbows | 30 | 0 | 0.00% |
| Wrist/hands | 30 | 0 | 0.00% |
| Lower back | 30 | 0 | 0.00% |
| Hips/thighs | 30 | 0 | 0.00% |
| Knees | 30 | 0 | 0.00% |
| Ankles/feet | 30 | 2 | 6.66% |

**Table 11:** Have you at any time during the last 12 months had any trouble (such as ache, pain, discomfort, numbness) in

| Body Region | Total No. of Patients | Yes | |
|---|---|---|---|
| | | No. of Patients | Percentage of Patients |
| Neck | 30 | 4 | 13.33% |
| Shoulders | 30 | 5 | 16.66% |
| Upper back | 30 | 3 | 10.00% |
| Elbows | 30 | 4 | 13.33% |
| Wrist/hands | 30 | 4 | 13.33% |
| Lower back | 30 | 2 | 6.66% |
| Hips/thighs | 30 | 2 | 6.66% |
| Knees | 30 | 3 | 10.00% |
| Ankles/feet | 30 | 2 | 6.66% |

**Table 12:** During the last 7 days have you had trouble in

| Body Region | Total No. of Patients | Yes | |
|---|---|---|---|
| | | No. of Patients | Percentage of Patients |
| Neck | 30 | 1 | 3.33% |
| Shoulders | 30 | 3 | 10.00% |
| Upper back | 30 | 4 | 13.33% |
| Elbows | 30 | 5 | 16.66% |
| Wrist/hands | 30 | 3 | 10.00% |
| Lower back | 30 | 2 | 6.66% |
| Hips/thighs | 30 | 3 | 10.00% |
| Knees | 30 | 1 | 3.33% |
| Ankles/feet | 30 | 3 | 10.00% |

## Breast Stroke

**Table 13:** Have you at any time during the last 12 months had any trouble (such as ache, pain, discomfort, numbness) in

| Body Region | Total No. of Patients | Yes | |
|---|---|---|---|
| | | No. of Patients | Percentage of Patients |
| Neck | 30 | 9 | 30.00% |
| Shoulders | 30 | 9 | 30.00% |
| Upper back | 30 | 8 | 26.66% |
| Elbows | 30 | 6 | 20.00% |
| Wrist/hands | 30 | 3 | 10.00% |
| Lower back | 30 | 5 | 16.66% |
| Hips/thighs | 30 | 2 | 6.66% |
| Knees | 30 | 18 | 60.66% |
| Ankles/feet | 30 | 1 | 3.33% |

**Table 14:** During the last 12 months have you been prevented from carrying out normal activities (e.g. Job, housework, hobbies) because of this trouble in

| Body Region | Total No. of Patients | Yes | |
|---|---|---|---|
| | | No. of Patients | Percentage of Patients |
| Neck | 30 | 4 | 13.33% |
| Shoulders | 30 | 4 | 13.33% |
| Upper back | 30 | 2 | 6.66% |
| Elbows | 30 | 2 | 6.66% |
| Wrist/hands | 30 | 2 | 6.66% |
| Lower back | 30 | 2 | 6.66% |
| Hips/thighs | 30 | 1 | 3.33% |
| Knees | 30 | 2 | 6.66% |
| Ankles/feet | 30 | 0 | 0.00% |

**Table 15:** During the last 7 days have you had trouble in

| Body Region | Total No. of Patients | Yes | |
|---|---|---|---|
| | | No. of Patients | Percentage of Patients |
| Neck | 30 | 5 | 16.66% |
| Shoulders | 30 | 7 | 23.33% |
| Upper back | 30 | 4 | 13.33% |
| Elbows | 30 | 1 | 3.33% |
| Wrist/hands | 30 | 1 | 3.33% |
| Lower back | 30 | 1 | 3.33% |
| Hips/thighs | 30 | 2 | 6.66% |
| Knees | 30 | 6 | 20.00% |
| Ankles/feet | 30 | 2 | 6.66% |

Analysis of results revealed that of the 120 respondents there were 30 athletes of each stroke. A total of 90 athletes (75%) indicated that they had musculoskeletal disorder, and mainly shoulder problems (67.33%), followed in descending order by knee injuries and low back pain problems. The prevalence of musculoskeletal disorders ranked highest among freestyle swimmers (N=29) followed by breaststroke (N=22), butterfly (N=18) and finally backstroke (N=13) swimmers. Musculoskeletal disorders are common in an elite swimmers and thus care must be taken for their prevention and early safe return to play.

## Discussion

The results reveal a significant high percentage of swimming athletes being affected with a musculoskeletal pain and disorder which may occur due to their overhead motion. Supporting this William C. McMaster *et al* study on correlation between shoulder laxity and interfering pain in competitive swimmers reveals that thirty-five percent of this group of senior national and elite swimmers reported the current presence of interfering shoulder pain. These findings suggest positive relation with our previous observations which based on competitive swimmers and further supports and reaffirms the concern towards the which might have on the ability of our swimmers to effectively compete in the national arena. It is our belief that a common denominator in the aquatic athlete with interfering shoulder pain is the degree of inherent shoulder laxity. Overhead athletes from a variety of sports show changes in the rotator cuff muscles on strength testing [8].

The reason for higher prevalence of knee pain in breastrokers is due to the whip-like kick performed against a propulsive force. Knee pain in swimmers occurs primarily in those who do the breaststroke and thus has been termed "breaststroker's knee." Kennedy and colleagues surveyed 2,496 competitive swimmers throughout Canada and found 70 who were affected by knee pain, all of whom were breaststrokers.

Breaststroker's knee is characterized by pain and tenderness in the medial aspect of the knee joint and has been thought to be due to incorrect mechanics of the breaststroke whip kick. Knee effusions and patellofemoral pain and crepitus have also been reported [1].

Another study by Amanda Weiss Kelly on Non-Contact Sports: Running, Swimming, and Dance — Identifying Common Injuries showed that swimmers are prone to back problems because the muscles overlying and connecting to the vertebrae often adapt themselves to accommodate the quadriceps, which enlarge due to kicking, the latissimus, which strengthens from pulling and the constant turning and twisting of the back as the sport is pursued. The resultant skeletal alignment produced by these muscular forces is an increased lumbar curve or lordosis, which is seenpredominately in butter flyers, breaststrokers and sprinters [9].

## Conclusion

Competitive swimming is a rigorous sport being engaged in by an increasing number of young athletes, Among competitive swimmers, shoulder pain isthe most common musculoskeletal complaint. It is usually repetitive impingement beneath the coracoacromial arch, and it occurs in freestyle, backstroke, and butterfly stroke swimmers. The treatment, which is basically conservative, includes alteration of stroke mechanics and workout schedules, flexibility and strengthening exercises, and local measures to reduce inflammation and pain.

Shoulder pain prevention can be done with the help of specially designed training schedules, inclusion of strength training, flexibility training and inclusion of correct technique of swimming. One should always consider importance of recovery phase in swimming along with pull through phase. Inflammation of medial retinaculum of knee lead to development of breast strokers knee which develops due to repeated stress while performing breast stroke. Most

investigators have found inflammation of the tibial collateral ligament as the source of pain. The treatment is focused on correcting abnormal kick mechanics and limiting the amount of training using the whip kick. Prevalence of inflammation in the dorsum of foot is less frequently observed as compared to shoulder pain and knee pain.

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