

## Injury Profile of High School Club Gymnasts

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### ABSTRACT

**Background:** Gymnastics, a sport well known in young age participants involve repetitive powerful movements which demands musculoskeletal strength and flexibility open to increased risk of most injuries. However studies in past has shown their prevalence, incidence and typical injury patterns but none of them highlighted the Indian gymnasts. The aim was to carry-out the survey on injury profile of high school club gymnasts.

**Objective:** To identify the types, frequency, and location of musculoskeletal injuries.

**Methods:** A cross-sectional study of 100 school professional competitive club gymnasts with a mean age of  $11.12 \pm 2.67$  years was collected as per inclusion criteria. Injury profile was obtained by the subjects through a self-administered validated questionnaire.

**Results:** Seventy-four percent (n=74) reported injuries during data collection. The most common injury included those of the wrist (39%), back (35%) and ankle (35%). 78.37% of gymnasts had reported soft tissue type of injury.

**Conclusion:** This study on injury profile highlighted higher rates of injuries in wrists and back and ankle. While majority of them had soft tissue injury which is associated with injuries while doing floor exercises. These findings reinforce the need for scientific sports specific training and preventive fitness measures to reduce the higher risk of musculoskeletal injuries.

**Keywords:** musculoskeletal injuries, gymnasts, injury profile, prevalence, training.

### INTRODUCTION

Gymnastics evolved from exercises originated by the ancient Greeks that included the skills for performing mounting and dismounting maneuvers. There is an increase in popularity of gymnast particularly females in the last few years through their astonishing and elegant performances in competition. <sup>(1-3)</sup> These gymnasts are generally required to be smaller, younger and thinner basically those who are able to flip and twist faster and higher.

Unlike other sports, gymnastics require to coordinate with the apparatus and

flexibility to achieve the position. They constantly practice the basics at their routine training until they achieve perfection of the position. It is a physically demanding sport and predispose to diverse injuries of the musculoskeletal system. The long term effects of these injuries give rise to concern about their severity and risk in young gymnasts. <sup>(4)</sup>

With increased intensity of their training they tend to perform even more difficult moves on different equipment which when combined, frequently leads to injuries. <sup>(4,5)</sup> Studies are available in the scientific literature with related to the

different types of gymnastics that requires significant amount of flexibility specifically the back extension. (4) Researchers have found that despite higher sports participation in gymnasts during early childhood, they rapidly declined in adolescent owing to higher rate of injuries. (6,7)

The injury profile for each of these gymnasts is different and directly related to the amount of time spent by the young gymnast. They generally practice around 30-50 hours per week during their competitive career. (8) Previous studies have shown varied differences in the injury location, rates, and type of severity, which refers to the level of gymnastic ability, their competitive level. In female gymnasts, the incidence of musculoskeletal injuries is comparatively high. (2,9) Much of the epidemiological studies deals with female athletes, but varies with study designs, reporting inaccuracies and defining injury providing useful insight about the injury location and patterns. (5)

Few studies found out a mixed distribution of injury location of the upper extremity, spine and lower extremity. (5,9) Thus, in view of previously reported studies on gymnasts, the purpose of this study was to identify the types, frequency, and location of musculoskeletal injuries in high school gymnasts in Mumbai region.

## MATERIALS AND METHODS

A cross-sectional study was carried out to ascertain the injuries were most common amongst the high school professional club gymnasts. Ethical approval to conduct the study was obtained from the DY Patil University, Navi Mumbai. Prior consent was obtained from their parents and the study subjects gave their signed informed assent form before participating in the study. The study subjects were ensured about their anonymity of the data. The participants comprised of 100 high school gymnast from Mumbai region. After 3 gymnastic clubs agreed to participate in the study we met their

respective coaches and explained the objectives and procedure of the study. The inclusion criteria of the study were gymnasts from age group 7 to 16 years and involved active participation in competition.

The data was collected using a self-administered validated questionnaire. The questionnaire consisted of personal information and questions regarding injury information, frequency of play, anatomical location of injury, situation that caused the pain and treatment received. The questionnaires were validated by two experienced researchers who had conducted similar studies previously to evaluate the content. Later a pilot study among ten gymnasts was conducted to check whether the questions were understood by these gymnasts. The final questionnaire was used to collect the data amongst the gymnastic clubs. Approximately 10 to 15 minutes were taken by the gymnast to fill in the questionnaire. The author was present during the completion of questionnaire to attend for any queries. The data was further analyzed descriptively using frequency distribution & percentage.

## RESULTS

The study population of gymnasts included 34% boys and 66% girls from school clubs gymnasts. Although 112 questionnaires were filled by the gymnasts, twelve could not be analyzed due to incomplete information. The descriptive characteristic of these gymnasts is given in Table 1.

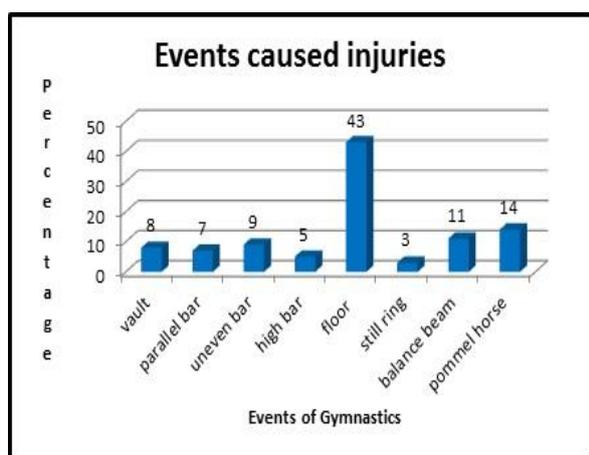
**Equipments which caused injuries in gymnasts:** The event in which maximum injuries have taken place is floor exercise (43%) most likely to cause injury, followed by pommel horse (14%), balance beam (11%), uneven bar (9%), Vault (8%) Parallel bar (7%), high bar (5%), and still ring (3%) as shown in Fig 1.

**Type of Injury:** The most common nature of injury seen was soft tissue injuries 78.37% followed by fractures 21.63% shown in Fig 2

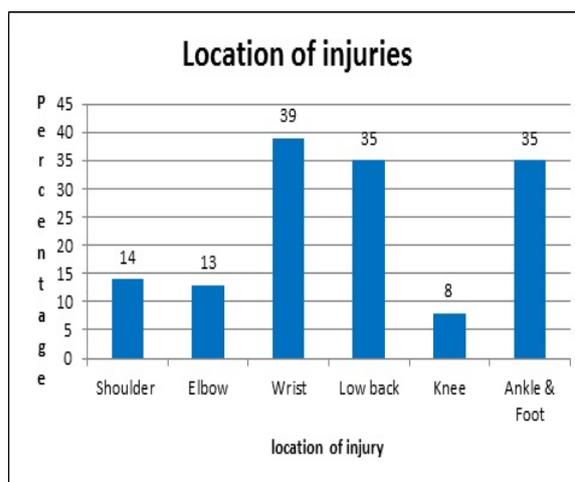
**Table 1: Descriptive characteristics of the gymnasts**

	Males (n=34)	Females (n=66)	Total (n=100)
Age (years)	11.85(2.98) <sup>a</sup>	10.74 (2.44) <sup>a</sup>	11.12(2.67) <sup>a</sup>
Experience of practice (years)	6.29 (3.34) <sup>a</sup>	5.36(2.83) <sup>a</sup>	5.46(2.84) <sup>a</sup>
<b>Type of Gymnasts</b>			
Artistics	34%	41%	75%
Rhythmic	Nil	25%	25%
<b>Competitive level of gymnasts</b>			
Club level	10%	19%	29%
District level	6%	21%	27%
State level	6%	11%	17%
National level	12%	15%	27%
<b>Training hours in practice per week</b>			
During Competition	15.62 <sup>b</sup>	19.02 <sup>b</sup>	15.54 <sup>b</sup>
Regular Practice	15.49 <sup>b</sup>	19.8 <sup>b</sup>	19.53 <sup>b</sup>

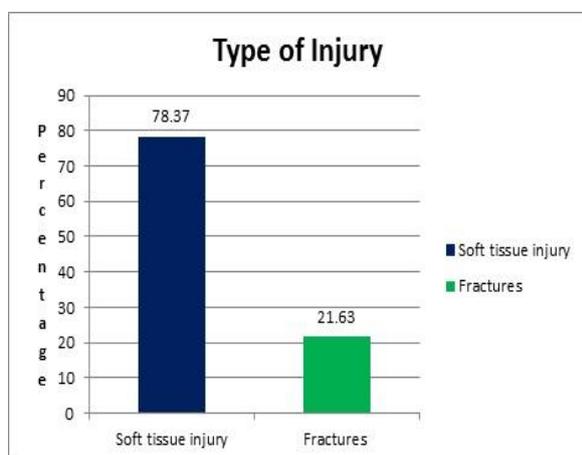
<sup>(a)</sup> are the values expressed in mean (SD, <sup>b</sup> are the values expressed in hours per week



**Figure 1.** Representation of events causing injuries in gymnasts



**Figure 3.** Location of injuries reported by gymnasts



**Figure 2.** Representation of type of injuries seen in gymnasts

**Injury location:** In this study gymnasts had reported multiple locations of injuries. In upper extremity wrist injuries comprised of 39%, shoulder 14%, elbow 13%. Low Back comprised of 35%. In lower extremity ankle injuries comprises of 35% then followed by knee 8%. Fig. 3

**Practice and Competition:** High school gymnasts devoted good amount of time in their training and competitive period. They spent 15.54 hours per week during competition and 19.53 hours per week. They also reported that 58.10% injured during competition and 41.9% during regular routine practice.

**Treatment taken by Gymnasts who suffered from injuries:** 80% Gymnast preferred giving rest to the affected area and discontinued the practice during injury and remaining 20% of those who were injured received injury care management from the professionals. 2.70% required surgical intervention and remaining 97.29% were conservatively treated. 30% of gymnasts used protective devices to avoid recurrence of injury and rest 70% did not use.

## DISCUSSION

The present study of 100 gymnasts included 34% males and 66% females at

various high school clubs in Mumbai region. Current study reported a higher prevalence of 74% injuries in these young gymnasts. The risk of injuries in this sport of gymnastics is higher owing to the practice of difficult skills and the significant amount of training taken by them. But previous epidemiological studies with different study design have shown the same proportion of the location and the types of injury. <sup>(5)</sup>

This study supports the common injury trends similar to the researches are done in the past but with mixed variation in their injury location. Although ankle and foot are the most affected joints as seen in previous researches but in the upper extremity, wrist (39%) was to be the most common region to be affected in this study. During gymnastics activities, the upper extremity is subjected to a higher stress of weight bearing, where the wrist is subjected to forces double the body weight. <sup>(5,10)</sup> In males the wrist pain was commonly seen in the events of floor exercise and pommel horse, similarly in females wrist pain was commonly seen in floor exercise and vault events. In addition, to it, shoulder accounted 14% of injuries in upper extremities. Previous studies also reported range from 4% to 19% risk of injury at shoulder particularly in males. <sup>(6,7)</sup> Males were found to be more affected than female gymnasts particularly because of the events performed by the males like still rings produces considerable stress at shoulder region possibly because of the use of dowel grip which increases the force across shoulder by allowing the gymnasts to reach higher velocities. <sup>(5)</sup>

In gymnasts, low back is the most repeatedly injured area of the spinal region gaining significant attention. In this study, 35% gymnasts reported of low back as their site of injury. Compared with the other sports, in gymnastics, there is significant amount of stresses placed on the low back, particularly when these young gymnasts involved in strenuous training and competition. <sup>(5,11)</sup> Repetitive movements like

extreme hyperextension and twisting postures which occur during dismounts, somersaults and vaulting cause micro-trauma and macro-trauma that result in damage to the lumbar spine. Also, during landing there is a vertical and compressive impact loading of the vertebral column, resulting into a greater risk of injury to the spine. <sup>(5,9,11)</sup> Flexibility is essential in the performance of gymnast as they always tend to attempt greater ranges of motion going beyond their physiological limit. So performing at the end ranges predisposes injury to the back. <sup>(5)</sup>

In lower extremity the ankle and foot (35%) were most frequent injury location reported by the gymnasts and their injuries consistent with the previous studies, <sup>(6,7)</sup> While performing these maneuvers of take offs and landing from different heights, tremendous amount of physical load is placed on the lower limb owing to be as the common site of injury. <sup>(9)</sup> The ankle injury is one of the most common injuries seen in gymnastics since long as majority of this injuries resulted because of the high stresses which occur during landing and acrobatic maneuvers on floor exercise. Sudden and recurrent ankle injury is a result of repetitive landing in twisting and in rotation from different heights. During takeoffs and landing, the forces at the ankle are high as up to 5 to 17 times the body weight of gymnast, leading to the increased risk and prevalence of ankle injuries. <sup>(12)</sup>

The knee injuries account 8% of injuries in our study. However, knees are prone to various acute injuries which are often associate various dismount maneuvers which require forces that are greater than landing. <sup>(5)</sup>

The current findings for the overall sample were that 78.37% of injuries were soft tissue injuries that included sprains, strains, and overuse injuries. We had to combine these types of injury as they could not differentiate the words like strains and sprains and to recollect the type of soft tissue injury they had experienced owing to self-reported nature of the data collection.

Fracture (20.27%) and dislocation (1.36%) was another type of injury reported. In our study, all these traumatic types of injuries were seen in upper extremities. These injuries caused by trauma were as resulted due to missed moves, fall from apparatus or incorrect dismounts creating large forces around upper extremity leading to these types of traumatic injuries. <sup>(13)</sup> Performing on floor mats was the event of the injury which results in these traumatic injuries in young gymnasts. The emphasis on correct landing techniques and training on thicker mats will prevent such injuries. <sup>(2,14)</sup> It was important to understand that from where does the risk of these high injuries occur. Gymnasts participate in the variety of events or apparatus. Our study shown that floor exercise (43%) was associated with maximum injuries, followed by pommel horse (14%), balance beam (11%), uneven bars (9%), vault (8%), parallel bars (7%), high bars (5%), still rings (3%). Many studies have also reported floor exercise being the event with high injury rate. <sup>(5,9,11)</sup>

The risk of spinal injury is increased when performing maneuvers of take offs, landing or rebounding, particularly during the floor exercise events. These all other events produce multiple repetitive impact forces on the extremities and spine responsible for increased risk of injury.

Usually gymnasts devote good amount of time in their training and few hours spent their competitive period. Usually competitive gymnasts in western countries train around 40 hours per week and participate up to maximum of 10 competitions in a year. <sup>(6-8)</sup> Our study had shown the amount of training hours spent during competition and routine practice was nearly the same per week.

In our study, the injury rate was high as 58% in competition as we observed that they practice with more of protective devices than during competition. Differences are been observed in few studies wherein injury is more common during training or in competition. <sup>(6)</sup>

Some studies shown maximum injuries have occurred during the training period and very few occur in competition but the rate of injury is doubled in competition when compared with routine practices when the amount of exposure is accounted, <sup>(5-7,9,12)</sup> Here these young gymnasts have to repeatedly perform the same routine maneuvers until they are perfect with their skills but during competition, they have to perform unassisted and with perfect precision, and timing and often performed in real time. Studies recommended that reducing the number of training hours will reduce the occurrence of muscle-tendon units and fractures. Even if the training hours are reduced as observed in our study the rate of injury is high. <sup>(6,7,15)</sup> There could be a possibility that their desire to perform the exercise of increasing complexity, training and learning for such exercises can cause injury during training hours.

The result highlights the need for the use of preventive measures and sports specific strengthening trying to reduce the number of injuries that may occur. Also, new designs of equipment's are encouraged is which allows better absorption and transmission of forces, especially in young children. Collaborative teamwork should be taken to shape the athlete career keeping in mind the increased risk of injury and their potential detrimental effects.

Further studies are required to carry out regarding the severity of these injuries in Indian gymnasts, the incidence of injury in younger athletes and to determine their various causative intrinsic and extrinsic risk factors. Analysis of this data can assist in identifying acknowledged risk factors which can be used for the implementation of sports specific intervention programs to younger high school gymnasts.

## CONCLUSION

The current study found out high prevalence of musculoskeletal injuries in high school gymnasts affecting wrist, low back and knee the most. Also soft tissue

injuries are the most common type of injury followed by fractures. The results could help young gymnasts, their coaches and parents to identify and prevent potential risk of injury and thus extending their competitive careers.

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