# RELATIONSHIP BETWEEN ISOKINETIC PEAK TORQUE AND PHYSICAL CONDITIONING IN JAPANESE PROFESSIONAL BASEBALL PLAYERS

**T Nakayama, T. Satoh, T. Tsuboi, K. Egawa & M. Miyazaki**
**Hanshin Tigers Baseball Club Inc., School of Human Sciences, Waseda University**

## INTRODUCTION

Isokinetic dynamometers enables assessment of human muscular performance through a full range of motion with the most frequently reported evaluation parameters being peak torque, average power, and total work (Hislop et al. 1967, Perrin 1986). Microcomputer interfacing of newer generation isokinetic dynamometers with extensive database capability have provided the clinician and guiding skill of the coach with many parameters and options from which to choose. Previously, isokinetic assessment performed on the Cybex II isokinetic dynamometer ( Lumex, Inc., NY, USA) was able to occur through a full range of motion( Rankin et al. 1983) and it was one of the typical isokinetic machines used for rehabilitation in Japan. Isokinetic exercise was used to test the parameter required to condition players in the Japanese pro-baseball world. Baseball is one of the most popular sports in Asia. Despite the large number of baseball players in Japan, research dealing with the performance capacity of professional Japanese baseball players was lacking. Baseball players were commonly afflicted with overuse syndromes of the shoulder complex that appear to be directly related to the duration and intensity of participation at games (Hill 1983). It was necessary to measure and describe the physical conditioning and isokinetic muscle strength of baseball players. Because the relationship between shoulder strength and performance was inconclusive. The physical conditioning of each player played an important role for team performance in professional baseball. Moreover, the coach was able to keep players conditioned in several physical and psycho-physical areas. The use of measurement interchangeable items has only been established for the shoulder rotator musculature (Perrin et al. 1993).

The purpose of this study was to determine the relationship between peak torque produced by shoulder internal/external rotation, physical conditioning in Japanese professional baseball players.

## METHODOLOGY

Fifty-eight professional baseball players ( mean age 24.5 S.D. 4.7 yr., mean height 179.2 S.D. 4.36 cm, mean weight 79.65 S.D. 7.82 kg ) participated in the

measurement upon giving their full informed consent. Pitchers were thirty men in this study. Subjects were excluded from the study if they had any history of pathology in the lower extremity. There was no inexperienced subjects on the Cybex II in this study.

All isokinetic testing was conducted on the Cybex I1 340 at Hanshin Tigers baseball Club. Subjects were assessed for both isokinetic contractions concentric and eccentric torque ( Nm ) of both the dominant and non-dominant shoulder extensor and flexor musculature using the isokinetic dynamometer at three different velocities 90deg/sec, 180deg/sec and 270deg/sec respectively. Most reliability testing has focused on measuring peak torque and work output of the extensors during concentric and eccentric loading( Kramer 1990 ). Subjects were assessed through a range of motion of 30 to 160 degrees.

Subjects performed maximal voluntary efforts with their dominant arm, defined as the *arm* that they would use in throwing a ball. The subjects were stabilized and positioned in standing upright as the recommended neutral posture in the Cybex II testing manual. Testing of both right and left shoulders consisted of three sets of eccentric and concentric muscular activations. Subjects were prepared to become familiar with the machine and a 1 minute of rest was given between each trial of three maximal efforts performed at three different velocities. Data were collected in the form of maximal peak torque, defined as the best peak torque achieved during each tested speeds.

The body mass index (BMI, kg/m2) was calculated for each subject. A ratio of eccentric to concentric peak torque was calculated for each subject using the peak torque for each trial and subject. In addition to peak torque( Nm ) value, Newton-meter per kilogram of body weight( Nm/kg ) was also calculated. The strength ratio between shoulder flexors and shoulder extensors of each shoulder, Internal/External(Int/Ext) ratio, was also calculated at tested speeds. Mean and standard deviations of anthropomorphic and measurement items were calculated for pitchers and the non-pitchers. An independent t test was used to compare ratios between pitchers and the non-pitchers( $p < .05$) using SAS package software.

Table 1: Anthropomorphic data

| Variables | Pitchers Mean±SD | Non-pitchers Mean±SD |
|---|---|---|
| Age (years) | 24.13±4.3 | 26.1±5.3 |
| Height (cm) | 180.3±4.0 | 178.0±4.6 |
| Weight (kg) | 81.2±8.2 | 78.1k7.4 |
| BMI | 25.0±2.3 | 24.6±2.1 |
| Body fat (%) | 14.1k3.4 | 12.6±3.3 |

## RESULTS

Table 1 shows the anthropomorphic measurements for pitchers and non-pitchers. There was little difference in BMI between pitchers and non-pitchers. The pitchers were about 2 % higher value in their body compositions. The correlation coefficients for concentric and eccentric peak torque ranged from r = 0.85 to r = 0.98, but there was little correlation between peak torque and BMI in all subjects. The average value of peak torque obtained by this experiment had the tendency that other players were higher than pitchers at each tested speed. However, there were no significance between pitchers and non-pitchers($p < .05$). It was not significant different between pitchers and non-pitchers in averaged peak torque considering each body weight. Moreover, comparisons of the dominant and non-dominant shoulder indicated no significant bilateral difference in shoulder internal/external rotation, and these results were similar to previous findings (Chin et al. 1994).

Table 2: Mean ±SD of peak torque pitcher and others for dominant shoulder INT/EXT rotations

(Nm)

| Tested speed | Pitchers(Mean±SD) | | Non-pitchers(Mean±SD) | |
|---|---|---|---|---|
| | External | Internal | External | Internal |
| 90degree/sec | 43.517.9 | 64.216.3 | 46.5±5.9 | 67.5±11.6 |
| 180degree/sec | 38.1±7.7 | 56.0±5.9 | 40.0±5.1 | 59.4±5.4 |
| 270degree/sec | 33.116.1 | 49.5±5.7 | 35.1±4.6 | 53.0±7.3 |

## DISCUSSION

The results of this study indicate that a strong relationship exists between isokinetic average peak torque in each tested speed for shoulder internal and external musculature. We found no significant difference between the internal/external ratios of pitchers and non-pitchers, possibly because we were unable to obtain a large enough sample size or sample term or there actually was no difference. We were unable to show an effect of arm dominance in concentric or isometric shoulder strength in a normal population (Murray et al. 1985, Reid et al. 1989). These values may be used interchangeably when reporting isokinetic strength and diagnosing

muscular performance. The repetitive high load from eccentric contraction may lead to skeletal damage. Shoulder injuries are epidemic in throwing athletes who are represented by pitchers in baseball. These findings are also in agreement with the findings that reported similar relationships for the shoulder musculature in overuse injuries (Richardson 1983). The pitching motion involved both concentric and eccentric muscle contraction (Jobe et al. 1984). Concentric muscle contraction, upper extremity strength characteristics were well described in normal (Connelly et al. 1989, Otis et al. 1990) and baseball players (Brown et al. 1988, Cook et al. 1987, Hinton 1988). However, few studies focused on muscular strength and BMI. The Body composition is an important aspect of fitness for professional baseball as the game now demands more physical activities. These results led to specific training programs for each players, and rehabilitation programs for injured players.

In this study, the isokinetic data for post and middle season was presented with the relationship between isokinetic peak torque and BMI. BMI correlated with percent body fat but not with isokinetic power suggesting that the condition of physical performance was not affected. It is yet unclear what effects isokinetic muscular performance may have on both injury prevention and physical condition. A prospective investigation is necessary to document the role of muscle contraction in injury prevention and supported physical condition. In addition, testing protocols to ascertain local muscular fatigue may be useful in baseball players who engage in repetitive motions of the arm. More detailed investigations of the knee, trunk and shoulder muscle strength under isometric, concentric and eccentric conditions may be of value during training and rehabilitation similarly to obtain anthropometric measures.

In conclusion, a strong relationship exists between average peak torque for each tested speed. This relationship supports the use of these variables when reporting isokinetic data. However, there were few relationships between BMI and isokinetic peak torque at any position. The lack of major individual differences in isokinetic muscular performance per BMI, and the similarity in any position, suggests that our findings are applicable to a wide range of individuals of professional players. Lengthy and careful consideration should be given to these parameters.

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