5–2. THE CHARACTERISTICS OF JUDO PLAYERS' STANDING POSTURE

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It is widely known that a sports player's somatotype depends on the physical movements required of the sports event. However, there have not been many reports analyzing the standing postures of several sports players.

In this survey we measured the curvature of the spines, the center of gravity, the shoulder unbalance, and the body weight distribution (left and right distribution) of 37 Judoists of the University of Tsukuba, and made a comparative study of the standing postures of other sports players (12 different sports events).

I. Method

(1) Subjects

As shown in Table 1, the survey was made of 256 Tsukuba University male students who actively participate in 13 sports events: track and field athletics, basketball, handball, volleyball, soccer, rugby, swimming, gymnastics, Kendo, and Judo.

(2) Procedure of Measurement

Having each subject take a standing posture which he thought to be right, we measured the following: the curvature line of the spine, the shoulder unbalance, the center of gravity, and the distribution of body weight.

Table 1 Qualities of Subjects

Events	Number	Experience year	Age (year)	Training schedule
Sprint	16	4–8	19–21	2.5–3 h. (day)/5–6 times (week)
Distance	15	4–8	19–21	2.5–3 h. (day)/5–6 times (week)
Jump	18	4–8	19–21	2.5–3 h. (day)/5–6 times (week)
Throw	9	4–8	19–21	2.5–3 h. (day)/5–6 times (week)
Basketball	21	4–8	19–21	2 h. (day)/5 times (week)
Handball	13	4–5	19–21	3 h. (day)/5 times (week)
Volleyball	22	4–8	19–21	2.5 h. (day)/6 times (week)
Soccer	38	4–8	19–21	2 h. (day)/6 times (week)
Rugby	19	4–5	19–21	2 h. (day)/6 times (week)
Swimming	12	4–10	19–21	2.5 h. (day)/5–6 times (week)
Gymnastics	13	4–8	19–21	2–4 h. (day)/7 times (week)
Kendo	23	4–8	19–21	2 h. (day)/6 times (week)
Judo	37	4–9	18–22	2 h. (day)/6 times (week)

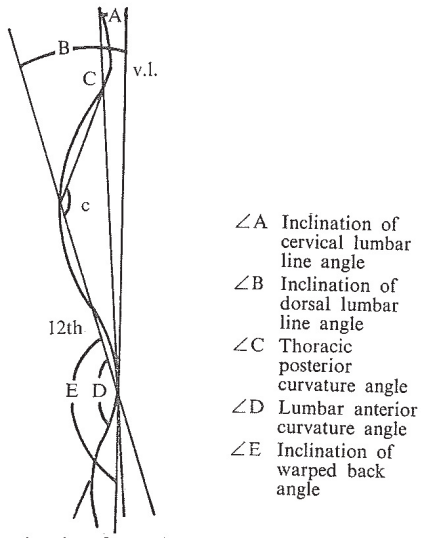

Fig. 1 Angles of Spinal Curvature

(2)–1 Curvature of the Spine

Using Conformateur (a curvature-of-spine measuring machine manufactured by Yamakoshi Seisakusho), measured the curvature line of the spine and culculated the each angle as shown in Fig. 1.

Measured the inclination of cervical lumbar line angle (∠A), the inclination of dorsal lumbar line angle (∠B) and the inclination of warped back angle (∠E) to observe the degree of inclination of upper body, and also measured the thoracic posterior curvature angle (∠C) and the lumbar anterior curvature angle (∠D) to observe the curve of spine.

(2)–2 Difference of Bi-acromion Height

Using two height meters which had been specially attached with the slidable ruler on the side ruler, measured the subject's both shoulders' height at the same time in order to find the different height between the left and right shoulders—right>left plus (+) and the reverse minus (−).

(2)–3 Weight Distribution

Measured the weight distribution of the left and right feet by the weight distribution meter (manufactured by Ogawa Electronics Industry) in order to find the weight distribution difference between the left and right feet.

(2)–4 Center of Gravity

Using two weight meters, measured the center of gravity of Y-axis by the balance board supported by two points. Also the foot length was measured in order to find the ratio between the center of gravity from the heel and the foot length.

II. Results

(1) Curvature of the Spine

(1)–1 Inclination of cervical lumbar line angle (∠A)

The average cervical lumbar line angle of the subjects was −1.44°, which showed a slight posterior inclination. As shown in Fig. 2, the subjects which showed an extreme anterior inclination were gymnastics and throwing events players. A significant difference from the total average was noticed. The ones which showed a posterior inclination were rugby and Kendo players. They also showed a significant difference from the total average. Judo players showed a very close value to the total average.

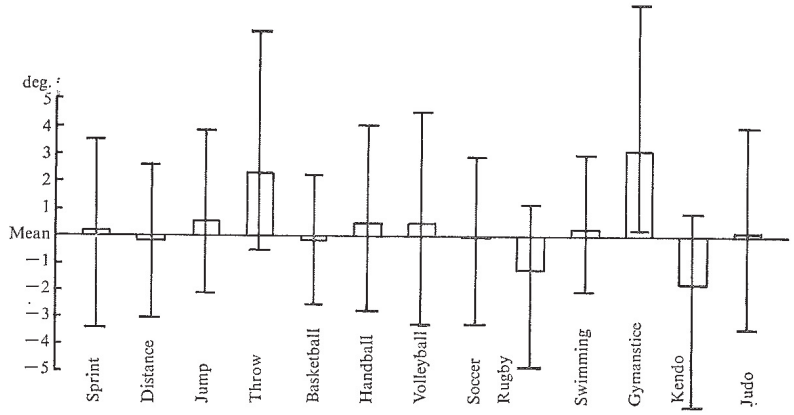

Fig. 2 Inclination of cervical lumbar-line

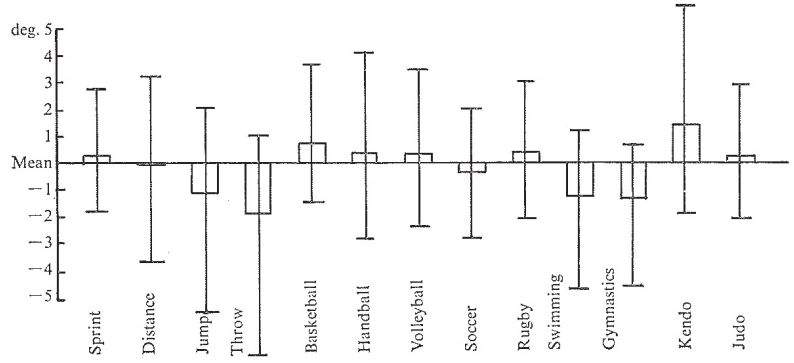

Fig. 3 Inclination of dorsal lumbar-line

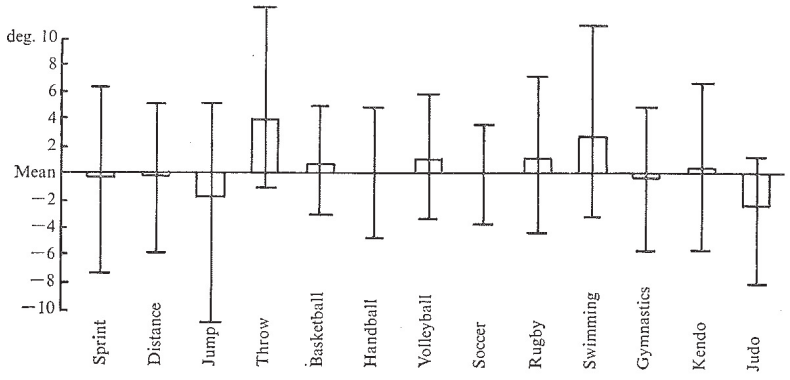

Fig. 4 Thoracic posterior curvature

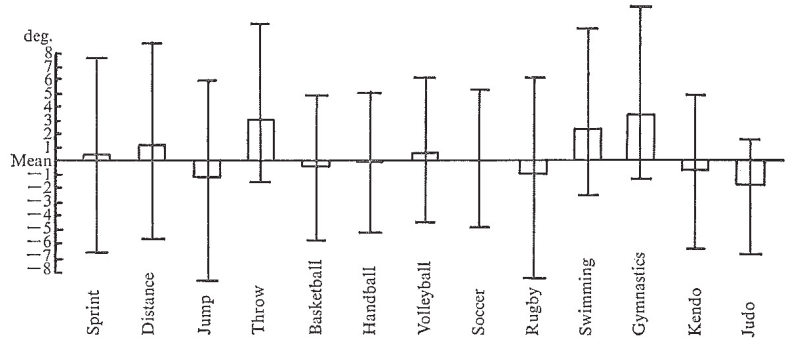

Fig. 5 Lumbar anterior curvature

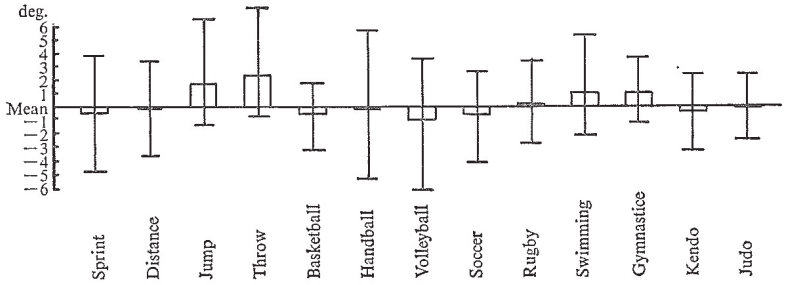

Fig. 6 Inclination of warped back

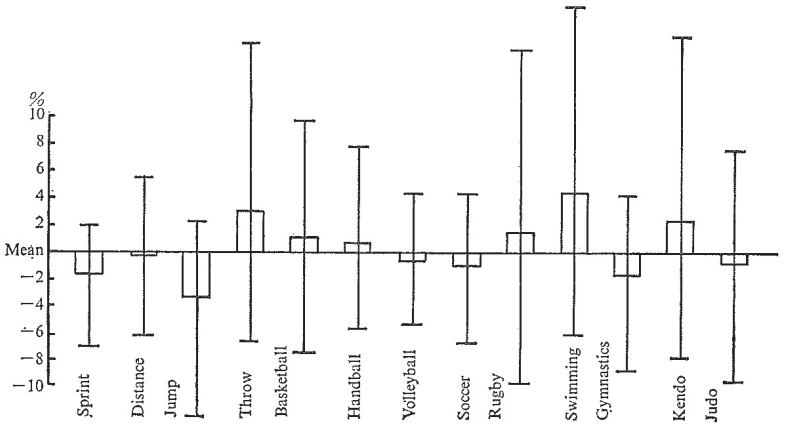

Fig. 7 Center of Gravity of Y-axis

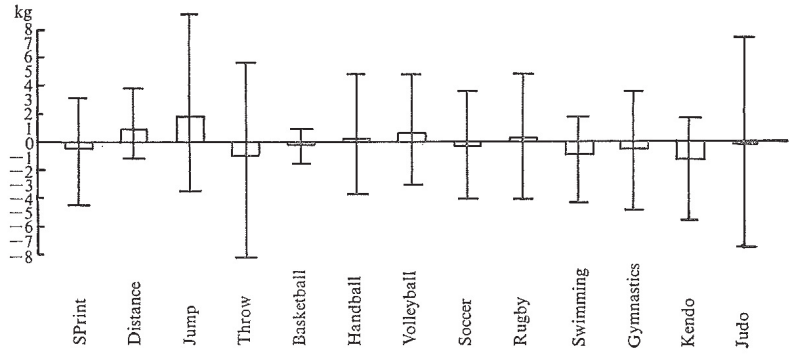

Fig. 8 Weight Distribution

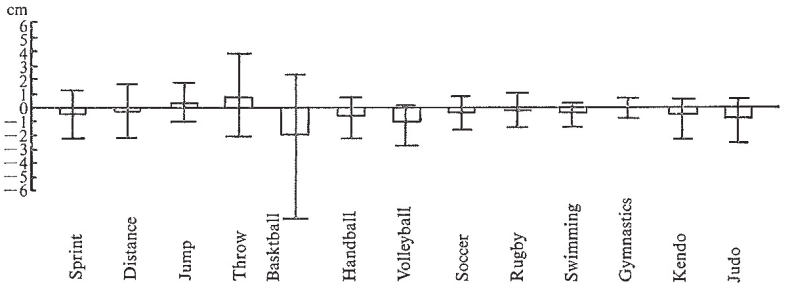

Fig. 9 Difference of Bi-acromion Height

(1)–2 Inclination of dorsal lumbar line angle (∠B)

The total average of the subjects was 9.19°. As shown in Fig. 3, the ones showing a slight anterior inclination of the upper body were jumping-event, throwing-event, swimming, and gymnastics players. Basketball and Kendo players showed a posterior inclination. Judo players showed a very close value to the total average value, though slightly inclined forward.

(1)–3 Thoracic posterior curvature angle (∠C)

The average of the subjects was 160.51°. As shown in Fig. 4, swimming and throwing players' angles were wide because of their flat backs. The angles of Judo and jumping-event players were a little narrower which indicated their round backs.

(1)–4 Lumbar anterior curvature angle (∠D)

The average of the subjects was 158.43°. As shown in Fig. 5, swimming, gymnastics, and throwing-event players showed wider spinal curvature angles than the average and the lumbars were stretched. On the other hand, the angles of Judo and jumping-event players were a little narrower than the average and showed a strong lumbar anterior curvature.

(1)–5 The inclination of warped back angle (∠E)

The average of the subjects was 170.93°. As shown in Fig. 6, the inclination of the warped backs of jumping-event, throwing-event, swimming, and gymnastics players was wider than the average, and their backs are stretched straight. Volleyball and soccer players showed a slight postrior inclination. Judo players were just about the average.

(2) The Center of Gravity

The average center of gravity of the subjects was 43% from the heel setting the foot length as

100%. As shown in Fig. 7, jumping-event, sprint, and gymnastics players' center of gravity was largely closer to the heel. Judo players' was also slightly toward the heel. On the other hand, swimming, Kendo, rugby and throwing-event players' values showed closer to the toe than the average.

(3) Weight Distribution

The average value of weight distribution of the subjects was −0.06 kg. As shown in Fig. 8, middle-distance runners, jumping-event, and volleyball players showed a tendency of overweight on the right foot. On the other hand, throwing-event, swimming, and Kendo players were overweighted on the left foot. Basketball, handball, soccer, rugby, and Judo players showed a little difference.

(4) Difference of Bi-acromion Height

The average difference of bi-acromion height of the subjects was −0.47 cm, which was slightly right-ward. As shown in Fig. 9, basketball, Kendo, Judo players showed a minus value, which means the apex of the left shoulder was higher than that of the right making the right shoulder drop to one side. The subjects with the left shoulder drop were jumping-event and throwing-event players. Gymnastics players showed very little difference.

III. Discussion

(1) Curvature of Spine

The three curves can be observed in the curvature line of the spine: an anterior curvature of the cervix, a posterior curvature of the thoracic vertebrae, and an anterior curvature of the lumbar. In this survey we measured the following two parts: a posterior curvature of the thoracic vertebrae and an anterior curvature of the lumbar. An excessive increase of the thoracic vertebrae curvature is called *kyphosis*, and that of the lumbar curvature is called *lordosis* which comes of various causes.

Though Judoists look like *kyphosis* in appearance because of the heavy muscles on their shoulders and around the scapular, it should not be confused with morbid *kyphosis* which causes a forward-bending posture through the lack of the extensor muscle tonus of the spine. Judoists are inclined to have slightly round backs owing to the excessive development of their back muscles and the increase of the thoracic vertebrae curvature by stretching the back muscles might be one of the contributing factors because they are forced to keep a forward-bending posture with their heads and arms constantly stretching forward.

The anterior curvature of the lumbar sometimes is caused as a compensational reaction. However, in Judo movements, it is observed that a great strength works when a dynamic strength is focused on the shoulder, by making use of the back as a lever and the lumbar joint as a fulcrum. For instance, the force received on the fifth lumbar becomes 202.5 kg when a Judoist of 81 kg bends forward in 60°. When he holds a 22.5 kg weight in his hand, a 382.5 kg force is received on the fifth lumbar. A development of the sharp lumbar anterior curvature is considered to be a natural phenomenon in Judo, because both players pull each other with an enormous strength, therefore, the enormous strength as well as the upper body weight is received on the fifth lumbar.

The angles of Judoists' inclination of cervical lumbar-line and of dorsal lumbar-line which show the anterior curvature of the head, face, and upper body were almost the average, denying the former image of a Judoist as a *Peking man*. Probably it was because they were requested to take a "right" posture at the time of measurement and they held the heads up. If a relaxed or comfortable posture had been urged to take, some different results might have been brought about.

(2) Center of Gravity and Weight Distribution

The center of gravity of Judo players showed 42% from the heel, which was slightly toward the heel. According to Takaaki Asami's survey[1] of the center of gravity of college Judo players on standing posture and *shizen-tai*, in the case of still standing posture, measured in 1978, it was 46.5% from the heel in the case of still standing posture and 40.5% from the heel in *shizen-tai* respectively.

It indicates that the gravity of Judo player's standing posture is slightly toward the heel. Con-

sidering the Judo movements frequently pulled and thrown down, it can be conjectured that they unconsciously try to keep the center of gravity constantly backward in order to keep balance.

There was no difference in right-left weight distribution. But in Yoshizo Matsumoto's[2] survey of the best players' weight distribution measured in 1963, it was pointed out that right-hold players showed a tendency of putting their weight on the left foot. Therefore, it was necessary to separate the group into two groups—right-hold and left-hold Judo players—for the accuracy.

(3) Difference of Bi-acromion Height

A slight drop to the right was recognized in Judo players' drop shoulder. In 1977 Hisashi Yanagisawa[3] took the pictures of 26 college Judo players from behind, and measured the upper and lower angles of both shoulders. The result was: 44% (11 persons) had a right shoulder drop, 28% (7 persons) a left shoulder drop, and 28% (7 persons) an equal drop. He reported that there was no relation between the ways of holding (kumi-kata) and the drop shoulder.

It was also reported that the right-hold players in general showed a tendency of a right shoulder drop. Probably the Judoists in this report were mostly right-hold, and this might have influenced the result.

IV. Summary

As to the Judoist's curvature of spine, there were tendencies of a slight posterior curvature of the thoracic vertebrae (round back) and of an anterior curvature of the lumbar compared with other players. The center of gravity was located slightly toward the heel, and the weight distribution was almost equal. A slight rightward drop was seen in the shoulder.

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