

# Characteristics of Japanese wrestlers with respect to function and structure of limbs

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## INTRODUCTION

It is well known that hypertrophy and strength gain of the human skeletal muscle are induced by muscle training. It has also been shown that the training effect on size and strength of the skeletal muscle are altered the different athletic training protocols (1, 4). From these findings, it seems possible that wrestlers possess the hypertrophied muscle and stronger muscle strength by specific training.

In the present study, we assess the functional and structural characteristics of the skeletal muscle in Japanese wrestlers.

## METHOD

**SUBJECT.** Twenty four Japanese elite vesity wrestlers and aged much 42 untrained males served as subjects. Their physical characteristics are presented in Table 1. These wrestlers had always ranked at high level in the inter collegiate competition in Japan.

**TABLE 1**  
Characteristics of subjects

|        | Wrestlers<br>(n=24) | Untrained males<br>(n=42) |
|--------|---------------------|---------------------------|
| Age    | 20.77 ± 1.17        | 20.66 ± 2.43 (yr)         |
| Height | 168.8 ± 6.80        | 170.5 ± 7.00 (cm)         |
| Weight | 72.71 ± 14.6        | 65.19 ± 11.5 (kg)         |

**MUSCLE AREA MEASUREMENT.** Cross-sectional images for upper arm, thigh and leg in the right side of the body were obtained by Ultrasonic method (ALOKA SSD-120) which was described previously (2). The ultrasonic picture of each limb was taken at 60% the way down from the acromion to the radiale for the upper arm, midpoint between the greater trochanter and the tibiale for the thigh, and 30% the way down from the tibiale and the sphyrion for the leg, respectively. Based on these picture, we determined the cross-sectional area of the flexor and the extensor muscle at elbow, knee and the ankle joints by using a computerized digitizer.

**MAXIMUM ISOMETRIC STRENGTH MEASUREMENT.** The maximum isometric voluntary strength of flexion and extension of elbow and knee joints were measured by using Cybex II dynamometer with the elbow joint angle of 90 degrees and with the knee joint angle of 110 degrees. The maximum isometric strength for plantar and dorsal flexion were measured on a custom made dynamometer with ankle joint of 90 degrees.

## **RESULT AND DISCUSSION**

Significant differences of flexor and extensor muscle area at elbow and knee exist between wrestlers and untrained males ( $p < 0.001$ , Fig. 1) except for plantar and dorsal flexor muscle. Larger muscle area of trained men than that of untrained subjects were agreed with previous studies (3, 4).

The maximum isometric strength for flexion and extension of the elbow, the knee and the ankle for wrestlers were significant higher than those for untrained males except for the knee flexion strength ( $p < 0.05$ , 001, Fig. 2). It may be considered that the knee flexion exercise is rare in the wrestler's practice and training.

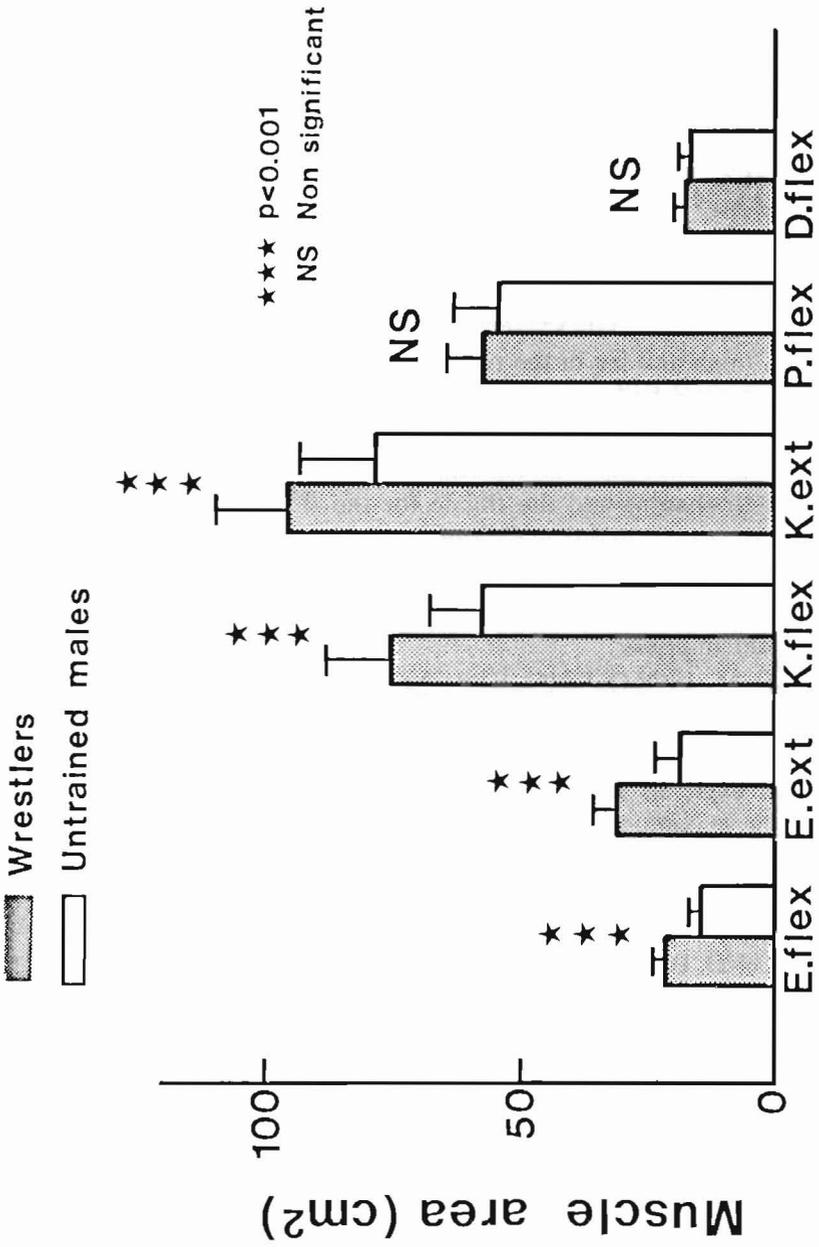


Fig. 1. Cross-sectional area of flexor and extensor for elbow, knee and ankle.

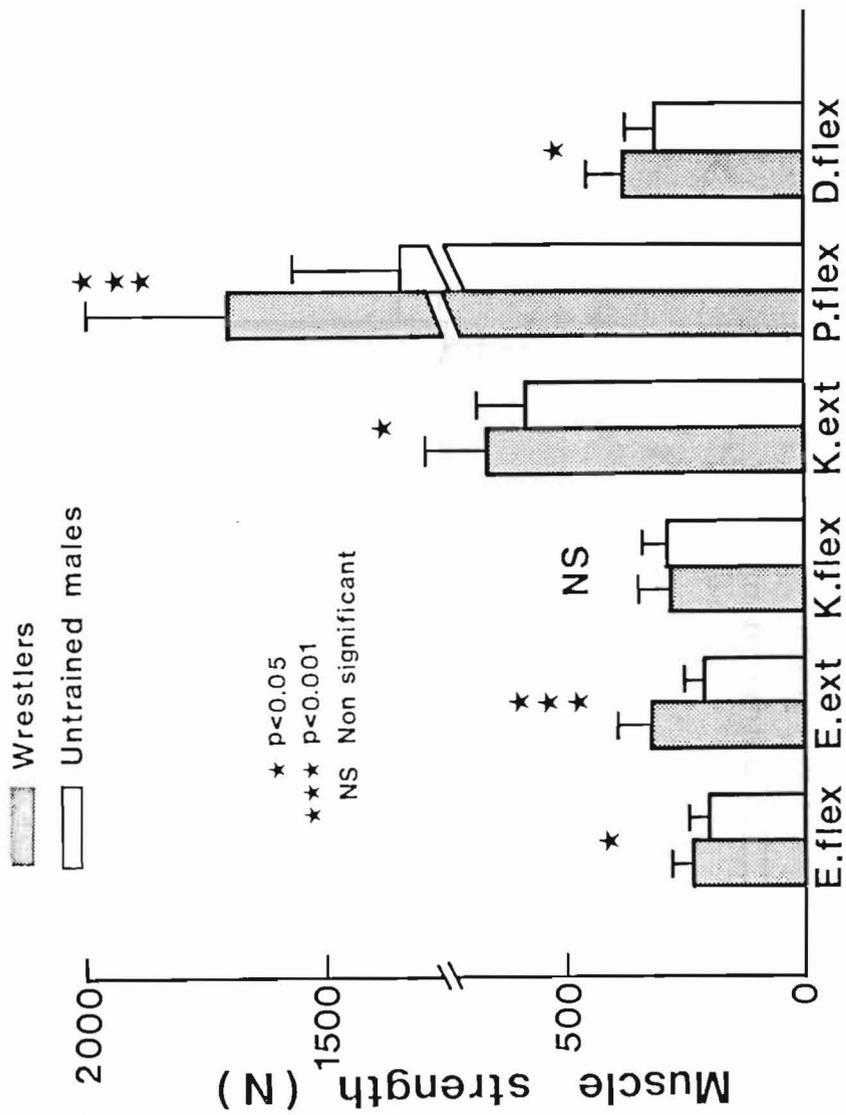


Fig. 2. Maximum isometric strength of flexion and extension for elbow, knee and ankle.

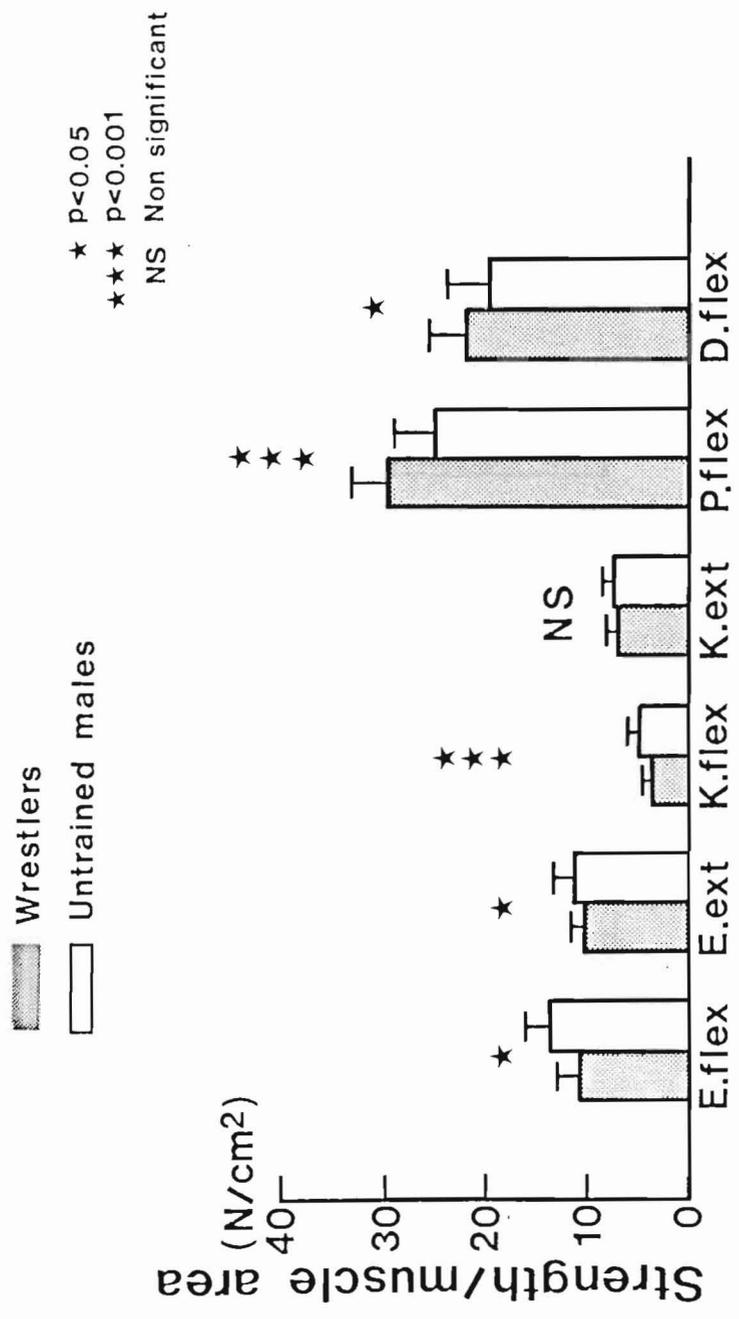


Fig. 3. Ratio of strength to muscle area (ST/area) for elbow, knee and ankle.

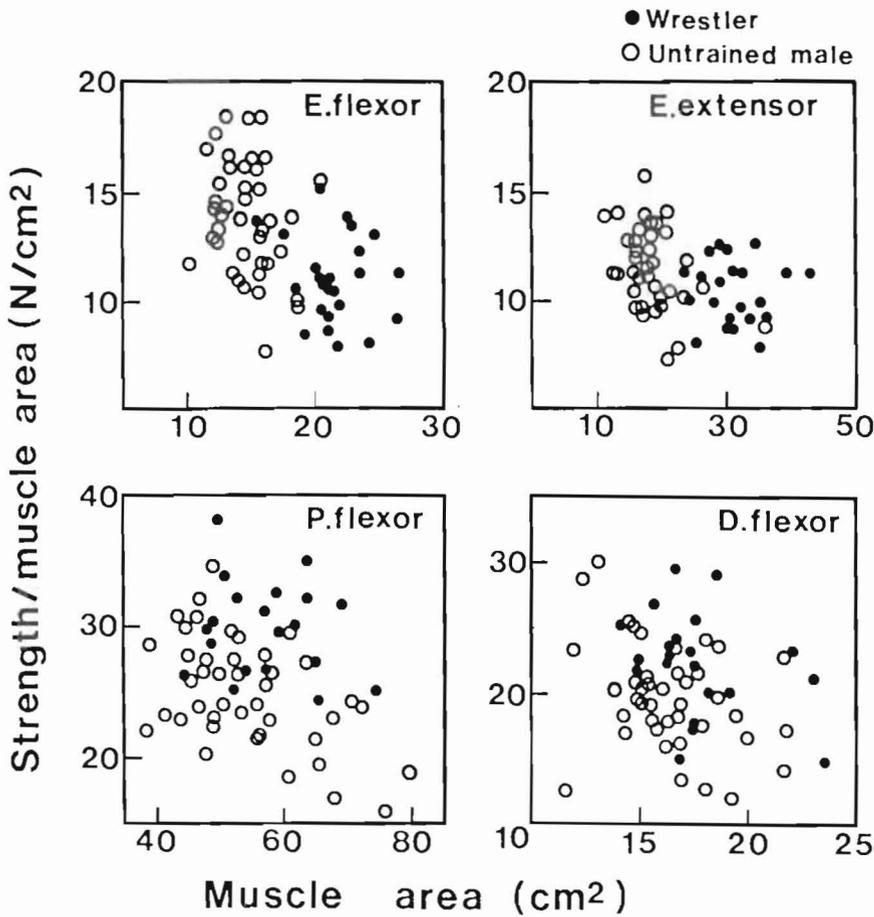


Fig. 4. The relationship muscle area and ratio of strength to muscle area in the elbow and ankle.

Figure 3 showed the ratio of strength to cross-sectional area of each muscles (ST/area). Untrained subjects showed significant higher ST/area ratio than wrestlers for the elbow flexor ( $p < 0.05$ ), the elbow extensor ( $p < 0.05$ ) and the knee flexor ( $p < 0.01$ ). On the contrary, in the ratio for both plantar flexor and dorsal flexor, wrestlers indicated significant higher than untrained males ( $p < 0.001, 0.05$ ).

As shown in figure 4, in upper arm, wrestlers had larger muscle area and stronger muscle strength than non athlete. While in the ST/area ratio of arm muscle, wrestlers indicated significant lower ratio than untrained.

As in the previous studies, the ST/ratio is fairly constant among males, females, and trained subjects (1,6), it may be possible that wrestlers have more potentiality of increasing muscle strength.

Eventhough wrestlers and untrained subjects have same size of muscle area in the leg, the higher ST/area ratio exist in the wrestler's plantar flexor and dorsal flexor (Fig. 4). Pennman (5) reported the increased strength without hypertrophy by muscle strength training. It was possible that wrestler's muscle strength of plantar and dorsal flexor increased without hypertrophy.

It seems that wrcestlers have hypertrophied muscle in upper arm and thigh and stronger leg muscle induced by exercise and training of wrestling.

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