

## II-3

### Leg extension power in heavyweight elite judo athletes

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#### INTRODUCTION

It is well known that mental fortitude, technique, and physical strength are the factors that contribute to competitiveness in sports. In judo, these factors are sometimes referred to as “*shin-gi-tai*,” literally meaning “mind, skill, and body,” which are essential elements in competition. Physical strength in particular affects competitiveness. Improving functional elements, particularly physical strength, is necessary for increasing competitiveness. Leg strength is particularly important in many competitive sports, and evidence from a study that observed leg extension during judo throwing techniques indicates<sup>2)</sup> that leg extension power likely influences the success of judo techniques. In judo tournaments, athletes must throw their opponent quickly and with force to earn a high score for their throwing technique. Therefore, it is considered that extending the legs quickly and forcefully while performing a throw has an advantage in judo. For example, leg extension is observed in “flipping” movements where athletes extend their lower leg while they support themselves on one leg with their knees flexed and throw an opponent during an *uchi-mata*. It is also observed in the rapid extension of both legs while throwing an opponent over the shoulder during a *seoi-nage*. Thus, leg extension is considered to play an important role in both of these movements. Furthermore, because judo practitioners must also react quickly to their opponent’s moves and maintain their posture to avoid being thrown, leg extension power is another important factor in maintaining posture and balance, while being attacked by an opponent. Based on these observations, it is logical to assume that an athlete must have a very high skill level to become an elite judoka.

#### PURPOSE

This study compared the leg extension power of elite Japanese heavyweight male judoka with that of elite Japanese lightweight male judoka, and clarified the exhibited characteristics.

#### METHODS

Eleven All Japan Judo Federation certified heavyweight male judoka and 12 All Japan Judo Federation certified lightweight male judoka were analyzed. The Aneropress 3500<sup>1)</sup> (Combi Wellness, Tokyo, Japan) was used in this study because it measures leg extension power through movements similar to the knee extension movements in judo throwing techniques. In addition, it allows measurements to be easily gathered while teaching. The measured items included leg extension power, height, weight, body fat percentage, lean body mass, thigh circumference, and crus circumference. A risk ratio of less than 5% was considered statistically significant ( $P < 0.05$ ).

#### RESULTS

The average leg extension power values were  $2169.0 \pm 165.5$  W and  $2105.0 \pm 73.9$  W for the heavyweight judoka and lightweight judoka, respectively, with the average value for the heavyweight judoka being higher, albeit not significantly (Fig. 1). However, significantly higher height, weight, body fat percentage, lean body mass, thigh circumference, and crus circumference values were recorded in the heavyweight judoka ( $P < 0.01$ ) (Table 1).

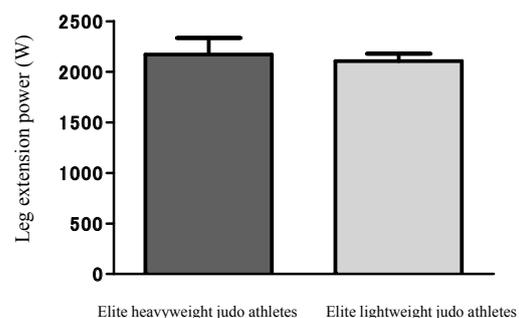


Fig. 1 Comparison of leg extension power between elite heavyweight and lightweight judo athletes

## DISCUSSION

First, we can easily infer that leg extension power is closely related to leg muscle mass. Significant differences were observed between the study groups for body weight, LBM, and thigh and crus circumferences. This indicates a large discrepancy in muscle mass between heavyweight and lightweight elite judoka.

**Table 1 Physical characteristics of the athletes in each group**

	Height (cm)	Weight (kg)	%Fat (%)	LBM (kg)	Age (yrs.)	Experience (yrs.)
Heavyweight elite judoka group (n=11)	181.4 ± 2.1	117.4 ± 4.6	24.2 ± 1.2	88.6 ± 2.7	25.3 ± 1.2	16.9 ± 1.4
Lightweight elite judoka group (n=12)	166.8 ± 0.9	71.3 ± 1.2	14.0 ± 0.4	61.2 ± 0.9	22.1 ± 0.7	16.3 ± 0.9

	Right thigh circumferences (cm)	Left thigh circumferences (cm)	Right crus circumferences (cm)	Left crus circumferences (cm)
Heavyweight elite judoka group (n=11)	68.0 ± 1.4	67.5 ± 1.2	45.2 ± 0.7	45.1 ± 0.7
Lightweight elite judoka group (n=12)	55.3 ± 1.1	54.8 ± 1.2	37.3 ± 0.5	37.2 ± 0.4

(Average ± SD)

\* : P < 0.05, \*\* : P < 0.01

Next, we observed no difference in leg extension power between heavyweight and lightweight elite judoka. This indicates that even though heavyweight elite judoka have considerably more muscle mass and are much stronger than lightweight elite judoka, heavyweight elite judoka do not exhibit their leg extension power to the maximum. In other words, lightweight elite judoka exercise leg extension power more efficiently than heavyweight elite judoka. These results also suggest that a lack of leg extension power may have a negative impact on the performance for current Japanese heavyweight judoka. Compared with lightweight judoka, heavyweight judoka more often compete against opponents who are heavier than they are, and leg extension power should naturally be more important for heavyweight judoka than lightweight judoka. Nevertheless, the heavyweight elite judoka measured in this study did not have the same leg extension power as the lightweight counterpart. This also indicates that the top Japanese heavyweight judoka do not have sufficient leg extension power to throw an opponent with a similar build while supporting their own weight.

## CONCLUSION

These results clarify that while the heavyweight judoka had superior physical characteristics, such as greater lean body mass and thigh circumference, there was little difference in leg extension power between the heavyweight and lightweight judoka. Furthermore, there is an urgent need to develop specialized training equipment that can enhance leg extension power and to establish training methods that can more effectively improve leg extension power for heavyweight elite judoka.

## REFERENCES

- 1) Ito, M. and Yoda, Y., Development of an apparatus to measure instantaneous leg extension power output, *J. J. Sports Sci.*, 11, 742-746, 1992.
- 2) Ishi, T., Kanamaru, Y., Ae, M., Okada, O., and Komata, K., Tai-sabaki and the body position in Seoi-nage, *Bulletin of the Association for the Scientific Studies on Judo*, Kodokan, 13, 87-96, 2011.
- 3) Sato, T., Relationships between leg extension power and Judo competitive ability in elite judoka, *Report of the Faculty of Education*, Kogakkan University, 5, 35-42, 2013.
- 4) Sato, T., Akimoto, H., Takezawa, T., Yokoyama, T., Miyake, K., Masuchi, K., and Kasugai, A., Evaluating judoka leg extension power: Comparing leading and student judoka using the Aneropress 3500, *Bulletin of the Association for the Scientific Studies on Judo*, Kodokan, 14, 81-87, 2013.