MUSCLE STRENGTH IN RELATION TO BODY COMPOSITION IN THE TURKISH MALE NATIONAL JUDO TEAM

MELEKOĞLU TUBA¹, ÖCAL DEFNE¹, BAYDİL BILGEHAN¹, SÖNMEZ M.¹

Abstract
The Objectives: The aim of this study was to examine the strength differences in weight categories. For this purpose we have investigated the relationship between body fats and strength of The Turkish National Male Judo Team.

The Methods: Thirty-nine members of The Turkish Male National Judo Team [n=39, age 19.34 ± 2.71 yr, body mass 81.63 ± 21.67 kg, height 175.26 ± 8.67 cm] were participated as subjects. For body composition profiles, body mass, standing height, lower extremity length (LE), skinfold thickness (biceps, triceps, subscapular, thigh, supraspinale), body fat percentage (BF %) and body mass index (BMI) were measured. Body fat percentage was estimated by using Brozek method. The strength values were measured from leg and back. The relationship between variables was determined by the Pearson Coefficient Correlation at the significance level of p<0.05.

The Results: Statistical significant correlations appeared in the leg and back strength with age, height, weight, lower extremity length, BF %, BMI. A negative correlation was found between training history and skinfold thickness. On the other hand, there was no significant correlation between strength values and training history. Also, no correlation was found between weight and skinfold thickness.

Conclusions: As judo is a weight classified sport, the correlation of weight and strength is important. The present study demonstrated that age, height, weight, lower extremity length, BF % and BMI effect leg and back strength. Judo players in higher weight classes present higher BF% and strength.

Keyword: Judo, Anthropometry, Strength, Body Fat Percentage.

Introduction
Judo is a body contact sport with requirements such as strength, judo specific techniques, tactical excellence, motor control and high degree of total body fitness.

Muscle mass is a considerable part of the human body weight. In addition, it has been reported that the muscle strength is highly correlated with muscle mass, muscle structure, body mass and neurophysiological factors (J. Janiak, B. Krawczyk, 1995). Therefore, among equally trained individuals, those with greater body weight demonstrate greater strength (V. M. Zatsiorsky, W.J. Kraemer, 2006). Also, it has been reported that, the correlation between the muscle strength and the lean body mass content in combat athletes were much higher than non- combat athletes (J. Janiak, B. Krawczyk, 1995). On the grounds that the muscle mass is the major determinant of strength, weight classes are designed for strength sports to promote competition between athletes of roughly equal size (L. Burke, 2007).

As judo is a weight classified sport, the correlation of weight and strength is important (M. Takahashi et al., 2005). It has been submitted that elite judoists should have low body fat and high muscle mass percentage (P.N. Ali, P. Hanachi, N.R. Nejad, 2010, E. Franchini, F.B. Del Vecchio et al., 2005, R. Callister, et al., 1991 ). E. Franchini, M.Y. Takito et al. (2005) reported that muscle mass percentage is about 45% of body weight in high level judoists. Also, it has been suggested that elite judo athletes had a larger fat-free mass than the non-elite judoists (V. Kankanala, E.A. Gunen, A.S. Igah, 2010; J. Kubo, T. Chishaki, N. Nakamura, 2006).

The aim of this study was to examine the strength differences in weight categories. For this purpose we have investigated the relationship between body fats and strength of The Turkish National Male Judo Team.

Material and Methods
Subjects:
Thirty-five members of Turkish National Male Judo Team participated in the study as subjects. All participants volunteered for the study, after being informed about the procedures of research. The physical characteristics and training history of subjects assessed in training camp in preparation for 2010 European Championship.

The participants were trained athletes (at least 7 years) and practiced between 12 and 20 hr per week (Table2). The subjects were divided in weight categories according to the conventional division into categories (D. Boguszewski, 2009, T. Okada et al., 2007) such as lightweight (-60kg, -66kg, -73kg), middleweight (-81kg, -90kg) and heavyweight (-100kg, and +100kg).

Table 1. The physical parameters of the subjects

<table>
<thead>
<tr>
<th>Variables</th>
<th>Males (n=35)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>19.34 ± 2.71</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>175.26 ± 8.67</td>
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<tr>
<td>Weight (kg)</td>
<td>81.50 ± 21.79</td>
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Anthropometrical Measurement:

Body heights were measured to the nearest 0.1 cm by using a Harpenden stadiometer (Holtain Ltd.). Body weight was measured in minimal cloths to the nearest 0.1 kg by digital scale. After having body weight, standing height, lower extremity length; skinfold thicknesses were measured at two times from five sites (triceps, biceps, subscapular, thigh, supraspinale) with a Harpenden caliper (Holtain Ltd.). The average of two readings was recorded. Total body fat percentage was calculated according to equation of Brozek et al. (1963) (W. Jagiello et al. 2007). Body mass index (BMI) was calculated as weight/height$^2$ and expressed as kg/m$^2$. All anthropometric measurements were done by the same experienced anthropologist using standard international procedures (ISAK).

Strengths:

After 15 min warm-up exercises including leg, abdomen and back muscles; the subjects performed measurements of maximal muscle strengths. Back and leg isometric strengths were assessed by using a Takei leg dynamometer. For the measurements, subjects were instructed to take position on the platform with the trunk straight and the knees flexed for leg strength (LS) and a stiff leg dead lift position with trunk flexed only slightly forward at the hip joints for back strength (BS). The subjects were not allowed to lean backward on the heels (C.J. Gore, 2000). The best result was recorded after three trials.

Statistics:

SPSS software for windows was used for statistical measurements. Means and standard deviations were calculated to express the results. Mann Whitney U test was performed for analyze the difference between groups. The correlation degree among the variables was evaluated on the basis of the values of the Pearson correlation coefficient, the level of $p<0.05$ and $p<0.01$ being considered significant.

Results

Thirty-five members of The Turkish National Male Judo Team participated in the study as subject and divided by three weight categories. The training history, including years of active sports-specific training (TY) and hours of total training per week (TH) of the subjects are shown in Table 2. In The Turkish Male National Judo Team, the training year averages of judoists in all weight categories were determined as not less than 7 years.
There were significant differences in weight, height, LE and BMI between all weight categories.

No significant differences (p>0.05) were remarked for BF% and skinfold measurements except subscapular (p<0.05) between LW and MW. However, when comparing MW and HW, significant differences in skinfold measurements and BF% (p<0.01 and p<0.001) were detected (Table 3). In addition, there were significant differences between LW and HW in skinfold measurements and BF% (p<0.001).

When comparing the weight categories, we were detected significant increase in strength values (LS and BS) parallel to the increase in weight. There were positive correlations between weight and leg strength, weight and back strength and weight and BF% (p<0.01).

Table 4 shows the correlation between anthropometrical and strength parameters of The Turkish Male National Judo team. According to the results there was negative correlation between BF% and TY (p<0.05). Also, there were positive correlation between age and strength variables (LS and BS) (p<0.01).

Table 5 shows the correlation between anthropometrical and strength parameters of LW and MW judoists in The Turkish Male National Team that their BF% was not significantly different (LW and MW, 9.11 ± 1.78 %, 11.03 ± 2.82%, separately, p>0.05).
Table 4. Correlation of anthropometrical and strength parameters of judoists

Pearson Correlation (n=35)

<table>
<thead>
<tr>
<th>Variables</th>
<th>Age</th>
<th>TY</th>
<th>TH</th>
<th>Weight Height</th>
<th>LE</th>
<th>BS</th>
<th>LS</th>
<th>Tric.</th>
<th>Bic.</th>
<th>Subscapular</th>
<th>Thigh</th>
<th>Supraspinale</th>
<th>BF%</th>
<th>BMI</th>
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<tbody>
<tr>
<td>Age</td>
<td></td>
<td>0.778*</td>
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<tr>
<td>TY</td>
<td>0.102</td>
<td>0.064</td>
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<tr>
<td>Weight</td>
<td>0.192</td>
<td>-0.188</td>
<td>0.084</td>
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<tr>
<td>Height</td>
<td>0.103</td>
<td>-0.045</td>
<td>0.248</td>
<td>0.814*</td>
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<tr>
<td>LE</td>
<td>0.002</td>
<td>-0.071</td>
<td>0.306</td>
<td>0.668* 0.838*</td>
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<tr>
<td>BS</td>
<td>0.501*</td>
<td>0.066</td>
<td>0.105</td>
<td>0.740* 0.534* 0.532*</td>
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<tr>
<td>LS</td>
<td>0.627*</td>
<td>0.183</td>
<td>0.123</td>
<td>0.595* 0.426* 0.350* 0.903*</td>
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<tr>
<td>Triceps</td>
<td>-0.008</td>
<td>-0.303</td>
<td>-0.009</td>
<td>0.860* 0.654* 0.544* 0.459* 0.314</td>
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<tr>
<td>Biceps</td>
<td>-0.038</td>
<td>-0.304</td>
<td>0.060</td>
<td>0.858* 0.665* 0.572* 0.482* 0.279 0.927*</td>
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<tr>
<td>Subscapular</td>
<td>0.143</td>
<td>-0.269</td>
<td>0.120</td>
<td>0.915* 0.648* 0.539* 0.677* 0.511* 0.846* 0.904*</td>
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<tr>
<td>Thigh</td>
<td>-0.164</td>
<td>-0.360*</td>
<td>0.014</td>
<td>0.752* 0.661* 0.554* 0.327</td>
<td>0.164 0.803* 0.739* 0.716*</td>
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<tr>
<td>Supraspinale</td>
<td>0.096</td>
<td>-0.286</td>
<td>0.046</td>
<td>0.911* 0.637* 0.506* 0.611* 0.437* 0.909* 0.931* 0.945* 0.768*</td>
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<tr>
<td>BF%</td>
<td>-0.016</td>
<td>-0.339*</td>
<td>0.072</td>
<td>0.897* 0.708* 0.590* 0.535* 0.358* 0.887* 0.882* 0.920* 0.932* 0.921*</td>
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<tr>
<td>BMI</td>
<td>0.816</td>
<td>-0.253</td>
<td>-0.039</td>
<td>0.945* 0.589* 0.488* 0.735* 0.593* 0.838* 0.819* 0.900* 0.682* 0.902* 0.849*</td>
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</tbody>
</table>

p<0.05*, p<0.01**, p<0.001***

Table 5. Correlation of parameters between lightweight and middleweight judoists

<table>
<thead>
<tr>
<th>Variables</th>
<th>Lightweight (n=14)</th>
<th>Middleweight (n=13)</th>
<th>Heavyweight (n=8)</th>
<th>Lightweight (n=14)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMI</td>
<td>17.8</td>
<td>23.5</td>
<td>25.3</td>
<td>17.8</td>
</tr>
<tr>
<td>BF%</td>
<td>0.048</td>
<td>0.071</td>
<td>0.073</td>
<td>0.048</td>
</tr>
<tr>
<td>Age</td>
<td>0.084</td>
<td>0.062</td>
<td>-0.008</td>
<td>0.084</td>
</tr>
<tr>
<td>TH</td>
<td>0.024</td>
<td>0.034</td>
<td>-0.012</td>
<td>0.024</td>
</tr>
<tr>
<td>BS</td>
<td>0.038</td>
<td>0.012</td>
<td>0.008</td>
<td>0.038</td>
</tr>
<tr>
<td>LS</td>
<td>0.008</td>
<td>0.003</td>
<td>0.000</td>
<td>0.008</td>
</tr>
<tr>
<td>Triceps</td>
<td>-0.016</td>
<td>-0.007</td>
<td>0.001</td>
<td>-0.016</td>
</tr>
<tr>
<td>Biceps</td>
<td>0.023</td>
<td>0.019</td>
<td>-0.005</td>
<td>0.023</td>
</tr>
<tr>
<td>Subscapular</td>
<td>-0.004</td>
<td>-0.001</td>
<td>0.000</td>
<td>-0.004</td>
</tr>
<tr>
<td>Thigh</td>
<td>0.001</td>
<td>0.000</td>
<td>0.000</td>
<td>0.001</td>
</tr>
<tr>
<td>Supraspinale</td>
<td>0.010</td>
<td>0.005</td>
<td>0.000</td>
<td>0.010</td>
</tr>
<tr>
<td>BF%</td>
<td>-0.002</td>
<td>0.000</td>
<td>0.000</td>
<td>-0.002</td>
</tr>
<tr>
<td>BMI</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
</tr>
</tbody>
</table>

p<0.05*, p<0.01**
Variables | Age | TY | TH | Weight | Height | LE | BS | LS | Tric. | Bic. | Subsc. | Thigh | Supra | BF% | BMI
Age | 0.839* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | -
TY | 0.094 -0.023 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | -
TH | 0.038 0.021 0.162 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | -
Weight | -0.172 -0.036 0.213 0.699* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | -
Height | -0.137 -0.044 0.293 0.634* 0.767* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | -
LE | 0.510* 0.217 0.113 0.518* 0.187 0.322 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | -
BS | 0.600* 0.261 0.135 0.443* 0.120 0.157 0.907* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | -
LS | -0.301 -0.092 -0.054 0.466* 0.319 0.456* -0.125 -0.259 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | -
Triceps | -0.188 -0.023 0.438* 0.310 0.479* -0.152 -0.338 0.820* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | -
Biceps | 0.442* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | -
Subscapular | 0.000 -0.067 0.167 0.728* 0.356 0.463* 0.395* 0.285 0.522* 0.604* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | -
Thigh | -0.316 -0.200 -0.163 0.360 0.352 0.260 -0.220 -0.284 0.644* 0.566* 0.511* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | -
Supraspinale | -0.142 -0.077 -0.090 0.554* 0.191 0.377 0.133 -0.035 0.676* 0.693* 0.742* 0.635* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | -
BF% | -0.228 -0.177 -0.048 0.561* 0.404* 0.380 0.002 -0.089 0.702* 0.558* 0.781* 0.936* 0.766* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | -
BMI | 0.191 0.059 0.052 0.825* 0.174 0.266 0.575* 0.520* 0.384* 0.351 0.705* 0.201 0.593* 0.435* | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | -
p<0.05*, p<0.01**

Discussion

The aim of this study was to examine the strength differences in weight categories. For this purpose we have investigated the relationship between body fats and strength of The Turkish National Male Judo Team.

Body fat percentage is a very important marker for the assessment of physical fitness especially in weight classified sports. A lower BF% may increase performance by improving the strength to weight ratio (W.D. McArdle, F. I. Katch., V.L. Katch, 2001). It has been indicated that body fat has significant inverse association with strength and muscle quality (A.B. Newman, et al., 2003). Researchers reported that elite judoists except for the heavyweight ones have generally low body fat (E. Franchini et al., 2005, R. Almansba et al., 2007). It has been reported that lighter categories have a higher performance of lean muscle mass with respect to the heaviest (R.E. Molina, et al. 2009).

We found that the BF% of the elite Turkish Judoists increase in proportion to their weight (P<0.01). And BF% values were found for all weight categories are similar to those found in other studies with elite judoists. The means of the BF% for LW, MW and HW were 9.11 ± 1.78 %, 11.03 ± 2.82 % and 20.06 ± 6.37 %, respectively. Several studies (R. Almansba et al., 2010, S. Sterkowicz et al., 1999, E. Franchini et al., 2007, K. Sterkowicz-Przybycien, R. Almansba, 2010) showed that BF% levels for elite male judoists in the range of 10-15, similarly with our findings. R. Almansba et al. (2010) reported that the BF% of Algerian Olympic Judoists were 12.28 ± 4.16 %. Š.S. Balci measured the Turkish male judoists in The Youth National Team aged 18.13 ± 0.77 years and he reported BF% such as 12.38 ± 8.95 % for 80.59 ± 13.43 kg weighted judoists. D.A. Santos et al. (2010) reported body fat percentage 9.2 ± 4.1 % at the period of stability and 8.0 ± 3.8 % prior to competition for elite male judoists. E. Franchini et al. (2007) compared the morphological and functional characteristics of the male judo players of the Brazilian Team A with the judo players of Team B and C. They found BF% 11.4 ± 8.4% for Team A and 10.1 ± 5.7% for Team B and C.

Since judo is rather a grappling martial art to throw the component, BMI has a significant impact on judo players (J. Pedro, 2001). In our research we found that elite male judo players have 22.88 ± 1.65 kg/m², 25.39 ± 1.77 kg/m² and 33.31 ± 4.13 kg/m² BMI values for LW, MW and HW, separately. According to our results, P.J. Nande, V. Mudafale
and S.A. Vali (2009) reported BMI value such as 21.6 ± 2.0 kg/m² for lightweight judoists (61.2 ± 6.3 kg). R. Almansba et al. (2010) reported BMI value 29.32 ± 6.30 kg/m² for 91.85 ± 25.06 kg weighted judoists. Earlier research on 27 elite male judoists (D.A. Santos et al., 2010) notified BMI as 23.6 ± 2.3 kg/m².

Muscle strength is highly correlated with lean body mass. Among trained individuals with a similar body percentage, those with greater body weight demonstrate greater strength (V. M. Zatsiorsky, W.J. Kraemer, 2006). Therefore, in weight classified sports such as judo, BMI and strength correlation has importance. In our study, we found a positive correlation between BMI and strength variables. We found leg strength values 116.89 ± 24.70 kg, 133.27 ± 26.23 kg and 152.56 ± 27.94 kg for LW, MW and HW, separately.

When we compare the groups that their BF% was not significantly different (LW and MW, 9.11 ± 1.78 %, 11.03 ± 2.82%, separately, p>0.05), a positive correlation revealed between BMI & leg strength (P<0.520, p<0.01) and BMI and back strength (P<0.575, p<0.01). Concurring with several other authors (J. Kubo, 2006, E. Franchini, 2007), we found that the strength variables increases in proportion to their BMI (p<0.01).

Conclusion

In this study, some anthropometrical variables, and strength levels of The Turkish Male National Judo Team were characterized. It was found that BF% of the elite Turkish Judoists increased in proportion to their weight. Also, we determined that leg strength and back strength were correlated with body weight and body mass index. Thus, it can be said that decreasing BF% and increasing fat-free mass cause the strength variables for the same weight category to increase. However, as much as gaining strength and body fitness, judo specific techniques and tactics are also important for predicting sport performance.

Acknowledgements

We would like to thank the athletes who have taken part in this study and The National Team Coach Mr.Yavuz Yolcu for their cooperation during the study. And also Mr. Cem Melekoğlu for his assistance to check English grammer.

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