Body composition of male and female elite Polish sumo wrestlers in different weight category

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Summary

Introduction. Sumo wrestlers are considered the biggest individuals in the world but the characteristics of their body composition have not been investigated thus far. Therefore, this study aimed to determine the contents of adipose and muscular tissues, and fat-free mass of sumo athletes competing in various weight categories. We assumed that the athletes from the highest weight categories are characterized by an excessive amount of body fat and the lowest relative contents of muscle mass and fat-free body mass.

Material and methods. This study included 41 leading Polish sumo wrestlers, among them 15 women and 26 men. Standard measurements of body height and weight were taken in all participating athletes, and their body composition was determined by means of electric bio-impedance measurements. The wrestlers were divided into groups corresponding to the weight categories they have been competing during the 2009 Polish Cup competition; FA (<65 kg) and FB (≥65 kg) groups were distinguished amongst female wrestlers, along with MA, (<85 kg), MB (85-115 kg) and MC (≥115 kg) groups amongst males.

Results. Female wrestlers from the FB group were characterized by the highest relative content of adipose tissue and the lowest relative levels of fat-free mass, both significantly different as compared to parameters determined in the FA, MA, and MB groups. Also, MM content was the lowest in the FB group, and significantly different from the remaining groups. The MM value of women from the FA group was significantly lower compared to men from the MA group, being at the similar level as those determined in the MB and MC groups.

Conclusions. Sumo wrestlers from the highest weight categories were characterized by the highest contents of adipose tissue, suggesting obesity and potential health risk. Increasing body mass in sumo wrestlers requires close monitoring of body composition in order to distinguish between muscle mass gain and inadvertent increase in adipose tissue content.
During sumo tournaments, athletes are classified into proper weight categories; women and men whose weight exceeds 65 kg and 115 kg, respectively, fit into an "open" category with no upper weight limit. Consequently, many wrestlers are determined to increase their body weight maximally, with no attention paid to the proportion between fat-free and fat body mass disregarding the potential health consequences of overweight.

According to Ochiai and Takeda [5], approximately eight hundred wrestlers are registered in the Japanese Sumo Federation. Their average body height and weight are 184±5 cm and 152±19 kg, respectively. Consequently, the average BMI of Japanese sumo wrestlers is estimated at 44.8±5.2. Although individual data on the percentage of body fatness (Fat%) is unavailable, the average adipose tissue content in superior athletes has been reported as 23.5% [5], which is a surprisingly low value.

The characteristics of body composition of sumo wrestlers have not been investigated thus far. Therefore, this study aimed to determine the contents of adipose and muscular tissues, and fat-free mass of sumo athletes competing in various weight categories. We assumed that the athletes from the highest weight categories are characterized by an excessive amount of body fat and the lowest relative contents of muscle mass and fat-free body mass.

Material and methods

This study included 41 leading Polish sumo wrestlers, among them 15 women with an average age of 22.9±4.5 years and 26 men with an average age of 23.0±6.6 years. Average body mass of female and male athletes amounted to 78.7±27.4 kg and 99.7±25.7 kg, respectively, and their body weight was equal to 165±7.5 cm and 179±9.2 cm, respectively. The athletes were divided into groups corresponding to the weight categories they have been competing during the 2009 Polish Cup competition; FA (<65 kg) and FB (≥65 kg) groups were distinguished amongst female wrestlers, along with MA, (<85 kg), MB (85-115 kg) and MC (≥115 kg) groups amongst males.

Standard measurements of body height and weight were taken in all participating athletes, and their body composition was determined by means of electric bio-impedance measurements. The measurements were taken with the BIA 101 analyzer Akern (Italy). Body composition was analyzed based on the measurements of reactance and resistance values of the human body and was determined with an aid of eight electrodes. As established by Piccoli et al. [13], this type of analysis is characterized by a high level of accuracy. Body resistance was determined with an 800 µA electric current with a constant 50 kHz frequency.

The results were presented as arithmetic means and standard deviations. Mean values of analyzed parameters determined in multiple groups were compared using the Tukey test for the unequal samples.

Results

Our analysis revealed no significant differences in age and training experience of participating athletes from the studied groups (Table 1).

Female wrestlers from the FA group were characterized by the lowest body height. Furthermore, their body height was significantly lower compared to all groups of male athletes. No significant differences in body height were observed between the FA and FB female groups. Furthermore, body height of women from the FB group was significantly lower than in males from the MC group.

Females from the FA group were characterized by the lowest body weight, significantly lower compared to the FB, MB, and MC groups. Males of the MC group were significantly heavier than the representatives of the MA and MB groups.

As expected, BMI was the lowest in the case of females from the FA group. Average BMI in this group was significantly lower than in the FB, MB, and MC groups. Male athletes of the MC group were characterized by the highest BMI levels, significantly higher than in the MA group.

Analysis of body mass composition revealed marked variability of absolute FFM and MM contents in the studied groups. Only the FB and MA groups were characterized by similar values of those parameters (Fig. 1). The FM content was the lowest in the FA and MA groups, while the FB and MC groups were characterized by significantly higher values (Fig. 1).

Table 1. Mean values of parameters analyzed in various weight categories of sumo wrestlers (n=41)

<table>
<thead>
<tr>
<th></th>
<th>FA (n = 10)</th>
<th>FB (n = 5)</th>
<th>MA (n = 11)</th>
<th>MB (n = 11)</th>
<th>MC (n = 4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experience [years]</td>
<td>2.65 ± 1.65</td>
<td>3.40 ± 1.52</td>
<td>4.33 ± 2.33</td>
<td>3.40 ± 2.79</td>
<td>5.75 ± 4.75</td>
</tr>
<tr>
<td>Body height [cm]</td>
<td>161.50 ± 5.23</td>
<td>171.00 ± 7.68</td>
<td>173.91 ± 8.48</td>
<td>180.00 ± 6.43</td>
<td>191.00 ± 5.94</td>
</tr>
<tr>
<td>Body weight [kg]</td>
<td>60.41 ± 5.45</td>
<td>101.42 ± 27.37</td>
<td>77.72 ± 8.27</td>
<td>105.07 ± 9.40</td>
<td>149.15 ± 18.85</td>
</tr>
<tr>
<td>FFM [kg]</td>
<td>45.78 ± 3.29</td>
<td>56.68 ± 7.39</td>
<td>65.42 ± 6.02</td>
<td>80.07 ± 7.38</td>
<td>101.00 ± 10.85</td>
</tr>
<tr>
<td>FF (%)</td>
<td>24% ± 5%</td>
<td>41% ± 5%</td>
<td>15% ± 5%</td>
<td>23% ± 5%</td>
<td>29% ± 3%</td>
</tr>
<tr>
<td>FM (%)</td>
<td>76% ± 5%</td>
<td>59% ± 5%</td>
<td>85% ± 5%</td>
<td>77% ± 5%</td>
<td>71% ± 3%</td>
</tr>
<tr>
<td>MM [kg]</td>
<td>29.77 ± 1.88</td>
<td>37.00 ± 4.60</td>
<td>48.89 ± 4.06</td>
<td>56.64 ± 6.38</td>
<td>67.63 ± 6.99</td>
</tr>
<tr>
<td>MM (%)</td>
<td>49% ± 3%</td>
<td>38% ± 4%</td>
<td>58% ± 4%</td>
<td>53% ± 4%</td>
<td>47% ± 3%</td>
</tr>
<tr>
<td>BMI</td>
<td>23.20 ± 1.92</td>
<td>33.62 ± 7.88</td>
<td>25.64 ± 2.50</td>
<td>32.31 ± 2.88</td>
<td>39.15 ± 3.35</td>
</tr>
</tbody>
</table>

FFM – fat free mass; FM – fat mass; MM – muscle mass; BMI – body mass index; FA – group of female wrestlers <65 kg; FB – group of female wrestlers ≥65 kg; MA – group of male wrestlers <85 kg; MB – group of male wrestlers 85-115 kg; MC – group of male wrestlers >115 kg.
Female wrestlers from the FB group were characterized by the highest relative content of FM and the lowest relative levels of FFM, both significantly different as compared to parameters determined in the KA, MA, and MB groups (Fig. 2). Also, MM content was the lowest in the FB group, and significantly different from the remaining groups. The MM value of women from the FA group was significantly lower compared to men from the MA group, being at the similar level as those determined in the MB and MC groups (Fig. 2).

**Discussion**

In this study, normal values of BMI were revealed only in female athletes from the FA group. BMI of males from the MA group slightly exceeded its normal limit. All remaining groups of wrestlers represented the second degree of obesity according to the guidelines proposed by [14]. Average BMI level was the least satisfactory in the MC group (39.15 kg/m²) and corresponded to the second and third degree of obesity.

Since sumo is a sport discipline which requires marked strength [5,7], one can mistakenly interpret higher BMI as a consequence of higher muscle mass. To avoid this mistake, we analyzed the percentage contents of muscle mass and fat mass separately. Women from the FB group were characterized by the lowest relative contents of MM and FFM, and the highest FM content (as much as 41%). This findings suggested obesity and were consistent with BMI in this matter. The content of MM in this group was significantly lower compared
to all other analyzed groups. Furthermore, the percentage content of FM in the FB group was higher than the MM content. Consequently, one can suppose that the diet of women from this group was inappropriate and manifested in increased body fatness. The combination of proper diet and sufficient physical activity should lead to increased muscle mass and muscle strength [8-12], improving sport performance more effectively than a simple increase in passive body mass.

According to the reference levels of adipose tissue content [15], obesity was also observed in male wrestlers from the MC group. However, simultaneous analysis of BMI and FM content suggested that the body weight gain in the MC group had more favorable etiology compared to women of the FB group since an increase in body fatness was accompanied by a rise in muscle mass content.

Average body fat content of lean individuals constitutes approximately 20-30% and 12-20% of body mass in females and males, respectively [16]. Similarly, the average level of body fat in elite young Turkish wrestlers were 18.5±2.8% and 9.7±6.3% respectively for women and men [17], and in Polish young wrestlers average of 7.4±3.1% [18]. Higher values are usually associated with a higher incidence of civilization-related disorders [19,20]. Consequently, in the case of athletes from the FA and MA groups, sumo training was not associated with an additional health risk. In contrast, female and male wrestlers who represented “open” weight categories were characterized by overweight or obesity, and their body mass gains were mostly associated with marked excess of adipose tissue content.

**Conclusions**

1. Sumo wrestlers from the highest weight categories were characterized by the highest contents of adipose tissue, suggesting obesity and potential health risk.
2. Increasing body mass in sumo wrestlers requires close monitoring of body composition in order to distinguish between muscle mass gain and inadvertent increase in adipose tissue content.

**Glossary**

**Sumo.** A sport consisting of hand-to-hand combat between two unarmed contestants trying to push the opponent outside the combat field.

**BIA – Bioelectrical Impedance.** The resistance to the flow of either alternating or direct electrical current. Allows to define the composition of body weight.

**BMI - Body Mass Index.** An indicator of body density as determined by the relationship of body weight and body height. BMI=weight (kg) / height squared (m²). BMI correlates with body fat. Their relationship varies with age and gender.

**Body fat content – fat mass.** Specialized connective tissue composed of fat cells. It is the site of stored fats, usually in the form of triglycerides. It is important in the diet as a source of energy.

**Muscle mass** – mass of skeletal muscle. Skeletal muscles are innervated and their movement can be consciously controlled. They are also called voluntary muscles. Allow active execution of move.

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