ORIGINAL ARTICLE

Nutritional assessment of Brazilian sumo wrestlers

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Abstract

Background & Study Aim: Since Brazil is the country that presents the largest contingent of immigrants settled outside Japan, studies addressing the impact of feeding habits on the Japanese culture are of great importance. Brazilian sumotoris have promoted the practice of sumo, the national sport in Japan, in order to maintain their culture and tradition. The present study aimed to perform an anthropometric assessment and to assess the qualitative and quantitative food intake of sumo wrestlers in comparison with other studies, as well as to determine the feeding habits of the Japanese immigrant considering the Brazilian Food Pyramid.

Material & Methods: The participants in the study were six sumo wrestlers aged between 21 and 36 years and presenting high body mass index (BMI), associated with high adiposity and other anthropometric and biochemical factors of risk for the development of non-transmissible chronic diseases.

Results: Data on food intake, similarly to those in other countries with Japanese population, also indicate that the nutritional transition has an impact of feeding adequacy and body composition, requiring specific reference indexes. Also concerning food intake, according to the nutritional guide for the Brazilian population, an increased intake of fruits and vegetables (FV) is recommended in order to reach 400 g/day.

Conclusion: Sumo wrestlers have a body composition different from that of the sedentary population, obese or not, which indicates that the anthropometric assessment should include selected indexes involving somatotype analysis. The strategy of increasing fruit and vegetable intake to adequate quantities should be adopted, as evidenced by several studies involving the nutritional transition impact on the Japanese-Brazilian community. Besides maintaining ties with homeland, sumo practice is a prevention/protection factor for Japanese-Brazilians against the already expressed phenotype of risk for the development of metabolic syndrome.

Key words: Anthropometry · Brazilian Food Pyramid · food intake · metabolic syndrome · sumotoris

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Introduction

Sumo is the national sport in Japan, including around 800 professionals; the wrestlers, named *sumotoris* or *sumocas*, are separated into lower and top leagues according to their abilities, and the wrestler who achieves the highest degree in the top league is called *sekitori* [1]. In Brazil, sumo is practiced since the arrival of the first Japanese immigrants as an attempt to preserve their culture, habits, customs and relationship to people from their homeland, especially by maintaining tradition and memory. In this sport, some athletes reach high adiposity levels since they consume from 5,122 to 5,586 kcal/day [1] and present obesity as the prevailing physical characteristic, differently from other martial arts athletes who have reduced body fat levels. Based on the competition nature, the physical essence for success in sumo is heavy bodyweight and low centre of gravity, since one of the factors for winning is the product of the body mass by the velocity of the Sumo wrestler attack [2]. The wrestlers achieve this purpose by ingesting calories exceeding their energy expenditures; however, only weight gain due to fat accumulation has negative effects on the athlete's performance since obesity is a chronic disease that compromises the practitioner's health [3].

The higher obesity incidence in several countries, especially in the United States, has increased the need to reflect about the application and the practicality of obesity detection methods [4]. The indexes used to assess body fat quantity are not applicable for individuals presenting small amounts of fat, including athletes and highly active individuals; in addition, the physique and the body composition vary from sport to sport and within one same sport modality [2]. However, several scientific articles in the field of cineanthropometry and nutrition applied to sport and performance have indicated that body mass index (BMI), known as index for clinical assessment of obesity, designed in the 19th century by Lambert Adolphe J. Quetelet, is employed in the nutritional assessment of athletes, similarly to what is done for obese individuals [5]. BMI is frequently associated with the measurement of fat percentage; however, even the combination of these anthropometric indexes may not be sufficient to determine the athlete's somatotype, which is defined as a physique description method that incorporates three dimensions: endomorphy (fatness), mesomorphy (muscularity) and ectomorphy (linearity) [5]. Besides body mass, the fat percentage of athletes of several sport modalities should be extremely low, the main reasons for which are: competitions, where participants are enrolled in weight categories below their usual bodyweight (5 to 10% lighter) with the aim of obtaining a technical advantage (e.g. Olympic wrestling, taekwondo, karate, boxing etc.); esthetical reasons intrinsic to the sport (e.g. gymnasts, skaters, bodybuilders etc.); and weight/potency rate optimization to improve the performance [6].

It is well documented in literature that the criterion adopted by the World Health Organization [7] and its cut off points in Caucasian sample for overweight (25kg/m^2) and obesity (30kg/m^2), based on the increased morbidity-mortality ratio, are not applicable to populations from Asia and the Pacific Islands, for example, underestimating and overestimating, respectively, the prevalence of obesity in these groups [8].

The cultural habits of the Japanese population were strongly established in Brazil [9], accounting for the highest contingent of immigrants settled outside Japan, with around 1 million and 300 thousand individuals [10,11]. An important structural body characteristic of Japanese-Brazilians is that their lower members are shorter than their trunk height, i.e. a pattern of relative mesomorph compared to the Japanese population somatotype; the *nikkei* are shorter, squat and more muscular than other ethnics; consequently, the higher BMI values of these individuals probably result from the fat mass [12,13]. In general, Asian people have a higher level of fat for a given BMI, compared to Caucasian population, which indicates that some ethnic groups have a relatively higher risk of obesity than other groups, predisposing them to non-transmissible chronic diseases (NTCD) [14,15].

The aim of the present work was to evaluate Sumo wrestlers as to expenditure and qualitative food intake in comparison with the recommendations established for the Brazilian population, as well as to investigate the body composition of these athletes by employing anthropometric parameters specific to this sport.

Material and Methods

This study had as participants 6 male competitive athletes belonging to the São Paulo State Sumo Federation, Brazil, between 23 and 39 years old. All the participants competed on the 2008 Sumo Wrestling World Championship. Selection criteria included individuals older than 21 years, regularly practicing exercises for competition purposes for more than 17.5 ± 7.8 years. Those who accepted participating in this study signed a Free Informed Consent according to the model approved by the Research

Ethics Committee at São Camilo University Centre, Brazil (COEP 44/08).

A nutritional history was obtained to collect socioeconomic information (age, occupation, smoking habit, personal history of diseases etc.). For nutritional status assessment, biochemical assays were performed by using a portable analyser for glucose, triglycerides and total cholesterol, brand *Accutrend GCT* (Roche Diagnostic, Brazil). The reliability of this system has been validated by the studies of Mose et al. [16] and Hauenschild et al. [17]. On the day of biochemical assessment, the individuals had undergone a fasting of at least 8 hours without practicing physical exercises in the previous 12 hours.

For body composition assessment, fat percentage (%F) was calculated according to the doubly indirect methods by using the predictive equation for body density (D) specific for sumo wrestlers [3] and the fat percentage according to Brozek [18].

The following anthropometric indicators were measured: height (cm), body mass (kg), circumferences (cm), and skinfolds (mm). Body mass (kg) was obtained by means of a portable digital scale, TBF 551 model (Tanita, Japan), 0.1 kg accuracy and 136 kg total capacity. Height (cm) was obtained with a portable anthropometer, Body meter 208 (Seca, United Kingdom), total of 200 cm, 1 cm accuracy. The ratio body mass / height squared was used to calculate BMI (kg/m^2), and the nutritional status was classified according to WHO [7]. BMI was divided into two other indexes: Fat-Free Mass Index (FFMI = lean mass/height^2) and Fat Mass Index (FMI = fat mass/height^2); both were expressed as kg * m^{-2} and their values were classified according to the criterion proposed by Hattori et al. [19].

The hip circumference (HC) and waist circumference (WC) were measured according to ISAK (2001) by employing a fiberglass-type tape, model Gulick (Mabis, Japan), 1 mm accuracy, total of 150 cm. In the right hemibody, the triceps and abdomen skinfolds were measured by an experienced anthropometrist in triplicate by using a plicometer, brand Lange, 1mm accuracy and 65 mm capacity [20].

Food intake was assessed by means of a 24-hour recall (R24H); the listed foods were analysed through the professional software Clinical Diet Win, ver. 3.0 (Brubins, 1995 – 2002), with tables including the centesimal composition of Brazilian foods. Results were compared as energy expenditure percentage by the total energy value (%TCV), according to the recommendations of the Brazilian Society on Food and Nutrition [21]. To analyse the qualitative adequacy of food intake, the foods were compared with the portions proposed by the Food Pyramid for the Brazilian population [22], including 8 groups with the following intake recommendations: G1: bread, cereal, rice, roots and pasta: 5

Table 1. Characteristics of Brazilian sumo wrestlers in comparison with other studies. Brazil, 2014 (statistical indicators: Mean ± SD)

	Present study (n=6)	Hattori et al. [2] (n=5 Shindeshi)	Hattori et al. [2] (n=12 Sandanme)	Yamauchi et al. [8] (n=15)	Hoshikawa et al. [24] (n=15)
Age (years)	27.8 ± 6.4	18.7 ± 3.1	19.8 ± 2.5	20.5 ± 0.5	17.2 ± 0.6
Weight (kg)	95.03 ± 27.02	110.7 ± 24.7	109.3 ± 18.2	125.1 ± 12.9	108.1 ± 18.8
Height (cm)	173.3 ± 8.1	177.3 ± 5.3	179.4 ± 4.4	176.8 ± 3.5	172.2 ± 6.7
BMI (kg/m^2)	31.25 ± 7.28	35.6 ± 9.1	34.0 ± 5.8	40.0 ± 3.9	-
FFMI (kg/m^2)	21.3 ± 4.6	25.0 ± 3.6	24.3 ± 3.1	29.6 ± 1.84	-
FMI (kg/m^2)	10.0 ± 4.0	10.0 ± 5.6	9.7 ± 3.0	10.5 ± 2.6	-
% Fat	36.2 ± 11.6	27.4 ± 11.3	28.2 ± 11.3	25.6 ± 3.6	29.3 ± 7.2
WC (cm)	101.2 ± 15.4	-	-	115.5 ± 9.6	-
RMR (kcal/day)	1962.5 ± 499.5	-	-	2952.0	-
TEE (kcal/day)	3434.4 ± 874.2	-	-	4305.0	-
Practice (years)	17.6 ± 7.8	-	-	-	-
Training (min)	140.0 ± 62.0	-	-	-	-

Legend: BMI (Body Mass Index); FFMI (Fat-Free Mass Index); FMI (Fat Mass Index); WC (Waist Circumference); RMR (Resting Metabolic Rate); TEE (Total Energy Expenditure).

Table 2. Biochemical data of Brazilian sumo wrestlers. Brazil, 2014 (statistical indicators: Mean ± SD; in square brackets: range).

	Present study (n=6)	Nishizawa et al [1] (n=96)	Cutoff points
Glucose (mg/dL)	97.0 ± 18.7 [64.0 – 122.0]	96.7 ± 61.0	< 100 normal[1,3]
Cholesterol (mg/dL)	192.0 ± 23.5 [161.0 – 225.0]	182.6 ± 117.0	< 200 optimal[2,3]
Triglycerides (mg/dL)	211.7 ± 78.6 [160.0 – 367.0]	113.7 ± 36.2	150 – 200 adjoining[2,3] 200 – 499 high

[1] Guidelines of the Brazilian Society of Diabetes [25]
[2] III Guideline of the Brazilian Society of Cardiology [26]
[3] Alberti et al [27].

to 9 portions; G2: vegetables: 4 to 5 portions; G3: fruits: 3 to 5 portions; G4: milk and dairy products: 3 portions; G5: meat, poultry and eggs: 1 to 2 portions; G6: beans and nuts: 1 portion; G7: oils and fats: 1 to 2 portions; G8: sugars and sweets: 1 to 2 portions; these data were obtained from the software.

Resting metabolic rate (RMR), kcal/day, was obtained through the predictive formula proposed by FAO/WHO/UNU [23]. An estimate of the total energy expenditure (TEE), kcal/day, was calculated by multiplying RMR values by the mean factor of occupational physical activity (OPA) of 1.75, specific to sumo wrestlers [8]. All calculations were done by using the software for nutritional assessment Clinical Diet Win, ver. 3.0 (Brubins, 1995–2002).

The variables were presented as measures of central tendency (mean) and variability (standard deviation).

Results

The present study was carried out with 6 male Brazilian sumo wrestlers, whose characteristics are shown in Table 1. As regards the weekly practice of sumo, 83% did it at least 1x/week.

Total energy expenditure was 1,487.83 ± 533 kcal, and the distribution of macronutrients according to the total energy intake (TEI) is represented in Figure 1. The means of intake were: carbohydrates 48.7 ± 10.9%TEI, protein 16.6 ± 3.4%TEI, and fat 34.7 ± 9.4%TEI.

The food groups recommended by the Brazilian Food Pyramid are presented in Figure 2, according to the number of portions consumed by sumo wrestlers.

Discussion

There are few studies involving nutritional assessment of sumo wrestlers, especially due to the difficulty in evaluating obese but athletic individuals [3]. The mean values of 31.25 ± 7.28 kg * m^{-2} BMI and 36.2 ± 11.6% fat, are extremely higher than those recommended for eutrophy considering the general population [7]. These values are even higher if the adopted cutoff points are those used for the classification of the Japanese population nutritional status, based on BMI between 23 and 24.9 kg/m^2, according to *The Japan Society for the Study of Obesity* (JASSO) [28], for overweight and obesity, respectively. Simony and collaborators [29] investigated this issue in Japanese-Brazilians and suggested that a BMI ³ 25 kg/m^2 should already be considered an increased risk factor for the development of diabetes and hypertension associated with obesity, although further investigation is required concerning its causes, especially those related to genetic, nutritional and/or metabolic factors. Also concerning this specific issue of obesity involving sumo wrestlers, since the use of BMI could not suitable, Yamauchi et al. [8] proposed a new specific criterion for nutritional assessment, which takes into consideration three main factors: 1) body composition: %F > 25%; 2) physical activity level: PAL < 1.75; and 3) daily food intake > 110% of the total energy expenditure.

As regards body composition, the obtained %F was used to calculate the FFMI (21.3 ± 4.6 kg/m^2) and the FMI (10.0 ± 4.0 kg/m^2) of Brazilian *sumocas*, adding information about their somatotype according to the classification proposed by Hattori et al [19], which includes solid (FFMI > 19.9 kg/m^2) and adipose (FMI > 4.4 kg/m^2) i.e. adipose-solid or meso-endomorphy. These results agree with those obtained for Japanese Sumo wrestlers of the *sandanme* and *shindenshi* league;

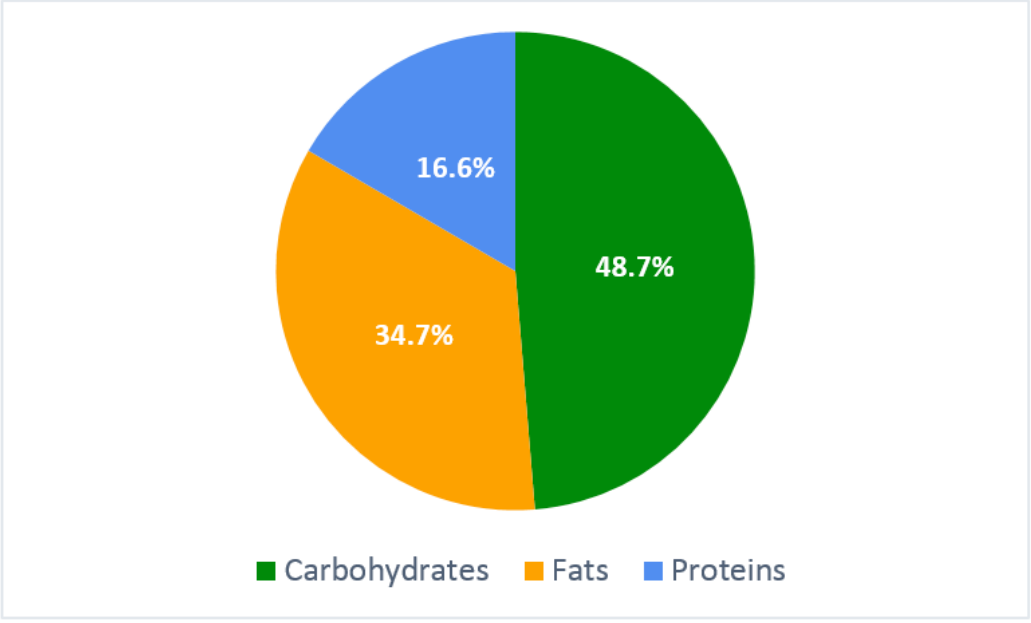

Figure 1. Distribution of macronutrient intake according to the total energy intake (TEI) of Brazilian sumo wrestlers. Brazil, 2014.

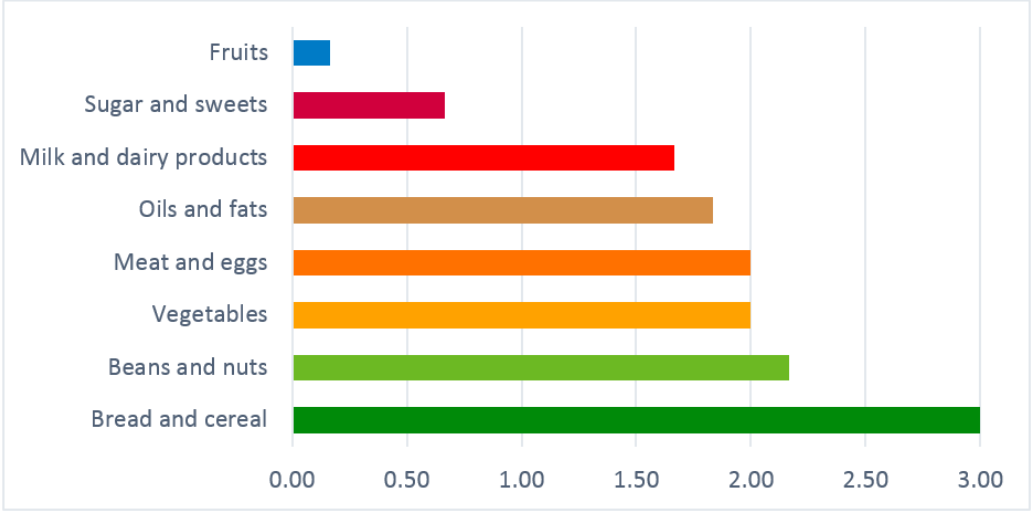

Figure 2. Distribution of the portions consumed by *sumocas* according to food groups recommended by the Brazilian Food Pyramid. Brazil, 2014.

however, hierarchical differences as to their body composition must be respected [2], since there are significant differences among all 6 official divisions of professional wrestlers, from the lowest to the top one: *jonokushi, jonidan, sandanme, makushita, juryo* and *makuuchi* [1,30,31]. All around the world, *sumotoris* have been increasingly reported to be a differentiated and challenging model of anthropometric and nutritional investigation due to their larger amount of lean mass, relative to sedentary individuals, obese or not, and their high-intensity physical activity [8].

Not only the quantity, but also the location of fat in the body is important in the diagnosis of complications associated with the excess adiposity, which can be evaluated based on the waist circumference (WC) [27]. Several national and international guidelines for Metabolic Syndrome (MS) diagnostic criterion indicate that abdominal obesity among male Japanese population, characterized by a waist circumference 85 cm, is already an essential condition [32]. Among *sumocas*, the mean value for this measure was 101.2 ± 15.4 cm, which was inferior to that found by Saito et

al [3], who obtained a mean value of 106.9 cm, while Yamauchi et al [8] reported 115.5 ± 9.6 cm.

In addition to anthropometry, other criteria should be considered in MS risk analysis among individuals not bearing cardiovascular diseases [25-27], including plasma concentration of fasting glucose (G), total cholesterol (TC) and triacylglycerol's (TG); the cut off points proposed for these parameters are shown in Table 2. Considering Brazilian *sumocas* in particular, there is only an alteration in TG concentration, whereas glucose and cholesterol results are similar to those obtained by Nishizawa [1] for 96 Japanese *sumocas*. The factors responsible for hypertriglyceridemia are related to genetic susceptibility and diet patterns, as strongly evidenced in the literature [33]; furthermore, our results are confirmed since hypertriglyceridemia is the lipid profile abnormality most commonly found in the Japanese-Brazilian population [13]. In a study with a Japanese-Brazilian sample, obesity was not detected, but the phenotypic characteristic was predisposing for MS, i.e. fat accumulation in the abdominal region; the hypothesis for this finding include marked socio-cultural changes in the process of migration to Brazil, especially concerning feeding habits (western diet) and sedentary lifestyle [34]. This hypothesis corroborates the study with Japanese people in the North American continent, where the increased risk for the development of chronic-degenerative diseases was strongly associated with environmental factors [35].

Thus, as important risk factors and triggers in MS aetiology, qualitative and quantitative food intake patterns must be investigated. Although R24H alone does not provide accurate data on the quantitative intake of nutrients, it can be used in the qualitative analysis, suggesting possible diet inadequacies [36]. The nutritional transition that occurred in the Brazilian population indicates increased prevalence of obesity, especially related to nutritional habits such as higher intake of saturated fatty acids, sugars and soft drinks, and decreased intake of complex carbohydrates, vegetables and fibres, especially in Metropolitan regions [37]. These foods are also source of fibres, vitamins and minerals (antioxidants); the Feeding Guide for the Brazilian Population [38] recommends the intake of 3 portions of fruits and 3 portions of vegetables, and the suggested minimum intake of these foods is 400 g/day. Considering Brazilian Sumo wrestlers, the intake was quite below that recommended per portion of groups G1 (bread, cereal etc.), G2 (vegetables), G3 (fruits) and G4 (milk and dairy products) and above those per portion of groups G5 (meat, eggs etc.), G6 (beans and nuts), G7 (oils and fats) and G8 (sugars and sweets) (figure 2). In a study carried out by the *Japanese-Brazilian Diabetes Study Group* with a Japanese-Brazilian community from Bauru, São Paulo State, there was the need of adopting immediate intervenient measures to increase the intake of fruits and vegetables (FV), especially concerning the youngest population, in order to reach the intake of 400 g/day, a goal related to risk factors for the occurrence of non-transmissible chronic diseases (NTCD) [10,39]. Low FV intake has been increasingly accepted as an important risk factor for several NTCD, specially cardiovascular diseases (CVD) [39].

The lipid profile can be improved by means of a bodyweight reduction in order to normalize blood pressure and correct dyslipidaemia and hyperglycaemia, consequently reducing the cardiovascular risk [40]. It is accepted that guided physical activity for obese individuals, including at least 30 minutes of moderate to vigorous activity, more than once a week, reduces the risk of death due to CVD, compared to obese, sedentary individuals [41]. These data suggest that Brazilian *sumocas* have a protective factor due to Sumo practice, since most of the evaluated individuals practiced the sport modality at least once a week for 140.0 ± 62.0 min and had a PAL of 1.75, considered by WHO [7] the minimum value to classify the individual as physically active [8].

Based on the studied context, we could observe that the population of the present study has a protective factor against the development of NTCD, brought by their cultural inheritance of the regular practice of a physical activity (sumo). Therefore, corroborating various works with Japanese-Brazilian population, the change in feeding habits, which include FV intake at portions sufficient to act as beneficial agents to the health, is also a desirable intervention measure for *sumotoris* and can act synergistically with sumo practice, reinforcing the Japanese cultural and traditional relationships of these immigrants settled in Brazil.

Conclusion

Sumo wrestlers have a body composition different from that of the sedentary population, obese or not, which indicates that the anthropometric assessment should include selected indexes involving somatotype analysis. The strategy of increasing fruit and vegetable intake to adequate quantities should be adopted, as evidenced by several studies involving the nutritional transition impact on the

Japanese-Brazilian community. Besides maintaining the cultural inheritance of Japanese immigrants, sumo practice can be considered a beneficial regular physical activity due to the positive alteration it causes in the body composition by increasing the lean mass and improving the biochemical parameters related to the metabolic syndrome, although the investigated athletes have confirmed phenotype of risk for its development.

Competing interests

The authors declare that they have no competing interests.

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