

Anthropometric characteristics of rhythmic gymnasts

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Abstract

In esthetic sports, such as rhythmic gymnastics, body size and body composition can directly affect performance and outcome. The aim of this study was to identify anthropometric characteristics and to notice their impact on the prediction of higher performance in rhythmic gymnastics. For the needs of this review, scientific literature was analyzed from prestigious scientific journals. This systematic review included available data from the following databases: Google Scholar, Springer, PubMed, Europe PMC and research databases. Studies with the following criteria were included: anthropometric characteristics, profile or status and somatic constitution, body composition, somatotypes and morphological models, factors influencing performance and the level of the performance (reliability), and being published in English and Serbian language. Out of total 52 studies, reviewed 9 studies met the inclusion criteria. Based on the findings of the present study it could be concluded that anthropometric characteristics are an important item on the basis of which talent identification, sports selection and programming of training and nutrition plan is performed.

Keywords rhythmic gymnastics • anthropometric characteristics • anthropometric profile • morphological models.

Introduction

Rhythmic gymnastics (RG) is a unique blend of gymnastics, dance and handling apparatus (ribbon, ball, clubs, hoop, rope). It is a sport that at first glance captivates with the elegance, great body movement and mastery with apparatus, all in the unbreakable connection with music.

It has already been well documented that body size and body build contribute significantly to performance in many sports, particularly in aesthetic sports and all kinds of dancing. Within the group of the so-called female aesthetic sports, the most demanding sports are: artistic gymnastics, rhythmic gymnastics, and figure skating (Mišigoj-Duraković, 2012).

Anthropometric measurements have traditionally been used in the identification of young talented female gymnasts (Bradshaw & Rossignol, 2004).

Anthropometrical assessment helps to improve the understanding of gross functioning of the human body by measurement of body's size, shape, proportions and compositions using non-invasive, affordable and portable devices (Claessens et al., 1991; Chamorro, et al., 2012; Muqarram, 2015; Kaur & Koley, 2019).

Rhythmic gymnasts are characterized by a below-average percentage of subcutaneous fat and below-average body height and body weight (Aleksander, 1991).

The establishment of morphological characteristics with performance of specific skills may be very helpful in the early stages of the rhythmic gymnastics training process as well as in the sport selection process (Jelicic, Sekulic, & Marinovic, 2002).

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Studying the contribution of anthropometry to the results of a sample of top female artistic gymnasts competing at the World Gymnastics Championships, Claessens et al (1999) found out that there is a relatively strong relationship between several anthropometric variables and gymnastic performance in a sample of elite female gymnasts, but the associations are not sufficiently high to predict performance scores on an individual basis.

Di Cagno et al (2008a), examining how leaping ability and body composition help in talent identification, found certain anthropometric measures, such as body height, thigh length and fat-free mass, to be good predictors of better performance.

Average body height and mass of female athletes in many sports, as in sports games, swimming, or tennis, to mention a few, corresponds to or is often above the median value of the average nontrained peer population of girls. However, in the group of esthetic sports, track disciplines of long-distance running and ballet, but especially in gymnastics, the key advantage is a smaller body size with a considerably reduced portion of fat in body composition and performance-related adequate fat-free mass in female athletes (Mišigoj-Duraković, 2012).

The aim of this study was to identify anthropometric characteristics and to notice their impact on the prediction of higher performance in RG.

Method

Study design

This paper is written and reported based on Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Liberati, et al., 2009).

Search strategy

This systematic review included available data from the following databases: Google Scholar, Springer, PubMed, Europe PMC and research databases. All the studies listed in this paper were published in the period from 2004 to 2016.

The following key words were used to find the study: rhythmic gymnastics, anthropometric characteristics, anthropometric profile, morphological models, somatotype, elite athletes,

maturation, body composition, body constitution, performance characteristics, level of performance.

Eligibility criteria and information sources

In order to identify the relevant literature, inclusion and exclusion criteria were clearly defined.

Studies with the following criteria were included: (i) anthropometric characteristics, profile or status and somatic constitution, (ii) body composition, (iii) somatotypes and morphological models, (iv) factors influencing performance and the level of the performance (reliability), and (v) were published in English and/or Serbian language. In addition, the following screening steps have been taken: the title and abstract were read to confirm that the criteria for inclusion of articles in our review article were met; if so, then the whole article is read in its entirety in order to extract data on the country, the year of the author and the publication, the sample size, the measuring instruments and the main descriptive results.

Exclusion criteria for choosing studies for this review was if (i) they were published in other language than English and Serbian, (ii) were not exclusively about rhythmic gymnasts and (iii) did not report anthropometric measures.

Study records, screening and selection of citations

Fifty-two studies were identified and on the basis of inclusion criteria. 41 studies were excluded and only 9 were included in this study. The whole process of citation is described in Figure 1 in the flow diagram.

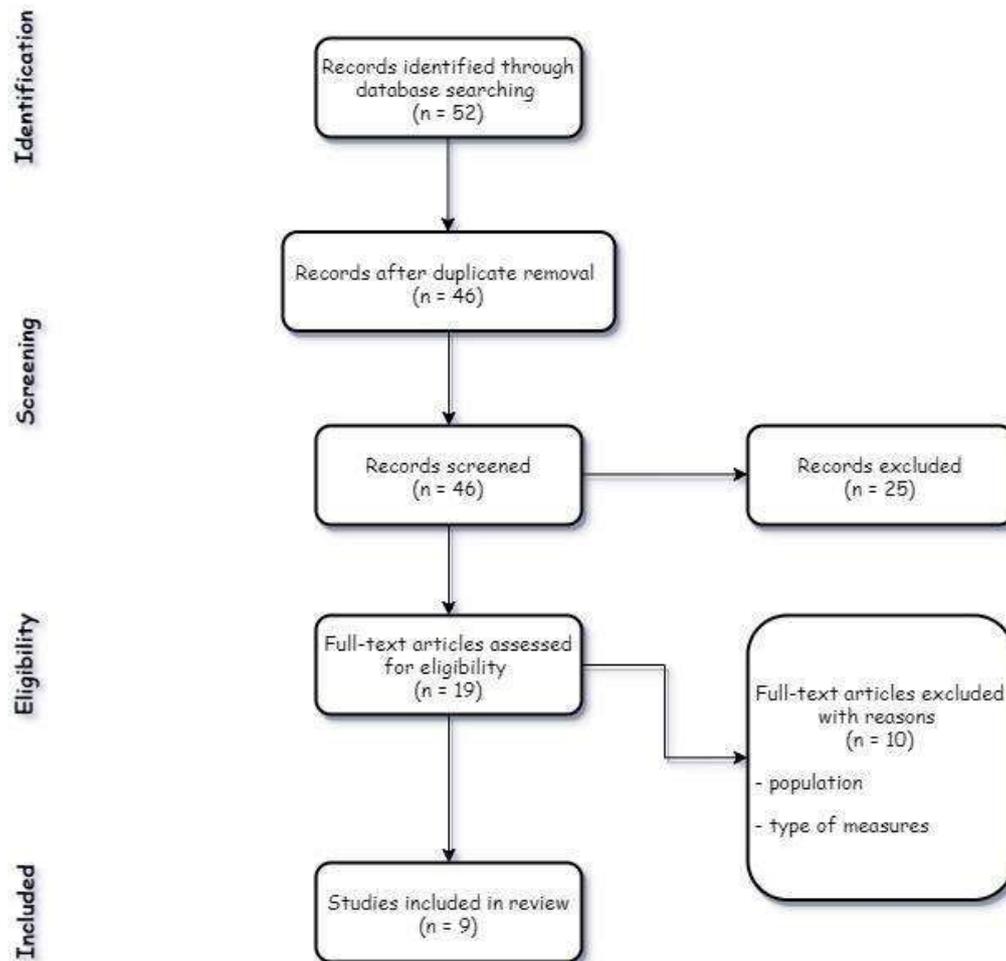


Figure 1. The PRISMA flow diagram

Results

A total of 537 rhythmic gymnasts participated in these studies. All 9 studies include female gymnasts and just one of them includes male gymnasts as well (Di Cagno, et al., 2009). The mean age of the gymnasts participated in these studies are 7 to 26 years. Complete data details of each study are presented in Table 1.

Table 1. Details of the studies used in this review: sample, origin, mean age, anthropometric variables, other variables.

Study	Sample	Origin	Mean age	Anthropometric variables	Other variables
Miletić, et al., 2004	n=50		7.10±0.3 years	Weight, height, biacromial diameter, wrist length, foot diameter, abdomen circumference, forearm circumference, upper leg circumference, triceps skinfold, subscapular skinfold and abdomen skinfold	13 motor and 20 specific rhythmic gymnastics tests
D'Alessandro, et al., 2007	n=55		15.2 ±2.2 years	Height, weight, middle arm circumference, forearm circumference, chest circumference, waist circumference, Hip circumference, triceps skinfold thickness, biceps skinfold thickness, subscapular skinfold thickness, iliac skinfold thickness, middle arm-muscle circumference	Body-mass index, fat mass, age at menarche
Di Cagno, et al., 2008b	n=63	Olympic Games in Athens	Juniors 14.1±2.2 years (2002) 12.2±1.8 years (2006) Seniors 15.8±2.0 years (2002) 17.8 ±1.5 years (2006)	Height, sitting height, weight, thigh length, five diameters - biacromial, toracic, bicristal, elbow and knee, two circumferences -relaxed and flexed upper-arm and skin-folds thickness at three body sites (triceps, subscapular, suprailiac)	Fat mass, fat free mass, body-mass index

Douda, et al., 2008	n=34		13.41±1.62 years	Height, body mass, armspan, sitting height, skin fold thicknesses (triceps and calf), 14 circumferences (shoulder, chest, waist, abdominal, buttocks, proximal thigh, midthigh, distal thigh, calf, ankle, arm, forearm, and wrist) and 8 diameters (biacromial, chest, biiliac, bitrochanteric, knee, ankle, elbow, and wrist)	Physical fitness, physiological measurements
Šebić-Zuhrić, et al., 2008	n=127	„Druga gimnazija“ High School in Sarajevo	16-18 years	Body height, body mass, arm, hand, leg and foot length, biacromial span, elbow, wrist, knee, ankle and hand diameter, bicrystal span, back skin fold, upper arm skin fold, stomach skin fold, lower leg fold	Mean chest, upper arm, upper and lower leg and waits volume; RG elements in exercises without props: children's jumps, "arabesque" level, two-leg 720-degrees turn, body wave aside, swing in front of legs, cat jump, ring" balance, rolling on the ground, far-high jump and deer jump
Di Cagno, et al., 2009	n=24		22±4 years	Stature, sitting height, body mass, thigh length, triceps, subscapular, suprailiac skin folds.	BMI, sitting-height-to-stature-ratio, fat-free mass and fat mass; Explosive leg power (squat jump, Countermovement jump, Hopping test) technical jumps (Split Leap with stretched Legs (SL); Cossack with 180° of rotation (CK); Jeté with turn (JWT))
Ávila-Carvalho, et al., 2012	n=84	RG World Cups in Portimão, Portugal (2009, 2010)	18.59±2.44 years	Body mass, height, thoracic circumference, hip circumference, arm circumference, thigh circumference, waist circumference, calf circumference	Body Mass Index, Body Fat, Fat Mass, Lean Body Mass; Age of initiation in RG, practice, training duration, training Volume; Age at menarche

Purenović-Ivanović & Popović, 2014	n=40	Serbian National Championships (2012)	13.04±2.79 Years	Body height, body mass, four skin folds (over triceps, subscapular, supraspinale, and calf), biceps girth (flexed 90° and tense), standing calf girth, humerus breadth and femur breadth	Endomorphy, mesomorphy, ectomorphy
Arriaza, et al., 2016	n=60	Chilean national team	Preschoolers and schoolers 10.6±1.1 years Juniors 13.7±0.8 years Seniors 17.0±1.1 years	Basic weight and height, skin folds: triceps, subscapularis, supraspinatus, abdomen, thigh and calf, body diameters: humerus and femur, body perimeters: relaxed arm, fully contracted arm, forearm, thorax, rip, mid-thigh and calf	BMI, muscular mass, fat mass, endomorphy, mesomorphy, ectomorphy

Discussion

Based on basic anthropometric data, most studies have studied body composition (body mass index, body fat, fat mass, lean body mass) (D'Alessandro, et al., 2007; Di Cagno, et al., 2008b; 2009; Šebić-Zuhrić, et al., 2008; Ávila-Carvalho, et al., 2012; Arriaza, et al., 2016). Some of them used anthropometric data to figure the somatotype of rhythmic gymnasts (Purenović-Ivanović & Popović 2014; Arriaza et al., 2016).

Based on the study by Miletić et al. (2004), the defined factors of anthropologic status of girls have a varying impact on learning new motor knowledge and skills depending on whether large amplitude movements or small amplitude wrist movements (specifically, apparatus manipulation) are performed. Accordingly, successful motor learning and performance of basic motor skills in RG (balance, jumps, rotation and flexibility) will primarily depend on the development of flexibility, and to a lesser extent of explosive strength, along with under-average adipose tissue, whereas successful apparatus (clubs, ribbon and ball) manipulation will depend on the frequency of movements, along with a moderate ectomesomorphic somatotype in girls.

Šebić-Zuhrić et al. (2008) confirmed that body mass and subcutaneous fat tissue have a highly negative impact on successful learning and mastering the basic body elements in beginner rhythmic gymnasts. Their research results also show that the girls with a greater body mass and a higher percentage of subcutaneous fat tissue will master the basic elements in rhythmic gymnastics exercises without props with more difficulties and much slower.

According to the PCA procedure applied in the study by Douda, et al. (2008), successful performance in rhythmic gymnastics depends on 6 components among which are anthropometric characteristics. One of their major findings is that RG performance-ranking scores can be significantly explained by anthropometric and aerobic-capacity components, and it should be noted that the latter was identified as the first predictor in elite rhythmic gymnastics athletes.

As rhythmic gymnastics began to be practiced by the male population, it is important to note that similar anthropological characteristics have to be attained to reach high results for both genders (Di Cagno, et al., 2009). Low fat mass and sitting-height-

to-stature-ratio values and high fat free mass values, stature and lower limb length, could be considered important variables in RG jumping ability (Di Cagno, et al., 2009).

The discussion on the anthropometric factors, in addition to a good command of the morphological type of elite gymnasts, must be based on the characteristics of beginners, the monitoring of the level of motor information and the relations with other segments of the anthropological status during growth and development (Šebić-Zuhrić, et al., 2008).

As mentioned earlier, the size, build and aesthetic appearance of the body, affect the better performance (Mišigoj-Duraković, 2012; Kaur & Koley, 2019), therefore, it could be concluded that all studies dealing with anthropometric characteristics, profile or status, somatic constitution, body composition, somatotypes, morphological models are one of a few keys leading coaches and their athletes to success in RG.

Conclusion

This review emphasizes the role of anthropometry in RG. It is very important to consider the connection between anthropometric characteristics with functional abilities and motor skills when selecting and training young talents. In addition to help in talent identification and sport selection process, anthropometric characteristics can serve as guidelines for programming the training and diet for higher performance.

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