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Physical fitness related to sportive performance in artistic gymnastics

Aptidão física relacionada ao desempenho esportivo na ginástica artística

Carla Fabiane dos Santos Lemos[1]
Danillo Reis dos Santos[1]
Nara Michelle Moura Soares[1]

Abstract – The practice of artistic gymnastics for children and adolescents develop both motor vocabulary, cognitive aspects and affective partners. The aim of the study was to analyze physical fitness characteristics related to sports performance of adolescents practicing artistic gymnastics. This study is a systematic review and used the following databases: Scielo, PubMed and SportDiscus, with no starting date and using as final cutoff the month of February 2017. The search strategy was based on the identification of the Population of adolescents practicing artistic gymnastics and outcome related to physical fitness characteristics related to sports performance, and allowed verifying how studies were evaluated. There was a predominance of studies related to anthropometric variables, such as BMI and body fat percentage (%F) of gymnasts. Based on this type of study, the information available in this study will contribute to help physical education professionals and other researchers in the field with current publications related to these aspects, according to the results of this study, particularly in the pedagogical information for coaches.

Key words: Adolescent; Physical fitness; Gymnastics.

Resumo – *A prática da ginástica artística para as crianças e adolescentes desenvolvem tanto o vocabulário motor, como aspectos cognitivos e sócios afetivos. O objetivo do estudo foi analisar as características da aptidão física relacionado ao desempenho esportivo de adolescentes praticantes de ginástica artística Este estudo é uma revisão sistemática e utilizou as bases de dados: Scielo, PubMed e SportDiscus, sem data limite de início e utilizando como ponto de corte final o mês de fevereiro de 2017. A estratégia de busca partiu da identificação da população de adolescentes praticantes de ginástica artística e desfecho relacionado às características da aptidão física relacionado ao desempenho esportivo. Falar de como foi a avaliação dos estudos. Foi constatado que houve uma predominância de estudos relacionados às variáveis antropométricas, como IMC e percentual de gordura (%G), de ginastas. A partir desse tipo de estudo as informações disponíveis no mesmo contribuirá para auxílio e despertar aos profissionais de Educação Física e demais pesquisadores da área publicações mais atuais relacionadas a estes aspectos abordados, pois o resultado do presente trabalho sugere a necessidade deste direcionamento, particularmente em caráter de informação pedagógica dos treinadores também.*

Palavras-chave: *Adolescente; Aptidão física; Ginástica.*

1 Tiradentes University. Laboratory of Human Biomotricity. Aracaju, SE. Brazil.

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INTRODUCTION

The term gymnastics, originating from the word *Gyminastiké,* expresses "the art of exercising the body to strengthen it and give it agility"[1]. Gymnastics and its characteristic elements were already perceived long before Christ in various civilizations of antiquity considered a form of physical activity through the daily needs of the people of that time, as well as acrobatic and rhythmic practices[2].

Alves and Alves[3] affirm that the practice of artistic gymnastics develops in children and adolescents motor vocabulary, cognitive aspects and affective partner. According to Nunomura and Nista-Piccolo[4], the AG context is composed of 19 elements fundamental for human motor development, such as rolling, balancing, jumping, spinning, among many others. Therefore, the experience of such movements facilitates the improvement of specific physical capacities such as coordination, flexibility, balance and agility[5].

Some studies have emphasized that flexibility is considered an important physical fitness component related to health and athletic performance for children and adolescents[6]. Normally, flexibility is a physical quality more predominant in girls than in boys, because females have wider hips, allowing greater levels of flexibility in this region compared to males[7].

Strength is one of the physical abilities also worked in AG, which allows the muscles or muscle groups to produce tension to react to a resistance in the action of pushing, pulling or lifting. AG strength training is performed with loads additional to the athlete's own weight, which does not develop only through specific movements of the modality[8]. Another important physical capacity in artistic gymnastics is motor coordination, which consists of a harmonious and economical interaction of the musculoskeletal, nervous and sensory systems to produce precise and balanced kinetic actions[9].

Within this modality practiced by both sexes, with regulation, apparatus, techniques and other specific aspects for each sex, there is a vast field to be explored by researchers. However, when we refer to the search for theoretical references related to AG, we realize that although there are many studies and scientific publications in the area, compared to other sports, this demand can be classified as small, taking into account the current growth of this sport.

Thus, the study is justified due to the fact that there is a lack of current studies on artistic gymnastics and its range of aspects, from pedagogical to technical. However, when referring to research on physical fitness related to athletic performance in AG, the lack of studies is even greater. Thus, the present study is a systematic review and aims to analyze the physical fitness characteristics related to the sports performance of adolescents practicing artistic gymnastics.

METHODOLOGICAL PROCEDURES

Literature search strategy

The systematic survey of primary studies was carried out in the following

databases: Scielo, PubMed and SportDiscus, with no starting date and using the final cutoff date as February 2017.

A search strategy was developed for MEDLINE, accessed through Scielo, where a strategy was used from keywords to retrieve the highest possible number of articles. For PubMed based on medical subject headings (MeSH) identified as terms and keywords. For SportDiscus, DeCS terms and their synonyms were used as starting point. Reference lists of all included articles were reviewed.

Various combinations with keywords "athletes", "sports performance", "artistic gymnastics", "strength", "resistance", "speed", "agility", "flexibility", "cardiorespiratory fitness", "body composition", "coordination", were used in English, Portuguese and Spanish, when appropriate.

The strategy used for Scielo was:

((((((((((("Athletes"[Mesh]) AND "Gymnastics"[Mesh]) OR "Exercise"[Mesh]) OR "Sports"[Mesh]) AND "Physical Fitness"[Mesh]) OR "Walking Speed"[Mesh]) OR "Physical Endurance"[Mesh]) OR "Muscle Strength"[Mesh]) OR "Pliability"[Mesh]) OR "Body Composition"[Mesh]) OR "Body Mass Index"[Mesh]) OR "Skinfold Thickness"[Mesh]) OR "Cardiorespiratory Fitness"[Mesh]

The strategy used for SportDiscus was:

"Athletes" AND "Gymnastics" AND "Exercise" OR "Sports" OR "Cardiorespiratory Fitness" OR "Physical Fitness" OR "Walking Speed" OR "Physical Endurance" OR "Skinfold Thickness" OR "Muscle Strength" OR "Pliability" OR "Body Mass Index"

The search strategy was based on the identification of the population of adolescents practicing artistic gymnastics and outcome related to physical fitness characteristics related to sports performance: strength, localized muscle strength, flexibility, speed, power, agility, cardiorespiratory fitness, motor coordination and anthropometric variables. In addition, there following filters were used "observational type studies (cross-sectional, cohort and case-control)".

Inclusion and exclusion criteria

The following inclusion criteria were independently applied: a) studies with adolescents; b) both sexes; c) artistic gymnastics athletes; d) observational studies (cross-sectional, cohort and case-control).

Exclusion criteria were: a) elderly; b) adults; c) children; d) athletes of other modalities; e) studies in which abstract or full text was not found.

Data extraction

The agreement among evaluators was observed by the Kappa Index. Two independent examiners searched the databases, analyzed the titles (k = 0.590, EP = 1.302, p 95%), abstracts (k = 1,000, SE = 0.000, p 95%) and reviewed the full articles with the objective of evaluating the eligibility for the inclusion of each study. All disagreements were discussed and, in case of persistence, a third reviewer was consulted.

RESULTS

Inclusion of studies

After searching the databases, 1585 articles were found. Then, 1373 were excluded by the title evaluation, 199 were duplicates, remaining 13 articles identified as eligible by the analysis of the abstract. After this step, 8 articles were excluded based on the complete reading of the abstract. Of these, 4 articles were selected for reading the full text (Figure 1).

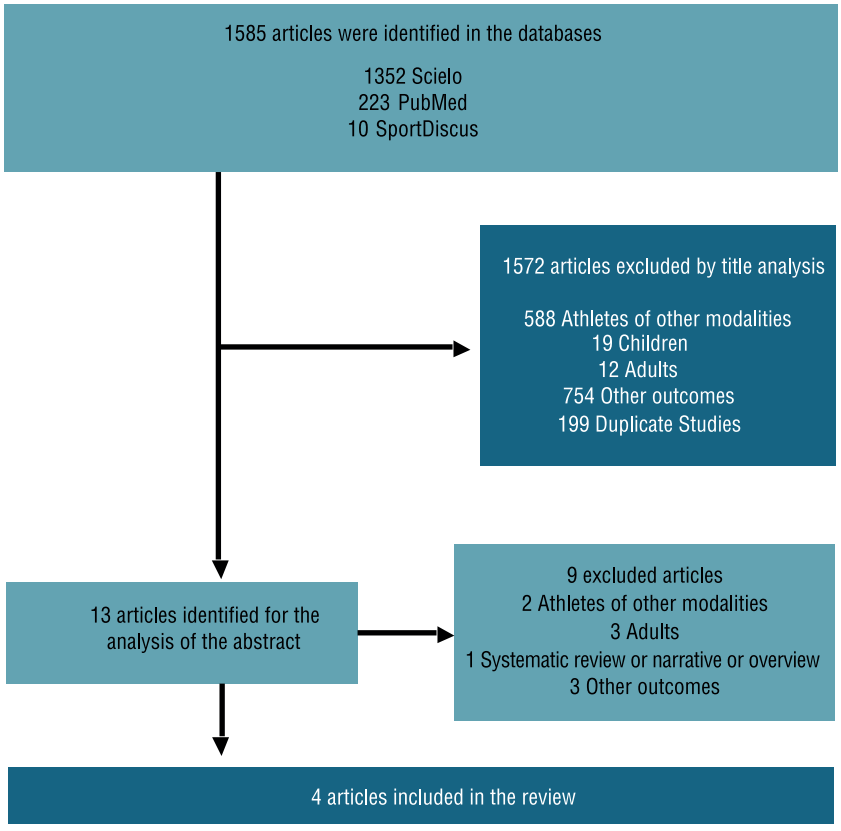

Figure 1. Flowchart of the selection process for the systematic review.

At the end of the research process, 4 studies met the inclusion criteria. Interventions were arranged in alphabetical order by surname of the first author (Table 1).

Variables and Design

Among all articles on physical fitness related to sports performance in artistic gymnastics, only anthropometric variables such as body mass index (BMI) and body fat percentage (%F) were found. The other variables (strength, endurance, speed, agility, flexibility, cardiorespiratory fitness and coordination) were not found in articles.

The design of articles[10,11] presented a control group composed of non-athletes, a group of base or non-elite athletes classified from their training with work load less than 30 hours a week, and the group of high-

performance or elite athletes with training load of 30 hours / week. The results found on the BMI of base and high-performance athletes were within normal range in the study. For the body fat percentage, the findings in these studies were that high-performance or elite athletes had lower values in relation to base or non-elite athlete.

The study by Fortes et al.[12] was composed of a group of artistic gymnastics athletes of both sexes, with training routine of 5 times per week and 1 hour per day. In the results, BMI and % F in the female sex were within normal limits, whereas males presented higher values in both variables.

The study by Ribeiro and Soares[13] presented two groups of AG athletes, both with training load of 6 times a week and 5 hours a day, in two periods (morning and afternoon). One of the groups located in São Paulo presented lower BMI and % F results, and the other in Rio de Janeiro were found to have higher results in the study variables.

Table 1. Summary of the characteristics and results of physical fitness studies related to the sport performance in artistic gymnastics.

Study	Sample	Design	Variables	Outcome
Neves et al.[10]	N = 413 Sex: M/F 12.86 ± 1.80 years	CG – non-athlete. G1 – training below 30 hours/ week. G2 – training of 30 hours/ week.	Anthropometric: BMI, %F.	↓ BMI – base athletes ↓ BMI – high-performance athletes ↑ BMI - non-athletes. ↓ %F - high-performance athletes. ↑ %F - base athletes. ↑ %F - non-athletes.
Neves et al.[11]	N = 285 Sex: M/F 12.86 ± 1.80 years	GA1 – training below 30 hours/week. GA2 – training of average 30 hours/week.	Anthropometric: BMI, %F.	Elite and non-elite athletes –normal BMI ↓ %F - elite athletes ↑ %F – non-elite athletes
Fortes et al.[12]	N = 580 Sex: M/F 10 - 19 years	GGA – training routine of 5 times per week and 1 h/day.	Anthropometric: BMI, %F.	BMI and %F ♀ - no difference. BMI and %F ↑ ♂
Ribeiro and Soares[13]	N = 46 Sex: F 11 - 14 years	GGFRJ/GGFSP-training of 6 time per week and 5 h/day (morning and afternoon).	Anthropometric: BMI, %F.	↓%F in GGFSP ↑ %F in GGFRJ ↓ BMI in GGFSP ↑ BMI in GGFRJ

CG - control group. G1 - group of base athletes. G2 - group of high-performance athletes. BMI - body mass index. % F – body fat percentage. GA1- group of non-elite athletes. GA2 - group of elite athletes. GGA - group of artistic gymnastics athletes. ♀ - female. ♂ - male. GGFRJ - group of athletes of feminine artistic gymnastics of Rio de Janeiro. GGFSP - group of athletes of female artistic gymnastics of São Paulo.

DISCUSSION

During the period of data collection, it was verified that investigations regarding the search of scientific materials related to the theme proposed were scarce and that there was a great predominance of studies aimed at evaluating the anthropometric profile of gymnasts.

At first, the expectation was to be able to analyze and compare the following variables: strength, endurance, speed, agility, flexibility, cardiorespiratory fitness, body composition and coordination. However, as

mentioned above, the maximum information available was related to anthropometric variables BMI and fat percentage.

For AG, the in-depth study directed to variables that the athlete should acquire, would allow a more conscious and effective performance, when referring to the periodization of the individualized training of each athlete[14]. Because it is an individual sport, it requires sensitivity from coaches and other people who compose the technical team, in order to progress and improve the mentioned variables[15].

In the present study, anthropometric variables such as fat percentage (% F) and BMI of high-performance and elite artistic gymnastics athletes are within the standard proposed by Fortes et al.[16]. On the other hand, base athletes obtained lower BMI result relative to %F, so the marked increase in body fat percentage of these athletes may be due to an imbalance between energy intake and expenditure, which are influenced by the training program and period, directly interfering with body composition[8,17]. In general, all study gymnasts are within normal BMI and %F values in relation to gender and age group[18].

According to Ferreira Filho, Nunomura and Tsukamoto[19], artistic gymnasts have lower body mass and height, which are advantages in the performance of extreme complexity acrobatics in high-performance sports. Soric et al.[20] obtained lower fat percentage in gymnasts compared to young people who did not practice physical activity, regardless of factors such as age, training program and research method used.

Regarding the height of artistic gymnastics athletes, studies aimed at such discussion have allowed demystifying that practitioners of the modality tend to grow. The study by Ferreira Filho et al.[21] is very enlightening regarding the non-interference in the growth spurt period of athletes practicing AG. The authors clarify in their study that the child's development will depend on genetic factors and not on the practice of sport.

Claessens et al.[22] carried out a study with elite female gymnasts and observed that anthropometric variables and gymnastic performance are strongly related. This may occur because in gymnastics, there is a differentiated pattern in the skeletal maturation and linear growth of practitioners, resulting in an attenuation of the growth potential more pronounced in boys than in girls [23].

The study by Ferreira Filho et al.[21] reported that the stature of high-level athletes in Brazil is within the modality, and that stature is not damaged due to high-level training. However, Sawicki et al.[24] reported that initial specialization of AG can influence the physiological and metabolic factors of practitioners. On the other hand, Burt et al.[25] and Maïmoun et al.[26] affirm that the practice of gymnastics before puberty is associated with an increase in bone strength, providing benefits only after the pubertal period.

In studies evaluated by this review, stature as well as the value resulting from BMI is within the acceptable parameters[27]. This explains that, generally, smaller athletes tend to have greater facility and development in AG than taller ones, therefore, the accomplishment of movements and

turns in the transversal and longitudinal axes become easier for people with smaller stature, consequently smaller people can reach better technical level[28]. According to Rogatto[17], these anthropometric changes from the practice in training programs in AG are not related to the muscular content of boys with pre-pubertal age, but to changes in body adiposity[29].

CONCLUSION

It was concluded that although there are many studies and publications in the area and if compared to other similar sports modalities, such as Rhythmic Gymnastics, AG presents a lack related to the availability of theoretical reference, as well as lack of review studies related to the athletic aptitude of its practitioners.

Based on the above, the main aim of this study was not reached due to the lack of material in the respective area; however, when identifying this lack, the result attributed to this review study is considered satisfactory, since it can serve as a guide, providing information for researchers in the area.

Based on this type of study, the information available in this study will contribute to help physical education professionals and other researchers in the field with current publications related to these aspects, according to the results of this study, particularly in the pedagogical information for coaches.

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CORRESPONDING AUTHOR

Carla Fabiane dos Santos
Av. Murilo Dantas, 300.
Farolândia. Coordenação de Educação Física.
Aracaju, SE, Brasil.
Email: carla_fabiane.tec.alimentos@hotmail.com