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Original article

## *Somatotype and body composition in athletes of the Colombian Cheerleading Team*

*Somatotipo y composición corporal en deportistas de cheerleading, de la selección  
colombiana*

*Somatotipo e composição corporal em atletas da seleção Colombia de Cheerleading*

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### **ABSTRACT**

The objective of this research was to determine the somatotype and body composition of the cheerleading athletes of the Colombian team, differentiated between the base and flyer



roles. For this purpose, a descriptive and cross-sectional study was made, in which 26 athletes participated, 16 men ( $25.5 \pm 3.9$  years) with the role of base, and 10 women ( $19.0 \pm 4.5$  years) who played the role of flyer. Anthropometric measurements were taken with the protocol of the International Society for the Advancement of Kinanthropometry, for restricted profile. Body mass indices were obtained; fat, muscle and bone percentages; endomorph, mesomorph and ectomorph components that determined the somatotype; the time of experience of each athlete was taken into account to determine the time of active practice of the sport expressed in months; and descriptive measures of mean and standard deviation were calculated. The results revealed a high level of skill in Cheerleading, at a national and international competitive level, achieved by athletes with adequate experience; the somatotype that prevailed in the evaluated athletes was endomesomorph in the base role, and balanced ectomorph in the flyer role, which demonstrated the importance of the muscular component in both sexes for the adequate performance of the different skills of this sport. In the work, the evaluation of body composition and somatotype in competitive cheerleaders at the level of a national team was presented.

**Keywords:** cheerleading, body composition, anthropometric profile, somatotype

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## RESUMEN

El objetivo de esta investigación fue determinar el somatotipo y la composición corporal de los atletas de cheerleading de la selección colombiana, diferenciados entre los roles de base y flyer. Para ello, se realizó un estudio de carácter descriptivo y transversal donde participaron 26 deportistas, 16 hombres ( $25,5 \pm 3,9$  años) con el rol de base, y 10 mujeres ( $19,0 \pm 4,5$  años) que ejecutaron el rol de flyer. Se tomaron medidas antropométricas con el protocolo de la sociedad internacional por el avance de la cineantropometría, para perfil restringido. Se obtuvieron índices de masa corporal; porcentajes graso, muscular y óseo; componentes endomorfos, mesomorfo y ectomorfo que determinaron el somatotipo; se tuvo en cuenta el tiempo de experiencia de cada atleta para determinar el tiempo de práctica activa del deporte expresada en meses; y se calcularon medidas descriptivas de media y desviación estándar. Los resultados revelaron un alto nivel de habilidad en Cheerleading, a



nivel competitivo nacional e internacional, alcanzado por los atletas con una experiencia adecuada; el somatotipo que prevaleció en los atletas evaluados fue endomesomorfo en el rol de base, y ectomorfo balanceado en el rol de flyers, lo que demostró la importancia en el componente muscular de ambos sexos, para la adecuada realización de las diferentes habilidades de este deporte. En el trabajo, se presentó la evaluación de la composición corporal y el somatotipo, en cheerleaders de competición a nivel de un equipo nacional.

**Palabras clave:** cheerleading, composición corporal, perfil antropométrico, somatotipo

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### RESUMO

O objetivo desta pesquisa foi determinar o somatótipo e a composição corporal das atletas Cheerleading da seleção colombiana, diferenciadas entre as funções de base e voadora. Para isso foi realizado um estudo descritivo e transversal no qual participaram 26 atletas, composto por 16 homens ( $25,5 \pm 3,9$  anos) que desempenhavam a função de base e 10 mulheres ( $19,0 \pm 4,5$  anos) que desempenhavam a função de voadora, as medidas antropométricas foram realizadas seguindo o protocolo da Sociedade Internacional para o Avanço da Cineantropometria (ISAK 2) para um perfil restrito. Foram obtidos índices de massa corporal (IMC), percentuais de gordura, músculo e osso, componentes endomórficos, mesomórficos e ectomórficos que determinam o somatótipo. O tempo de experiência de cada atleta foi levado em consideração para determinar o tempo de prática ativa da modalidade expresso em meses. Foram calculadas medidas descritivas de média e desvio padrão. Os resultados inferem que um alto nível de habilidade em Cheerleading em nível competitivo nacional e internacional pode ser alcançado por atletas que possuam experiência adequada. O somatótipo que prevalece nos atletas avaliados é o Endo Mesomórfico nas bases masculinas, e o ectomorfo balanceado nas mulheres voadoras. As bases são maiores que o volante, denotando importância na componente muscular de homens e mulheres para o bom desempenho das diferentes habilidades deste esporte. Até onde sabemos, isso fornece a primeira avaliação da composição corporal e do somatotipo em Cheerleaders competitivas em nível de seleção nacional.



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**Palabras-chave:** Cheerleading, Composição corporal, Perfil antropométrico, Somatótipo

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## INTRODUCTION

Cheerleading has become a sport with great projection, as it went from being a support activity to a competitive sport, to world tournaments with a great display of technique, high energy demands and high levels of strength, flexibility and aerobic capacity (Krivoruchko et al., 2018; Sánchez & Elizondo, 2021) .

This sport has been included in Olympic competitions, as an exhibition sport as it was in the 2018 Winter Olympic Games, held in Pyeong Chang, South Korea and organized by the International Olympic Committee (2016), where different teams were invited to do exhibitions within the framework of the games.

Athletes who practice cheerleading, whether they are bases or flyers, must possess a unique combination of physical skills to execute complex acrobatics in pairs and in groups, with dynamic routines in short times and high levels of coordination (Routman, 2023); likewise, its practice contributes to the development of resilience and self-esteem (Deng et al., 2022) .

Knowing the relationship between somatotype, body composition and performance in this sport is crucial for optimizing training (Deng et al., 2022), athlete selection (Krivoruchko et al., 2018) and injury prevention (Stroescu, 2018). Somatotype is a classification of body shape based on three components endomorphy , mesomorphy and ectomorphy, and has been widely studied in relation to sports performance (Bakhareva et al., 2018 ; Jakovljeviæ et al., 2022).

Athletes from different disciplines exhibit characteristic somatotypes that align with the physical demands of their sport, thus, anthropometric analysis in cheerleading allows for individualization of training, according to the needs of each athlete (Timofeeva et al., 2021).

Body composition, referring to the proportion of fat, muscle, and bone mass in the body, also plays an important role in athletic performance (Masanovic et al., 2019); a low



percentage of body fat and a high percentage of muscle mass are desirable in many sports (Reale et al., 2020), including cheerleading, as they contribute to strength, power, and movement efficiency (Suchomel et al. 2018; Weldon et al., 2022). Furthermore, an appropriate body composition can improve athletes' ability to perform stunts and withstand the physical demands of cheerleading routines. (Miletia et al., 2022).

There is little bibliography that addresses the topic discussed, as demonstrated by the bibliographic search and compilation carried out in the Redalyc, SciELO, Dialnet databases, the automated alert search engine of Google Scholar and the use of Boolean operators AND, OR and NOT, which allow for more precise filtering of the information required in the databases used.

The present study aimed to determine the somatotype and body composition of cheerleading athletes from the Colombian national team, from the differentiation between the base roles (men) and the flyer roles (women).

The results of this study are considered to provide valuable information for coaches, athletes and health professionals involved in cheerleading, and contribute to the optimization of training, athlete selection and injury prevention in this sport.

## ***MATERIALS AND METHODS***

A descriptive, cross-sectional study was conducted, in which a sample of 26 athletes belonging to the Colombian cheerleading team participated, with 16 men ( $25.5 \pm 3.9$  years) who played the role of base and 10 women ( $19.0 \pm 4.5$  years) who played the role of flyer; with an average of  $126.86 \pm 52.31$  months of experience for bases and  $106.80 \pm 54.98$ , for flyers. The Helsinki Declaration (World Medical Association, 2018) was followed in the study. All participants signed the informed consent before the start of the study and none presented impediments at the time of data collection.

Body composition was determined, somatotype of the athletes was established and the measurement protocol of the International Society for the Advancement of Kinanthropometry (ISAK-2) ISAK (2011) was applied for a restricted profile: basic (body



mass, height, sitting height, arm span), skinfolds (triceps, subscapular, biceps, iliac crest, supraspinatus, abdominal, thigh, leg), perimeters (relaxed arm, flexed and contracted arm, waist, hips, mid-thigh, leg), and bone width (humerus, bistyloid, femur), for a total of 21 anthropometric measurements.

Each participant was assessed for body mass and height. Skinfolds were assessed using a Harpenden skinfold caliper (Baty International, RH15 9LR. England), with a measuring range of 80 mm and a precision of 0.2 mm, a Tanita digital scale with a precision of 100 g, a GPM Martin Type anthropometer (Swiss) with a precision of 1 mm, a Flexalum metal measuring tape and a flexible measuring tape.

Participants were examined after at least two hours of a light meal, measurements were performed by two ISAK2 certified anthropometrists, with several years of experience in this field, the normal distribution of the data was determined through the Kolmogorov-Smirnov test.

From the measurements, fat mass was calculated using Faulkner's formula (1968); muscle mass was calculated using Lee et al. (2000); and bone mass was calculated using Rocha (1975). To calculate the somatotype, the average somatotype was determined using the Heath-Carter method (Carter, 1982) . - X axis = Ectomorphy Endomorphy

- Y axis = (2\*Mesomorphy) (Endomorphy + Ectomorphy)

Using the graphical representation of the somatotype, according to the nomination of the predominant component and the region in which the X and Y coordinate points were established, the athletes were classified according to ISAK (2011). Mean values and standard deviations were calculated that expressed the study parameters in intervals (mean  $\pm$  standard deviation).



## RESULTS AND DISCUSSION

In Table 1, the basic data of the 26 athletes evaluated were expressed, separated into the role of bases and flyers, along with the time of experience at the time of information collection, to corroborate their level of practice in this sport.

*Table 1. Basic data of athletes of the Colombian cheerleading team*

Parameters	Male cheerleaders ( Bases)		Female cheerleaders ( Flyers )	
	n=16		n=10	
	Average	Standard deviation	Average	Standard deviation
Age (years)	25.5 ±	3.9	19.0 ±	4.5
Weight (kg)	69.5 ±	6.6	47.1 ±	5.2
Size (cm)	167.4 ±	6.7	151.6 ±	2.8
BMI (kg/m <sup>2</sup> )	24.8 ±	2.2	20.4 ±	1.8
Time of experience (months)	126.8 ±	52.3	106.8 ±	54.9

The mean age of the male sample was 25.5 years, and that of the female sample was 19.0 years, which expressed an age that ranged between 19 and 34 years for men and 15 and 27 years for women.

Table 2 presents the anthropometric data and body composition percentages of cheerleaders of both sexes, in their roles as bases and flyers, respectively.





**Table 2.** Body composition of the athletes of the Colombian cheerleading team

Parameters	Male cheerleaders ( Bases)				Female cheerleaders ( Flyers )						
	n=16		n=10		n=10		n=10				
	Average	Standard deviation	Average	Standard deviation	Average	Standard deviation	Average	Standard deviation			
Skinfolds (mm)	Subscapularis	12.4 ± 3.0	10.9 ± 3.6	Tricipital	7.8 ± 1.8	11.2 ± 2.4	Bicipital	5.6 ± 7.1	6.1 ± 2.0		
	Abdominal	12.2 ± 6.0	13.0 ± 5.5	Suprailiac	6.7 ± 3.1	8.9 ± 5.1	Supracrestal	8.7 ± 3.2	11.7 ± 4.9		
	Inner thigh	8.0 ± 2.0	18.0 ± 4.1	Calf	5.7 ± 2.1	11.5 ± 3.8	Arm (relaxed)	32.4 ± 2.1	25.3 ± 23		
	Perimeters (cm)	Arm (flexed and tense)	34.3 ± 2.0	26.2 ± 2.2	Waist (minimum)	79.9 ± 4.4	71.9 ± 3.8	Hip (maximum)	94.4 ± 4.5	87.1 ± 4.0	
		Mid thigh	55.3 ± 3.0	49.9 ± 4.5	Leg	35.9 ± 1.9	31.7 ± 2.1	Humerus	6.7 ± 0.3	5.5 ± 0.3	
		Diameters (cm)	Doll	5.5 ± 0.3	4.5 ± 0.2	Femur	9.6 ± 0.3	8.1 ± 0.7			



Body composition (%)	Fatty	13.1	±	2.1	12.5	±	2.0
	Osseous	18.4	±	2.0	15.5	±	1,2
	Muscular	52.7	±	3.7	46.2	±	4.1
	Residual	35.8	±	4.1	56.8	±	2.8

The mean value of fat mass percentage in the male sample was 13.09, in the female sample 12.5%, which showed a lean mass that ranged between 30.8 and 38.06 kg in the case of men and 18.6 and 26.3 kg in the case of women. In relation to the body mass index, the average for men was 24.85 kg/m<sup>2</sup> and 20.44 kg/m<sup>2</sup> for women. Table 3 shows the results of the somatotype in the groups studied.

*Table 3. Somatotype of athletes from the Colombian cheerleading team*

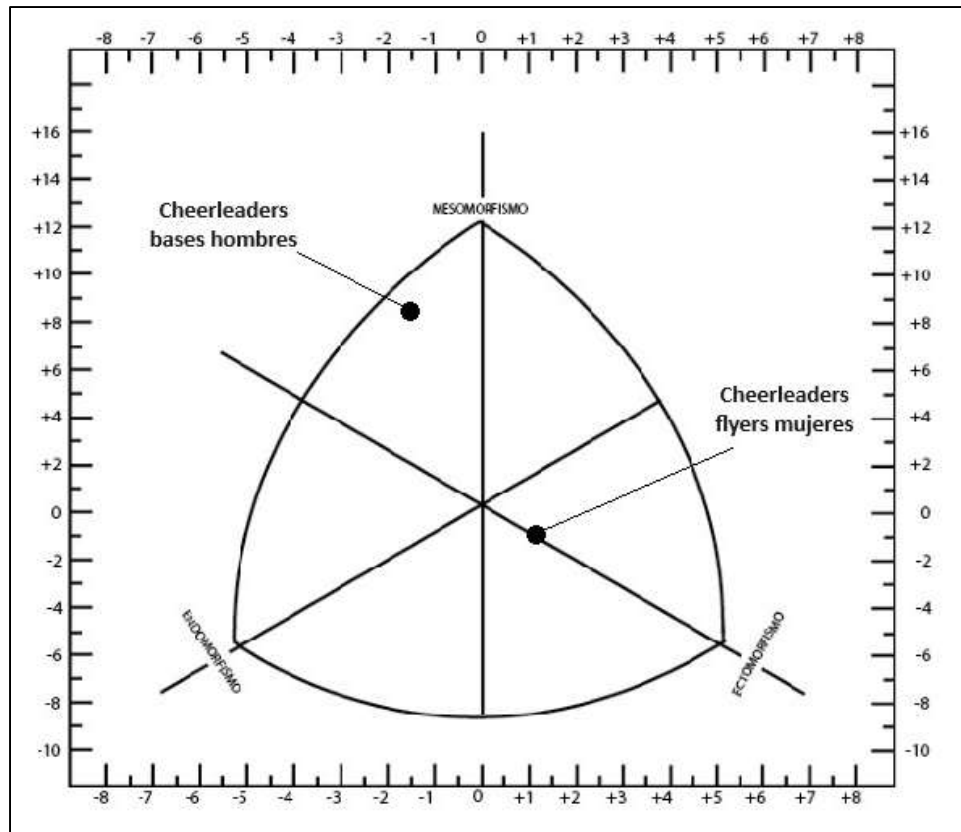
Component	male cheerleaders (bases)			female cheerleaders (flyers)		
	n=16			n=10		
	Mean	Standard deviation		Average	Standard deviation	
ENDO	2.7	±	0.79	3.5	±	1.05
MESO	5.6	±	1.04	2.9	±	0.88
Ecto	1,2	±	1.13	2.1	±	0.88
SOMATOTYPE	Endo mesomorph			Balanced Ectomorph		

Regarding the somatotype results, the athletes evaluated showed endomorphic values of 2.7 for men and 3.5 for women; ectomorphic values of 1.2 and 2.1 for men and women respectively, and mesomorphic values of 5.6 and 2.9 for the study sample.



In Figure 1, the somatocard or graphic representation of the somatotype was shown, where it was observed that for the bases, the dominant one was the mesomorph; and the endomorph was greater than the ectomorph; regarding this, Pons et al. (2015 , as cited in Navarro, 2020) defined that it is a body type that combines characteristics of the endomorph and mesomorph somatotypes.

Athletes with this classification had a higher proportion of muscle mass ( mesomorph ) and a certain predisposition to accumulate body fat (endomorph). Generally, they had a wider torso and a more developed muscular structure, which allowed them to gain strength and muscle mass more easily, although they also had more difficulty maintaining a low percentage of body fat.



*Figure 1. Graphic representation in the somatocard of the somatotype found for bases and flyers of the Colombian cheerleading team*



For flyers the dominant somatotype component was ectomorph, while the endomorph and mesomorph were equal and shorter, this meant that an athlete with this profile was thin, with light bone structure; this showed balance of the traits of the other two somatotypic components.

Given the limited literature on body composition and somatotype in this sport, the results obtained in sports modalities that presented a close relationship with cheerleading were reviewed. The female flyers in the present study presented a balanced ectomorph profile, in contrast to data from female artistic gymnastics athletes (Sterkowicz & Gualdi, 2019) who showed a mesoectomorph somatotype.

Likewise, studies carried out in Acrosport (Salas, et al., 2022 ; Taboada, et al., 2021; Vernetta, et al., 2021), showed similarities between those who play the role of tops (which they assume by climbing on top of the bases, in the acrobatics of this sport) with a mainly ectomorphic constitution and the same happens in studies carried out on high-performance rhythmic gymnasts (Masiá et al., 2021) reported with a balanced ectomorph profile, which indicated that a low body mass was related to a better execution of technical elements, and a better predisposition to obtain higher scores in this type of sports (Di Cagno et al., 2009).

Furthermore, it was shown that an ectomorph profile allowed for a significantly greater postural balance than the mesomorph profile (Penna et al., 2023), which was important in the role of the flyers for postural control in the execution of the various acrobatics typical of this sport. The men who developed the role of bases presented a high musculoskeletal robustness with a mesomorphic profile, which they also share with advanced level Polish male gymnasts and elite European artistic gymnasts who stood out in the different events of this sport modality (Jovanoviæ, et al., 2024; Sterkowicz & Gualdi, 2019 ; Sterkowicz, et al., 2019).

The somatotype found in the bases (endomesomorphic) was related to other sports where explosive strength prevailed such as rugby (García, et al., 2023), muay thai (Quintero, et al., 2024), Brazilian Jiu-jitsu (Quintero, et al., 2023), which explained that for works with a predominance of explosive strength such as cheerleading (Thomas et al., 2004), the



mesomorphic somatotype was related to the achievement of sports performance for this type of sports (Ryan, et al., 2018).

The results of this study are expected to provide valuable information for coaches, athletes and health professionals involved in cheerleading, and contribute to the optimization of training, athlete selection and injury prevention in this sport.

## CONCLUSIONS

In the Cheerleaders competition, at the national team level, there were no reports of an anthropometric evaluation, to obtain the percentages of body composition and the somatotype of its athletes, so it was considered novel to carry out a study in high-level Colombian athletes in this sport.

There were differences between both roles, the bases (men) were larger than the flyers (women), and there were higher percentages in the components of body composition, especially muscle. It was inferred that a high competitive level of cheerleading skill at national and international level was achieved by athletes with adequate experience and a mesomorphic somatotype in bases, and a balanced ectomorphic somatotype in flyers.

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