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Track and Field School Athletes in the Brazilian National School Games: Characterization of Nutritional Aspects, Anthropometric Profile, Sport Training and Performance

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Abstract

This article focuses on the relationship between anthropometric profile, dietary practices, sport training, and sports performance of school- athletes (15-17 years old) from athletics, participating in the national stage of the Brazilian School Games (JEBs) in the year 2013. This study is justified not only by the importance of these aspects in the preparation of sports but also for a role in the determination of income contribution. Still, the article through empirical data will complement the few data in the literature about the nutritional status of school athletes, mainly in athletics. The goal was to characterize the anthropometric profile, nutritional aspects and sport training practices (type, frequency and duration) of 50 Brazilian school-athletes (23♂ and ♀27) practitioners of athletics, and correlate this information to sports performance of these athletes on the national stage of the Brazilian School Games 2013, in the 15 to 17 years old category. As a method, we utilized a nutritional survey and a questionnaire to obtain data about sport training, which was collected through anthropometric measurements and analysed through the performance of these athletes through the competition results. Among the results, the following stand out: low fat percentage for boys and girls with stature and BMI predominantly normal, but with classification of overweight and obesity among female participants on field trials; calorie intake below the recommended but with macronutrient intake inadequate in proteins and carbohydrates; 28% used dietary supplements and 10% used drugs due to pain and anaemia; as for sports performance a large part of the sample qualified (25.5%) and some participated in the Final (42.5%) and took the podium (6.4%), even under these conditions. Among those who earned a place at the podium there was predominance for those who were born in the first half of the year.

Keywords

Profile; Young; Athletics; Nutrition; Brazil; Body composition; Competition school games; National games

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Introduction

Among the sports disciplines, athletics has been the biggest one in number of athletes and number of events. Given the wide range of events (more than 24 in all), this kind of sport requires the use of practically all systems of supply and storage of energy in the body. Therefore, the monitoring and understanding of metabolic and physical responses is critical to determine the sports result. Despite their importance, there are few studies investigating track and field athletes, especially in the school category. Macena [1] raises the question about metabolic and physiological aspects of the sport in this specific population. Concerning the anthropometric profile and dietary practices of school-athletes from athletics, there are only two studies: Brandt [2] examined the anthropometric profile and somatotype tests in 111 athletes (63♂ and 48♀) from three different categories – pré-mirim (until 13 years old), mirim (until 15 years old), and menor (until 17 years old); and Nozaki and Tanaka [3] about 24 athletes (14♂ and 10♀) from 11 to 14 years. In this study, the authors identified adequate intake of macronutrients, though inadequate in relation to calories and eutrophic (93% ♂ and ♀ 60%), with the presence of obesity (7% ♂ and ♀ 20%) and malnutrition (♀ 20%) in a higher level than that found in non-athlete adolescents.

In the case of school athletes, this question becomes problematic for three reasons:

(1) They are in growth stage, development and maturation

(2) To allow the mobilization of energy substrates during exercise, appropriate physiological and metabolic conditions are necessary, linked to body composition [4]. There are studies highlighting the existence of characteristic morphological profiles of each sport and considering the anthropometric assessment as a good strategy to monitor and propose training [5,6]

(3) although the importance of nutrition in sports performance and health is understood [7,8], this is ignored by the vast majority of the population focus from study [9-12], and even among professional athletes [13,14] and may generate harm to health and sports performance [9-12].

Focusing on the physiological and metabolic characteristics of athletics, food practices should enhance the aerobic and anaerobic systems of energy transformation. Thus, attention should be paid to the appropriate supply of macro and micronutrients in order to optimize the energy production mechanisms and muscle recovery [15,16]. Therefore, it is important to detail the nutritional plans prior to, during and after activity. To ensure adequate nutritional status is essential to monitor the growth, body composition, and food intake. All referenced studies encourage further research on the specific nutritional needs of young athletes and establish nutrition education as a priority, in order to provide longevity as an athlete, health and quality of life.

Considering the scarce scientific literature as shown on the paragraphs above, the aim of this study was to identify the anthropometric profile, dietary habits, training, and sport results of track and field school-athletes from 15 to 17 years old participating in the National Stage of Youth School Games in 2013 (JEBs). This study

is original and brings new data for the area. The results will serve to aid athletes and coaches who are not properly conscious about proper nutrition. Our hypothesis is that the school athletes, similar to their peers do not ingest adequate nutrition to their needs.

Methodological Procedures

Participants

Data collection was performed at Mangueirão Stadium (Belém, Pará, Brazil) during the National Stage of the 2013 Brazilian School Games.

In order to be correlated overall, the sample represented both sexes of the largest possible number of Brazilian states, which is composed by 27 federative units. Thus, the sample consisted of 50 school-athletes (23♂ and 27♀) of 23 Brazilian federative units. The approach to the athletes was made before the competition, taking care not to interfere in the competition, preparation or rest of the athletes. After the necessary explanations about the importance of the study, those who agreed to participate signed an Informed Consent Form which also contained the signature of their coach, in accordance with the Declaration of Helsinki. The Ethics Committee of the Estacio de Sá University approved this research by the Opinion No. 879,972.

Collection procedures

The survey contained three procedures. First, after proper instruction, participants received the survey form which requested to fill: personal data information (date of birth, height and weight); 24-hour recall for the assessment of dietary intake; data on the training routine, which involved a number of days and hours of training per week as well as the type of training (whether general or specific from athletics). The second procedure was to measure skinfold (chest, axilla, triceps, subscapular, abdominal, iliac crest and thigh) with a Lange® compass [17]. The third procedure was the analysis of the athletes' results at the competition considering their performance in the qualifiers and finals.

Analysis of anthropometric data

To assess the adequacy of body weight, a comparison was made to the Dietary Reference Intakes [18]. As reference standard for the height utilized the growth curve of the National Center for Health Statistics (NCHS) of the World Health Organization (WHO). The Body Mass Index (BMI) was calculated by Antro Plus Program© of the World Health Organization which corrects the data according to age and sex.

For estimation of body composition from the skin folds, we used the equation of Jackson & Pollock [17] to estimate body density:

$$D\left(\frac{g}{cm^3}\right) = 1{,}112 - 0{,}00043499.SS + 0{,}0000055.SS^2 - 0{,}00028826.AGE$$

D=density; SS=sum of skinfolds (chest, axilla, triceps, subscapular, abdominal, iliac crest and thigh).

Then, we estimated body density by the Siri equation [19] determine the percentage of body fat:

$$\%BF = \frac{495}{D} - 450$$

BF=body fat; D=density.

The reference value used to verify the adequacy of % BF according to sex and age was the Lohman [20]. For the descriptive statistics calculations we used the Excel 2013® and SPSS 22®.

Dietary Analysis and Energy Balance

Diet analysis was conducted using a 24-hour dietary recall (Rec24h) [21,22] which was completed by researchers together with the participants. The dietary recalls were calculated with the aid of the software Avanutri® online version. The food composition was evaluated according to the table of Núcleo de Estudos e Pesquisas em Alimentação [23] and the nutritional information provided by the manufacturer. From this analysis, we calculated the energy intake (EI), macronutrients (carbohydrates, lipids and proteins), vitamin D and the mineral calcium. Also, we questioned whether school athletes were using dietary supplements or medications.

To calculate estimated Recommendation Intake (RI) of daily caloric intake, we calculated the Energy Expenditure Daily (EED) by the formula of Harris & Benedict [24], which considers the Basal Metabolic Rate (BMR) multiplied by the physical activity factor (2.1=very intense).

Harris-Benedict ♀: BMR=665 + (9,6 x weight in KG) + (1,8 x Height in CM) - (4,7 x age in years) → X 2,1=ER/EED

Harris-Benedict ♂: BMR=66 + (13,7 x weight in KG) + (5 x Height in CM) - (6,8 x age in years) → X 2,1=ER/EED

The calculation of Energy Balance (EB) was conducted to assess whether the Energy Intake (EI) is classified as adequate, below or above the estimated Recommendation Intake (RI):

EB= EI-RI

In EB, for analysis of the amount of IE from macronutrients (Carbohydrates=CHO; Proteins=PRO; Lipids=LIP) were used the guidelines of ACMS [15], FAO/WHO/ONU [25] e Hellwig, Otten & Meyers [18]:

CHO – 6 up to 10 g/kg of weight PRO – 1,2 up to 1,7 g/kg of weight LIP – 20 up to 35 % of the TEV

TEV=total energy value (ingested)

To analyse the amount of Calcium (Ca^+) and Vitamin D (Vit D), we used the appropriate recommendation to the sex and age of the FAO/WHO/ONU [25] e Hellwig, Otten & Meyers [18]:

Ca^+: 1300 mg Vit D: 5mcg

Sport Training

The data reported related to the type of training, namely the main training (specific to athletics) and complementary training (strength training, flexibility and others). The weekly frequency and duration of training sessions were tabulated for descriptive purposes and correlated with the other variables.

Sports Results

The competition Results Bulletin was analysed to obtain the results of athletes. These data were classified into four types, and is considered the best result among the trials that the participates completed (they could participate in up to 3 events):

0=no qualified in the knockout stage (stage 1)

1=was qualified in the knockout stage (stage 1)

2=was qualified for the final stage (stage 2 or 3, depending on the event in question)

3=won 1st, 2nd or 3rd place

School athletes in this study participated in 2.0 ± 1.0 events, which may have been track events, field trials or mixed, as was the case of three athletes who participated in combined events (heptathlon) for example.

Results and Discussion

The group of 50 (23♂ and 27♀) school athletes (15-17 years old) evaluated had a body weight of 63.0 ± 11,4 kg (69.2 ± 12.0♂ e 52.3 ± 4.0♀), and the height 169. ± 7.6 cm (164 ± 7.1♂ e 163.9 ± 4.1♀), setting BMI 21 ± 1♂ e 19 ± 2♀. Table 1 shows the anthropometric variables of athletes.

Weight and height are above the values found by Nozaki & Tanaka [3], but in accordance with Brandt [2]. Overall, 54%♀ of female athletes and 46%♂ of the male athletes are within the weight recommended. The height is in accordance with the growth curve of the NCHS/WHO. The % BF on average for both sexes was 7.7 ± 3.9♂ and 14.3 ± 6.1♀. In general, it was ranked among very low and great for male athletes (respectively, 26% for track, 52.2% field and 21.7% for combined events), and between very low and moderately high for the female athletes (respectively 48.1% for track, 22.2% for field and 7.4% for combined events) [20] (Table 2), and lower than that found in studies of Brandtand Nozaki and Tanaka [3]. Overall, BMI presented appropriate values. However, higher values of %BF and BMI were found in athletes who performed field trials, combined events and were female athletes. Anthropometric and demographic variables are presented in Table 1. There was no data on the type of test 3 of 50 school athletes; because they weren't even found in the Scorecard. Most likely, the participants did not compete for some reason.

Table 3 shows the energy balance data. The number of daily meals was 3.0 ± 1.15. Considering the volume of training and the age group this number of meals is counterproductive to the nutritional needs and therefore to sports training [26]. The Energy Intake (EI) was lower than recommended, which can cause nutrient deficiency, dehydration, low height, pubertal delay, menstrual irregularity, bone changes, higher incidence of injuries and eating disorders [9-13].

Table 1. Demographic and anthropometric variables of the participants, according to the type of events (Track, Field and Mixed) carried out.

Characteristics	**Athletes by type**							
	Track events		**Field Events**		**Mixed Events**		**Total**	
	n/value	**%**	**n/value**	**%**	**n/value**	**%**	**n/value**	**%**
Sex								
Male	13	56.,5%	7	30,4%	2	8,7%	23	46%
Female	11	40,7%	9	33,3%	5	18,5%	27	54%
Age								
15 years old	4	8,5%	3	6,4%	0	0,0%	7	14,9%
16 years old	13	27,6%	5	10,6%	3	6,4%	21	44,7%
17 years old	7	14,9%	8	17,0%	4	8,5%	19	40,4%
Weight (kg)								
Male	69,2 ± 12,0	56,5%	62,3 ± 6,0	30,4%	66,4 ± 1,4	8,7%	67,3 ± 10,4	46%
Reference 61 kg								
Female	52,3 ± 4,0	40,7%	69,3 ± 10,7	33,3%	57,5 ± 7,8	18,5%	59,6 ± 11,1	54%
Reference 54kg								
Height (cm)								
Very Low	0	0%	0	0%	0	0%	0	0%
Low	0	0%	0	0%	0	0%	0	0%
Appropriate	24	100%	16	100%	7	100%	47	100%
BMI (kg/m²)								
Thinness	0	0%	0	0%	0	0%	0	0%
Eutrophic	24	100%	11	64,7%	6	85,7%	41	84,8%
Overweight	0	0%	5	35,2%	1	14,2%	6	15,2%
% Body Fat	**%BF**	**% Athletes**	**%BF**	**% Athletes**	**%BF**	**% Athletes**	**%BF**	**% Athletes**
Male M ± DV	**7,2 ± 3,7**	**56,5%**	**9,2 ± 4,1**	**30,4%**	**5,3 ± 0,0**	**8,7%**	**7,7 ± 3,9**	**46%**
Very Low	≤6%	38,5%	≤6%	14,3%	≤6%	100%	≤6%	26,0%
Low	6,1-10%	61,5%	6,1-10%	57,1%	6,1-10%	0,0%	6,1-10%	52,2%
Great	10,1-20%	7,7%	10,1-20%	28,6%	10,1-20%	0,0%	10,1-20%	21,7%
Moderately High	20,1-25%	0,0%	20,1-25%	0,0%	20,1-25%	0,0%	20,1-25%	0,0%
High	25,1-31%	0,0%	25,1-31%	0,0%	25,1-31%	0,0%	25,1-31%	0,0%
Very High	≥31,1%	0,0%	≥31,1%	0,0%	≥31,1%	0,0%	≥31,1%	0,0%
Female M ± DV	**10,7 ± 4,2**	**40,7%**	**18,7 ± 5,8**	**33,3%**	**10,6 ± 0,7**	**18,5%**	**14,3 ± 6,1**	**54%**
Very Low	≤12%	69,2%	≤12%	0,0%	≤12%	80%	≤12%	48,1%
Low	12,1-15%	23,0%	12,1-15%	33,3%	12,1-15%	20%	12,1-15%	22,2%
Great	15,1-25%	0,0%	15,1-25%	44,4%	15,1-25%	0,0%	15,1-25%	22,2%
Moderately High	25,1-30%	0,0%	25,1-30%	22,2%	25,1-30%	0,0%	25,1-30%	7,4%
High	30,1-35%	0,0%	30,1-35%	0,0%	30,1-35%	0,0%	30,1-35%	0,0%
Very High	≥35,1%	0,0%	≥35,1%	0,0%	≥35,1%	0,0%	≥35,1%	0,0%

Table 2. Variables related to Sports Training of the 50 school athletes by type of events (Track, Field and Mixed) carried out.

	Training							
Track (n=24)	**Frequency of Main Training**	**n**	**%**	**Duration of Main Training**	**n**	**%**	**Complementary Training**	
Period throughout	1x/week	3	12,5%	30min-1h	1	4,2%	Yes	91,7%
	2x/ week	1	4,2%	1h-1h30	4	16,7%	No	8,3%
	3x/ week	3	12,5%	>1h30	19	79,2%		
	4x/ week	0	0,0%					
	5x/ week	5	20,8%					
	6x/ week	12	50,0%					
	7x/ week	0	0,0%					
Field (n=16)	**Frequency of Main Training**	**n**	**%**	**Duration of Main Training**	**n**	**%**	**Complementary Training**	
Period throughout	1x/week	0	0,0%	30min-1h	2	12,5%	Yes	100%
	2x/ week	4	25%	1h-1h30	4	25%	No	0%
	3x/ week	1	6,2%	>1h30	10	62,5%		
	4x/ week	2	12,5%					
	5x/ week	6	37,5%					
	6x/ week	3	18,7					
	7x/ week		0,0%					
Mixed (n=7)	**Frequency of Main Training**	**n**	**%**	**Duration of Main Training**	**n**	**%**	**Complementary Training**	
Period throughout	1x/week	0	0,0%	30min-1h	0	0,0%	Yes	100%
	2x/ week	0	0,0%	1h-1h30	2	28,6%	No	0%
	3x/ week	0	0,0%	>1h30	5	71,4%		
	4x/ week	1	14,3%					
	5x/ week	1	14,3%					
	6x/ week	4	57,1%					
	7x/ week	1	14,3%					

The EI is below the recommended and is in accordance with data from Nozaki and Tanaka [3], except that in their study there was adequate intake of macronutrients, as the participants of this study had less than consumption recommendation in respect of CHO (71.4%), Vit D (100%) and Ca+ (100%). The protein intake was adequate in 42.8%, with the remainder with higher (28.5%) or lower (28.5%) intake when compared to the recommendation. The lipid intake was adequate for the majority (71.4%), with the remainder being higher intake (14.2%) or lower (14.2%) in comparison to the recommended (20-35%).

The calculation of the Energy Balance (EB) with reference to the values of ACSM [15], FAO/WHO/ONU [25] and Hellwig et al. [18] showed a deficit in CHO, PRO, Vit D and Ca. The CHO is essential for intermittent activities, mainly by mobilizing muscle glycogen. During competitive periods, the consensus of ACSM [15] has recommended an intake of 10 g/kg/day and the average intake reported by athletes in this study was 4.7 ± 2.3 g/kg/day. The PRO operates in tissue integrity and with Vit D is essential to the immune system. In addition, studies show that the protein needs of young people are greater than those of sedentary adults [27] but there are no specific studies concluding that the optimal amount of this nutrient or that it will bring benefits to the adolescent athlete. However, Petrie, Stover and Horswill [28] agree that there are differences in protein consumption needs among adolescent athletes and adolescent non-athletes. The Ca+ is essential to muscle contraction and bone growth, and its low power consumption between the school athletes is a concern.

The lipid intake was adequate, and in this regard, there is a consensus that children 4 years old to teenagers under 18 should consume 25-35% of EI in lipids [29], because young athletes have higher levels of use of fats such as metabolic component. Regarding the use of nutritional supplements, 28% reported using and 22% of those by recommendation of the Physical Educator, and the others by recommendation of a nutritionist or doctor. Among the nutritional supplements used are: whey protein (n=1), BCAA (n=6), maltodextrin (n=4), multivitamin (n=1) and creatine (n=1).

However these athletes, like their peers [30], do not have adequate knowledge of this resource, which is evident when we consider the food intake of school-athletes and the claims made for the use of these nutritional supplements – avoid hypoglycemia, gain of muscle mass, gain of muscle mass and strength, increased body weight, food supplement and recovery.

Of school-athletes surveyed, 10% were using drugs (anti-inflammatory or ferrous sulfate) claiming back pain, shin splints, septal deviation, physical wear and anemia.

Table 4 lists the results of school sports athletes in the competition. In the sporting results, the 50 students-athletes surveyed represented 8.9% of the total of 563 competitors in athletics. A representative sample of athletes in school sports belonged to both sexes and came from 23 states of Brazil. Among those surveyed, 25.5% were classified, 42.5% participated in some final, and 6.4% got the podium. In the category that got the podium (6.4%) there is a predominance of those born in the first half of the year which is consistent with the literature regarding the fact that the maturation of difference affects the sports results in this age group?

Table 3: Energy Intake (EI) of the Track and Field School Athletes.

	Athlete		
Energy/Nutrient	**Track Events**	**Field Events**	**Mixed Events**
Energy (kcal)			
Energy Intake (EI) (kcal)	2209 ± 848	2155 ± 1147	2252 ± 927
Recommended Intake (RI) (kcal)	3220 ± 357	3550 ± 459	3243 ± 349
Carbohydrate			
EI (g/kg)	5,1 ± 2,3	4,0 ± 3,2	5,2 ± 1,7
RI (g/kg)	6-10g/kg	6-10g/kg	6-10g/kg
Appropriate (%)	25,9%	18,7%	28,5%
Below RI (%)	70,3%	81,2%	71,4%
Above RI (%)	3,7%	0%	0%
Lipid			
IE (%)	26,0 ± 8,0%	27,2 ± 7,5%	24,5 ± 3,4%
RE (% regarding to the TEV)	20-35%	20-35%	20-35%
Appropriate (%)	62,9%	68,7%	71,4%
Below RI (%)	18,5%	12,5%	14,2%
Above RI (%)	11,1%	18,7%	14,2%
Protein			
IE (g/kg)	1,9 ± 0,7	1,5 ± 1,0	1,5 ± 0,7
RE(g/kg)	1,2-1,7 g/kg	1,2-1,7 g/kg	1,2-1,7 g/kg
Appropriate (%)	29,6%	25%	42,8%
Below RI (%)	18,5%	50%	28,5%
Above RI (%)	51,8%	25%	28,5%
Vitamin D			
IE (mcg)	2,8 ± 2,7	3,0 ± 2,4	1,7 ± 1,1
RE (RDA/mcg)	5	5	5
Appropriate (%)	14,8%	25%	0%
Below RI (%)	85,1%	75%	100%
Above RI (%)	0%	0%	0%
Calcium			
IE (mg)	588 ± 443	606 ± 316	602 ± 266
RE (RDA/mg)	1300	1300	1300
Appropriate (%)	7,4%	0%	0%
Below RI (%)	92,5%	100%	100%
Above RI (%)	0%	0%	0%

Table 4: Variable of sport result of the surveyed School Athletes in the national stage of the Brazilian School Games.

Characteristics	**Athletes**							
	Track Events		**Field Events**		**Mixed Events**		**Total**	
Sport Result	**n**	**No. born at the first half**	**n**	**No. born at the first half**	**n**	**No. born at the first half**	**n**	**No. born at the first half**
Failed to classify	6	2	5	1	1	1	12	4
Classified	10	5	2	2	0	0	12	7
Participated in the Final	7	3	8	6	5	2	20	11
Got podium in 1st, 2nd or 3rd place	1	1	1	1	1	1	3	3

Conclusion

The school athletes in the present study despite being athletes in the growing phase and performing a considerable training load showed anthropometric and dietary inadequacies common to Brazilian adolescents which can negatively impact the sports result and the processes of growth and development. Despite the general consistency of height, there were variations in weight, BMI, and % BF especially among athletes in field trials. The athletes' dietary pattern indicates the need for corrections, especially with regard to EI, ingestion of CHO, PRO, Ca^{+}, and Vit D. It was considerable the number of athletes who achieve a favourable outcome in the competition (25.5%) in despite of their anthropometric and nutritional conditions. We emphasize that there should be an ideal relationship between food consumption and energy expenditure of athletes and careful attention should be given to those at the level of growth, development, and maturation to optimize results. This study will certainly contribute to the understanding of the relevant aspects

of the school athletes in track and field, with regard anthropometry, nutrition, training, and sport outcomes.

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