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CAN THE ADAPTATIONS PROMOTED BY RESISTANCE EXERCISES BE ENHANCED BY A NUTRITIONAL SUGGESTION, WITHOUT THE SUPPORT OF A NUTRITIONIST?

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ABSTRACT

Introduction and objective: Nutrition sport is characterized by the application of nutritional principles to improve sports performance. In this sense the proper nutrient intake can be a determining factor in sports, especially for resistance training practitioners. The characteristics adaptations of resistance exercise, regardless of the method are dependent upon a proper exercise program associated with a balance between protein synthesis and degradation. So, our goal is to determine whether a simple nutritional suggestion, without the accompaniment of a dietitian, can be an influential factor in these morphological adaptations. Materials and Methods: The sample consisted of 32 men between 18 and 40, and voluntary RT practitioners. They were divided into 4 groups. Two experimental groups (with nutritional suggestion) and two control groups. Used the protocol of Brown and Weir (2001) to determine the maximum load (1RM) and De Rose (1984) for anthropometric assessments. We used two-way ANOVA with Tukey posttest and Student t test for independent samples. Results and Discussion: The results indicate that morphological adaptations resulting from resistance training are not potentiated by a simple nutritional suggestion. Training methods were effective, however, without proper monitoring of a nutritionist, food self-adequacy, was not enough to boost the adaptations. Conclusion: working together with a professional nutritionist is essential for the enhancement of the characteristics of resistance training adaptations.

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INTRODUCTION

From a conceptual point of view sports nutrition is characterized by complex application of basic nutritional principles in order to promote improved sports performance, whether in the training process or competitive athletic performance, and effectively assist in post-workout recovery (Valenta & Dorofeeva, 2018). The nutritional support is a determining factor in the characteristic results of resistance training, ie the reduction of fat mass depends on a substantial increase in lean body mass (muscle tissue)(Gomes, da Silva Triani, & da Silva, 2017), which will only be possible with a balanced intake of essential nutrients such as protein (De Souza & Navarro, 2011).

Thus, resistance training programs depend on an effective and adequate nutritional intake (de Oliveira, Liberali, & Coutinho, 2012) when associated with the proper use of the principles of sports training (Prestes, Foschini, Marchetti, Charro, & Tibana, 2016) can lead, practitioners of resistance training, the characteristic results of the methods, whether tension or metabolic (Gentil, 2014). Methods of resistance training, didactic, can be divided into two manifestations, tension-based resistance training and metabolic-base resistance training (Gentil, 2014), differentiated on the basis of variations in load or overhead and number of retries (Allegretti , Charro, & Figueira Junior, 2018). Tension-based resistance training is most efficient when it comes to strength gain (Olivoto, de

Moraes Fischer, & Mendes, 2019). The tension-based resistance training is characterized by mechanical stress generated in the muscle tissue and may or may not be able to promote changes in local metabolism. Such stimulation is achieved through high loads (close to 100% of 1RM), low number of repetitions, sustained predominantly by anaerobic metabolism alactic (Allegretti et al., 2018; Gentil, 2014). Metabolic-based resistance training is characterized by series with a higher number of repetitions (±15) (Gentil, 2014), less load to be overcome and shorter interval between stimuli (Allegretti et al., 2018). In this method, the muscle activity on pre occlusion remain in state for a longer time than observed in the tension-based method for moving the anaerobic lactic metabolism system (predominantly) (Sobral & Rocha, 2017). The predominance of the lactic anaerobic system leads to an accumulation of cellular metabolism byproducts, especially the free hydrogen, which promote immediately the fall of the ph(Kemp, 2005). This phenomenon promotes moments of intracellular acidosis resulting in blocking of metabolic activity, especially ATPase, reducing the resynthesize of ATP and the consequent drop in capacity to develop muscle contraction (Bogdanis, 2012).

A resistance training program properly planned and executed can promote the features adjustments to the methods employed (Quaresma & Oliveira, 2018). Such adaptations may be potentiated if it is associated with the exercise program a diet, duly organized and accompanied (Goston & Mendes, 2011). Eager for quick results, practitioners of resistance exercises, most of the time, usually associate the increase in muscle mass consumption, in addition to the normal diet, protein. Such behavior makes these practitioners ingest protein, in general, only on the basis of nutritional suggestions, without proper monitoring of a professional nutrition (Damilano, 2013). Even though nutritional intake an important factor in the adaptations resulting from resistance training (Mata, Espig, & dos Santos, 2012), practitioners insist on keeping the consumption of macronutrients without proper monitoring of a professional nutritionist (Silva Marques de Azevedo et al., 2007). So, the objective was to determine whether a simple nutritional suggestion, without the accompaniment of a dietitian, can be an influential factor in morphological adaptations and the ability to generate force, characteristics of resistance training.

MATERIALS AND METHODS

The sample consisted of 32 men in the range between 18 and 40 years, with voluntary and meeting the following inclusion criteria: the age range, resistance exercise training time (more than 3 months but less than 3 years), absence of injury arising from the practice of resistance exercises or practice any other, not cardiac or diabetic and not make use of dietary supplements or anabolic. The sample was divided into four (4) sample groups, two experimental groups and two control groups. Each group was composed of 8 subjects randomly set. All groups were submitted to resistance exercise program lasting eight weeks and weekly frequency of 3 days. All groups performed the same exercises, rowing low, supine, elbow extension, elbow flexion, leg extension and flexion of legs. The groups were divided into experimental group A, B experimental group, control group A and control group B. All research participants read and signed the Informed Consent Form (ICF). The study was approved by the Ethics Committee on Human Research of the State University of Western Paraná on the date of 27.07.2018 with number 2787781 appear.

Training protocols: The experimental group A (EGA) performed resistance training 80% of the maximum load (tension) in 3 sets of 8 to 12 repetitions, and 8 min to be held and 12 maximums, with nutritional suggestion. The internal load control mechanism has been given the realization of the repetition interval by the protocol. The interval between sets was 60 seconds between exercises 180 to 240 seconds(Fleck & Kraemer, 2017; Ratamess et al., 2009). Experimental group B (EGB) performed resistance training with 60% of the maximum load (metabolic), in 4 series of 16 repetitions, with nutritional suggestion. Between each series the interval was 60 seconds between exercises between 180 and 240 seconds. In this protocol the load adjustment was conducted by the presence of concentric failure before reaching the 16 repetitions, in this case the load was reduced in 5% occurred for the initial adjustment and possible return to the load set. Control Group A (CGA) conducted the same protocol EGA resistance training without the nutritional suggestion. Control Group B (CGB) performed the same resistance training protocol EGB without nutritional suggestion. Maximum Load Test (1RM) was based on the protocol by Brown and Weir (2001)which encompasses 1) General heat (3 to 5 minutes), 2) slight and brief stretches, 3) test acclimation phase with 8 repetitions and 50% of the estimated maximum load at 3-minute intervals; 4) 3 repetitions and 70% of the estimated load and 5) load increase until the practitioner makes a single complete isotonic contraction at time interval of 5 minutes after each load increment; the test was concluded when the participant was not able to reach the maximum load until the fifth-load increment t. A new test should be performed 48 hours later in order to assess whether it was possible overcoming the maximum load in a single complete isotonic contraction.

Anthropometric evaluation: the protocol and the equations suggested byDe Rose (1984)were used to evaluate the body composition. Fat percentage (%F) was determined through the Faulkner formula (%F = (Σ of the 4 folds x 0.15) + 5.78) - fatty weight (FW) was expressed as kilograms (FW = TW * (%F/100)). The Von Döble method adapted by Rocha was used to calculate bone weight (BW), this method uses stature data, radius diameter (bisthiloid) and femur diameter (biepicondilian) ($BW= 3.02*(S^2*R*F*400)^{0.712}$; wherein, S^2 = squared stature expressed in meters, R = radius diameter (bisthiloid) expressed in meters and F = femur diameter (biepicondylian) expressed in meters. The formula proposed by Würch (RW = TW * (24.1/100)) was used to determine the residual weight (RW), since this protocol rationalizes muscle weight (MW) based on Drinkwater. Muscle weight (MW) was calculated by subtracting the total weight (TW) of the simple sum of FW, BW and RW (MW = TW - (RW + BW + FW)). Total weight (TW) was determined by simply weighing the subject on a regular scale and by measuring stature with a stadiometer coupled to the scale. Limb perimetry (circumference) was determined based on the protocol described by Rocha (2016). Nutritional suggested protocol: the practice of resistance training often is associated with consumption of ergogenic with very different goals(Albuquerque, 2012; Cantori, Sordi, & Navarro, 2012; Wagner, 2011; Weber, Brandt, Olivoto, & Flores, 2018) but always associated with performance, or better performance. This relentless pursuit of results leads the practitioner to use these resources without proper guidance from a qualified professional, which can result in various problems (Nogueira, Souza, & Brito, 2013; Weber et al., 2018). To mimic this behavior of the components in this sample were not subject to strict control of food intake, we merely a suggestion and indicate that food still higher and lower total protein and wherein the amount approximate macronutrient should be eaten, without defining quantity, quality and variety. The Experimental group was instructed to maintain a diet with approximately 40% protein, without control of other macronutrients, during the time that they would be the resistance training program. The same happened with the experimental group B, however, in this case the indication is that the feed to maintain about 60% protein. The control group had no indication regarding the consumption of macronutrients. Results were expressed as mean and standard deviation of the mean. The Student's t-test and/or ANOVA followed by Tukey's post-test, were used in the comparative analysis. The Shapiro-Wilk test was applied to determine normal results. The Student's t test was the instrument used to calculate dependent samples, paired data, independent samples and unpaired data. Data analysis and plotting were performed in the GraphPad Prism System software (San Diego, CA, U.S.A.). Differences were statistically significant when the probability of having a null hypothesis was ≤0.05 - p≤0.05 (*) and p≤0.01 (**) were significant.

Anthropometric data presented in Figure 01 indicate that, regardless of the experimental group, there were no statistical differences when comparing the data before and after resistance training period. Moreover, it was observed that the results on the increase in circumference of the chest of the subjects of the control group were higher and significant in relation to the subjects in the experimental groups, as well as the results of the circumference of the arm of the subjects of the control group practitioners of the tension-based resistance training (table 2), however, were not sufficient to identify significant differences in morphological adaptations of the subjects of the experimental and control groups (Figure 1). Despite significant increases in girth of subjects of the control groups, the overall results showed that there were no significant differences in anthropometric variables between the sample groups (Figure 2), however, the average morphological adaptations of subjects of the control group were higher than those subject groups experimental, post-resistance training program. In contrast, the results for the strength of manifestation of ability indicated significant differences between the pre and posttests subjects of the control group in most exercises performed, except in bench press exercises and elbow flexion for the subjects of the BGC.

Table 1. Quantitative data to characterize the sample. Organized data on mean and standard deviation

Sample	n	Age (x)[a]	PT (months)[b]	*p*	*p-value*
EGA	08	24,57±1,16	13,28±1,03	≤ 0,05	0,4449[a]
EGB	08	23,57±0,96	12,85±1,01		
CGA	08	21,85±0,67	12,14±1,02		0,1097[b]
CGB	08	24,14±1,04	13,00±1,20		
Total	32				

Source: Author´s data, 2019.

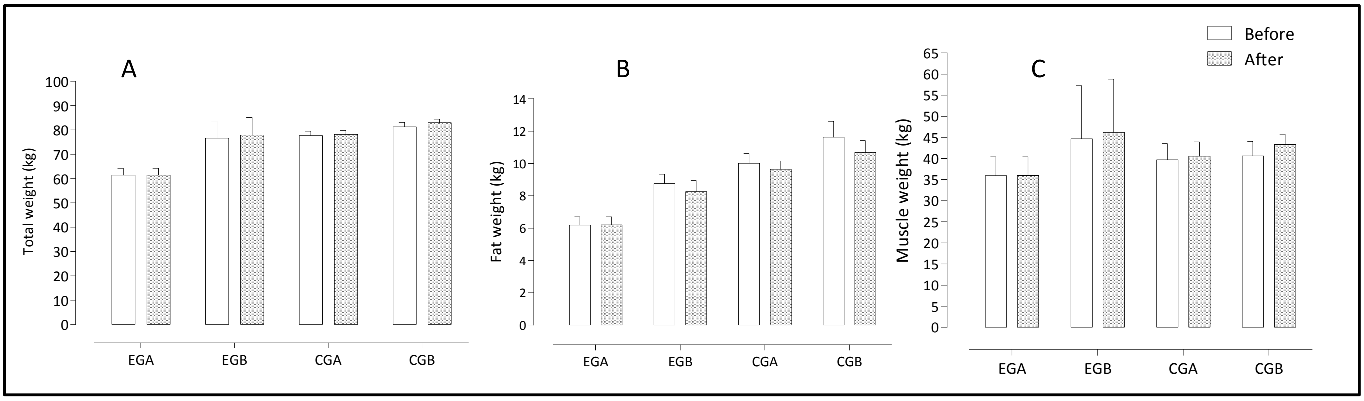

Figure 1. Anthropometric data of the samples before and after the training period. A - Total weight of the samples before and after the resistance training period. B - Fat weight of the samples before and after the resistance training period. C - Muscle weight of the samples before and after the resistance training period. Data were organized as mean and standard deviation of the mean.* Statistically different in the *Student'st* test applied to paired samples p≤0.05;and ** statistically different in the *Student's t* test applied to paired samples p≤0.01

Table 2. Quantitative data about the circumference of the evaluated limbs before and after the resistance training program

	EGA		CGA		EGB		CGB	
	Before	*After*	*Before*	*After*	*Before*	*After*	*Before*	*After*
Arm	29.12±1.04	29.42±0.96	30.34±0.57	31.96±0.36	33.64±1.96	33.64±1.96	31,35±0,64	33,51±0,51
Thorax	87.64±1.19	88.35±1.19	95.10 0.84	97.64±0.91	95.67±3.18	95.67±3.18	97,00±0,98	100,42±0,81**
Leg	45.89±0.80	47.39±0.60	54.38±0.69	55.64±0.61	56.27±0.97	56.27±0.97	51,35±0,82	53,57±0,83

Data were organized as mean and standard deviation of the mean.** statistically different in the *Student'st* test applied to paired samples p≤0,01. Source: authors' data.

RESULTS

The descriptive data of the sample groups, shown in Table 1 indicated a normal distribution in relation to age and time experience to participate in the resistance training program. Furthermore, there are significant are differences between pre- and post-testing of the subject in the ACD leg extension exercise. The subjects of the control group showed an increase in the ability to express greater strength when compared to the results of the experimental group.

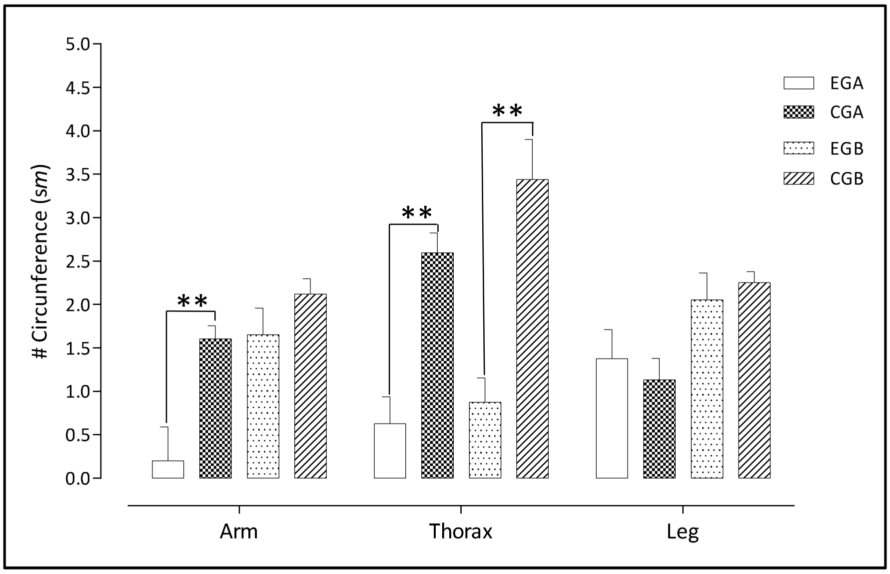

Figure 2. Comparative data circumference of the differences between the pre and posttest of the experimental and control groups. Data organized in mean and standard deviation from mean. ** statistical difference for unpaired samples at p≤0.01. Parametric data. Arm, (EGA vs CGA) p value 0.0005; Chest, (EGA vs CGA) p value 0.0001, (EGB vs CGB) p value 0.0012

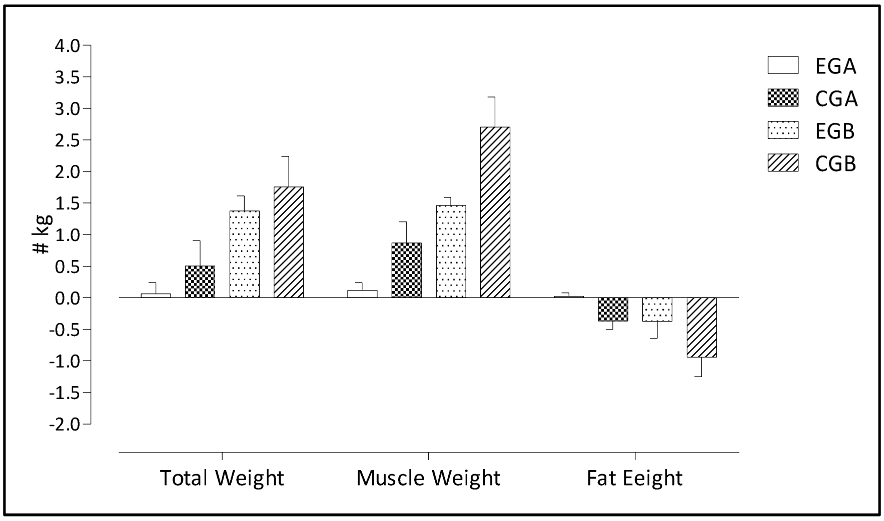

Figure 3. Comparative data of anthropometric differences between the pre and posttest of the experimental and control groups. Data organized in mean and standard deviation from mean. The data showed no difference statist for unpaired samples. Parametric data

Table 3. Quantitative data test of 1 RM, before and after the period of application of resistance exercise program. Data organized in mean and standard deviation from mean

	EGA		CGA		EGB		CGB	
	BeforeAfter		*BeforeAfter*		*Before*	*After*	*Before*	*After*
Bench press	46,85±6,46	52,86±5,66	29,00±1,96	39,71±2,22*	59,00±11,7	62,14±2,62	32,29±2,22	36,86±2,55
Low rowing	52,85±5,66	64,64±6,66	73,14±2,72	91,71±3,31**	59,29±5,71	60,71±6,04	79,00±2,94	93,14±5,14**
Elbow extension	41,07±4,48	48,93±5,17	63,07±2,49	76,71±2,61**	55,71±8,25	59,64±8,48	67,14±3,23	75,57±4,37**
Elbow flexion	41,07±4,48	45,36±5,53	62,36±2,79	81,71±3,38**	49,64±7,10	50,71±7,41	66,86±3,26	80,00±5,12
Leg extension	80,35±3,37	92,50±2,76 *	84,29±1,71	111,86±4,05**	76,79±5,85	82,86±6,20	99,71±3,27	115,29±4,38**
Bending legs	42,14±1,79	52,50±2,66	68,64±2,03	91,29±4,02**	45,36±3,53	47,86±4,15	66,29±3,07	80,57±4,01**

Data are expressed as mean and standard deviation. * Statistically different in the Student's t test applied to paired samples p≤0.05; and ** statistically different in the Student's t test applied to paired samples p≤0.01. Source: author´s data.

Despite resistance training methods employed are effective to increase the ability to manifest strength of the practitioners in this case, the best performance occurred in the groups without any suggestion of nutritional intake. In contrast, the results for the strength of manifestation of ability indicated significant differences between the pre and posttests subjects of the control group in most exercises performed, except in bench press exercises and elbow flexion for the subjects of the BGC.

Furthermore, there are significant are differences between pre- and post-testing of the subject in the ACD leg extension exercise. The subjects of the control group showed an increase in the ability to express greater strength when compared to the results of the experimental group. Despite resistance training methods employed are effective to increase the ability to manifest strength of the practitioners in this case, the best performance occurred in the groups without any suggestion of nutritional intake.

DISCUSSION

The results shown by our data indicate a nutrition suggestion that the appropriate follow-up of a professional nutrition is not efficient to enhance the characteristic results of resistance training, regardless of the method to be used. A resistance exercise program, properly organized and executed, can promote the morphologic characteristics (Fleck & Kraemer, 2017), according to the results presented in this study. The adjustments occur in various cell levels, such as the molecular level, providing an increase in the cross-section of the muscle cells (Paes, 2016), the increase in the number and availability of vesicles neurotransmitters in the motor end plates, concomitantly, the increase in the recruitment capacity of these plates (Koeppen & Stanton, 2018; Kraemer, Fleck, & Evans, 1996). Every cellular adaptation, either in normal or in response to external stimuli, such as resistance training, occurs via the protein translation process, ie, the balance between the synthesis and protein degradation (Bompa, 2001; Lent, 2010; Moro et al., 2018). In the case of practice of resistance exercises, protein balance, it may no longer be a factor associated with and becomes a determining factor of the adaptive processes resulting from resistance training (Graber et al., 2019).

The daily protein consumption, physical exercise practitioners, should be proportional and appropriate characteristics of sports practice, especially regarding the intensity of the imposed load, time needed to occur the adaptations and the physical characteristics of the practitioners in this case the indicative values range from 1.0 g/kg/ day to 2.0 g/kg/day (Quaresma & Oliveira, 2018). Moreover, there is recent evidence to suggest a muscle atrophy of the association both detraining as the imbalance between protein synthesis and muscle protein degradation, but that the practice of resistance training can reverse the atrophic framework (Phillips, 2014). Although the findings do not show an atrophic framework in sample groups, there was a lower hypertrophy adaptation in trained groups for a given protein intake at each meal during the training program. In this sense, it seems clear that the consumption of macronutrients, whether in power or through ergogenic needed to enhance the adaptations of the training program should be monitored and verified by a qualified practitioner, a nutritionist (Phillips, 2014). The diet for resistance training practitioners must be associated with two important points to spare, concurrently, the need for protein structures to occur adaptations, whether in level enzyme, whether at the tissue level, too, the intake of a contribution of macronutrient directly involved in the replacement of energy substrates. In this case, the intake of carbohydrates is fundamental to promote the replacement of immediately available energy reserves and the intake of key proteins for the traditional way (Bosse & Dixon, 2012; Cooper & Hausman, 2016; Egan & Zierath, 2013; Fry, Kirby, Kosmac, McCarthy, & Peterson, 2017; Herring et al., 2013; Poortmans, Carpentier, Pereira-Lancha, & Lancha Jr, 2012).

The results confirm the efficiency of the training methods applied to promote the adaptation characteristics of these exercises, namely hypertrophic responses (Ito, Ruegg, & Takeda, 2018; Olivoto et al., 2019; Takada et al., 2012). However, the nutritional suggestion without proper monitoring of a professional, were not enough to increase the hypertrophic responses of the subjects of the experimental groups, even though a common practice and common among practitioners of resistance training program the use of ergogenic resources and/or modify the direct consumption of macronutrients in the diet with guidance from other professionals than nutritionist (Borges, Silva, & Rodrigues, 2016; Domingues & Marins, 2007; Weber et al., 2018). In legal terms, it is the prerogative of the professional nutrition the responsibility of the organization and monitoring of dietary changes, diets, whether with or without the regular practice of physical exercises (Nutricionistas, 2018), even more, in the issues health practitioners, the performance of this professional becomes key to achieving positive results (Ferreira, dos Santos Marques, de Carvalho Cordeiro, de Sá, & Frazão, 2018). On the other hand, to the indiscriminate use of ergogenic resources and/or change in macronutrient intake without proper guidance, can lead to significant changes in health parameters such as hypercalciuria, weight gain, kidney and liver overload and especially muscle damage (Pinto, Pinto, da Silva, dos Reis, & Rocha, 2018). The results of this study indicate that the practice of features adaptations of resistance exercise may have decreased depending on the concentration and control the intake of macronutrients in a daily diet. Our results are corroborated by other studies that showed positive responses in sample groups undergoing resistance training and control of nutritional intake by a professional nutritionist (Lima, Lima, & Bragança, 2018) and even usually groups submitted to resistance exercises and showed concern the results to consult a nutritionist for proper control of nutritional intake (Maia Oliveira, Torres, & da Silva Vieira, 2012).

Improper use of macronutrients, amount of intake higher than necessary or consumption of unnecessary specifically proteins for physical exercise (Bacurau, 2009), usually performed without proper guidance, can cause diarrhea, nausea and increased blood pressure among others (Oliveira Pinto, 2013) and causing cellular change in plasma osmolality (Torres & Marzzoco, 2007). The increase of solutes in blood flow slows down and therefore cause delay in the removal of characteristic waste of energy systems prevalent in resistance exercises, especially the lactic anaerobic metabolism (Houssay & Cingolani, 2004; Robergs, Ghiasvand, & Parker, 2005). The solute, especially proteins, blood flow, are the major responsible for changing oncotic pressure, and increasing this pressure exerts a positive force to the displacement (osmosis) water and ions through the capillary walls in the direction of the blood in order to promote the osmotic balance (Koeppen & Stanton, 2018). This cellular efflux of water reduces their availability in the intracellular fluid, and consequently reduces the enzymatic activity involved in energy synthesis available for the exercise, especially the resynthesize of ATP (Torres & Marzzoco, 2007). The cellular adjustments in osmolar normal, are associated with an increase in enzyme protein translation and in synthesis of new molecules of ATP (Cooper & Hausman, 2016) directly related to the intensity, duration of stimulus of resistance training (Fleck & Kraemer, 2017). In cooperation with the signaling pathways for translation of new molecules of ATP, are activated calcium regulatory pathways and rapamycin complex (mTOR) (Ito et al., 2018), and resistance exercises have property to generate signals modulators to activate a protein complex focused on the mTOR (Hall, 2013), responsible for controlling protein synthesis, and consequently promote tissue growth. Already muscle protein synthesis occurs through the dynamic equilibrium between the synthesis and degradation, and the availability of determining factor proteins for this process (Graber et al., 2019). In this case, a positive result in hypertrophic process is made possible with the proper prescription and delivery of resistance exercise (Fleck & Kraemer, 2017) capable of triggering the appropriate signals to the normal enzyme functionality (Cooper & Hausman, 2016; Hall, 2013) and adequate control of nutritional intake, especially the amount and quality of protein to be ingested (Maia Oliveira et al., 2012; Nutricionistas, 2018).

Conclusion

Methods of resistance training used in this study were effective in relation hypertrophic responses and the ability to generate force, regardless of the variables included in this study. When we analyze the increase in the capacity to generate force between sample groups, we realized that the control group, which received no nutritional suggestions, presented the most efficient results. The same was observed, partially, in relation to circumference. Regarding the anthropometric variables, the results showed no difference statist, but the media indicate that the control group showed better results. The data set indicates that an organized resistance training program and managed properly may have their depressed adaptations due to an inadequate intake of macronutrients. In this sense, we can conclude that a simple nutrition tip, without proper monitoring of a nutritionist, is not able to enhance the morphologic characteristics of resistance training. Thus, the joint work between the physical educator and nutritionist seems to be the path that would lead to the best results in resistance training programs.

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