



## ***Development of maximum strength, resistance and body composition: a comparison between users and non-users of anabolic androgenic steroids***

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### ARTIGO ORIGINAL

#### **ABSTRACT**

The present study aimed to verify the effects of the use of anabolic androgenic steroids (AAS) in the development of maximum strength, resistance strength and body composition in resistance training practitioners. This research is characterized as applied, with a descriptive field study with a quantitative approach. The intentional non-probabilistic sample was composed of 20 male individuals, experienced in strength training. Participants were allocated into two groups: GU (group of EAA users), and GNU (non-EAS users group). The subjects were submitted to an evaluation of body composition, maximum strength test (1RM) and maximum repetitions test (80%RM). The results found indicate that the use of EAA increases the production of maximum strength and relative strength, causing a moderate increase in fat-free mass. The improvement in performance by its use is not found in the number of maximum repetitions at 80% RM, as well as it does not seem to influence fat mass and body fat percentile.

**Keywords:** Anabolic androgenic steroids. Resistance training. Maximum force. Body composition.

## **Desenvolvimento de força máxima, resistência e composição corporal: uma comparação entre usuários e não usuários de esteróides anabolizantes androgênicos**

### **RESUMO**

O presente estudo teve como objetivo verificar os efeitos do uso de esteróides anabólicos androgênicos (EAA) no desenvolvimento da força máxima, força de resistência e composição corporal em praticantes de treinamento resistido. Esta pesquisa caracteriza-se como aplicada, com estudo descritivo de campo com abordagem quantitativa. A amostra não probabilística intencional foi composta por 20 indivíduos do sexo masculino, experientes em treinamento de força. Os participantes foram alocados em dois grupos: GU (grupo de usuários de EAA) e GNU (grupo de não usuários de EAS). Os sujeitos foram submetidos à avaliação da composição corporal, teste de força máxima (1RM) e teste de repetições máximas (80%RM). Os resultados encontrados indicam que o uso de EAA aumenta a produção de força máxima e força relativa, causando aumento moderado da massa magra. A melhora no desempenho por seu uso não é encontrada no número de repetições máximas a 80% RM, assim como não parece influenciar a massa gorda e o percentual de gordura corporal.

**Palavras-chave:** Esteroides anabólicos androgênicos. Treinamento resistido. Força máxima. Composição corporal.

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## **INTRODUCTION**

Resistance training is characterized as the execution of exercises that require the musculature to move (or try to move) against an opposing force, which can be presented in the form of free weights, machines, elastic bands and even body weight (FLECK; KRAEMER, 2017). This type of training gained popularity for improving physical fitness and conditioning in athletes, which later attracted fans who aimed to increase maximum strength, endurance strength and changes in body composition (increase in muscle mass and reduction in fat mass), a fact well supported by the current literature (SCHOENFELD et al., 2021).

However, it is noteworthy that the incessant pursuit of an athletic (sculptural) body made explicit by social media often causes an adverse reaction in gym goers, who end up leaving aside the quality of life and looking for means for the physical development of faster way, sometimes skipping stages of its development (DA SILVA SOUZA et al., 2018). The results of physical exercises are not always achieved as desired, making them look for “shortcuts” for this purpose, resorting to the use of Anabolic Androgenic Steroids (AAS) (OLIVEIRA; CAVALCANTE NETO, 2018). The excessive and unmonitored use of these pharmacological agents gains great proportions, leading to several health disorders, all in pursuit of the ideal physique (ROCHA; AGUIAR; RAMOS, 2014).

AAS are synthetic hormones, based on testosterone, known to give secondary sexual characteristics in men, and for the effects caused on skeletal muscle, such as increased strength and cross-sectional area (MCARDLE; KATCH; KATCH, 2015). We can cite as an example of EAA trenbolone acetate, testosterone propionate, testosterone enanthate, testosterone cypionate, testosterone undecanoate, nandrolone phenylpropionate, nandrolone decanoate or testosterone, boldenone, dianabol, halotestin, turinabol, nandrolone (deca), trenbolone, hemogenin, stanozolol, oxandrolone, primobolan, masteron and proviron (HALUCH, 2019).

These ergogenic resources were created to contribute to the treatment of some diseases, but have been used to improve the performance and appearance of bodybuilders, all with little or no guidance (OVIEDO, 2013). It is noteworthy that the



indiscriminate use and without recommendation and/or professional guidance can lead to health disorders. “Thus, a more careful look at the subject is necessary, in order to provide relevant and scientific information on the use of anabolic steroids” (OVIEDO, p.2, 2013). There are countless damages to our health with the excessive use of these substances and without the help of a qualified professional to advise on the subject (ROCHA; AGUIAR; RAMOS, 2014).

In view of the theme presented, this study has the problem question: What are the effects of the use of anabolic androgenic steroids on the development of maximum strength, endurance strength and body composition in resistance training practitioners? The objective of the study is to verify the effects of the use of anabolic androgenic steroids in the development of maximum strength, endurance strength and body composition in resistance training practitioners.

The increase in the search for an ideal body and the recurrent use of AAS justifies the need to understand the effects caused by the use of these drugs on the physical performance of resistance training practitioners, considering that the control of training variables by the physical education professional is based on the evolution of characteristics such as maximum and relative strength, as well as changes in body composition.

## **MATERIAL & METHODS**

### ***Participants***

This research is characterized as applied, with a descriptive field study with a quantitative approach. The intentional non-probabilistic sample was composed of 20 male individuals living in União da Vitória, Paraná, and Porto União, Santa Catarina, experienced in strength training. Participants were divided into two groups: GU (AAS user group), comprising 10 individuals; and GNU (non-EAS users group) composed of 10 individuals. The criteria for inclusion in the sample were: being able to perform the tests imposed by the study; be between 20 and 43 years old (considering physiological maturation factors); be experienced in the practice of strength training (> 2 uninterrupted years, and minimum weekly frequency of three days); to individuals from the GU positive report for the use of AAS through a previous questionnaire; and



signature of the informed consent form.

### ***Test protocol***

The procedures adopted by the study were carried out in three meetings. The first meeting was used for the assessment of body composition and familiarization with the 1RM tests and the exhaustion test, in the bench press exercise, and the survey on the use of AAS (type, dosage, frequency of application and time of use), making eligible to participate in the GU. In the second meeting, the 1RM test was performed, and in the third meeting, the exhaustion test was performed.

To assess body composition, data collection was performed using the physical assessment program Afig Actuar<sup>®</sup>, following the assessment protocol, according to Jackson and Pollock (1978), based on anthropometric measurements, body mass (BM) and height (ET), using a scale and a stadiometer. Skinfolds, subscapular (SE), triceps (TR), pectoral (PE), mid-axillary (AX), suprailiac (SI); abdominal (AB), and thigh (CX), measured by a scientific caliper of skinfolds of the brand Cescorf<sup>®</sup>. The days, times and place of application of the assessment were agreed with each participant in the sample, so that they are carried out under the same conditions, thus preventing changes due to external factors (time, temperature and previous effort).

Initially, all participants underwent a familiarization session, during which the subjects performed the exercise used in the 1RM and maximum number of RM tests. The objective was to standardize the exercise technique. After 24 hours of the familiarization period, the 1RM test for the bench press was performed. During the 1RM test, each subject performed a maximum of 5 1RM attempts with a 5-min rest interval between attempts. No pauses were allowed between the eccentric and concentric phases of a repetition or between repetitions. For a repetition to be considered successful, a full range of motion, as is normally defined for the exercise, must be completed.

The procedures adopted followed the study by Matuszak et al. (2003), where after a general warm-up (10 minutes of low-intensity running on a treadmill), individuals performed 8 repetitions with an estimate of 50% 1 RM of the exercise being tested using the training experience, and after 1 minute of rest, 3 repetitions with an estimated 70% of 1 RM were performed. After 5 minutes, subsequent trials were performed for 1



repetition with progressive weight increase until 1 RM was determined.

The muscular endurance test (exhaustion) was performed 48 h after the maximum strength test. The test was performed by performing repetitions until exhaustion. After a short warm-up period of light aerobic exercise (10 minutes of low-intensity running on a treadmill), participants performed as many repetitions as possible without stopping or pausing between repetitions at a fixed cadence and 80% of 1 RM (Prestes et al., 2009), in the same exercise performed (bench press).

### ***Statistical analysis***

Descriptive statistics were applied to the collected data, tested for normality using the Shapiro-Wilk test, tabulated and analyzed for frequency and significance using Student's t test for two samples and paired data. For the differences found, the Cohen's d test was applied to verify the size of the effect. For better visualization the data were presented through graphs and tables in comparative analysis, mean and standard deviation. Data were tabulated using the BioEstat 5.3 Software, adopting a significance level of 95% ( $p \leq 0.05$ ) for all measurements.

The volunteers who agreed to participate in the study were given an explanation about the objectives and motivations of the research, in addition to clarifying all the procedures that were listed, reiterating the freedom of participation as well as the secrecy and anonymity of their answers and identity. The Informed Consent Form was delivered in two copies, both signed by the researcher and the participant, listing the essential ethical bond for carrying out the research. The proposed methodology was formulated respecting Resolutions 466/12 of the National Health Council, and approved by the Ethics and Bioethics Center of the Vale do Iguaçu University Center – Uguv (protocol: 2022/122).

## **RESULTADOS**

The GNU was formed by 10 individuals aged  $27.9 \pm 6.41$  years, 50% of whom practice uninterrupted resistance training between one and three years, 40% over three years and 10% between six months and one year. The weekly training frequency of 90% of this group is every day, the others (10%) train between three and five days a week.

The GU, formed by 10 individuals, mean age of  $33.7 \pm 6.94$  years, is characterized

by the practice of uninterrupted resistance training for over three years (90%) and only one has been training for two years (10%). The weekly training frequency of 60% of this group is every day, the rest (40%) train between three and five days a week. In addition to these characteristics, all claim to use EAA, with 50% using testosterone enanthate and another 50% using sustanon. The dosage informed by 50% of the sample is concentrated in 800 to 1000 mg of the substance per week, another 40% claims to use between 200 and 400 mg, and 10% between 400 and 800 mg. Still, 70% of users have been using it for over a year, 10% for one year and 20% for six months.

The comparison between the body composition of the groups is shown in Table 1. All data showed homoscedasticity (normality), as well as there was no significant difference between the groups for any of the anthropometric variables evaluated. The effect size evaluated between the variables is small for body mass and fat mass, insignificant for height, medium for fat mass and large for fat-free mass.

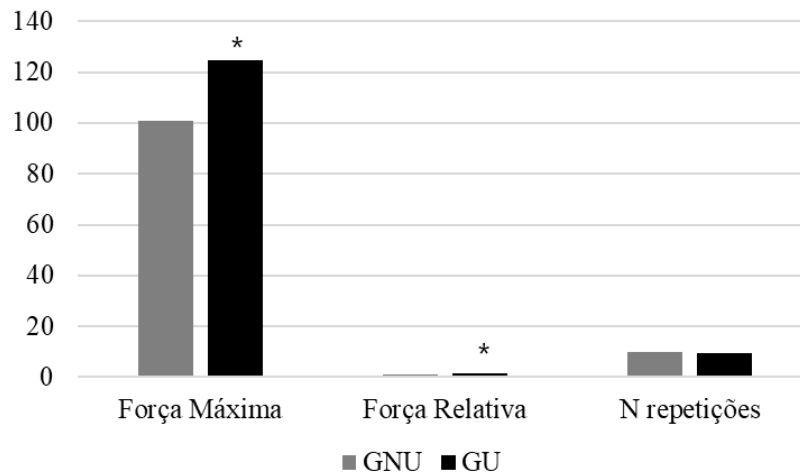
**Table 1 – Comparison of body composition between groups**

	GNU	GU	p	d
Body Mass (kg)	85.18 ± 9.90	88.19 ± 8.80	0.2409	0.34
Height (m)	1.78 ± 0.06	1.77 ± 0.06	0.1905	0.18
%Fat	13.71 ± 5.74	11.37 ± 3.53	0.1431	0.66
Fat mass (kg)	11.95 ± 5.56	10.23 ± 10.04	0.2192	0.42
Fat free mass (kg)	73.22 ± 7.18	77.95 ± 5.85	0.0619	0.80

The data pointed out by this study show that the use of EAA can positively influence the fat-free mass, although it does not present a statistical difference due to the sample size, it shows a large effect size in this variable, which is one of the objectives desired by users.

The comparison of maximum strength, relative strength and the number of repetitions achieved at 80% of maximum strength is shown in graph 1. The comparison between groups showed a significant difference in favor of GU for maximum strength ( $p=0.0116$ ) and for the relative strength ( $p=0.0226$ ). The performance presented in the number of repetitions did not present a significant difference ( $p=0.4734$ ).

**Graph 1 - Comparison of maximum and relative strength and number of repetitions between groups**



Comparison between groups in performance showed a large effect size in maximal strength ( $d=0.91$ ) and relative strength ( $d=0.82$ ), and insignificant difference in the number of repetitions ( $d=0.02$ ).

## DISCUSSION

The results found in this study indicate that the use of AAS influences the fat-free mass, maximum strength and relative strength. It should be noted that the results presented by GU are based on the use of supraphysiological testosterone dosages and for a period longer than one year.

This factor is pointed out by Mazzeo (2018) where they expose that athletes usually use AAS to improve performance, also pointing out that this use is greater among bodybuilding athletes due to the positive effects of the substance in increasing fat-free mass. The author also mentions that the use is normally done uninterruptedly for several weeks/years.

Regarding the profile of AAS users, Zahnow et al. (2018) designed a study to identify the typology among users. Among the 611 men participating in the study, the authors point out that 11.1% were young people motivated by fat loss, 38.6% wanted to be in shape, 25.4% sought to increase muscle mass and strength and another 24, 9% pursued other specific goals. These data are in line with those of the current research, and the use of AAS seems to influence strength and muscle mass.

In a systematic review with meta-analysis in trained healthy adults, Andrews et





al. (2018) point out a 52% higher rate of change in force for the groups that used AAS. The study also points to a moderately greater increase in lean mass among users. Such data corroborate those raised in this research, which, despite not having a statistically significant difference, showed a large effect size for fat-free mass, and showed a higher rate of strength development among users.

Albano et al. (2021) points out that the use of EAA is able to increase the size of muscle fibers, as well as in the individual's strength performance. This fact is due to the increase in satellite cells and myonuclei in the muscle group through the use of the substance, factors that increase protein synthesis, and within a positive nitrogen balance, provide an increase in the cross-sectional area of the muscles.

Another factor pointed out by Mendes (2019) is related to the recovery time between sessions. The author states that EAA users train for more days a week, with high intensities and perform more exercises for each muscle group, factors that influence performance and anthropometric improvement. These data are corroborated by the study by Miranda et al. (2020), who point out that AAS users perform greater volumes (number of exercises and series) for muscle groups, including the pectoral, evaluated in this study.

A limitation of the present study is the fact that the performance between GU and GNU was not verified during a complete training session, considering that variables such as number of series, exercises, recovery interval, order of exercises, among others, characterize strength training aimed at gains in muscle mass and strength. The deleterious effects generated by the excessive use of AAS were not part of the objectives of the present study.

## **CONCLUSIONS**

The use of anabolic androgenic steroids influences the production of maximum strength and relative strength, causing small effects on fat free mass. The improvement in performance by its use is not found in the number of maximum repetitions at 80% RM, as well as it does not seem to influence fat mass and body fat percentile.

Failure to control the type and amount of AAS use in the user group is a limiting



factor for the inclusion of subjects. More research on this topic should be developed to clarify the real effects on strength and body composition.

## CONFLICTS OF INTEREST

The authors have no conflict of interest.

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