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# DIFERENTES MÉTODOS DE TREINAMENTO COM PESOS ALTERAM O APETITE DE ADULTOS JOVENS?

## DO DIFFERENT WEIGHT TRAINING METHODS CHANGE THE APPETITE OF YOUNG ADULTS?

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**ABSTRACT**
Este estudo verificou os efeitos de diferentes métodos de treinamento com pesos (TP) sobre a sensação de apetite de homens treinados. Amostra foi composta por 10 homens, com idades entre 18 e 29 anos. Foram realizadas duas sessões experimentais com *wash out* de sete dias: no método circuito (MC) os exercícios foram realizados alternados por segmento em forma de estações, enquanto que durante o método tradicional (MT) os exercícios foram realizados em séries consecutivas. Ambos os métodos tiveram o mesmo trabalho total. A sensação de fome e perspectiva do consumo alimentar foram coletados nos momentos: basal, imediatamente após a sessão e 1hora. Foi identificada diferença apenas entre os momentos ($p<0,05$), não havendo diferença entre métodos ou efeito de interação ($p>0,05$). Assim, conclui-se que os métodos de TP não alteraram a sensação de fome e a perspectiva de consumo alimentar, porém nota-se que a magnitude de elevação foi maior no MT.
**Palavras-chave**: Treinamento de resistência. Fome. Ingestão alimentar.

**ABSTRACT**
This study assessed the effects of different weight training (WT) on appetite feeling in trained men. The sample consisted of 10 men aged between 18 to 29 years old. There were two experimental sessions with a *wash out* of seven days: in the circuit weight training (CWT), exercises were performed by alternating segment in stations, while during the traditional method (TM) exercises were performed in consecutive series. Both methods had the same total workload. The perception of hunger and perspective of food intake were measured in moments: at baseline, after exercise and 1 hour. Differences only in feelings of hunger among moment ($p>0.05$) were showed, and there were not differences between methods or effect of interaction ($p>0.05$). Thus, we concluded that both training methods are not altering the feeling of hunger or perspective of food intake, however the magnitude to raise is higher in TM.
**Keywords**: Resistance training; Hunger; Eating.

## Introduction

Weight training (WT) is classically used aiming at increasing muscle mass, localized muscle resistance, strength and power[1-2]. Additionally, WT also plays a key role on the energy balance, because it is capable of raising the energy expenditure (EE) both acute and chronically (via increased metabolic rate of rest)[3-5] and this way to act in the weight reduction, relating to the mechanisms that modulate the hunger, the appetite and food intake[6].

In addition to raising the EE post-exercise, some studies have demonstrated that physical exercise seems to reduce the food ingestion, through a phenomenon called "anorexia induced by exercise"[7]. The post-exercise anorexia consists of the hunger suppression that may occur after physical exercise sessions and may be quantified indirectly by scales or questionnaires[8-9] and circulating levels of the hormones involved in the central control of food intake[10-11] and directly via the quantification of food intake[6,12]. The post-exercise anorexia has been widely reported in aerobic activities with intensity above 60% of maximum oxygen consumption ($VO_{2max}$)[6].

Even with the great potential of WT for weight control, few studies have investigated a possible anorexic effect of this type of training, and the limited information available are inconclusive. Bromm et al.[10] verified that the WT promotes hunger suppression after 10 exercises with intensity of 80% of 12 RM, however Laan et al.[13], Ballard et al.[14] and Balaguerra-Cortes et al.[15] did not observe any effect of WT about the hunger of their adepts, this controversy can be, to some extent, explained by the different training protocols employed, which vary in the variables: muscular action, number of series and repetitions, intensity of the loads, speed of movement execution, rest interval between series and exercises, selection and the order of the exercises, and weekly frequency, being relevant to the understanding of these factors since that, the characteristics of the training session induce EE with different magnitudes[16-18]. The understanding of factors that influences the EE and the maintenance of body mass is of great importance in current days, since the number of several physiopathologies associated to disturbances in the energy balance is growing[19].

Considering that Aniceto et al.[20] demonstrated that different methods of WT carried out with the same volume and intensity (total work) present similar energy expenditure, it is necessary to know the potential effects of WT on food consumption.

Thus, this study aims to analyze the acute effects of different methods of WT on appetite for young trained men. Our hypothesis is that, when standardized the total work, there is no difference between the methods in the sensation of hunger and perspective of food consumption of men after the implementation of the methods.

## Methodological procedures

This study is of experimental cross-over, randomized, counterbalanced. The sample was comprised of 10 adult men trained recreationally. The selection of the sample was made through dissemination (posters/invitations) held in the campus of the Superior School of Physical Education at the University of Pernambuco. The sample inclusion criteria were: being a man aged between 18 to 30 years; being suitable for physical activity practice assessed by questionnaire PAR-Q[21]; to practice regularly WT for a minimum of six months and a maximum of two years, and with minimum frequency of three times a week; having a body mass index between 18.5 kg/m² and 29.9 kg/m². It was not included in the sample subjects who during the research consumed any food supplement, medication, alcoholic beverages or tobacco; had any musculoskeletal or cardiovascular aggravating circumstance; and if the individual practiced any physical exercise 48 h before the experimental sessions. Among the previous recommendations, the subjects were instructed not to consume caffeine and food normally up to 12 hours before the test.

All of them participated in a voluntary way by signing a free and informed consent term. The present study was approved by the Research Ethics Committee at the University of Pernambuco (protocol 226/10).

*Anthropometric measurements and estimation of body composition*

To evaluate the body mass index, it was used a Filizola® scale with a precision of 100g, to obtain the body mass (kg) and wooden stadiometer, with accuracy of 0.05cm for height (cm). The measurement of body composition was assessed with scientific Lange® skinfold calipers with accuracy of 0.5mm and resolution of 1mm for skinfold measurements. The protocol used to estimate the percentage of fat (%G) was the three skinfold (pectoral, abdominal and thigh average) of Jackson and Pollock[22] (1978). Then it was made conversion of body density to %G by Siri equation[23]. The reliability coefficients (ICC) for the skinfold measurements were 0.993 (pectoral), 0.970 (abdominal) and 0.942 (thigh average). All

measurements were made by a single experienced assessor following the recommendations of the *International Society for the Advancement of Kinanthropometry*[24].

*One repetition maximum test*

To determine the percentage of the load used in experimental sessions (60% of 1RM), it was performed the 1RM test according to recommendations of Kraemer et al.[25]. It was performed a slight warm-up of five to ten repetitions using 40 to 60% of the estimated load 1RM on the basis of the report of the subject. After 1 minute of recovery, three to five repetitions were executed with 60 to 80% of the estimated load of 1RM. Subsequently, after 2 minutes, three to five attempts were performed with progressive loads seeking to identify 1RM, being given 3-minute interval among the attempts. This process of increased load continued until reaching an attempt with concentric failure. The complete amplitude of movement and correct technique was necessary for each test to be considered successful. In addition, standardized instructions were provided before the test, so that the evaluated person becomes aware of all the routine, as well as verbal stimuli were performed during the implementation attempts of 1RM. It was given an interval of 2 minutes between exercises.

The order of testing followed the same order of exercises of the experimental sessions: 1st Bench press, 2nd Leg press, 3rd Seated row, 4th Leg curl, 5th Triceps pulley, 6th Leg extension, 7th Biceps curl, and 8th Adductor chair. During the realization of 1RM test the subjects had no access to the values of the loads so that there was no possibility of influence in relation to the final value of this variable.

*Familiarization*

After the end of the 1RM test, a session of familiarization with the exercise protocol and speed of execution of the movement of the experimental sessions was performed. This session consisted of a series with 10 repetitions for each exercise with 1-minute interval between the exercises, a cadence of 1 second for the concentric phase and 1 second to eccentric, controlled by a metronome (Korg MA30).

*Appetite evaluation*

The appetite was measured through the visual analogic scale (VAS), being analyzed the feeling of hunger and the prospect of food consumption before the session WT (baseline), immediately after the session (IAS) and 60 minutes for recovery passive (1 hour). The VAS consists of a horizontal line of 100 millimeters, which portrays little or no sensation of hunger/perspective of food consumption in the left end, and at the opposite end of the right side, the maximum feeling of hunger/perspective of food consumption. For both, the following questions were performed: How hungry do you feel? How much do you think you can eat? The volunteers were instructed to mark a vertical line at the point at which their feeling of hunger/perspective of food consumption perceived approached the end referred to, for more or less and in proposed moments. The point marked by individual was then measured with the aid of a ruler, the left end (minimum score) to right (maximum score), with the objective of determining the scores of hunger and from the perspective of food consumption[8].

*Experimental protocols*

Collection was performed at the Laboratory of Biodynamics School of Physical Education at the University of Pernambuco using muscle fitness equipment brand *NEW FIT*. The subjects performed three visits to the laboratory, being the first to anthropometric measurements, 1RM test and familiarization with the implementing protocol exercises, and on

the other two visits they were randomized through drawing lots (*randomizer.org*) for the strength training sessions for traditional method (TM) and the circuit weight training (CWT). The experimental sessions occurred with the wash-*out* of seven days among the same[4,26-27]. For the two training sessions (CWT and TM), the subjects arrived at the laboratory between 7 and 8 a.m. in the morning after an overnight fast for 12 hours, and they were seated in the supine position at rest for 45 minutes. Then the volunteers ingested a standard snack (1 roll of bread of 50g with 1 slice of danbo cheese of 30g and 1 glass of juice fruit of 200ml) with energy density of 350 kcal (carbohydrate: 61.7%; protein: 13.4% and lipids: 24.9%), and the VAS was applied. The volunteers were sitting at rest in the supine position for 30 minutes more until the beginning of the exercise session. During the verbal instructions sessions were given to the volunteer remain the positioning, the execution technique of the exercise and the articular amplitude, with the objective that the evaluated person retained the cadence and the angulation needed[28].

The training sessions were equalized for the same total work: 60% of 1RM, 24 series or 24 stations, 10 repetitions and execution speed for 1s in the concentric phase and 1s in the eccentric phase of each exercise, alternating per body segment, being the ration work: rest in TM 60s (1:3) and CWT 60s (1:3), i.e., 20s of time under tension and 60 s rest. The only differential between each session was that in TM the exercise protocol was alternated per segment performed in multiple series, three consecutive series were held of the same exercise, to then perform the following exercise. Now in the CWT the exercise protocol was also alternated per segment, however, carried out in the form of sequential stations, being that soon after the 1st station in an exercise the subject would go to the next subsequent station, being necessary then the implementation of seven stations to repeat again the execution of a same exercise.

*Statistical analysis*

The sample size was calculated by the software (G*Power 3.1.9 and based on the literature, using a correlation coefficient of 0.5, *effect size* of 0.6, power of 0.80 and a α 0.05, it was determined that a minimum of eight men were required to test both the main effects and interaction in comparisons of repeated measures in the sensation of appetite[1]. The calculations have followed the recommendations of Beck[29] and Faul et al.[30].

Normality and homogeneity of variance of data were confirmed by Shapiro-Wilk and Levene tests, respectively. Subsequently, it was used the two-way ANOVA (methods x moments) with post-hoc of Newman-Keuls to compare the measures in the sensation of hunger and from the perspective of food consumption (2 x 3). The data are presented in mean ± standard deviation with a significance level of $p<0.05$. The analyzes were performed with the software STATÍSTICA 10.

Additionally, the effect size was calculated to determine the magnitude of the differences in the sense of hunger between the methods and moments. Due to the fact of the outcome to be about the sensations/perceptions and to use a psychometric instrument, it was applied the test *d* proposed by Cohen[31] and their respective classifications: 0.2, 0.5 and 0.8, respectively, were used to define as small, moderate and large the magnitude of the effect of treatment.

## Results

After the publication of the survey, 21 subjects volunteered to participate. Out of these, six did not met the inclusion criteria and five did not conclude all experimental sessions. Thus, the final sample was comprised of 10 volunteers. Table 1 presents the

descriptive and anthropometric characteristics of the subjects and the workloads of exercises obtained in 1RM test.

**Table 1.** Descriptive and anthropometric characteristics of the subjects and loads of 1RM test.

| **Variables (n=10)** | **Average ± Standard deviation** |
|---|---|
| Age (years) | 21,30 ± 3,33 |
| Body mass (kg) | 80,46 ± 6,84 |
| Height (cm) | 176,55 ± 5,11 |
| BMI (kg/m²) | 25,88 ± 2,85 |
| Percentage of body fat (%) | 19,98 ± 4,30 |
| Training time (months) | 13,10 ± 6,38 |
| 1RM bench press (kg) | 78,80 ± 20,22 |
| 1RM 45º leg press (kg) | 244,20 ± 70,08 |
| 1RM seated row (kg) | 90,80 ± 17,95 |
| 1RM leg curl (kg) | 44,00 ± 5,75 |
| 1RM triceps *pulley* (kg) | 38,40 ± 7,45 |
| 1RM leg extension (kg) | 63,90 ± 11,94 |
| 1RM biceps curl (kg) | 36,40 ± 8,31 |
| 1RM adductor chair (kg) | 50,50 ± 8,61 |

1 Rm = one maximum repetition;
Source: The authors.

Figure 1 presents the answers in the sensation of hunger in basal periods, IAS and 1 hour of recovery after experimental sessions. In the sensation of hunger, it was not identified difference between moments ($p>0.05$). In the analysis of the scores higher values in the sensation of hunger were found in TM at the time immediately after the session, (TM = 4.66 ± 3.53 cm vs. CWT = 3,15 ± 3,12 cm) and 1 hour after the sessions of WT (TM = 5.74 ± 3.60 cm vs. CWT = 5,39 ± 3,46 cm). There was no difference between groups or interaction effect for the score of this variable ($p>0.05$).

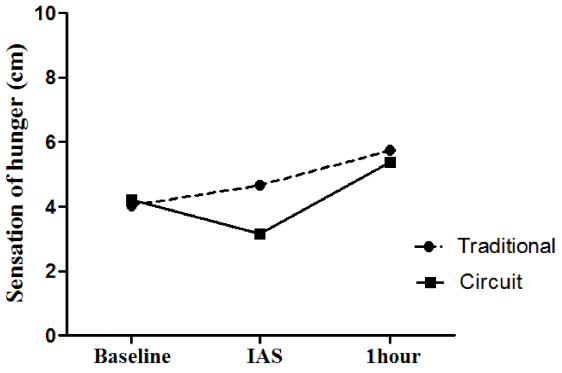


**Figure 1.** Sensation of hunger at baseline, at the time immediately after the session (IAS) and 60 minutes of passive recovery (1hour) after exercise in the circuit and traditional methods.

Source: The authors.

In Figure 2 it is presented the differences from the perspective of food consumption in the baseline period, IAS and 1 hour after the sessions of WT. In food intake it was identified difference only between the moment at the time immediately after the session (TM = 4.7 ± 3.49 cm vs. CWT = 4.6 ± 3.16 cm) and 1 hour after exercise (TM = 6.9 ± 3.20 cm vs. CWT = 5,7 ± 3,13 cm) ($p<0,05$). There was no difference between groups or interaction effect for the score of this variable ($p>0.05$).

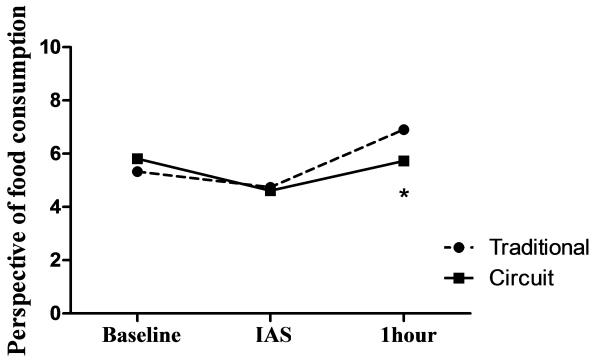


**Figure 2.** Acute effects of short-term and in the perspective of food consumption at baseline, at the time immediately after the session (IAS) and 60 minutes for recovery passive safety (1 hour) after exercise in the circuit and traditional methods.

*a significant difference between the acute point and 1 hour after exercise ($p<0.05$).

Source: The authors,

Table 2 shows the effect size of the differences in the sensation of hunger between the methods (CWT vs TM) and between moments (basal vs IAS, basal vs 1hour), the data showed small magnitudes of change in the sensation of hunger, except for the comparison between the baseline and 1 hour in TM, which presented an effect size moderate in the increase of hunger.

**Table 2.** Effect size of the differences between the methods of training with weights and between moments in the sensation of hunger (n= 10).

| **Methods** | | |
|---|---|---|
| | **CWT *vs* TM** | |
| Basal | -0,06 (small) | |
| IAS | 0,48 (small) | |
| 1 hour | 0,10 (small) | |
| **Moments** | | |
| | **Basal *vs* IAS** | **Basal *vs* 1 hour** |
| CWT | -0,35 (small) | 0,38 (small) |
| TM | 0,28 (small) | 0,75 (moderate) |

CWT - circuit weight training; TM - traditional method; IAS -time immediately after the session; 1hour - 60 minutes of passive recovery.

Source: The authors.

**Table 3.** Effect size of the differences between the methods of training with weights and between moments in the perspective of food consumption (n= 10).

| **Methods** | | |
|---|---|---|
| | **CWT *vs* TM** | |
| Basal | -0,18 (small) | |
| IAS | 0,04 (small) | |
| 1 hour | 0,37 (small) | |
| **Moments** | | |
| | **Basal *vs* IAS** | **Basal *vs* 1 hour** |
| CWT | -0,46 (small) | -0,03 (small) |
| TM | -0,33 (small) | 0,89 (Big) |

CWT - circuit weight training; TM - traditional method; IAS -time immediately after the session; 1hour - 60 minutes of passive recovery.

Source: The authors.

Table 3 shows the *effect size* of the differences of the perspective of food consumption between the methods (CWT vs TM) and between moments (basal vs IAS, basal vs 1hour), the data showed small magnitudes of alteration in food intake, except for the comparison between the baseline and 1 hour in TM, which presented an effect *size* large in the increase of hunger.

## Discussion

The main finding of this study was that there are no differences between the TM and CWT on the sensation of hunger and the prospect of food consumption in basal, IAS and 1 hour of recovery, however the TM has increased the perspective of food consumption 1 hour after the session when compared to IAS. Several studies using both the TM as the CWT demonstrated that acutely the WT inhibits the concentrations of plasma ghrelin levels. Considering that ghrelin acts in the central nervous system stimulating orexigenic neuropeptides that consequently will stimulate the hunger, it was expected the inhibition in the sensation of hunger after the WT[10,15,19,13,32]. As some studies that used the CWT and the TM observed reduction of ghrelin after the WT, it assumes that the same has occurred in the present study, whose protocol is similar to those used in earlier studies[10,13,14,15,33-34,32]. However, despite of this possible reduction, no alteration was observed in the sensation of hunger with the WT. A possible explanation is that the other orexigenic and anorexigenic agents (peptides, nutrients and hormones), in addition to ghrelin, might influence in the suppression of hunger after exercise[35]. Blundell et al.[6] emphasizes that post-exercise anorexia occurs due to a substantial redistribution of the blood flow of the splenic movement toward the muscles, which is well reported in vigorous aerobic exercises (>60% of VO2 max). Thus due to the different characteristics of different types of exercise (aerobic exercise and with weights) it is possible that the intensity of both methods has not been able to generate a sufficient blood redistribution. In addition, studies have reported similar outcomes in both methods for their variables such as muscle damage and the total energy expenditure when standardized protocols CWT and TM[20,36]. Additionally, it is believed that due to the CWT and TM exhibit the same volume and intensity, that was what resulted in not obtaining significant differences between the methods.

Despite of not observing significant differences between the methods and moments, except in acute moment and 1 hour, it is important to note that between the baseline moment

vs. 1 hour in the sensation of hunger and food consumption perspective the effect size indicates a moderate and large magnitude, respectively, in TM. According to Tran[37] we should not take into account only significant differences (yes/no) based on the level of significance of the study, but it is necessary to observe the clinical importance of effect size or vice versa, this way, despite of not having found significant differences between the methods, there is a strong tendency that TM increases the feeling of hunger and perspective of food consumption. Despite of being based on previous studies this behavior does not lead to a compensatory ingestion, since the authors concluded that the food intake after training with weights presents no differences between the groups of WT and control[14-15]. The effect size is an important gauge of the magnitude of the effect of the study, being a standardized measurement that can be reproduced and enable better comparison between studies[29,38].

It is important to highlight that the maintenance of the feeling of hunger has been reported in previous studies. Ballard et al.[14] observed that after a session of WT the TM with a protocol similar to our study which consisted of eight exercises alternated per segment, four series, 70 % of 1RM, with an interval between the series of 2 minutes and between exercises for 3 minutes, there was no change in the sensation of hunger when compared with the baseline moment. In the same study it was also observed that there was a compensatory food ingestion in until approximately two hours after exercise, which was justified by significant attenuation of the concentrations of plasma ghrelin levels after the protocol.

In the study conducted by Laan et al.[13] In that the subjects were submitted to five exercises of WT, performed in three series, 10 to 12 repetitions, with one-minute interval between the series and exercises, it was also not observed suppression of hunger after WT, which was evidenced after completion of aerobic exercise. In contrast, Broom et al.[10] observed effect of WT in the suppression of hunger after 10 exercises with intensity of 80% of 12 RM. Considering that the protocol of this study had higher volume in comparison with the present study and previous studies, it is possible that this may be an intervening factor in the suppression of hunger with the WT, a fact which should be investigated in further studies.

The individual data presented in this study showed great variability in the responses of the sensation of hunger after the completion of the WT. A possible explanation for this concerns the very nature of the variable, which for being subjective not always directly reflects the post-exercise food intake [39].

Even considering the methodological rigor employed, and our findings are consistent with the literature, the present study has some limitations such as the absence of a control group, the measures of blood flow and metabolic markers (glucose, lactate) and hormonal (orexigenic peptides and anorexigenic), which could provide additional subsidies for better elucidate the results reported here.

## Conclusion

The results of this study suggest that both the TM and the CWT do not alter the feeling of hunger and perspective of food consumption acutely, but it is realized that the TM has a greater effectiveness to increase the feeling of hunger as perspective of food consumption. If this result is confirmed by other studies in the long term, such information may contribute to the improvement of the quality of the prescription of WT especially for individuals that aim the weight control.

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