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HIIT TRAINING AND CONTINUOUS TRAINING AND THE DIFFERENCE BETWEEN CALORIC SPENDING AND EPOC

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ABSTRACT

The research focuses on HIIT training and continuous training, seeking to understand caloric expenditure and COPD. HIIT training is the main method for weight loss, so a series of moderate intensity activities are used that can provide an effect on oxygen consumption and recovery after exercise. The objective of this article is how much the HIIT training and the continuous training assists in the improvement and quality of life of the individuals, observing the weight loss practicing the series, respecting the intervals, being aware that it is a long term training. Regarding the methodology, the scientific bases of data were researched as Efedeportes, Scielo, and also theoretical references that approach the theme. Based on these theoretical contents, it was possible to start with the considerations that inform HIIT training and the continuous training in being a main characteristic for the improvement and quality of life as the main ideal, developing weight loss, energy expenditure and consumption of oxygen, and thus, through training with its different intensities, can bring a well-being to individuals, especially for individuals who seek to help with cardiovascular and respiratory diseases, among others, but the main search is the weight loss.

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INTRODUCTION

This research has as main discussion to approach the training HIIT (Interval Training of High Intensity) and in the continuous training as the difference in the EPOC. According to Reichert *et al.* (2007) one of the main reasons for the low adherence to physical exercise programs, justified by the population is the lack of time. From this assumption comes the suggestion of the High Intensity Interval Training (HIIT), which allows the practitioner to perform the training session in a short period of time at high intensity. The high intensity interval training (HIIT) method and the continuous moderate exercise (ECM) have been the subject of studies and are topics of great relevance for researchers and the entire scientific community (TJONNA *et al.,* 2013). High intensity interval training (HIIT) consists of stimuli performed at high, maximum or supramaximal intensity, although there is no consensus about the name of HIIT (VECCHIO *et al.,* 2014).

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There is now a new variation gaining place in the market, the so-called high intensity interval training (HIIT). The use of this method has been requested not only by athletes, but also by people who seek weight control (Dantas, 2014). According to Tremblay *et al.* (1994), this training promotes abdominal fat reduction, weight control and maintenance of muscle mass. The literature suggests that such a method is an efficient strategy for favorable metabolic adaptations, hitherto attributed only to low intensity continuous exercises. The conclusions of several recent studies on HIIT indicate that it is a suitable time-efficient tactic to provide improvement in cardiorespiratory fitness, reducing cardiometabolic risks, improving fat oxidation, leading to a significant weight loss in sedentary populations with obesity and overweight (Alahmadi, 2011; NIE *et al*., 2012; Heydare, 2012; Alahmadi, 2014). High intensity interval training is a much-needed resource in training environments, due to the shorter stimulus time because of its increased intensity, breaking the monotony of traditional training (WILMORE, COSTILL, 2013). However, when HIIT is compared to moderate-intensity aerobic training

in non-athletes trained individuals, the effects seem to equate between groups (Hottenrott, Ludyga and Schulze *et al.,* 2012). According to Almeida *et al.* (2014), aerobic exercises alter innumerable functions of the organism, introducing various metabolic and skeletal muscle performance adaptations, mitochondrial biogenesis and oxidation of energetic substrates including glucose and fats. When used in populations at risk, due to their conditions, more specifically, the deficit in the cardiovascular system, the HIIT protocols undergo adaptations in order to preserve the physical integrity of the individual, seeking to ensure its benefits, maintaining an effective method and, mainly, safe (Rognmo *et al.,* 2012). The intensity, stimulus interval and rest are paramount for the success of the HIIT program, but there is no consensus in the literature regarding intensity, duration and numbers of ideal series and repetitions (Podstawki *et al.*, 2013). In the current context, many individuals who would like to be involved in exercise practices do not have great time availability making it difficult to practice. Continuous low- and moderate-intensity exercises are mentioned and prescribed when the goal is body fat loss, however, these methods have been judged to be of real efficiency (Gentil, 2011). This method of training has been shown to show greater adherence to exercise due to the shorter stimulus time and the reduction of monotony in view of attention to change of intensity (Wilmore, Costill, 2013). According to Brooks (2000), interval training is characterized by the repeated applications of exercises and rest periods, alternately.

Therefore, high-intensity interval exercise can be considered a good strategy to improve health levels, as it optimizes lipid oxidation, promotes beneficial physiological adaptations, in relation to metabolic control and cardiovascular function (Gala *et al.,* 2012). Its main characteristic is the repetition of continuous cycles alternating high and low intensities, with the contribution of the energy systems being dependent on the number and duration of the repetitions and the period of recovery between them. Some HIIT protocols have been used by the population, and have reported favorable cardiovascular, musculoskeletal, and metabolic adaptations (Little *et al*., 2011a; Tjonna *et al*., 2008; Wisloff *et al*., 2007). Their proposal is to improve the anthropometric variables by means of the energetic expenditure obtained, since their intensity does not directly recommend the specific work that can mobilize fat deposits as an energy substrate, contrary to the training of moderate intensity (De Piano *et al*. 2012). The objective of this article was to understand how to apply HIIT in the everyday life of active people as a way of improving health and fitness in a pleasurable and possible way (Balady *et al*., 2006).

Literature Review

HIIT Training: The HIIT consists of a training method, whose work is done with alternation of intensity, sprints are performed in high intensity, with rest period in moderate low intensity (active rest) or even without any physical activities (rest passive), being performed in enclosed environment on motorized treadmills, cycle ergometers or without the use of materials (body HIIT), but can also be performed in other activities known as: running, swimming, rowing, sloping walking (JUNEAU *et al.* TJONNA *et al.,* 2013). One of the methods that has been proposed and gaining space for its efficiency in the loss of total body fat, abdominal fat loss and cardiorespiratory improvement, in a shorter stimulus period than continuous training is the high intensity interval training, HIIT, in the acronym for High Intensity Interval Training (ASTORINO *et al.,* 2013). High-intensity interval training, following the appropriate adaptations and limitations of the individual, is an excellent tool for those involved in body fat reduction programs, mainly with little availability of time (MECKEL *et al.,* 2011). In addition to these benefits, the use of HIIT in obese populations may lead to changes in the inflammatory profile, the reduction of inflammatory cytokines, and the concomitant increase in anti-inflammatory properties, since HIIT is able to promote body weight reduction. reduction of visceral adiposity and improvement of the lipid profile (STECKLING *et al.,* 2015). As a consequence, with the decrease of body fat, there is an increase in the parameters of lean mass and fat free mass, parameters directly linked to the improvement of the lipid parameter evaluated. Therefore, the increase of the basal metabolic rate and linked to the increase of the lean mass, as well as, with the insertion of regular exercise, added to the action of the phototherapy in the muscle (AQUINO JÚNIOR, 2015). According to Paffenbarger *et al.* (1996), the studies clearly show that high-intensity exercises, even if eventually, result in greater cardioprotection and greater impact in reducing mortality. In this way, adding high-intensity exercise, even for a few minutes, once or twice a week, seems to be the most current form of exercise prescription.

Although high-intensity intervals are pre-judged regarding their safety, when implanted in a cardiac rehabilitation protocol, there is strong evidence that there is a contrary association between relative intensity of physical exercise and the risk of developing coronary pathologies (Schonohr *et al.,* 2012). According to Monteiro (2004), physical performance is the result of a complex combination of physiological, biomechanical and psychological factors. HIIT (High Intensity Interval Training) has been methodically applied successfully in the sporting context for almost a century. This form of training is characterized by intermittent periods or repetitions of high intensity (equal to or greater than the speed of maximum steady state of lactate), interspersed by periods of low intensity (active or passive) for recovery (BILLAT, 2001). Interval training methods such as HIIT were developed specifically to meet healthy individuals and aimed at increasing athletes' performance (Astorino *et al*., 2012). Gibala *et al*. (2012), scores HIIT as a high intensity interval training where short, intermittent and intensity series are performed, interspersed with periods of rest or light physical activity.

The relation of HIIT training and continuous training

Based on studies derived from the efficacy of HIIT for the sports environment, HIIT for the sporting environment, in the last decades research has been carried out relating HIIT to specific physiological adaptations and health indicators (Kessler; Sisson; Short, 2012). To answer this problem, Almeida (2018), reports that some aspects of interval training come to the assumption of its effectiveness in improving body composition, reside in the fact of using high intensity workload. The performance of aerobic activities of moderate intensity increases the mobilization of fats at the moment of exercise. However, activities of high intensity mobilize this substrate even further in the post-exercise period, and therefore, the high intensity interval training (HIIT) is which is a very interesting training method due to its reasonably fast results and reduced duration (Alkahtani *et al*., 2013). One of the most common methods, continuous training, is one of the

best known for health maintenance, improving physical conditioning and ensuring an increase in the functional reserve of the individual, characterized by practices without pause and intervals of rest, being performed in mild intensities , due to its high training volume (Pescatello *et al*., 2004). According to Santos *et al*. (2003), both interval training and continuous training have similar effects on aerobic endurance, there being no evidence that can specify the superiority of one system over the other in improving aerobic capacity. In a chronic way, this type of training influences lipid balance, helping to reduce body fat (Richards *et al*., 2010). Affirming, according to Tsekouras *et al*. (2008) reported that there was a greater reduction of subcutaneous fat due to HIIT than a continuous protocol. HIIT is able to produce physiological adaptations similar to those already identified for continuous exercise of moderate intensity, despite the reduced volume of exercise as well as the shorter duration of the session (Gibala; Gillen; Percival, 2014). Both methods can be successful, knowing that cardiopulmonary capacity is composed of aerobic and anaerobic conditioning (BROOKS, 2000).

Another method, not so recent but used today is interval work, which consists of an exercise in which there are pauses / rest intervals between practice, which can be performed passively (inertia) or active (with less activities (Table 1). In the present study, it was observed that the training intensity was higher than the intensity of the training (Pescatel *et al*., 2004). The great differential was to evidence the chronic effect of HIIT to promote blood pressure control, since uncontrolled systemic arterial hypertension (HBP) is responsible for higher expenditures of the health system, considering morbidity and mortality rates and physical impacts such as cardiac ischemic, cerebrovascular accident, besides renal and cardiac insufficiency (CARVALHO *et al*., 2013). According to Fox (1992), this method of training has been widely used to increase the oxygen uptake capacity of the working muscles, since in comparison to the continuous training, it provides a lower degree of fatigue due to the greater energy performance of ATP-CP systems and consequently , lower production of lactic acid. The relationship between time and intensity in training models with continuous and interval exercise. It is evidenced the prevalence of greater cardiovascular overload in continuous training, which may result in greater risks or health problems. In the interval training model, we can see that after an overload of the system. It is also important to note that the interval can also bring favorable results in training, in level of intensity (Pickering *et al*., 2005).

In fact, studies have shown that high intensity interval training (HIIT) training sessions reduce the risk of hypoglycemia during and after exercise compared to continuous exercise (Yardley *et al*. ., 2013). According to Albert *et al*. (2000), there are risks of intercurrences during and after the physical exercise session, in individuals from 40 to 80 years of age, due to a supposed autonomic balance during and after exercise, obviously this factor is attenuated by the systemized training according to the years have elapsed. The training method should be related according to the individual and their level of physical fitness. In this way, the choice between the continuous and interval method, should respect the characteristics of the practitioner, being important to help in weight loss, to insert the exercise and balanced diet, aiming to generate in a negative energy balance (Ferreira *et al*., 2006). They point out that the practice of interval exercises is an alternative to improve health, as well as continuous exercises, however, their studies report that a weekly training volume of two to three times a week, with sessions lasting 20 to 30 minutes daily , are sufficient to cause a positive impact, similar to the training methods with greater volume in their composition, showing to be an excellent response to the lack of time for the practice of physical exercises (BARTLETT *et al*., 2011).

According to Kardel and Kase (1998), HIIT should be avoided during the gestational period, due to the great effort made, since it can cause gestational complications. Studies show that its practice may increase the number of miscarriages and premature births in addition to causing, in the short term, transient fetal bradycardia and, in the long term, fetal weight loss at birth.

Caloric Expenditure

According to Silva and Nunes (2015), the practice of aerobic exercise generates a modest loss of weight when compared to the inclusion of the caloric restriction, being the feeding a decisive factor for a good result when allied to the physical activity. This is attributed to the energy expenditure equation, which corresponds to the union of the basal metabolic rate of energy spent during physical activity practice and the technical effect of food (Francischi *et al*., 2001). Physical exercise, when regular, produces acute and chronic effects on fat metabolism. In addition to direct caloric expenditure during exercise, the metabolism is still increased for a period after the execution (Trombetta, 2003). The literature demonstrates that a few weeks' HIIT program can promote changes in the body mass of subjects with excess body fat, it was observed that the energy expenditure for a HIIT session was shown to be low for people wishing to decrease body fat, according to ACSM (American College of Sports Medicine) (Donnelly *et al*., 2009).

The knowledge of daily habits, both in food intake and in the practice of physical activities, provides a reliable indicator of the person's risk of accumulating excess fat, as a function of the imbalance between intake and caloric expenditure (SINGHAL, 2003). The main criticism of their contribution to weight loss seems to be the low caloric expenditure of a training session. However, studying the energy expenditure of the force activity is not a simple task, since there are numerous possibilities of combinations of exercises, number of sets, recovery interval, number of repetitions, execution speed and load, and individual characteristics can interfere, such as race, gender, age, body composition and level of physical fitness. These variables may hinder the conclusion of several surveys (Meirelles and Gomes, 2004). The energy expenditure associated with physical exercise is considered the most variable component and corresponds to approximately 15% of total energy expenditure in sedentary individuals, while in active individuals it can reach 30% (Meirelles and Gomes, 2004). Analyzing the aspect of energy expenditure during the activity, a meta-analysis is performed, which exacerbates the work of force in the form of a circuit and verifies a variation between 3.0 calories per minute and 8.0 calories per minute of energy consumption in training which had a workload ranging from 27 minutes to 60 minutes (Meirelles and Gomes, 2004). It is extremely important to know the energy expenditure of physical exercise, as well as the metabolic responses triggered by it, to aid in the calculation of the energy needs of an individual, as well as to determine the efficiency of the body during the performance of an exercise Matsuura.

The resting metabolic rate is defined as the energy expenditure necessary to maintain the physiological processes in the post-abortive state, reaching up to 60 to 70% of the total energy expenditure, depending on the level of physical activity (Foureaux, 2006, p.394). To perform the weight loss program within the strength training, one can apply the training method in circuit, alternating the training volume, increasing the duration of the session and activating more the aerobic system, resulting in a greater energetic expenditure during the exercise , but still within the characteristics of the strength exercises (FLECK; KRAEMER, 2006). The daily energy expenditure is composed of three main components: the Basal Metabolic Rate (TMB), the Food Thermal Effect (ETA) and the Thermal Effect of Physical Activity (ETAF). The former accounts for 60 to 75% of daily energy expenditure and is associated with maintenance of most bodily functions. ETA is the cumulative increase in energy expenditure after meals (digestion) and constitutes approximately 10% of daily energy expenditure. The ETAF is the component with the greatest variation in daily energy expenditure and may constitute 15% to 30%. The ETAF includes energy expenditure related to physical work, muscle activity and physical exercise (SCHNEIDER; MEYER, 2007).

The efficiency of interval training lies mainly in the correct choice of recovery intervals, since the work / recovery relationship and their physiological demands determine the energy system to be prioritized by training (Volkov, 2002; Roche, 2004). According to Santos *et al*. (2008) gave more importance to the intensity of the exercise by increasing the energy expenditure during the recovery of the body, totaling a higher caloric expenditure during the 24 hours of the day, facilitating the weight loss, besides being more efficient in the improvement of physical conditioning. Energy intake in the last 40 years has not increased, a time when obesity has grown dramatically. Obtaining the explanation for such an epidemic in the reduction of energy expenditure due to insufficient daily physical activity, clearly explained by the mechanization of many activities of the day (MATSUDO, 2006).

The Caloric Expenditure and the Difference of Copd: The interval training method consists of performing aerobic exercise, intercalating periods of high intensity with periods of low intensity, showing to be efficient to increase VO2maximum and increase in cardiorespiratory capacity (MACHADO, 2010). The energy expenditure resulting from physical activity presents great variability among individuals, representing 15% to 50% of the daily energy expenditure, being influenced by the duration, intensity, specificity, activity, level of conditioning and diet individual (POWERS & HOWLEY, 2000). According to Darling, Linderman and Laubach (2005) evaluated energy expenditure during exercise and also EPOC (Excess Postexercise Oxygen Consumption) during a continuous 30-minute run at 70% VO2maximum, and during an intermittent race, in three times of 10 minutes, at the same intensity, of continuous running, in men in the age group of 18 to 25 years of age. Energy expenditure, both during exercise and in recovery, was higher. The body composition, basal metabolic rate and peak oxygen consumption and muscle strength of overweight or obese adolescents, who do not practice physical training, or who are fit for physical activity (Schneider *et al*., 2005). During physical exercise there is an increase in oxygen consumption that remains high even after its end, which is advantageous we call COPD (Excess Post Exercise Oxygen Consumption) (PORTO; GODOY JUNIOR, 2011). The excess of oxygen consumption after exercise (EPOC) consists of rapid and / or prolonged physiological processes for the return of homeostasis, and its magnitude and duration are related to exercise intensity (FOUREAUX; PINTO; DÂMASO, 2006). The main factors that would lead them to contribute to weight reduction would be the maintenance of the resting metabolic rate, through the maintenance of muscle mass and the increase in exercise post-oxygen consumption (EPOC). After exercise, oxygen consumption remains above resting levels for a certain period of time, denoting greater energy expenditure during this period, resulting in an increase in daily caloric expenditure, but research on the subject is very contradictory (Guedes Junior, 2003). A study on the effect of physical exercise intensity on abdominal visceral fat and body composition, indicate that intense exercise is more efficient to alter the body composition of obese women with Metabolic Syndrome, because it was shown reduction of abdominal subcutaneous fat (- 47 cm2 x - 11 cm2) and abdominal visceral fat (- 24 cm2 - x - 7 cm2) through HIIT (Irving *et al*., 2008). The thermogenic effect of food (ETS) is the increase in basal metabolism caused by food consumption. It is due to the energy expended in the digestion, absorption, transport and utilization of food. It corresponds to about 10% of the energy expenditure and this effect varies according to the energy substrate consumed. In young individuals carbohydrate intake increases energy expenditure by 5 to 10%, lipid intake increases from 0 to 3% and protein increases from 20 to 30% (MATSUURA; MEIRELLES; GOMES, 2006).

One of the consensual aspects of COPD in counter-resistance exercise refers to the acceptance that post-exercise metabolic reactivity results from a combination of several training variables (such as number of sets, exercise intensity, recovery interval between sets and the duration of EPOC, in its fast, slow and ultra-slow components (MATSUURA *et al*., 2006).). The effect of an acute session of resistance exercise on COPD and observed that it is elevated during 48 hours (SCHUENKE *et al*., 2002). In this study, we evaluated the effect of free fatty acids on the amount of free fatty acids in the diet, which is the main source of free fatty acids, allowing a respiratory quotient close to 0.7 (high consumption of free fatty acids) (BORSHEIM *et al*., 2003; ORMSBEE *et al*., 2007). However, COPD values during recovery in supramaximal exercise are significantly higher than those found in submaximal exercise (LAFORGIA *et al*., 1997). The total caloric expenditure is divided into the resting metabolic rate, the thermal effect of the food, the energy spent during the physical exercise and the recovery (MCARDLE; KATCH and KATCH, 2008). According to Silva (2010), this extra oxygen consumption would be used to compensate for the oxygen deficit, this was called in the first studies of oxygen delivery. Subsequently, it became more appropriate to call it excessive oxygen consumption after exercise (EPOC, Excess PostExercise Oxygen Consumption).

According to Porto (2011, page 45), Oxygen consumption remains high because physical effort causes loss of homeostasis, changes in temperature, concentration of ions and substrates. These imbalances require greater efforts of the physiological systems (cardiovascular, respiratory, endocrine and others), causing them to consume oxygen. Thus, physical exercise occupies a prominent place in the control of body weight, being able to reach 30% of the daily energy expenditure and, consequently, control of overweight and

obesity, since the physical exercise has been shown to have a positive effect on the reduction of and adipose tissue (SABIA; SANTOS; RIBEIRO, 2004). The influence of different recovery intervals between series on exercise EPOC versus resistance by finding a COPD magnitude of 59 calories in 30 minutes of analysis (multiple series of 5 series of 5RM, recovery interval of 30 seconds in only one exercise in 4, 4 minutes duration (RATAMESS *et al*., 2007). The energy demand during the recovery period after physical exercise is known as excessive oxygen consumption, or even excess postexercise oxygen consumption (EPOC), since after the end of physical exercise and oxygen consumption does not return to rest values immediately (MCARDLE, KATCH and KATCH, 2008).

The temporal evolution of oxygen consumption after exhaustive exercise decreases exponentially. This means that the rate at which oxygen is consumed is not constant throughout the recovery period (FOSS, 2000). COPD is found after aerobic and also anaerobic activities. There are indications that resistance exercise produces higher COPD.

There are two factors that have been attributed to this fact:

The first factor refers to the hormonal responses that can alter metabolism, specifically catecholamines, cortisol and GH. The second refers to tissue damage accompanied by the stimulus for tissue hypertrophy, since protein synthesis is decreased during exercise itself, but after exercise there is a consistent phenomenon, in which protein turnover appears to be stimulated. In addition, the process of protein synthesis requires high energy demand (6 ATP per mole of peptide formed). This mechanism may also contribute to a long stimulation of energy expenditure after exercise (Foureaux, 2006, p.395). The duration of COPD can be prolonged when resistance exercise is followed by aerobic exercise, although the caloric expenditure, coming exclusively from this factor, has been low (LIRA *et al*., 2007). In addition to the energy expenditure promoted by the exercise itself and energy intake, excessive post-exercise oxygen consumption (COPD) is also an essential factor in the determination of energy balance, since it is an indicator of post-exercise energy expenditure. It is well established that, at the end of the exercise, oxygen consumption does not return to resting values immediately (EPOC) (FOUREAUX; KELERSON; DÂMASO, 2006). In relation to the reduction of fat percentage, interval training is more efficient due to the effects of EPOC (Post-exercise Oxygen Excess Consumption), which is higher after interval exercise than after continuous-rhythm exercises. As COPD is associated with a high metabolic rate, a longer period of COPD will result in an increase in energy expenditure, which should lead to weight loss. At the moment, when exercise becomes more intense, less fat is metabolized by each spent calorie, but a higher total fat and calories are generally used. In addition, after high-intensity exercise, fat metabolism may be even higher if it is used to restore low glycogen stores (Silva, 2010).

Conclusion

Interval training and continuous training has been presenting the most appropriate training for beginners, both men and women, in an exercise program, to achieve body weight loss, in a way that the progressive method, so that individuals can achieve exercising, without much physical exertion, or energy, in order to obtain all the necessary results with the exercises. However, for a calorie expenditure to be made, a combination that is essential is reconciling healthy eating habits and rest nights so that individuals can make the series more easily. The HIIT training, with its intensity from mild to moderate, can help in the treatment of some cardiovascular and respiratory diseases, due to the possibility of carrying out a greater total volume of exercise than continuous training, with recovery intervals contributing to less fatigue muscular. In this way, the individuals achieve a calmer recovery, being able to be practiced by individuals with diverse health restrictions. The higher energetic demands that are caused by EPOC in the post-training period, especially when the interval between the series decreases, or when the interval or continuous training is performed. The important role of physical exercise is in increasing energy expenditure, it is essential, but also, changes in food intake control systems, such as hunger, appetite and caloric intake, so that it is possible to control the energy balance with regular physical activity. The influence of body weight will always study so that you can apply the best training, the sequence of series, the intervals, and thus, achieve greater energy expenditure. The training modes present energy expenditures recommended for long-term weight loss, but with improvements in training and maintenance of the individuals physical fitness. Taking into consideration, women show a lower energy expenditure compared to men, probably due to a lower absolute muscle mass. Individuals trained at the same intensity show a lower energy expenditure than less active or sedentary individuals exercised at the same intensity. Therefore, we can not affirm that only strength training is effective in the weight loss process, but that this is a potent adjuster and modifier of the resting metabolic rate of COPD, since it can be done from light to high intensity, being able to favor much in the slimming, and aiding in some aspects of health. HIIT training and the continuation and analysis of EPOC and nutrient intake during recovery show an improvement in individuals' quality of life, bodybuilding, or even resistance exercise as an important tool for weight loss and maintenance body.

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