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EFEITOS DO INTERVALO DE RECUPERAÇÃO SOBRE A FORÇA DOS EXTENSORES DE TRONCO EM ADULTOS

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Tese apresentada ao Programa de Pós-Graduação em Educação Física da Universidade de Brasília como requisito para obtenção do grau de Doutor em Educação Física.

ORIENTADOR: Professor Doutor Wagner Rodrigues Martins.

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‘‘*Veni, Vidi, Vici*’’
General Júlio César

RESUMO EXPANDIDO

EFEITOS DO INTERVALO DE RECUPERAÇÃO SOBRE A FORÇA DOS EXTENSORES DE TRONCO EM ADULTOS

Sacha Clael Rodrigues Rêgo

Introdução: Existem na literatura diversos protocolos de extensão de tronco em pessoas saudáveis e com condições clínicas adversas, entretanto nenhum deles tem a justificativa do intervalo de recuperação, este é colocado como um valor arbitrário pelos autores. Assim, faz-se necessário verificar o tempo de intervalo de recuperação mais eficiente para o movimento de extensão de tronco no dinamômetro isocinético, a fim de deixar mais assertivo os protocolos do ponto de vista do intervalo de recuperação. Dessa forma, o objetivo do presente estudo é analisar diferentes intervalos de recuperação entre séries com baixas repetições em adultos. **Materiais e Métodos**: Trata-se de um estudo comparativo, com 65 homens entre 18 e 55 anos, os indivíduos fizeram uma visita ao laboratório, no qual realizaram os seguintes procedimentos: 1) medição do tamanho do tronco, das vértebras C7 até S1; 2) aquecimento geral na esteira, entre 60% a 70% da frequência cardíaca máxima; 3) aquecimento e familiarização específica no dinamômetro isocinético com o movimento de extensão de tronco, 1 série de 20 repetições a 300º/s; 4) e o teste de força de extensão de tronco no dinamômetro isocinético, 2 séries de 4 repetições a 60º/s e mais 2 séries de 4 repetições a 120º/s. O tempo do intervalo de recuperação entre as séries da mesma velocidade foi definida de forma aleatória por sorteio simples, entre 30s, 60s ou 90s de descanso, e utilizou-se o pico de torque como principal medida. Para verificar a diferença entre grupos foi aplicada uma ANOVA 2x3 [2 velocidades (60º/s e 120º/s) x 3 intervalos de recuperação (30s x 60s x 90s)] com o *post hoc* de Bonferroni. **Resultados**: Não houve diferenças no pico de torque ($p > 0,05$) e nas demais variáveis do isocinético ($p > 0,05$) entre os diferentes intervalos de recuperação em ambas as velocidades. **Conclusão**: O intervalo de recuperação mais eficiente para o movimento de extensão de tronco com baixas repetições é o de 30s, tendo em vista que a variação deles não afeta a produção de força.

Palavras-chave: isocinético, *seated compressed*, pico de torque, lombar.

Introdução

O aumento de força resulta em melhora no desempenho esportivo, como maior potência, habilidades esportivas, altura do salto, aceleração, corrida, agilidade e redução do risco de lesões [1]. Além dos benefícios esportivos, o aumento da força está associado à redução do risco de doenças, além de diminuir o risco de mortalidade [1]. A força também melhora as atividades da vida diárias, como carregar compras e subir escadas, tornando a pessoa mais independente [2]. No entanto, para que a produção de força atinja valores mais altos, é necessário um descanso adequado [3].

O descanso entre séries permite a recuperação dos níveis de ATP-CP, estes são cruciais para exercícios de alta intensidade [2]. Sem descanso adequado, os níveis de ATP podem não ser totalmente restaurados, resultando em uma queda de desempenho [1]. Além disso, períodos adequados de descanso entre séries são importantes para prevenir a fadiga muscular excessiva, que pode comprometer a capacidade de produzir força e aumentar o risco de lesões [2]. A fadiga muscular é aumentada por intervalos curtos de descanso, que não permitem a remoção adequada de metabólitos [1].

A produção de força é um processo altamente complexo que envolve a integração de múltiplos sistemas corporais, como o sistema nervoso central e o muscular [4]. A ativação das unidades motoras, essenciais para a geração de força muscular, depende da coordenação precisa entre o córtex motor primário, o cerebelo e os núcleos da base [4]. O descanso adequado entre momentos de produção de força é crucial para a recuperação de neurotransmissores e a remoção de metabólitos acumulados, que podem afetar a capacidade do sistema nervoso central de gerar estímulos de alta frequência de forma sustentada [1,4]. Assim, intervalos de recuperação bem estruturados são fundamentais para otimizar o desempenho, e prevenir a fadiga neural e o risco de lesões [2,4].

A avaliação isocinética é considerada o padrão-ouro para a avaliação da força em diferentes populações e articulações [5]. Devido às várias aplicações do dinamômetro isocinético, existem diferentes protocolos para cada condição clínica, o que pode impactar negativamente a avaliação dos pacientes e a reprodutibilidade dos dados [2]. Um dos problemas identificados é o intervalo de recuperação entre séries para avaliar os extensores do tronco. Revisam recente cita diversos protocolos, mas nenhum deles fornece justificativa ou explicação para o intervalo de recuperação escolhido entre as séries [6,7]. Assim, o objetivo do presente estudo é analisar o intervalo de recuperação na extensão do tronco entre séries com baixas repetições em adultos.

Materiais e Métodos

A amostra foi composta por 65 adultos, que realizaram extensão de tronco no dinamômetro isocinético nas velocidades de 60º/s e 120º/s, duas séries e quatro repetições em cada velocidade. Os intervalos de recuperação, 30s, 60s ou 90s, foram sorteados previamente. As variáveis coletadas foram, pico de torque (absoluto e relativo), trabalho total (absoluto e relativo), potência média e tempo de aceleração. Nesse contexto, os voluntários fizeram uma visita ao laboratório para a coleta dos dados. Para caracterizar a amostra e as variáveis quantitativas, foram realizadas estatísticas descritivas com média e desvio padrão, enquanto frequências simples e relativas foram utilizadas para as variáveis qualitativas. Além disso, para verificar a normalidade e homogeneidade da distribuição dos dados, foram aplicados os testes de Kolmogorov–Smirnov e Levene, respectivamente. Também foi aplicada uma ANOVA 2x3 [2 velocidades (60º/s e 120º/s) x 3 intervalos de recuperação (30s x 60s x 90s)] para verificar a diferença entre os grupos, com *post hoc* de Bonferroni.

Resultados

Não houve diferença significativa entre as variáveis do isocinético nos intervalos de recuperação nas velocidades 60º/s e 120º/s. Ademais, o maior valor de trabalho total foi atingindo na repetição de número três em todas as séries.

Discussão

O estudo teve como objetivo analisar se há diferença entre diferentes intervalos de recuperação na extensão do tronco em adultos. A maioria dos participantes foi classificada como intermediária em treinamento de força, e é sabido que indivíduos treinados podem ter uma capacidade de recuperação melhorada em um curto período, no qual um intervalo de 30s pode ser suficiente para uma recuperação quase completa, comparável a intervalos mais longos [2].

Alguns grupos musculares, como a musculatura lombar, que é predominantemente composta por fibras do tipo I [8], têm uma capacidade adaptativa que permite uma recuperação mais rápida, o que minimiza a diferença na produção de força independentemente do intervalo de descanso [1]. Essas fibras, conhecidas por sua alta resistência à fadiga e eficiência no uso de oxigênio, recuperam-se mais rapidamente do que as fibras do tipo II, facilitando a remoção de subprodutos metabólicos [1]. Isso pode explicar a falta de diferença nas variáveis de trabalho total, pico de torque e potência média entre os diferentes intervalos de recuperação. Além disso, durante exercícios de força máxima, a recuperação de ATP-CP pode atingir um platô após 30s a 60s [1], o que justifica o fato de que intervalos adicionais não aumentaram a produção de força.

Conclusão

Não há diferença entre 30s, 60s ou 90s de intervalo de recuperação, em baixas repetições, na extensão de tronco no isocinético nas velocidades 60º/s e 120º/s em adultos.

Referências

1. McArdle WD, Katch FI, Katch VL. *Exercise physiology: nutrition, energy, and human performance*. Lippincott Williams & Wilkins; 2010.
2. Fleck SJ, Kraemer W. *Designing resistance training programs, 4E*. Human Kinetics; 2014.
3. Willardson JM. A brief review: factors affecting the length of the rest interval between resistance exercise sets. *The Journal of Strength & Conditioning Research*. 2006;20(4):978-984.
4. Purves D, Augustine GJ, Fitzpatrick D, Hall WC, LaMantia A-S, White LE. *Neuroscience*. Sinauer Associates, Inc.; 2012.
5. Brown LE. *Isokinetics in human performance*. Human Kinetics; 2000.
6. Reyes-Ferrada W, Chirosa-Rios L, Martinez-Garcia D, Rodríguez-Perea Á, Jerez-Mayorga D. Reliability of trunk strength measurements with an isokinetic dynamometer in non-specific low back pain patients: A systematic review. *J Back Musculoskelet Rehabil*. 2022;35(5):937-948. doi:10.3233/bmr-210261
7. Reyes-Ferrada W, Chirosa-Rios L, Rodriguez-Perea A, Jerez-Mayorga D, Chirosa-Rios I. Isokinetic Trunk Strength in Acute Low Back Pain Patients Compared to Healthy Subjects: A Systematic Review. *Int J Environ Res Public Health*. Mar 4 2021;18(5)doi:10.3390/ijerph18052576
8. Padwal J, Berry DB, Hubbard JC, Zlomislic V, Allen RT, Garfin SR, Ward SR, Shahidi B. Regional differences between superficial and deep lumbar multifidus in

patients with chronic lumbar spine pathology. *BMC Musculoskelet Disord*. 2020 Nov 20;21(1):764. doi: 10.1186/s12891-020-03791-4.

SUMMARY

FIGURES LIST

TABLE LIST

1. INTRODUCTION

Increases in strength result in improved performance in sports, such as increased power, sports skills, jumping height, acceleration, running, agility, and reduced injury risk [1]. In addition to the sports benefits, increased strength is associated with a reduced risk of diseases such as cancer [2] and cardiovascular diseases [3], as well as a reduced mortality risk [4]. Furthermore, increased strength improves activities of daily living, such as carrying groceries, climbing stairs, and carrying objects, making the person more independent [5]. However, for force production to reach higher values, adequate rest is necessary [5].

Rest between sets is crucial to allow recovery of ATP-CP levels, which are essential for high-intensity exercise [6]. Without adequate rest, ATP levels may not be fully restored, resulting in decreased performance [6]. Furthermore, adequate rest periods between sets are important to prevent excessive muscle fatigue, which can compromise the ability to produce force and increase the injury risk [7]. Muscle fatigue is exacerbated by short rest intervals, which do not allow for adequate metabolites removal such as lactic acid and hydrogen ions [7]. Also, removing metabolites is important to the central nervous system to maintain contraction, because the metabolites accumulation can generate neural fatigue [8].

Force production is a highly complex process that involves the multiple body systems integration and their combinations, such as the central nervous system, muscular system, and motor units [9]. During high-intensity movements, the primary motor cortex in the brain is responsible for sending electrical impulses along the spinal cord to the skeletal muscles, where muscle contraction occurs [9]. In addition, proprioception and coordination, mediated by the cerebellum, are essential for precisely adjusting force with the help of base nuclei [9]. Adequate rest between force production moments is crucial to allow the neurotransmitters recovery and the accumulated metabolites removal, which can affect the central nervous system ability to generate high-frequency stimuli in a sustained manner [6]. Therefore, well-structured recovery intervals are essential not only to optimize performance but also to prevent neural fatigue and minimize the injury risk associated with central nervous system overload [8]. Then, assessing recovery intervals and their respective force productions is important for clinical and sports practice [10].

Among the different ways of assessing strength, there is isokinetic [5]. The isokinetic is an instrument considered the gold standard for assessing strength in different populations [5] and joints [11]. Due to the various isokinetic applications, there are divergent protocols for each clinical condition [12], which can negatively affect patient assessment and data reproducibility, and one of these problems is the recovery interval between sets to assess trunk extensors. Recent review in healthy individuals [13] cite several protocols in their studies, however, none of them provide a justification or explanation for the recovery interval chosen between sets.

The trunk extension movement analysis is essential to understanding the muscle activation and neuromotor control involved in spinal stabilization and mobility, which are crucial in rehabilitation and strength training [14]. This movement, which mainly recruits the paravertebral muscles and the erector spinal muscles, is essential for maintaining posture and preventing injuries and is particularly relevant in individuals who perform intense physical activities or require post-injury recovery [14]. In addition, the study of recovery intervals between sets is vital to optimize performance and avoid excessive muscle fatigue, allowing muscle fibers to adequately recover their ATP levels and remove accumulated metabolites, which can directly influence exercise efficiency and safety [6]. It is hypothesized that there is no difference in force production between different recovery intervals at few repetitions. Because the trunk extension primary motor muscles are predominantly type I, and these are more resistant to fatigue [15].

2. AIMS

GENERAL AIM

To analyze the recovery interval between sets in adults on trunk extension.

SPECIFIC AIM

1. To check different recovery intervals at different speeds, 60º/s and 120º/s, on adults;
2. To investigate changes in isokinetic measurements at different recovery intervals and different speeds.

3. LITERATURE REVIEW

3.1. STRENGTH NEUROPHYSIOLOGY

The sending of signals to the central nervous system begins with sensory stimuli detection by receptors located in various body parts, such as the skin, muscles, joints, and tendons [9]. These receptors detect changes in the internal and external environment, such as pressure, temperature, pain, and muscle tension [9]. The sensory information is converted into electrical signals called action potentials, which travel along afferent nerve fibers to the spinal cord [9]. From the spinal cord, these signals are transmitted to various regions of the central nervous system, especially the somatosensory cortex, where they are processed to produce an appropriate response [9]. This processing allows the body to integrate sensory information and initiate the motor responses necessary for force production and coordinated movement [9].

When sensory signals reach the central nervous system, they are first processed in the spinal cord and then forwarded to the brain [9]. In the brain, sensory information is interpreted primarily by the somatosensory cortex, where conscious perceptions of this information are formed [9]. The motor cortex then uses this processed data to plan and initiate appropriate movements, depending on the task. Communication between the sensory and motor areas of the brain occurs through complex neural networks, which allow the integration of different types of sensory information for a coordinated response [9]. This communication is critical for the precision and efficiency of movements, allowing the modulation of muscle strength according to the demands of the physical activity [9].

The neurological response to stimuli processed by the central nervous system involves the activation of motor units, which are formed by a motor neuron and the muscle fibers it innervates [9]. From the motor cortex, electrical signals are sent via motor neurons and travel down the spinal cord to neuromuscular synapses, where neurotransmitters such as acetylcholine are released to stimulate muscle contraction [9]. The frequency and firing pattern of motor neurons determines the amount of force generated, as well as the coordination and timing of muscle contractions [9]. This process is regulated by sensory feedback mechanisms, where information about body position and the state of muscle contraction is continually sent back to the central nervous system for fine-tuning in real time [9].

Adequate rest between efforts is crucial for the recovery of the neuromuscular system and for maintaining the capacity to generate force [10]. During rest periods, neurotransmitter levels are restored, cellular energy stores, ATP-CP, are replenished, and anaerobic metabolic products, such as lactate, are removed [10]. This allows the central nervous system to recover its ability to send high-frequency signals and maintain efficient motor control [9]. Without adequate rest, neural fatigue can set in, resulting in a decrease in the capacity to recruit motor units, which compromises the strength, precision, and efficiency of movements [10]. Thus, recovery intervals are essential not only to optimize performance but also to protect the central nervous system from overloads that can lead to injury [10].

3.2. AEROBIC AND ANAEROBIC TRAINING

Aerobic and anaerobic exercises are the opposite in the pathways recruitment for energy supply. At the movement biodynamics, aerobic movements are cyclical and recruit the oxidative pathway, while anaerobic movements are acyclical and recruit the glycolytic pathway and ATP-CP [6].

In high-intensity exercise that can be performed for longer periods, 10 to 60 seconds before exhaustion, anaerobic glycolysis of stored glucose and muscle glycogen is responsible for much of the energy required for power production. The longer the exercise period in the 10 to 60-second range, the greater the proportion obtained from anaerobic glycolysis, as evidenced by the increasing amounts of lactic acid found in the exercising muscle and subsequently in the blood. Recovery and return to resting ATP and CP concentrations, as well as removing lactic acid, are accomplished through the aerobic metabolism of carbohydrates and fats [6].

As exercise intensity is reduced and the exercise period prolonged, aerobic metabolism takes over the responsibility for energy production. In this case, it occurs by default, as the smaller waves of neural excitation in the spinal cord become increasingly less capable of recruiting type II motor units. Aerobic metabolism of carbohydrates and fats in the mitochondria provides the energy for the resynthesis of ATP and CP, and exercise can be continued. When exercise intensity is reduced to marathon pace (approximately 75% to 85% of VO2max), all energy production depends on the aerobic metabolism of the involved muscle cells [6].

Strength training is an anaerobic exercise performed at high intensities with a limited number of movements. The primary adaptation after a few weeks of strength training is an increase in the size of primarily type II fibers. On the other hand, running training is a type of aerobic exercise performed at low intensity and predominantly involves recruiting type I fibers. Possible increases in the size of type I muscle fibers will not improve aerobic performance, whereas increases in the oxidative metabolic capacities of these fibers and the availability of oxygen to type I fibers will enhance performance.

The oxidative metabolism of type I muscle fibers is enhanced by an increase in the concentration of oxidative enzymes, mitochondrial size and number, and myoglobin content. The oxygen supply is improved through an increase in the capillarization of type I muscle fibers, an increase in stroke volume and cardiac output, and an increase in the blood's oxygen-carrying capacity [16]. The spinal extensor muscle groups, such as the erector spinal, predominantly comprise type I muscle fibers, also known as slow-twitch fibers [17]. These fibers are highly resistant to fatigue and are adapted to sustain prolonged, low-intensity activities, such as maintaining posture and stabilizing spine control [17]. Due to their high aerobic capacity and high mitochondrial density, type I fibers are ideal for performing postural functions and resisting fatigue during low-intensity, everyday activities [17]. This muscle profile is essential for ongoing spinal stabilization and preventing injury during prolonged, repetitive activities [17].

3.3. ISOKINETIC

Measuring muscle strength is a fundamental aspect of both scientific research and clinical practice, as it provides objective data on the functional capacity of muscles and the overall state of the neuromuscular system [18]. Strength can be measured in several ways, such as maximal strength (isometric strength) and dynamic strength (isotonic or isokinetic strength) [18]. Maximal strength generally reflects the muscle's ability to generate the greatest possible amount of force against a fixed resistance, while dynamic strength measures the muscle's ability to generate force throughout a movement [18]. Measuring muscle strength is crucial for monitoring progress in rehabilitation programs, prescribing exercises, and assessing athletic performance [18]. In addition, strength measurement can identify muscle weaknesses, imbalances, and the risk of injury, allowing appropriate preventive interventions [18].

Several types of equipment are used to measure muscle strength, each suited to different assessments [5]. Among the most common are dynamometers, which can be manual, isometric, or isokinetic [5]. Isokinetic dynamometers, for example, are widely used in research and clinical settings to measure muscle strength at different angular velocities and allow for detailed analysis of muscle performance during controlled movements [5]. Another measurement method includes force platforms, which assess ground reaction force and are especially useful in lower limb assessments [5]. The one-repetition maximum test is another traditional technique to assess maximum strength in specific movements, usually in resistance exercises such as the bench press and squat [5]. Each method has its advantages and disadvantages, but the choice depends on the specific context of the assessment and the objectives of the test [5].

Recovery intervals play a crucial role in accurate muscle strength measurements, as they ensure that the neuromuscular system has recovered adequately before the next measurement [8]. In general, recovery intervals range from 1 to 3 minutes between sets or attempts of strength measurements [8]. Studies suggest that shorter intervals, such as 1 minute, may be sufficient for partial recovery, but to ensure near-complete recovery, especially in maximal strength tests, intervals of 3 minutes or longer are recommended [8,19]. These intervals allow ATP-CP levels to be restored, as well as ensure that the accumulation of metabolites that may interfere with muscle contraction is dissipated [8]. It is important to consider that the duration of the recovery interval may vary depending on the intensity of the previous exercise and the muscle group involved [10].

The scientific literature offers a variety of recommendations for specific recovery intervals when measuring trunk strength, which includes muscles such as the abdominals, paraspinal muscles, and other stabilizing muscles [5]. In general, recovery intervals of 2 to 3 minutes between sets of tests are often suggested to ensure adequate recovery of these muscles, which play a key role in stability and posture [20]. For isokinetic trunk strength tests, some studies recommend rest intervals of up to 4 minutes, especially when measuring maximal strength in high-intensity exercise [20]. These longer rest intervals are recommended to ensure that fatigue does not interfere with subsequent measurements and that the muscles are in optimal condition to generate maximal force again [20].

4. MATERIALS AND METHODS

STUDY DESIGN

This is a comparative study with one session, and the recovery interval time was randomly defined. The anamnesis and anthropometric variables were done before the warm-up. The subjects went to the laboratory for only one day, the lab was at room temperature. All data was collected at the Ceilândia College of the University of Brasília. The volunteers must have not performed physical exercise for at least 72 hours before data collection.

SAMPLE

Sixty-five volunteers with different levels of strength training were recruited from the Federal District and surrounding region using the intentional sampling technique. Recruitment was carried out through a public call. Militaries, elderlies, and women were excluded because they were more resistant to pain [21], were not the target audience for the study, and were due to hormonal fluctuations, respectively. The following parameters were used to classify subjects according to their level of strength training: uninterrupted training time, detraining time, and previous training experience [22].

The sample size was calculated considering: 1) 2x3 repeated measures ANOVA (intra x between groups); 2) two speeds (60º/s and 120º/s); 3) three recovery intervals (30s x 60s x 90s); 4) 0.20 average effect size; 5) type I error of 5%; 6) type II error of 20%; 7) 80% the test statistical power [23]. As there are no previous studies, with a design similar to the proposed, the effect size was estimated conservatively. With the mentioned parameters, the G*Power software (version 3.1.9.6) calculated a total sample of 64 individuals.

INCLUSION CRITERIA

1. Civilians from Distrito Federal and surrounding areas;
2. Adults;
3. People who practice physical exercise;
4. Men;
5. Individuals between 18 and 55 years old;
6. Are physically fit and willing to complete the training sessions.

EXCLUSION CRITERIA

1. Signs of infections or inflammation in the spine, lower and upper extremities in the last 3 months;
2. Post-operative period of chest and abdomen less than 6 months;
3. Spinal trauma or surgery;
4. Fibromyalgia;

5. Rheumatological or myopathic diseases;
6. Uncontrolled cardiovascular disease;
7. Neurological disease;
8. People who have undergone physiotherapy treatment for the spine or who have undergone it in the last 3 months;
9. People who are away from work for medical reasons.

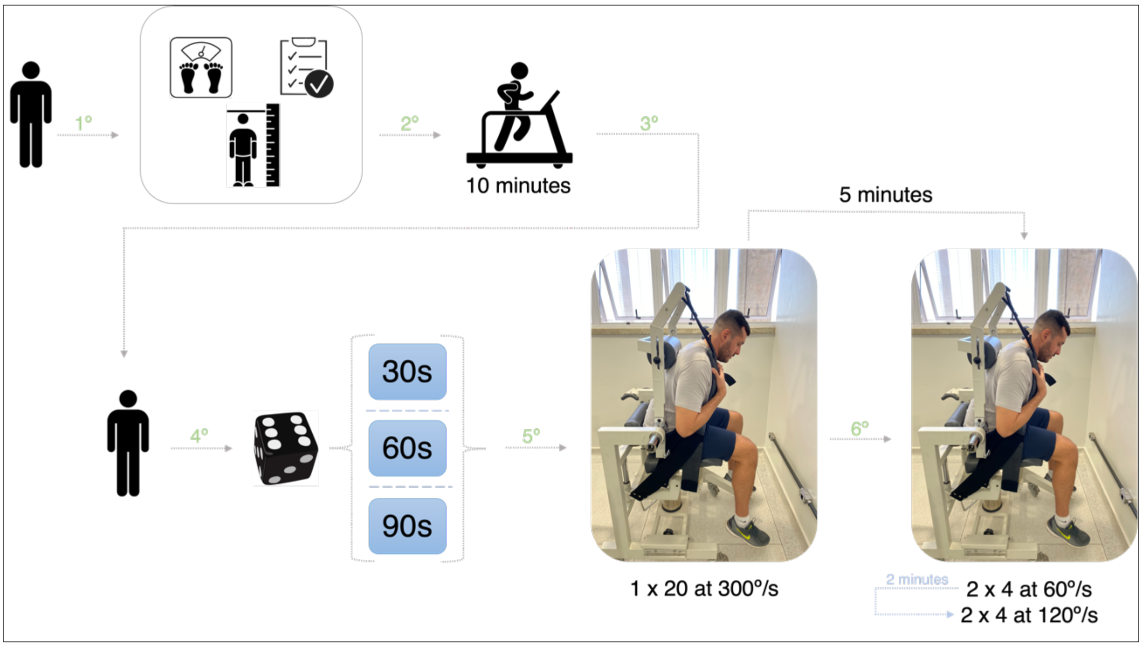
ETHICAL ASPECTS (A Appendix)

Each participant previously received an informed consent form, stating the benefits and risks of the research, by Google Forms, to be signed by the guidelines and regulatory standards for research involving humans, and resolution number 196/96 of the National Health Council. This study was approved by the ethics committee under number 59896822.0.0000.0030, registered in the Brazilian Clinical Trials Registry under number RBR-4mm5xd3, and registered with the World Health Organization under number U1111-1284-4717.

ASSESSMENT PROCEDURES AND INSTRUMENTS

Upon arriving at the laboratory, the trunk size was measured, and then the volunteer was directed to the global warm-up. After the global warm-up, the recovery interval was randomized. Furthermore, familiarization and specific warm-up were performed at the isokinetic (Figure 1). All exercise sessions were supervised by professionals and students of Physical Education or Physiotherapy.

Figure 1. Procedures Overview.



Source: The author.

ANAMNESE

The volunteers answered the anamnesis questions to obtain personal data and general clinical conditions (B Appendix). In addition, the physical training level of the individuals was calculated [22].

ANTHROPOMETRIC MEASUREMENTS

To assess body mass, the subject must be barefoot and standing with feet together and facing forward, shoulders relaxed and upper limbs along the body, rigorously positioned [6]. Then, it was measured using an electronic/digital scale with a resolution of 100 grams (Filizola brand, model Personal Line 200, Filizola Ltda., Brazil). To measure height, the subject was requested to take a maximum breath in, followed by apnea, and then the reading was done on a stadiometer [6] (Country Technology INC brand, model Gays Mills, WI, USA), with a resolution of one centimeter.

Finally, the trunk length was measured using the interval between C7 to S1 [24], it was performed using a flexible measuring tape. The participant is positioned laid, with their feet shoulder-width apart and arms relaxed at their sides [25]. The measurement is taken from the spinous process of the C7 vertebra down to the S1 vertebra, following the natural spine curvature. The evaluator ensures the tape remains in contact with the skin without compressing soft tissues [25].

WARM UP AND FAMILIARIZATION

Global warming started with a 10-minute walk on the treadmill at 60% to 70% of the maximum heart rate, and the Tanaka formula was used to estimate the maximum heart rate [26]. The treadmill's palmar heart rate monitor was used to monitor the heart rate. Specific warm-up and familiarization occurred in the isokinetic exercise; volunteers sat in the seated compressed position and performed submaximal trunk extension movements, with one series of 20 repetitions at 300º/s. After this, a 5-minute recovery interval was used to rest for strength exercises [6].

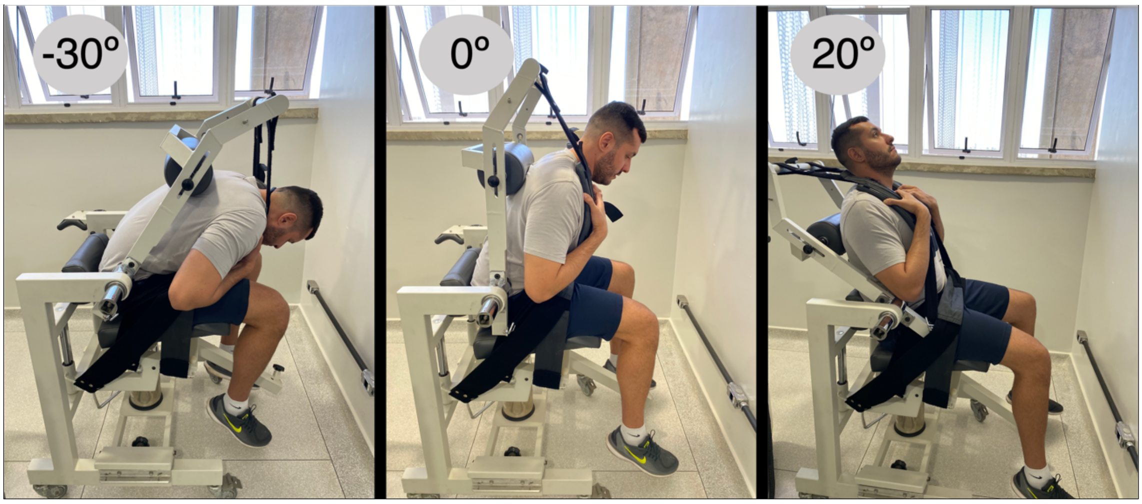
ISOKINETIC

The isokinetic variables were measured using an isokinetic dynamometer (Biodex System 3, Biodex Multi-Joint System model, Biodex System Inc. Software version 4.5, Shirley, NY). Before starting each day of assessment on the isokinetic dynamometer, the equipment calibration procedures were performed according to the rules available in the manufacturer's manual. The protocol consisted of two sets of four repetitions at 60º/s, after which the participants rested for two minutes and performed two more sets of four repetitions at 120º/s, the protocol was adapted from a previous study [12]. The recovery intervals between sets were randomly selected, and verbal encouragement was provided throughout the exercise.

Assessing maximal muscle strength with just one repetition can be risky [5]. The four-repetition test offers a safer way to measure strength, reducing the injury risk, since it does not require the individual to lift their absolute maximum load just once [5]. Also, four repetitions represent a relatively high load, which allows a good estimate of the individual's maximum strength [5]. The weight that can be lifted in four repetitions is generally very close to maximum strength but with a greater margin of safety [5]. Furthermore, the four-repetition test allows the muscle strength assessment without causing the muscle fatigue high level that testing with more repetitions could cause, so less fatigue means more accurate and consistent results [5].

The volunteers performed the test in the seated compressed position, with the hip flexed at 90º about the back of the chair and without support from the lower limbs. The volunteers performed a muscular action with a range of motion of 50º, starting from -30º of trunk flexion to 20º of trunk hyperextension (Figure 2) [27]. Also, peak torque (absolute and relative), total work (absolute and relative), average power, and acceleration time were collected.

Figure 2. Isokinetic Positions.



Source: The author.

RANDOMIZED RECOVERY INTERVAL

The selection of different recovery intervals — 30, 60, and 90 seconds — was guided by their distinct neuromuscular and metabolic implications on strength performance and recovery [10]. Shorter rest intervals (30s) primarily challenge the body's ability to recover from metabolic byproducts, such as lactate, emphasizing muscular endurance and aerobic recovery pathways [28]. In contrast, moderate (60s) and longer (90s) rest intervals allow for more substantial phosphocreatine resynthesis, which is critical for maximal force production in repeated high-intensity efforts [28].

The 90s rest period approaches optimal recovery for phosphagen energy system restoration, allowing for near-full muscular force recovery between sets [28]. By utilizing these three intervals, it becomes possible to assess how varying levels of fatigue and energy system recovery affect maximal strength performance, providing insights into the interaction between metabolic recovery and neuromuscular fatigue [29].

5. STATISTICAL TREATMENT

To characterize the sample, descriptive statistics were performed with mean and standard deviation for quantitative variables, while simple and relative frequencies were used for qualitative variables [23]. Furthermore, to verify the normality and homogeneity of data distribution, the Kolmogorov–Smirnov and Levene tests were applied, respectively [23]. Also, to verify the difference between groups, a 2x3 ANOVA [2 velocities (60º/s and 120º/s) x 3 recovery intervals (30s x 60s x 90s)] was applied, with Bonferroni post hoc [23]. The Statistical Package for the Social Sciences software version 29.0 for iOS was used for data analysis, and the significance level adopted was $p \leq 0.05$.

6. RESULTS

The characterization data of 65 individuals who performed the tests are described in Table 1.

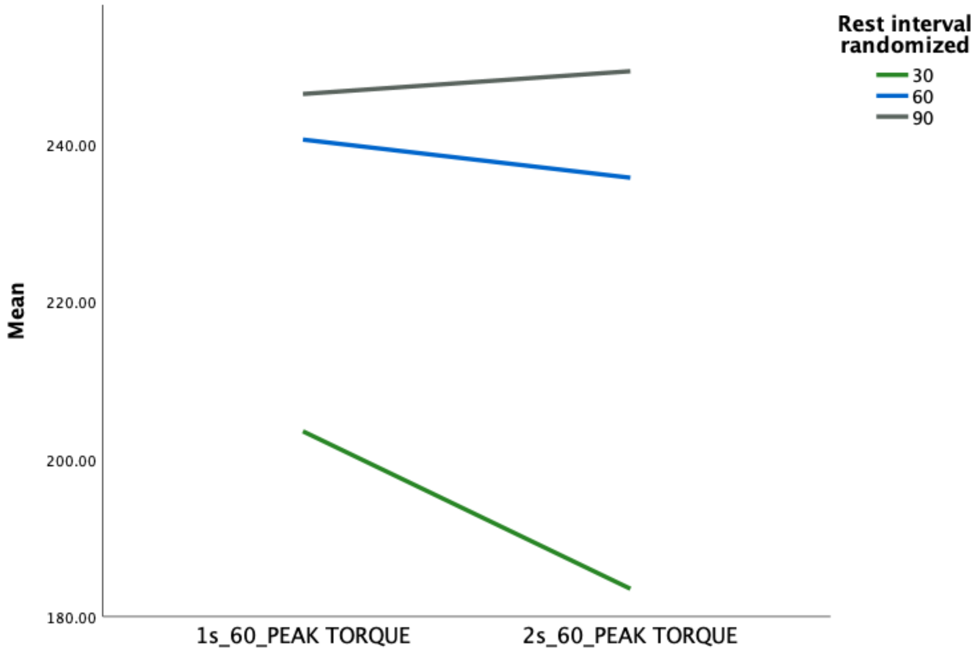
Table 1. Sample Characterization.

	30s (n = 20)	**60s** (n = 23)	**90s** (n = 22)	***p* value**
	Mean ± SD	Mean ± SD	Mean ± SD	-
Age (years)	23.75 ±4.24	26.22 ± 6.20	28.41 ± 8.05	0.07
Weight (Kg)	69.31 ± 16.77	82.08 ± 10.29	80.84 ± 12.27	0.46
Height (cm)	178.35 ± 7.10	177.00 ± 5.05	178.00 ± 6.64	0.76
Trunk size (cm)	49.35 ± 3.32	50.43 ± 3.52	49.95 ± 2.62	0.54
Training Level (*f*)				
Beginner	5 (25%)	2 (8.70%)	5 (22.73%)	$p > 0.05$
Intermediate	7 (35%)	12 (52.17%)	12 (54.54%)	$p > 0.05$
Advanced	8 (40%)	8 (34.78%)	5 (22.73%)	$p > 0.05$
Highly advanced	0 (0%)	1 (4.35%)	0 (0%)	$p > 0.05$

Kg: kilograms; cm: centimeters; SD: standard deviation; *f*: frequency. Numbers in parentheses at training level refer to relative frequency.

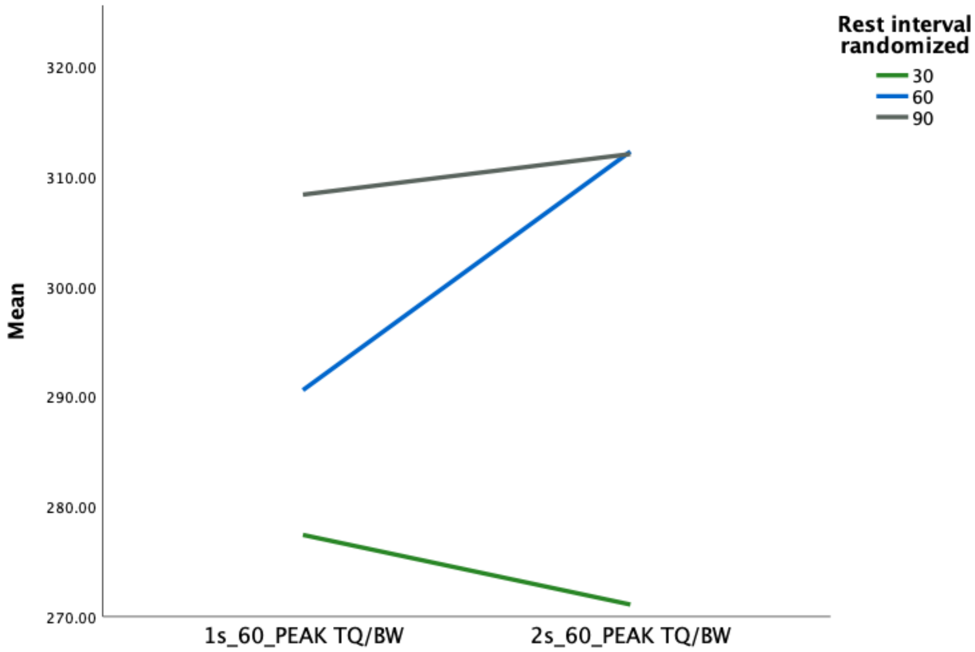
There is no difference between rest intervals on 60º/s and 120º/s at isokinetic variables (Figures 3 to 16). The max work repetition was the number three.

Figure 3. Peak Torque at 60º/s.



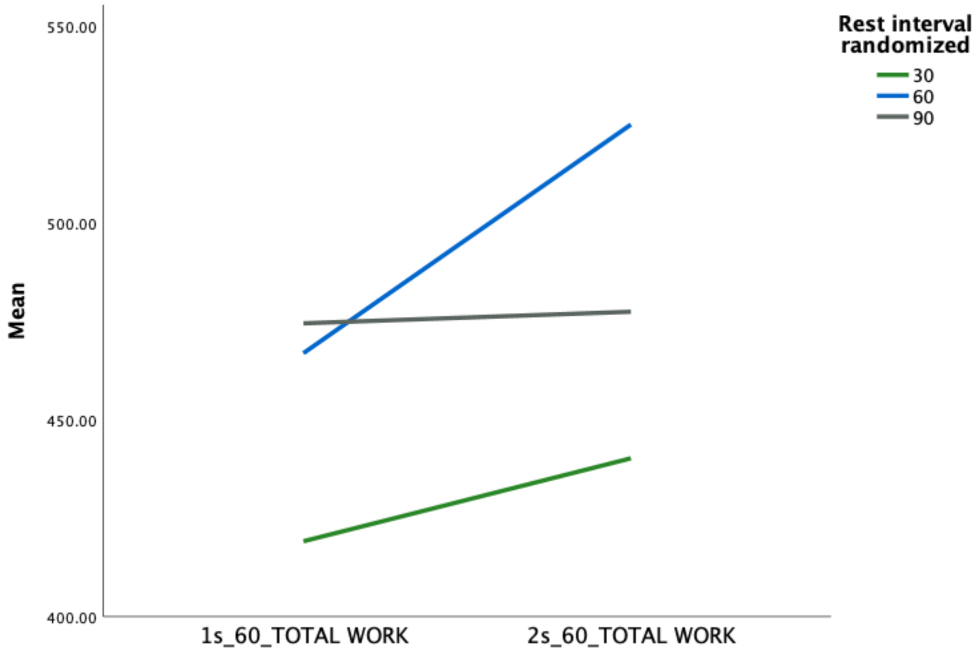
1s: first set; 2s: second set; 60: 60º/s. Mean is in Newton meter.

Figure 4. Peak Torque Adjusted by Weight at 60º/s.



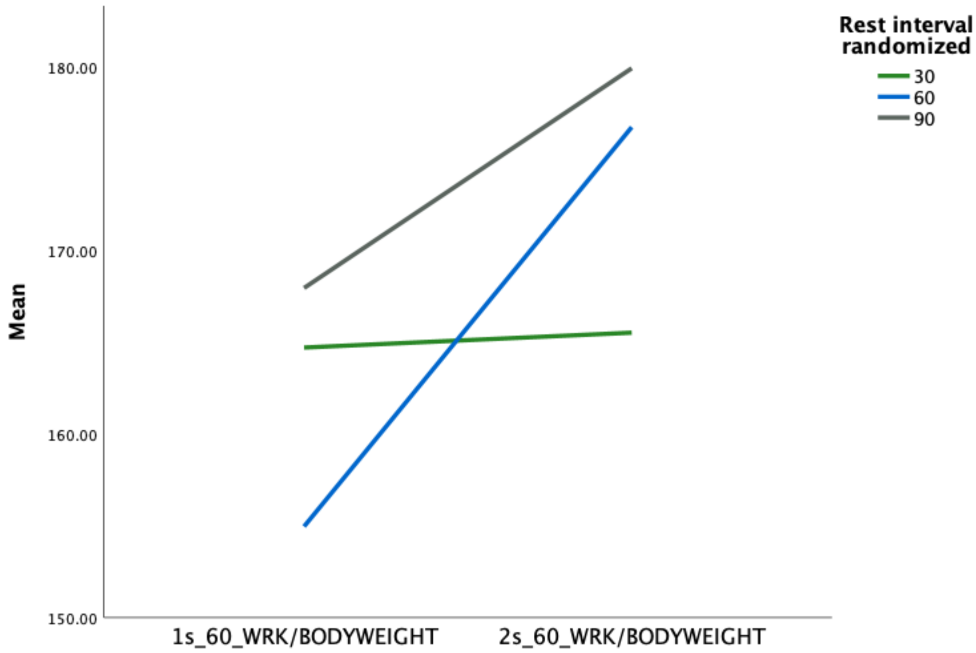
1s: first set; 2s: second set; 60: 60º/s; Peak TQ/BW: peak torque adjusted by weight. Mean is in Newton meter.

Figure 5. Total Work at 60º/s.



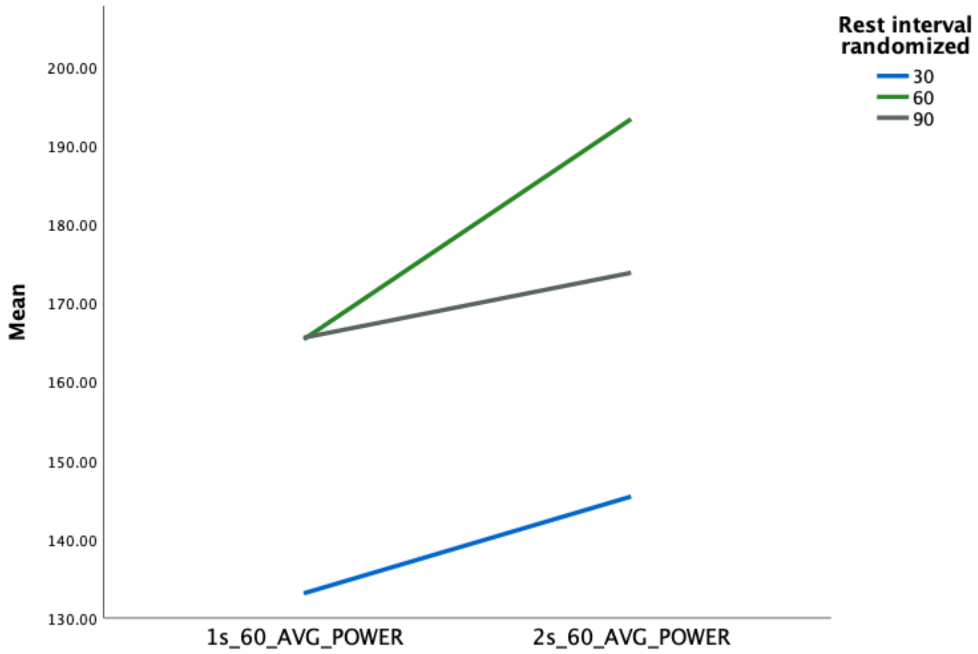
1s: first set; 2s: second set; 60: 60º/s. Mean is in Newton meter.

Figure 6. Total Work Adjusted by Weight at 60º/s.



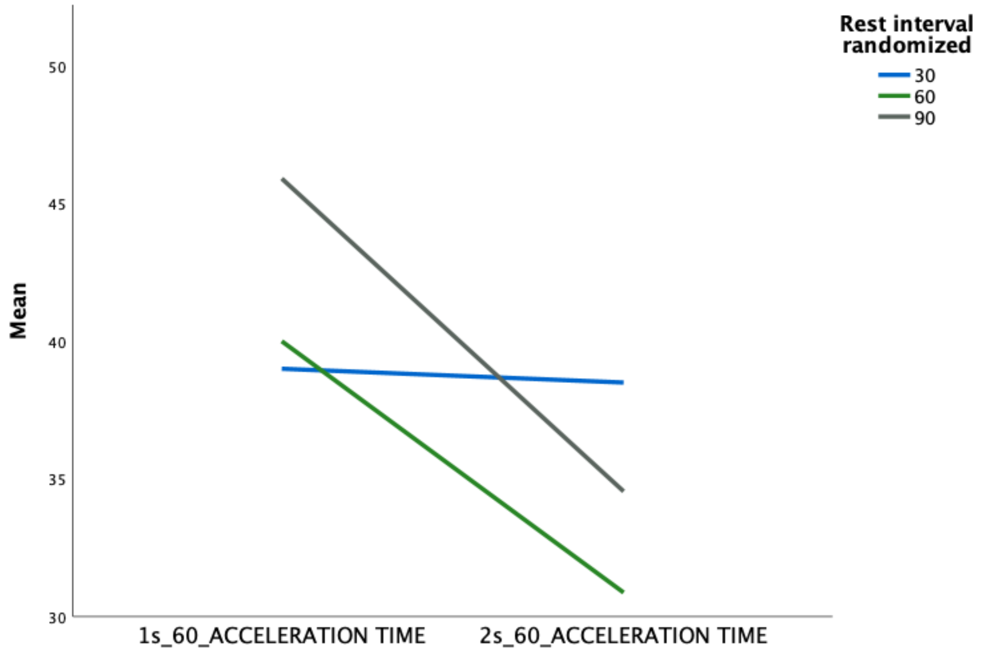
1s: first set; 2s: second set; 60: 60º/s; WRK/BODYWEIGHT: total work adjusted by weight. Mean is in Newton meter.

Figure 7. Average Power at 60º/s.



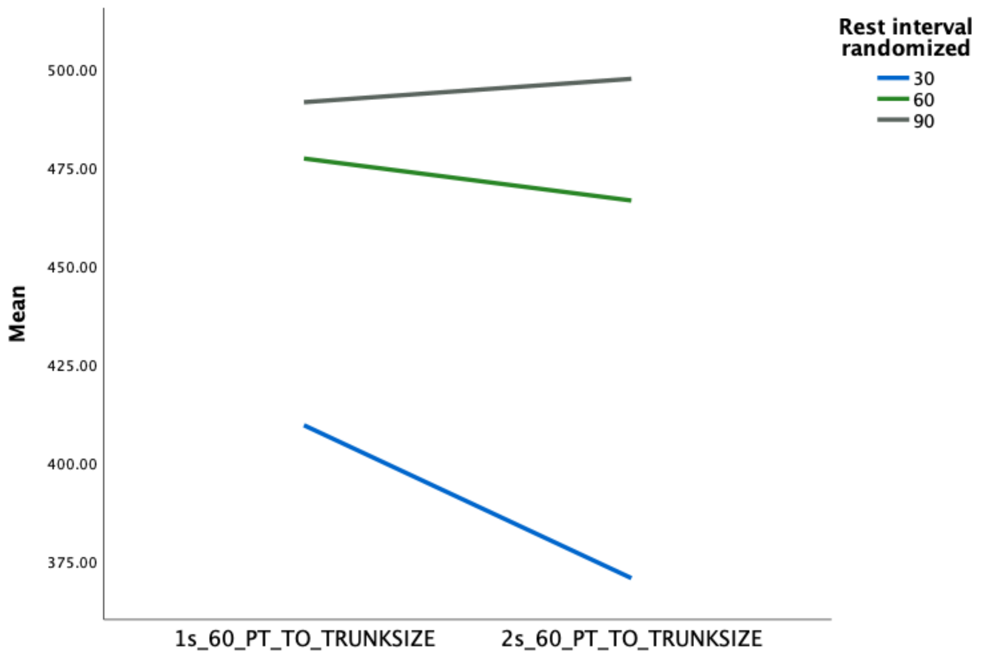
1s: first set; 2s: second set; 60: 60º/s; AVG_POWER: average power. Mean is in Watts.

Figure 8. Acceleration Time at 60º/s.



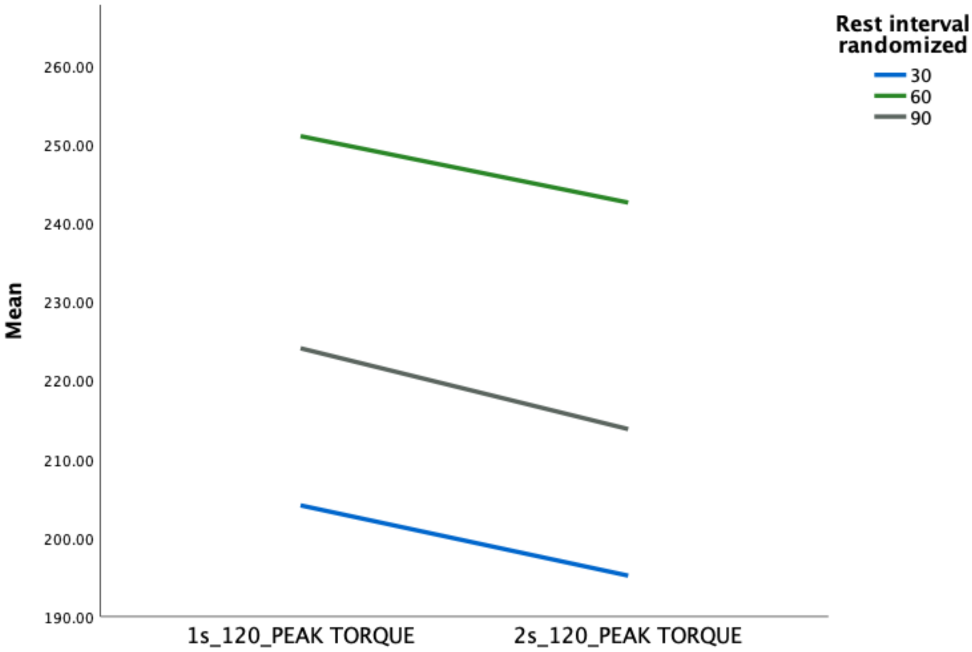
1s: first set; 2s: second set; 60: 60º/s. Mean is in millisecond.

Figure 9. Peak Torque Adjusted by Trunk Size at 60º/s.



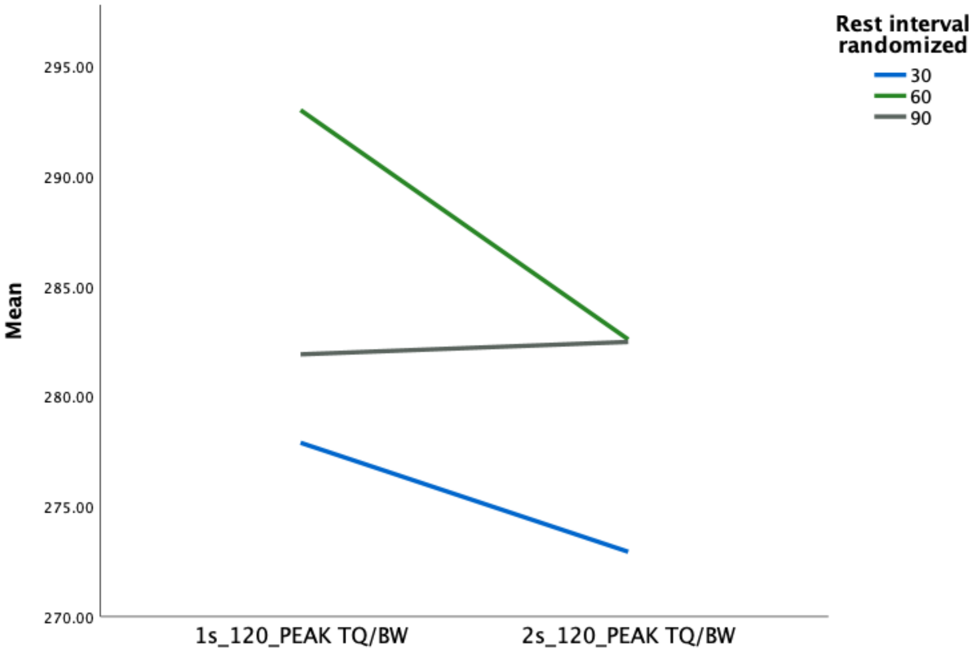
1s: first set; 2s: second set; 60: 60º/s; PT_TO_TRUNKSIZE: peak torque adjusted by trunk size. Mean is in Newton meter.

Figure 10. Peak Torque at 120º/s



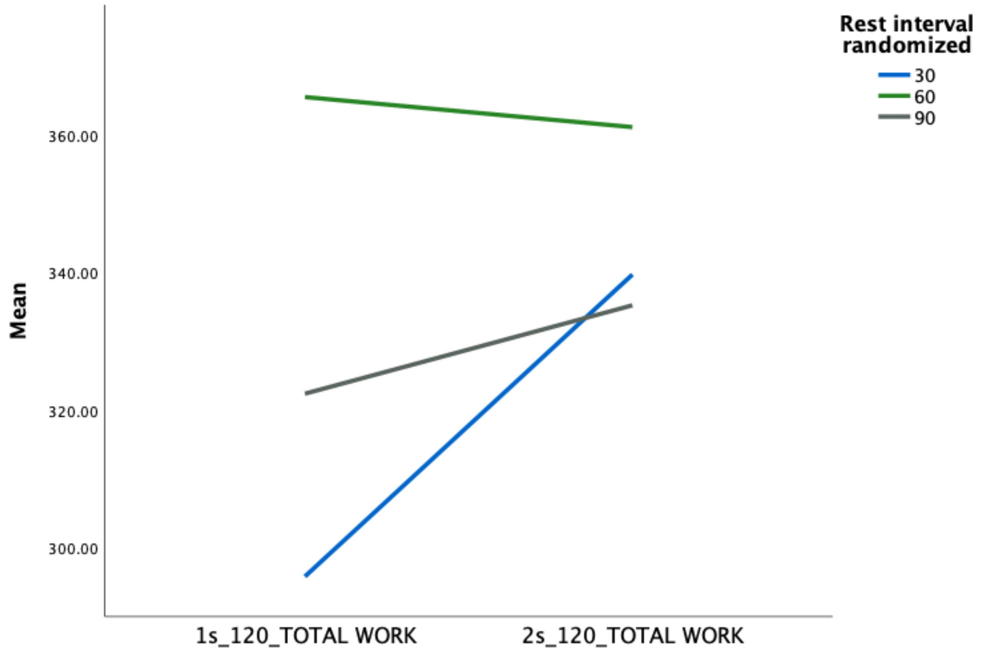
1s: first set; 2s: second set; 120: 120º/s. Mean is in Newton meter.

Figure 11. Peak Torque Adjusted by Weight at 120º/s.



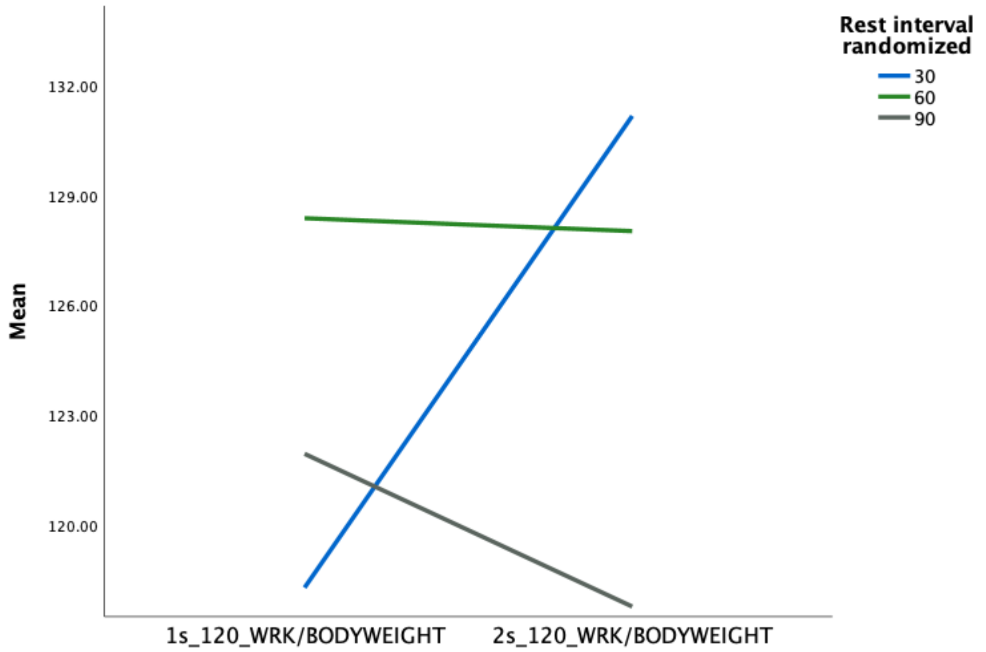
1s: first set; 2s: second set; 120: 120º/s; PEAK TQ/BW: peak torque adjusted by weight. Mean is in Newton meter.

Figure 12. Total Work at 120º/s.



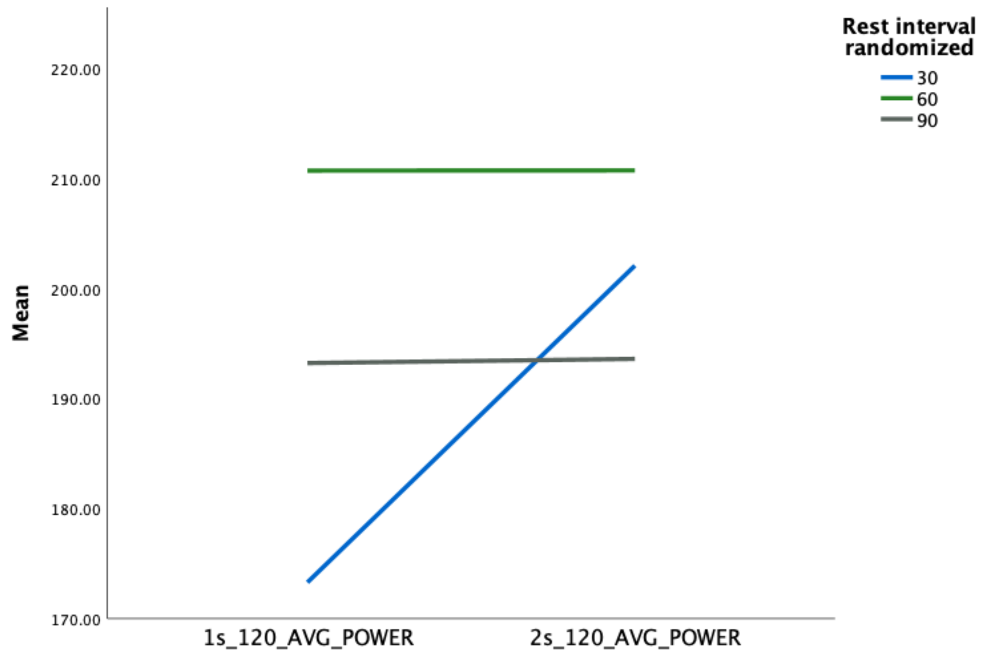
1s: first set; 2s: second set; 120: 120º/s. Mean is in Newton meter.

Figure 13. Total Work Adjusted by Weight at 120º/s.



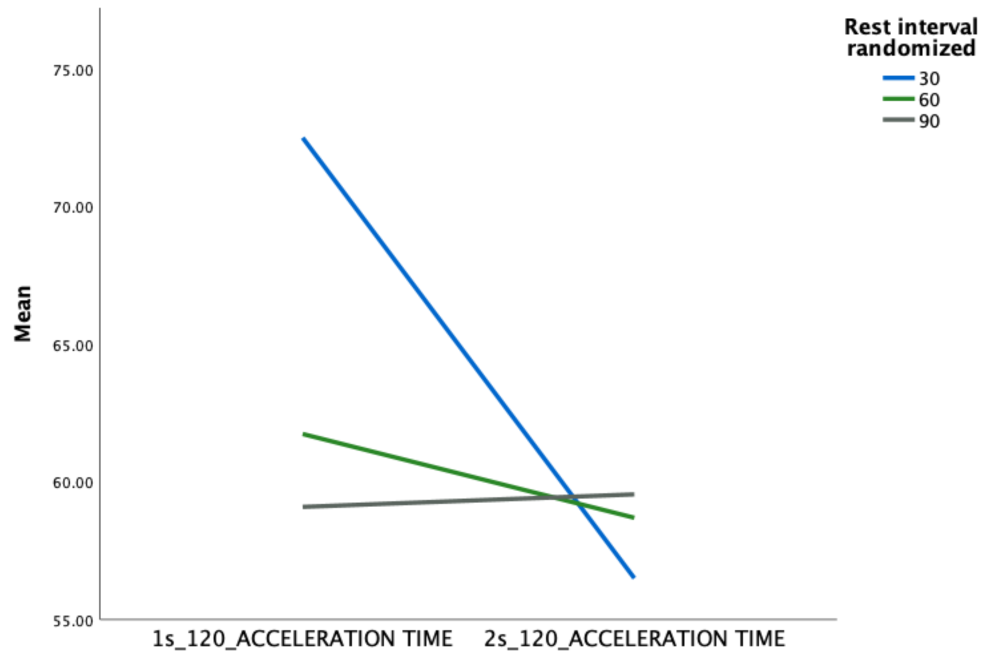
1s: first set; 2s: second set; 120: 120º/s; WRK/BODYWEIGHT: total work adjusted by weight. Mean is in Newton meter.

Figure 14. Average Power at 120º/s.



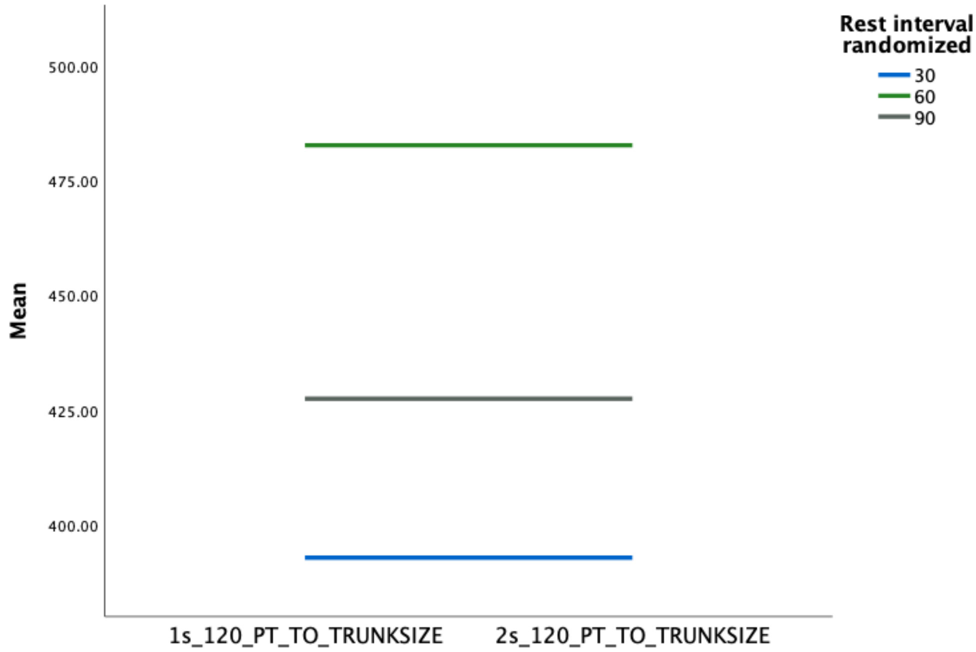
1s: first set; 2s: second set; 120: 120º/s; AVG_POWER: average power. Mean is in Watts.

Figure 15. Acceleration Time at 120º/s.



1s: first set; 2s: second set; 120: 120º/s. Mean is in millisecond.

Figure 16. Peak Torque Adjusted by Trunk Size at 120º/s.



1s: first set; 2s: second set; 120: 120º/s; PT_TO_TRUNKSIZE: peak torque adjusted by trunk size. Mean is in Newton meter.

7. DISCUSSION

The present study aimed to analyze if there is a difference between different recovery intervals on sets at four repetitions in adults on trunk extension. The study shows that there is no difference between the randomized recovery intervals (30s, 60s and 90s) at the determined velocities (60º/s and 120º/s).

The sample majority is classified as intermediate on strength training, it is known that trained individuals may have an improved recovery capacity in a short period, in which a 30s recovery interval may be sufficient for almost complete recovery, comparable to longer recovery intervals, depending on the exercise and muscle group [5]. In this case, force production after the 30s may be similar to production after 60s or 90s, which did not influence the results of absolute and relative peaks torque.

In some exercises, the recovery of ATP levels and the removal of metabolites may be sufficiently rapid, even with short rest intervals, which allows the muscle to reach peak torque at a similar time regardless of the recovery interval [19]. Furthermore, some individuals may be able to rapidly recruit enough muscle fibers to reach peak torque at the same time despite the length of the recovery interval [30]. Such situations may explain the no difference in time to peak torque and acceleration time.

Some muscle groups or fiber types may have an adaptive capacity that allows for faster recovery, which minimizes the difference in force production regardless of the rest interval, as is the case of the lumbar musculature, which is predominantly type I fibers, also known as slow-twitch fibers or endurance fibers [6]. These fibers are highly resistant to fatigue and are especially suited to postural support activities, an essential function of the lumbar muscles [15]. Type I muscle fibers recover faster than type II fibers, which are fast-twitch fibers because type I fibers have a greater oxidative capacity and are more efficient in using oxygen, which facilitates the removal of metabolic byproducts and accelerates recovery [31]. This situation may explain the no difference in the variables of total work, absolute and relative, and average power.

During maximal strength exercises, the main energy pathway is ATP-CP, also the recovery of these phosphates can reach a plateau after some time, between 30s and 60s, and once this recovery is maximized, additional intervals may not improve force production [6]. This situation may explain why the greatest total work was in the third repetition of the sets. This finding also shows that the individuals performed the test until exhaustion, as they were unable to produce any more force in the last repetition [32]. Furthermore, the primary muscles involved in trunk extension are essential for maintaining posture and are constantly under stress, which explains the reduced need for long recovery periods [33].

The present study has some limitations. First, the sample heterogeneity, some volunteers were beginners in strength training. Second, the study was conducted only with men. Third, the volunteers could not perform maximal strength, because the sets were with four repetitions. Therefore, it is suggested that future studies should include homogeneous samples about the level of strength training, women, other populations, or clinical conditions, and assess one repetition.

For practical application in scientific research that uses few repetitions in the series, the 30-second recovery interval can be used to improve efficiency. Furthermore, in clinical, there may be a variation in the recovery interval within the same series to provide greater comfort to the subject without losing focus on the rehabilitation. Finally, depending on the training type and the desired goal in strength training within the same series, it is possible to use different recovery intervals. All these practices are aimed at the intervals studied in this work, as well as for the trunk extension movement.

8. CONCLUSION

There is no difference between 30s, 60s or 90s of rest interval, with few repetitions, on trunk extension at isokinetic on 60º/s and 120º/s velocities in adults.

9. REFERENCES

1. Suchomel TJ, Nimphius S, Stone MH. The Importance of Muscular Strength in Athletic Performance. *Sports Med*. Oct 2016;46(10):1419-49. doi:10.1007/s40279-016-0486-0
2. Parra-Soto S, Pell JP, Celis-Morales C, Ho FK. Absolute and relative grip strength as predictors of cancer: prospective cohort study of 445 552 participants in UK Biobank. *J Cachexia Sarcopenia Muscle*. Feb 2022;13(1):325-332. doi:10.1002/jcsm.12863
3. Tikkanen E, Gustafsson S, Ingelsson E. Associations of Fitness, Physical Activity, Strength, and Genetic Risk With Cardiovascular Disease: Longitudinal Analyses in the UK Biobank Study. *Circulation*. Jun 12 2018;137(24):2583-2591. doi:10.1161/CIRCULATIONAHA.117.032432
4. Underland LJ, Schnatz PF, Wild RA, et al. The impact of weight change and measures of physical functioning on mortality. *J Am Geriatr Soc*. Apr 2022;70(4):1228-1235. doi:10.1111/jgs.17626
5. Fleck SJ, Kraemer W. *Designing resistance training programs, 4E*. Human Kinetics; 2014.
6. McArdle WD, Katch FI, Katch VL. *Exercise physiology: nutrition, energy, and human performance*. Lippincott Williams & Wilkins; 2010.
7. Weir JP, Wagner LL, Housh TJ. The effect of rest interval length on repeated maximal bench presses. *The Journal of strength & conditioning research*. 1994;8(1):58-60.
8. Gandevia SC. Spinal and supraspinal factors in human muscle fatigue. *Physiol Rev*. Oct 2001;81(4):1725-89. doi:10.1152/physrev.2001.81.4.1725
9. Purves D, Augustine GJ, Fitzpatrick D, Hall WC, LaMantia A-S, White LE. *Neuroscience*. Sinauer Associates, Inc.; 2012.

10. Willardson JM. A brief review: factors affecting the length of the rest interval between resistance exercise sets. *The Journal of Strength & Conditioning Research*. 2006;20(4):978-984.

11. F Caruso J, Brown L, Tufano J. *The reproducibility of isokinetic dynamometry data*. vol 20. 2012:239-253.

12. Bottaro M, Russo AF, de Oliveira RJ. The effects of rest interval on quadriceps torque during an isokinetic testing protocol in elderly. *J Sports Sci Med*. Sep 1 2005;4(3):285-90.

13. Estrazulas JA, Estrazulas JA, de Jesus K, de Jesus K, da Silva RA, Libardoni Dos Santos JO. Evaluation isometric and isokinetic of trunk flexor and extensor muscles with isokinetic dynamometer: A systematic review. *Phys Ther Sport*. Sep 2020;45:93-102. doi:10.1016/j.ptsp.2020.06.008

14. McGill S. Low back disorders: evidence-based prevention and rehabilitation. Human Kinetics; 2015.

15. Padwal J, Berry DB, Hubbard JC, et al. Regional differences between superficial and deep lumbar multifidus in patients with chronic lumbar spine pathology. *BMC Musculoskelet Disord*. Nov 20 2020;21(1):764. doi:10.1186/s12891-020-03791-4

16. Powers SK, Howley ET. Exercise physiology: Theory and application to fitness and performance. McGraw-Hill New York, NY; 2007.

17. Lexell J, Downham D, Sjöström M. Distribution of different fibre types in human skeletal muscles. *Journal of the neurological sciences*. 1983;61(3):301-314.

18. Knudson DV, Knudson D. *Fundamentals of biomechanics*. vol 183. Springer; 2007.

19. Fitts RH. Cellular mechanisms of muscle fatigue. *Physiol Rev*. Jan 1994;74(1):49-94. doi:10.1152/physrev.1994.74.1.49

20. Brown LE. *Isokinetics in human performance*. Human Kinetics; 2000.

21. Morgan III CA, Doran A, Steffian G, Hazlett G, Southwick SM. Stress-induced deficits in working memory and visuo-constructive abilities in special operations soldiers. *Biological psychiatry*. 2006;60(7):722-729.

22. Santos Junior ERT, de Salles BF, Dias I, Ribeiro AS, Simão R, Willardson JM. Classification and Determination Model of Resistance Training Status. *Strength & Conditioning Journal*. 2021;43(5):77-86. doi:10.1519/ssc.0000000000000627

23. Field A. Discovering statistics using IBM SPSS statistics. Sage publications limited; 2024.

24. Frostell A, Hakim R, Thelin EP, Mattsson P, Svensson M. A Review of the Segmental Diameter of the Healthy Human Spinal Cord. *Front Neurol*. 2016;7:238. doi:10.3389/fneur.2016.00238

25. Norton K, Olds T. Anthropometrica: a textbook of body measurement for sports and health courses. UNSW press; 1996.

26. Tanaka H, Monahan KD, Seals DR. Age-predicted maximal heart rate revisited. *J Am Coll Cardiol*. Jan 2001;37(1):153-6. doi:10.1016/s0735-1097(00)01054-8

27. Juan-Recio C, Lopez-Plaza D, Barbado Murillo D, Garcia-Vaquero MP, Vera-Garcia FJ. Reliability assessment and correlation analysis of 3 protocols to measure trunk muscle strength and endurance. *J Sports Sci*. Feb 2018;36(4):357-364. doi:10.1080/02640414.2017.1307439

28. Bogdanis GC, Nevill ME, Boobis LH, Lakomy HK, Nevill AM. Recovery of power output and muscle metabolites following 30 s of maximal sprint cycling in man. *J Physiol*. Jan 15 1995;482 (Pt 2)(Pt 2):467-80. doi:10.1113/jphysiol.1995.sp020533

29. Girard O, Mendez-Villanueva A, Bishop D. Repeated-sprint ability—part I: factors contributing to fatigue. *Sports medicine*. 2011;41:673-694.

30. Enoka RM. *Neuromechanics of human movement*. Human kinetics; 2008.

31. Fitts RH, Widrick JJ. Muscle mechanics: adaptations with exercise-training. *Exerc Sport Sci Rev*. 1996;24(1):427-73.

32. Krzysztofik M, Wilk M, Wojdala G, Golas A. Maximizing Muscle Hypertrophy: A Systematic Review of Advanced Resistance Training Techniques and Methods. *Int J Environ Res Public Health*. Dec 4 2019;16(24):4897. doi:10.3390/ijerph16244897

33. Schönau T, Anders C. Force capacity of trunk muscle extension and flexion in healthy inactive, endurance and strength-trained subjects—a pilot study. *German Journal of Exercise and Sport Research*. 2024;54(2):213-220.

10. APPENDIX

A Appendix. Ethics Committee.

UNIVERSIDADE DE BRASÍLIA
FACULDADE DE EDUCAÇÃO FÍSICA
CAMPUS UNIVERSITÁRIO DARCY RIBEIRO - BRASÍLIA/DF
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Termo de Consentimento Livre e Esclarecido

Convidamos o(a) Senhor(a) a participar voluntariamente do projeto de pesquisa "EFEITOS DO INTERVALO DE RECUPERAÇÃO SOBRE A FORÇA DOS EXTENSORES DE TRONCO EM ADULTOS", sob a responsabilidade do pesquisador Sacha Clael Rodrigues Rêgo. O projeto investiga diferentes intervalos de recuperação para o movimento de extensão de tronco no equipamento isocinético.

O objetivo desta pesquisa é analisar o intervalo de recuperação entre as séries em adultos. Com tais dados será possível melhorar a qualidade científica de futuros estudos utilizando o isocinético.

O(a) senhor(a) receberá todos os esclarecimentos necessários antes e no decorrer da pesquisa e lhe asseguramos que seu nome não aparecerá sendo mantido o mais rigoroso sigilo pela omissão total de quaisquer informações que permitam identificá-lo(a).

A sua participação se dará por meio de uma visita ao laboratório para a coleta de dados. Na visita o senhor(a) irá realizar o exercício de extensão de tronco no equipamento isocinético com diferentes intervalos de recuperação, 30 segundos, 60 segundos e 90 segundos, tais intervalos de recuperação serão escolhidos mediante sorteio. Além do exercício iremos realizar uma anamnese e coletar dados antropométricos do senhor(a). A visita não ultrapassará 60 minutos. Os possíveis desconfortos serão mal-estar, dor local ou dores musculares tardias após o treinamento. A pesquisa levará um total de um dia, ocorrendo uma vez na semana. Todas as sessões ou visitas desta pesquisa serão realizadas na Faculdade de Ceilândia da Universidade de Brasília com um tempo estimado de cada visita de no máximo 60 minutos. A visita será realizada com agendamento prévio, de acordo com sua disponibilidade.

Será coletada a força do tronco no movimento de extensão, com isso conseguiremos determinar qual o melhor intervalo de recuperação para protocolos de extensão de tronco no equipamento isocinético.

Os riscos decorrentes de sua participação na pesquisa são: leves desconfortos musculares devido à sobrecarga de peso que será imposta pelo exercício. Tais desconfortos são esperados devido ao processo de adaptabilidade. Espera-se que tais alterações fisiológicas gerem menor desconforto com o passar do tempo, tornando os indivíduos mais fortes. Esse risco será minimizado com um aquecimento prévio a execução do exercício, a fim de evitar possíveis desconfortos decorrentes do treinamento.

Caso aconteça algo durante o período de treinamento ou coleta de dados, o pesquisador assegura assistência imediata integral e gratuita ao participante da pesquisa para atender complicações e danos decorrentes, direta ou indiretamente, da participação na pesquisa.

O(a) senhor(a) pode se recusar a responder (ou participar de qualquer procedimento) qualquer questão que lhe cause constrangimento, podendo desistir de participar da pesquisa a qualquer momento sem nenhum prejuízo para o(a) senhor(a). Sua participação é voluntária, isto é, não há pagamento por sua colaboração.

Todas as despesas que o(a) senhor(a) e o(a) e seu(sua) acompanhante, quando necessário) tiver (tiverem) relacionadas diretamente ao projeto de pesquisa (tais como, passagem para o local da pesquisa, alimentação no local da pesquisa ou exames para realização da pesquisa) serão cobertas pelo pesquisador responsável.

Caso haja algum dano direto ou indireto decorrente de sua participação na pesquisa, o(a) senhor(a) deverá buscar ser indenizado(a), obedecendo as disposições legais vigentes no Brasil. Os resultados da pesquisa serão divulgados na Universidade de Brasília podendo ser publicados posteriormente. Os dados e materiais serão utilizados somente para esta pesquisa e ficarão sob a guarda do pesquisador por um período de cinco anos, após isso serão destruídos.

Se o(a) senhor(a) tiver qualquer dúvida em relação à pesquisa, por favor telefone para: Sacha Clael Rodrigues Rêgo ou para o Prof. Wagner Martins (professor orientador), na Universidade de Brasília (Campus Ceilândia) no telefone fixo: +55 (61) 3376-0252 ou móvel: +55 (61) 983837418, disponível inclusive para ligação a cobrar. Também é possível entrar em contato por meio do e-mail: sachaclael@hotmail.com.

Este projeto foi aprovado pelo Comitê de Ética em Pesquisa da Faculdade de Ciências da Saúde (CEP/FS) da Universidade de Brasília. O CEP é composto por profissionais de diferentes áreas cuja função é defender os interesses dos participantes da pesquisa em sua integridade e dignidade e contribuir no desenvolvimento da pesquisa dentro de padrões éticos.

As dúvidas com relação à assinatura deste termo ou os direitos do participante da pesquisa podem ser esclarecidas pelo telefone (61) 3107-1947 ou do e-mail cepfs@unb.br ou cepfsunb@gmail.com, horário de atendimento das 10:00hs às 12:00hs e de 13:30hs às 15:30hs, de segunda a sexta-feira. O CEP/FS se localiza na Faculdade de Ciências da Saúde, Campus Universitário Darcy Ribeiro, Universidade de Brasília, Asa Norte.

Caso concorde em participar, pedimos que assine este documento que foi elaborado em duas vias, uma ficará com o pesquisador responsável e a outra com o(a) senhor(a).

____

Nome e assinatura do Participante de Pesquisa

____

Nome e assinatura do Pesquisador Responsável

Brasília, ___ de __________de _________.

B Appendix. Anamnesis.

UnB

Termo de Consentimento Livre e Esclarecido

Este é um questionário desenvolvido para coletar o seu consentimento a respeito da pesquisa, os seus dados pessoais e as suas condições clínicas. Os dados deste questionário serão utilizados para a tese de doutorado do aluno Sacha Clael Rodrigues Rêgo da Faculdade de Educação Física da Universidade de Brasília (link do Lattes: http://lattes.cnpq.br/6249802655545689)

sachaclaelrr@gmail.com Alternar conta

*Obrigatório

E-mail *

Seu e-mail

Termo de Consentimento Livre e Esclarecido

sachaclaelrr@gmail.com Alternar conta

*Obrigatório

Anamnese

Seu nome completo *

Sua resposta

Idade em anos, considerando o ano de 2022 completo (coloque somente os números) *

Sua resposta

Peso em kilogramas *

Sua resposta

Estatura em centímetros *

Sua resposta

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sachaclaelrr@gmail.com Alternar conta

*Obrigatório

Nível de treinamento

Qual o seu tempo de treinamento ininterrupto, EM MESES? Considerando o ano de 2022 completo (colocar somente números) *

Sua resposta

Quanto tempo você já ficou sem treinar, EM MESES? Considerando o ano de 2022 completo (colocar somente números) *

Sua resposta

Quanto tempo você tem de experiência prévia com treinamento, EM MESES? Considerando o ano de 2022 completo (colocar somente números) *

Sua resposta