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RESEARCH ARTICLE

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DIFFERENT NEUROMUSCULAR ELECTROSTIMULATION RESOURCES IN MUSCLE POWER GAIN: A SYSTEMATIC REVIEW

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ABSTRACT

This study aimed to review the scientific literature on the use of neuromuscular electrical stimulation to gain muscle power. Neuromuscular electrical stimulation is defined as application of electric current at the neuromuscular junction and surrounding muscle fibers, in order to produce a visible muscle contraction due to the activation of intramuscular nerve branches.Among the benefits provided by this current we have the increase in strength through neuromuscular electrostimulation, which is also justified due to motor learning and neural facilitation, which would lead to a more efficient pattern of recruitment of motor units, with a greater number of them triggering impulses to a higher frequency. This study aimed to review the scientific literature on the gainmuscle power through the use of different neuromuscular electrostimulation currents.

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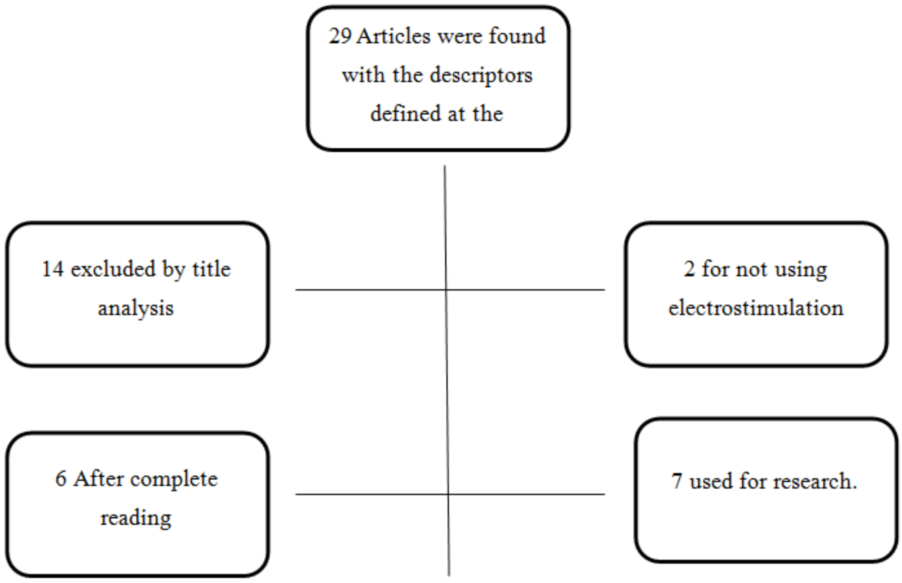
INTRODUCTION

Neuromuscular electrical stimulation (NMES) is defined as the applicationof electric current at the neuromuscular junction and surrounding muscle fibers in order to produce a visible muscle contraction due to the activation of intramuscular nerve branches. NMES can be used to: (1) preserve muscle mass and function during prolonged periods of disuse or immobilization; (2) recovery of mass and muscle function after prolonged periods of disuse or immobilization; (3) improved muscle function in different healthy populations: the elderly, recreational athletes and athletes; and (4) preoperative strengthening. It has been suggested that NMES should be used in combination with traditional strengthening programs, given that the use of chains is an excellent ally for gaining muscle strength, and the effect of this is believed to be that NMES occurs through increased muscle's ability to generate strength (IMOTO, 2013). Electrical stimulation promotes an increase in the contractile activity of innervated muscle fibers, producing depolarization of your nerves when stimulated with sufficient intensity, resulting in muscle contraction, increasing the dynamics of glucose uptake and metabolism and the activity of cellular metabolic pathways (COSTA, 2019). Among the benefits provided by this current we have the increase in strength through NMES, which is also justified due to motor learning and neural facilitation, which would lead to a more efficient pattern of recruitment of motor units, with a greater number of them triggering impulses to a higher frequency (CHAVES, 2011). Chaves (2011) argued that the increase in muscle strength induced electrically occurs due to the increase in blood flow, which can be 20% after one minute of its application and can hang afterwards. This means that electrically induced muscle contraction can take advantage of the blood supply, thereby improving muscle performance. Emilio (2012) described two types of force, reactive and active force and more specifically, three different types of force manifestations: explosive, explosive-elastic and explosive-elastic-reactive, which can be assessed by squat jumping, jumping against movement and drop jump respectively. Despite what has been exposed about the physiological changes caused by electrostimulation in muscle power, the literature lacks literature reviews on the use of NMES and with well-established protocols with the objective of muscle power available for the clinical practice of physiotherapy professionals. Therefore, it is essential to carry out studies in this segment, since accelerating the increase in power would be beneficial for sports and rehabilitation in general. So this study seeksreview the scientific literature about the gain muscle power through the use of neuromuscular electrostimulation.

MATERIALS AND METHODS

It is a systematic review study without meta analysis, following the criteria of PRISMA recommendations (Main Item for Reporting Systematic Reviews and Meta analysis). The present study was of bibliographic character which sought to systematize controlled and randomized clinical trials, evaluating the commitment to the inclusion criteriafor integration into this research. Due to the increasing amount and complexity of information in the health area, the development of artifices, in the context of scientifically based research, capable of delimiting more concise methodological steps and providing professionals with better use of the elucidated evidence, has become essential. in numerous studies. As systematic reviews summarize the results of all original studies on a given topic, systematic reviews are usually considered to be high-quality evidence. As the scientific literature produced annually is increasing at an exponential rate, systematic reviews that collect the available evidence have become increasingly important. Since 1989, there has been a growing increase in the use of systematic review as a research methodology, and with this increase the recommendations to conduct this type of research have also increased (DONATO, 2019). The following databases were used as a source of studies evaluated: Virtual Health Library (VHL), Scientific Electronic Library Online (SCIELO), Medical Literature Analysis and Retrieval System Online (MEDLINE), US National Library of Medicine National Institutesof Heath (PUBMED), Controlled Trials database (COCHRANE). To search for articles, we used the following descriptors ("neuromuscular electrical stimulation therapy", "neuromuscular electrical stimulation", "vertical jump", "squat jump", "explosive strength"), using the following Boolean AND indicators “Electrical Stimulation Therapy and Muscle Strength ”“ Electrical Stimulation Therapy and Exercise ”. "Therapy by electrical stimulation and muscle power". “Electrical stimulation therapy and squat jumping”. For inclusion criteriaarticles published between the years 2010 to 2020 were selected in the following languages: “Portuguese”, “English”, “Spanish” that used electrical currents to gain muscle power and clinical trial type studies. For exclusion criteria, articles that were not freely available, those that were duplicated, were excluded. The procedures for selecting the articles were read the titles and abstracts of the articles and after the selection of the articles they were read in full for



exclusion and inclusion criteria. The methodological quality of the articles was assessed using the PEDro scale. This scale assesses the following question: 1) eligibility criteria; 2) random distribution; 3) blind distribution; 4) difference between groups in the baseliner; 5) blind participation; 6) blind intervention; 7) blind assessment; 8) results with more than 85% of the sample; 9) control situation; 10) intergroup results; 11) precision measures. The scale score ranges from 0 to 10 points. Equivalent to one point each of the 11 criteria, if satisfied, the first item is not scored. The randomized studies considered to be of good quality and the form chosen for this research were those that scored above 04 points and included in the survey. During the research, total 29 articles with the keywords used in the research. 22 articles were discarded, 14 after analyzing the title, as they did not fit the proposed theme 2 were excluded for not having the use of neuromuscular electrostimulation.

RESULTS

The results obtained were tabulated according to the following criteria: author / year of publication, title of the study, type of study / research sample, protocols used, variables for assessing potency. The information obtained through the 7 analyzed studies is shown in the table below:

Chart 1. Distribution of articles according to methodological criteria. Vitória da Conquista-BA

Author / year of publication / study title	Study type / research sample	Protocols used	Variables for power evaluation	Main results
Lopez et al. 2012 Effects ofthecombinationofelectrostimulationandplyometric training programon jumping height in teen athletes	Experimental approach composed of 98 athletes 51 (52%) men and 47 women sprinters (48%) with weight (58.17 ± 6.56 kg, height (1.64 ± 0.075m) body mass index- BMI- (21.54 ± 4.57 kg / m²), age (17.91 ± 1.42) and 5.16± 2.56 years of training experience	The NMES groups participated in an 8-week training. The training took place 2 days a week. The NMES the parameters were: stimulation frequency of 85 and 150 Hz for group 2 and 3, respectively, pulse widthof 350 msandwith the traction-relaxation time was 3 to 12 seconds, each NMES lasted 12 min with intensity at the maximum tolerated. 4 groups were divided. The control group (CG: plyometrics (PT) only) G1: EENM 150 Hz (PT + EENM) G2: EENM 85 Hz (EENM + PT) G3: in this group, G1 and G2 training sessions were held alternatively on each of the 2 training days. The electrodes were placed at the motor points of the entire quadriceps	Muscle power was assessed using the squat jump (SJ), opposite movement jump (CMJ) anddropjump (DJ) wereperformedtoevaluatetheeffectsofthe training protocolson 98 athletes.	Differences in the height of the jump were observed the results of the SJ after analysis revealed that G1 and G3 showed significant increases in relation to the CG in the post-intervention measures. The results between G2 and GC were similar, except in the sixth week where G2 achieved a slight improvement ($p < 0.05$). The results of the CMJ test were not observed significant differences in relation to the height of the jump when comparing the relationship between the groups. The analysis showed a significantly greater increase for G1 ($p < 0.01$) when paired with the CG after 8 weeks of training. The DJ results found significant differences in the height of the jump between the subjects. The analysis revealed that in comparison to the CG, G1 showed improvement in jumping from the fourth week of training, and these differences became more evident in the coming weeks, especially in the sixth week ($p < 0.001$). There was no statistically significant difference when compared to G2, G3 compared to CG.
Ottavio Et al. 2019 Effect of two modalities of full body electrostimulation Strength and power resistance circuit training and programs	Experimental approach composed of 22 participants, 13 men and 9 women who performed at least 3 training sessions per week, mainly soccer divided into 3 groups Control group (CT-DS, n = 8) and two experimental groups (WB-EENM1), n = 6; EENM2), n = 8	12 trainings Sessions held for 6 weeks. The first group (CT-DS) underwent circuit training at the academy. (DS), using overloads, 10 repetitions and 3series were performed with a load equal to 65% of a maximum repetition (1-RM). The rest time between sets was 1 min and 30 s. The second (EENM1) and the third group (EENM2) formed the electro-muscular whole-body stimulation group (NMES) - according to electrical and methodological parameters. During the NMES treatments, each participant was invited to execute exactly at the beginning of the impulse, the following set of ten isometric exercises (2 min per exercise), without any machine or external loads. The session lasted 20 min, the pulse duration was 4 seconds with a pause of 6 seconds. The duty cycle was 24 " / 36 " (to rest) for G1 and 32 " / 28 " for group 2, pulse rate of 50 G1 and 85 G2, pulse width 350ms for both, pulse ramp 0.5 for G1 and 0.1 G2. Where various muscle groups stimulated biceps brachii, triceps brachii, trapezius, dorsal, pectoral muscles, abdomen adductors, gluteus maximus, quadriceps femoris and biceps femoris	To determine the force-speed curves, a Gyco accelerometer. Qfor training with NMES, the subjects wore a special gym suit.	According to statistical analyzes, in relation to the squat test to assess strength and power, no differences were evident between treatments. Regarding the bench press test to also assess strength and power, no significant difference was confirmed.

DISCUSSION

After analyzing the studies, it was possible to observe that there is a consensus among the authors that NMES associated with specific training brings chronic benefits and gains in relation to muscle power even using different parameters when compared to training without using it. Regarding training time, only one of the seven studies brought the acute effects of NMES (<4 weeks of training) (KAÇOGLU, 2016). The others brought about chronic responses (> 4 weeks), with the supposed premise that NMES needs more time for peripheral or central neural adaptation (LÓPEZ, 2012; OTTAVIO, 2019; FILIPOVIC, 2016; DAWN, 2011; BILLOT , 2010; WIRTZ, 2016). With regard to muscle power, the vertical jump countermovement and Sprint in a straight line were one of the variables that did not present obvious gains, however the jump against movement showed gains when associated with plyometrics (LÓPEZ, 2012). For the consideration of the gains obtained in the plyometrics, in some studies broughtthat this increase may be due to the use of a higher stimulation frequency 150 Hz (LÓPEZ, 2012). However, it may also have been influenced by the relationship between stimulation intensity and creatine kinase activity level (Emilio, 2012). Flipovic (2011) brought in his study a significantly greater increase in Human Growth Hormone (hgH) and creatine kinase activity for the EMS group compared to voluntary exercise, which may have been evident due to the increase in intensity.

Ward and Shkuratova, (2002) stated that the combination of voluntary exercises and NMES seemed to be more effective in increasing the height of the jump, as it is a more complete training program, where voluntary exercise follows the principle of size and exercise and electrical stimulation preferentially recruits fibers for power. It is important to consider that PT exercises should be focused on the type of strength, but because of the large number of variables studied in previous investigations (ie, type, volume and intensity of the exercises), it is not easy to design a protocol ideal training according to the type of strength. The most obvious change in the functions of the nervous system is an increase in the neural impulse from the supraspinatus entrance to the muscles after EMS resistance training. Vertical jump control largely based on pre-programmed muscle contraction patterns. Therefore, such movement control depends heavily on the storage capacity of the central nervous system.The delayed optimization of such models in the central nervous system can delay the vertical leap in development (late neural adaptation) after NMES training (KAÇOGLU 2016). Maffiuletti et al (2000) found that EMS training for 4 weeks increased strength at high concentric speeds (180, 240 and 300º / s), but had no effect on slow concentric speeds (60 and 120º / s) of the extensors of the knee and jumping performance (SJ and CMJ).
Another relevant factor for good results from the use of NMES is that the motor units are activated according to the principle of size and that during the use of NMES you can activate fast motor units more easily than voluntary contraction and thus potentiate the powders. -activation (Maffiuletti, 2007).

Hodgson et al (2005) suggested that post-activation potentiation provides positive potentiation by increasing the excitability of the motor neuron and increasing the sensitivity of calcium and contractile protein. Flipovic in 2011 brought to his study that a high increase in stress load through NMES training, in addition to the normal training / game load can negatively influence or hinder transfer of strength. Additional specific plyometric training and could have positively influenced the transfer of strength in explosive movements, such as jumping and kicking. The studies by Gulick et. al (2011) and Filipovic et. al (2016) show that complex tasks can have an influence on the results, considering that vertical jumping is not a movement used in daily life and when compared to sports movements it is done dynamically and not static. As a matter of some studies not being beneficial they were the short time and for some when choosing the public they related some participants with high level of physical aptitude and others not, the time of treatment in the studies had great divergences. However, the studies showed quite different protocols and methods and diversified training, considering that, in some articles, they used low, medium and high frequency that varied from 30 to 150 Hz, with high frequency with greater use, thus bringing up many questions in relation to which parameters to be used for the premise of a protocol.
The use of NMES also had in contrast the relationship of the muscles worked, which in some articles stimulated only one muscle group and others stimulated several muscle groups, thus, an important predisposition of difference in results, where jumping and use of muscle power is necessary for a production of power transmission you do not only need a muscle group.

Conclusion

From the research conducted, it can be seen that electrostimulation presents significant results with regard to the use of neuromuscular electrostimulation in power gain, however, there is still a scarcity of studies and few recommendations that use neuromuscular electrostimulation for this purpose, as well as well-defined protocols, thus there being a greater need for studies of high methodological quality that aim to elucidate the use of neuromuscular electrostimulation in order to gain muscle power. However, the results shown here may already suggest a benefit from the use of NMES aiming to improve muscle power, which could be used in clinical practice aiming to accelerate the recovery of professional or amateur athletes, as well as optimize their sports practice.

REFERENCES

BILLOT, Maxime et al. Effects of an electrostimulation training program on strength, jumping, and kicking capacities in soccer players. *The Journal of Strength & Conditioning Research,* v. 24, n. 5, p. 1407-1413, 2010.

CHAVES, Josias Justino Cambinja. Effects of neuromuscular electrostimulation on the electrical activity and strength of the biceps brachii muscle. 2012.

CHAVES, Leury Max Da Silva et al. Influence of functional and traditional training on muscle power, quality of movement and quality of life in the elderly: a randomized and controlled clinical trial. *Brazilian Journal of Cineanthropometry & Human Performance,* v. 19, n. 5, p. 535-544, 2017.

D'OTTAVIO, Stefano et al. Effects of two modalities of full body electrostimulation programs and resistance circuit training on strength and power. *International Journal of Sports Medicine,* Vol. 40, n. 13, p. 831-841, 2019.

FILIPOVIC, Andre et al. Effects of a whole-body electrostimulation program on strength, sprinting, jumping, and kicking capacity in elite soccer players.

Journal of sports science & medicine, vol. 15, n. 4, p. 639, 2016.

GULICK, Dawn T. et al. Effect of standardized neuromuscular electrical stimulation on vertical jump in university athletes. Sport Health, vol. 3, n. 2, p. 152-157, 2011.

Hodgson, M., Docherty, D., & Robbins, D. (2005). Post-activation potentiation.Sports Medicine, 35 (7), 585-595.

IMOTO, Aline Mizusaki et al. Is neuromuscular electrical stimulation effective for improving pain, function and activities of daily living of knee osteoarthritis patients? A randomized clinical trial. *Sao Paulo Medical Journal*, Vol. 131, n. 2, p. 80-87, 2013.

JUBEAU, M. et al. Activation of the random motor unit by electrostimulation. *International Journal of Sports Medicine,* v. 28, n. 11, p. 901-904, 2007.

KAÇOGLU, Celil; KALE, Mehmet. Acute effects of lower body electromyostimulation application with two different frequencies on isokinetic strength and jumping performance. *Journal of Physical Education and Sport*, v. 16, n. 1, p. 38, 2016.

Maf fi uletti, NA, Cometti, G, Amiridis, IG, Martin, A, Pousson, M, and Chatard, JC. The effects of electromyostimulation training and basketball practice on muscle strength and jumping ability. *Int J Sports Med* 21: 437–443, 2000.

MARTÍNEZ-LÓPEZ, Emilio J. et al. Effects of the combination of electrostimulation and plyometric training program at the height of the jump in adolescent athletes. *Journal of Sports Science & Medicine*, Vol. 11, n. 4, p. 727, 2012.

PEDROSA, Gustavo Ferreira et al. Comparison of the maximum number of repetitions in multiple sets among individuals with different times of experience in strength training. *Brazilian Journal of Science and Movement*, v. 27, n. 4, p. 139-146, 2019.

WARD, Alex R .; SHKURATOVA, Nataliya. Russian electrical stimulation: the early experiments. Physical therapy, v. 82, n. 10, p. 1019-1030, 2002.

WIRTZ, Nicolas et al. "Effects of Loaded Squat Exercise with and without Application of Superimposed EMS on Physical Performance." *Journal of sports science & medicine* vol. 15.1 26-33. 23 Feb. 2016

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