The effect of a nutritional program on the electromyography (EMG) of some muscles of weightlifters in the snatch lift

El efecto de un programa nutricional sobre la electromiografía (EMG) de algunos músculos de levantadores de pesas en el levantamiento de arranque

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How to cite in APA

Khalid Yasir, O., Husein Ali, M., & Jafar Hassan Alhusseini, A. M. (2025). The effect of a nutritional program on the electromyography (EMG) of some muscles of weightlifters in the snatch lift. *Retos, 70*, 1438–1445. https://doi.org/10.47197/retos.v70.117105

Abstract

Objective. This study aimed to investigate the effect of a balanced nutritional program on the electrical activity of muscles in some quadriceps weightlifters. The results will be analyzed to determine the extent to which nutrition affects muscle performance.
Research methodology. The researcher used the experimental method with a two-group design, a control group and an experimental group with pre- and post-tests, to suit the nature of the problem. The research sample was deliberately selected from the Baghdad Municipality Club's four-legged players for the 2024/2025 sports season, numbering (36) weightlifters. They were randomly divided into two groups, with (18) weightlifters for each group. The nutritional program was applied to the experimental group only, and the control group relied on the nutritional program approved by the players and the club's management.
Results. The results of the control group show insignificant differences in the muscle variable (erector dorsi) and significant differences in the muscle variable (femoris, anterior deltoid) for the variable (Peak EMG). Despite a slight improvement in peak electrical activity between the pre- and post-tests, this improvement resulted from the training and nutritional program approved by the trainer.
Conclusions. The experimental group demonstrated improved electrical activity in some quadriceps muscles, and the control group did not achieve significant differences in electrical activity in the muscles under study.

Keywords

Nutritional program; electromyography (EMG); muscles weightlifters; snatch lift.

Resumen

Objetivo. Este estudio tuvo como objetivo investigar el efecto de un programa nutricional equilibrado sobre la actividad eléctrica muscular en algunos levantadores de pesas de cuádriceps. Los resultados se analizarán para determinar en qué medida la nutrición afecta el rendimiento muscular.
Metodología de la investigación. El investigador utilizó el método experimental con un diseño de dos grupos: un grupo control y un grupo experimental con prepruebas y pruebas posteriores, para adaptarse a la naturaleza del problema. La muestra de investigación se seleccionó deliberadamente entre los jugadores de cuadrúpedos del Club Municipal de Bagdad para la temporada deportiva 2024/2025, con un total de 36 levantadores de pesas. Se dividieron aleatoriamente en dos grupos, con 18 levantadores de pesas en cada grupo. El programa nutricional se aplicó únicamente al grupo experimental, mientras que el grupo control se basó en el programa nutricional aprobado por los jugadores y la dirección del club.
Resultados. Los resultados del grupo control muestran diferencias insignificantes en la variable muscular (erector dorsal) y significativas en la variable muscular (femoral, deltoides anterior) para la variable (EMG pico). A pesar de una ligera mejora en la actividad eléctrica máxima entre las pruebas previas y posteriores, esta mejora se debió al programa de entrenamiento y nutrición aprobado por el entrenador.
Conclusiones. El grupo experimental mostró una mejora en la actividad eléctrica en algunos músculos cuádriceps, mientras que el grupo control no alcanzó diferencias significativas en la actividad eléctrica de los músculos estudiados.

Palabras clave

Programa nutricional; electromiografía (EMG); músculos de los levantadores de pesas; levantamiento de arranque.

Introduction

Skeletal muscle is an important component of athletic performance in strength sports, such as weightlifting. Electromyography (EMG) is an important technique used to analyse muscle performance. EMG evaluates the electrical activity caused by muscle contractions. EMG is a reliable measurement of muscle performance and is often used in research evaluating exercise and nutrition.

Nutrition plays a significant role in athletic performance. Proper nutrition is extremely important in providing energy in preparation for exercise, recovery, and improving strength and endurance. Studies suggest that adequate nutrition is key to improving muscle performance and modifying EMG, which can ultimately influence subsequent muscle strength and performance (Robles Hernández et al.,2025).

In the context of weightlifting, adequate nutrition is necessary for any athlete looking to maximize performance. For example, the inclusion of carbohydrates into the diet will help replenish muscle glycogen stores needed for endurance during activity. In addition, adequate protein should be consumed to build muscle and repair muscle tissue after exercise (Radhi & Obaid, 2020: Chávez Erives et al., 2025). Findings suggest protein promote muscle performance following exercise as well as during exercise. Protein consumption following exercise subsequently improved EMG (Yasir, 2025). Consumption of healthy fats are an important consideration also. Healthy fats allow for an additional energy source for promoting athletic performance.

There are numerous studies investigating the relationship between nutrition and athletic performance, specifically in strength sports. Carbohydrates are regularly consumed in meals with athletes' diets as they make up the primary source of energy for high-intensity exercise (Yasir, 2025). By consuming carbohydrates in pre-exercise meals prior to exercise will improve performance through greater availability of muscle glycogen.

The role of protein's role in supporting muscle recovery is also firmly established. In a study by (Phillips & Van Loon, 2022), they suggest consuming protein through a post-exercise meal will improve muscle protein synthesis which enhances the overall strength and muscle mass. The effective of protein consumption is higher following exercise when the timing of protein consumption is sooner after exercise. Other studies have also examined the role of healthy fats in an athlete's diet. (Burke et al., 2011) acknowledge the fact that fats are incredibly important for energy, especially in low-intensity activities. Additionally, as adapted from Burke et al. (2011) fats are very important for nutritional balance all the way up to high-intensity activities. As well, fats promote overall health to decrease inflammation to help promote athletic performance.

(Maughan et al. ,2022) states that nutrition will not only improve electrical activity in muscles but indicate the importance of balance in carbohydrates, protein, and fats in an athlete's diet is paramount. An even balance in nutrients will support the optimal function of performance will assist in recovery post-exercise. In addition, studies indicated that an imbalance in nutritional status and dietary intake will potentially impair performance and increase risk of injury.

The studies by (Smith, 2022) were among the first studies to investigate the effect of nutrition on electrical activity in muscles. Overall, the findings suggest the athletes that consistently consumed a diet in balance with carbohydrates, protein, and fats achieved noteworthy improvements in electrical activity in their muscles compared to athletes who followed an unbalanced diet. This demonstrates nutrition and muscle performance is strongly linked (Smith, 2022). also indicates evidence shows understanding the relationship between nutrition and electrical activity in muscles can support improved athletic performance. For example, athletic professionals will be more knowledgeable to establish and prescribe individualized nutritional programs for athletes according to exercise volume to enhance performance and improve strength as well as endurance.

Research problem

The main problem in this study for weightlifters is that despite the effective role of nutrition in supporting muscle performance and enhancing training efficiency, some athletes, especially weightlifters, still neglect this aspect, which may lead to the weakness of this vital aspect.

Although previous studies have examined the impact of nutrition on athletic performance, few have focused on the direct relationship between nutritional programs and electrical activity in weightlifting.

Shedding light on this issue will enable coaches and athletes to develop effective nutritional strategies that enhance athletic performance, leading to improved results in athletic competitions.

Research objective

This study aimed to investigate the effect of a balanced nutritional program on the electrical activity of muscles in some quadriceps weightlifters. The results will be analyzed to determine the extent to which nutrition affects muscle performance.

Method

Research Methodology

The researcher used the experimental method with a two-group design, a control group and an experimental group with pre- and post-tests, to suit the nature of the problem.

Community and sample research

The research sample was deliberately selected from the Baghdad Municipality Club's four-legged players for the 2024/2025 sports season, numbering (36) weightlifters. They were randomly divided into two groups, with (18) weightlifters for each group. The nutritional program was applied to the experimental group only, and the control group relied on the nutritional program approved by the players and the club's management.

Research Sample Tests

- Snatch Test: The snatch test was administered to the research sample. Using a special registration form containing the weightlifter's name and the number of attempts (three), each sample member was given three attempts. The best lift was selected from among the three attempts, according to the internationally recognized protocol for selecting the best lift. This was preceded by a sufficient warm-up before the test, using EMG testing during a full snatch is the ideal choice because it provides accurate data on peak muscle activity in a realistic movement context, reflecting the actual demands of weightlifting. This is consistent with the principle of measurement specificity and enhances the accuracy and reliability of results compared to isolated or non-specific tests. (Yasser, 2014).
- Electromyography (EMG) Test. The electromyography (EMG) test is a technique used to measure the electrical activity produced by muscles during contraction. This test provides valuable information about how muscles are activated during the snatch, helping to evaluate muscular performance and the impact of various factors such as nutrition. Identifying the muscles used in the test: Three primary muscles were selected for the snatch lift: the quadriceps femoris, the erector spinae, and the anterior deltoid. Peak EMG was used, which represents the highest level of electrical activity recorded by a muscle over a specific period. It is used to assess muscle strength and response to stimulation, Peak EMG is one of the most important indicators used to analyze neuromuscular activation during complex movement performances, such as the snatch in weightlifting, noted that a deep understanding of neuromuscular responses is essential for developing strength and explosiveness, making the use of peak EMG an effective tool for determining the degree of contribution each muscle makes to performance.

Preparation prior to test assessment:

- Ensure the athlete is healthy.
- Discuss the assessment procedures of the test to the athlete so that the athlete understands the acclamation of the assessment and test.
- Apply electrodes over the skin on top of the identified muscles and then surface electrodes.
- Ensure that the skin is clean and dry for good contact.

Nutritional Approach

Nutrition is a physiological factor in the enhancement of sport performance. Nutrition can affect the upswing action of muscle since muscle is energy sources for body as energy is crowed on of use to utilize muscle efficiently, specifically weightlifting. Diet is significant factor in the improvement of muscle capacity, endurance and recovery. To achieve maximal athletic performance one has to account for balancing biological aspects of protein, carbohydrates and fat in addition vitamins and minerals.

The purpose of the study was to assess the effects of a nutritional program on the EMG (electromyography) activity of selected quadriceps. A nutritional plan was created for the athletes to monitor their performance. The nutritional focus will be on the nutrients necessary for muscle function. The objectives of a nutritional plan is:

- To facilitate muscle function.

- Facilitate the electrical impulse activity of the identified muscles.

- expedited muscle recovery post exercise.

To estimate the daily caloric needs for weightlifters the following equation was used:

Harris-Benedict Equation

For Men

BMR = 88.362 + (13.397 x weight (kg)) + (4.799 x height (cm)) - (5.677 x age (years))

To calculate the daily calorie requirement, multiply BMR by the activity factor. Since the activity used by the sample was moderate activity, ranging from 3-5 training sessions per week, this equation was adopted.

BMR × 1.55 (International Weightlifting Federation (IWF), 2022)

Nutritional Components

Proteins

- Sources: Lean meat, poultry, fish, eggs, and dairy products.
- Amount: 1.6–2.2 grams per kilogram of body weight per day.
- Timing: Eat a protein-rich meal immediately after exercise to promote recovery.

Carbohydrates

- Sources: Whole grain breads and cereals, fruits, vegetables, and legumes.
- Amounts: 3-7 grams per kilogram of body weight per day.
- Timing: Carbohydrates should be consumed before exercise, as they will help improve performance. For workouts of long duration, carbohydrates should be consumed during the workout to help replenish energy stores.

Healthy Sources of Fats

- Sources: Avocado, nuts, seeds, and olive oil.
- Amounts: 20-35% of total daily calories
- Timing: Can be consumed in main meals and snack.

Sample Daily Eating Routine

- Breakfast: Oatmeal with low-fat milk, banana, and spoonful of almond butter.
- Snack: Greek yogurt with fresh fruit.
- Lunch: Grilled chicken breast with brown rice and vegetables.
- Pre-workout snack: Fruit with a handful of nuts.
- Dinner: Grilled fish with spinach and green salad.

- Bedtime snack: Glass of milk or cheese.
- Hydration. Drink enough water to keep yourself hydrated throughout the day and esp. before and after exercise. Overall, drink 2-3 L of water per day depending on the level of physical activity.

The purpose of this nutritional information is to support the needs of weightlifters, and to enhance their muscle performance with a balanced diet. The end purpose of the research is to increase electromyography (EMG) activity and ultimately improve athletic performance.

A multi-level strategy was adopted to ensure the research sample's adherence to the nutritional program, combining education, monitoring, daily documentation, and motivation, which enhances the credibility of the data related to the effect of nutrition on electrical muscle activity.

Statistical Methods

The statistical package (SPSS) was used to process the data and results.

Findings

Presentation, analysis of the results:

Table 1. Shows the arithmetic means, standard deviations, calculated t-value, error level, and significance of differences between the results of the pre- and post-tests for the Peak EMG index of the erector dorsi, femoris, and anterior deltoid muscles of the control group.

Variables	Unit of Measurement	Pre-test		Post-test		Arithmetic mean of difference	Standard deviation of differences	T value calculated	Level Sig	Type Sig
		Arithmetic mean	Standard deviation	Arithmetic mean	Standard deviation					
Erector Dorsal	microvolt/s	341.222	24.184	339.833	22.953	1.388	3.945	0.352	0.729	Non sig
Femoral	microvolt/s	904.166	85.612	913.555	82.121	9.388	4.254	2.207	0.041	Sig
Anterior Deltoid	microvolt/s	673.111	35.965	677.888	33.568	4.777	1.322	3.613	0.002	Sig

Significant at the error level ≤ (0.05)

Table 2. Shows the arithmetic means and standard deviations, the calculated (t) value, the error level, and the significance of the differences between the results of the pre- and post-tests of the (Peak EMG) index for the erector dorsi, femoris, and anterior deltoid muscles of the experimental group.

Variables	Unit of Measurement	Pre-test		Post-test		Arithmetic mean of difference	Standard deviation of differences	T value calculated	Level Sig	Type Sig
		Arithmetic mean	Standard deviation	Arithmetic mean	Standard deviation					
Erector Dorsal	microvolt/s	338.500	27.238	394.611	20.344	56.111	3.829	14.652	338.500	Sig
Femoral	microvolt/s	892.055	104.607	934.944	96.394	42.888	17.392	2.466	892.055	Sig
Anterior Deltoid	microvolt/s	675.833	34.373	706.388	26.613	30.555	3.758	8.130	675.833	Sig

Significant at the error level ≤ (0.05)

Table 3. Arithmetic means, standard deviations, calculated t-value, error level, significance of differences and effect size between the results of the post-test for the control group and the post-test for the experimental group for the Peak EMG index of the erector dorsi, femoris and anterior deltoid muscles

Variables	Unit of Measurement	post-test for the control		post-test for the experimental		T value calculated	Level Sig	Type Sig	Effect size
		Arithmetic mean	Standard deviation	Arithmetic mean	Standard deviation				
Erector Dorsal	microvolt/s	339.833	22.953	394.611	20.344	7.577	.0000	Sig	0.628
Femoral	microvolt/s	913.555	82.121	934.944	96.394	.7170	.4790	Non sig	0.015
Anterior Deltoid	microvolt/s	677.888	33.568	706.388	26.613	2.823	.0080	Sig	0.190

Significant at the error level of ≤ (0.05) and with a degree of freedom of 34.

Discussion

Upon reviewing the data presented in Table (1), the Peak EMG findings of erector dorsi muscle variable in the control group showed no significant differences, however, the Peak EMG related to the femoris, anterior deltoid muscle variable yielded significant differences. There was a slight improvement in Peak EMG between the pre- and post-tests; this was a result of the training and nutrition intervention approved by the trainer.

The Peak EMG outcomes for the erector dorsi muscle variable for the control group showed there were no significant differences suggesting that the training and nutrition intervention of the sample did not positively influence activity of this muscle variable and that the subjects were familiar with this sort of exercise (Smith et al., 2022: Vinu et al., 2025: García-Soareset al.,2024). The Peak EMG results for quadriceps and anterior deltoid muscle variables showed were significant differences for the control group, indicating that the control group's training and nutrition intervention was effective in increasing activity of these two muscles, which is likely due to specific focus of some exercises, such as squats and deadlifts, which target those muscles directly along with inclusion of exercises that involve strong arm movements that likely stimulated greater muscle activation (Johnson & Williams, 2023: Mahmood Abdullah et al., 2025).

Accurate nutrition regulated with basic macro-nutrient calculations is crucial for weightlifting athletes to optimize their performance. When the body is fueled with the needed nutrition the electrical activity in muscles can be improved and shows up as Peak EMG resultsThus, athletes and weightlifters need to practice a healthy and complete nutritional program to help obtain an athlete's performance and its goals. In the experimental group (Group-1, table (2)), there was a statistically significant difference for erector dorsi and anterior deltoid, whereas conversation regarding quadriceps muscle (Qn) the differences were non-significant. In review of Peak EMG, although the experimental group did boast a small mean increase at the post-test, this difference remained non-significant as well. It is pertinent to note that ate-verything regarding the subject matter on a nutritional program's impact on athlete performance. The nutritional characteristics tend to influence training-ability, recovery and overall performance regarding the athlete. Therefore, we are going to take a methodical look at the nutritional program undertaken by the experimental group in particular consideration of whether or not there will be a Peak EMG impact on develop-peak factors in the muscles in review. The following explanation will help how the nutrition could help consider the peak improvement in electrical activity in weight lifters. Good nutrition is critical for high performance in sport. Research suggests that adequate nutrient consumption can directly affect the capacity to perform in a physical performance. Carbohydrate is the principal energy source for activity. Before one's activity, research indicated that exogenous carbohydrates could benefit performance and promote peak EMG (Jeukendrup, 2022: Rodríguez Pinto et al., 2025). Protein is equally significant to fitness in relation to the building of muscle and tissue repair. The research shows that protein consumption after physical exercise could improve recovery and enhance peak electrical activity.A study (Jasem et.al, 2024: Ali & Khalid, 2018) confirmed that consuming 20-30 grams of protein following exercise augments muscle protein synthesis; this is what we found in our study. Some recent studies also suggest that with high- quality protein (like meat, eggs, or dairy) there is an increase in muscle electrical activity. For example, (Phillips and Van Loon ,2022: Peñarrubia-Lozano et al., 2021: Heredia García, 2024) conducted a study on professional weightlifters and found that a protein intake of 1.6 g protein per kilogram of bodyweight per day resulted in an increase in muscle electrical activity relative to their improved endurance and strength. Healthy fats provide an important source of energy, particularly for long-duration activities. (Maughan et al., 2022: Yasser, 2021: Reyes Rodríguez et al., 2022) indicated that healthy fats can improve overall performance and improve endurance and central nervous system activity. The nutritional program that was followed in the present study (experimental group) was intended to satisfy the participants' training needs, since adequate recovery is a necessary component of any training program, and consuming the right nutrient composition following foced exercise could reduce somatic inflammation and improve recovery. (Maughan et al., 2022: Yasir et al., 2025) suggested that consuming a mixture of carbohydrates and protein will improve recovery, and improve peak electrical activity.

(Burd et al. ,2022: Salinas Martínez et al., 2010) suggested that capturing muscle electrical activity frequently establishes baselines for measuring the success of nutritional programs to provide a baseline of peak electrical activity so that athlete's and coaches can adjust based on results.

Understanding the impact of nutrition on muscle electrical activity is important to development of performance. The findings in this study indicated that balanced and appropriate nutrition resulted in significant increases in peak electrical activity, which would lead to improvements in muscle force generation and performance. Further studies and continuous research can assist coaches and athletes to improve their nutritional literacy and ultimately perform better in competitive sport.

It is the integration of nutrients and the synergism of nutrients in a combination of proteins, carbohydrates, fats, vitamins, and minerals that achieves ideal nutritional balance for the athlete.

Conclusions show that good nutritional programs, if designed and implemented, can have a positive effect on muscle electrical activity, which increases performance for athletes. Therefore, coaches and athletes must consciously consider the importance of nutrition as a component of training programs.

Conclusions

- The experimental group did improve electrical activity of, some of the four quadriceps muscles.

- The control group did not show significant changes of any electrical activity in the studied muscles.

- This study indicates that a balance between nutrition and not supplememting with only one before an intensity can help improve electrical activity.

- The difference of having a nutritional plan that included all right nutrients can dramatically improve an athlete's performance.

Recommendations

- Weightlifters would benefit from guidance starting on an ideal nutrition plan that should have a macro nutrient balance of complex carbohydrates, protein of high biologic value, and healthy fats to optimize performance

- The nutritional program should be individualized according to activity level, the athlete's weight and the athlete's goals.

- Periodically measure electrical activity in the muscles (EMG) so that performance changes can be evaluated and then the diet can be adjusted based on changes in performance metrics.

- Athletes and coaches need to be educated on nutrition's importance and its relevance to improving athletic performance. Workshops and training programs could be used to address this issue.

- Athletes needs a sports nutritionist. They need to develop a nutritional plan that is right for them and helps them achieve their training goals.

The researcher recommends using this study, selecting additional muscle groups from the weightlifters' bodies.

Acknowledgements

None.

Financing

None.

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