



The effect of vitamin D supplementation on the balance of testosterone and cortisol hormones in the blood and their relationship to clean and jerk performance among weightlifters at Al-Kadhimiya Sports Club

El efecto de la suplementación con vitamina D sobre el equilibrio de las hormonas testosterona y cortisol en la sangre y su relación con el rendimiento en clean and jerk entre los levantadores de pesas del Al-Kadhimiya Sports Club

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Abstract

Objective: This research aims to explore the effect of vitamin D supplementation on the balance of testosterone and cortisol hormones and their relationship to the athletic performance of weightlifters. By addressing this problem, the study can contribute new insights and practical guidance for athletes and coaches, thereby enhancing athletic performance and contributing to improved overall health.

Research methodology: The researcher used the experimental method, specifically a single-group pre-test/post-test design with correlational analysis, as it was the most suitable approach for the nature of the research problem. The research sample was selected purposively from the Al-Kadhimiya Sports Club for Weightlifting, consisting of (50) advanced weightlifters. All weightlifters from the club were chosen as the research sample, representing 100% of the club's weightlifters.

Results: show an improvement in testosterone levels and a decrease in cortisol levels after taking a vitamin D supplement, this may indicate the vitamin's importance in enhancing athletic performance. This could guide coaches and athletes toward incorporating vitamin D supplementation as part of their training and nutrition strategies.

Vitamin D supplementation had a positive effect on testosterone and cortisol levels, which is reflected in the performance of Olympic weightlifters.

Conclusions: Regular vitamin D intake helps increase blood testosterone levels, regular vitamin D intake helps reduce blood cortisol levels, and regular vitamin D intake helps increase muscle strength, as demonstrated by clean and jerk performance.

Keywords

Vitamin D of testosterone and cortisol hormones; clean and jerk; weightlifters.

Resumen

Objetivo: Esta investigación busca explorar el efecto de la suplementación con vitamina D en el equilibrio hormonal de testosterona y cortisol, y su relación con el rendimiento deportivo de los levantadores de pesas. Al abordar este problema, el estudio puede aportar nuevos conocimientos y orientación práctica para atletas y entrenadores, mejorando así el rendimiento deportivo y contribuyendo a una mejor salud general.

Metodología de la investigación: El investigador utilizó el método experimental, específicamente un diseño pre-test/postest de un solo grupo con análisis correlacional, por ser el enfoque más adecuado para la naturaleza del problema de investigación. La muestra de investigación se seleccionó intencionalmente del Club Deportivo Al-Kadhimiya de Halterofilia, compuesto por 50 levantadores de pesas avanzados. Todos los levantadores de pesas del club fueron seleccionados como muestra de investigación, representando el 100% de los levantadores de pesas del club.

Resultados: Se muestra una mejora en los niveles de testosterona y una disminución en los niveles de cortisol después de tomar un suplemento de vitamina D, lo que podría indicar la importancia de esta vitamina para mejorar el rendimiento deportivo. En este caso, podría crear conciencia entre entrenadores y atletas sobre la necesidad de incluir la suplementación con vitamina D en sus estrategias de entrenamiento y nutrición.

La suplementación con vitamina D tuvo un efecto positivo en los niveles de testosterona y cortisol, lo cual se refleja en el rendimiento de los levantadores de pesas olímpicos.

Conclusiones: La ingesta regular de vitamina D ayuda a aumentar los niveles de testosterona en sangre, a reducir los niveles de cortisol en sangre y a aumentar la fuerza muscular, como lo demuestra el rendimiento en el envión.

Palabras clave

Vitamina D de las hormonas testosterona y cortisol; envión; levantadores de pesas.

Introduction

Weight lifting is one of the most challenging athletic activities as performance depends carefully both on physical strength and hormonal aspects. Testosterone is one of the main hormones that helps build muscle and increase strength, whereas cortisol is a stress hormone that can interfere with performance when it's elevated. Therefore, to know the association of these hormones with athlete performance is important (Sist et al., 2023)

Is vitamin D intake related to sporting performance for athletes? Vitamin D is a vital nutrient synthesized in the body when skin is exposed to sunlight, and has numerous effects on health, such as controlling calcium and phosphate balance that can influence bone and muscle health (Garcia et al., 2023). Studies also show vitamin D is an essential ingredient in hormone modulation (including testosterone and cortisol) so it is a good supplement for athletes to add to their regimen (Fitzgerald et al., 2018).

The significance of this research becomes apparent for several reasons. First, weightlifting has become increasingly popular as a sport and there is greater demand to learn factors that affect performance. Hormonal balance is critical to the best weightlifting performance possible. Higher testosterone concentration can improve muscle gain, and higher cortisol levels can reduce an individual's performance (Yasir, 2025)

Second, vitamin D contributes to overall health, which can indirectly affect athletic performance. Studies indicate that vitamin D deficiency can lead to muscle weakness and an increased risk of injury, negatively affecting athletic performance.

Third, the findings can guide athletes and coaches toward better nutrition strategies to enhance performance by understanding how vitamin D supplementation affects hormone levels, enabling athletes to make informed decisions about supplement use (Sist et al., 2023).

Recent research indicates that vitamin D supplementation may contribute to improved athletic performance through its effect on hormone levels. A study by (Jasem & Yasser, 2024) showed that vitamin D supplementation led to a significant increase in testosterone levels in athletes, which improved exercise performance. A study by (Fitzgerald et al., 2018). Showed that vitamin D supplementation helped reduce cortisol levels, leading to improved physical performance.

In another study, (Saeed et al., 2020) examined the effect of vitamin D on the athletic performance of weightlifters. The results showed that improvements in hormone levels were associated with improved performance in weightlifting exercises. (Garcia et al., 2023) also indicated that vitamin D supplementation could help boost immunity and reduce injuries, thus contributing to improved overall athletic performance.

Other studies suggest that vitamin D can affect testosterone production in the body. According to a study by (Monson et al., 2023), individuals with vitamin D deficiency were more likely to have lower testosterone levels. This suggests that vitamin D supplementation can have a positive effect on testosterone levels, enhancing muscle building and increasing strength.

In addition to its effect on testosterone, vitamin D can also affect cortisol levels. A study (Jasem & Yasser, 2024). showed that taking vitamin D supplements helped reduce cortisol levels, which may help reduce stress and improve performance. For athletes, this is especially helpful because elevated cortisol levels can cause less than optimal performance and an increased risk for injuries.

There is no doubt about the connection between hormones and competitive success. Research has found a strong connection between hormones and workouts. Testosterone is an essential hormone that affects building muscle, as well as increasing strength, whereas cortisol is a stress hormone which can hurt performance. Results have showed that by increasing the level of testosterone and decreasing cortisol levels improvement could be done in athletes performance (Monson et al., 2023).

This research problem originates from the question: What is the effect of vitamin D supplementation on serum total testosterone and cortisol levels among weightlifters'? In addition, how are these hormone levels related to clean and jerk lifting performance in weightlifting.

This study was designed for investigating the effects of vitamin D supplementation on testosterone and cortisol balance, which are possible mechanisms underlying athletic performance in weight lifters. By



solving this problem, the proposed study will provide novel insights and practical recommendations for athletes and coaches that may help improve their sport performance and health.

This study seeks to provide new insights into the role of vitamin D in improving athletic performance through its effect on hormone balance. By understanding these relationships, coaches and athletes can make informed decisions about nutritional supplements and develop effective training strategies. The expected results of this study may contribute to enhancing the scientific understanding of the importance of vitamin D in improving athletic performance and promoting the overall health of athletes.

Research objective

The present study was conducted to determine the effect of vitamin D supplementation on serum testosterone and cortisol levels by comparing these hormones before and after the intervention. It also examined the correlations between saliva hormone levels and clean and jerk performance of supplement consuming weightlifters.

Research hypothesis

The research hypothesis was that there would be significant differences in pre and post testosterone and cortisol scores, with post tests being higher. Additionally, the author predicted a positive association between testosterone and cortisol responses and performance.

Material and methods

Research Methodology

The researcher used the experimental method, specifically a single-group pre-test/post-test design with correlational analysis, as it was the most suitable approach for the nature of the research problem. The research sample was selected purposively from the Al-Kadhimiya Sports Club for Weightlifting, consisting of (50) advanced weightlifters. All weightlifters from the club were chosen as the research sample, representing 100% of the club's weightlifters.

Study Tools

1. 50 x 20 kg barbells.
2. Various Olympic weights (0.5, 1, 1.5, 2, 2.5, 5, 10, 15, 20, 25 kg), in addition to a 2.5 kg legal lock.
3. A drum for performing the clean and jerk lift.

Research Tests

A specialist physician was consulted before the test to receive appropriate advice and ensure the absence of any health conditions that could affect the results. The test was conducted early in the morning (9:00 AM), as testosterone levels are at their peak during this time. Athletes were advised to avoid taking any medications or supplements that might affect testosterone levels for 24 hours prior to the test.

1. **Testosterone Test:** Free testosterone levels were measured using high-performance liquid chromatography (HPLC). The analysis was performed using a reverse-phase analytical column (C18) with dimensions of (250 mm × 4.6 mm) and a particle size of 5 μm, which is designed to achieve high-resolution separation and accurate measurement of the hormone. The mobile phase consisted of a mixture of acetonitrile and water in a ratio of (60:40, v/v), and it was connected at a flow rate of 1.0 mL/min. The column temperature was maintained at (30) °C throughout the analysis. Testosterone was detected using an ultraviolet detector at a wavelength of (240) nm. This method allows for an accurate and reliable measurement of free testosterone levels, which is the biologically active form of the hormone (Fitzgerald et al., 2018).
2. **Cortisol Test:** Cortisol levels were measured using a commercially available immunoassay kit (Company: XYZ, Model: ABC-123, Country: USA). According to the manufacturer's instructions, serum samples were used for analysis. Blood samples were collected in the morning and allowed to clot for 30 minutes at room temperature. The serum was then separated by centrifugation at 3000 rpm for 10 minutes. The serum samples were stored at -20°C until biochemical analysis.



Normal morning blood cortisol levels range from 6 to 23 micrograms per deciliter ($\mu\text{g}/\text{dL}$), and values may vary depending on age and general health status (Tsigos & Chrousos, 2022).

- Clean and jerk achievement test: The clean and jerk achievement test was performed on the research participants. Using a registration form that included the lifter's name and the number of attempts (three), each participant was given three attempts. The best lift was selected from among the three attempts, following the internationally recognized protocol for determining the optimal lift. Which one the participants warmed up adequately before the test (Yasser, 2014).

Each participant was given three attempts according to the internationally recognized protocol of the International Weightlifting Federation (IWF). The procedures included:

- A standardized warm-up protocol was performed before the test.
- Each attempt was recorded on a form that included the participant's name and attempt number.
- The best lift was selected from the three attempts to determine the level of achievement.
- Predetermined rest periods of 3–5 minutes were taken between attempts.
- The lifting weights were gradually increased according to the participant's performance.

A pilot test conducted on two participants on March 21, 2025, at 8:30 a.m., helped to validate the tests, ensure the suitability of the equipment and instruments, estimate the time required for the tests, and avoid potential errors. The homogeneity of the research sample was also confirmed, as shown in Table (1).

Table 1. Homogeneity of the Research Sample in the Variables (Height - Weight - Age)

| Variables | Mean | Std. Deviations | Median | Skewness |
|-----------|------|-----------------|---------|----------|
| Height | 176 | 0.942 | 175.164 | 0.644 |
| Mass | 69 | 4.959 | 68.632 | 0.841 |
| Age | 20 | 1.932 | 21 | 0.675 |

A skewness coefficient between (± 3) indicates a homogeneous sample that falls under the normal distribution curve.

The researcher conducted the pretest on Wednesday, March 23, 2025. The researcher and his team began the biochemical tests, performed by a specialized team (using the scientific procedure for preserving blood until the variables were measured), at 9:00 AM to measure testosterone and cortisol levels. At 4:00 PM, the clean and jerk lift was performed.

Main Experiment

After coordinating with Al-Kadhimiya Sports Club for Weightlifting and obtaining the necessary approvals to conduct the research experiment on weightlifters, written informed consent was obtained from each participant before the study began. The Ethics Committee of the College of Physical Education and Sports Sciences, University of Baghdad approved all research procedures, including experimental tests and the collection of biological samples.

The researcher developed a three-month (twelve-week) Vitamin D supplementation program, based on the product instructions and the opinions of nutrition and supplement specialists, to provide participants with the supplement safely and effectively. Each participant received the supplement after breakfast, which included healthy fats such as eggs or avocado, at a dose of 800 International Units (IU), according to US FDA guidelines (Abushamma, 2022).

The program was implemented daily for all participants during the club's internal training camp in preparation for local and international championships. A standardized dietary plan was also followed for all participants to ensure consistency in nutritional and physical performance conditions. The post-test was conducted on Monday, June 23, 2025, under the same conditions as the pre-test, and all variables were carefully documented, including time, place, testing method, assistance team, and test sequence, to ensure that the same conditions were maintained during the post-tests.



Statistical Methods

Descriptive statistics (arithmetic mean and standard deviation) and inferential statistical tests, such as the paired samples t-test to compare pre- and post-measurements, as well as Pearson's correlation coefficient, were used to study the relationship between hormone levels and clean and jerk performance. The level of statistical significance was set at ($p \leq 0.05$), as values below this threshold were considered statistically significant.

Results

Presentation, analysis of the results:

Table 2. Arithmetic means, standard deviations, arithmetic mean of differences, its standard deviation, calculated t-value, error level, and significance for the research variables under study for the pre-test and post-test N=50, where N represent advanced weightlifters

| No. | Variables | Measuring unit | Pre-test | | Post-test | | Arithmetic mean of difference | T value calculated | Level Sig | Type Sig |
|-----|-------------------------|----------------|-----------------|--------------------|-----------------|--------------------|-------------------------------|--------------------|-----------|----------|
| | | | Arithmetic mean | Standard deviation | Arithmetic mean | Standard deviation | | | | |
| 1 | Testosterone | ng/dL | 560.000 | 145.686 | 712.400 | 166.727 | 152.400 | 6.385 | .0000 | Sig |
| 2 | Cortisol | µg/dL | 13.820 | 3.629 | 10.500 | 2.786 | 3.320 | 5.821 | .0000 | Sig |
| 3 | Achievement performance | Kg | 132.720 | 13.000 | 139.900 | 9.125 | 7.180 | 6.078 | .0000 | Sig |

Note: Differences were considered statistically significant at $p \leq 0.05$.

Table 3. Meaning, standard deviation, and correlation of testosterone and cortisol with pretest achievement

| Correlations | | | | |
|--------------|---------------------|-------------|----------|--------------|
| | | Achievement | Cortisol | Testosterone |
| Achievement | Pearson Correlation | 1 | 0.076 | 0.103 |
| | Sig. (2-tailed) | | 0.598 | 0.477 |
| | N | 50 | 50 | 50 |

Table 4. Arithmetic mean, standard deviation, and correlation value of testosterone and cortisol with post-test achievement

| Correlations | | | | |
|--------------|---------------------|-------------|----------|--------------|
| | | Achievement | Cortisol | Testosterone |
| Achievement | Pearson Correlation | 1 | 0.626 | 0.525 |
| | Sig. (2-tailed) | | 0.857 | 0.001 |
| | N | 50 | 50 | 50 |

Discussion

Vitamin D is an important hormone that plays a crucial role in many processes. The effect of vitamin D on testosterone levels is significant. Research indicates a relationship between vitamin D and testosterone levels. A study (Hu et al., 2022) showed that increased vitamin D levels lead to increased testosterone levels in men (Vitamin D and testosterone). This is because vitamin D affects Leydig cells in the testes, which produce testosterone. Vitamin D binds to its receptors on these cells, thus enhancing testosterone production.

A study (Monson et al., 2023) indicated that men with vitamin D deficiency were more likely to have lower testosterone levels than those with sufficient vitamin D levels. Testosterone levels are vital for athletic performance, especially in strength sports like weightlifting. In recent years, the importance of vitamin D in promoting overall health and athletic performance has become a subject of increasing interest. Table 2 shows the significant differences between the pre-test and post-test scores, favoring the post-test scores for the variables under investigation. This study aims to explore the effect of vitamin D supplementation at a dose of 800 IU daily on testosterone levels in 50 Olympic weightlifters. Recent studies suggest that vitamin D has positive effects on testosterone levels. According to a study (Monson et al., 2023), researchers demonstrated that vitamin D supplementation can increase testosterone levels in men, particularly those deficient in this vitamin, Vitamin D can also influence the regulation of genes associated with hormone production, thus increasing the efficiency of the manufacturing process.



Another study by (Williams et al., 2023) confirmed that vitamin D supplementation at a dose of 800 IU daily for three months led to a significant increase in testosterone levels in athletes. This suggests that the vitamin is not only important for general health but also essential for optimal athletic performance.

As shown in Table 3, the correlation between performance and testosterone was weak in the pre-test, but a positive correlation emerged in the post-test. If the results show a significant increase in testosterone levels after taking vitamin D supplements, this could have positive effects on athletic performance. Therefore, it may be beneficial to incorporate vitamin D supplements into athletes' diets to enhance performance.

The effect of vitamin D on cortisol: Some studies indicate that vitamin D plays a role in regulating cortisol levels. A study published (Al Refaie et al., 2022) found that vitamin D supplementation Vitamin D may help reduce cortisol levels in individuals with chronic stress, it can influence the adrenal-pituitary-adrenal (HPA) axis, which regulates the body's stress response, by improving the body's stress response. Furthermore, vitamin D may help reduce cortisol secretion (Ali & Khalid, 2018; Yasir et al., 2025; Yasir, Ali, & Alhuseini, 2025).

Recent studies have shown that vitamin D plays a role in regulating the body's stress response via the hypothalamic-pituitary-adrenal (HPA) axis. This is achieved through its influence on cortisol secretion via receptors in brain regions that control hormones, through both genetic and non-genetic pathways (Kulzhanova et al., 2025; Ali & Khalid, 2018). These findings are consistent with those observed in the current study, which recorded a significant decrease in cortisol levels after 12 weeks of daily 800 IU vitamin D supplementation in Olympic weightlifters. This suggests that vitamin D may contribute to reducing the stress response and improving athletic performance.

Testosterone and cortisol levels play a pivotal role in the physical performance of strength athletes, particularly in the clean and jerk and snatch of Olympic weightlifters. Recent studies have shown that vitamin D can influence Leydig cells in the testes, enhancing testosterone production by binding to vitamin D receptors and activating specific gene pathways (Hu et al., 2022). Furthermore, evidence suggests that vitamin D has a regulatory role on the hypothalamic-pituitary-adrenal (HPA) axis, which controls the body's response to physical stress. This may contribute to improved muscle recovery efficiency and hormonal balance during intense training (Al Refaie et al., 2022). Based on these mechanisms, it can be concluded that vitamin D supplementation plays a complementary and strategic role in supporting athletic performance by improving the hormonal environment of muscles and enhancing the effectiveness of the physical response, without revisiting the previously mentioned statistical findings.

In recent years, evidence has shown that vitamin D plays a crucial role in supporting athletic performance, particularly in strength sports such as Olympic weightlifting. Elevated vitamin D levels are associated with the stimulation of Leydig cells in the testes to produce testosterone, a hormone essential for enhancing muscle strength and the ability to perform heavy lifting (Hu et al., 2022). Vitamin D also plays a regulatory role on the hypothalamic-pituitary-adrenal (HPA) axis, contributing to lower levels of cortisol, a stress hormone that can impair athletic performance when elevated (Al Refaie et al., 2022). The results of the current study show that taking 800 IU of vitamin D daily for 12 weeks led to a significant increase in testosterone levels and a decrease in cortisol in 50 Olympic weightlifters. This hormonal balance was reflected positively in athletic performance, as an improvement in weightlifting ability was observed compared to the pre-test. These results support what recent studies have shown about the ability of vitamin D to enhance muscle strength and reduce the effect of hormonal stress, making it an effective supplement for weightlifters who undergo intensive training programs (Kulzhanova et al., 2025).

Studies have shown that vitamin D can improve performance in sports. A study by (Abushamma, 2022) discovered that vitamin D intake enhances the overall physical strength and performance of athletes, which influences the outcome of competitive matches.

Vitamin D helps to control calcium and phosphorus, important muscle nutrients. Vitamin D also increases muscle strength and performance through regulating gene expression that affects muscle hypertrophy (Sist et al., 2023). These processes can work to enhance athletic performance and boost aerobic capacity. According to research, led by (Williams et al., 2023) athletes who were given vitamin D supplements in a daily dose of 800 IU for 3 months significantly improved performance, such as strength and endurance. This highlights the possibility that vitamin D has an effect on sports performance. The



performance enhancing effects of vitamin D supplementation found in the current study can have favorable applications for training plans in athletes and could initiate inclusion of vitamin D supplements into their diets, as increased performance might result in superior competitive results and thereby increase the likelihood to be successful.

Table (4) Represents the, Mean, Standard Deviation and correlation coefficient between testosterone - cortisol – performance In the post-test There is significant relationship between: Testosterone & Performance. Testosterone is an important hormone when it comes to gaining muscle and strength. Strongly in line with the present findings, (Williams et al., 2023) found that testosterone levels were strongly positively associated with performance between athletes such that trainers who had higher testosterone performed better in strength and power task.

Alternatively, cortisol is related to stress induction, which has been demonstrated to have negative effects on performance. Cortisol levels and its relation with performance Studies (Sist et al., 2023) found a negative relationship between cortisol production and after-*vis-a-Dara* level successes. Cortisol elevations are thought to be related to impaired performance ability, emphasizing the need for stress management in order to achieve better athletic performance.

At the same time, if reports indicate higher testosterone and lower cortisol levels after supping with a vitamin D supplement then it could mean that this nutrient has something going for it when it comes to athletic support. This may direct coaches and athletes to the inclusion of vitamin D supplementation in their training, and nutritional plans.

Vitamin D supplementation may have a favorable effect on testosterone and cortisol in the operation of Olympic weightlifters.

Conclusions

- Regular vitamin D intake results in increased blood testosterone.
- Regular vitamin D consumption results in decreased blood cortisol.
- Regular vitamin D consumption leads to higher muscle strength which is evident in the low and high clean and jerk performance.
- The pre-tests indicated that there was no linear relationship between the two variables tested: clean and jerk performance and testosterone.
- The pre-test revealed that there was no linear relationship between the two data sets tested in clean and jerk performance and the other, cortisol.
- The post-test indicated that the increase in the clean and jerk performance indicated a linear relationship to the testosterone.
- The post-test showed that there was no linear relationship between the two data sets tested: clean and jerk performance and cortisol.

Recommendations

- It is important to enhance testosterone levels, since they have a high influence in physical performance and undoubtedly in sports training programs.
- Additional research may be useful in explaining the inter-relationships of these variables.
- The period of experiment and the number of samples should be extended to disclose other results.
- The dose of the vitamin D supplement should be escalated according to due medical consideration.

- The results suggest that additional studies with other food supplements must be undertaken to explain the no-significant of these variables.
- The sample consisted of non-weightlifters.

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