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# Impact of nutritional supplements on kidney function in bodybuilders: a cross-sectional study

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## أثر المكملات الغذائية على وظائف الكلى لدى لاعبي كمال الأجسام: دراسة مقطعية

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**Abstract:**
The use of dietary supplements among bodybuilders has become increasingly prevalent, as individuals seek to enhance their athletic performance and achieve optimal muscle hypertrophy. Although these supplements may offer performance benefits, there is growing concern about their potential adverse effects on kidney function, particularly because the kidneys play a vital role in filtering waste products and maintaining fluid and electrolyte balance. This study aims to investigate the impact of common dietary supplements on kidney function parameters in bodybuilders. A cross-sectional analytical study was conducted involving 100 male bodybuilders aged 16 to 40 years. Participants were categorized into two groups: 50 individuals who used supplements and 50 who did not. Demographic data and supplement usage information were collected. Venous blood samples were drawn to assess kidney function markers, including serum urea, creatinine, sodium (Na), and potassium (K) levels. Data analysis was performed using SPSS version 26. Statistical significance was evaluated using independent t-tests and Pearson correlation analysis. Participants who used supplements showed significantly higher levels of urea (35.02 mg/dL vs. 29.06 mg/dL, p=0.001) and creatinine (1.08 mg/dL vs. 0.976 mg/dL, p=0.002) compared to non-users. Additionally, sodium levels were lower in supplement users (140.54 mmol/L) compared to non-users (141.65 mmol/L), with this difference being statistically significant (p=0.020). No significant difference was found in potassium levels between the two groups (p=0.584). A weak positive correlation was observed between the duration of supplement use and the levels of urea, creatinine, and potassium, while a slight negative correlation was noted with sodium. However, none of these correlations reached statistical significance. The study highlights a potential association between the use of common dietary supplements and altered kidney function markers in bodybuilders. The findings suggest that prolonged or excessive use of these supplements may contribute to renal stress or dysfunction. Therefore, it is advisable for bodybuilders and healthcare professionals to exercise caution regarding supplement use and to monitor renal function periodically.

**Keywords**: Dietary Supplements, Anabolic Androgenic Steroids (AAS), Bodybuilders, Urea, Creatinine, Electrolytes, Kidney Function.

**الملخص**
أصبح استخدام المكملات الغذائية بين لاعبي كمال الأجسام منتشرًا بشكل متزايد، حيث يسعى الأفراد إلى تعزيز أدائهم الرياضي وتحقيق تضخم عضلي مثالي. على الرغم من أن هذه المكملات الغذائية قد تقدم فوائد في الأداء، إلا أن هناك قلقاً متزايداً بشأن آثارها السلبية المحتملة على وظائف الكلى، خاصةً لأن الكلى تلعب دوراً حيوياً في تصفية الفضلات والحفاظ على توازن السوائل والكهارل. تهدف هذه الدراسة إلى دراسة تأثير المكملات الغذائية الشائعة على معايير وظائف الكلى

لدى لاعبي كمال الأجسام. أُجريت دراسة تحليلية مقطعية مستعرضة شملت 100 من لاعبي كمال الأجسام الذكور الذين تتراوح أعمارهم بين 16 و40 عاماً. تم تصنيف المشاركين إلى مجموعتين: 50 شخصاً استخدموا المكملات الغذائية و50 شخصاً لم يستخدموها. تم جمع البيانات الديموغرافية ومعلومات استخدام المكملات الغذائية. سُحبت عينات الدم الوريدي لتقييم علامات وظائف الكلى، بما في ذلك مستويات اليوريا والكرياتينين والصوديوم والبوتاسيوم في الدم. تم تحليل البيانات باستخدام الإصدار 26 من برنامج SPSS. تم تقييم الدلالة الإحصائية باستخدام اختبارات ت المستقلة وتحليل ارتباط بيرسون. أظهر المشاركون الذين استخدموا المكملات الغذائية مستويات أعلى بكثير من اليوريا (35.02 ملغم/ديسيلتر مقابل 29.06 ملغم/ديسيلتر، p=0.001) والكرياتينين (1.08 ملغم/ديسيلتر مقابل 0.976 ملغم/ديسيلتر، p=0.002) مقارنة بغير المستخدمين. وبالإضافة إلى ذلك، كانت مستويات الصوديوم أقل لدى مستخدمي المكملات الغذائية (140.54 مليمول/لتر) مقارنة بغير المستخدمين (141.65 مليمول/لتر)، وكان هذا الفرق ذو دلالة إحصائية (P=0.020 ).
لم يتم العثور على فرق كبير في مستويات البوتاسيوم بين المجموعتين (p=0.584). ولوحظ وجود ارتباط إيجابي ضعيف بين مدة استخدام المكملات الغذائية ومستويات اليوريا والكرياتينين والبوتاسيوم، بينما لوحظ وجود ارتباط سلبي طفيف مع الصوديوم. ومع ذلك، لم تصل أي من هذه الارتباطات إلى دلالة إحصائية. تسلط الدراسة الضوء على وجود ارتباط محتمل بين استخدام المكملات الغذائية الشائعة وتغير علامات وظائف الكلى لدى لاعبي كمال الأجسام. تشير النتائج إلى أن الاستخدام المطول أو المفرط لهذه المكملات الغذائية قد يساهم في إجهاد الكلى أو الخلل الوظيفي. لذلك، يُنصح لاعبو كمال الأجسام وأخصائيو الرعاية الصحية بتوخي الحذر فيما يتعلق باستخدام المكملات الغذائية ومراقبة وظائف الكلى بشكل دوري.

**الكلمات المفتاحية:** المكملات الغذائية، الستيرويدات الأندروجينية الابتنائية (AAS)، لاعبو كمال الأجسام، اليوريا، الكرياتينين، الإلكتروليتات، وظائف الكلى.

**Introduction**

Weightlifting and bodybuilding have become increasingly popular activities across the globe. In pursuit of enhanced performance, strength, and muscle mass, many athletes and fitness enthusiasts turn to various performance-enhancing drugs (PEDs), including dietary supplements. These supplements often include substances such as protein powders, creatine, amino acids, and anabolic androgenic steroids (AAS) [1, 2]. While their use may yield desired physical results, the potential health risks, particularly concerning renal function, are not fully understood and are frequently underestimated.

Dietary supplements are commonly consumed without adequate medical oversight or understanding of their physiological impact. Although some supplements may be beneficial in specific contexts such as when dietary intake is inadequate or food options are limited, their indiscriminate use can pose significant risks [3]. Doping, defined as the use of prohibited substances by athletes to gain a competitive advantage, is a well-documented phenomenon. The World Anti-Doping Agency (WADA) has banned many of these substances, including AAS, which are among the most commonly abused agents [1].

Beyond AAS, other classes of drugs, such as stimulants and peptide hormones, are also misused in sports. Supplements like creatine, caffeine, and alkalinizing agents have been shown to enhance high-intensity performance. However, despite their popularity, most of these supplements lack conclusive evidence of efficacy across different sports disciplines [3]. Moreover, unregulated supplements may contain undisclosed or banned substances, increasing the risk of adverse outcomes and positive doping tests.

AAS and similar substances are often used by both athletes and non-athletes to increase lean muscle mass and physical strength. These agents are associated with a range of side effects that are dose-dependent and may be irreversible. Reported adverse outcomes include infertility, gynecomastia in men, virilization in women, hepatic neoplasms, cardiovascular issues, tendon injuries, and psychological disturbances [4]. Among these, renal damage has gained increased attention as the kidneys serve as key organs in the metabolism and excretion of xenobiotics. The liver and kidneys are the primary organs involved in metabolizing and excreting exogenous substances, including those found in dietary supplements. Of particular concern is the potential for these supplements to increase nitrogenous waste, which may overload renal filtration mechanisms and lead to glomerular injury [5, 6]. Elevated serum levels of urea and creatinine are commonly used clinical markers for assessing renal function. The persistence of elevated nitrogenous metabolites may indicate hyperfiltration and increased glomerular pressure, thereby predisposing individuals to acute kidney injury (AKI) and eventually chronic kidney disease (CKD) [7, 8, 9].

This study was undertaken to examine whether commonly used dietary supplements affect renal function among male bodybuilders in Libya. The investigation focused on detecting any deviations in serum urea, creatinine, sodium, and potassium levels and establishing correlations with the duration and type of supplement use.

## Material and methods

### Study design and setting

The study employed a cross-sectional design and was conducted in Tripoli, Libya, from June to July 2023. Blood samples were analyzed at Crown of Health Laboratory.

### Participant selection

A total of 100 male bodybuilders aged 16 to 40 years were recruited from various gyms including Al-Shat Gym, Omega Fit, and others. The study sample was divided into two groups: 50 individuals who regularly used dietary supplements and 50 who did not. Participants with a history of chronic kidney disease, inflammatory disorders, acute or chronic infections, hematological conditions, or alcoholism were excluded.

### Data and sample collection

Demographic details (age, weight), training background, and supplement usage (type, duration) were collected via structured interviews. Blood (3 mL) was drawn from the antecubital vein under aseptic conditions. Serum was separated via centrifugation (10 minutes at 4000 rpm) and analyzed for urea, creatinine, Na, and K.

### Laboratory analysis

Demographic data, including age, gender, body weight, and type of supplement used, were systematically recorded for each participating bodybuilder through a standardized data collection form. These details were obtained prior to sample collection to ensure accurate stratification of the study population.

A total of 3 mL of venous blood was aseptically collected from the antecubital vein of each subject using sterile, disposable syringes. The blood samples were transferred into plain (non-heparinized) test tubes and allowed to clot. Following clot formation, the samples were centrifuged at 4000 revolutions per minute (rpm) for 10 minutes to separate the serum from the cellular components.

The obtained serum samples were analyzed for renal function biomarkers, including urea, creatinine, sodium ($Na^+$), and potassium ($K^+$). Biochemical assessments were performed using a BTS-350 semi-automated chemistry analyzer. For the estimation of urea levels, the Biomagreb (Tunisia) diagnostic kit was employed. Serum creatinine concentrations were measured using the Biolabo kit (Biolabo S.A.S, France), while electrolyte analysis ($Na^+$ and $K^+$) was conducted using a MEDICA electrolyte analyzer (Bedford, MA 01730, USA).

All procedures adhered to standard laboratory safety and quality control protocols to ensure the reliability and reproducibility of the results.

### Procedures

#### Urea estimation

Three cuvettes were prepared and labeled as Blank, Standard, and Test Sample. To each cuvette, 1 mL of the working reagent (prepared by mixing R2 with R1) was added. Subsequently, 10 µL of the standard solution was added to the Standard cuvette, while 10 µL of the serum sample was added to the Test Sample cuvette. All cuvettes were incubated at room temperature for 5 minutes. Following the initial incubation, 1 mL of R4 was added to each cuvette, and the cuvettes were incubated for an additional 5 minutes. After a total of 10 minutes, the cuvettes were placed sequentially into the BTS-350 analyzer in the order of Blank, Standard, and Test Sample for absorbance reading and result recording. The reference range for serum urea concentration is 10–50 mg/dL.

#### Creatinine estimation

Similarly, three cuvettes were labeled as Blank, Standard, and Test Sample. Each cuvette received 500 µL of reagent R1. Then, 100 µL of the standard solution was added to the Standard cuvette, and 100 µL of the serum sample was added to the Test Sample cuvette. The cuvettes were then loaded into the BTS-350 analyzer in the sequence of Blank, Standard, and Test Sample to measure and record the creatinine concentration. The normal reference range for serum creatinine is 0.8–1.4 mg/dL.

#### Electrolyte analysis (Sodium and Potassium)

For the analysis of serum electrolytes ($Na^+$ and $K^+$), the collected serum was transferred into a microtube. The tube was then inserted into the Medica electrolyte analyzer, where the sample was aspirated through a built-in needle for automated analysis. Results for serum sodium and potassium levels were recorded accordingly. The reference range for serum sodium is 136–145 mmol/L, while that for potassium is 3.5–5.5 mmol/L.

### Statistical analysis

Data were entered into Microsoft Excel and analyzed using SPSS version 26. Independent t-tests were used to assess group differences. Pearson correlation was applied to examine associations between duration of supplement use and renal function markers. Significance was set at $p<0.05$.

## Results

### Participant demographics

The average age of supplement users was 27.56 ± 6.45 years, compared to 24.78 ± 7.08 years in non-users (p=0.043) (Table 1). Body weight was slightly higher in the supplement group (82.56 ± 10.65 kg) than in the non-user group (78.29 ± 12.97 kg).

**Table 1.** The clinical characteristics of supplement users compared to non-supplement users.

| Characteristic | Uses supplements (N=50) | | | Does not use Supplements (N=50) | | |
|---|---|---|---|---|---|---|
| | Range | Mean | SD | Range | Mean | SD |
| **Urea (mg/dl)** | 20-60 | 35.02 | 8.99 | 16-52 | 29.06 | 8.01 |
| **Creatinine (mg/dl)** | 0.8-1.4 | 1.08 | 0.17 | 0.7-1.4 | 0.976 | 0.16 |
| **Na (mmol/L)** | 135-144.9 | 140.54 | 2.25 | 136.8-147.3 | 141.65 | 2.43 |
| ***K (mmol/L)*** | 3.2-4.91 | 4.08 | 0.35 | 3.53-5.49 | 4.12 | 0.36 |

### Biochemical findings

Supplement users demonstrated significantly higher mean urea levels (35.02 mg/dL) than non-users (29.06 mg/dL), with a p-value of 0.001 (Figure 1). Similarly, creatinine levels were elevated in supplement users (1.08 mg/dL) compared to non-users (0.976 mg/dL), with p=0.002. Sodium concentrations were slightly lower in supplement users (140.54 mmol/L) compared to non-users (141.65 mmol/L), with statistical significance (p=0.020). Potassium levels did not differ significantly between groups (4.08 vs. 4.12 mmol/L; p=0.584).

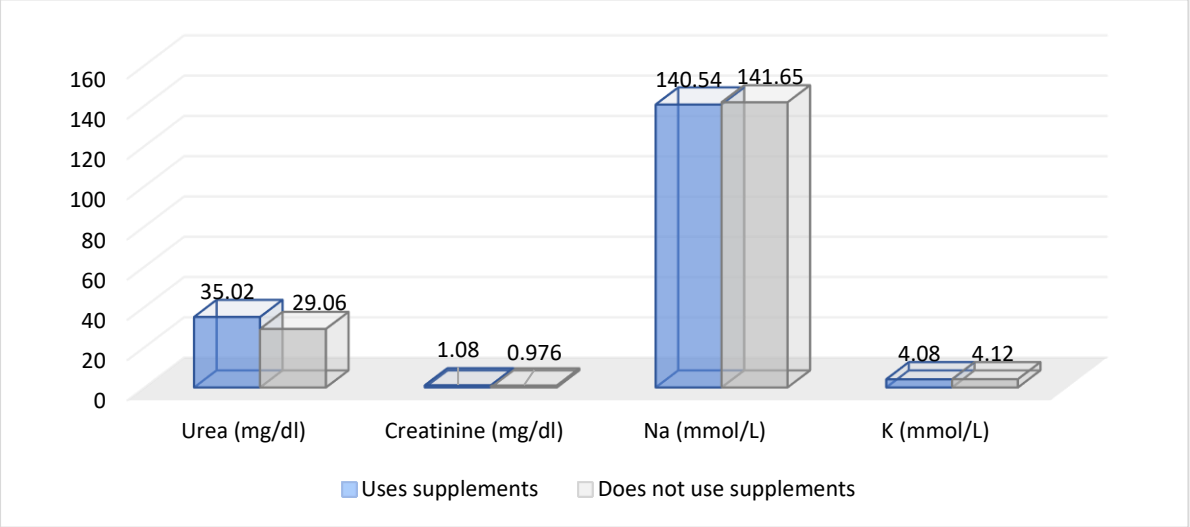


**Figure 1.** The mean clinical characteristics of the study groups.

### Correlation with duration of supplement

Use Pearson correlation revealed weak positive associations between the duration of supplement use and levels of urea (r=0.204), creatinine (r=0.145), and potassium (r=0.234) (Table 2). Sodium showed a weak negative correlation (r=-0.049). However, none of these correlations were statistically significant (Figure 2).

**Table 2.** Results of Pearson's correlation of variables in supplement users.

| Parameter | Pearson's correlation coefficient (r) | P-value |
|---|---|---|
| Duration of supplement (in months) | | |
| Urea (mg/dl) | 0.204 | 0.156 |
| Creatinine (mg/dl) | 0.145 | 0.315 |
| Na (mmol/L) | -0.049 | 0.738 |
| K (mmol/L) | 0.234 | 0.102 |

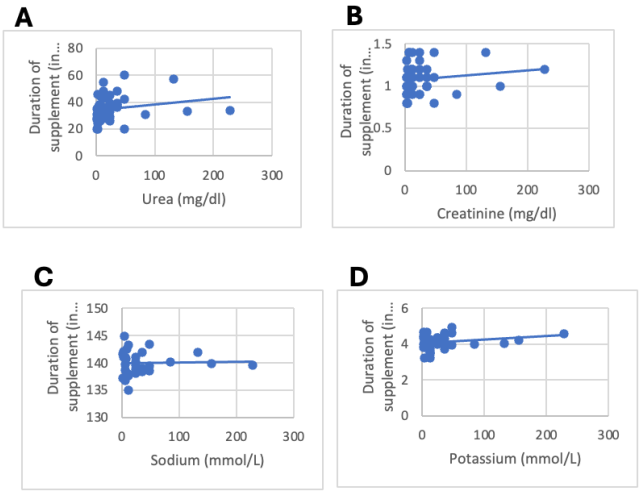


**Figure 2.** Correlation between duration of supplement and Urea U (A) and Creatinine C (B), Sodium Na (C), and Potassium K (D).

**Supplement usage distribution**

Table 4 presents the frequency and corresponding proportions of the various types of supplements employed by the study participants. The most commonly used supplements were creatine (68%), whey protein (52%), and amino acids (40%). Others included multivitamins (22%), steroids (20%), mass-protein (18%), iso-protein (14%), omega-3 (8%), and miscellaneous products (18%).

**Table 3.** Frequency of the supplements used by the research participants.

| ***Supplement*** | ***Frequency (N)*** | ***Percentage (%)*** |
|---|---|---|
| *WHEY protein* | 26 | 52% |
| *Amino acids* | 20 | 40% |
| *Multi-vitamins* | 11 | 22% |
| *Creatine* | 34 | 68% |
| *Iso-protein* | 7 | 14% |
| *Steroids* | 10 | 20% |
| *Mass-protein* | 9 | 18% |
| *Omega-3* | 4 | 8% |
| *Other* | 9 | 18% |

**Discussion**

In the quest to enhance physical performance and accelerate muscle hypertrophy, bodybuilders often incorporate dietary supplements into their training regimens. While these supplements may provide performance benefits, their potential effects on vital organ systems particularly renal function warrant careful evaluation. The kidneys serve a fundamental role in maintaining homeostasis by filtering metabolic waste, regulating electrolytes, and ensuring fluid balance. Therefore, any alterations in renal function could have significant implications for overall health and athletic performance [10–12].

This study aimed to evaluate the impact of commonly used supplements on kidney function markers among bodybuilders. Our findings indicate that supplementation is associated with significant changes in renal biochemical parameters. Specifically, serum urea levels were significantly elevated in supplement users compared to non-users ($p = 0.001$), a trend consistent with previous studies that have observed elevated nitrogenous waste products following protein-rich supplementation [6,13]. These findings suggest a possible increase in protein metabolism and nitrogen load, both of which can influence urea concentrations.

Similarly, serum creatinine levels were significantly higher among supplement users ($p = 0.002$), echoing results from prior research [13–15]. This elevation may be attributed to the metabolic breakdown of creatine—a common component in many supplements which increases creatinine production. These results reinforce concerns that prolonged or excessive use of certain ergogenic aids could burden renal filtration processes.

Electrolytes, particularly sodium and potassium, play essential roles in fluid regulation, neuromuscular function, and cellular signaling [16]. In our cohort, sodium levels were significantly elevated in supplement users ($p = 0.020$), with an average concentration of 140.54 mmol/L. However, this finding contrasts with earlier reports, such as that of [17], who observed lower sodium levels (mean 121.8 mmol/L) among bodybuilders. Such

discrepancies may stem from variations in study populations, dietary intake, hydration status, and measurement methodologies.

Potassium levels among supplement users averaged 4.08 mmol/L, which closely aligns with the findings of [17], who reported a mean value of 3.92 mmol/L. Nevertheless, our study did not find a statistically significant difference in potassium levels between supplement users and non-users ($p = 0.584$). This similarity may reflect overlapping dietary patterns among participants, particularly the consumption of potassium-rich foods such as fruits, vegetables, and legumes [18,19].

Analysis of the relationship between the duration of supplement use and kidney function parameters revealed a mild positive correlation for urea, creatinine, and potassium. Interestingly, sodium levels showed an inverse correlation with duration of supplement intake. These trends highlight the complex interplay between the intensity and duration of supplement use, metabolic demand, and renal physiology [20]. Prolonged exposure to high metabolic loads, as seen in regular supplement use, may gradually influence renal excretory function and electrolyte homeostasis.

**Conclusion**

In conclusion, this study contributes valuable insights into the effects of common dietary supplements on kidney function markers among bodybuilders. The findings demonstrate that supplement use is significantly associated with elevated levels of urea and creatinine, indicative of increased renal workload or metabolic byproduct accumulation. Although sodium levels were also elevated among supplement users, potassium levels did not differ significantly between groups. Notably, the duration of supplement use exhibited a mild positive correlation with urea, creatinine, and potassium, and a negative correlation with sodium levels.

These findings underscore the importance of monitoring kidney function in individuals who engage in long-term or high-dose supplementation, especially within the context of intensive physical training. Future studies with larger sample sizes, controlled dietary intake, and longitudinal designs are warranted to better understand the long-term renal implications of supplement use in athletic populations. This research lays the groundwork for more comprehensive investigations into the balance between performance enhancement and physiological safety in bodybuilding.

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