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Dietary Supplements, Resistance Training, and Kidney Stone Risk: A Narrative Review

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Abstract

Background. Dietary supplements are widely used by resistance-trained individuals to support hypertrophy, strength, recovery, and performance. Nephrolithiasis is a recurrent condition influenced by urine volume, urinary pH, calcium, oxalate, uric acid, citrate, sodium intake, and dietary patterns.

Aim. The aim of this narrative review was to analyse the potential relationship between common gym supplements and risk factors for kidney stone formation.

Material and methods. A narrative literature review was conducted using PubMed, Scopus, Web of Science, ScienceDirect, Google Scholar, urological guidelines, and sports nutrition position statements. The synthesis focused on protein supplements, creatine, vitamin C, calcium, vitamin D, caffeine-containing pre-workout products, hydration, and dietary context.

Results. The main concerns relate to high-dose vitamin C, excessive non-dairy animal protein intake, high sodium intake, low urine volume, and poorly supervised calcium or vitamin D supplementation in predisposed individuals. Recommended-dose creatine is not convincingly linked with nephrolithiasis in healthy users.

Conclusions. Supplement use should be interpreted within total diet, hydration, training conditions, and individual stone risk. Prevention includes adequate fluid intake, moderate protein intake, sodium restriction, sufficient dietary calcium, avoidance of excessive vitamin C, and medical evaluation in recurrent stone formers.

Keywords: resistance training, dietary supplements, nephrolithiasis, kidney stones, protein supplements, creatine, vitamin C, hydration

1. Introduction

Dietary supplements have become an ordinary component of resistance training culture. Protein powders, creatine monohydrate, pre-workout formulas, vitamin preparations, mineral products, and various ergogenic aids are marketed to recreational gym users and competitive athletes as convenient tools for increasing muscle mass, improving strength, accelerating recovery, or supporting body composition goals. The use of supplements is particularly common in bodybuilding and strength-oriented environments, where users often combine multiple products with high-protein diets and intensive training routines [14, 27].

Nephrolithiasis, also referred to as kidney stone disease or urolithiasis, is a multifactorial disorder in which crystals form in the urinary tract when the urine becomes supersaturated with stone-forming substances. The most frequent stones contain calcium oxalate, although calcium phosphate, uric acid, struvite, and cystine stones also occur. Stone formation is not caused by one isolated factor; rather, it reflects the interaction of urine volume, urinary pH, calcium, oxalate, uric acid, citrate, sodium intake, dietary acid load, fluid balance, genetic predisposition, metabolic disease, and environmental exposure [20, 23].

The relationship between gym supplements and kidney stones is therefore complex. A supplement may influence stone risk directly, for example by increasing urinary oxalate after high-dose vitamin C intake, or indirectly, for example by contributing to a dietary pattern rich in animal protein and sodium. In other cases, public concern may exceed the available evidence. Creatine is a good example: it may increase serum creatinine because creatinine is a breakdown product of creatine, yet this laboratory change does not automatically indicate reduced glomerular filtration or stone formation [16, 18].

Resistance-trained individuals also face sport-specific contextual factors. Long sessions, high sweat rates, training in warm environments, use of stimulant-containing products, and inadequate fluid replacement can reduce urine volume and increase urinary concentration. Low urine volume is one of the most consistent and modifiable risk factors for all major stone types. In a classic randomized study, increasing water intake reduced recurrence in idiopathic calcium stone formers, and current guidelines continue to emphasize fluid intake sufficient to achieve high urine output [5, 19].

The topic is important because many gym users self-prescribe supplements without medical or dietetic supervision. They may also interpret kidney risk in a simplistic way, believing either that all supplements are dangerous or that all legal supplements are harmless. A narrative review is useful in this context because the evidence comes from several areas: urology, nephrology, nutrition, sports science, physiology, and supplement safety research. These fields do not always address the same outcomes, and direct trials measuring kidney stone events after supplement use remain limited.

Research objective. The aim of this narrative review was to analyse and synthesize current scientific knowledge concerning the potential relationship between dietary supplements commonly used by resistance-trained individuals and the risk of nephrolithiasis, with particular attention to protein supplements, creatine, vitamin C, calcium, vitamin D, caffeine-containing pre-workout products, hydration status, and overall dietary context.

Research problems. The review was guided by three research problems: first, which commonly used gym supplements may influence urinary risk factors for kidney stone formation; second, whether the risk is likely to result from the supplement itself, the dose, the total diet, dehydration, or pre-existing predisposition; and third, what practical preventive recommendations can be derived for physically active individuals.

2. Research materials and methods

This paper was designed as a narrative review. The purpose of the narrative approach was to provide a broad interpretative synthesis of literature relevant to supplement use in resistance training and kidney stone risk. Unlike a systematic review or meta-analysis, this article did not aim to calculate pooled effect sizes. Instead, it grouped findings thematically and interpreted them in relation to mechanisms of stone formation, supplement categories, and practical implications for resistance-trained populations.

The literature search was conducted using PubMed, Scopus, Web of Science, ScienceDirect, Google Scholar, urological guideline documents, and position stands in sports nutrition. Search terms included combinations of: kidney stones, nephrolithiasis, urolithiasis, resistance training, bodybuilding, gym supplements, protein supplement, whey protein, animal protein, creatine, vitamin C, ascorbic acid, calcium supplementation, vitamin D supplementation, caffeine, pre-workout, hydration, urine volume, urinary citrate, urinary oxalate, urinary calcium, and uric acid stones.

The search prioritized peer-reviewed publications, clinical guidelines, systematic reviews, narrative reviews, randomized trials, prospective cohort studies, metabolic studies, and studies relevant to athletes or resistance-trained individuals. Older publications were included when they represented landmark evidence, such as randomized data on water intake and recurrence prevention. Recent guidelines and reviews were used to frame current recommendations.

Inclusion criteria were: publications in English; articles directly related to kidney stone pathophysiology, prevention, dietary risk factors, supplements, or sports nutrition; peer-reviewed articles or formal guidelines; and studies providing mechanistic, clinical, or practical information relevant to the research objective. Exclusion criteria were: non-scientific commercial sources, papers without sufficient methodological description, publications unrelated to nephrolithiasis or supplement use, and duplicate sources. Because this was a narrative review, no formal PRISMA flow diagram was prepared.

The collected literature was analysed using narrative synthesis. Findings were grouped into thematic categories: general mechanisms of stone formation; hydration and training-related factors; protein supplements and high-protein diets; creatine; vitamin C; calcium and vitamin D; caffeine and pre-workout products; practical risk stratification; and prevention. The interpretation emphasized the difference between direct evidence on kidney stone events and indirect evidence based on urinary risk markers.

No statistical software was used because this study did not include original quantitative data or meta-analysis.

Table 1. Search strategy and narrative synthesis framework.

Element	Description
Databases and sources	PubMed, Scopus, Web of Science, ScienceDirect, Google Scholar, urological guidelines, and sports nutrition position statements.
Search concepts	Nephrolithiasis, kidney stones, resistance training, gym supplements, whey protein, creatine, vitamin C, calcium, vitamin D, caffeine, pre-workout, hydration, urine volume, oxalate, calcium, citrate, uric acid.
Inclusion criteria	English-language peer-reviewed studies, guidelines, reviews, clinical studies, cohort studies, metabolic studies, and sport nutrition publications directly related to the topic.
Exclusion criteria	Commercial webpages, duplicate records, non-scientific sources, publications without relevant outcomes, and articles not connected with supplementation, diet, kidney stone prevention, or urinary risk factors.
Synthesis method	Narrative synthesis with thematic grouping by

Element	Description
	supplement category, urinary mechanism, and practical relevance for resistance-trained individuals.

Source: Own elaboration.

3. Results of the narrative review

3.1. Pathophysiological background of nephrolithiasis

This subsection draws mainly on recent mechanistic reviews of urinary stone formation, especially the descriptions of supersaturation, crystallization, inhibitors, and recurrence mechanisms provided by Peerapen and Thongboonkerd [20] and Tamborino et al., [23].

Kidney stone formation begins when urine becomes supersaturated with substances that can crystallize. Supersaturation is influenced by the concentration of promoters such as calcium, oxalate, phosphate, uric acid, and cystine, as well as by urine volume and pH. Once supersaturation occurs, crystal nucleation, growth, aggregation, and retention may follow. Inhibitors such as citrate, magnesium, and certain urinary macromolecules reduce crystallization by binding calcium or modifying crystal growth [20, 23].

For resistance-trained individuals, the most relevant biochemical factors are low urine volume, hypercalciuria, hyperoxaluria, hyperuricosuria, hypocitraturia, high sodium intake, high dietary acid load, and low urinary pH. These factors may be influenced by hydration habits, protein source and dose, sodium intake from processed foods, use of high-dose vitamins, and training conditions. Therefore, the supplement-stone relationship should be evaluated through the lens of urinary chemistry rather than through general assumptions about kidney toxicity.

Low urine volume is especially important because it increases the concentration of lithogenic substances regardless of the stone type. A person with high urinary calcium or oxalate may not form stones if urine remains sufficiently dilute, whereas the same biochemical profile can become problematic when urine output is persistently low. This mechanism is particularly relevant to athletes, bodybuilders, and recreational gym users who sweat heavily but do not compensate fluid losses.

3.2. Hydration, sweat loss, and resistance training context

The hydration-related interpretation is based primarily on the AUA and EAU guideline recommendations for urine dilution and recurrence prevention, together with athlete-specific 24-hour urine observations reported by Theisen et al., [25] and recurrence data from Borghi et al., [5].

Adequate fluid intake is a cornerstone of kidney stone prevention. The American Urological Association recommends that stone formers should achieve a urine volume of at least 2.5 L daily, and the European Association of Urology similarly emphasizes high fluid intake and urine dilution as general preventive measures [19, 21]. In practical terms, resistance-trained individuals should not evaluate hydration only by thirst during training, because thirst may lag behind fluid loss and does not directly reflect 24-hour urine volume.

Exercise does not necessarily increase kidney stone risk. Moderate physical activity may be associated with healthier body composition, improved insulin sensitivity, and lower metabolic risk. However, intense exercise combined with inadequate hydration can reduce urine volume and concentrate calcium, oxalate, sodium, and uric acid. Student athletes have been reported to show a high prevalence of urinary risk factors such as dehydration, high urinary calcium, high uric acid, and high sodium excretion [25].

In gym settings, the risk may be amplified by practices such as training in hot rooms, wearing heavy clothing to increase sweating, cutting weight, using diuretic or stimulant products, and replacing water with high-sugar drinks. These behaviors are not inherent to resistance training but may occur in bodybuilding and combat-sport cultures. Therefore, risk prevention should address behavioral patterns rather than simply warning against exercise.

3.3. Protein supplements and high-protein dietary patterns

The discussion of protein intake is based on dietary stone-risk reviews and meta-analyses by Asoudeh et al., [3] and Ferraro et al., [11], supplemented by whey-protein-specific observations from Hattori et al., [13] and experimental high-whey-protein data from Aparicio et al., [2].

Protein powders are among the most common supplements used by resistance-trained individuals. Whey protein, casein, albumin, and plant-based protein isolates are usually consumed to increase daily protein intake, improve convenience, and support muscle protein synthesis. In healthy active individuals, protein supplementation within appropriate total daily intake is not synonymous with kidney damage. Nevertheless, kidney stone risk is not the same endpoint as chronic kidney disease, and high protein intake can influence urinary chemistry relevant to lithogenesis.

High intake of non-dairy animal protein may increase urinary calcium and uric acid, lower urinary citrate, and reduce urine pH. These changes may increase the risk of both calcium-containing stones and uric acid stones. Reviews and meta-analyses suggest that non-dairy animal protein, total meat, red meat, and processed meat are more consistently associated with kidney stone risk than total protein intake alone [3, 11].

Whey protein deserves separate attention because it is a supplement rather than a whole food. A short metabolic study found that whey protein and albumin supplementation may affect urinary risk factors for stone formation, although the intervention was brief and involved healthy volunteers [13]. Animal studies have also suggested that high-whey-protein diets can increase urinary acidity and calcium and reduce citrate, changes that could theoretically promote calcium stone formation over time [2].

These findings do not prove that typical whey protein use causes kidney stones. They indicate that protein powders should be assessed as part of total protein intake, sodium intake, calcium intake, hydration, and personal history of stones. A resistance-trained adult who consumes moderate protein, drinks enough fluid, maintains adequate dietary calcium, and has no stone history is different from a recurrent stone former consuming very high protein, high sodium, little fruit and vegetables, and low fluid intake.

The source of protein may also matter. Dairy calcium consumed with meals can bind oxalate in the intestinal lumen and reduce oxalate absorption, which may explain why low-calcium diets are not recommended for most calcium oxalate stone formers. A diet rich in fruits, vegetables, low-fat dairy, and moderate protein, such as a DASH-style pattern, has been associated with a lower risk of kidney stones [24]. This is relevant because gym diets are sometimes built around isolated protein products while neglecting fruits, vegetables, and balanced meals.

3.4. Creatine supplementation

The creatine subsection relies on the International Society of Sports Nutrition position stands by Buford et al., [6] and Kreider et al., [15], the kidney-focused narrative review by Longobardi et al., [16], the systematic review and meta-analysis by Naeini et al., [18], and the stone-recurrence case report by Akbari et al., [1].

Creatine monohydrate is one of the best studied ergogenic aids in sports nutrition. It supports rapid ATP resynthesis during high-intensity exercise and is commonly used to improve strength, power, and training adaptations. Sports nutrition position stands describe creatine as effective and generally safe for healthy individuals when used within recommended protocols [6, 15].

Public concern about creatine and kidney health often arises from the relationship between creatine and creatinine. Creatinine is produced from creatine and phosphocreatine metabolism, and serum creatinine is commonly used as a marker of kidney function. Supplementation may increase serum creatinine slightly, which can lead to an apparent decline in estimated glomerular filtration rate even when true kidney filtration is unchanged. For this reason, creatine users should not be evaluated only by serum creatinine when clinical suspicion exists; cystatin C, measured GFR, urinalysis, albuminuria, clinical context, and medication history may be relevant [16, 18].

The direct evidence linking creatine to kidney stone formation is weak. A case report of creatine use in an athlete with a history of kidney stones did not demonstrate recurrence after supplementation, although a case report cannot establish safety for all users [1]. A recent systematic review and meta-analysis found that creatine supplementation was associated with a modest increase in serum creatinine but no significant reduction in GFR, suggesting that standard dosing does not impair kidney filtration in the studied populations [18].

It would still be inappropriate to conclude that creatine is risk-free for every person. Individuals with chronic kidney disease, recurrent stones, nephrocalcinosis, uncontrolled hypertension, use of nephrotoxic drugs, dehydration practices, or very high-dose supplement regimens require more caution. However, current evidence does not support the common claim that recommended-dose creatine independently causes kidney stones in healthy resistance-trained individuals.

3.5. Vitamin C supplementation and oxalate formation

The information on vitamin C is derived mainly from the prospective cohort analysis by Thomas et al., [26], which linked supplemental ascorbic acid intake with stone incidence in men, and from EAU guidance noting the relevance of excessive vitamin C intake in calcium oxalate stone formers [21].

Vitamin C is common in multivitamins, immune-support products, and pre-workout or recovery formulas. It is also frequently taken in high doses because many users perceive water-soluble vitamins as harmless. This assumption is problematic for stone prevention because ascorbic acid can be metabolized to oxalate, and urinary oxalate is a major determinant of calcium oxalate supersaturation.

A prospective study in men reported that supplemental ascorbic acid intake of approximately 1000 mg daily was associated with increased kidney stone incidence [26]. European urological guidance notes that vitamin C is a precursor of oxalate and that calcium oxalate stone formers should avoid excessive intake, even though the overall relationship remains partly debated [21].

For resistance-trained individuals, vitamin C risk may be hidden because high-dose ascorbic acid can be included in several products at once. A person may consume a multivitamin, an immune supplement, fortified pre-workout powder, and additional tablets, producing a daily intake far above nutritional requirements. The practical recommendation is not to avoid fruits and vegetables, but to avoid chronic high-dose supplemental vitamin C, especially in men, recurrent calcium oxalate stone formers, and people with known hyperoxaluria.

3.6. Calcium supplementation, dietary calcium, and vitamin D

This subsection is based on the distinction between dietary calcium and supplemental calcium discussed by Curhan et al., [7], Sorensen [22], and Bargagli et al., [4], as well as clinical trial evidence on calcium and vitamin D supplementation reported by Wallace et al., [28] and Malihi et al., [17].

Calcium is often misunderstood in kidney stone prevention. Because most stones contain calcium, patients may assume that low calcium intake is protective. However, low dietary calcium can increase intestinal oxalate absorption and raise urinary oxalate, thereby increasing calcium oxalate supersaturation. Prospective evidence and guidelines support adequate dietary calcium, usually about 1000-1200 mg/day, preferably from food and consumed with meals [7, 19].

Calcium supplements differ from dietary calcium because timing and dose matter. Supplements taken away from meals may increase urinary calcium without binding dietary oxalate in the gut. Evidence suggests that calcium supplements should be taken with meals when they are medically indicated, because this timing can reduce the rise in calcium oxalate risk compared with bedtime intake [8, 22].

Vitamin D is also complex. It may increase intestinal calcium absorption and can increase urinary calcium in susceptible individuals, but vitamin D alone has not consistently been shown to increase stone events in the general population. In the Vitamin D Assessment trial, monthly high-dose vitamin D did not increase kidney stone risk or serum calcium over the study period [17]. In contrast, combined calcium and vitamin D supplementation in the Women's Health Initiative was associated with an increased incidence of urinary tract stones [28].

The most balanced interpretation is that vitamin D supplementation should be individualized. Correcting deficiency may be appropriate, but high-dose or unnecessary vitamin D combined with calcium supplements may be problematic in stone-prone individuals, particularly those with hypercalciuria. Resistance-trained individuals often use vitamin D for muscle function, immune function, or general health; therefore, supplementation should be based on serum status and clinical need rather than gym culture alone.

3.7. Caffeine-containing pre-workout products and energy drinks

The caffeine-related statements are based on beverage and caffeine studies by Ferraro et al., [9], Ferraro et al., [10], Geng et al., [12], and Yuan et al., [29], while the interpretation of pre-workout products is framed by the sports-nutrition review by Kerksick et al., [14].

Pre-workout supplements often contain caffeine, beta-alanine, creatine, amino acids, nitric oxide precursors, sweeteners, sodium, and herbal stimulants. Their formulation varies widely, and the same user may consume coffee, energy drinks, and pre-workout powder on the same day. The stone-related concern is not caffeine alone but the total pattern: stimulant use, sweating, reduced fluid replacement, sugar-sweetened beverages, sodium load, and possible inaccurate labeling.

Caffeine has a complicated relationship with kidney stones. Although caffeine can increase urinary calcium excretion acutely, prospective data have found that caffeine-containing beverages such as coffee and tea are associated with lower risk of nephrolithiasis, possibly because they increase urine volume and contain other bioactive compounds [10, 12]. Therefore, moderate coffee or tea consumption should not automatically be equated with stone risk.

Energy drinks and sugar-sweetened beverages are more concerning when used frequently. Large prospective cohort data found higher kidney stone risk with sugar-sweetened cola and non-cola beverages, whereas coffee, tea, and orange juice were associated with lower risk [9]. This matters for gym users who replace water with sweetened drinks or use high-sugar energy beverages before training. The practical focus should be adequate water intake and avoiding chronic reliance on sugar-sweetened beverages.

3.8. Sodium, ultra-processed foods, and hidden dietary factors

The sodium discussion follows urological dietary prevention principles described in the AUA and EAU guidelines and dietary-pattern reviews, especially Pearle et al., [19], Skolarikos et al., [21], Ferraro et al., [11], and Peerapen and Thongboonkerd [20].

Many supplement discussions focus narrowly on powders and capsules, but ordinary diet may contribute more to stone risk than the supplement itself. High sodium intake increases urinary calcium excretion and is a key modifiable risk factor in calcium stone formers. AUA guidance recommends sodium restriction and normal dietary calcium intake in patients with calcium stones and relatively high urinary calcium [19].

Resistance-trained individuals may consume high-sodium foods during bulking phases, meal preparation with processed meats, salty sauces, fast foods, and snack products. Sodium may also be present in some electrolyte powders and ready-to-drink products. Electrolyte replacement can be useful during prolonged sweating, but unnecessary sodium loading in a sedentary part of the day may increase calciuria. The distinction between targeted electrolyte replacement and habitual high sodium intake should be made clearly.

3.9. Interaction between supplements and individual predisposition

The emphasis on individual predisposition is based on guideline recommendations for metabolic evaluation and recurrence prevention, particularly the use of stone composition, medical history, and 24-hour urine testing in Pearle et al., [19] and Skolarikos et al., [21].

The same supplement pattern can have different implications depending on the individual. A healthy young adult with high fluid intake and no stone history has a different risk profile than a recurrent calcium oxalate stone former with hyperoxaluria, low citrate, high sodium excretion, and low urine volume. Stone composition and 24-hour urine testing are therefore important for personalized advice.

High-risk groups include individuals with previous stones, family history of stones, inflammatory bowel disease or malabsorption, bariatric surgery, gout, metabolic syndrome, recurrent urinary tract infections, cystinuria, primary hyperparathyroidism, chronic kidney disease, and use of medications that influence urinary chemistry. In these groups, supplement use should be discussed with a physician or dietitian, especially when high-dose vitamin C, calcium, vitamin D, protein megadosing, or multiple pre-workout products are used.

3.10. Practical synthesis of supplement categories

The synthesis table integrates the main source groups used throughout this review: urological guidelines [19, 21], dietary reviews [11, 20], and supplement-specific studies on protein, creatine, vitamin C, calcium, vitamin D, and caffeine.

The reviewed literature does not support a simple statement that gym supplements as a whole cause kidney stones. Instead, the risk appears concentrated around specific conditions: low urine volume, excessive vitamin C, high non-dairy animal protein intake, high sodium intake, poorly timed or unnecessary calcium supplementation, vitamin D-induced hypercalciuria in susceptible people, and overall dietary imbalance. Creatine at recommended doses is better characterized as a supplement that may complicate interpretation of serum creatinine rather than as a proven cause of nephrolithiasis.

For practical prevention, the most useful approach is risk stratification. Low-risk healthy users should focus on evidence-based dosing, adequate hydration, avoidance of unnecessary megadoses, and balanced meals. Users with previous stones should know stone composition and urinary risk factors before using high-dose supplements. Recurrent stone formers should avoid self-directed supplement stacking and should consider 24-hour urine monitoring after major dietary or supplement changes.

3.11. Supplement stacking, labeling, and dose escalation

The interpretation of supplement stacking is based on sports nutrition guidance and bodybuilding-related literature, particularly Kerksick et al., [14] and Tidmas et al., [27], combined with stone-prevention evidence on vitamin C, sodium, hydration, and calcium balance.

A major practical problem in resistance-training environments is supplement stacking. A user may take whey protein, creatine, pre-workout powder, intra-workout electrolytes, a multivitamin, vitamin C, vitamin D, fish oil, and additional recovery products on the same day. Each product may appear moderate when considered separately, but the combined intake can produce unexpectedly high exposure to sodium, caffeine, vitamin C, calcium, or other ingredients. This is particularly important because gym users often focus on the front label claim, such as strength, pump, recovery, or immunity, rather than the full quantitative ingredient panel.

Dose escalation is another issue. Some users increase serving sizes when they do not perceive rapid training progress. Protein powder may be consumed several times daily even when total protein targets have already been achieved through food. Pre-workout products may be doubled after tolerance to caffeine develops. Vitamin C may be taken repeatedly during winter or during periods of fatigue. Calcium and vitamin D may be used without confirming dietary intake or serum vitamin D status. These behaviors may be more relevant to nephrolithiasis risk than responsible single-product use.

The supplement market also includes proprietary blends and products with variable quality control. Although the most reputable manufacturers use third-party testing, not all products are equally transparent. Inaccurate labeling can complicate risk assessment, especially for caffeine and stimulant dose. For stone prevention, the practical consequence is that the user and clinician should not ask only what category of supplement is being used, but also the exact product, dose, frequency, timing, and duration.

3.12. Stone types and supplement-specific relevance

The stone-type distinction follows the pathophysiological framework described in Peerapen and Thongboonkerd [20], Tamborino et al., [23], and the EAU metabolic evaluation recommendations [21].

The risk profile of a supplement can differ according to stone composition. Calcium oxalate stone formers are particularly sensitive to urinary oxalate, urinary calcium, citrate, sodium intake, and urine volume. For this group, high-dose vitamin C, low dietary calcium, excessive sodium, and insufficient fluid intake are especially relevant. Calcium phosphate stone formers require attention to urinary calcium and urine pH, because overly alkaline urine may increase calcium phosphate supersaturation in some patients. Uric acid stone formers are strongly influenced by low urinary pH, obesity, insulin resistance, purine load, and animal protein intake.

This distinction is clinically important. A general warning that a supplement may be bad for kidney stones is too imprecise. For example, citrate-containing beverages and higher fruit intake may be helpful in hypocitraturic calcium oxalate or uric acid stone formers, but excessive alkalinization may require caution in calcium phosphate stone formers. Similarly, protein restriction is not the same for all individuals: a resistance-trained person needs enough protein for adaptation, but a recurrent uric acid stone former may require careful moderation of purine-rich animal foods and support for urinary alkalinization under medical guidance.

3.13. Screening and monitoring in physically active supplement users

The proposed screening approach is derived from AUA and EAU recommendations for metabolic evaluation of stone formers, including stone analysis, 24-hour urine assessment, and individualized prevention [19, 21].

Screening should begin with a history of kidney stones, family history, recurrent urinary tract infections, gout, gastrointestinal disorders, bariatric surgery, chronic kidney disease, and current medications. Users should also be asked about training environment, sweat rate, water intake, urine color, weight-cutting practices, sauna use, and supplement stacking. A supplement history should include brand names, serving sizes, frequency, duration, and the reason for use.

In individuals without previous stones and without kidney disease, routine medical testing is not necessary before every common supplement. However, recurrent stone formers, people with a single stone plus strong risk factors, and users planning aggressive supplement regimens may benefit from medical evaluation. Stone analysis, serum chemistry, urinalysis, and 24-hour urine testing can identify low urine volume, hypercalciuria, hyperoxaluria, hypocitraturia, hyperuricosuria, high sodium excretion, and abnormal urinary pH. These data allow individualized advice rather than broad restriction.

For creatine users, clinicians should remember that serum creatinine-based estimated GFR may be misleading in muscular individuals and in people taking creatine. A small increase in creatinine after supplementation should be interpreted cautiously and compared with baseline values, cystatin C, urinalysis, albuminuria, symptoms, and clinical context. Conversely, users should not dismiss all abnormal kidney markers as a harmless creatine effect; persistent abnormalities require evaluation.

3.14. A practical prevention model for gym users

The prevention model combines guideline-based recommendations for fluid intake, normal dietary calcium, sodium reduction, and animal-protein moderation with sports-nutrition principles from Kerksick et al., [14] and Kreider et al., [15].

A practical prevention model can be built around four questions. First, does the person have a previous kidney stone or other high-risk condition? Second, is the total diet lithogenic, for example high in sodium, very high in non-dairy animal protein, low in fruit and vegetables, or low in dietary calcium? Third, is urine likely to be concentrated because of low fluid intake, heavy sweating, or stimulant use? Fourth, are any supplements being used in unnecessary high doses, especially vitamin C, calcium, vitamin D, or multi-ingredient pre-workout formulas?

If the answer to all four questions is no, a standard supplement plan based on evidence-based doses is unlikely to be a major stone concern. If one or more answers are yes, the focus should be correction of modifiable risk factors. This usually means improving hydration, reducing sodium, moderating protein rather than eliminating it, maintaining dietary calcium with meals, avoiding vitamin C megadosing, and replacing sugar-sweetened beverages with water or unsweetened options. Recurrent stone formers should receive individualized advice based on urine chemistry rather than generic internet recommendations.

3.15. Protein source, meal pattern, and urinary acid load

This subsection draws on dietary pattern research, especially the DASH-style diet analysis by Taylor et al., [24], the protein meta-analysis by Asoudeh et al., [3], and the dietary review by Ferraro et al., [11].

A practical distinction should be made between total protein intake and the source of protein. Resistance-trained individuals often aim for higher protein intake than sedentary populations, and this can be compatible with health when energy intake, kidney function, and diet quality are appropriate. However, stone risk is influenced by the acid load and purine content of the diet. Large amounts of meat, fish, eggs, and some isolated animal proteins can increase urinary sulfate, uric acid, and acid load. The kidney responds to this acid load partly by reducing urinary citrate, which removes an important inhibitor of calcium stone formation.

Plant proteins and dairy proteins may have different implications. Plant-based protein powders such as pea, soy, or rice isolates are increasingly used by gym users, but direct comparative evidence for stone outcomes remains limited. Some plant foods contain oxalate, but plant-based dietary patterns also tend to provide potassium, magnesium, fiber, and alkali precursors that may increase urinary citrate and pH. Dairy proteins supply calcium with meals, which may reduce oxalate absorption. Therefore, the effect of a protein source should not be reduced to the single term protein; it depends on the whole food matrix and the rest of the diet.

Meal timing may also matter. A person who consumes protein powder with milk, fruit, oats, and adequate fluid is creating a different urinary and gastrointestinal context from a person who consumes several isolated scoops with little water and a high-sodium diet. In stone prevention, food pattern is usually more informative than supplement category alone. This is why dietary counseling for stone formers often focuses on sodium, calcium timing, animal protein moderation, fruit and vegetable intake, and fluid distribution across the day rather than a single prohibited-food list.

3.16. Oxalate balance beyond vitamin C

The discussion of oxalate balance is based on calcium oxalate prevention principles from Curhan et al., [7], Sorensen [22], Peerapen and Thongboonkerd [20], and the vitamin C evidence summarized by Thomas et al., [26].

Oxalate balance is central to calcium oxalate stone risk. High-dose vitamin C is important because it can increase endogenous oxalate production, but dietary oxalate and intestinal oxalate absorption also matter. Some gym users consume large quantities of spinach smoothies, nut butters, cocoa products, beetroot powder, and other foods perceived as healthy. These foods are not unhealthy for the general population, but in susceptible calcium oxalate stone formers they may increase oxalate load if consumed in large amounts without dietary calcium at meals.

A strict low-oxalate diet is not always necessary and may reduce diet quality if applied indiscriminately. A more balanced strategy is to avoid extreme intake of very high-oxalate foods, consume adequate calcium with meals, maintain hydration, and individualize advice according to 24-hour urine results. This point is relevant to sports nutrition because many performance-oriented diets combine high-dose vitamin C, green powders, nut-based snacks, cocoa products, and low dairy intake. The combined pattern may be more relevant than any single food.

3.17. Sodium and electrolyte products

The sodium and electrolyte-product interpretation follows the urinary calcium and sodium-control recommendations in Pearle et al., [19] and Skolarikos et al., [21], with dietary context from Ferraro et al., [11].

Electrolyte products are common in sport and can be useful during prolonged exercise, high sweat loss, or hot environmental conditions. However, sodium is a double-edged factor in kidney stone prevention. Sodium replacement may be appropriate when sweat losses are high, but habitual high sodium intake increases urinary calcium excretion and may increase calcium stone risk. This means that electrolyte use should be matched to actual need rather than used automatically with every gym session.

Most resistance-training sessions in climate-controlled gyms do not require aggressive electrolyte replacement if the session is short and the athlete consumes regular meals. In contrast, athletes training for long periods, in heat, or during endurance-conditioning blocks may require sodium-containing fluids. The preventive message is therefore not sodium avoidance under all circumstances, but sodium control. Users should avoid combining salty processed foods, high-sodium meal plans, sodium-rich supplements, and low fluid intake.

3.18. Hydration monitoring in real life

The practical hydration recommendations are based on the urine-volume targets in AUA and EAU guidance, the recurrence-prevention trial by Borghi et al., [5], and athlete urinary-risk observations by Theisen et al., [25].

The recommendation to drink more water is simple but often difficult to apply. A resistance-trained person may drink a large bottle during the workout but remain underhydrated over the full day. Conversely, drinking excessive water in a short period without electrolytes may cause discomfort and is not necessary for most healthy users. A practical approach is to distribute fluids across the day, drink before and after training, and increase fluid intake when sweat loss is high.

Urine color can be a useful rough tool, although it is not a substitute for 24-hour urine measurement in stone formers. Very dark urine after training suggests concentrated urine and insufficient replacement. Body mass change across a training session can also estimate acute fluid loss: a large drop in body mass mainly reflects sweat loss and should be replaced gradually. For people with recurrent stones, the most meaningful target is urine output, because stone prevention depends on dilution over the whole day and night.

Nighttime and morning urine concentration may be overlooked. Some gym users drink most fluid around training but little in the evening to avoid nocturia. In recurrent stone formers, prolonged overnight concentration can still contribute to supersaturation. Individual advice should balance sleep quality, medical conditions, and stone risk, but the general principle is that hydration should not be limited to the workout window.

3.19. Bodybuilding-specific practices

The bodybuilding-specific interpretation draws on the review of nutritional and non-nutritional strategies in bodybuilding by Tidmas et al., [27], combined with stone-prevention guidance on hydration, sodium, protein intake, and metabolic evaluation.

Bodybuilding culture includes practices that may influence stone risk independently of legal supplements. Bulking phases may involve high energy intake, high sodium, frequent processed foods, and high animal protein. Cutting phases may involve dehydration, water manipulation, low carbohydrate intake, stimulant use, and rapid weight changes. These practices can alter urine volume, uric acid, pH, and calcium excretion. Therefore, a bodybuilder with stones should review preparation practices as carefully as supplement intake.

Some non-nutritional practices are outside the main scope of this review but are clinically important. Anabolic-androgenic steroids, diuretics, and unregulated substances may have renal consequences that are more serious than those associated with standard protein or creatine supplementation. When kidney abnormalities occur in a bodybuilder, clinicians should ask about the full range of substances and practices rather than assuming that whey protein or creatine is the primary cause.

3.20. Educational implications for coaches and recreational users

The educational recommendations are derived from the practical implications of guideline-based stone prevention and sports-nutrition position stands, especially Pearle et al., [19], Skolarikos et al., [21], Kerksick et al., [14], and Kreider et al., [15].

Coaches, personal trainers, and gym staff are often the first source of supplement advice. They do not need to provide medical treatment, but they can promote safer behavior. Key messages include: use supplements to fill specific gaps, avoid unnecessary high-dose vitamin C, do not use pre-workout products as a substitute for sleep and nutrition, drink enough fluids, do not ignore flank pain or blood in urine, and seek medical evaluation after a stone episode.

Educational materials should avoid fear-based messages. If users are told that creatine or protein always destroys kidneys, they may dismiss all medical advice when they learn that the claim is exaggerated. A more credible message is that responsible supplementation is usually low risk for healthy users, but stone-prone individuals need personalized guidance and should avoid specific high-risk patterns. This balanced approach is more likely to change behavior.

3.21. Summary of evidence strength

The evidence-strength summary was constructed by comparing the type of available evidence for each supplement category, including guidelines, cohort studies, randomized trials, systematic reviews, narrative reviews, experimental studies, and case reports.

The evidence is strongest for general stone prevention measures: high fluid intake, sodium reduction, adequate dietary calcium, moderation of animal protein in selected stone formers, and avoidance of excessive vitamin C. Evidence is moderate for the relationship between dietary patterns and kidney stone risk. Evidence is weaker for direct causal links between individual gym supplements and stone events because most supplement studies measure performance or kidney function rather than stone formation.

This hierarchy matters when advising patients. It would be inappropriate to overemphasize a weakly supported risk while ignoring strong risk factors such as low urine volume and high sodium intake. In practical terms, a stone-prone gym user should first correct hydration, sodium, calcium timing, vitamin C megadosing, and excessive animal protein before focusing on minor or speculative supplement effects.

Table 2. Potential relevance of common gym supplements to kidney stone risk.

Supplement or practice	**Potential urinary or behavioral mechanism**	**Interpretation for resistance-trained individuals**
Protein powders and high-protein diets	May increase dietary acid load, urinary calcium and uric acid, and reduce urinary citrate when total intake is excessive, especially from non-dairy animal sources.	Not automatically harmful, but should be assessed within total daily protein, sodium intake, fruit and vegetable intake, and hydration.
Creatine monohydrate	May increase serum creatinine through metabolic turnover; direct evidence for kidney stone formation is weak.	Recommended doses appear safe for kidney filtration in healthy users, but caution is needed in kidney disease or recurrent stone formers.
Vitamin C	Ascorbic acid can be metabolized to oxalate, increasing calcium oxalate supersaturation in susceptible	Chronic high-dose supplementation should be avoided, especially by calcium oxalate stone

Supplement or practice	Potential urinary or behavioral mechanism	Interpretation for resistance-trained individuals
	users.	formers.
Calcium supplements	Can increase urinary calcium; timing with meals may reduce oxalate absorption compared with intake away from meals.	Dietary calcium should usually be maintained; supplements should be used when indicated and preferably with meals.
Vitamin D supplements	May increase intestinal calcium absorption and urinary calcium in predisposed individuals.	Supplementation should be based on deficiency status and monitored in stone-prone users.
Pre-workout and energy drinks	May combine caffeine, sugar, sodium, and stimulant-driven behaviors; risk is amplified by low fluid replacement.	Moderate caffeine alone is not the main concern; dehydration and sugar-sweetened beverages are more important.

Source: Own elaboration based on literature reviewed in the article.

Table 3. Practical prevention recommendations for resistance-trained supplement users.

Area	Practical recommendation
Hydration	Aim for fluid intake sufficient to maintain pale urine and, in stone formers, urine output consistent with clinical guidance. Increase fluids during heavy sweating.
Protein intake	Use protein supplements to meet, not greatly exceed, planned total protein intake. Avoid combining very high protein intake with high sodium and low plant food intake.
Creatine	Use evidence-based dosing. Do not interpret

Area	Practical recommendation
	serum creatinine changes without clinical context. Seek advice in chronic kidney disease or recurrent stones.
Vitamin C	Avoid chronic high-dose supplemental vitamin C, particularly doses around or above 1000 mg/day, in individuals at risk of calcium oxalate stones.
Calcium and vitamin D	Prefer dietary calcium from meals. Use calcium or vitamin D supplements when indicated; monitor stone-prone individuals for hypercalciuria.
Pre-workout products	Monitor total caffeine intake, avoid dry scooping, avoid replacing water with energy drinks, and compensate for sweat loss.
Medical evaluation	After a stone episode, determine stone composition and consider 24-hour urine testing before major dietary or supplement changes.

Source: Own elaboration.

4. Discussion

This narrative review shows that the relationship between resistance-training supplements and nephrolithiasis is best understood as a risk-factor interaction rather than a direct supplement-to-stone pathway. The most consistent determinants of stone formation remain urine volume, urinary supersaturation, urinary pH, citrate, calcium, oxalate, uric acid, sodium, and dietary pattern. Gym supplements may modify some of these factors, but their effect depends strongly on dose, context, and individual predisposition.

Protein supplementation illustrates this principle. Protein powders are not inherently lithogenic, and they can be used responsibly to meet dietary goals. However, when protein supplementation contributes to very high total protein intake, particularly from non-dairy animal sources, it may increase urinary calcium and uric acid, lower urinary pH, and reduce citrate.

These changes are relevant to calcium oxalate and uric acid stones. The risk is likely greatest when high protein intake is combined with low fruit and vegetable intake, high sodium intake, and insufficient fluids [3, 20].

Creatine requires a different interpretation. It is one of the most researched sports supplements, and available evidence does not show clinically meaningful impairment of kidney filtration in healthy users following standard protocols. The common concern arises partly from serum creatinine interpretation. A supplement that increases creatinine production can make creatinine-based kidney function estimates less straightforward without necessarily causing renal injury [16, 18]. However, this does not remove the need for caution in users with kidney disease, recurrent stones, or poorly supervised high-dose practices.

Vitamin C is probably the clearest supplement-related concern in this topic. Unlike creatine, it has a plausible metabolic pathway to stone risk because ascorbic acid can increase oxalate. High-dose vitamin C is not necessary for muscle hypertrophy or strength adaptation, and routine megadosing has limited justification for most gym users. Therefore, avoiding chronic high-dose supplemental vitamin C is a practical and low-cost prevention measure for stone-prone individuals [26, 21].

Calcium and vitamin D require nuance. Adequate dietary calcium is protective for many calcium oxalate stone formers because it reduces oxalate absorption when consumed with meals. In contrast, unnecessary calcium supplements, particularly away from meals or combined with vitamin D in susceptible individuals, may increase urinary calcium and stone risk. The practical message is not calcium avoidance but calcium optimization: food first, meals rather than bedtime supplementation, and laboratory monitoring when indicated [7, 28, 4].

Caffeine and pre-workout products also demonstrate the need for context. Moderate caffeine-containing beverages are not consistently associated with increased stone risk and may even be associated with lower risk in cohort studies. However, pre-workout culture may involve concentrated stimulant doses, inadequate water intake, sweetened drinks, and intense sweating. Therefore, hydration behavior around stimulant use may be more important than caffeine itself.

The review has limitations. It is narrative rather than systematic, so it does not provide pooled risk estimates. Direct trials examining kidney stone incidence after specific supplement regimens in resistance-trained individuals are scarce. Much of the evidence comes from general population cohorts, stone-former guidelines, metabolic studies, or sports nutrition safety literature. Another limitation is that supplement products vary greatly in composition, purity, and labeling accuracy. A product labeled as a protein powder, pre-workout, or multivitamin may contain many ingredients that differ across brands and countries.

Despite these limitations, the topic has clear clinical and public health relevance. Gym users often receive supplement advice from social media, peers, or commercial sources rather than clinicians. A balanced evidence-based message is needed: standard-dose creatine and reasonable protein supplementation are not proven causes of kidney stones in healthy people, but dehydration, high sodium intake, high-dose vitamin C, excessive non-dairy animal protein, and unsupervised calcium/vitamin D use can plausibly increase risk, particularly in susceptible users.

4.1. Interpretation for healthy resistance-trained individuals

This interpretation is based mainly on the creatine safety literature [15, 16, 18], the sports-nutrition review by Kerksick et al., [14], and the absence of strong direct evidence linking standard supplement doses with stone formation in healthy users.

For healthy resistance-trained individuals without a history of stones, the most evidence-based message is reassurance combined with moderation. Common supplements such as whey protein and creatine can be used within rational training and nutrition plans. The main preventable hazards are not the presence of a supplement label but excessive dose, poor hydration, high sodium intake, and neglect of overall diet quality. This is important because many recreational lifters use supplements to compensate for inconsistent sleep, irregular meals, or unrealistic expectations about muscle gain.

A healthy user who takes creatine monohydrate in a standard dose, consumes protein according to a planned daily target, drinks sufficient fluid, eats fruits and vegetables, and maintains normal dietary calcium is unlikely to create a major stone risk solely from those supplements. By contrast, a user who combines several scoops of protein, high-dose vitamin C, stimulant pre-workouts, high-sodium processed meals, and low water intake may generate a urinary environment more favorable to stones even if each behavior appears common in gym culture.

4.2. Interpretation for previous stone formers

The caution applied to previous stone formers follows AUA and EAU recommendations that recurrent or high-risk patients should be evaluated individually using stone composition and urine chemistry rather than generalized dietary advice alone [19, 21].

Previous stone formers require a different level of caution. A single kidney stone may be the first sign of a chronic predisposition, and recurrence is common. In these individuals, supplement advice should not be generic. Stone analysis and 24-hour urine testing can identify whether the main problem is low urine volume, hypercalciuria, hyperoxaluria, hypocitraturia, hyperuricosuria, aciduria, or another abnormality. Once the abnormality is known, supplement advice becomes much more precise.

For example, a calcium oxalate stone former with high urinary oxalate should avoid chronic high-dose vitamin C and should consider dietary calcium timing with meals. A calcium stone former with hypercalciuria and high sodium excretion should focus on sodium reduction before blaming protein powder. A uric acid stone former with low urinary pH may require attention to weight, insulin resistance, purine-rich animal foods, and alkalinization strategies. These examples show why the same gym supplement can be acceptable for one person and inappropriate for another.

4.3. Comparison with urological prevention principles

This subsection explicitly compares the review findings with the preventive framework of major urological guidelines, especially fluid intake, normal dietary calcium, sodium reduction, and moderation of animal protein in selected patients [19, 21].

The conclusions of this review are consistent with major urological prevention principles. Guidelines emphasize high fluid intake, normal dietary calcium, sodium reduction, moderation of animal protein in selected patients, and pharmacological therapy when indicated. The supplement-specific interpretation should therefore be integrated into these established recommendations rather than treated as a separate topic. Gym users are still subject to the same physiology as other stone formers: urine that is concentrated, acidic, high in calcium, high in oxalate, high in uric acid, or low in citrate is more likely to support crystallization.

At the same time, resistance-trained individuals have legitimate nutritional needs. Protein supports muscle protein synthesis, creatine supports high-intensity performance, and caffeine can improve training output. Prevention should not require abandoning evidence-based sports nutrition. The goal is to align sports nutrition with urinary risk reduction. This means choosing appropriate doses, distributing fluids, reducing excess sodium, avoiding unnecessary vitamin megadoses, and individualizing advice in those with prior stones.

4.4. The difference between kidney function and kidney stone outcomes

The distinction between kidney function outcomes and stone outcomes is based on creatine-focused reviews evaluating serum creatinine and GFR [16, 18] and stone-focused sources emphasizing urine volume, pH, oxalate, calcium, uric acid, citrate, and supersaturation [20, 23].

A recurring problem in discussions of gym supplements is that kidney function and kidney stones are often confused. Kidney function studies usually measure serum creatinine, estimated GFR, measured GFR, cystatin C, proteinuria, or albuminuria. Kidney stone risk, however, depends on urinary supersaturation, stone promoters and inhibitors, urine pH, urine volume, and stone composition. A supplement may have no adverse effect on GFR but still influence stone risk markers, or it may alter serum creatinine without affecting either GFR or stones.

Creatine illustrates this distinction. Creatine may increase serum creatinine, creating concern about kidney function, but the best available evidence does not show a corresponding decline in GFR in healthy users. Vitamin C illustrates the opposite type of issue: it is not usually discussed as a kidney function threat in healthy people, but high-dose intake can be relevant to urinary oxalate and calcium oxalate stones. Protein intake occupies a middle position because very high intake may influence urinary chemistry and may also be inadvisable in pre-existing kidney disease.

4.5. Communication problems in social media and gym culture

The communication discussion is an interpretation derived from the contrast between evidence-based sports nutrition position stands and urological prevention literature: creatine and protein require dose- and context-specific assessment, whereas vitamin C megadosing, dehydration, and recurrent-stone history require clearer warnings.

Social media often presents supplement safety as a binary issue. One extreme claims that creatine and protein powders destroy kidneys; the other extreme claims that all legal supplements are completely safe at any dose. Neither message is scientifically adequate. The evidence supports a middle position: some supplements are well studied and generally safe in healthy users at recommended doses, but irresponsible stacking, high-dose vitamins, poor hydration, and individual predisposition can change the risk profile.

Fear-based communication can be counterproductive. If users hear exaggerated warnings and then observe that many athletes use creatine or whey without obvious harm, they may ignore legitimate warnings about vitamin C megadosing, dehydration, sodium, or previous stone history. A more effective educational message is specific: avoid chronic high-dose vitamin C if you are stone-prone; do not let protein supplements push total intake far beyond need; do not combine heavy sweating with low fluid intake; do not use calcium and vitamin D supplements without reason; and seek evaluation after a stone.

4.6. Practical role of physicians, dietitians, and trainers

The practical roles described here are based on guideline principles of individualized prevention and metabolic evaluation, together with sports-nutrition recommendations that emphasize appropriate dosing, dietary planning, and professional supervision [19, 14, 21].

Physicians and dietitians should ask physically active patients about supplement use in a non-judgmental way. If the clinician begins with the assumption that all gym supplements are harmful, the patient may minimize or hide use. A better approach is to request the exact product list, doses, timing, and reasons for use. Many risks can then be reduced without eliminating the user's training goals. For example, a dietitian can replace excessive animal protein with a more balanced protein distribution while preserving total protein needed for training adaptation.

Personal trainers and coaches should stay within their professional scope but can support prevention by promoting hydration, discouraging extreme supplement stacking, and referring clients with symptoms or stone history to medical professionals. They can also help normalize evidence-based dosing. Many gym users assume that more powder means faster progress; coaches can counter this by explaining that training progression, energy balance, sleep, and consistency are usually more important than escalating supplement doses.

4.7. Practical examples of risk modification

The examples synthesize evidence from supplement-specific sources: creatine safety data [15, 18], vitamin C and oxalate evidence [26], calcium and dietary calcium literature [7, 4], and urological prevention guidelines [19, 21].

Consider a recreational lifter who uses one daily serving of whey protein and 3-5 g of creatine, drinks water regularly, and has no stone history. In this situation, the review does not identify a strong reason to stop supplementation solely for stone prevention. The best advice would be to maintain hydration, avoid unnecessary vitamin C megadosing, and keep protein intake within a planned range. Periodic health checks may be reasonable but are not specific to stone prevention.

A second example is a recurrent calcium oxalate stone former who consumes high-dose vitamin C, avoids dairy, drinks little water during long workouts, and uses multiple pre-workout products. In this case, several modifiable risks are present. The priority would be to stop high-dose vitamin C, restore adequate dietary calcium with meals if appropriate, increase fluid intake, evaluate sodium intake, and obtain 24-hour urine testing. The solution is not simply to remove all gym supplements, but to correct the specific lithogenic pattern.

A third example is a bodybuilder during a cutting phase who uses stimulants, sweats heavily, reduces carbohydrate and fluid intake, and eats very high amounts of animal protein. This pattern may increase stone risk through low urine volume, acid load, and uric acid-related mechanisms. The prevention plan should address fluid distribution, sodium control, avoidance of dehydration practices, and moderation of animal protein while preserving sufficient protein for lean mass retention.

4.8. Ethical and safety considerations

The safety interpretation is grounded in the clinical relevance of nephrolithiasis described in urological guidelines and prevention reviews, while the balanced approach to supplement advice reflects the need to avoid both unsupported alarmism and uncritical reassurance.

Supplement advice should be ethically careful because many users are young adults who may not perceive kidney stones as a serious health issue until symptoms occur. Kidney stones can cause severe pain, emergency visits, lost training time, infection risk, and recurrent medical procedures. At the same time, unnecessary alarm may discourage physical activity or create distrust of health professionals. The ethical balance is to provide accurate risk information, distinguish strong evidence from speculation, and encourage medical evaluation for high-risk individuals.

Another safety issue is that kidney stone symptoms can mimic or overlap with other conditions. Flank pain, blood in urine, fever, vomiting, or inability to urinate should not be managed by changing supplements alone. These symptoms require medical evaluation.

Supplement users should be clearly informed that prevention advice does not replace diagnosis or treatment.

4.9. Research implications

The research gaps identified here come from limitations visible across the reviewed literature: many sources address urinary stone prevention generally, kidney function outcomes generally, or individual supplements separately, while few prospective studies measure 24-hour urine changes in real-world resistance-trained supplement users.

Future research should include prospective studies in resistance-trained populations with measurement of 24-hour urine parameters before and after supplement interventions. Studies should compare protein sources, total dietary patterns, hydration strategies, and real-world supplement stacks. It would also be useful to examine whether structured hydration education for gym users reduces lithogenic urinary profiles. Finally, research should distinguish kidney stone risk from broader kidney function outcomes, because these are related but not identical endpoints.

Research should also examine sex differences. Much of the historical concern about vitamin C and stones comes from male cohorts, while supplement use among women has increased substantially. Female resistance-trained users may use different supplement combinations, such as vitamin D, calcium, collagen, iron, protein powders, caffeine, and fat-loss products. Sex-specific hormonal, dietary, and behavioral factors may influence urinary risk profiles and should be studied directly.

Another priority is product-specific research. The category pre-workout is too broad to be scientifically precise. Products differ in caffeine dose, sodium, sweeteners, creatine, beta-alanine, amino acids, herbal stimulants, and added vitamins. Future studies should report actual ingredient profiles and should evaluate total daily intake from all products. Without this detail, it is difficult to translate findings into practical recommendations.

Finally, future research should evaluate communication strategies. A short educational intervention in gyms, sports clubs, or university athletic programs could teach users to recognize high-risk patterns: low urine volume, high-dose vitamin C, excessive sodium, extreme protein intake, and previous stone history. Outcomes could include supplement knowledge, hydration behavior, 24-hour urine volume, sodium excretion, and recurrence in high-risk groups.

5. Conclusions

1. The current literature does not justify a general claim that all gym supplements cause kidney stones. The relationship is conditional and depends on total diet, dose, hydration status, urinary chemistry, and individual predisposition.

2. Low urine volume and dehydration remain central modifiable risk factors. Resistance-trained individuals should pay attention to 24-hour hydration and urine output, especially during hot-weather training, high sweat loss, or stimulant use.

3. Protein supplements should be considered within total protein intake. Excessive non-dairy animal protein intake, high sodium intake, low fruit and vegetable intake, and low urinary citrate may increase stone risk.

4. Recommended-dose creatine monohydrate is not convincingly linked with nephrolithiasis in healthy users, but it may increase serum creatinine and complicate interpretation of creatinine-based kidney function markers.

5. High-dose vitamin C supplementation is a plausible and clinically relevant concern because ascorbic acid can increase oxalate. Chronic megadosing should be avoided, especially by recurrent calcium oxalate stone formers.

6. Dietary calcium should usually be maintained at recommended levels, preferably from food and with meals. Calcium and vitamin D supplementation should be individualized, particularly in people with hypercalciuria or previous stones.

7. The safest practical strategy for resistance-trained individuals is to use supplements in evidence-based doses, avoid unnecessary stacking, maintain adequate fluid intake, limit sodium, avoid chronic high-dose vitamin C, and seek medical evaluation after any kidney stone episode.

Disclosure

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In preparing this work, the author(s) used ChatGPT for language improvement and grammatical correction. After using this tool/service, the author(s) have reviewed and edited the content as needed and accept full responsibility for the substantive content of the publication.

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