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The Rise of Supplement Use in Recreational Athletes: Benefits and Health Risks – A Literature Review

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ABSTRACT

Introduction: Supplements have become increasingly used in the last several years, most prominently among recreational athletes. Although some supplements, such as protein powders, creatine, or pre-workouts, are helpful in the short term, their use in unmonitored environments can become a health concern. In this article, we cover some of the newer supplements in use among this population and attempt to distinguish between the intelligent, goal-directed use of supplements and the less desirable trend of excessive use. Methods: The research authors conducted a systematic literature review, searching ResearchGate and PubMed. The peer-reviewed journals also underwent searching of July 1995 - May 2025, focused on journals of the past few years. Systematic reviews of the most popular supplements like protein, caffeine, and creatine supplements, and observational research, randomized trials satisfied the inclusion criterion. The authors reviewed and assessed 68 studies according to the PRISMA protocol. Conclusion: While others may provide better performance or assist in recovery, the performance is variable and dependent on the circumstances, dose, and the user's health. The recreational exerciser is not always able to resort to the advantage of the experienced opinion and is therefore vulnerable to abuse of supplements. The result of all of this is that awareness and education in the correct use of supplements are needed. After all, no supplement will ever replace the fundamentals: good nutrition, good rest, and hydration—more than anything, they are the ultimate determiners of athlete performance and recovery.

Keywords: dietary supplements, recreational athletes, protein supplementation, creatine

1. INTRODUCTION

Over recent years, the usage of dietary supplements has grown enormously. Both among competitive athletes and recreational exercisers (Coates et al., 2024). As fitness gains more popularity, social media's influence, and increased accessibility of supplements, an ever-growing population prefers to start independent supplementation to improve performance, ease recovery, or even enhance overall

health (Hilkens et al., 2021). Supplements have become a part of the routine for amateur athletes in their training programs. Used carefully and in small doses, some supplements can actually work wonders. It goes wrong when amateur athletes use supplements too frequently or without thoroughly understanding the mechanisms behind them. Although experts are typically guided by doctors or nutritionists, the majority of non-experts rely on second-hand information or internet sources, and they may not be accurate (Karbownik et al., 2019). Thus, whether to take a supplement is usually determined due to an advertisement or an internet trend (Kumar et al., 2024). In this article, we will explore whether we are "trend of over-supplementation" among recreational athletes. The work will discuss the most common supplements, their scientifically supported advantages and medicinal risks, marketing, and public awareness. The purpose of the paper is to provide functional recommendations to recreational athletes about safer and more educated supplementation.

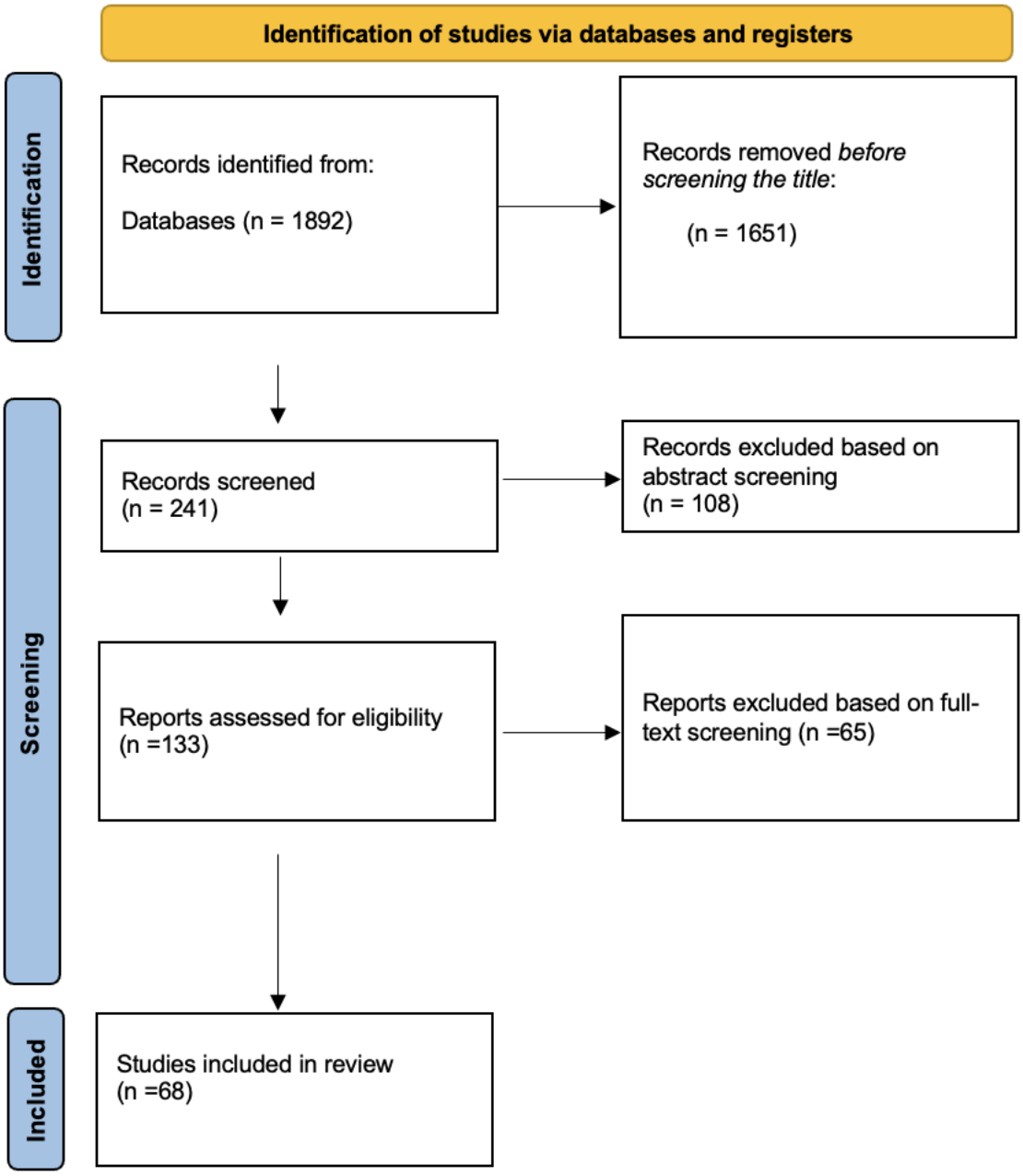

Figure 1. PRISMA flow diagram.

2. REVIEW METHODS

To find pertinent literature for the purpose of this review, the PubMed and ResearchGate databases were accessed. The terms "dietary supplements," "recreational athletes," "protein supplements," and "creatine" were searched along with Boolean operators like "AND" and "OR" to limit the search and locate especially publications on the use of supplements in non-professional athletes. The review incorporates literature published between July 1995 and May 2025 but concentrates specifically on studies published since 2010 to ensure that the latest evidence has been incorporated.

Inclusion: English peer-reviewed articles that are composed of randomized controlled trials, systematic reviews, and observational studies examining the consumption, effectiveness, or potential adverse effects of regular dietary supplements among non-elite sport participants.

Exclusion criteria: Peer-reviewed studies that were not subjected to peer review, papers with major methodological errors, or English non-language publications were excluded.

We then screened the search results by reading the titles and the abstracts. For those studies that were found to satisfy our inclusion criteria, we retrieved the full texts. A total of 68 studies were ultimately chosen for thorough review and qualitative analysis based on the PRISMA flow diagram (Figure 1).

3. RESULTS AND DISCUSSION

Overview of the Most Common Supplements Used

Protein is one of the most important constituents of an athlete's diet. For normal people, the quantity of protein required on a daily basis is generally estimated to be 0.8 to 1 gram per kilogram of body weight. However, for competitive athletes, in some situations, the quantity required is raised to up to 2 grams per kilogram of body weight (Wu, 2016). A regular diet is not often sufficient to provide such high protein intake, and for this reason, most sportspeople turn to protein powder as an easy option. Ingested protein has a beneficial effect not only on the musculoskeletal system but also on the cardiovascular, hormonal balance, and immune systems (Patel et al., 2024). The most common reason for supplement consumption of protein is to support muscle mass gain. As a structural unit of muscle tissue, protein not only supplies the amino acids necessary for this process but also initiates the mTOR signaling pathway, which controls muscle protein synthesis (MPS) (Bodine et al., 2001). Branched-chain amino acids (BCAAs), particularly leucine, play a crucial role in maintaining anabolic signaling. Elevated leucine intake stimulates the phosphorylation of p70 S6 kinase, the main effector of the mammalian target of the rapamycin (mTOR) pathway. This cellular signaling cascade plays a significant role in stimulating myofibrillar protein synthesis in skeletal muscle (Blomstrand et al., 2006). Numerous studies indicate that protein supplements also positively affect the cardiovascular system. Systematic supplementation—particularly alongside exercise—lowers levels of LDL-cholesterol by approximately 5 mg/dL, triglycerides by approximately 8 mg/dL, and systolic blood pressure by 3 mmHg (Prokopidis et al., 2025). Research also illustrates a beneficial effect of protein on carbohydrate metabolism. The preprandial supplementation of whey protein was demonstrated to decrease blood glucose at 60 and 120 minutes by a considerable margin and improve insulin levels compared to the control group given the placebo. Incremental area under the curve (AUC) for glucose at 60 and 120 minutes decreased by 2.67 mmol/L and 1.59 mmol/L, respectively, in the whey protein-supplemented group (Chiang et al., 2022). Experiments on rats also demonstrate a potential impact of whey protein consumption on the immune system. In the WPC-treated rats after exposure to the antigen, there was a significant augmentation in the counts of B lymphocytes and helper T lymphocytes, with higher plasma immunoglobulin G levels, compared with the control group.

Additionally, cytokine IL-2 and IL-4 levels were highly elevated, indicating an elevation in cellular and humoral immune responses (Lee et al., 2020). Additionally, bioactive amino acids and peptides such as L-glutamine in whey protein have been shown to alleviate oxidative stress suffered by cells after hard exercise (Cruzat et al., 2014). A one-year randomized controlled trial in the elderly between 55 and 80 years old with mild cognitive impairment revealed that daily consumption of 15 grams of milk fat globule membrane-enriched whey protein powder led to significant improvement in total cognitive function as measured by the MoCA test compared to a placebo group (Li et al., 2025). However, the findings of other research have been different, and additional research is needed to make final comments.

β-Methylguanidinoacetic acid, or as it is also called, creatine, is synthesized endogenously as a result of a reaction involving the amino acids methionine, glycine, and arginine. The first step of biosynthesis occurs in the pancreas and kidneys, while the second step occurs in the liver (Wu, 2021). The body of an individual is estimated to synthesize around 2 grams of creatine per day (Brosnan et al., 2011). However, in sports persons who are training, the demand for creatine can be anywhere from 5 to 10 grams a day (Kreider et al.,

2003). Because dietary intake of creatine is relatively low - between 0,525 grams for every 100 grams of fresh meat - athletes turn to creatine supplements that are rich in it in order to meet the body's requirements (Di Corcia et al., 2022). Creatine is added a phosphate group by the enzyme creatine kinase in muscle cells. The product of this reaction is phosphocreatine, a molecule that is able to transfer its phosphate group to adenosine diphosphate (ADP) with relative ease, thereby forming adenosine triphosphate (ATP) (Silva et al., 2013). ATP is the prevailing provider of energy for muscles in the context of short-term, intense exercise. Therefore, increasing stored creatine yields more ATP, which in turn allows for long durations of strenuous muscular exercise (Balsom et al., 1995). Creatine also has the role of an antioxidant within cells. With reference to in vitro research, it has the potential to scavenge various reactive oxygen and nitrogen species, such as the superoxide anion and peroxynitrite. In experiments on rats in vivo, which were supplemented with high doses of creatine, it was found that there is a reduction in muscle ROS content of 34-41% compared to the placebo group. Therefore, creatine guards against oxidative stress in mitochondria, thereby preserving their membrane potential, structural integrity, and ability to produce ATP (Lawler et al., 2002). In recent years, numerous benefits of creatine supplementation beyond its athletic uses have been documented. In cerebral ischemia in mice due to middle cerebral artery occlusion, pre-treatment with creatine reduced infarct volume by 56%, markedly reduced the effect of reperfusion on neurological function, and inhibited activation of the neuronal apoptotic pathway (Zhu et al., 2004). Another investigation also studied the effect of 20 g daily supplementation of creatine on cognitive functions in Alzheimer's disease patients. At the end of an 8-week intervention, the study group had statistically significant gains in oral reading, working memory, and fluid intelligence and averaged a 4.9-point gain on the Flanker test. Extremely positive as such results are, the study was a first attempt on a small group of subjects, and thus, the results may be statistically biased (Smith et al., 2025). Another group of supplements regularly taken by athletes is the so-called pre-workouts. Their explicit purpose is to energize the body before exercise. The effects of such supplements are most frequently credited to agents like caffeine, beta-alanine, citrulline, or taurine (Jagim et al., 2019).

Caffeine exerts a stimulating effect on the body through various mechanisms. Due to its similar chemical composition, it is an antagonist of adenosine receptors—A1, A2A, A2B, and A3—present in the nervous system (Allen and Westerblad, 1995). Adenosine inhibits the activity of neurons, slows down heart rate, and dilates brain arteries by binding to specific receptors, having a calming effect in the body. Caffeine accelerates heart rate, enhances the release of neurotransmitters, and increases striatal dopamine by blocking the activity of adenosine (Poltev et al., 2015). Caffeine is also a phosphodiesterase inhibitor, increasing intracellular cAMP. This promotes catecholamine release and improves muscle function (Domaszewski et al., 2021). Caffeine has been shown to increase the release of calcium ions from the sarcoplasmic reticulum, causing a rise in muscle tension and fall in relaxation (Allen and Westerblad, 1995). Beta-alanine is a positional isomer of the proteinogenic amino acid alanine.

Its action is attributed to an interaction with histidine to form carnosine, a dipeptide that amplifies the buffering capacity of hydrogen ions on occasions of peak physical exertion (Caruso et al., 2012). This action retards cellular acidosis, thereby enhancing endurance for activities lasting between 1 and 4 minutes (Lancha Junior et al., 2015). Carnosine is also an antioxidant that scavenges free radicals and chelates iron and copper ions. This protects muscle tissue against oxidative stress during exercise (Trexler et al., 2015).

L-Citrulline is an amino acid and is a precursor to the amino acid L-arginine, which is primarily metabolized in the kidneys. L-arginine is involved in the production of nitric oxide (NO) by nitric oxide synthase (Martin et al., 2008). Nitric oxide is a vasodilator, increasing blood flow and nutrient delivery to muscles and accelerating the removal of toxic metabolic waste products (Turner-McGrievy et al., 2015). A number of studies have raised the issue of whether citrulline may even be effective as a supplement in enhancing endurance or muscle strength (Viribay et al., 2022).

Taurine is a sulfur-containing amino acid that enhances muscle function by various mechanisms. It has antioxidant properties and also inhibits the accumulation of lactate in muscles, thereby delaying fatigue in intense exercise. Taurine also sensitizes myocytes to calcium ions. Taurine also triggers the breakdown of fats for use as energy during long aerobic activity (Carvalho et al., 2020). In experiments carried out on a cohort of professional speed skiers, anaerobic power increased markedly, enhancing performance during sprints and short, all-out efforts (Buzdağlı et al., 2023). Consequently, taurine has relatively well-documented effects in short, high-intensity efforts as well as in long, low-intensity training.

Potential Benefits of Supplement Use in Recreational Sports

Recreationally competitive individuals seek supplementation to achieve a greater output, quicker recovery, or higher capacities to train. Although no supplement provides similar efficacy, a number have been researched as to their potential values should they be taken properly.

Pre-/per/exercise protein supplementation could potentially assist with peak power output maintenance and minimizing concentrations of creatine kinase after resistance exercise, but seems to decrease delayed onset-muscle soreness to a small, insignificant degree. Whey protein, specifically, shows a small, transient advantage by accelerating recovery of muscular function. Fewer than half of the randomized, blinded studies, however, report overall favorable results (Davies et al., 2018).

Creatine supplementation has been deemed to be generally safe with long-term and short-term supplementation among healthy individuals, who are old or young, or male or female. Creatine supplementation is unique in being effective to augment strength, fat-free mass, and performance with a one-and multi-sprint task. Creatine supplementation also enhances recovery from high-power exercise and arguably during injury recovery. There are benefits among recreational exercise individuals and competitive sport individuals with a wide age bandwidth, and vegans reported higher increments to their pre-supplementation baseline measures (Wax et al., 2021).

BCAA supplementation has a small influence over body composition and exercise output but decreases muscle soreness, especially after resistance exercise. The result of endurance exercise has been inconsistent. The research designs were inconsistent, with few including total daily protein intake, so results were constrained by their inability to be transferrable to practical life. The BCAAs are consumed with other supplements, so it becomes hard to know any idea what they actually yield. The perceived benefit from them, such as reducing soreness and deferring fatigue, should be taken with caution (Martinho et al., 2022).

Convenient dosing with caffeine increases energy accessibility and daily energy output but decreases perceived exercise effort and tiredness. Physical, motor, and mental function are optimised by increasing alertness, wakefulness, and energy. Mental fatigue decreases, reaction times are quicker and more accurate, and concentration and focus are enhanced. Short-term memory, judgment, cognitive capacity, and coordination are boosted by caffeine, too. Even moderate doses are demonstrated to be free from safety concerns amongst otherwise healthy, non-pregnant adults (Glade, 2010). It has been suggested by some investigators that dietary supplements with antioxidants, including vitamins E and C, and coenzyme Q10 (CoQ10), may inhibit the generation of free radicals, hence reducing injury to muscles and fatigue, and help recovery (Merry and Ristow, 2016).

Ashwagandha (Withania somnifera) was a potent adaptogen and anti-stress molecule with the promise to enhance physical performance. The meta-analysis and systematic review were substantially better than a placebo to enhance strength, power, cardiorespiratory endurance, and recovery from fatigue in healthy men and women. The probability of having a small but significant effect to enhance performance exceeds 95%. There remains, however, a necessity to have more similar studies within resistance-trained and athletic populations to better estimate its real effect (Bonilla et al., 2021).

Usage patterns in recreational exercisers are invariably motivated by objectives such as improved recovery, higher exercise delivery, nutrient supplementation, and practicality, with inconsistent levels of evidence-based efficacy by individual supplement. Strategic supplementation among recreational exercisers can have salient benefits within exercise delivery, recovery, and nutrient supplementation, but supplements are never a replacement for a balanced dietary regimen and regular exercise.

Side Effects and Overuse of Supplements

Although the use of dietary supplements is effective when used in the correct form, their overdosage or abuse will lead to several health hazards, of course, for those individuals with limited exposure to experienced dietitians and coaches. Side effects have been understood among individuals from being moderate to extreme. A study done through Gillani et al., among 57 male recreational exercisers, suggests the experience of the occurrence of the occurrence of the side effects after taking the dietary supplements, most of them being used without the advice of a dietitian. The most realized commonly side effects are dehydration, constipation, insomnia, nausea, and palpitations of the heart (Gillani et al., 2020).

Instances of excessive protein supplement intake are increasingly common in nonprofessional athletes. Many consumers assume that greater doses will yield faster or more dramatic results (Hartmann and Siegrist, 2016). Nevertheless, the research conducted by Vasconcelos et al. showed that chronic whey protein supplementation increases the expression of irritability. This is a result of the action of BCAA in whey protein, acting to compete with tryptophan and thus suppress the synthesis of serotonin. A diminished concentration of this neurotransmitter, related to impulsivity and depression, may cause intensification of aggression (Vasconcelos et al., 2021). A high-protein diet also has the effect of modifying the microbiota, and this could give rise to problems within the colon. Due to amino acid fermentations, harmful metabolites are generated, and they could negatively influence the health and metabolism of the whole body (Portune et al., 2016). The daily intake of whey protein may be connected to the triggering or intensification of existing acne. The action is related to the composition of insulin and of the insulin-like growth factor-1 (IGF-1), both of which stimulate elevated

sebum production, building conditions favorable for the appearance of skin inflammation (Muhaidat et al., 2024). Athletes should be informed that a high intake of protein in the diet could strongly augment the kidneys' workload through the influence on glomerular filtration. Excessive intake of protein supplements could give rise to the marked elevation of glomerular filtration rate and renal blood flow. Research indicates that such increases could generate glomerular damage through increased intraglomerular pressure and flow. In the long term, such actions could give rise to the evolution of glomerular injury and sclerosis, most of all in people in whom kidney infections already exist. The recommendation is the requirement for special precautions in recreation exercise enthusiasts who are protein supplementing and most vulnerable to kidney disease (Ko et al., 2020).

The Kreider et al., (2025) 680 clinical studies survey concluded with the remark that the supplementary use of creatine does not widen the number nor the range of undesirable effects, in healthy volunteers nor in patients with illness. Pre-training supplements, such as the synephrine-caffeine combination, have also been studied by De Jonge et al., (2023). There is support for cardiovascular risk in the form of findings that consumption of the supplements is associated with increased blood pressure and heart rate, most likely because of sympathetic stimulation. The latter in turn could, in certain individuals, bring about the synthesis of chest discomfort, nausea, anxiety, arrhythmias, ischemic coronary artery disease, and even cerebrovascular disease (De Jonge et al., 2023).

The research study literature of the study of Maughan et al., (2018) indicates that the occurrence of gastrointestinal symptoms, including stomach cramps, diarrhea, and nausea, is increased after taking iron supplements in individuals with sufficient iron stores.

Another issue that has been the topic of concern in terms of the use of high doses of supplements in the absence of surveillance is the potential for negative interactions with prescription medication. In their study, Sood et al., (2008) identified that garlic, valerian, kava, ginkgo, and St. John's wort—two of the most used natural supplements—were responsible for 68% of all potentially clinically important interactions. The result of this study, which involved a group of patients, was that the medication used to prevent thrombotic disease was the most notable in interactions with supplements. The absolute size of the risk that such interactions represent is, however, questionable.

With such a wide range of potential health harm and ill health, the use of supplements—more so in the absence of trained advice—deprecates the prospect of more ill than good. The greater danger is that of those hearing of anecdotal recommendations or internet fashion instead of evidence-based recommendations. There is thus the necessity of building awareness of the use of safe supplements alongside opening the availability of trained advice so that harm is lessened and long-term health is achieved among recreational users (Table 1).

Table 1. Summary of Benefits and Potential Risks of Popular Supplements

Supplement	Benefits	Potential Risks
Protein	Muscle growth, recovery, metabolism support	Kidney strain, acne, mood changes
Creatine	Strength, energy, recovery, brain health	Water retention (mild)
Pre-Workouts	Energy boost, focus, endurance	Heart rate, anxiety, GI issues
BCAAs	Reduced soreness, minor performance aid	Unclear impact, often mixed with others
Ashwagandha	Improved endurance, reduced fatigue	Limited research in athletes
Antioxidants	Reduced muscle damage, recovery aid	May hinder adaptation if overdosed

The Role of Marketing and Misinformation

Extensive studies have gone a step further to maintain social media's contribution to poor body image and poor eating, a problem increasing by generation, particularly young sport individuals, who are becoming increasingly reliant on social media and are constantly exposed to idealized body image representations (Murray et al., 2016). There is evidence to suggest that body image's destruction from a critical viewpoint comes from exposure to certain kinds of content, but prolonged Internet exposure, particularly to

slimming content, is less so (Sanzari et al., 2023). Body-focused images have been utilized to develop custom-designed communication strategies with a view to affecting young individuals' purchasing habits, as they have been found to be associated with users of a sport club's food supplements (Hilkens et al., 2021).

Despite overwhelming evidence, corporations have been conducting aggressive ad campaigns, using social media influencers more and more to market their products, prompting doctors to urge regulation of a potentially up to nearly $20 billion-a-year industry (Klein and Schweikart, 2022). Ricke and Seifert, (2025) took a step further to inspect their work to specifically detail the contents of products most promoted by influencers, concluding nearly two-thirds of aggressively promoted dietary supplements were past the previously recommended daily maximum intake and did not have adequate dosing and contraindication information.

Discussion and Practical Recommendations

Supplementation has become a commonplace element in modern athletic programs and is likely to remain so in the future. Nevertheless, vast numbers of sportspeople introduce them into their programs with minimal real comprehension of their overall effects. For that reason, supplementation should be considered after sportspeople have considered potential benefits, including risks. For recreational sportspersons who exercise daily but do so at a non-professional standard, several dietary supplements have been proven effective, provided their use is within an appropriate context (Šelb and Lenasi, 2017). In this article section, our discussion remains with regard to supplements better researched and with real benefits to sportspersons.

Creatine monohydrate is the researched and promoted compound of creatine, which is effective and safe. Aid with supplementation by creatine benefits with assistance from several exercise activities. It aids muscular performance with extremely short exercise bouts of resistance exercise, with extremely high intensity. Creatine supplementation could be said to be overall benign, with extremely few side effects occurring. The most experienced side effect continues to be transitory water retention, which continues to be probable with initial start-up. Creatine continues to be a dietary supplement with a broad research foundation and evidence (Hall and Trojian, 2013).

Caffeine leads to research-performed and consumed ergogenic aids. The caffeine is easily absorbed within 1 hour after ingestion, and with maximum effect, it should be consumed 30 to 60 minutes pre-competition or pre-exercise (Antonio et al., 2024). It has been associated with research where caffeine ingestion advocates exercise work during endurance exercise and demonstrates potential during intermittent exercise and exercise strength (Martins et al., 2020). The International Society of Sports Nutrition suggests 3 to 6 mg per kilogram body mass to achieve better exercise work. Low to moderate doses, specifically, prove to be safe among healthy adults, but their tolerance alters with tolerance, body mass, and sensitivity (Antonio et al., 2024). To achieve better cognitive potential, small dosing from 1 to 3 mg per kilogram decreases reaction time, increases speed, and provides memory help (Sainz et al., 2020). Side effects from caffeine, however, are rapid heart rate, heart palpitations, anxiety, headache, insomnia, and poor sleep patterns (Pallarés et al., 2013). Certain dietary supplements are required where nutrient deficiencies are present or where food intake is becoming insufficient (Maughan et al., 2018).

Protein supplements are taking center stage among bodybuilders, sports individuals, and those who exercise daily, thanks to their proven roles in fixing, building, and rebuilding muscles (Ferrando et al., 2023). Supplementing with whey protein, which includes protein isolates, promotes recovery from resistance exercise-induced changes throughout muscle work (Davies et al., 2018). Supplementing with protein boosts body mass and strength considerably, especially among those who consume less than 1.6 g/kg/day (Morton et al., 2018). Still, where one's dietary schedule already settles with sufficient protein, additional protein may not justify additional benefit. The optimum dose of protein varies with several factors, including body mass, body disposition, exercise volume, and protein provision from dietary sources. The standard bodybuilding and athletic professional tends to require 1.2 to 2.0 grams per kilogram body mass per day to maintain overall body repair and development across muscles (Wu, 2016). High chronic dosing with whey protein has been associated with adverse effects from excessive dosing with whey protein supplementation, including adverse kidney and liver effects, exacerbating exercise-induced tissue damage, acne, and changes across gut microbiota, so excessive long-term dosing tends to have adverse effects across overall body health (Vasconcelos et al., 2021).

Vitamin D deficiency represents a leading global public health issue to justify escalating risks to a broad spectrum of bone and non-bone diseases and is associated with a number of enduring side effects (Rusińska et al., 2018). Supplementing becomes judicious where suboptimal levels of sun exposure are encountered to achieve levels of sufficient vitamin D. Rupprecht et al., (2023) proved daily supplementing by up to 1,000 IU to elevate, by a mean of 36 nmol/L, serum 25(OH)D concentrations in adults with restricted skin-synthesized cuts. Vitamin D's benefits include bone health, immune function, and overall well-being. Daily doses taken by ≥2000 IU for

a duration of a minimum of seven days contribute to recovery from exercise and exercise injury, to some extent, by virtue of anti-inflammatory processes (Rojano-Ortega and Berral-de La Rosa, 2023).

Education needs for recreational athletes

Certain supplements are toxic to an extreme extent, particularly during periods of taking outside approved dosages, expanding side effects beyond benefits (Ronis et al., 2018). Personalized methodologies to nutrition are vital since humans are diverse with exercise and nutritional interventions. Supplementation needs to be personalized according to each athlete's needs (Nieman and Cialdella-Kam, 2022). Coaches, being influential on recreational individuals, should introduce responsible supplementation methods from an early age. Athletes should be cautious about the benefits and risks of any supplement before taking it. There's limited or no scientific evidence to support a vast number of supplements, with many being poorly backed by research. Moreover, a vast number of individuals venture into supplementation with no legitimate scientific proof to back safety or efficacy. That's where access to credible sources remains vital to curbing health risks (Maughan and Shirreffs, 2013).

4. CONCLUSION

The low-cost, high-use among recreational exercisers is a testament to both the rising awareness of health advantages among the group and the force of appeals of promotion. Whilst there is evidence of the advantage of individual substances—e.g., power for creatine and muscle recoverability for whey protein—a practical advantage all too often plateaus or disappears when in quantities larger than that required physiologically. Furthermore, intake of vast quantities of supplements could have health consequences such as manipulation of gut bacteria, saturation of the kidneys, or emotional trauma. The lack of professional guidance significantly enhances the likelihood of unwanted consequences of taking supplements. This emphasizes the importance of the provision of accessible, reliable, evidence-based content, in particular for the recreational exerciser. Supplements must become an addition—but not a substitute for—a balanced diet, suitable rest, and individualized recovery. More accurate marking of products and harmonized regulation of products could also support consumers in making wiser, safer decisions. Responsible use of supplements is ultimately dependent not on the current social media craze or consensus, but on an informed, clear understanding of the individual's requirements and evidence-based advice.

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The authors declare that there is no conflict of interest.

Data and materials availability

All data associated with this work are present in the paper.

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