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Dietary Supplements and Popular Nutritional Strategies among Young Adults: Effectiveness, Safety, and Potential Health Risks – A Current Review of the Literature

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ABSTRACT

Dietary supplements and various nutritional strategies have become an integral part of young adults' lives in recent years, a trend observed in an increasing proportion of the population. The popularity of supplementation has been rising, driven by the easy availability of preparations, the influence of social media, and the belief that health and physical performance should be supported with additional substances. However, growing attention is being paid to the

inadequate regulation of the dietary supplement market and the fact that some of the preparations available online contain ingredients that do not match the manufacturer's declaration. At the same time, there has been a marked increase in the interest in restrictive dietary strategies, such as the ketogenic diet, high-protein diet, plant-based diets, and intermittent fasting. Although these approaches may offer metabolic and performance-related benefits, they can also adversely affect the health of young adults if used improperly.

The aim of this study was to present current evidence on the efficacy and safety of the most commonly used supplements and dietary strategies in the young adult population. Reports from clinical trials, observational studies and systematic reviews published between 2014 and 2024 were analyzed, with particular focus on health risks such as hepatotoxicity, electrolyte disturbances, interactions between active ingredients, and the risk of deficiencies associated with inadequately balanced diets. The available data indicate that although some supplements have a favorable safety profile, their unsupervised and combined use increases the risk of adverse effects. Similarly, many dietary patterns can be effective but require appropriate planning and, in some cases, professional supervision. These findings highlight the need for targeted health education, routine clinical assessment of supplement and diet use, and stricter regulation of the dietary supplement market.

Keywords: dietary supplements, safety, young adults, ketogenic diet, high-protein diet, intermittent fasting, plant-based diet, nutrition, health risks

INTRODUCTION

In recent years, there has been a marked increase in the popularity of dietary supplements and a variety of dietary patterns among young adults [1-3,18,21]. This phenomenon is particularly evident in individuals aged approximately 18–35 years, who are also among the most active users of social media and highly susceptible to health-related content and marketing messages [1-3]. In everyday clinical practice, young adults rarely report supplement use unless explicitly asked, which means that a potentially relevant part of their health behavior often remains invisible to healthcare professionals. Interestingly, informal conversations with young adults suggest that many of them do not perceive supplements as “real” pharmacological agents. This

attitude often leads to unintentional underreporting, creating a gap between their actual behaviors and what clinicians assume during routine visits.

Available studies suggest that between 40% and 70% of adults use dietary supplements on a regular basis, with even higher prevalence in physically active groups and recreational or competitive athletes [1-3,18,21]. Similar trends have been observed in Polish recreational and competitive athletes, who frequently use dietary supplements to enhance performance and to compensate for perceived nutritional gaps [18,21]. The most frequently reported motivations include improving physical appearance and performance, increasing energy levels and concentration, and a general desire to "support health" [1-3,18,21]. A recent study published in the Journal of Education, Health and Sport demonstrated similar motivations among recreationally trained men, with most individuals using dietary supplements to improve physical performance and to compensate for an insufficient diet [21]. At the same time, many users have only limited knowledge of the quality of preparations, potential interactions between active ingredients, and possible adverse effects [1-3,6,18]. In many recent studies, social media has emerged as one of the primary sources of information about supplements and diet among young adults, often surpassing traditional channels such as physicians, dietitians or pharmacists [1-3,18]. Image-centric platforms and fitness-oriented accounts frequently promote protein powders, pre-workout products, "fat burners" and various herbal preparations as essential elements of a "healthy" or "aesthetic" lifestyle. Observational data from young male gym users suggest that intensive, appearance-focused social media use is positively associated with the use of dietary supplements and even anabolic-androgenic steroids, with many individuals reporting that they first encountered these products online rather than in a medical context [26]. Similar patterns are described in broader young adult populations, where social media influencers and targeted advertising campaigns significantly shape perceptions of supplement efficacy and safety, despite the limited or selectively presented scientific evidence [18,26]. This environment may reinforce the belief that supplements are harmless lifestyle accessories, encourage stacking several preparations at once, and normalize practices that would likely be questioned in a face-to-face medical consultation. For clinicians, it is therefore important to recognize that social media is not only a marketing channel, but also a powerful, largely unregulated educational space that directly competes with evidence-based counselling [18,26].

Parallel to the growing use of supplements, interest has increased in a range of dietary patterns promoted as effective and health-enhancing [11-14,16-17,23-24]. Especially popular among young adults are high-protein diets, ketogenic diets, intermittent fasting regimens and plant-based diets. These strategies may provide measurable benefits in terms of body mass control,

metabolic parameters and overall cardiovascular risk [11-14,16-17,23-24]. However, they are also associated with specific limitations and potential complications, particularly when followed without adequate education, medical supervision or regular laboratory monitoring [10-14,16-17,23-24].

An additional concern is the relatively weak regulatory framework that applies to dietary supplements in many countries [4-8]. In contrast to medicinal products, supplements are often placed on the market without robust pre-marketing efficacy and safety evaluation. Analyses of products purchased online have revealed the presence of undeclared pharmacologically active substances, including stimulants and agents with hepatotoxic potential [4-8,15,18]. Young adults, who frequently buy supplements via the Internet, may therefore be exposed to preparations that are mislabeled, adulterated or of poor quality [4-8,18,20].

Aim of the review

The aim of this article is to provide an up-to-date narrative review of current knowledge on dietary supplements and popular nutritional strategies used by young adults, with particular emphasis on their safety and potential health risks. Both beneficial and adverse effects are discussed to offer practical guidance for healthcare professionals, dietitians and young adults themselves.

METHODS OF LITERATURE SEARCH

A narrative review of the literature was conducted. The PubMed, Scopus and Google Scholar databases were searched for articles published between January 2014 and April 2024. The following keywords and their combinations were used: dietary supplements, young adults, creatine, protein supplements, pre-workout, weight-loss supplements, adaptogens, hepatotoxicity, ketogenic diet, high-protein diet, intermittent fasting, plant-based diet, vegan, vegetarian, cardiovascular risk. Priority was given to clinical trials, observational cohort and cross-sectional studies, and systematic reviews. Case reports and case series were included when they provided important safety signals (e.g. hepatotoxicity or kidney stone formation).

Where possible, data specifically concerning young adults (approximately 18–35 years) or physically active populations were selected. Articles in English were included. The search strategy was not registered and did not follow the formal PRISMA framework; therefore, the present work should be considered a narrative, rather than systematic, review.

1. Characteristics of the supplement market and patterns of use

The dietary supplement market has expanded rapidly over the last two decades [1-3,6,18]. In many countries, supplements can be bought not only in pharmacies but also in supermarkets, fitness clubs and, increasingly, via online platforms [1-3,6,18]. Studies conducted in Europe, North America and the Middle East indicate that young and middle-aged adults, particularly those who are physically active, constitute one of the largest groups of supplement consumers [1-3,18,21]. Self-reported prevalence of use in these populations often exceeds 60%, and many individuals take multiple preparations concurrently [1-3,18,21].

The most common reasons for supplement use among young adults include the desire to improve sports performance, accelerate post-exercise recovery, control body weight, boost immunity and enhance cognitive performance [1-3,18,21]. Social media and influencer marketing play a central role in shaping these behaviors [1-3,18]. Many users report that their decisions regarding supplement choice are based on recommendations from friends, fitness trainers or online content rather than from healthcare professionals [1-3,18,21,25].

Importantly, a substantial proportion of young adults do not consult a physician or dietitian before starting supplementation [1-3,18,21]. In surveys, almost half of respondents reported choosing products independently, based on online information or advertising [1-3,18,21]. This lack of professional input increases the risk of using inappropriate doses, unnecessary combinations or preparations that are contraindicated in specific clinical situations.

Another important aspect is the source of purchase. Although many high-quality supplements are available from reputable manufacturers, analyses of products sold online have revealed serious concerns [4-6,7,8,18]. Studies have shown that a notable proportion of weight-loss supplements, pre-workout formulations and “fat burners” contain undeclared pharmacologically active substances such as ephedrine analogues, methylsynephrine (oxilofrine), DMAA or other synthetic stimulants [4-6]. Some products have been found to contain different substances than those declared on the label, or to include multiple stimulants in combination [4-6]. From a legal and ethical standpoint, contaminated supplements also pose a notable risk for physically active individuals, potentially leading to inadvertent anti-doping violations despite the declared use of over-the-counter preparations [18,20].

From a regulatory perspective, dietary supplements are often classified as food products and are therefore subject to less stringent pre-marketing control than medicinal products [4-8,20]. Manufacturers may not be required to provide robust randomized controlled trial data on efficacy and safety [4-8]. Surveillance of adverse effects usually relies on voluntary reporting, which likely underestimates the true scale of complications [7,8]. For young adults who are

otherwise healthy and may not undergo regular medical check-ups, such an environment creates conditions in which problems can remain undetected until severe symptoms appear [7,8,15].

2. The most commonly used supplements – overview of safety and efficacy

2.1. Creatine

Creatine monohydrate is one of the most thoroughly researched supplements used in sports nutrition [9,22]. This is consistent with a recent JEHS review, which emphasized the wide range of applications of creatine in both recreational and professional sport and its favorable safety profile when used according to established guidelines [22]. Numerous randomized controlled trials and meta-analyses have demonstrated that creatine supplementation increases muscle strength, power and lean body mass, particularly in conjunction with resistance training [9]. A typical regimen includes a loading phase of 20 g/day divided into 4 doses for 5–7 days, followed by a maintenance dose of 3–5 g/day. Many young adults, however, skip the loading phase and use only maintenance doses, which still appears to be effective.

The safety profile of creatine in healthy individuals is generally favorable [9,22]. Long-term studies have not shown an increased risk of renal impairment when recommended doses are adhered to. Adverse effects, when reported, mainly include transient gastrointestinal discomfort, water retention and mild weight gain due to increased intracellular water. Concerns about nephrotoxicity largely stem from case reports in individuals with pre-existing kidney disease or those using multiple nephrotoxic agents [10].

In everyday practice, a more realistic problem is not creatine itself but the quality of multi-ingredient formulations. Some pre-workout products or “mass-gainer” blends that include creatine have been found to contain undeclared stimulants or anabolic agents [4-6]. Therefore, while pure creatine monohydrate from reputable manufacturers appears safe, the use of unverified multi-ingredient preparations carries additional risks.

2.2. Protein preparations

Protein supplements are widely used among young adults, especially those engaged in strength training or mixed training programs [1-3,18,21]. Whey protein concentrates and isolates, casein preparations and, increasingly, plant-based protein blends (e.g., peas, rice, soy) are marketed to support muscle hypertrophy and post-exercise recovery. Numerous studies confirm that adequate protein intake facilitates muscle protein synthesis and adaptation to resistance training [9,10].

A daily protein intake of approximately 1.4–2.0 g/kg body weight is generally considered safe and sufficient for most physically active individuals [10]. Within this range, protein

supplements can be a convenient way to reach target intake, particularly for those with high energy expenditure or limited time for meal preparation.

Problems arise when protein intake persistently exceeds physiological needs [10]. In everyday practice, it is not uncommon to meet individuals whose protein intake appears to be shaped more by online fitness trends than by genuine physiological requirements. This mismatch may gradually impose unnecessary metabolic strain, even though the users believe they are optimizing their performance. Chronic consumption substantially above 2 g/kg body weight, particularly in the context of low fluid intake, may increase renal workload, promote hyperuricemia and contribute to dehydration [10]. Although robust evidence of direct renal damage in healthy individuals remains limited, caution is advised in young adults with undiagnosed kidney disease, hypertension, diabetes or a family history of chronic kidney disease.

Independent analyses of commercially available protein supplements have also revealed heavy-metal contamination and microbiological issues in some low-cost products, highlighting once again the importance of purchasing from reputable sources [6,18]. A recent article in Quality in Sport examined the quality of supplements used by athletes, confirming that contamination and mislabelling remain widespread issues despite regulatory efforts [18]. In addition, some consumers report gastrointestinal complaints, likely linked to lactose intolerance, poorly tolerated sweeteners, or the high osmotic load of certain preparations.

2.3. Caffeine and pre-workout supplements

Caffeine is one of the most widely used psychoactive substances and a well-documented ergogenic aid [9]. It can enhance alertness, improve reaction time and reduce perceived exertion during exercise. In sports-related research, doses of 3–6 mg/kg body weight consumed approximately 30–60 minutes before exercise have been shown to improve performance in various modalities.

In the general population, moderate caffeine intake up to about 400 mg/day is considered safe for most healthy adults [9]. However, young adults often obtain caffeine from multiple sources: coffee, energy drinks, pre-workout supplements and high-dose caffeine “shots” [1-3,18]. When several of these products are consumed within a short time frame, total daily intake may easily exceed recommended limits.

Excessive caffeine consumption can lead to palpitations, tachycardia, elevated blood pressure, anxiety, tremor and sleep disturbance [9]. Case reports describe episodes of supraventricular and ventricular arrhythmias, particularly in individuals who also used other stimulants or were

dehydrated. Pre-workout supplements are of particular concern because they frequently combine caffeine with other stimulatory ingredients, such as synephrine or various plant extracts, which may further increase adrenergic activity [4-6,18].

2.4. Weight-loss supplements and "fat burners"

Weight-loss supplements and so-called "fat burners" constitute one of the most problematic categories of dietary supplements [7,8,15]. Many of these products are marketed with strong claims of rapid fat reduction, appetite suppression or metabolic acceleration, yet clinical trials often fail to demonstrate substantial or sustained effects on body weight [7,8].

Despite questionable efficacy, this group of supplements is disproportionately represented in reports of adverse events. Observational data and case series indicate that weight-loss preparations are among the leading causes of drug-induced liver injury (DILI) related to herbal and dietary supplements [7,8,15]. Hepatotoxicity may manifest as elevations in aminotransferases, cholestatic patterns, acute hepatitis or, in severe cases, liver failure.

The greatest risks are associated with products purchased through unverified online sources [4-6,18]. Analyses have shown that some of these supplements contain undeclared synthetic stimulants, multiple adrenergic agents or compounds withdrawn from the pharmaceutical market for safety reasons [4-6]. Falsified composition and high doses of active ingredients significantly increase the risk of hypertension, arrhythmias, psychiatric symptoms and severe hepatic injury in young consumers [7,15].

2.5. Adaptogens and herbal supplements

Adaptogens such as ashwagandha (Withania somnifera), ginseng (Panax species) and rhodiola (Rhodiola rosea) have gained popularity due to claims that they improve stress resilience, mood and cognitive performance [15]. Some clinical trials suggest potential benefits in reducing subjective stress, mild anxiety or fatigue, but the overall quality of evidence remains moderate, with many studies characterized by small sample sizes and methodological limitations [15].

Herbal supplements are frequently perceived as "natural" and therefore safe, which may lead to their liberal use and under-reporting to physicians [7,8,15]. In reality, these products can interact with conventional medications and cause adverse effects, including palpitations, elevated blood pressure, insomnia and, in some cases, hepatotoxicity. Over the last decade, several case series have documented liver injury associated with ashwagandha use, often in young or middle-aged adults with no prior liver disease [15].

As with other supplement categories, the risk is further exacerbated by inadequate quality control and the possibility of contamination or adulteration [4-8]. Multi-herbal products, which

combine several adaptogens with vitamins, minerals or stimulants, pose particular challenges in attributing causality when adverse reactions occur.

2.6. Energy drinks and high-caffeine beverages

Energy drinks represent a specific subgroup of stimulant-containing products that are particularly popular among adolescents and young adults [18,27,28]. They are often consumed together with pre-workout supplements or coffee, which can substantially increase total daily caffeine intake. In contrast to traditional sources of caffeine, such as coffee or tea, commercial energy drinks frequently combine high doses of caffeine with other stimulatory ingredients, including taurine, guarana, ginseng, B-vitamins and various herbal extracts [27,28]. Recent systematic reviews and randomized trials indicate that even in healthy young adults, consumption of energy drinks is associated with acute increases in heart rate and blood pressure, as well as prolongation of the QTc interval on the ECG [27]. These changes are usually transient, but may be clinically relevant in individuals with unrecognized cardiovascular disease, congenital channelopathies or a family history of sudden cardiac death [9,27].

From a practical standpoint, energy drinks are often marketed as convenient “performance boosters” for studying, gaming or training. Young adults may consume several cans within a short period, sometimes in combination with alcohol, nicotine or other stimulants [18,27,28]. Case reports and observational data link such patterns of use with supraventricular and ventricular arrhythmias, episodes of severe hypertension, myocardial ischemia and, in rare cases, acute myocardial infarction in previously healthy individuals [27,28]. A recent JEHS review emphasized that repeated exposure to high-caffeine energy drinks, especially when combined with physical exertion and inadequate hydration, can create substantial adrenergic stress and may contribute to both acute events and long-term cardiovascular risk in susceptible users [28]. For clinicians, it is therefore important to ask specifically about energy drink consumption when evaluating young adults who present with palpitations, chest pain, syncope, elevated blood pressure or unexplained anxiety, and to address the cumulative stimulant load from coffee, energy drinks and pre-workout products [9,18,27,28].

Table 1. Common supplements used by young adults – main intended effects and key safety concerns.

Supplement category	Main intended effects	Main safety concerns
Creatine	Increased strength and anaerobic performance	Mild GI discomfort; water retention; caution in kidney disease
Protein supplements	Convenient protein intake; muscle recovery	Possible renal strain with very high intake; dehydration; contamination
Caffeine / pre-workout	Increased alertness; reduced perceived exertion	Palpitations; hypertension; arrhythmias; increased risk when combined with other stimulants
Weight-loss supplements	Appetite suppression; “fat burning” claims	Highest risk of adulteration; DILI; stimulant toxicity
Adaptogens	Stress reduction; mood improvement	Hepatotoxicity (ashwagandha); drug interactions; insomnia
Multi-ingredient blends	Combined ergogenic claims	Unpredictable interactions; arrhythmias; electrolyte issues; DILI
Energy drinks / high-caffeine beverages	Increased alertness; reduced fatigue; improved short-term concentration	Hypertension; tachycardia; QTc prolongation; arrhythmias; synergistic risk with other stimulants

3. Interactions and risks associated with combining supplements

Young adults frequently use several supplements simultaneously in an attempt to maximize ergogenic or aesthetic outcomes [1-3,18,21]. Common combinations include caffeine-rich pre-workout products, creatine, protein supplements, L-carnitine and various fat-burning preparations. While each product may appear relatively safe when used alone at recommended doses, cumulative exposure and potential interactions create a more complex risk profile.

Combining stimulants is of particular concern [4-6,18]. Caffeine used together with synephrine or other adrenergic compounds can result in excessive sympathetic activation, manifesting as tachycardia, increased blood pressure, anxiety and sleep disturbances [4-6]. Physically active individuals who train at high intensities may be especially vulnerable, as exercise itself increases sympathetic drive. In some cases, this combination may contribute to arrhythmias or myocardial ischemia, particularly in the presence of dehydration or electrolyte abnormalities.

Thermogenic products that promote sweating and fluid loss, when used concurrently with high-dose stimulants or in the context of inadequate fluid intake, may also lead to disturbances in water–electrolyte balance [5-8,12]. Hyponatremia, hypokalemia or other electrolyte imbalances may develop insidiously and remain unnoticed until clinically significant symptoms, such as muscle weakness, dizziness or cardiac arrhythmias, appear.

From a hepatic perspective, the use of multiple herbal and weight-loss supplements at the same time increases the risk of DILI due to overlapping hepatotoxic mechanisms or cumulative metabolic burden [7,8,15]. Multi-ingredient products – especially those bought online – are frequently implicated in case reports, making it difficult to determine which component is primarily responsible for the injury [4-8,15,18].

Finally, extensive supplementation can mask underlying dietary deficiencies. Young adults who rely on protein powders, multivitamins and "health boosters" may develop a false sense of security and maintain diets that are low in whole foods, fiber and micronutrients. This pattern may delay the diagnosis of iron deficiency, vitamin B12 deficiency or other nutritional problems and contribute to persistent fatigue or impaired immune function.

4. Popular nutritional strategies used by young adults: current knowledge and safety

4.1. Ketogenic diet

The ketogenic diet (KD) is among the most frequently adopted restrictive dietary patterns in recent years [11,23,24]. It is characterized by a substantial reduction in carbohydrate intake, typically below 50 g/day, accompanied by a high intake of fats and moderate protein consumption. By inducing a state of nutritional ketosis, the KD shifts the primary energy source from glucose to ketone bodies.

Multiple clinical studies and meta-analyses have demonstrated that ketogenic diets can be effective in reducing body weight and improving certain metabolic parameters, such as fasting glucose, insulin sensitivity and triglyceride levels, at least in the short to medium term [11,23,24]. Comparable outcomes were reported in a JEHS literature review, where ketogenic diet protocols led to significant reductions in body weight and improvements in key metabolic parameters among adults with overweight or obesity [23,24]. Some individuals report decreased appetite and improved subjective concentration while following the KD, which may further facilitate adherence.

However, the diet is not without risks. Elevated LDL cholesterol and other atherogenic lipid fractions have been observed in a subset of individuals, particularly when saturated fats constitute a major component of dietary fat intake [11]. Long-term cardiovascular implications

of such changes remain uncertain. Moreover, ketogenic diets may promote disturbances in water–electrolyte balance and increase the risk of kidney stone formation, likely due to changes in urinary citrate, calcium and uric acid excretion [12]. At the same time, JEHS reports suggest that ketogenic diets may improve glycemic control in selected metabolic disorders, although such interventions require strict medical supervision due to their potential long-term adverse effects [23,24].

Case reports describe episodes of non-diabetic ketoacidosis, especially in individuals who combined strict carbohydrate restriction with intensive physical activity, intercurrent illness, or the use of certain medications. Young adults who follow the KD without dietetic supervision are also at risk of deficiencies in fiber, certain B-vitamins, magnesium and other micronutrients, as well as gastrointestinal complaints such as constipation.

4.2. High-protein diets

High-protein diets remain popular among young adults, particularly those engaged in strength training or bodybuilding [1-3,10]. In such diets, protein may provide 25–35% or more of total energy intake. Evidence suggests that higher protein intake supports gains in muscle mass, facilitates post-exercise recovery and may contribute to increased satiety and weight management [10].

A daily intake of 1.4–2.0 g/kg body weight is generally considered safe and sufficient for most healthy, physically active individuals [10]. Within this range, protein can be derived from a combination of whole foods and supplements. Problems arise when intake consistently exceeds this threshold, especially when accompanied by low fluid intake and a diet poor in fruits, vegetables and whole grains.

Excessive protein consumption may increase renal workload and lead to hyperfiltration, potentially exacerbating pre-existing kidney disease. Additionally, diets very high in animal protein may raise serum uric acid levels, thereby increasing the risk of gout or kidney stones in susceptible individuals. Electrolyte imbalances and dehydration may occur if high protein intake is combined with inadequate water consumption or the use of diuretics and thermogenic supplements [10,12].

Another concern is that many young adults combine high-protein diets with multiple protein supplements, often consumed in large servings immediately after training and before sleep. This pattern may result in chronic metabolic strain and can displace other important food groups, including vegetables, fruits and whole grains, from the diet.

4.3. Intermittent fasting

Intermittent fasting (IF) has become highly popular in recent years, owing largely to extensive promotion on social media and in popular science literature [13,14,19]. The most common IF protocols include time-restricted eating (e.g., 16/8 or 18/6 schedules) and the 5:2 approach, which combines regular eating on five days with substantial caloric restriction on two non-consecutive days.

Systematic reviews and meta-analyses indicate that IF can lead to weight loss and improvements in metabolic parameters, such as insulin sensitivity, fasting glucose and certain lipid markers, with efficacy comparable to continuous caloric restriction in many studies [13,14,19]. Recent analyses published in Quality in Sport similarly report improvements in metabolic parameters among young adults following time-restricted eating protocols such as 16/8 or 18/6 [13,19]. Some participants report subjective improvements in well-being, mental clarity and appetite control.

Despite these potential benefits, IF presents notable challenges for young adults, especially those with high levels of physical activity or irregular schedules [13,14]. Prolonged fasting windows may cause hypoglycemia, dizziness, headaches, irritability and impaired concentration, which can interfere with work, study or training. Overly restrictive patterns may predispose susceptible individuals to binge-eating episodes during non-fasting periods, potentially undermining metabolic benefits and mental well-being.

In women, disturbances in menstrual cycles and hormonal fluctuations have been reported during strict IF regimens, particularly when energy intake is chronically low [14]. Combining IF with high doses of stimulants – such as caffeine or pre-workout formulations – may further increase sympathetic activation in the context of low caloric and carbohydrate availability, raising the risk of palpitations, arrhythmias or excessive fatigue [4-6,9,13].

4.4. Plant-based diets

Plant-based diets, including vegetarian and vegan patterns, have become increasingly common among young adults [16,17]. A substantial body of evidence indicates that well-planned plant-based diets are associated with lower body weight, improved lipid profiles and reduced incidence of cardiovascular disease and type 2 diabetes. These benefits are largely attributed to higher intakes of fiber, unsaturated fats, antioxidants and phytochemicals, along with lower consumption of saturated fats and processed meats.

However, plant-based diets require careful planning to ensure adequate intake of certain nutrients [16,17]. Improperly designed vegan or vegetarian diets may result in deficiencies of

vitamin B12, iron, zinc, iodine and long-chain omega-3 fatty acids such as DHA [16,17]. Inadequate protein quality and quantity may also become an issue, particularly in individuals with high training loads who rely on limited plant protein sources.

Young adults often adopt plant-based diets for ethical or environmental reasons and may underestimate the need for supplementation with vitamin B12 or the importance of including diverse protein sources such as legumes, soy products, nuts and seeds. Inadequate intake of these nutrients can contribute to anemia, fatigue, impaired immune function and, in the long term, potentially to neurological complications [16,17]. Recent expert reviews underline that vitamin B12 deficiency is a particularly important concern in individuals choosing plant-based diets, because unfortified plant foods do not provide a reliable source of this vitamin [29]. Population data suggest that serum vitamin B12 levels are substantially lower in vegans and, to a lesser extent, in vegetarians compared with omnivores, and that clinical manifestations may develop even in the absence of macrocytic anemia [16,17,29]. Neurological symptoms such as fatigue, impaired concentration, memory problems and mood changes may precede hematological abnormalities, which makes early diagnosis challenging in everyday practice [29]. For young adults who follow vegan or near-vegan diets, routine supplementation with vitamin B12 and periodic laboratory monitoring are therefore strongly recommended by multiple nutrition societies [16,17,29]. In the context of restrictive eating patterns combined with intensive training and supplement use, failure to recognize vitamin B12 deficiency may lead to a paradoxical situation in which an individual invests considerable effort in "optimizing health" while gradually developing potentially reversible, but clinically significant, neurocognitive and hematological complications. Despite these risks, some individuals adhering to restrictive plant-based diets undergo laboratory testing less frequently than those following more traditional diets, increasing the likelihood of unrecognized deficiencies.

4.5. Hybrid dietary patterns

Many young adults do not follow a single, clearly defined dietary strategy. Instead, they combine elements of several approaches into complex "hybrid" patterns [1-3,9-14,18]. Examples include pairing intermittent fasting with a ketogenic diet, using high-protein intake within a predominantly plant-based framework, or alternating between extreme restriction during the week and liberal intake on weekends.

Such combinations are often motivated by the desire to accelerate weight loss, maximize performance or align diet with personal ethical beliefs. However, when these patterns are poorly structured, they can adversely affect metabolic stability [9-14,19]. Studies suggest that hybrid

dietary protocols may carry a greater risk of glycemic variability, hypoglycemia, dehydration and electrolyte abnormalities compared with single, consistent dietary strategies [11-14].

In practice, a young adult may begin the day in a fasting window, break the fast with a high-fat, low-carbohydrate meal, consume multiple protein supplements around training, and then rely on plant-based dishes for ethical reasons. When combined with stimulant-containing supplements and irregular sleep, this pattern can create substantial physiological stress despite the intention to "live healthily" [4-6,9,11-14].

DISCUSSION

Available studies clearly show that dietary supplements and a variety of nutritional strategies have become an established part of the lifestyle of many young adults. These behaviors are often driven by a desire to improve health, physical appearance or athletic performance. However, the present narrative review indicates that such practices carry inherent risks and require appropriate knowledge, planning and clinical awareness. This is particularly evident in cases where individuals combine several dietary strategies based on fragmented online advice. In such situations, even well-intentioned attempts to improve health may inadvertently lead to physiological instability or misleading interpretations of emerging symptoms.

Supplementation in this age group is frequently undertaken on an ad hoc basis, without professional consultation. This increases the probability of using products of questionable quality or those containing undeclared ingredients, including synthetic stimulants and hepatotoxic compounds. The literature repeatedly emphasizes that supplements purchased through unverified online marketplaces present a disproportionately high risk of adulteration and mislabeling, contributing to cases of severe liver injury and cardiovascular complications in otherwise healthy individuals. In everyday clinical work, this pattern is often revealed only incidentally, for example when a detailed history is taken before surgery, competitive sports qualification or routine laboratory testing. Young adults frequently admit that they have never discussed their supplement stack or dietary strategy with a physician, assuming that such information is irrelevant as long as they "feel well". This subjective feeling of safety may persist for a long time, because many adverse effects – such as a gradual rise in liver enzymes or subtle changes in blood pressure – remain asymptomatic. In this context, the absence of routine, structured questions about supplement use and diet in standard medical forms represents an additional, system-level barrier to early detection of complications.

The tendency to combine several supplements further amplifies these risks. Young adults often assume that using multiple products simultaneously provides additive or synergistic benefits. In practice, such combinations may trigger excessive adrenergic stimulation, arrhythmias,

dehydration and the accumulation of hepatotoxic metabolites, particularly when thermogenic agents and stimulants are used together. Epidemiological data and systematic reviews indicate that multi-ingredient supplements are over-represented among products linked to serious adverse events and DILI.

Equally important are the health consequences of poorly supervised restrictive diets. The ketogenic diet, although effective for weight loss and certain metabolic outcomes, may increase LDL cholesterol and promote kidney stone formation, especially in individuals with genetic predispositions or inadequate hydration. High-protein diets may support physically active young adults but, when combined with excessive supplementation and insufficient fluid intake, may contribute to renal strain, hyperuricemia and electrolyte disturbances.

Intermittent fasting, despite its popularity and documented benefits, may lead to hypoglycemia, fatigue, impaired concentration or menstrual irregularities in some individuals, particularly when implemented in a rigid manner or in conjunction with high training loads. Meanwhile, plant-based diets, though associated with favorable cardiovascular outcomes, require systematic attention to vitamin B12, iron, zinc and omega-3 fatty acid intake; these aspects are often neglected by young adults who adopt such diets for ethical or environmental reasons.

A particularly noteworthy trend is the simultaneous combination of multiple dietary strategies and supplement use – the hybrid approach that seems to dominate real-life practice. Physically active young adults may fast for extended periods, follow low-carbohydrate or ketogenic macronutrient distributions, consume high amounts of protein and use several ergogenic supplements at the same time. According to the literature, this cumulative load may predispose them to greater glycemic variability, dehydration and electrolyte abnormalities than would be expected with a single, well-structured diet alone.

Furthermore, many young adults base their dietary and supplementation choices predominantly on information obtained from social media influencers, online forums and marketing content. This environment favors oversimplified or misleading narratives, such as the belief that “natural” always equates to safe, or that more supplements necessarily produce better results. As a result, clinically relevant symptoms – such as persistent fatigue, palpitations, elevated liver enzymes or gastrointestinal complaints – may not be linked by the patient to their supplement use or dietary patterns, unless the clinician asks directly.

The collected evidence underscores the need for enhanced health education targeted at young adults. Ideally, such education should start early, for example in secondary schools and universities, and should involve physicians, dietitians, pharmacists, physiotherapists and trainers. A crucial component of preventive strategies involves raising awareness of the

importance of product quality, evidence-based indications and the limitations of supplements as substitutes for a balanced diet.

Healthcare professionals should routinely inquire about supplement use and dietary patterns during consultations, particularly when evaluating symptoms such as unexplained fatigue, mood changes, arrhythmias, hypertension, gastrointestinal issues or abnormal liver function tests. Simple, non-judgmental questions about energy drinks, pre-workout products, weight-loss supplements and current diet may uncover important clues that would otherwise remain hidden. Another important issue that emerges from the available literature, but is often overlooked in everyday practice, concerns the variability in individual responses to both supplements and dietary interventions. Even within the same age group and similar training routines, young adults may differ substantially in their metabolic rate, gut microbiota composition, hormonal balance, and genetic predispositions influencing lipid metabolism or caffeine clearance. These factors contribute to the fact that two individuals following nearly identical supplementation protocols may experience entirely different outcomes—one reporting improved energy and performance, and the other presenting with palpitations, elevated liver enzymes or profound fatigue. The heterogeneity of responses highlights the limitations of generalized online recommendations that assume the same level of tolerance and benefit across the entire population. Such advice may be misleading, particularly for individuals with unrecognized medical conditions, borderline hypertension, or early stages of insulin resistance, who often remain undiagnosed until symptoms become more pronounced.

Additionally, the psychological context of supplement use and restrictive dieting deserves closer attention. Many young adults rely on these strategies not only for health and performance, but also for reasons associated with body image, self-esteem, or pressure to meet social expectations shaped by fitness culture and social media. This behavioral pattern may predispose some individuals to excessive or compulsive supplement intake, cycling between restrictive diets and compensatory overconsumption, or engaging in unsafe combinations of stimulants during periods of academic or professional stress. While these tendencies rarely reach clinical thresholds for eating disorders, they may still cause unstable energy intake, mood fluctuations, impaired cognitive performance and a greater risk of dehydration or nutritional imbalance. These psychosocial motivators are rarely investigated in clinical studies but are repeatedly observed in real-world consultations with young adults reporting fatigue, poor recovery or episodes of tachycardia.

The role of misinformation also warrants deeper consideration. Young adults frequently obtain dietary and supplement-related information from influencers, forums, unverified websites or

short-format videos that prioritize engagement over accuracy. These sources often promote extreme narratives—such as “ketogenic diet cures everything,” “fasting resets all hormones,” or “natural means safe”—which may unintentionally downplay real health risks. Misinformation also contributes to unrealistic expectations, making individuals more likely to escalate doses or combine multiple products when desired results are not achieved quickly. Without structured education, this cycle can lead to increasing physiological stress and delayed recognition of adverse effects. From a public health perspective, improving media literacy and providing accessible, evidence-based educational materials for young populations may serve as an essential preventive measure.

Finally, a growing number of studies emphasize that the lack of coordinated guidance across healthcare professions results in inconsistent or conflicting recommendations. Physicians, dietitians, pharmacists, personal trainers and physiotherapists often operate within separate informational frameworks, which may confuse patients who seek advice. For instance, a trainer might encourage aggressive pre-workout use for performance, while a physician warns about tachycardia and hypertension, and a dietitian highlights the risks of overreliance on supplements instead of whole foods. Establishing structured, interdisciplinary channels of communication could help young adults navigate these discrepancies more safely. Such an approach would also facilitate earlier detection of warning signs, such as recurrent gastrointestinal symptoms, persistently elevated heart rate during training, or changes in laboratory results that might otherwise be dismissed as unrelated to diet or supplementation.

LIMITATIONS

This review has several limitations. First, it is a narrative rather than a systematic review, and the search strategy was not registered in a public database. Although efforts were made to identify relevant studies using multiple databases, some publications may have been missed. Second, only articles published in English were included, which may have introduced language bias and limited access to data from certain regions. Third, relatively few studies focus specifically on young adults aged 18–35 years; many investigations include broader age ranges, and results extrapolated to young adults should therefore be interpreted with caution. Finally, the heterogeneity of study designs, supplement formulations and dietary protocols makes direct comparison of results challenging and precludes firm quantitative conclusions regarding risk.

IMPLICATIONS FOR PRACTICE AND FUTURE RESEARCH

For clinical practice and public health, several practical implications emerge from this review:

1. Routine assessment of supplement use should become part of the medical history in young adults, especially in those who are physically active or present with unexplained symptoms.

2. Educational interventions targeted at students, athletes and gym-goers should address the limitations of the supplement market, the risks of buying products online and the importance of evidence-based indications.

3. Closer collaboration between physicians, dietitians, pharmacists, coaches and sports organizations is needed to provide consistent messages regarding safe supplement use and dietary planning for young adults. Joint educational campaigns and interdisciplinary workshops in universities, fitness clubs and sports academies could help bridge the gap between evidence-based recommendations and everyday practice.

4. Regulatory measures could focus on stricter control of online supplement sales, better labeling requirements and more robust post-marketing surveillance of adverse events.

5. Future research should investigate long-term health outcomes associated with combined use of multiple supplements and complex dietary patterns in young adults, including detailed cardiovascular, hepatic, renal and psychological endpoints.

CONCLUSIONS

The available literature indicates that dietary supplements and popular nutritional strategies play a substantial role in the daily routines of young adults, yet their use is associated with both potential benefits and noteworthy risks. The most significant challenges include inadequate health literacy, limited consultation with qualified professionals, and the widespread availability of products with uncertain composition, particularly those sold online.

Regular laboratory monitoring, informed supplement selection and cautious combination of dietary approaches may help reduce adverse outcomes. Healthcare professionals should actively ask about dietary patterns and supplement use, as this information is rarely disclosed spontaneously. Further research – especially long-term, prospective studies – is needed to better evaluate the metabolic, cardiovascular and hepatic consequences of supplementation and

restrictive diets in young adults. From a practical standpoint, the most urgent task is to develop simple, evidence-based tools that help clinicians quickly identify risky combinations of supplements and dietary strategies during routine appointments and support safe decision-making in the everyday environment of young adults. These tools could include brief clinical screening questions regarding supplement use, practical checklists for identifying risky combinations of stimulants, and easy-to-understand educational materials targeting students, amateur athletes and individuals relying heavily on online health content. Strengthening public health messaging in this area may help counteract widespread online misinformation and reduce the growing disconnect between perceived and actual safety of dietary strategies and supplements among young adults. Ultimately, improving awareness, facilitating early risk identification and promoting judicious use of supplements may collectively reduce the burden of preventable metabolic, cardiovascular and hepatic complications in this population.

DISCLOSURE

The authors declare that they have no relevant financial or non-financial interests to disclose.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

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