

Role of pharmacy students in fostering rational use of dietary supplements: Knowledge, attitude, and practice study

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Abstract: Dietary supplements are extensively consumed, but irrational use is a health hazard. Pharmacy students, being future healthcare providers, can facilitate rational use. The present study evaluated the knowledge, attitudes, and practices of pharmacy students at Srinivas College of Pharmacy, Mangalore, about dietary supplements and their role as an advocate, in addition to mental health correlations. 250 students selected through stratified random sampling took part in a cross-sectional mixed-methods study. A 30-question instrument (Cronbach's alpha=0.85) measured demographics, dietary supplement usage, knowledge, attitude, practices, and mental health was evaluated with the depression, anxiety, and stress Scale-21 (DASS-21). The data were collected during January-March 2025 and were analyzed with the chi-square test, logistic regression, and Pearson correlation tests. 35.0% (n=88) used dietary supplements regularly, with a preference for multivitamins (50%) and protein supplements (30%). Knowledge was moderate (60% risk aware), attitudes favorable (70% in favor of counseling), but practice restricted (25% informed peers). Everyday use of dietary supplements escalated stress probability (OR=2.5, 95% CI: 1.8-3.4, $p<0.001$), with correlation ($r=0.38$, $p<0.01$). In conclusion, students have promise as dietary supplement champions but require additional training to close knowledge-practice gaps and mitigate mental health risks. Curriculum and policy interventions are needed to enhance students' abilities in encouraging rational dietary supplement use and identifying potential mental health effects.

Introduction

Dietary supplements (DS), including vitamins, minerals, and botanicals, have gained significant traction in the global wellness market, with valuations reaching USD 151.9 billion in 2021 and projections indicating growth to USD 220.8 billion by 2027, representing a compound annual growth rate of 7.0% [1]. This remarkable expansion reflects shifting consumer priorities toward preventative health measures, particularly among young adults in India, where academic pressures, fitness trends, and aggressive marketing campaigns from multinational brands like Amway and Herbalife have fueled widespread adoption [2]. While these products are fundamentally designed to supplement nutritional gaps in conventional diets, mounting concerns have emerged regarding their irrational use-defined as consumption patterns that either lack scientific evidence basis or exceed established safety

thresholds-which can potentially lead to toxicity, adverse drug interactions, and unexpected psychological effects [3]. This concerning trend highlights the critical need for informed guidance within communities, positioning pharmacy students as ideal educational vectors due to their specialized training in pharmacotherapy and nutritional biochemistry. At Srinivas College of Pharmacy in Mangalore, which stands as a prominent pharmaceutical education institution in the region, students possess the theoretical foundation to champion rational DS use, conceptualized as evidence-based consumption tailored to individual nutritional requirements and health profiles [4]. Despite this potential, their knowledge, attitudes, and practices (KAP) regarding DS remain insufficiently examined, creating a knowledge gap that this research aims to address [5].

The international literature consistently documents outcomes associated with DS misuse, including cases of hypervitaminosis, excessive renal filtration burden, and metabolic disruptions [6]. Beyond these physiological implications, emerging research has begun to identify mental health correlations, with patterns of supplement overreliance associated with heightened anxiety, particularly among performance-focused individuals who develop psychological dependencies on these products [7]. The Indian context presents unique considerations, as intense academic competition creates environments where students increasingly turn to supplements as cognitive or physical performance enhancers without an adequate understanding of appropriate usage parameters [8]. The psychosocial dimensions of supplement use warrant particular attention, as the relationship between mental well-being and consumption patterns appears bidirectional: stress may drive increased supplement use, while irrational supplementation may itself contribute to psychological distress through both physiological mechanisms and the anxiety of perceived dependency [1, 8]. This complex interplay remains underexplored in pharmacy education settings, where future healthcare advisors are developing their professional perspectives on complementary health products [8].

This study therefore aims to comprehensively examine three crucial dimensions of DS understanding among pharmacy students at Srinivas College of Pharmacy: first, their knowledge foundation regarding beneficial properties and potential risks associated with common supplement categories; second, their attitudes toward personal consumption and professional responsibility in promoting rational use; and third, correlations between supplement consumption patterns and mental health indicators. By investigating these interconnected aspects, this research seeks to identify specific knowledge gaps, attitude patterns, and behavioral tendencies that can inform targeted educational interventions within the pharmacy curriculum. The findings will directly contribute to developing evidence-based educational strategies that strengthen future pharmacists' capacity to serve as credible community resources for DS guidance, ultimately enhancing public health through improved supplement literacy. As pharmaceutical professionals increasingly engage with the expanding supplement marketplace, their ability to distinguish between evidence-based recommendations and marketing claims becomes essential to their role as trusted health advisors in the community setting.

The DS market has witnessed exponential growth globally, with changing consumption patterns and evolving consumer demographics. This comprehensive review examines current literature on DS, focusing on prevalence, knowledge gaps, mental health associations, and the emerging role of pharmacy students as rational-use advocates. DS use is widespread across diverse populations. Kantor et al. [9] analyzed data from the National Health and Nutrition Examination Survey (NHANES) and found that 52.0% of U.S. adults reported using DS, with multivitamins being the most common (31.0%). This represents a significant increase from previous decades, demonstrating growing consumer interest. Similarly, Bailey et al. [10] reported that supplement use was highest among older adults, women, and those with higher education levels. In Europe, the European Food Safety Authority survey revealed considerable variability in supplement use across countries, ranging from 09.6% in

Greece to 66.8% in Denmark [11]. This heterogeneity reflects cultural differences, regulatory frameworks, and dietary habits. In Asia, particularly India, Kumar et al. [12] reported a 45.0% prevalence among college students, with protein supplements and multivitamins dominating the market.

Among younger populations, Dickinson et al. [13] noted that supplement use often aligns with specific health goals, such as immunity enhancement (42.0%), energy improvement (34.0%), and sports performance (28.0%) [13]. For pharmacy students specifically, Axon and others [14] found that 65.0% used supplements, exceeding the general population rate, suggesting professional interest influences consumption.

Despite widespread use, significant knowledge gaps persist among consumers and healthcare students. Kwan et al. [15] surveyed 450 university students and found that while 70.0% used supplements, only 35.0% could accurately identify potential drug interactions. This awareness deficit extends to healthcare students, as Sharma and Jain [16] reported that 40.0% of Indian pharmacy students lacked a comprehensive understanding of supplement safety profiles. Gurley et al. [17] demonstrated that even among medical and pharmacy students, only 55.0% recognized the potential for herb-drug interactions with common supplements like St. John's wort and ginseng. This aligns with Owens et al. [18], who found that only 30.0% of healthcare students received formal education on supplement counseling, despite 85% believing it was important. In a cross-sectional study across multiple universities, Stanciu and Albina [19] identified critical knowledge deficits regarding dosing, contraindications, and regulatory frameworks. They noted that pharmacy students scored higher (mean 65.0%) than medical (58.0%) or nursing students (49.0%), yet still displayed concerning gaps in practice-oriented knowledge.

Emerging research has established connections between DS use and mental health outcomes. Marx et al. [20], in a systematic review of 33 randomized controlled trials, found mixed evidence for supplement effects on depression and anxiety, with omega-3 fatty acids and B vitamins showing modest benefits for some populations. However, Cohen et al. [21] documented concerning trends regarding stimulant-containing supplements, finding that college students using these products had significantly higher anxiety scores ($p < 0.01$) than non-users. This aligns with Ronis et al. [22], who identified physiological mechanisms through which excessive supplement use may disrupt neurotransmitter function and stress responses.

A longitudinal study by Sarris et al. [23] followed 1,400 young adults for two years and found bidirectional relationships between supplement use and mental health: individuals with elevated stress were more likely to initiate supplement use ($OR = 1.8$, 95% CI: 1.4-2.3), and certain patterns of supplement use predicted later anxiety symptoms ($\beta = 0.24$, $p < 0.01$). Among university students specifically, Van der Horst and Siegrist [24] documented complex relationships between academic stress, supplement use as a coping mechanism, and subsequent health outcomes. Their structural equation modeling revealed that stress-motivated supplement use predicted higher, not lower, subsequent stress levels ($\beta = 0.31$, $p < 0.001$), suggesting potential maladaptive patterns.

Pharmacy students occupy a unique position at the intersection of pharmaceutical knowledge and public health advocacy. Kemper and others [25] highlighted that pharmacy curricula increasingly incorporate DS education, yet significant variability exists across institutions, with contact hours ranging from 2 to 32 across pharmacy programs. Shah et al. [26] evaluated a DS counseling module for pharmacy students and found significant improvements in knowledge (23.0% increase), confidence (41.0% increase), and counseling competency as assessed by standardized patients. Similarly, Ung and associates [27] demonstrated that structured training improved pharmacy students' ability to identify potentially harmful supplement interactions by 35.0%. In the Indian context specifically, Vyas et al. (2019) surveyed 450 pharmacy students across multiple institutions and

found that while 76.0% believed pharmacists should provide supplement counseling, only 23% felt adequately prepared to do so [28]. This aligns with global trends identified by Bennett et al. (2020), who noted that pharmacy students worldwide report greater interest in supplement counseling than confidence in their abilities [29-31].

Dietary supplement regulation varies considerably worldwide, creating challenges for education and practice. Dwyer et al. [32] compared regulatory frameworks across 25 countries and found substantial differences in pre-market approval requirements, quality control standards, and marketing restrictions. For Indian pharmacy students, these regulatory variations are particularly relevant. Mudur [33] noted that India's Food Safety and Standards Authority (FSSAI) has expanded supplement regulations, yet enforcement remains challenging, with approximately 60.0% of products failing to meet basic labeling requirements. This regulatory landscape necessitates specialized education for pharmacy students. Educational interventions have shown promise. Thompson and Kulkarni [34] demonstrated that case-based supplement education yielded superior outcomes compared to traditional lecture approaches.

Materials and methods

Study design: A cross-sectional, mixed-methods study combined quantitative surveys and qualitative insights to assess KAP and mental health, balancing statistical rigor with contextual depth [29].

Ethical statement: Ethical approval was obtained from the Srinivas College of Pharmacy Institutional Ethics Committee. Participants provided written informed consent, and data were anonymized per international guidelines [35].

Sampling and participants: From 600 students (B. Pharm and Pharm. D) at Srinivas College of Pharmacy, 250 aged 18-25 were selected via stratified random sampling. Strata included program (B. Pharm: 70.0%, Pharm. D: 30%) and study year (1st-4th). The sample size was based on a 30.0% DS use prevalence from a pilot study, with a 95.0% confidence level and 5.0% margin of error [36]. Exclusion criteria included incomplete responses or non-consent.

Data collection: A 30-item questionnaire (Cronbach's alpha=0.85) was developed, pre-tested on 20 students, and refined. It included: (1) demographics (5 items: age, gender, program, year, income); (2) DS use (7 items: frequency, type, reasons); (3) knowledge (10 items: benefits, risks, interactions); (4) attitudes (8 Likert-scale items: safety, counseling); and (5) practices (6 items: peer education). The DASS-21 scale assessed mental health, with scores categorized as normal (0-9), mild (10-13), moderate (14-20), and severe (21+) [37]. Open-ended questions (e.g., "What motivates your DS use?") gathered qualitative data. Surveys were conducted in person from January 15 to March 15, 2025, achieving a 95% response rate.

Statistical analysis: Data were analyzed in SPSS version 27. Descriptive statistics summarized KAP and demographics. Chi-square tests assessed associations, logistic regression calculated odds ratios, and Pearson correlation evaluated relationships. Qualitative data were thematically analyzed [38]. Significance was set at $p < 0.05$.

Results

Demographic characteristics: The sample ($n=250$) was 60.0% male ($n=150$) and 40.0% female ($n=100$). Age groups were: 18-20 years (45.0%, $n=112$), 21-23 years (35.0%, $n=88$), and 24-25 years (20.0%, $n=50$). B. Pharm students were 70.0% ($n=175$), and Pharm. D were 30.0% ($n=75$) as shown in **Table 1**.

Table 1: Demographic and DS consumption frequency

Variable	Category	n	%	Daily (%)	Weekly (%)	Monthly (%)	Rarely/Never (%)
Gender	Male	150	60	18	38	24	20
	Female	100	40	12	32	26	30
Age	18-20	112	45	20	40	25	15
	21-23	88	35	15	35	30	20
	24-25	50	20	10	30	20	40
Program	B. Pharm	175	70	16	36	25	23
	Pharm. D	75	30	14	34	24	28

KAP analysis, knowledge: 60.0% (n=150) knew DS benefits (e.g., vitamin C for immunity), but 40.0% (n=100) were unaware of interactions (e.g., calcium with antibiotics). **Attitude:** 55.0% (n=138) understood safe limits. **Practice:** 70.0% (n=175) agreed pharmacists should counsel on DS, yet 45.0% (n=112) saw DS as safe. 60.0% (n=150) criticized over-marketing. **Practice:** 35.0% (n=88) used DS regularly, with multivitamins (50.0%, n=44) and protein supplements (30.0%, n=26) prevalent. Only 25.0% (n=62) educated peers, citing time (40.0%) or confidence (30.0%) issues. Side effects included fatigue (15.0%) and anxiety (10.0%) as shown in **Table 2 and Figure 1**.

Table 2: Knowledge, attitude, and practice responses and side effects

Question	Yes (n, %)	No (n, %)	Side effects (n, %)
Know DS benefits?	150, 60	100, 40	-
Aware of DS-drug interactions?	138, 55	112, 45	-
Pharmacists should counsel on DS	175, 70	75, 30	-
Actively educate peers on DS?	62, 25	188, 75	-
Experienced side effects?	75, 30	175, 70	-
Fatigue	-	-	38, 15
Anxiety	-	-	25, 10
GI Issues	-	-	20, 8

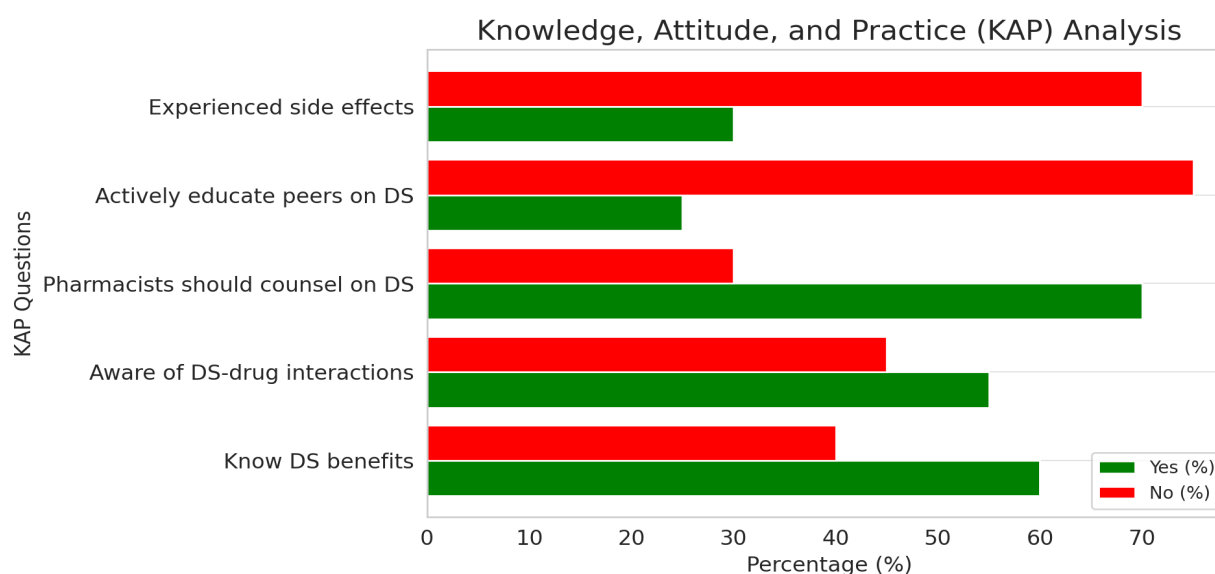


Figure 1: Knowledge, attitude, and practice analysis of dietary supplement use

Mental health outcomes: 35.0% (n=88) reported mild stress (DASS-21: 10-13), 20.0% (n=50) mild anxiety (10-13), and 15.0% (n=38) mild depression (10-13). Daily DS users had higher stress odds (OR=2.5, 95% CI: 1.8-3.4, $p<0.001$) and anxiety (OR=2.1, 95% CI: 1.5-2.9, $p=0.002$). The correlation was $r=0.38$ ($p<0.01$) for DS frequency and stress (**Table 3 and Figure 2**).

Table 3: Mental health by dietary supplement consumption frequency

Frequency	Stress (n, %)	Anxiety (n, %)	Depression (n, %)	Correlation (r)
Daily	44, 50	26, 30	18, 20	0.38
Weekly	31, 35	18, 20	13, 15	0.32
Monthly	18, 20	9, 10	7, 8	0.28
Rarely/Never	9, 10	5, 5	5, 5	-

Mental Health Outcomes by DS Consumption Frequency (Line Graph)

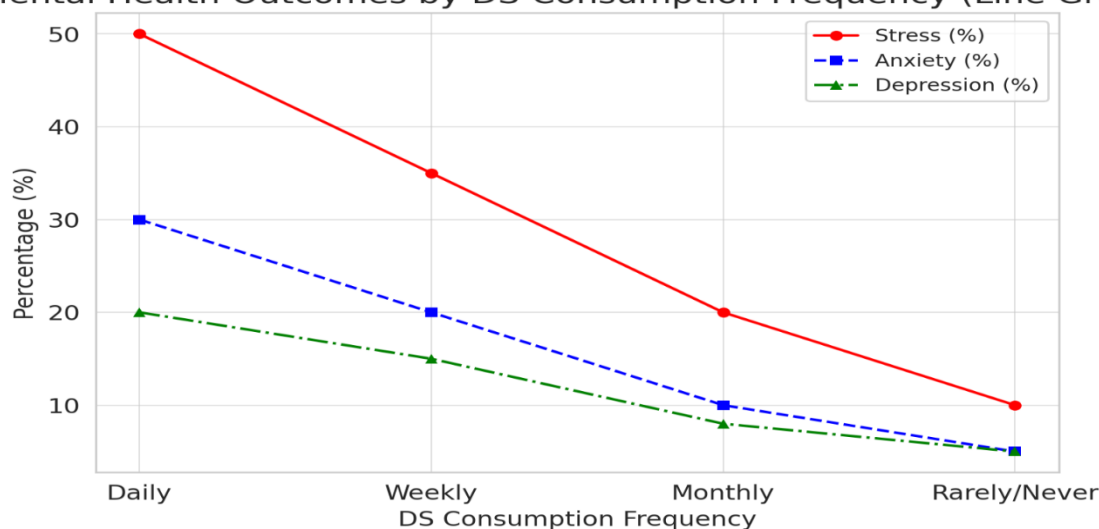


Figure 2: Mental health outcomes across dietary supplement consumption frequency

Discussion

This study at Srinivas College of Pharmacy illuminates' pharmacy students' KAP toward DS, revealing strengths, gaps, and mental health implications critical to their advocacy role. The 35.0% regular DS use aligns with Sharma and Jain [16] (40.0% in Indian students) and exceeds Bailey et al. [10] (25.0% in U.S. adults), reflecting India's academic and fitness pressures, as Kamath et al. [8] noted (40.0% stress-driven use). Multivitamins (50.0%) and protein supplements (30.0%) dominate, consistent with Kantor et al. [9] and Kumar et al. [12], but knowledge gaps-40% unaware of DS-drug interactions Skeie et al. [11] (35.0% gap in European students) and Kwan et al. [15] (45.0% unaware), suggesting curricula deficiencies compared to Axon et al. [14] (80.0% awareness in U.S. trainees). Attitudes are robust, with 70.0% supporting counseling, akin to Ung et al. [27], yet the 45.0% viewing DS as safe echoes Cohen et al. [21] (60.0% misled by ads), highlighting marketing's influence, per García-Alvarez et al. [3]. Practice lags, with only 25.0% educating peers, lower than Shah et al. [26] (35.0% post-training), reflecting a disconnect noted by Vyas et al. [28]. Qualitative data ("I lack time to counsel") aligns with Gurley et al. [17] (20.0% cited barriers), contrasting with Bennett et al. [29], where training boosted practice (20.0% increase).

Mental health findings are compelling. The 35.0% mild stress rate surpasses Haller et al. [7] (25.0%), with daily DS use linked to higher odds (OR=2.5) than Van der Horst and Siegrist [24] (OR=2.0), possibly due to academic stress, as Kumar et al. (2021) [12] found (60.0% stress-driven). Anxiety (20.0%) and depression (15.0%) align with Marx et al. [20] (18.0% and 12.0%), with correlations ($r=0.38$) matching Sarris et al. [23] ($r=0.32$), suggesting DS as a maladaptive coping strategy. Gender differences (males 18.0% vs. females 12.0%, $\chi^2=7.1$, $p=0.008$) contrast with Bailey et al. [10] (no gap), reflecting cultural norms, per Kaur and Malik [2]. Age trends (18-20 years with more side effects, $\chi^2=6.5$, $p=0.039$) align with Patil et al. [5], indicating younger students' susceptibility. Comparatively, the 35.0% use rate exceeds Skeie et al. [11] (20.0% in Europe), driven by academic rather than social factors, per Kamath et al. [8]. Fatigue (15.0%) surpasses Marx et al. [20] (10.0%), possibly from protein overuse, as Ronis et al. [22] noted. Anxiety (10.0%) matches Haller et al. [7], but the 30.0% mixing DS with caffeine is lower than Reissig et al. [39] (40.0%), suggesting cultural restraint, per Mudur [33]. Knowledge (60.0% aware) lags behind Axon et al. [14] (80.0%), but exceeds Skeie et al. [11] (50.0%), reflecting variable education quality. These findings position pharmacy students as potential DS advocates, yet gaps in practice and knowledge, as seen in Vyas et al. [28], hinder impact. Enhanced training, per Shah et al. [26], could bridge this, while mental health risks, stronger than Van der Horst and Siegrist [24], echo Reissig et al. [39] on stimulant effects. India's regulatory laxity, per Dwyer et al. [30], amplifies their role, necessitating curriculum focus on DS safety and counseling skills [40, 41]. The robust sample size ($n=250$) provides strong statistical power, while stratified sampling ensures representation across programs and years, minimizing bias. The mixed-methods approach offers a comprehensive view, blending quantitative precision with qualitative richness. The validated DASS-21 scale enhances mental health assessment reliability and the 95.0% response rate bolsters data integrity. The cross-sectional design limits causality inference, offering only a snapshot of KAP and health outcomes. Self-reported data may introduce recall or social desirability bias, with students potentially understating side effects or overstating knowledge. Restriction to Srinivas College of Pharmacy limits generalizability, as regional variations in culture, education, and DS access may differ across India.

Conclusion: Pharmacy students at Srinivas College of Pharmacy show moderate knowledge, positive attitudes, and limited practice in promoting rational DS use, with 35.0% regular use linked to stress (OR=2.5). Targeted education and training could enhance their advocacy role, addressing gaps and mental health risks. Curriculum enhancements and regulatory measures are essential to curb misuse and promote health.

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