

Self-Reported Pharmacological Cognitive Enhancement Among Orthopaedic Surgeons in Türkiye: A Cross-Sectional Survey of Use Patterns, Academic Motivation, and Ethical Perceptions

Gökhan Güzel

gokhan.guzel@atlas.edu.tr

Atlas Üniversitesi

Osman gorkem muratoglu

Atlas Üniversitesi

Hasan Ceylan

Atlas Üniversitesi

Sahan Daglar

Haseki Eğitim ve Araştırma Hastanesi

Nafiye Selcan Yildirim

İstanbul Kanuni Sultan Süleyman Eğitim ve Araştırma Hastanesi

Ecem Esmâ Yegin

Istinye University

Cem Yildirim

Atlas Üniversitesi

Research Article

Keywords: Cognitive Enhancement, Methylphenidate, Academic Motivation, Ethical Perception, Orthopedic Surgeons

Posted Date: October 13th, 2026

DOI: <https://doi.org/10.21203/rs.3.rs-11197173/v1>

License: © ⓘ This work is licensed under a Creative Commons Attribution 4.0 International License.

[Read Full License](#)

Additional Declarations: No competing interests reported.

Abstract

Purpose

Cognitive-enhancing drugs are used to improve attention and alertness, but use among surgeons remains poorly understood. This study aimed to determine the proportion and patterns of self-reported lifetime cognitive-enhancing drug use among physicians working in orthopedics and traumatology in Turkey and examine associations with academic, motivational, and ethical factors.

Methods

This cross-sectional, anonymous questionnaire study included 160 physicians and assessed demographic and professional characteristics, lifetime drug use, academic motivation, and ethical perception. Cronbach's α values for core academic motivation and ethical perception were 0.82 and 0.76, respectively. Associations with use were examined using multivariable logistic regression.

Results

Overall, 25 physicians (15.6%) reported lifetime use. Methylphenidate was the most commonly reported agent (88%); 68% reported exam- or period-based use, and 92% cited improving focus or attention. Use was more frequent among physicians with knowledge of these drugs (32.7% vs 6.7%, $p < 0.001$). Users had lower ethical perception scores than non-users (2.78 ± 0.71 vs 3.57 ± 0.71 , $p < 0.001$). In multivariable analysis, drug knowledge (OR 5.35, 95% CI 1.82–17.25, $p = 0.003$) and an academic career goal (OR 13.85, 95% CI 2.60–110.79, $p = 0.005$) were associated with higher odds of use. Higher core academic motivation (OR 0.46, 95% CI 0.21–0.96, $p = 0.043$) and ethical perception (OR 0.24, 95% CI 0.10–0.50, $p < 0.001$) were associated with lower odds.

Conclusion

Cognitive-enhancing drug use was associated with lower ethical perception, drug knowledge, and academic career goals, while core academic motivation showed an inverse association. These findings suggest that use may reflect a multidimensional behavior related to ethical attitudes, academic orientation, and motivation.

Level of Evidence:

Level IV – Cross-sectional survey study

Introduction

Cognitive performance has become an increasingly important research topic in neuroscience, clinical medicine, and bioethics over the past two decades. Cognitive enhancement (CE) is defined as strengthening or expanding the mind's core capacity through the development of internal or external information processing systems [1]. This concept now encompasses pharmacological and non-pharmacological interventions aimed at improving attention, memory, executive functions, learning capacity, and decision-making in healthy individuals[1–3]. In addition to behavioral approaches such as regular physical activity, sleep regulation, and cognitive training programs, pharmacological agents are also used to improve performance.

In the field of pharmacological cognitive enhancement, central nervous system stimulants constitute the most commonly component. These agents include methylphenidate and amphetamine derivatives, commonly used in the treatment of attention deficit hyperactivity disorder (ADHD), as well as modafinil, an agent that increases alertness [4]. Initially developed and approved for the treatment of specific clinical indications, these drugs are reported to be used by healthy individuals beyond medical indications to enhance cognitive or academic performance [5, 6]. However, the cognitive effects of these agents in healthy individuals are not clear; results may vary depending on the drug used, the cognitive function assessed, the individual's pre-drug performance, and sleep status[7, 8].

A significant portion of research on the use of CE drugs has been conducted on university students, particularly medical students [9, 10]. In these groups, the frequency of non-medical use of prescribed psychostimulants has been reported to range from approximately 5% to 30%; reported rates vary depending on the study population, geographic region, the definition used, and the research method [9, 11, 12]. Improving concentration, maintaining alertness for longer periods, enhancing academic productivity, and coping with intense exam periods are among the most frequently reported reasons for use [10]. However, rather than focusing solely on short-term success expectations, factors such as academic achievement expectations, perception of competition, environmental pressures, and demanding educational conditions can also influence the use of cognitive enhancers [13]. The use of cognitive-enhancing drugs by healthy individuals also raises safety and ethical concerns. These concerns include possible adverse effects, dependence, fairness, academic integrity, and professional responsibility [3, 14, 15].

Surgeons perform high-demand tasks that require simultaneous processing of large amounts of information, and excessive intraoperative cognitive workload may adversely affect performance [16, 17]. These conditions may create a context in which physicians consider using cognitive-enhancing drugs; however, evidence on their use among physicians remains limited [18, 19]. In particular, the frequency, methods of use, and related factors of these drugs among orthopedic and traumatology physicians have not been sufficiently clarified. In this context, cognitive-enhancing drug use may reflect the combined influence of professional pressures, academic expectations, motivational orientation, and ethical appraisal. We hypothesized that awareness of cognitive-enhancing drugs and having an academic career goal would be associated with higher odds of use, whereas higher ethical perception and core academic motivation would be associated with lower odds of use. Accordingly, this study aimed to

determine the proportion and patterns of self-reported lifetime cognitive-enhancing drug use among physicians working in orthopedics and traumatology in Turkey and to examine its associations with academic, motivational, and ethical factors.

Materials and Methods

Study design and participants

This cross-sectional, anonymous, questionnaire-based study evaluated cognitive-enhancing drug use, academic motivation, and ethical perceptions among physicians working in orthopedics and traumatology in Turkey. Ethical approval was obtained from the XxxXXX. XxxxXXX Ethics Committee (Approval No: XxxX/XxX). The study was conducted in accordance with the principles of the Declaration of Helsinki.

Data were collected between February 12 and February 21, 2026, using an online questionnaire created with Google Forms. Participation was voluntary, and electronic informed consent was obtained from all participants before they proceeded to the questionnaire. Participants were recruited through professional networks and communication channels commonly used by orthopedic surgeons. Because the survey was distributed through open professional networks, the total number of physicians who received the invitation and the response rate could not be determined.

Physicians who were actively working in orthopedics and traumatology, were aged over 18 years, and provided informed consent were eligible to participate. A total of 163 submissions were recorded. Three submissions were excluded during data cleaning because of substantial missing questionnaire data.

Questionnaire and variables

The questionnaire consisted of four main group of questions: demographic and professional characteristics, academic motivation, cognitive-enhancing drug use, and ethical perception.

Demographic and professional variables included age, sex, professional title, years in specialty, institution type, previous academic publication, and academic career goal. To improve interpretability and avoid sparse subgroup comparisons, professional title was collapsed into two prespecified categories. Group 1 included residents and specialist physicians, whereas Group 2 included associate professors and professors.

The primary outcome was self-reported lifetime cognitive-enhancing drug use, assessed using a yes/no item asking whether the participant had ever used such drugs.

Academic motivation and ethical perception measures

Academic motivation was assessed using an 8-item Likert-type block scored from 1 to 5. Items reflecting uncertainty and amotivation were reverse-coded before analysis. The academic motivation items were adapted from the Turkish version of the Academic Motivation Scale [20]. Internal consistency analysis showed that the full 8-item academic motivation block had insufficient reliability, with a Cronbach's alpha of 0.58. Therefore, the full block was not analyzed as a unidimensional composite.

The full eight-item block showed insufficient internal consistency when evaluated as a single composite score (Cronbach's alpha = 0.58) and was therefore not used as a unidimensional measure. The four-item core academic motivation score showed good internal consistency (Cronbach's alpha = 0.82) and was used as the main academic motivation variable. The external-pressure and uncertainty/amotivation domains were considered exploratory.

Ethical perception was assessed using an 8-item Likert-type block, including one reverse-coded item. The ethical perception items were informed by previous work on ethical sensitivity assessment [21]. An ethical perception score was calculated as the mean of the available items, with higher scores indicating stronger ethical concern regarding cognitive-enhancing drug use. The score was calculated when at least six of the eight items had been answered. The ethical perception block showed acceptable internal consistency (Cronbach's alpha = 0.76).

Statistical analysis

Continuous variables were summarized as mean $\pm$ standard deviation and, when appropriate, as median with interquartile range. Categorical variables were presented as counts and percentages. The normality of continuous variables was assessed using the Shapiro–Wilk test.

Between-group comparisons for continuous variables were performed using Student's t-test or the Mann–Whitney U test, depending on distributional assumptions. Categorical variables were compared using Pearson's chi-square test or Fisher's exact test, as appropriate.

For selected descriptive analyses, the core academic motivation and ethical perception scores were also categorized using a mean score of 4 as the cutoff. The continuous versions of these scores were retained in the main regression analyses. Academic career goal was dichotomized as yes versus no or undecided.

Because the number of outcome events was limited, with 25 participants reporting lifetime cognitive-enhancing drug use, parsimonious multivariable logistic regression models were used to reduce the risk of overfitting. Multivariable analyses were conducted using complete-case data. The primary multivariable model included professional group, knowledge of cognitive-enhancing drugs, dichotomized academic career goal, core academic motivation score, and ethical perception score. Institution type was evaluated in a separate sensitivity model after collapsing sparse categories.

All statistical tests were two-sided, and a p value of < 0.05 was considered statistically significant.

Results

A total of 163 responses were initially received. Three submissions were excluded during data cleaning because of substantial missing questionnaire data. A total of 160 physicians were included in the final analysis. The mean age was 35.95 ± 7.87 years. Most participants were men (152/160, 95.0%), and the majority belonged to Group 1 (residents or specialist physicians, 134/160, 83.8%). Overall, 55 participants (34.4%) reported knowledge of cognitive-enhancing drugs, and 117 (73.1%) reported having an academic career goal. The full academic motivation block showed poor internal consistency, whereas the 4-item core motivation construct showed good reliability.

Ethical perception demonstrated acceptable reliability (Table 1). There was no statistically significant overall correlation between core academic motivation and ethical perception (Spearman's $\rho = 0.142$, $p = 0.073$). Overall, 25 of 160 participants (15.6%) reported lifetime use of a cognitive-enhancing drug. Use was numerically more frequent in Group 1 than in Group 2 (16.4% vs 11.5%), but this difference was not statistically significant (Fisher's exact $p = 0.769$). Age did not differ between users and non-users (35.16 ± 5.47 vs 36.10 ± 8.25 years, Mann-Whitney $p = 0.944$) (Table 2). There were no significant unadjusted associations with sex, years in specialty, prior publication history, or dichotomized core academic motivation status. By contrast, knowledge of cognitive-enhancing drugs was associated with use (32.7% vs 6.7%, $p < 0.001$). Drug use was also more common among physicians working in private institutions than among those in non-private/public settings (41.2% vs 12.6%, Fisher $p = 0.0066$). Academic career goal showed a borderline association with use (18.8% vs 7.0%, Fisher's $p = 0.086$).

Table 1
Internal consistency diagnostics and analytic use of the study measures.

Scale	Items	Cronbach's alpha	Analytic use
Full academic motivation block	Q9-Q16 (Q15 and Q16 reverse-coded)	0.58	Not retained as a single composite
Core academic motivation	Q9-Q12	0.82	Primary motivation measure
External pressure (exploratory)	Q13-Q14	0.52	Exploratory only
Uncertainty/amotivation (exploratory)	Q15R-Q16R	0.77	Exploratory only
Ethical perception	Q24-Q31 (Q29 reverse-coded)	0.76	Retained as main composite

The full 8-item academic motivation block showed insufficient internal consistency and was therefore not used as a unidimensional primary exposure. The 4-item core academic motivation score was retained for the main analyses

Table 1. Internal consistency diagnostics and analytic use of the study measures.

Cronbach's alpha coefficients were calculated in the present sample. The full 8-item academic motivation block was not retained as a unidimensional composite because of insufficient internal consistency. The 4-item core academic motivation score was used as the main academic motivation measure, whereas the external-pressure and uncertainty/amotivation domains were considered exploratory. R indicates a reverse-coded item.

Table 2
Participant characteristics according to self-reported lifetime cognitive-enhancing drug use.

Characteristic	Non-users (n = 135)	Users (n = 25)	p value
Age, years	36.10 ± 8.25	35.16 ± 5.47	> 0.9
Sex			0.6
Male	129 (96%)	23 (92%)	
Female	6 (4.4%)	2 (8.0%)	
Professional group			0.8
Group 1: Assistant + Specialist	112 (83%)	22 (88%)	
Group 2: Associate professor + Professor	23 (17%)	3 (12%)	
Institution			0.010
University hospital	40 (30%)	9 (36%)	
State hospital	73 (54%)	9 (36%)	
Private hospital	10 (7.4%)	7 (28%)	
Other	12 (8.9%)	0 (0%)	
Previous academic publication			0.6
No	50 (37%)	8 (32%)	
Yes	85 (63%)	17 (68%)	
Academic career goal			0.2
No	19 (14%)	1 (4.0%)	
Undecided	21 (16%)	2 (8.0%)	
Yes	95 (70%)	22 (88%)	
Core academic motivation score	4.17 ± 0.80	3.97 ± 0.75	0.12
Ethical perception score	3.57 ± 0.71	2.78 ± 0.71	< 0.001
Knowledge of cognitive-enhancing drugs			< 0.001
No	98 (73%)	7 (28%)	
Yes	37 (27%)	18 (72%)	

For institution type and academic career goal, the p values shown in the table refer to comparisons across the original four-category and three-category variables, respectively. Results of the dichotomized comparisons (private vs non-private and yes vs no/undecided) are reported in the text.

Table 2. Participant characteristics according to self-reported lifetime cognitive-enhancing drug use.

Values are presented as mean ± standard deviation or number (percentage). Between-group p values were obtained using the Mann–Whitney U test for continuous variables and Pearson’s chi-square test or Fisher’s exact test for categorical variables, as appropriate. Group 1 included residents and specialist physicians, whereas Group 2 included associate professors and professors. For institution type and academic career goal, the p values shown in the table refer to comparisons across the original four-category and three-category variables, respectively. Results of the dichotomized comparisons—private versus non-private institutions and yes versus no/undecided academic career goal—are reported in the text.

Core academic motivation did not differ significantly between non-users and users in the unadjusted analysis (4.17 ± 0.80 vs 3.97 ± 0.75 , Mann-Whitney, $p = 0.123$). In contrast, ethical perception was substantially lower among users than among non-users (2.78 ± 0.71 vs 3.57 ± 0.71 , Mann-Whitney $p < 0.001$) (Fig. 1). When dichotomized at a mean score of 4, high ethical perception was also associated with a lower prevalence of drug use (2.8% vs 19.5%, Fisher $p = 0.017$). When analyses were stratified by professional group, core academic motivation remained non-significant in both strata (Group 1 $p = 0.169$, Group 2 $p = 0.596$). Ethical perception remained significantly lower among users in both strata (Group 1 $p = 1.3 \times 10^{-5}$, Group 2 $p = 0.024$).

Figure 1. Ethical perception scores according to self-reported lifetime cognitive-enhancing drug use.

Individual points represent participants, and boxplots summarize the distribution of ethical perception scores. Higher scores indicate greater ethical concern regarding cognitive-enhancing drug use. The analysis included 159 participants with calculable ethical perception scores. Scores were significantly lower among users than among non-users (Mann–Whitney U test, $p < 0.001$).

In the primary multivariable logistic regression model, which included 159 participants with complete data, knowledge of cognitive-enhancing drugs, academic career goal, core academic motivation, and ethical perception were associated with the odds of drug use after adjustment, whereas professional seniority group was not. Knowledge of cognitive-enhancing drugs was associated with a more than fivefold increase in the odds of use (OR 5.35, 95% CI 1.82–17.25, $p = 0.003$). Reporting an academic career goal was also independently associated with use (OR 13.85, 95% CI 2.60–110.79, $p = 0.005$). Higher core academic motivation was inversely associated with use (OR 0.46 per 1-point increase, 95% CI 0.21–0.96, $p = 0.043$). Ethical perception showed the most robust inverse association (OR 0.24 per 1-point increase, 95% CI 0.10–0.50, $p < 0.001$) (Table 3; Fig. 2). In a sensitivity model additionally including institution type, employment in a private hospital remained independently associated with higher odds of use (OR 7.78, 95% CI 1.73–41.13, $p = 0.010$).

Table 3
Primary exploratory multivariable logistic regression model for self-reported lifetime cognitive-enhancing drug use.

Predictor	Adjusted OR	95% CI	p value
Group 2 vs Group 1	0.42	0.08–1.72	0.260
Knowledge of cognitive enhancers (yes)	5.35	1.82–17.25	0.003
Academic career goal (yes)	13.85	2.60–110.79	0.005
Core academic motivation (per 1-point increase)	0.46	0.21–0.96	0.043
Ethical perception (per 1-point increase)	0.24	0.10–0.50	< 0.001

The primary adjusted model was based on 159 observations, as one participant had missing data on the ethical perception composite. The professional group was not independently associated with drug use after adjustment.

Table 3. **Primary exploratory multivariable logistic regression model for self-reported lifetime cognitive-enhancing drug use.**

Adjusted odds ratios were obtained from a complete-case analysis including 159 participants; one participant did not have a calculable ethical perception score. Academic career goal was categorized as yes versus no/undecided. Group 1 included residents and specialist physicians, whereas Group 2 included associate professors and professors. Because only 25 outcome events were available, the adjusted model was considered exploratory. CI, confidence interval; OR, odds ratio.

Figure 2. **Adjusted odds ratios for self-reported lifetime cognitive-enhancing drug use.**

Points represent adjusted odds ratios, and horizontal lines represent 95% confidence intervals. The dashed vertical line indicates the null value of OR = 1; the horizontal axis is displayed on a logarithmic scale. Estimates were obtained from the primary exploratory complete-case model including 159 participants. Group 1 included residents and specialist physicians, whereas Group 2 included associate professors and professors. Academic career goal was categorized as yes versus no/undecided. CI, confidence interval; OR, odds ratio.

Across the primary and sensitivity models, ethical perception remained inversely associated with cognitive-enhancing drug use. Among the 25 respondents who reported drug use, methylphenidate was the most commonly reported agent (88%), followed by modafinil (16%), other agents (12%), and amphetamine derivatives (4%). Most users described their pattern as exam- or period-based use (68%), whereas only one participant (4%) reported regular use. The most common reasons for use were to improve focus or attention (92%) and academic productivity (44%), followed by staying awake longer (32%) and suppressing fatigue (12%). The most frequent acquisition route was prescription access

(60%), followed by friend or colleague recommendation (36%) and non-prescription access (16%) (Fig. 3). Only 12% of users reported experiencing an ethical dilemma during use.

Figure 3. Characteristics of cognitive-enhancing drug use among participants reporting lifetime use (n = 25).

The panels show the reported drug types (A), frequency of use (B), purposes of use (C), and access routes (D). Bars represent the percentage of users, and accompanying labels show percentages and participant counts. Multiple responses were permitted for drug type, purpose of use, and access route; therefore, percentages in panels A, C, and D may exceed 100% when summed. Frequency-of-use categories in panel B were mutually exclusive.

Discussion

In this study, 15.6% of orthopedic and traumatology physicians in Turkey reported using CE drugs at some point in their lives. A key finding of the study was that users had lower ethical perception scores regarding CE drugs compared to non-users, and this relationship persisted in both the main and sensitivity analyses. Knowledge of CE drugs and having an academic career goal were associated with a higher likelihood of reporting use, while the four-item core academic motivation score was associated with a lower likelihood of use in the main model. Considering these findings together, it is suggested that CE drug use cannot be explained solely by the pursuit of short-term performance enhancement; it may be a multidimensional behavior related to ethical considerations, academic orientation, motivation, and professional context.

Evidence regarding the use of CE drugs among healthcare professionals remains limited [18, 19]. In contrast, a significant portion of existing research focuses on university and medical students [9, 10]. This lack of information is particularly relevant for physicians whose work conditions require sustained attention, rapid decision-making, and high levels of responsibility. In orthopedic and traumatology practice, lengthy surgeries, acute trauma management, and simultaneous academic responsibilities create significant occupational conditions requiring the maintenance of cognitive performance. In this context, the lifetime use rate of 15.6% identified in the research sample suggests that the use of CE drugs is a behavior worthy of investigation within this professional group; however, due to the sampling method, this rate should not be considered a national prevalence estimate representing all orthopedic and traumatology physicians in Turkey.

The usage rate observed in the research sample generally coincides with the wide range of rates reported in studies conducted on university and medical students. However, direct comparisons should be made with caution due to differences in the definitions and assessment methods of CE drug use among the study groups [11, 22–24]. In previous studies, increasing concentration, staying awake for longer periods, and coping with exam periods were among the frequently reported reasons for use [10, 25]. The fact that the most frequently reported aims in our study were to increase attention or focus and improve academic performance suggests a partial similarity with the motivations identified in student

samples. However, these results do not allow for inferences about the effects on clinical performance or patient safety, which were not directly assessed in our study.

One of the most significant findings of the study is the inverse relationship between ethical perception scores regarding the use of CE drugs and lifetime use. Users were found to have lower ethical perception scores, and this relationship persisted even after adjusting for other variables. Pharmacological cognitive enhancement has long been debated in terms of justice, equal opportunity, academic integrity, and professional responsibility [3, 15]. However, the fact that only 12% of users reported experiencing an ethical dilemma during use may suggest that this behavior is not always perceived as an ethical problem by users. Nevertheless, the current measure reflects ethical attitudes towards the use of CE drugs rather than general ethical sensitivity. Furthermore, since ethical perception is measured after the use experience, it is not possible to determine whether low ethical perception existed before use or developed after the use experience.

Knowledge of CE drugs was found to be associated with a higher likelihood of reporting use in the adjusted model. This association can be explained by the fact that awareness of the effects and access routes of the drugs reduces perceived barriers to use. However, since knowledge was assessed with a binary question, the actual level of knowledge of the participants was not measured. It is also possible that experience of using these drugs led to knowledge acquisition. Therefore, knowledge should not be interpreted as the cause of use or as an independent risk factor. Nevertheless, the finding suggests that informing physicians should cover not only potential cognitive effects but also issues of safety, appropriate use, and professional responsibility.

The presence of an academic career goal is another factor associated with the use of CE drugs in the multivariate model. Physicians planning an academic career may face additional demands such as research productivity, publication expectations, career advancement, and professional competition. However, since these pressures were not directly measured in the study, it cannot be said that the observed relationship stems from academic pressure. The inverse correlation of the four-item core academic motivation score with use in the main model suggests that the presence of an academic goal and personal motivation toward academic work may represent different aspects. This finding is generally consistent with self-determination theory, which emphasizes the relationship between intrinsic motivation and sustained participation and well-being; however, this interpretation should be made cautiously as the four-item score used is not a directly validated intrinsic motivation scale [26].

In the sensitivity model, employment in a private hospital was associated with higher odds of cognitive-enhancing drug use. Given the limited number of users and the exploratory nature of this analysis, this finding should be interpreted cautiously and requires confirmation in larger samples.

When usage characteristics were examined, methylphenidate was the most frequently reported medication, and most users reported use related to exams or periods of high demand rather than regular use. Increased attention or focus, and academic performance, were the most frequently cited purposes. These findings suggest that use is mostly associated with increased performance demands during

specific periods. It is noteworthy that prescription access was the most frequently reported method of obtaining the medication; however, the survey did not ask who issued the prescription, for what reason, or for what medical indication. Therefore, prescription access alone does not indicate whether use occurred under medical supervision or outside of a medical indication. Friend or colleague recommendation and non-prescription access were also reported, indicating that medication use and access routes among physicians warrant further investigation.

This study has several limitations. Due to its cross-sectional design, the direction and causality of the observed relationships cannot be determined; furthermore, current measures of academic motivation and ethical perception were compared with lifetime usage history. The reliance on self-reported usage information may have led to recall and social desirability biases. Due to the convenience sampling method used to select participants from professional networks and the unknown total number of physicians reached, the response rate could not be calculated, and the possibility of selection bias could not be ruled out. Since the usage question did not explicitly distinguish between use for medical indications and use for performance enhancement, some participants may have also reported clinically relevant uses. The item groups used for academic motivation and ethical perception were created or adapted within the scope of this study and have not been comprehensively validated in an independent sample. The limited number of participants reporting use (25) increases the risk of overfitting in multivariate models and uncertainty in confidence intervals. The predominantly male sample, the focus on a single specialty, and the inclusion of physicians working only in Turkey also limit the generalizability of the results to other groups. Finally, burnout, perceived stress, sleep quality, mental health, and detailed workload characteristics were not directly assessed.

Despite these limitations, the study contributes to the limited literature on the use of CE drugs in orthopedic and traumatology physicians. The combined assessment of usage rates and characteristics, as well as academic motivation and ethical attitudes toward the use of CE drugs, provides initial data on the academic and ethical context of this behavior. These findings can serve as a foundation for studies with larger and more representative samples.

Conclusion

The use of CE drugs was reported at a significant rate in this sample of physicians working in the field of orthopedics and traumatology in Turkey. Lower ethical perception, knowledge of cognitive-enhancing drugs, and having an academic career goal were associated with use. The four-item core academic motivation score was inversely associated with use in the main model, whereas professional seniority was not. These results suggest that the use of CE drugs is a multidimensional behavior that may be related to ethical attitudes, academic orientation, motivation, and professional context. Further studies using clear usage definitions, validated measurement tools, larger and more representative samples, and longitudinal designs are needed in the future.

Declarations

Author Contribution

Conceptualization: G.G., O.G.M., C.Y.; Methodology: G.G., O.G.M., N.S.Y., E.E.Y.; Supervision: G.G., C.Y.; Data Collection and Processing: G.G., H.C., S.D.; Formal and Statistical Analysis: E.E.Y.; Interpretation of Results: G.G., O.G.M., N.S.Y., E.E.Y.; Literature Search: O.G.M., H.C., S.D.; Writing – Original Draft: G.G., O.G.M., H.C.; Writing – Review and Editing: G.G., O.G.M., H.C., S.D., N.S.Y., E.E.Y., C.Y. All authors reviewed the manuscript. The first draft of the manuscript was written by GG, and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

Data Availability

The datasets generated and analysed during the current study are not publicly available due to participant confidentiality but may be made available upon reasonable request, subject to applicable ethical approvals and participant consent.

References

1. Bostrom N, Sandberg A (2009) Cognitive enhancement: methods, ethics, regulatory challenges. *Sci Eng Ethics* 15:311–341. <https://doi.org/10.1007/s11948-009-9142-5>
2. Dresler M, Sandberg A, Ohla K, Bublitz C, Trenado C, Mroczko-Wąsowicz A et al (2013) Non-pharmacological cognitive enhancement. *Neuropharmacology* 64:529–543. <https://doi.org/10.1016/j.neuropharm.2012.07.002>
3. Lucke JC, Bell SK, Partridge BJ, Hall WD (2011) Academic doping or Viagra for the brain? The history of recreational drug use and pharmacological enhancement can provide insight into these uses of neuropharmaceuticals. *EMBO Rep* 12:197–201. <https://doi.org/10.1038/embor.2011.15>
4. Bisagno V, González B, Urbano FJ (2016) Cognitive enhancers versus addictive psychostimulants: the good and bad side of dopamine on prefrontal cortical circuits. *Pharmacol Res* 109:108–118. <https://doi.org/10.1016/j.phrs.2016.01.013>
5. Chen LY, Crum RM, Strain EC, Alexander GC, Kaufmann C, Mojtabai R (2016) Prescriptions, nonmedical use, and emergency department visits involving prescription stimulants. *J Clin Psychiatry* 77:e297–e304. <https://doi.org/10.4088/JCP.14m09291>
6. Smith ME, Farah MJ (2011) Are prescription stimulants smart pills? The epidemiology and cognitive neuroscience of prescription stimulant use by normal healthy individuals. *Psychol Bull* 137:717–741. <https://doi.org/10.1037/a0023825>
7. Repantis D, Schlattmann P, Laisney O, Heuser I (2010) Modafinil and methylphenidate for neuroenhancement in healthy individuals: a systematic review. *Pharmacol Res* 62:187–206. <https://doi.org/10.1016/j.phrs.2010.04.002>
8. Battleday RM, Brem AK (2015) Modafinil for cognitive neuroenhancement in healthy non-sleep-deprived subjects: a systematic review. *Eur Neuropsychopharmacol* 25:1865–1881.

<https://doi.org/10.1016/j.euroneuro.2015.07.028>

9. Sharif S, Guirguis A, Fergus S, Schifano F (2021) The use and impact of cognitive enhancers among university students: a systematic review. *Brain Sci* 11:355. <https://doi.org/10.3390/brainsci11030355>
10. Emanuel RM, Frellsen SL, Kashima KJ, Sanguino SM, Sierles FS, Lazarus CJ (2013) Cognitive enhancement drug use among future physicians: findings from a multi-institutional census of medical students. *J Gen Intern Med* 28:1028–1034. <https://doi.org/10.1007/s11606-012-2249-4>
11. McCabe SE, Knight JR, Teter CJ, Wechsler H (2005) Non-medical use of prescription stimulants among US college students: prevalence and correlates from a national survey. *Addiction* 100:96–106. <https://doi.org/10.1111/j.1360-0443.2005.00944.x>
12. Helmer SM, Pischke CR, Van Hal G, Vriesacker B, Dempsey RC, Akvardar Y et al (2016) Personal and perceived peer use and attitudes towards the use of nonmedical prescription stimulants to improve academic performance among university students in seven European countries. *Drug Alcohol Depend* 168:128–134. <https://doi.org/10.1016/j.drugalcdep.2016.08.639>
13. Weyandt LL, Oster DR, Marraccini ME, Gudmundsdottir BG, Munro BA, Rathkey ES et al (2016) Prescription stimulant medication misuse: where are we and where do we go from here? *Exp Clin Psychopharmacol* 24:400–414. <https://doi.org/10.1037/pha0000093>
14. Leonard BE, McCartan D, White J, King DJ (2004) Methylphenidate: a review of its neuropharmacological, neuropsychological and adverse clinical effects. *Hum Psychopharmacol* 19:151–180. <https://doi.org/10.1002/hup.579>
15. Sahakian B, Morein-Zamir S (2007) Professor's little helper. *Nature* 450:1157–1159. <https://doi.org/10.1038/4501157a>
16. Dias RD, Ngo-Howard MC, Boskovski MT, Zenati MA, Yule SJ (2018) Systematic review of measurement tools to assess surgeons' intraoperative cognitive workload. *Br J Surg* 105:491–501. <https://doi.org/10.1002/bjs.10795>
17. Almukhtar A, Caddick V, Naik R, Goble M, Mylonas G, Darzi A et al (2025) Objective assessment of cognitive workload in surgery: a systematic review. *Ann Surg* 281:942–951. <https://doi.org/10.1097/SLA.0000000000006370>
18. Rubin-Kahana DS, Rubin-Kahana Z, Kuperberg M, Stryjer R, Yodashkin-Porat D (2020) Cognitive enhancement drug use among resident physicians: prevalence and motivations for use – results from a survey. *J Addict Dis* 38:250–256. <https://doi.org/10.1080/10550887.2020.1747337>
19. Etheridge T, Kennedy B, Millar MM, Brintz BJ, Wu C, Pettey J (2022) Cognitive enhancing supplements and medications in United States resident physicians. *BMC Med Educ* 22:744. <https://doi.org/10.1186/s12909-022-03778-w>
20. Can G (2015) Turkish version of the Academic Motivation Scale. *Psychol Rep* 116:388–408. <https://doi.org/10.2466/14.08.PR0.116k24w5>
21. Tirri K, Nokelainen P (2007) Comparison of academically average and gifted students' self-rated ethical sensitivity. *Educ Res Eval* 13:587–601. <https://doi.org/10.1080/13803610701786053>

22. Kudlow PA, Treurnicht Naylor K, Xie B, McIntyre RS (2013) Cognitive enhancement in Canadian medical students. *J Psychoact Drugs* 45:360–365. <https://doi.org/10.1080/02791072.2013.825033>
23. Wasserman JA, Fitzgerald JE, Sunny MA, Cole M, Suminski RR, Dougherty JJ (2014) Nonmedical use of stimulants among medical students. *J Am Osteopath Assoc* 114:643–653. <https://doi.org/10.7556/jaoa.2014.129>
24. Retief M, Verster C (2016) Prevalence and correlates of non-medical stimulants and related drug use in a sample of South African undergraduate medical students. *South Afr J Psychiatry* 22:a795. <https://doi.org/10.4102/sajpsychiatry.v22i1.795>
25. Teter CJ, McCabe SE, LaGrange K, Cranford JA, Boyd CJ (2006) Illicit use of specific prescription stimulants among college students: prevalence, motives, and routes of administration. *Pharmacotherapy* 26:1501–1510. <https://doi.org/10.1592/phco.26.10.1501>
26. Ryan RM, Deci EL (2000) Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *Am Psychol* 55:68–78. <https://doi.org/10.1037/0003-066X.55.1.68>

Figures

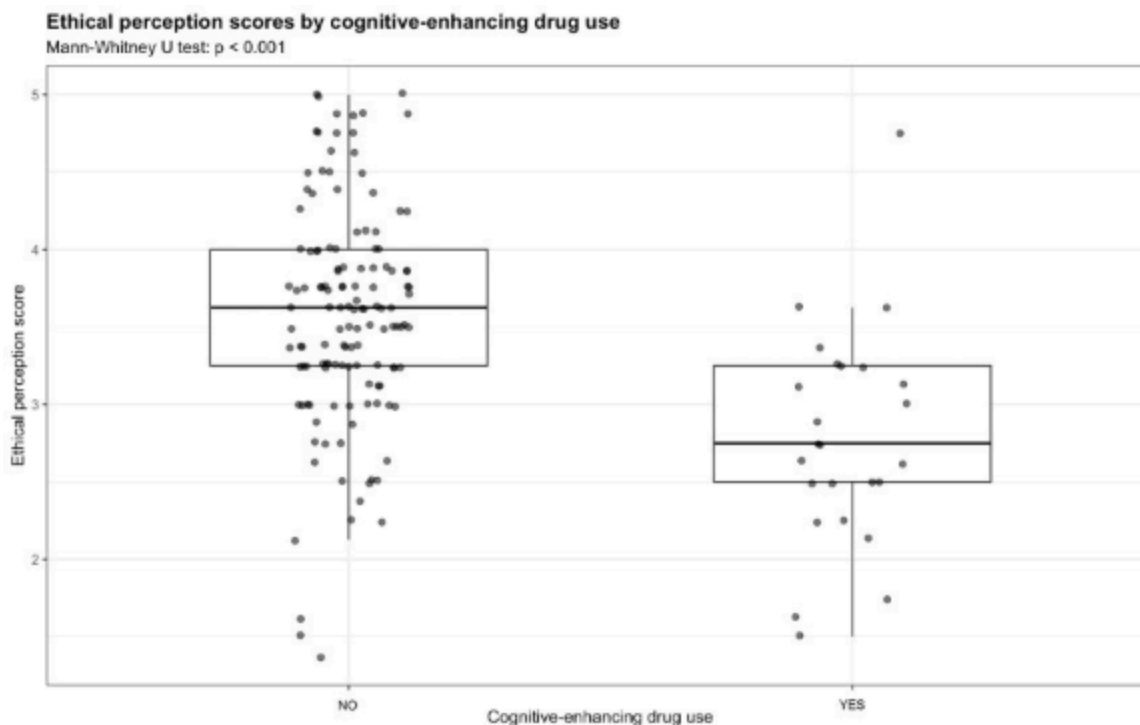


Figure 1

Ethical perception scores according to self-reported lifetime cognitive-enhancing drug use.

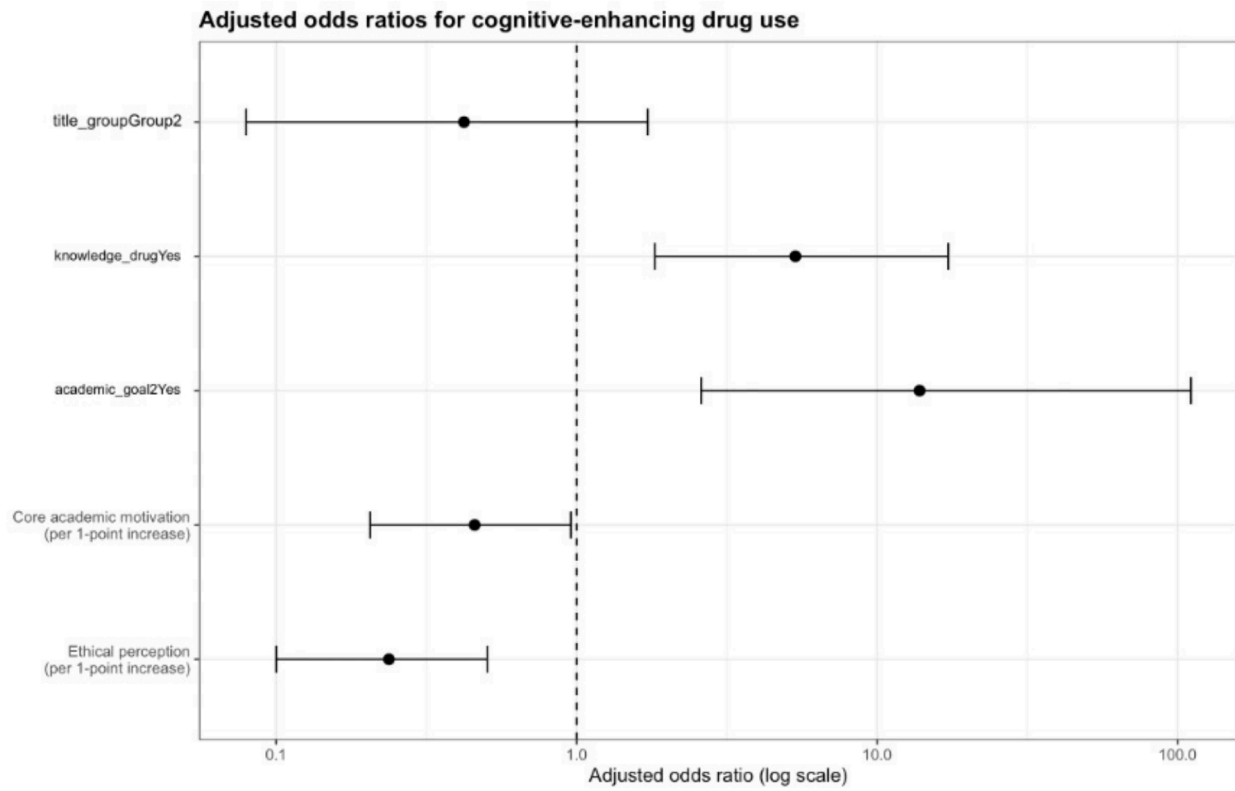


Figure 2

Adjusted odds ratios for self-reported lifetime cognitive-enhancing drug use.

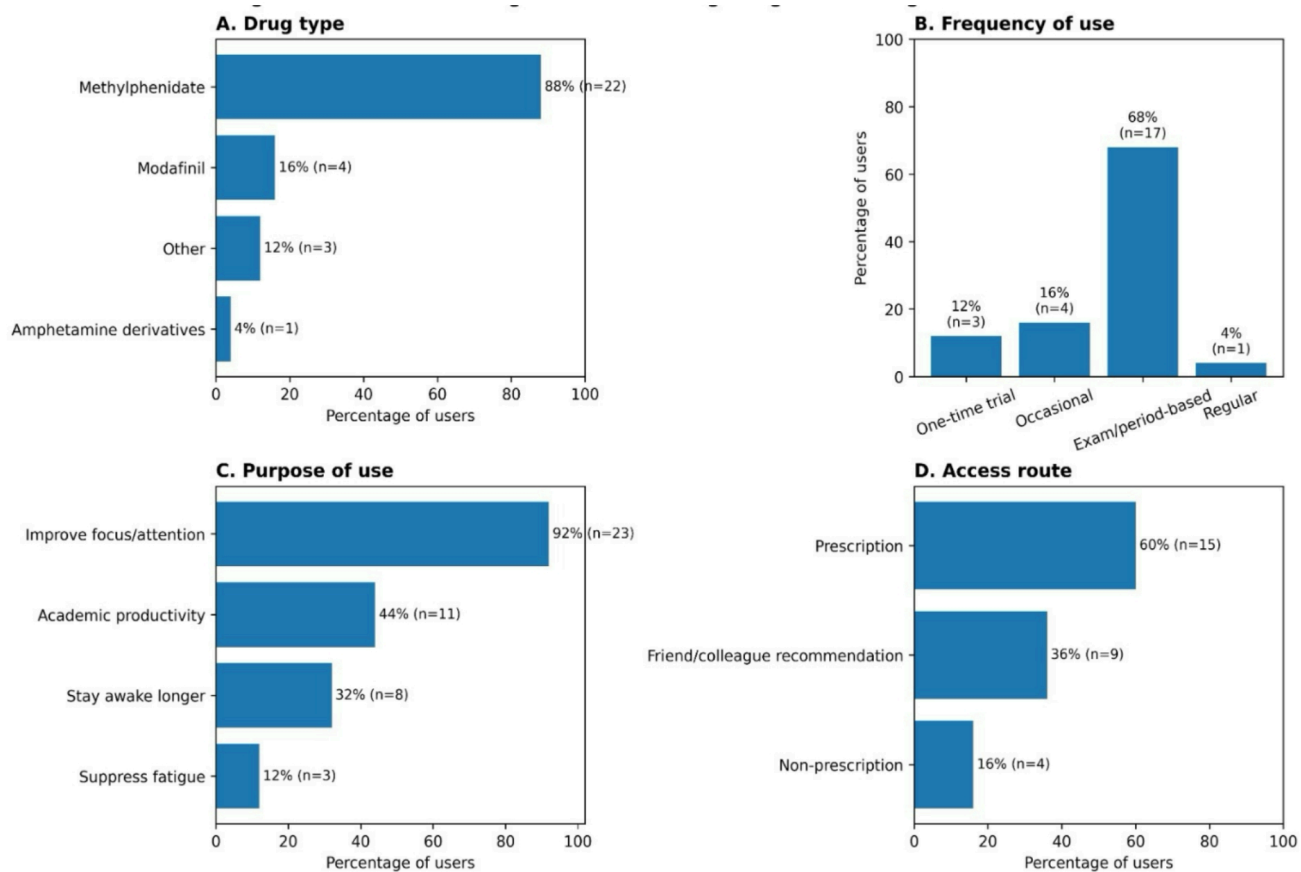


Figure 3

Characteristics of cognitive-enhancing drug use among participants reporting lifetime use ($n = 25$).