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Caffeine, Alcohol, and Drug Use as Work Adjuncts Among Neurosurgeons. Prevalence, Contributing Factors, and Proposed Strategies

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BACKGROUND: **Neurosurgeons may resort to caffeine, alcohol, and various drugs to maintain peak performance as they grapple with work demands and escalated stress. The prevalence of this controversial strategy remains largely unexplored.**

METHODS: **An anonymous survey of 23 questions formulated by our research group was distributed through personal contacts and neurosurgical societies. Inquiries revolved around the use of medications and other substances for job-related reasons. Data were analyzed via regression and descriptive statistics in python.**

RESULTS: **In total, 215 neurosurgeons (43 residents) were included, with 213 disclosing their gender (94 females). Out of all, 9.3% were <30, 38.1% were 30–39, 44.6% were 40–59, and 7.9% were >60 years old. Most (70.7%) practiced in Europe, 18.6% in Asia, 6.5% in North and South America, and the rest in Africa or Australia. While 132 participants stated they consume caffeine to manage challenging schedules, drugs for cognitive and mood enhancement were utilized by 18 and 35 respectively. Alcohol was employed for stress relief by 28 with 4 reporting as heavy drinkers. Drugs posed a solution to sleep disorders for 82, and helped 8 others in strengthening their hand dexterity. Notably, 12 of those claiming drug use initiated it in medical school. Exercise, self-care activities, and relational support were the main alternatives sought. Ultimately, most responders recommended extending mental health assistance and raising awareness about drug use.**

CONCLUSIONS: **Reflecting on our results on job-associated drug use by neurosurgeons, we propose the judicious use of pharmacological or nonpharmacological adjuncts, alongside the prioritization of neurosurgeons' well-being.**

INTRODUCTION

Neurosurgeons, amongst few professionals, are afforded the opportunity to make a profound difference in others' lives and thereby discover a meaningful purpose in their work. In spite of its merits, pursuing a career in neurosurgery, as in many surgical specialties, also comes with substantial challenges that may prompt surgeons to rely on caffeine, alcohol or various drugs to alleviate stress, fatigue, concentration deficits, or depression.[1-3] The ongoing discourse has not reached a consensus

Key words
- Alcohol use among neurosurgeons
- Caffeine use among neurosurgeons
- Cognitive enhancement among neurosurgeons
- Drug use among neurosurgeons
- Mood enhancement among neurosurgeons
- Performance drugs in neurosurgery
- Stress management in neurosurgery

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on how this tactic might interfere with surgeons' capacity to perform surgeries and the potential consequences for patients' health.[3]

Personality-related factors have also been implicated as surgeons have been shown to exhibit more negative feelings (neuroticism) but also higher levels of conscientiousness. There's still uncertainty, though, about whether these traits are intrinsic or if they are closely tied with elements of the surgical profession, such as its high-stakes nature, the long working hours, and the constant confrontation with mortality.[4] Unfortunately surgeons often overlook warning signs of emotional or physical exhaustion due to their ingrained belief in avoiding weakness and refraining from complaining.[5]

While the work-related difficulties experienced by surgeons with or without drug use prevalence analysis are well covered within the literature,[1,6-9] studies geared toward neurosurgeons are absent. To compensate for this shortage, the present study was carried out, embodying the collective effort of the Global Rising Of Women In Neurosurgery Group (GROWING) consortium, an independent multinational research group composed mainly of female neurosurgeons at varying career stages. The group members abstain from either endorsing or opposing the role of drug use for job associated reasons. Instead, they aspire to spark a fruitful discussion with the overarching goal of enhancing neurosurgeons' well-being and promoting self-awareness.

METHODS

An electronic survey of 23 questions was designed on Google forms and disseminated either directly to personal worldwide contacts of the group members or through European neurosurgical societies with familiar associations, mainly corresponding to the authors' country of clinical practice. The survey was not shared through social media channels to minimize bias. Participants were informed at the survey's outset that their anonymity would be upheld, that all questions were optional to answer, and that they retained the right to halt the survey at any point. Responses to some questions outnumbering responders are explained by the multiple choices permitted. Consent was implied by the completion of the survey and both researchers and responders lacked any incentives.

The study period spanned from June 2023 to February 2024, and all digital records were kept in protected environments. The study adhered faithfully to the Principles of the Declaration of Helsinki, and since it was neither institution-based nor included clinical subjects but was rather undertaken by an independent research group, Ethics Review Board approval was not seen as required. Moreover, care was taken to navigate any potential stigmatizing perceptions tactfully and with complete anonymity.

The primary parameters investigated among neurosurgeons were the prevalence of caffeine and alcohol consumption, the use of cognitive and mood enhancers, the use of drugs to combat stress, hand tremor or sleep disorders, the negative effects of substance abuse, the alternative approaches to medication as well as participants' viewpoints. Since this constitutes an exploratory study aimed at avoiding confirmation bias, no hypotheses were used. Instead, the study adopted a more flexible approach to data analysis, allowing for the emergence of unexpected patterns and themes. Besides, elaboration on illicit drug use was avoided due to the varying definitions and legislative differences across countries.

Descriptive analysis was performed, comparing responses between participants. Calculating the total survey response rate was not feasible, given our intention to safeguard responders' anonymity and confidentiality during the distribution process. Age was presented as a discrete variable using decades as age groups and all survey responses were summarized using counts and proportions. Survey answers were analyzed based on the participants' gender. Correlation and chi-square analyses were performed using the packages *pandas* and *scipy* in python. Data were visualized using matplotlib and seaborn in python. The threshold for statistical significance was set at $P < 0.05$.

RESULTS

Participants' Demographics

A total of 216 individuals participated in the study, with one being ineligible for inclusion for returning a blank e-sheet. Cut-offs depending on the completion rate of each questionnaire were not implemented due to the high completion minimum of 77% and completion average of 93% (**Table 1**). As a result, statistical analysis incorporated data from 215 responders, with 20% being trainees and 80% specialized neurosurgeons. Gender was revealed by 213, namely 119 males and 94 females. Of all, 9.3% were <30, 38.1% were 30–39, 44.6% were 40–59, and 7.9% were >60 years old. 70.7% reported practicing in Europe, 18.6% in Asia, 6.5% in North or South America, 2.3% in Australia and 1.9% in Africa (**Table 2**).

Caffeine, Alcohol, and Drug Use Prevalence

When questioned about caffeine consumption, 61.4% (n = 132/215) stated that they consume coffee or caffeinated beverages/pills to cope with work-related stress and pressure. As far as the overall alcohol use is concerned, 20.8% (n = 44/212) did not drink any alcohol, 60.4% (n = 128/212) were social drinkers and 17% (36/212) were moderate drinkers defined as 3–7 drinks per week for women and 3–14 drinks per week for men. Remarkably, 1.9% (4/212) were classified as heavy drinkers, meaning ≥4 drinks on one occasion or ≥8 drinks per week for women and ≥5 drinks per occasion or ≥15 drinks per week for men (**Figures 1 and 2**).

With respect to drugs/substances used for nonmedical reasons, out of 215 responders, 8.4% admitted using cognitive enhancers. In detail, 4.2% made rare use (a few times a year), 1.4% made occasional use (approximately once a month), whereas 2.8% used drugs regularly (once a week or more) (**Figures 1–3**). When asked to specify the substances used, from a given catalog with preset and free-written options, antidepressants, amphetamines, modafinil and mood stabilizers were the most popular and chosen by 11, 5, 5 and 4 responders respectively. When the use of drugs/substances for mood enhancement, recreation or self-presentation at work was queried, 16.3% gave a positive answer (**Figures 1–3**). Specifically, 34 turned to alcohol, 9 to antidepressants, whereas mood stabilizers, amphetamine, modafinil, and illicit drugs were all selected by 4.

In terms of drugs/substances used to tackle stress, 34 of 215 (15.8%) mentioning drug use specified it as follows: 28 opted for alcohol, 7 for antidepressants, 5 for β-blockers, 4 for illicit drugs, 3

Table 1. Table Summarizing all the Questions Included in the Survey Accompanied by Their Respective Completion (Response) Rate

Question List	Completion Rate
1. Are you a resident or an attending neurosurgeon?	100% (n = 215)
2. What is your gender identity?	99% (n = 213)
3. How old are you?	100% (n = 215)
4. Which continent do you practice in?	100% (n = 215)
5. Do you consume coffee or caffeine containing drinks/pills to cope with your working schedule or to manage stress and work-related pressures?	100% (n = 215)
6. Do you use drugs/substances without a medical need for cognitive enhancement?	100% (n = 215)
7. In case you take drugs for cognitive enhancement, please specify. (Select all that apply)	82% (n = 177)
8. Do you use drugs/substances without medical need for mood enhancement, recreation, or improvement of your self-presentation at work?	100% (n = 215)
9. In case you use drugs for mood enhancement, please specify. (Select all that apply)	81% (n = 175)
10. Do you use drugs/substances without a medical need to manage stress at work?	100% (n = 215)
11. In case you use drugs to manage stress, please specify. (Select all that apply)	81% (n = 175)
12. Do you use drugs/substances to reduce hand tremor and improve your dexterity during surgery?	99% (n = 214)
13. In case you take drugs to improve your surgical performance please specify. (Select all that apply)	77% (n = 166)
14. Do you use drugs/substances to deal with sleep disorders due to working conditions?	99% (n = 214)
15. In case you take drugs to deal with sleep disorders, please specify. (Select all that apply)	79% (n = 170)
16. In case you drink alcohol, how much alcohol do you consume?	98% (n = 212)
17. In case you take any of the aforementioned drugs/substances (apart from alcohol/caffeine), how do you get them? (Select all that apply)	91% (n = 196)
18. In case you use drugs, have you ever experienced negative consequences because of your drug or substance use? (Select all that apply)	92% (n = 199)
19. In case you use drugs, have you ever been under the influence of drugs or alcohol while performing a surgical procedure?	94% (n = 203)
20. In case you use drugs, when did you start?	95% (n = 204)
21. In case you use drugs for a non-medical cause, what is the reason? (Select all that apply)	92% (n = 199)
22. If you have tried alternative methods to deal with the aforementioned conditions, please specify. (Select all that apply)	94% (n = 203)
23. What is your perspective and recommendations regarding drug/substance use among neurosurgeons? (Select all that apply)	97% (n = 210)

for amphetamines, 3 for benzodiazepines. 3 for mood stabilizers, and 3 for sleeping pills. Antihistamines and a handful of other substances ranked lower in preference. Only 8 of 214 (3.7%) individuals admitted taking drugs/substances to improve hand dexterity with β-blockers chosen by 6 and benzodiazepines, alcohol, antidepressants, and mood stabilizers by 2 (Figures 1–3). On the contrary, a notable portion of responders (38.3%, n = 82/214) sought solace to drugs or various substances owing to sleep disorders. Melatonin, alcohol, and stimulants including caffeine were the most favored choices (n = 13, 12, 13) followed by benzodiazepines and other sleeping pills in lower numbers (Figures 1–3).

When we inquired how someone was provided with the drugs/substances, 11 obtained them from a colleague or friend, 10 from their treating physician, 8 used self-prescription, 5 off-market drugs, and 3 the hospital reservoir. In regard to negative consequences linked to drug use, 4 faced relationship issues, 4 mentioned difficulties in functioning in everyday activities, 3 suffered from health problems, 1 had to deal with legal matters, and 1 with impaired capacity to fulfill work responsibilities. Eight of 203 (3.9%) reported they have operated while under the influence of drugs, without prompting them to clarify whether this had any unwanted effect on patients' outcome.

Causatives and Proposals

Referring to the age of first use, 12 started as medical students, 6 as young neurosurgeons, 5 as seniors, 5 as residents, and 1 when they stepped into a leadership position. When requested to choose all the applicable causes of drug use, stress at work and pleasure seeking were pointed out by 12 each, followed by the need to improve surgical performance and handle family or relationship issues (n = 5,4). When invited to discuss alternatives to drug use, 46 chose exercise, 33 self-care activities, 23 support from relatives, 19 meditation, 18 counselling, and 1 gardening (Figure 4).

In the last question about participants' perspectives and recommendations, the vast majority underlined the value of advancing support for mental health and boosting awareness about the risks and benefits of drug use (67.6%, n = 142/210 and 42.4%, n = 89/210 in respect). Of note, 27 favored the implementation of drug testing at work and 17 recommended strict penalties for offenders.

Table 2. Responders' Demographic Data

Participants' Demographics	Values
Career Stage	(215 responses)
Attending Neurosurgeons	80% (n = 172)
Neurosurgical Trainees	20% (n = 43)
Gender	(213 responses)
Females	44.1% (n = 94)
Males	55.9% (n = 119)
Age	(215 responses)
<30 Years Old	9.3% (n = 20)
30–39 Years Old	38.1% (n = 82)
40–49 Years Old	26.5% (n = 57)
50–59 Years Old	18.1% (n = 39)
>60 Years Old	7.9% (n = 17)
Continent	(215 responses)
Africa	1.9% (n = 4)
Asia	18.6% (n = 40)
Europe	70.7% (n = 152)
North America	4.2% (n = 9)
South America	2.3% (n = 5)
Oceania	2.3% (n = 5)

There were 25 proponents of destigmatizing drug use whereas fewer emphasized the relevance of recognizing addiction, encouraged nonjudgmental counselling and suggested reducing administrative tasks and competition at work.

Statistical Correlations

Gender-based analysis was performed after stratifying our results by sex and the chi-square test was used to check whether any significant differences were attributable to gender. Yet, no statistically significant findings were identified. Correlation analysis yielded 3 significant correlations. The strongest correlations were observed between drug use for stress management and drug use of cognitive enhancement (rho = 0.52, P-value = 3.95e-16)/mood enhancement (rho = 0.51, P-value = 7.40e-16). The third significant correlation was identified between drug use for cognitive enhancement and drug use for mood enhancement (rho = 0.41, P-value = 4.13e-10) (**Figure 5**). Upon gathering all responses specifying drug/substance use (Q: 7,9,11, 13, 15) 48 picked up one kind of drugs/substances, 17 opted for 2, 6 for 3, and other 6 for more than 4 ones (**Table 1**, **Figure 6**).

DISCUSSION

The discipline of neurosurgery presents the chance for significant personal and professional fulfillment. During the last years, there has been a considerable research surge in this burgeoning surgical field pertaining especially to historical, social, educational, or ethical issues.[10-15] Although the trials and tribulations encountered by neurosurgeons have been adequately underscored, a study examining the prevalence, underlying factors, and ethical considerations of the so-called "neurosurgeon's doping" along with counterbalancing strategies has not been conducted so far, at least to the best of our knowledge.

Neurosurgeons are frequently exposed to overwhelming timetables, resulting in tiredness or even mental and physical exhaustion. Top-tier scientific journals have brought attention to the rigorous demands of medical practice and the widespread use of stimulants within the broader scientific community.[16-18] The ever-rising stimulant use across educational institutions and the rapid developments in the pharmaceutical industry also necessitate an honest glimpse into the pros and cons of the often-termed "brain doping."[9,19] In the current study, 8.4% of the participants acknowledged using cognitive enhancers (**Figure 3**), thus keeping in line with a large-scale study encompassing 1.145 general surgeons and reporting a similar value of 8.9%.[1] According to an Australian study, the motives for stimulant use among students unfolded as follows: 1) "getting ahead," 2) "keeping up," and 3) "going out,"[20] mirroring the range of their psychological effects. Stimulants also seem to offer a convenient alternative to time-consuming behavioral coping mechanisms and to caffeine that is proven to exacerbate hand tremor.[1,21-23]

On the other hand, randomized controlled trials, reviews, and meta-analyses, showed scarce evidence supporting pro-cognitive effects of pharmaceutical stimulants or anti-dementia drugs in otherwise healthy, non–sleep-deprived individuals on simple and higher cognitive domains, a situation that differed in the instance of sleep deprivation.[1,24-26] Similarly, a study on surgical novices trained on a laparoscopic simulator demonstrated that while caffeine and taurine brought surgical performance back to rested levels, they did not decrease errors.[27] In our study 61.4% of the responders used caffeine to address overloaded work schedules, which is close to the results of a prior study involving surgeons, attendees of international conferences[2,28] and another one on German pupils and students.[28] Fatigue-fighting was the leading cause of caffeine consumption in the first study, while in the second, school grades played a major role.[2] In the cons column, stimulants (aka nootropics or "smart drugs") can possibly induce autonomic adverse effects or lead to addiction and an overestimation of one's abilities.[1,3,24]

Caffeine is well known for its stimulating effects on the central nervous system and for intensifying physiological tremor.[28,29] Despite the increased consumption of caffeine among those surveyed (n = 132/215), only 8 noted the need to medically address surgical tremor, mostly with b-blockers (**Figures 1–3**). The existing literature on tremor and its impact on surgical performance is primarily sourced from the field of ophthalmic surgery. Simulation studies revealed that novice vitreoretinal surgeons' performance declined after receiving caffeine, improved with caffeine plus propranolol administration, and further enhanced with propranolol-only treatment. The same substances in senior surgeons affected tremor but not dexterity, proposing that experience serves as a counterbalance to caffeine exposure.[29-31] Avoidance of fasting, alcohol, and sleep deprivation as well as adoption of suitable surgical ergonomics has also been advocated.[29,32]

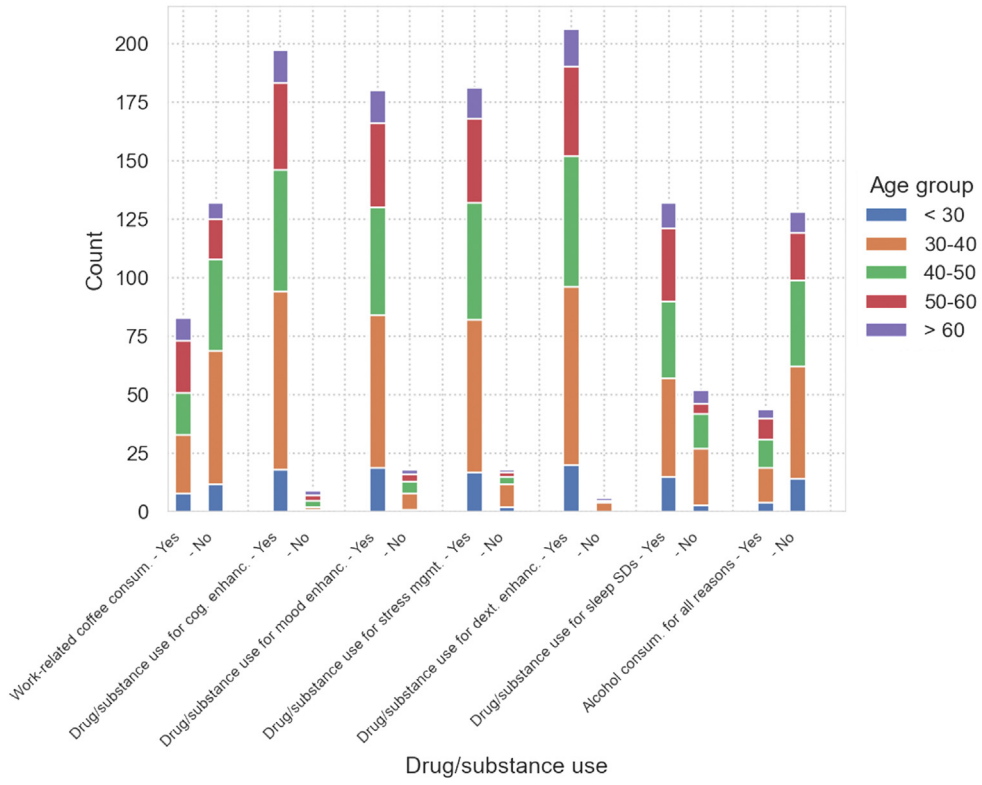

Figure 1. Bar graph summarizing response count on caffeine, alcohol and drug/substance use for work-related reasons as either "Yes" or "No." Consum, consumption; cog, cognitive; enhanc, enhancement; mgmt, management; dext, dexterity; SDs, sleep disorders.

In the context of alcohol consumption, our study cohort consisted of at least 36 moderate and 4 heavy drinkers, taking into account the 212 responses given on the relevant question (**Figures 1 and 2**). Collins et al. uncovered a more disconcerting proportion when they surveyed 622 individuals within the academic surgery community, with 11% testing positive for alcohol abuse disorder.[33] Although Vasankari et al. found no difference in microsurgical performance following small quantities of alcohol consumption,[34] another study concluded that blood-alcohol concentrations of 0.11%-0.15% deteriorated surgical dexterity regardless of the surgeon's level of expertise.[32] Ameliorating stress and finding pleasure were the most common motives for any drug/substance use in our survey, whereas another study on 1.311 surgeons outlined surgeons' high stress levels and further correlated the latter with medical care of inferior quality.[35]

Beyond hectic workloads, neurosurgeons are often encumbered by stress stemming from the high morbidity and mortality rates that are either dictated by the natural history of the disease or occur postoperatively. Herein, we highlight that 16.3% of those queried engaged in drug use for mood elevation, and 15.8% to overcome stress (**Figures 1–3**). This falls slightly below the outcomes of a 10-year systematic review, which documented a median depression and anxiety percentage of 24% and 20% among surgeons.[36] These conditions may signal the beginning of burnout, predominantly characterized by depersonalization, emotional exhaustion, and diminished achievement.[37] In a recent study on 282 neurosurgeons, 23.4% satisfied the criteria for diagnosed burnout as per the verified Maslach burnout inventory.[38] Meanwhile, in another study limited to residents, the self-reported burnout rate stood at 30%.[39] Published evidence suggests that women display heightened vulnerability to burnout and attrition compared to men.[37,40] That said, our research unveiled a subtle male preponderance in drug use for controlling stress and mood disorders (**Figure 2**).

A percentage as high as 38.3% relied on drugs to alleviate sleep disturbance, which is an important observation particularly in the light of studies indicating that extended periods of on-call duty and especially night shifts either compromised the surgical performance,[41] or prolonged the operation time.[42] While Lehmann et al. showcased in their prospective stimulation study that limited sleep deprivation in clinical settings may not necessarily diminish typical surgical aptitude,[43] the study faced significant criticism for susceptibility to Hawthorne effect, where participants sustain good performance because they know they are evaluated.[44]

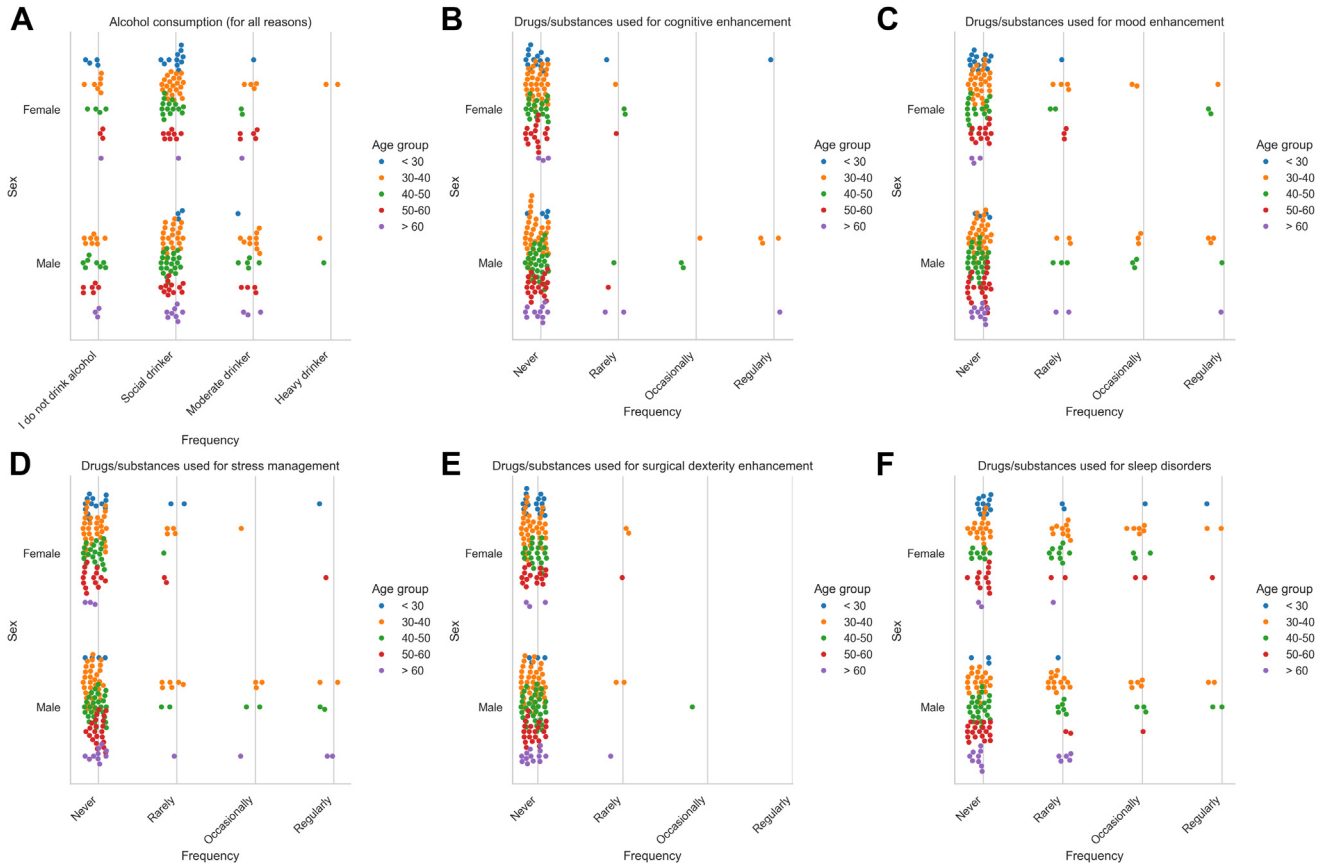

Figure 2. Swarm plots of the drug/substance intake frequency, stratified by sex and age group. (**A**) Alcohol consumption (for any reason). (**B**) Drugs/substances used for cognitive enhancement. (**C**) Drugs/substances used for mood enhancement. (**D**) Drugs/substances used for stress management. (**E**) Drugs/substances used for surgical dexterity enhancement. (**F**) Drugs/substances used to deal with sleep disorders.

For those seeking nonmedical strategies in order to mitigate job stressors or contend with personal concerns, physical exercise, cultivation of other self-renewal practices, and support from relatives/friends were top ranked in our survey, followed by meditation (Figure 4). This aligns with the findings from a study targeting the wider medical field which stressed out additionally, the need for supportive networks, and the emotional resonance evoked by deriving meaning from surgical practice.[8] Wolfe et al. reviewed 7 organized wellness programs for US neurosurgery residents, which featured essential components, such as participating in the annual neurosurgery softball tournament or other fitness events, attending conference lectures, and providing gym memberships.[45]

In our final call for guidance and insights on the topic, most participants voted for psychological aid and a proactive stance toward neurosurgeons' well-being, parallel to spreading awareness on drug use. Convergent to that, Abdelmageed et al. reiterated the imperative need for transparent and readily available support systems for neurosurgeons throughout their training and practice.[37] Training in coping strategies and deepening the understanding of neurosurgical practice have also been recommended as key elements of the contemporary medical school curriculum.[1,15] Conversely, voices siding with penalties or counter-measurements to drug use partially echo in the literature.[46-49]

Key Pointers

Drawing from the above, the authors have devised clear and actionable directives irrespective of any drug/substance use: To support the holistic wellness of neurosurgeons, healthcare systems should focus on optimizing workload management and monitoring sleep patterns to prevent burnout and ensure sufficient rest. Establishing robust mental health support, promoting mindfulness, and organizing social activities can further bolster staff well-being. Special provisions for mothers, such as flexible scheduling and accommodating maternity leave policies, are also vital. Last but not least, tackling other common issues like hand shaking, caffeine overuse/withdrawal, episodic depression and adjustment disorder through education, meditation training, and happy hours among co-workers can pave the way for a healthier and more sustainable work environment for all healthcare professionals.

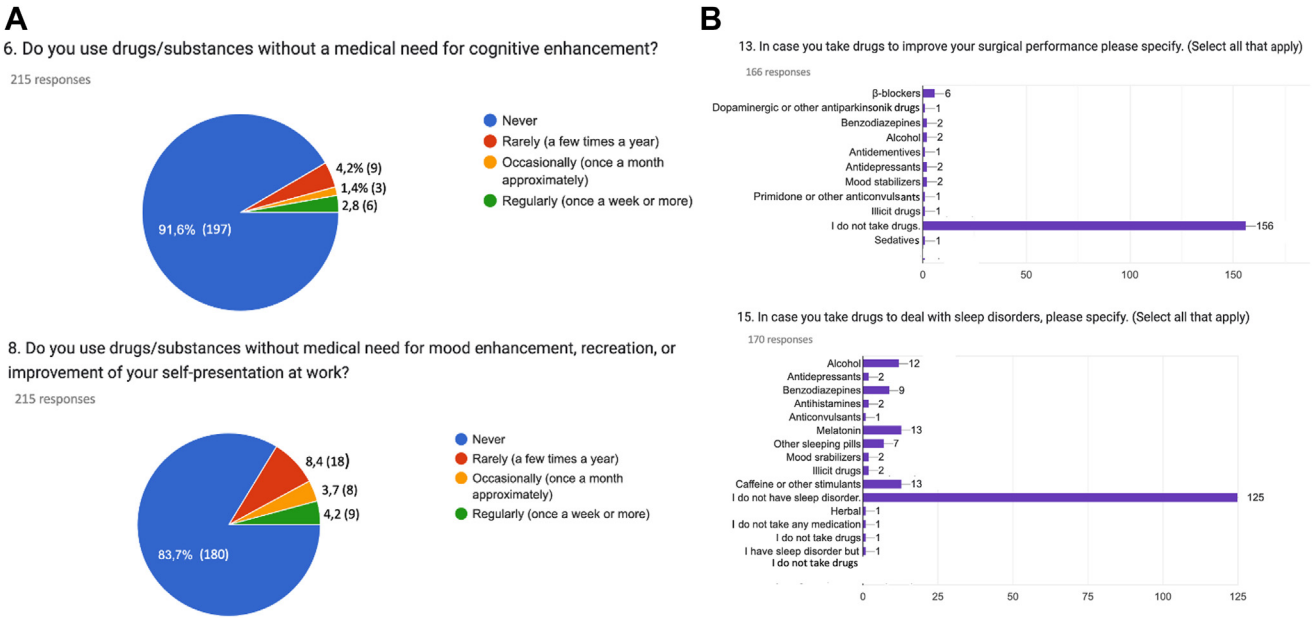

Figure 3. (**A**) Pie plots showing the different types of response to question No. 6 and 8. (**B**) Bar graphs showing the different types of response to question No. 13 and 15. All the questions asking to specify the drugs/substances used did not include caffeine, except the one pertaining to sleep disorders (not shown here). No, number.

Study Limitations

Given the sensitive nature of the survey, it is possible that individuals hesitated to respond truthfully. The response rate, while fundamental to many investigations, could not be accurately measured so as to preserve anonymity. However, rough estimates suggest it was lower than 15%, considering our overall distribution efforts. Furthermore, this is a self-reporting study and the exact portions of participants, with either positive or negative inclination toward the topic is unknown, bringing up concerns about participation, social desirability, recall, and response and bias. Responses to questions with completion rate below 100% are also conveyed as absolute values, hence confusion may arise.

This novel study comprises a relatively small heterogeneous population with different cultural, socio-economic and religious traits. There is, though, a dominant European representation, attributed mainly to the European working background of most of the authors. These region-specific factors may affect both the accessibility and preference for substances among neurosurgeons. Consequently, any generalization of the results could lead to misconceptions. To broaden the relevance of the current findings, larger studies entailing an even wider range of backgrounds are warranted.

Consideration might also be given to including substances such as nicotine in future analysis. Integrating more variables in follow-up studies could provide a more comprehensive understanding of the supplementary methods neurosurgeons utilize to confront work-related challenges. While simple and practical suggestions are made by the authors, this area of research is still immature, and further investigations on more subjects are needed to provide evidence-based recommendations at individual and organizational level. Our study also doesn't capture the benefits of personalized interviews, but we view it as an initial step toward achieving openness, depth, and greater inclusion. That is, we anticipate this endeavor to motivate additional pertinent research into an issue commonly perceived as contentious.

CONCLUSIONS

The enduring surgical cultural norm of maintaining high fatigue tolerance together with the innate demands of the neurosurgical discipline may drive professionals toward high caffeine, alcohol, or drugs intake. This study serves as confirmation to neurosurgeons that numerous colleagues encounter similar challenges and that unplugging from the working environment is crucial. The responsibility for change is also a 2 way-process and in that aspect healthcare organizations should acknowledge that fostering physicians' wellness is not only beneficial for business but also the ethical thing to do.[5]

Even though the expected effectiveness of "doping" may outweigh its actual efficacy,[24] and the ethical and social ramifications following its potential liberalization are critically assessed,[50] the notion of pharmaceutical neuroenhancement should not be dismissed outright.[25] From the findings of this study, it is apparent that substances, whether legal or illegal, may confer advantages such as improving cognition and lessening tremors. However, their extensive use among vulnerable populations, such as students and residents who are poised to become future neurosurgeons, is troubling. Therefore,

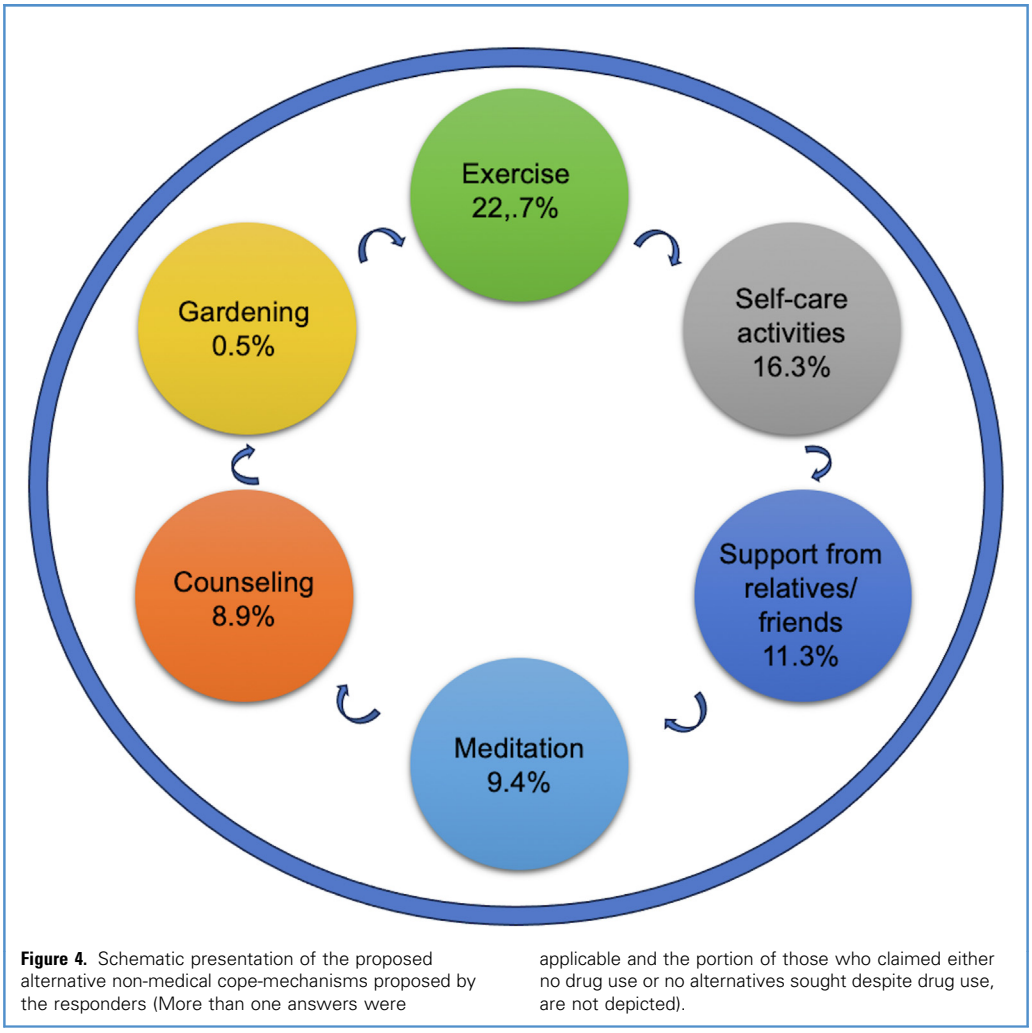

Figure 4. Schematic presentation of the proposed alternative non-medical cope-mechanisms proposed by the responders (More than one answers were applicable and the portion of those who claimed either no drug use or no alternatives sought despite drug use, are not depicted).

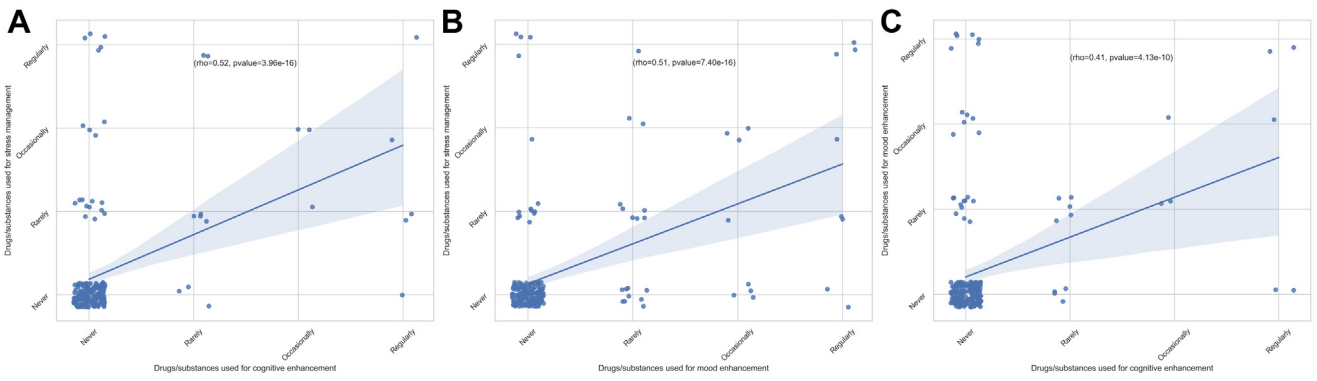

Figure 5. Regression plots of the correlations. Spearman's rho and *P*-value for each correlation are reported. (**A**) Drugs/substances used for stress management versus for cognitive enhancement, (**B**) Drugs/substances used for stress management versus for mood enhancement. (**C**) Drugs/substances used for mood enhancement versus for cognitive enhancement.

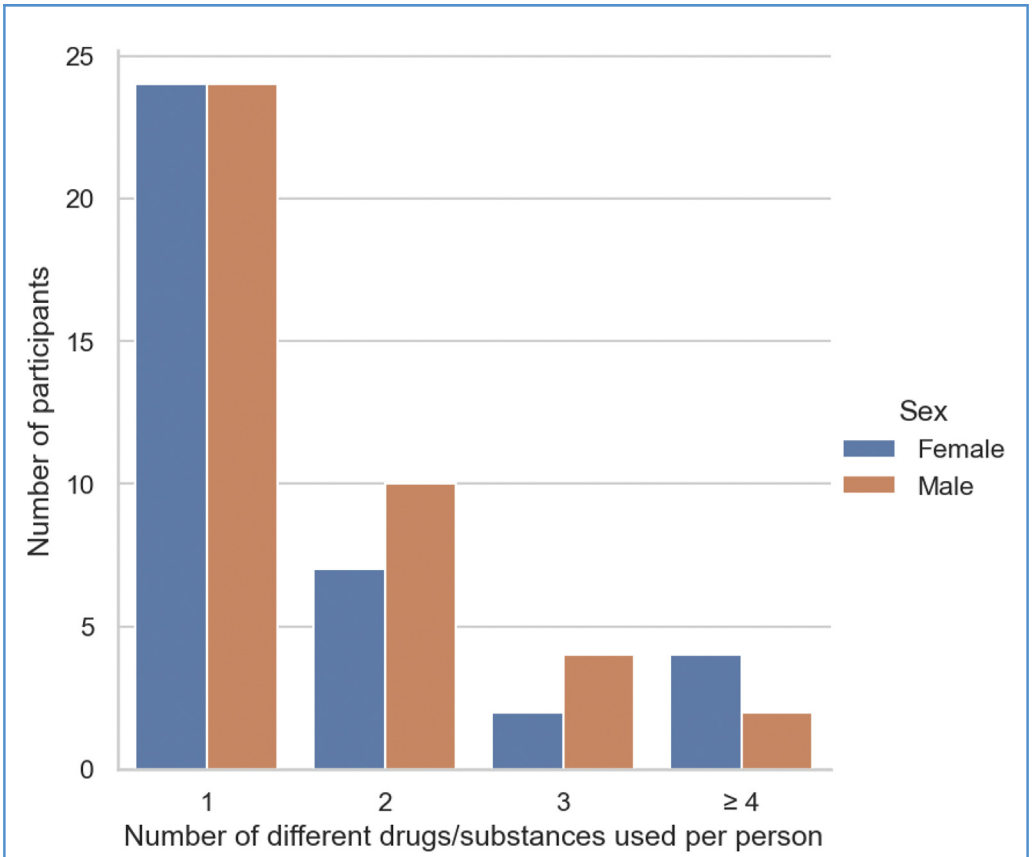

Figure 6. Bar plot grouped by sex, demonstrating the number of responders opting for 1, 2, 3, and ≥4 kinds of drugs/substances for all work-related reasons based on answers to questions: 7, 9, 11, 13, and 15.

the authors assert the paramount importance of early detection of unhealthy stress, depression, and burnout, and the exhaustion of nonmedical options first.

When medication intake is inevitable, surgeons should be aware of the potential side effects of any substance used and exercise themselves on discerning the manner and timing in which their personal distress influences the quality of care they provide.[6] Finally, additional studies are called for in order to validate the current deductions and determine any potential implications for patient safety.

CRediT AUTHORSHIP CONTRIBUTION STATEMENT

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