Heliyon 7 (2021) e08118

Contents lists available at ScienceDirect

Heliyon

journal homepage: www.cell.com/heliyon

Research article

Concept generation of cognitive enhancement: healthcare professionals' approach towards the impact and utilization of cognitive enhancers in academic context

Sadia Shakeel [a,*], Wajiha Iffat [b], Ambreen Qamar [c], Fareeha Butt [d], Faiza Ghuman [e], Imran Ahsan Mallick [a], Anees ur Rehman [f], Shazia Jamshed [g]

[a] Department of Pharmacy Practice, Faculty of Pharmaceutical Sciences, Dow College of Pharmacy, Dow University of Health Sciences, Karachi, Pakistan
[b] Department of Pharmaceutics, Faculty of Pharmaceutical Sciences, Dow College of Pharmacy, Dow University of Health Sciences, Karachi, Pakistan
[c] Department of Physiology, Dr. Ishrat Ul Ebad Khan Institute of Oral Health Sciences (DIKIOHS), Dow University of Health Sciences, Karachi, Pakistan
[d] Department of Physiology, Dow Medical College, Dow University of Health Sciences, Karachi, Pakistan
[e] Department of Medicine, Dow University Hospital, Dow University of Health Sciences, Karachi, Pakistan
[f] Department of Pharmacy Practice, Faculty of Pharmacy, Bahauddin Zakariya University Multan, Multan, Pakistan
[g] Department of Clinical Pharmacy and Practice, Faculty of Pharmacy, Universiti Sultan Zainal Abidin, UniSZA, Kuala Terengganu, Malaysia

ARTICLE INFO

Keywords:
Cognitive enhancers
Healthcare professionals
Neuroenhancement
Brain function augmentation
Pakistan

ABSTRACT

Cognitive enhancers (CEs) encompass a wide range of drugs, including prescription medications for attention deficit disorders and pharmacological compounds for cognitive enhancement. It is well-documented that the students are the leading cohort of CEs users. Exploring how healthcare professionals perceive the use of CEs for academic accomplishments is significant to understand their encouragement of CE use. Hence, the purpose of the current study was to look at healthcare professionals' attitudes and perceived understanding about the usage of CEs in academic contexts. The study was a quantitative cross-sectional research design conducted in different healthcare and academic settings of Karachi. The respondents were approached either through social media platforms or the official email addresses of their working organizations. Data were collected through a web link of an online questionnaire that included four sections; inquiring about the respondents' demographics characteristics, their knowledge about CEs, their attitudes towards the use and impact of CEs, and their inclination to use a hypothetical prescription-only CE. The response rate of the study was 73.3%. The majority of the respondents negated to permit university students to using CEs for cognitive boost (n = 360, 67.1%), to concentrate (n = 406, 75.7%), to increase vigilance (n = 394, 73.5%) or to mitigate the effects of other medicines (n = 312, 58.2%). The pharmacists were more likely to refute that using CEs by the students is safe (pharmacists 10.8% vs. physicians 8.3%, p=<0.001), beneficial (pharmacists 12.7% vs. physicians 5.3%, p=<0.001), or necessary (pharmacists 17.6% vs. physicians 12.8%, p=<0.001). The major reasons for not encouraging the use of CEs were fear of misuse (n = 510, 95.1%), safety concerns (n = 495, 92.3%), and their consideration for CE as unnecessary medical intervention (n = 441, 82.2%). The findings indicated that overall, respondents have a clear consensus of not letting university students use CEs for cognitive improvement or any other purpose implying that cognitive enhancement is not yet a common or approved medical practice by the healthcare professionals in Pakistan.

1. Introduction

Cognitive enhancement is described as an "amplification or expansion of basic mental capability through improved internal and external information processing systems" (Arias-Hernandez et al., 2012). It can be accomplished either "pharmacologically," by using cognitive enhancer (CE) substances/drugs; or "non-pharmacologically," by following healthy standards of living (d'Angelo et al., 2017; Green et al., 2019). CE, sometimes known as smart medicines, are prescription medications that are used by individuals, either without a prescription or at a higher dose than recommended, to increase cognitive skills such as concentration, alertness, or memory (Maier et al., 2018). CE was first developed to treat

* Corresponding author.
E-mail address: sadia.shakeel@duhs.edu.pk (S. Shakeel).

https://doi.org/10.1016/j.heliyon.2021.e08118
Received 2 July 2021; Received in revised form 11 September 2021; Accepted 29 September 2021

a variety of diseases such as Alzheimer's disease, Attention Deficit Hyperactivity Disorder (ADHD), and narcolepsy by addressing different impairments in cognitive functioning such as attention, abnormal learning, and the absence of top-down cognitive control (Eack et al., 2018). However, they are increasingly being used by healthy people to improve cognition, despite concerns about their capacity to do so in non-clinical groups (Brunyé et al., 2020). Prescription stimulating medications such as modafinil, methylphenidate and amphetamines are increasingly being used for cognitive improvement, particularly in tertiary academic settings (Brühl et al., 2019; Cohen et al., 2021). Methylphenidate is a central nervous system stimulant that is clinically recommended for ADHD. Although studies have shown that methylphenidate has a favorable effect on healthy people's memory, further research is needed to establish its capability (Batistela et al., 2016).

Research suggest that persons with low-to-average intellect benefit the most from cognition-enhancing medications (Ram et al., 2017). The university students are believed to be common users of CE to boost attentiveness, increase vigilance, stay awake for an extended period, or do better intellectually (Miranda and Barbosa, 2021a; Ram et al., 2021). With the explosion of knowledge the students are turning to use CEs to strengthen and increase their attention, memory, vitality, and other measures of wellbeing (binti Suhaimi & binti Hussin, 2017; Lanning and Mallek, 2017). The lifetime prevalence of CE usage among university students has been observed to be between 1.2 - 34 % (Lengvenytė and Strumila, 2016; Lengvenyte et al., 2016; Miranda and Barbosa, 2021a; Riddell et al., 2018). Low consideration of negative health consequences and principles of use are associated with unnecessary use among healthy individuals (Colaneri et al., 2018). Personal views about the use of CEs, the broader attitudes of social networks, and possibly biased information received from the media, the internet, and friends affect the decision to utilize CEs (Green et al., 2019). Similar to drug addiction in which the group norms surrounding social approval drive patterns of usage, the effect of social networks and attitudes toward usage enhances the use of CEs (Riddell et al., 2018).

Despite the availability of research among tertiary students investigating their approaches and motives to use CEs, evidence is scarce on professional knowledge and tolerance of CE usage in academic contexts (Elfferich, 2021). The understanding of professionals' perspectives about the CEs use in academic settings is significant since the different perspectives and a deficit of clear agreement on the usage of CEs within and between professions can impact both students and professionals (Franke et al., 2012). Hence, the purpose of the present study was to look at healthcare professionals (HCPs) knowledge and attitudes about the usage of CEs in academic contexts and their inclination to utilize a hypothetical prescription-only CE.

2. Methods

2.1. Study design and population sampling

The study was carried out as a cross-sectional online survey from February 2021 to May 2021. Data were collected through a web-link of an online questionnaire with closed-ended questions. The respondents from the healthcare and academic settings of Karachi were approached either through different social media platforms or official email addresses of their working organizations and invited to complete the survey form. The snowball and convenient sampling method was adopted for the study.

2.2. Inclusion criteria

Physicians, pharmacists, dentists, nurses and respondents from other disciplines of basic health sciences who were involved in academic activities were invited to participate in the study. The HCPs who were not associated with academic activities and those who refused to participate were excluded.

2.3. Sampling technique

Raosoft sample size calculator was employed for calculating the sample size (Omair, 2014). The recommended sample size was 377. Based on the ease of data collection and response of the pilot study, we increase the sample size as a large sample size can enhance the significance level of the findings since the confidence in the result is likely to increase. Therefore the sample size was increased and 800 survey questionnaires were distributed to HCPs.

2.4. Study tool

Respondents were surveyed by the researchers using an online questionnaire developed by a literature review of similar studies (Franke et al., 2014; Kudlow et al., 2013; Ram et al., 2020, 2021) to evaluate the HCP's knowledge and attitude towards the use of CEs in academic settings. For carrying out the content validity, the questionnaire was pre-tested in a lower portion of the respondents (n = 30), to estimate the precision and transparency of questionnaire items (face validity). Cronbach alpha was used for calculating the internal reliability testing whose value was found to be 0.793, which is satisfactory to achieve the objectives of the current study. There was a slight modification needed in the questionnaire after the pilot testing. The HCPs who contributed to the pilot study were excluded from the final study.

The questionnaire included four sections inquiring about the respondents' demographics characteristics, their CEs knowledge, attitudes towards the use and impact of CEs in academic settings, and willingness to use a hypothetical prescription-only CE. (Supplementary materials) Section one consists of five questions on the respondent's demographic information, such as gender, age, working organization, profession, and experience. There were six questions in the domain of acquiring respondents' knowledge about CEs. Thirteen questions inquired the attitude of HCPs towards the use and impact of CEs in an academic setting. Each questionnaire item was followed by a 5-point Likert scale ranging from 1 = strongly disagree to 5 = strongly agree. The last section inquires the respondents' willingness to use hypothetical prescription-only CEs and in case of their positive response, the subsequent question was to find out the reason for using CEs.

2.5. Ethical considerations

The study was carried out in accordance with the Helsinki Declaration's guidelines and approved by the Institutional Review Board of Liaquat College of Medicine and Dentistry, Darul Sehat Hospital, Karachi, Pakistan (Reference No. DSH/IRB/2021/0029). The written consent was taken from the respondents before the study.

2.6. Data collection

The online Google form was developed having four sections, with the objectives of the study mentioned on the first page. Various social media channels, including “WhatsApp” and “Facebook Messenger,” were used to distribute the survey, subjected to the respondents' convenience and preferences. Some of the respondents whose official email addresses were available were invited to participate through email. For the ease of respondents, they were permitted to respond to all of the questions by just clicking on a specified link.

The respondents were requested to share the questionnaire with their colleagues' at their workplaces. All data were gathered in the form of answers on a Google form (https://docs.google.com/forms/), which were then transferred into the data analysis software.

2.7. Data collection and analysis

The data were evaluated by Statistical Package for the Social Sciences® (SPSS) for Windows version 25.0 (IBM Corporation, Armonk, NY, USA). All categorical variables were defined using frequencies (n) and proportions

(%). Data were statistically analyzed with χ^2 tests (or Fisher-exact tests) with the *p-value set at* < 0.05 as the threshold for statistical significance.

3. Results

3.1. Respondent's demographic information

In the current study, 800 survey forms were distributed among the respondents by the researchers; 587 were returned. Hence the response rate was 73.3%. However, a total of 536 filled forms were included in the study since the remaining were either incomplete or the consent form was not filled appropriately. Greater than half 359 (66.9%) of the respondents were female (Table 1). The respondents include physicians 266 (49.6%), pharmacists 102 (19.0%), dentists 42 (7.8%), nurses 16 (2.9%) and other HCPs 110 (20.5%). More than half 347 (64.7%) of the respondents were serving in the public sector. The respondents' mean age was 35.3 ± 7.2 years and more than 70% of respondents were having a work experience of more than 5 years.

3.2. Respondents' knowledge about CEs

The majority, 93.6% (n = 502) of respondents had already heard about the use of substances of any kind for CE. The major sources of respondents about CE were digital media (TV, internet) 27.5%, Continuing medical education (CME) 20.4% and print media (newspapers, magazines) 18.6% (Figure 1) whereas (6.4%) respondents stated that they do not know about CE. The majority of respondents graded their knowledge of CE usage in healthy individuals as either somewhat knowledgeable (n = 332, 61.9%), or not very knowledgeable (n = 114, 21.2%). When the respondents were probed to name the CEs they'd heard of, the most often mentioned CEs were methylphenidate (n = 223, 41.6%), modafinil (n = 174, 32.4%), amphetamine (n = 63, 11.7%), and atomoxetine (n = 21, 3.9%).

3.3. Respondents' attitude towards the use and impact of CEs in academic setting

In general, respondents refused to allow university students to use CEs for cognitive boost (n = 360, 67.1%), to concentrate (n = 406, 75.7%), to increase vigilance/stay awake (n = 394, 73.5%) or to mitigate the effects of other medications (n = 312, 58.2%). Other HCPs were least agree to favor that allowing students with poor academic performance to utilize CEs is fair (Other HCPs 34.5% vs. pharmacists 28.4% vs. physicians 23.3%, p=<0.001). Likewise, the respondents working in private work settings were less likely to favor allowing the use of CEs (p=<0.001). Physicians strongly negated to permit students to take CEs to boost vigilance (physicians 45.1% vs. pharmacists 32.4%, p=<0.001) or to take CEs in excess or for purposes other than those authorized by a doctor (physicians 53.4% vs. pharmacists 45.5%, p=<0.001). More than 80% of the respondents negate permitting students who do not have a prescription to take CEs for any purpose or to take CEs in excess quantity (Table 2). Female respondents were more likely not to allow students to take CEs for any reason (Females 35.9% vs. males 26.6%, p = 0.005) or to take CEs in excess (Females 37.6% vs. males 29.9%, p = 0.041). Female respondents were less likely to consider that using CEs for cognitive improvement is safe for students (Females 11.4% vs. males 5.1%, p = 0.008). A significant association was observed between the profession of respondents and their attitude towards the CEs use. The pharmacists were more likely to negate that using CEs by the students is safe (pharmacists 10.8% vs. physicians 8.3%, p=<0.001), beneficial (pharmacists 12.7% vs. physicians 5.3%, p=<0.001), or necessary (pharmacists 17.6% vs. physicians 12.8%, p=<0.001). More than 50% of the respondents negated that the CEs use with a prescription or without a prescription is prevalent at universities. Pharmacists were more likely to negate that students utilize CEs on a regular basis at colleges either with a prescription (pharmacists 10.8% vs. physicians 6.0%, p = 0.006) or without prescription (pharmacists 12.5% vs. physicians 3.1%, p=<0.001). More than 65% of respondents were concerned that taking cognitive-enhancing medications, even if recommended by a doctor, will harm one's health. Pharmacists were more strongly concerned as compared to physicians or other HCPs that using CEs, even when authorized by a doctor, would harm one's health (pharmacists 21.6% vs. physicians 12.8% vs. other HCPs 4.7%, p=<0.001). The respondents having more working experience (11 years and more) negated that allowing university students with poor academic performance to utilize CEs is fair (p = 0.012), safe (p =<0.001), beneficial (p = 0.004) and necessary (p =<0.001). The major reasons affecting comfort levels of promoting CEs use by the respondents were fear of misuse (n = 510, 95.1%), safety concerns (n = 495, 92.3%) and their consideration for CE as unnecessary medical intervention (n = 441, 82.2%) (Figure 2).

Table 1. Characteristics of study population.

Baseline Characteristics	n (%)
Age (years)	
Mean ± SD	35.3 ± 7.2
Gender	
Female	359 (66.9)
Male	177 (33.0)
Profession	
Physicians	266 (49.6)
Pharmacists	102 (19.0)
Dentists	42 (7.8)
Nurses	16 (2.9)
Other HCPs	110 (20.5)
Work setting	
Private sector	189 (35.2)
Public sector	347 (64.7)
Experience	
1–5 years	154 (28.7)
6–10 years	165 (30.7)
11–15 years	164 (30.5)
16–20 years	32 (5.9)
>20 years	21 (3.9)

n = number of respondents.

3.4. Respondents' willingness to use a hypothetical prescription-only CEs

Respondents were inquired if they would themselves use a hypothetical prescription-only CE that has been demonstrated to be effective, has been approved by regulatory authorities and has no severe adverse effects. Of those who responded to the question, more than half of the respondents denied using a hypothetical CE, only (n = 106, 19.7%) of the respondents said they would. The respondents who showed their willingness were further asked the reason for their inclination to use CEs. Hypothetically, the causes they picked included improving focus (n = 21, 19.8%), increasing alertness (n = 28, 26.4%), relieving work-related pressure to perform better (n = 37, 34.9%) and experimenting (n = 13, 12.2%) whereas 7 respondents did not respond to the question. There were no significant inconsistencies between whether respondents had previously heard of a CE and their inclination to use a hypothesis CEs.

4. Discussion

The current study was conducted with the aim to explore the HCPs' views on the non-clinical usage of prescription stimulants and CEs were evaluated solely in connection to academic work among university students to help them in their academic studies. Over the last several years, there has been an increase in concern regarding the use of pharmaceutical CEs among university students throughout the world, with the

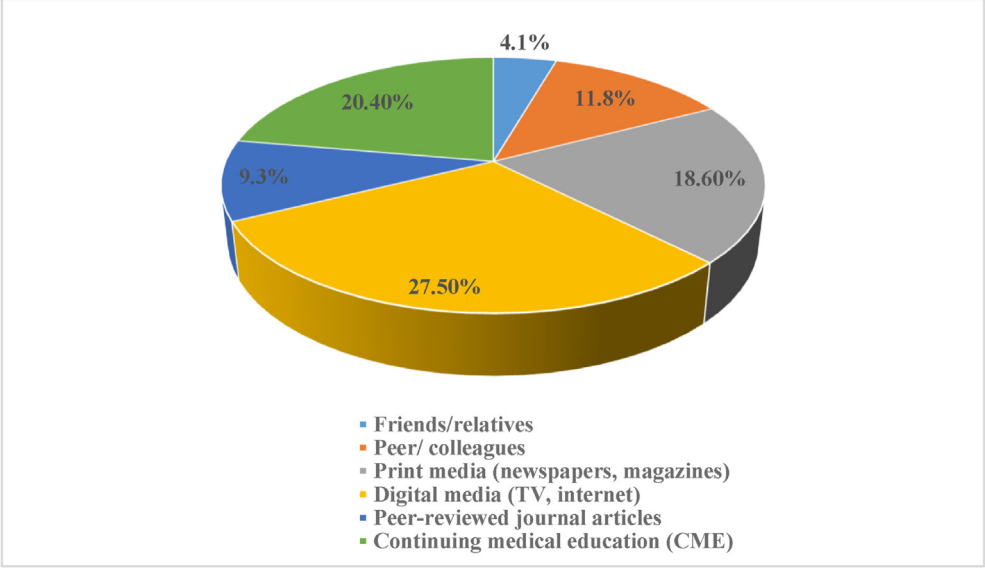

Figure 1. Respondents sources of information for cognitive enhancers (%).

Table 2. Respondents' attitude towards the use of cognitive enhancers (CEs) in academic setting.

Statement	Strongly agree	Agree	Neutral	Disagree	Strongly disagree	Gender	Profession	Experience	Work setting
Allowing university students with poor academic performance to utilize CEs for cognitive improvement is fair.	18 (3.3)	22 (4.1)	136 (25.3)	150 (27.9)	210 (39.1)		<0.001	0.012	<0.001
My colleagues think that students with a prescription should be able to take CEs as recommended by a doctor for cognitive enhancement.	12 (2.2)	230 (42.9)	122 (22.7)	118 (22.0)	54 (10.0)		0.002		
It is permissible for students who do not have a prescription to take CEs for any reason.	4 (0.7)	38 (7.0)	56 (10.4)	262 (48.8)	176 (32.8)	0.005	<0.001		0.004
It is acceptable for students who have a prescription to take CEs in excess or for purposes other than those authorized by a doctor.	2 (0.3)	50 (9.3)	52 (9.7)	244 (45.5)	188 (35.0)	0.041	<0.001		
It is ethical for students who do not have a prescription to take CEs to help them concentrate.	4 (0.7)	50 (9.3)	74 (13.8)	242 (45.1)	164 (30.5)			0.03	
It is permissible for students who do not have a prescription to take CEs to boost alertness/stability.	8 (1.4)	68 (12.6)	66 (12.3)	242 (45.1)	152 (28.3)		<0.001		
It is acceptable for students, with or without a prescription, to take CEs to mitigate the effects of other medications.	4 (0.7)	76 (14.1)	144 (26.8)	192 (35.8)	120 (22.3)		0.005		
I think that using CEs as recommended by a doctor for cognitive improvement is safe for students with a prescription.	30 (5.5)	268 (50)	108 (20.1)	78 (14.5)	52 (9.7)	0.008	<0.001	<0.001	
CEs, in my opinion, are beneficial for cognitive improvement.	14 (2.6)	186 (34.7)	228 (42.5)	74 (13.8)	34 (6.3)		<0.001	0.004	
CEs, in my opinion, are necessary for cognitive improvement.	6 (1.1)	74 (13.8)	140 (26.1)	244 (45.5)	70 (13.0)		<0.001	<0.001	
I think that students with a prescription for cognitive improvement utilize CEs on a regular basis at colleges.	10 (1.8)	104 (19.4)	138 (25.7)	250 (46.6)	34 (6.3)		0.006	0.002	
I believe that students using CEs without a prescription for cognitive improvement are prevalent at colleges.	24 (4.4)	128 (23.8)	134 (25)	218 (40.6)	32 (5.9)		<0.001	0.003	
I am concerned that using CEs for cognitive enhancement, even when authorized by a physician, would have a negative impact on one's health.	218 (40.6)	134 (25)	128 (23.8)	27 (5.0)	29 (5.4)		<0.001		

lifetime frequency of CEs abuse ranging from 6% to 20%, depending on the research subject (Kudlow et al., 2013). Research that examined the views of university students' parents and healthcare professionals about the use of CE found uncertainty and a lack of consensus about the frequency of CE usage among students (Miranda & Barbosa, 2021b). The present study explored the HCPs' knowledge, attitudes, familiarity with, and degree of comfort with using CE medicines in academic settings. The study found that the majority, 93.6% of respondents had an awareness of CE use, with methylphenidate being the most commonly recognized drug for CE. Though the majority graded their knowledge of CE usage in healthy individuals as either somewhat or not very knowledgeable. Similar findings were reported by another study in which 96% of the respondents had previously heard about the use of substances of any kind for CE mostly through friends, family, and colleagues (Franke et al., 2014). Contrary to this, another study reported that nearly half of the physicians were unaware of the matter of CE use, and only a small percentage were very familiar with the subject (Franke et al., 2014). The outcomes revealed that the comfort levels of respondents to letting the

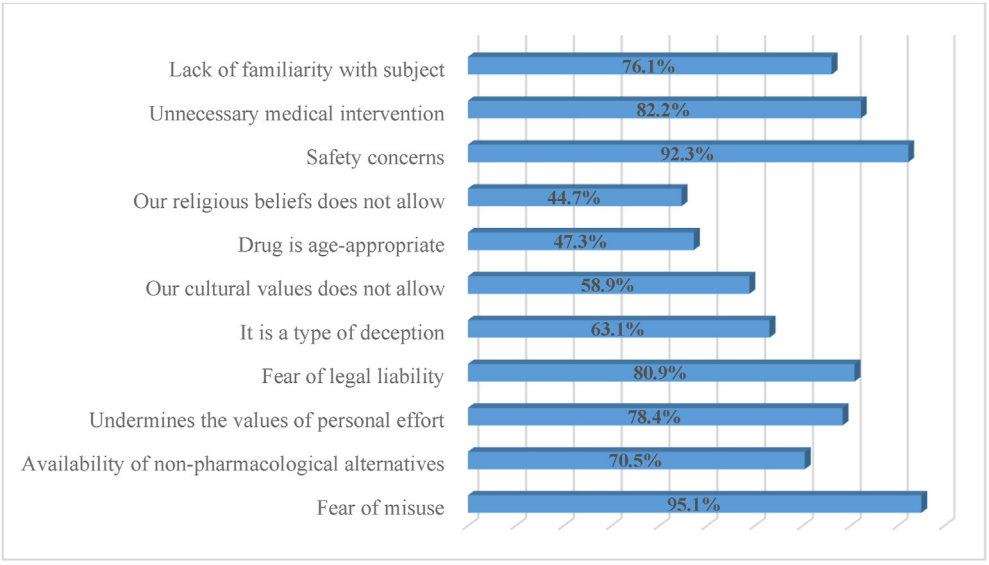

Figure 2. Major reasons affecting respondents' comfort levels of promoting CEs use (%).

students use CE drugs was low, and the key reasons reported were the fear of misuse of the CE, safety concerns, and their consideration for CE as a needless medical intervention. Similar finding were reported in another study depicting that the fear of misuse, the availability of non-pharmacological means of attaining the same aims, and the fact that individuals do not require the medicine were the most important factors influencing physicians' comfort levels when prescribing CE (Franke et al., 2014). Other studies likewise reported the respondents concerns about CE safety, which might explain their reluctance to prescribe enhancement medicines based on the risks that may befall otherwise healthy people (Forlini et al., 2013; Hotze et al., 2011). The findings of another study revealed the students' motivations for using CE for brain function augmentation and the legal considerations play a relatively little impact on them (Franke et al., 2012). Female respondents in the present study were less inclined to believe that taking CEs for cognitive enhancement is safe for students. Another study reported that males were two and a half times more likely to use CEs than females (McDermott et al., 2021).

The findings of the present study revealed that the majority of the respondents showed disagreement in allowing students to CEs use for intellectual improvement, concentration, increasing alertness/staying awake, or counteracting the effects of other drugs. Respondents showed reluctance on whether it is ethical to use CEs without a prescription for any purpose, and whether it is ethical for students with a prescription to use CEs in excess or for purposes other than those recommended by a doctor. These findings are parallel to another study depicting that healthcare practitioners were concerned about the fairness and social injustice that CE usage poses (Banjo et al., 2010). However, the present study contradicts the findings of another study reporting that parents and healthcare practitioners were ambivalent about using CE (Forlini and Racine, 2012). Pharmacists were more certain than other respondents that it is unethical for students to use CEs for any reason. Professional social and psychological variables may play a key influence in translating these attitudes toward CEs. Pharmacists, for example, tend to be more affiliated with the non-maleficent approach, with their key aim being to decrease the risk of harm, and so they may constantly choose a risk-averse strategy (Duffull et al., 2018).

In the current study, there is a clear consensus that using CEs is unfair; nevertheless, there is ambiguity about either it is appropriate to use CEs as recommended by a specialist and conflicting opinions are found on either using CEs as prescribed would harm one's health. In another study, the students have expressed confidence in the CEs safety because methylphenidate is a prescription medicine, not a recreational medication (Pighi et al., 2018). They consider it a safe medication that has undergone thorough testing by pharmaceutical firms as well as being prescribed by medical experts. Another study revealed the general practitioner views about the use of CEs were classified as rejectors, navigators, or acceptors, with majority of the respondents indicating comfort with optimizing students' skills (Petersen et al., 2019).

The understanding of CEs and their potential advantages are critical in deciding their utilization among users. It is observed that the individuals who thought CE use is morally and socially acceptable are more probable to utilize CEs (Racine et al., 2021). When respondents were inquired if they would use a hypothetical prescription-only CE that has been demonstrated to be effective, has been approved by regulatory authorities, and has no severe adverse effects, professionals' hypothetical readiness to utilize CEs (19.7%) was greater than the prevalence observed by students (Ram et al., 2021), although the motivations for use are the same for both professionals and students. Even if a hypothetical prescription CE was available, the majority of participants said that they would not take it. The hypothetical prevalence is greater than the lifetime prevalence (6.6%) recorded in one study (Ram et al., 2017), but it is within the range of 1.2%–34 % found among college students (Lengvenytė and Strumila, 2016; Miranda & Barbosa, 2021b; Ram et al., 2017; Riddell et al., 2018). The reasons mentioned for hypothetical usage were consistent with students' justifications for use including improving focus, increasing alertness, staying up lengthier, or performing better intellectually. It is acknowledged that the usage of CEs may expand outside the classroom and into the workplace as a result of work-related pressure to perform (Dinh et al., 2020; Ram et al., 2020). A variety of variables, including legal, societal, and ethical considerations might influence the availability of CEs for non-medical purposes in different nations (Mousavi et al., 2019). According to a study of surgeons conducted at five major conferences in 2011, 8.9 % of surgeons have used a prescription or illegal substance at least once as a CE in their careers (Franke et al., 2013). Furthermore, 1,400 people from 60 countries responded to Nature's informal online poll, 'Look who's doping.' It was stated that one in every five respondents had taken medications for non-medicinal reasons to aid concentration, improve attention, or memory (Maher, 2008).

It was reported in a study that a high number of primary care physicians have been asked to prescribe CE medicines by their patients, however, only a small proportion was fully informed about the potential of CE use (Franke et al., 2014). Another study reported that

several respondents perceived advantages from CEs, more than half were conversant with the potential side effects, and almost 40% experienced some negative consequences (McDermott et al., 2021). Some individuals experienced significant detrimental effects on their physiological and psychological well-being, clearly contradicting prior research indicating that CEs are safe drugs. The prevalence and negative character of side effects, such as sleeplessness and anxiety, could raise worries for the growing cohort of student users, especially in light of the student population's developing mental health difficulties (Mohamed, 2014).

As a preventative public health strategy, our findings emphasize the need of increasing awareness of the hazards of CE use, providing correct knowledge, revealing myths about "safe" CE use, and addressing cognitive enhancement at an early stage to decrease the negative, legal, and social consequences of drug use. CEs' usage might potentially be decreased if students' knowledge is enhanced, emphasizing that CEs' intake may represent a risk to safety, particularly in vulnerable persons. They should be informed that tolerance, dependency, withdrawal, cardiovascular and neurological problems, as well as a risk of mortality due to overdose, are all potential consequences of CE drug use (Hanna et al., 2018).

This study was the first one from Pakistan to report the HCPs' knowledge and attitudes about the usage of CEs in academic contexts. Furthermore, their inclination and potential motivating factors underlying a hypothetical CE usage were explored offering a better knowledge of the variables affecting their use. Universities must raise awareness of the frequency of CE usage among their students and consider adopting an active approach to decreasing it. This study should be of interest to universities since the potential increase in the use of stimulants for CE by students is a concern that both academic staff and student welfare services must address.

There are limitations to the present study; the data collection may be influenced by social desirability bias, underreporting, or a reluctance to divulge real opinions. Since the study includes the opinions of HCPs from a single city of Karachi, these findings may be difficult to generalize to the HCPs of other cities of Pakistan. It is difficult to compare hypothetical prevalence with self-reported usage since it is uncertain if self-reports of hypothetical usage would result in real use because self-reported data is reliant on memory and inclination to reveal. Because of the sensitivity of the issue and concern for confidentiality and privacy of reports, this study investigated hypothetical rather than actual use, and results may not reveal actual behaviors and views about CE use.

5. Conclusion

The study explored that the respondents believe that allowing students to utilize CEs for cognitive improvement is unethical, however, there is some disagreement regarding the safety and usage of CEs when recommended by a specialist. As a preventative public health strategy, our findings emphasize the need of increasing awareness of the hazards of CE use, providing correct knowledge, revealing myths about "safe" CE use, and addressing cognitive enhancement at an early stage to decrease the negative, legal, and social consequences of drug use.

Declarations

Author contribution statement

Sadia Shakeel: Conceived and designed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Wajiha Iffat: Conceived and designed the experiments; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Ambreen Qamar; Fareeha Butt; Faiza Ghuman: Performed the experiments; Contributed reagents, materials, analysis tools or data.

Imran Ahsan Mallick: Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data.

Anees ur Rehman: Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data.

Shazia Jamshed: Contributed reagents, materials, analysis tools or data; Wrote the paper.

Funding statement

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Data availability statement

Data will be made available on request.

Declaration of interests statement

The authors declare no conflict of interest.

Additional information

Supplementary content related to this article has been published online at https://doi.org/10.1016/j.heliyon.2021.e08118.

References

Arias-Hernandez, R., Green, T.M., Fisher, B., 2012. From cognitive amplifiers to cognitive prostheses: understandings of the material basis of cognition in visual analytics. Interdiscipl. Sci. Rev. 37 (1), 4–18.

Banjo, O.C., Nadler, R., Reiner, P.B., 2010. Physician attitudes towards pharmacological cognitive enhancement: safety concerns are paramount. PLoS One 5 (12), e14322.

Batistela, S., Bueno, O.F.A., Vaz, L.J., Galduróz, J.C.F., 2016. Methylphenidate as a cognitive enhancer in healthy young people. Dementia & Neuropsychologia 10, 134–142.

binti Suhaimi, F.A., binti Hussin, N., 2017. The influence of information overload on students' academic performance. Int. J. Acad. Res. Bus. Soc. Sci. 7 (8), 2222–6990.

Brühl, A.B., d'Angelo, C., Sahakian, B.J., 2019. Neuroethical issues in cognitive enhancement: modafinil as the example of a workplace drug? Brain Neurosci. Adv. 3, 2398212818816018.

Brunyé, T.T., Brou, R., Doty, T.J., Gregory, F.D., Hussey, E.K., Lieberman, H.R., Patton, D.J., 2020. A review of US Army research contributing to cognitive enhancement in military contexts. J. Cognit. Enhanc. 1–16.

Cohen, P.A., Avula, B., Wang, Y.H., Zakharevich, I., Khan, I., 2021. Five unapproved drugs found in cognitive enhancement supplements. Neurology: Clin. Pract. 11 (3), e303–e307.

Colaneri, N., Sheldon, M., Adesman, A., 2018. Pharmacological cognitive enhancement in pediatrics. Curr. Opin. Pediatr. 30 (3), 430–437.

d'Angelo, L.S.C., Savulich, G., Sahakian, B.J., 2017. Lifestyle use of drugs by healthy people for enhancing cognition, creativity, motivation and pleasure. Br. J. Pharmacol. 174 (19), 3257–3267.

Dinh, C.T., Humphries, S., Chatterjee, A., 2020. Public opinion on cognitive enhancement varies across different situations. AJOB Neurosci. 11 (4), 224–237.

Duffull, S.B., Wright, D.F., Marra, C.A., Anakin, M.G., 2018. A philosophical framework for pharmacy in the 21st century guided by ethical principles. Res. Soc. Adm. Pharm. 14 (3), 309–316.

Eack, S.M., Hogarty, S.S., Greenwald, D.P., Litschge, M.Y., Porton, S.A., Mazefsky, C.A., Minshew, N.J., 2018. Cognitive enhancement therapy for adult autism spectrum disorder: results of an 18-month randomized clinical trial. Autism Res. 11 (3), 519–530.

Elfferich, A., 2021. Social justice theories as the basis for public policy on psychopharmacological cognitive enhancement. Canadian Journal of Bioethics/ Revue canadienne de bioéthique 4 (1), 126–136.

Forlini, C., Gauthier, S., Racine, E., 2013. Should physicians prescribe cognitive enhancers to healthy individuals? CMAJ (Can. Med. Assoc. J.) 185 (12), 1047–1050.

Forlini, C., Racine, E., 2012. Stakeholder perspectives and reactions to "academic" cognitive enhancement: unsuspected meaning of ambivalence and analogies. Publ. Understand. Sci. 21 (5), 606–625.

Franke, A.G., Bagusat, C., Dietz, P., Hoffmann, I., Simon, P., Ulrich, R., Lieb, K., 2013. Use of illicit and prescription drugs for cognitive or mood enhancement among surgeons. BMC Med. 11 (1), 1–9.

Franke, A.G., Bonertz, C., Christmann, M., Engeser, S., Lieb, K., 2012. Attitudes toward cognitive enhancement in users and nonusers of stimulants for cognitive enhancement: a pilot study. AJOB Prim. Res. 3 (1), 48–57.

Franke, A.G., Lieb, K., Hildt, E., 2012. What users think about the differences between caffeine and illicit/prescription stimulants for cognitive enhancement. PLoS One 7 (6), e40047.
Franke, A.G., Papenburg, C., Schotten, E., Reiner, P.B., Lieb, K., 2014. Attitudes towards prescribing cognitive enhancers among primary care physicians in Germany. BMC Fam. Pract. 15 (1), 1–10.
Green, C.S., Bavelier, D., Kramer, A.F., Vinogradov, S., Ansorge, U., Ball, K.K., Edwards, J.D., 2019. Improving methodological standards in behavioral interventions for cognitive enhancement. J. Cognit. Enhanc. 3 (1), 2–29.
Hanna, L.-A., Rainey, J., Hall, M., 2018. A questionnaire study investigating future pharmacists' use of, and views on cognitive enhancers. Pharm. Educ. 18, 76–84.
Hotze, T.D., Shah, K., Anderson, E.E., Wynia, M.K., 2011. "Doctor, would you prescribe a pill to help me…?" A national survey of physicians on using medicine for human enhancement. Am. J. Bioeth. 11 (1), 3–13.
Kudlow, P.A., Treurnicht Naylor, K., Xie, B., McIntyre, R.S., 2013. Cognitive enhancement in Canadian medical students. J. Psychoact. Drugs 45 (4), 360–365.
Lanning, S., Mallek, J., 2017. Factors influencing information literacy competency of college students. J. Acad. Librarian 43 (5), 443–450.
Lengvenytė, A., Strumila, R., 2016. Do medical students use cognitive enhancers to study? Prevalence and correlates from Lithuanian medical students sample. Eur. Psychiatr. 33 (S1). S304-S304.
Lengvenyte, A., Strumila, R., Grikiniene, J., 2016. Use of cognitive enhancers among medical students in Lithuania. Nord. Stud. Alcohol Drugs 33 (2), 173–188.
Maher, B., 2008. Look who's doping. Poll results. Nature 452, 674–675.
Maier, L.J., Ferris, J.A., Winstock, A.R., 2018. Pharmacological cognitive enhancement among non-ADHD individuals—a cross-sectional study in 15 countries. Int. J. Drug Pol. 58, 104–112.
McDermott, H., Lane, H., Alonso, M., 2021. Working smart: the use of 'cognitive enhancers' by UK university students. J. Furth. High. Educ. 45 (2), 270–283.
Miranda, M., Barbosa, M., 2021a. Use of cognitive enhancers by Portuguese medical students: do academic challenges matter? Acta Med. Port. 34 (13).
Miranda, M., Barbosa, M., 2021b. Use of cognitive enhancers by Portuguese medical students: do academic challenges matter? Estratégias de Aprimoramento cognitivo em estudantes de Medicina portugueses: qual a relevância dos desafios académicos? Population 7, 8.
Mohamed, A.D., 2014. Reducing creativity with psychostimulants may debilitate mental health and well-being. J. Creativ. Ment. Health 9 (1), 146–163.
Mousavi, F., Shojaei, P., Pourgholami Markeh, H., 2019. The use of cognitive enhancers among medical students. Int. J. High Risk Behav. Addiction 8 (2).
Omair, A., 2014. Sample size estimation and sampling techniques for selecting a representative sample. J. Health Specialties 2 (4), 142.
Petersen, M.A., Ølgaard, L.J.L.-D., Nørgaard, L.S., 2019. Contextualizing study drugs-An exploratory study of perceptions and practices among study counselors, general practitioners, psychiatrists and from student polls. Res. Soc. Adm. Pharm. 15 (10), 1204–1211.
Pighi, M., Pontoni, G., Sinisi, A., Ferrari, S., Mattei, G., Pingani, L., Galeazzi, G.M., 2018. Use and propensity to use substances as cognitive enhancers in Italian medical students. Brain Sci. 8 (11), 197.
Racine, E., Sattler, S., Boehlen, W., 2021. Cognitive enhancement: unanswered questions about human psychology and social behavior. Sci. Eng. Ethics 27 (2), 1–25.
Ram, S., Hussainy, S., Henning, M., Stewart, K., Jensen, M., Russell, B., 2017. Attitudes toward cognitive enhancer use among New Zealand tertiary students. Subst. Use Misuse 52 (11), 1387–1392.
Ram, S., Russell, B., Kirkpatrick, C., Stewart, K., Scahill, S., Henning, M., Hussainy, S., 2020. Professionals' attitudes towards the use of cognitive enhancers in academic settings. PLoS One 15 (11), e0241968.
Ram, S., Russell, B.R., Stewart, K., Kirkpatrick, C., Henning, M., Scahill, S., Hussainy, S., 2021. Psychiatrists' attitudes towards and willingness to prescribe cognitive enhancers in academic settings. Drugs Educ. Prev. Pol. 28 (1), 59–66.
Riddell, C., Jensen, C., Carter, O., 2018. Cognitive enhancement and coping in an Australian university student sample. J. Cognit. Enhanc. 2 (1), 63–69.