Behavioral and Psychosocial Context of Pharmaceutical Cognitive Enhancers` Mistuse

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Research Article

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Abstract

Background

In an effort for better memory, greater motivation and concentration, otherwise healthy individuals use Pharmaceutical Cognitive Enhancers (PCE), medicines for the treatment of cognitive deficits of patients with various disorders and health problems, to achieve greater productivity, efficiency, and performance.

Methods

In our study, we examined the use of PCE among 289 students at the Slovenian Faculty of Electrical Engineering and Computer Science in the behavioral and psychosocial context (students’ attitudes towards study, parents, health, leisure time and work). Furthermore, we addressed also the immediate reasons, or the hypothesized connections of behavioral and psychosocial aspects, related to PCE misuse. The study consisted of a structured questionnaire, and the chi-square tests were used.

Results

An analysis of student statements revealed differences in students and parents attitudes toward good academic grades. In addition, students chose among 17 values relating to relationships with parents, friends, partners, careers, study obligations, leisure, hobbies, material goods, appearance and the future, and assessed their importance. Regardless of the group they belonged to, young people cited the same values among the most important. Good grades and parental opinions have proven to be key factors in the context of PCE abuse.

Conclusions

This research was the first study to examine the relation between PCE misuse and the role of different behavioral and psychosocial factors. However, the further research is needed, both on the actual effects of PCE on healthy people, as well as on continuing research towards behavioral and psychosocial factors.

Background

Pharmaceutical Cognitive Enhancers (PCE), or nootropics, an umbrella term that refers to cognitive-enhancing smart drugs, stimulants, supplements and other substances [1], are regulated prescription medicines which can improve or reduce the risk of disease in people with certain impairments or diseases. They were developed to treat cognitive dysfunction [2], nY, and are prescribed for the treatment of several disorders, including narcolepsy, sleep disorder, Attention Deficit Hyperactivity Disorder (ADHD), schizophrenia [3], Alzheimer’s disease [4], dementia [5], etc. Most often, methylphenidate (Ritalin, Concerta), mixed amphetamine salts (Adderall), modafinil [6] and armodafinil (Provigil, Modiodal), piracetam (Oxiracetam, Braintst) and others, racetams, diazepam, alprazolam, etizolam, lorazepam, efradrin, sertraline, fluoxetine, atomoxetine, morphine, oxycodone, bupropion, pyritinol (Encephabol), dihydroergocornine (Hyderg, Redergin), cinnarizine (Stugeron), xantinol-nicotinate (Complan) and Meclofenoxate (Lucidril) are mentioned. When used by healthy people with no specific disorders or diseases, nootropics, or PCE, can affect strengthening or improving the state of cognitive abilities, such as enhancing learning, memory [7], attention, concentration and raising of alertness. According to Stein (2012), so-called “smart pills” will be used to promote learning and clarify thinking, “happy pills” to increase mood and improve temperaments, and “pep pills” to increase energy and maximize motivation [8].

PCE prevalence estimates in different EU Member States range from 0.8–16%, depending on different factors, for example, country, field of work, university, type and purpose of the used drug [9, 10, 11, 12, 13]. In a 2008 study of Nature Magazine, 20% of 1,400 participants responded that they already used PCE as a cognitive enhancer [14]. Among German business newspaper users, the lifetime use of any drug for neuroenhancement was 88% [15]. 5% of employees in a German insurance company used PCE to enhance productivity or their mood [16]. In a survey of 1,145 surgeons attending an International Conference, 8,9% of them used PCE or drugs for cognitive enhancement [9].

Abuse of PCE is more common in occupations with emphasized cognitive abilities, and in workplaces where employees are required to pay more attention, focus and alertness - these are occupations where night, shift or extended work is present, work associated with intense intellectual work, high responsibility and stress. Thus, PCE use is more likely to occur among surgeons, nurses, pilots, air traffic controllers, firefighters, soldiers, drivers, and other occupational groups [17]. Comprehensive studies on the actual prevalence between occupational groups have not yet been carried out [18]. Due to the lack of empirical research, the motivations for the use of PCE among employees can be speculated based only on broader social and work trends and research among student populations. On the one hand, it is undoubtedly encouraged by competition and the desire for success of the individual, and, on the other hand, it depends on socio-economic factors and conditions and requirements in individual professional groups [19]. Finally, use is also associated with the general working population, which is supposed to use them to alleviate the effects of sleep deprivation and to cope with rising workloads [20].

The problem is more pronounced, especially in the student environment, as enhancing learning, memory, motivation, and concentration are important advantages in a highly competitive student environment. The use of PCE among students does not usually serve as an aid to those who are already achieving a higher study average and would like to improve it further [21, 22]. It is more common among those who abuse alcohol and illicit drugs, especially marijuana [9, 101, 11, 20, 23, 24]. The proportion of users is higher among senior students [12, 25], and more frequent in educational institutions with more demanding admission criteria and study requirements [21, 26]. Students use PCE because they believe they are an effective tool in study, and also for non-academic purposes [27, 28]; improve focus / concentration and performance, improve memory and wakefulness, improve sleep, reduce anxiety and fear, improve
thinking, and for recreational reasons - such as experimentation and increasing creativity [10, 19, 29, 30]. An important role in the student use of PCE is also played by parents, who, in many cases, are supposed to be aware that they enjoy it, even to support or encourage them [24, 31]. As Mehlman [31] writes, to improve cognitive abilities, parents should give PCE to their children intentionally. Diller [32] wrote about ritalin, which was given to children by ambitious parents, even on the recommendations of teachers who wanted more order in the classrooms. Similarly, Farah et al. [33] adds that the use of ritalin for this purpose is already evident in the number of users among children, which, in some school districts, exceeds the average number of patients with ADHD for whom the drug is prescribed.

These are indirect reasons for PCE misuse, already covered by existing studies. In our research, we are addressing the immediate reasons, or the hypothesized connections of behavioral and psychosocial aspects, related to PCE misuse, which has not been researched in any study so far.

In our research we developed the following research questions:

RQ1: What are the most important psychosocial factors among students’ PCE users?

RQ2: What is the attitude among PCE’s users towards study, and what is the role of their parents?

RQ3: Does the attitude towards psychosocial values differ from students who are users of PCE compared to other students?

Methods

Participants and procedures

The sample consisted of 289 students (39% female, 122; and 61 % male; 167) of the Faculty of Electrical Engineering and Computer Science in Maribor, Slovenia, with an age range from 18 to 34 years (M = 18, SD = 2.82). Due to the importance of students’ relationships with their parents, we obtained some data about parents as well. Among these participants’ parents, 58% (168) of the fathers and 45 % (130) of the mothers obtained a High School level of education or below, and 38 % (110) of the fathers and 41 % (119) of the mothers received an Graduate Degree or above. The others did not want to answer about the level of education of their parents.

Students were informed that their responses to questionnaires would be kept anonymous and confidential, and the collected data would be used for academic research only. It took approximately 15 min to complete the questionnaires. The students participated in the survey on a voluntary basis and were not compensated for their participation.

Measures

The survey on the use of cognitive enhancers consisted of a structured questionnaire. It was conducted in paper-and-pencil form during random class hours, in agreement with the Lecturer, who distributed and collected the surveys in the last half of 2019. Surveys were filled out by 289 students of the Faculty of Electrical Engineering and Computer Science in Maribor, Slovenia. Exclusion criteria were self-reported medical conditions of students with a prescription for PCE.

The survey questionnaire consisted of questions with closed answers, first regarding the level of agreement with statements about different psychosocial factors. The survey collected demographic data, including date of birth, gender, and the highest level of parental education.

The main purpose of the study was to explore the psychosocial and behavioral factors among PCE student users. We defined »smart drugs« for participants, and asked about potential use of PCE and the details of their experiences, which was filled out only by those who had already used PCE. Subjects had to mark substances they had used for cognitive enhancement with substrate and trademark names. The questionnaire also contained space to add further substances.

Next, we addressed the behavioral and psychosocial context with questions about students’ attitudes towards study, parents, health, leisure time and work; for instance, their competitiveness, desire for success, demands of parents, learning habits, attitude to academic grades, sleeping and eating habits, and leisure activities.

The questionnaire included a set of 32 statements, applying to:

- the attitude towards grades: How important are grades to students’ parents, how much effort students put into them, how much time they devote to learning, how and when they learn, what their personal beliefs are about the importance of good grades, and the impact of grades on the amount of pocket money,

- the importance of students’ grades in comparison to their friends, careers, leisure activities and other obligations, and sports,

- how healthy they are: Adequate and quality sleep, nutrition, exercise, relaxation, concentration and memory, and

- their attitude towards studies: Whether they find it challenging, boring, stressful, diverse or energy intensive.

Furthermore, students assessed 17 values related to relationships with parents, friends, partners, careers, study obligations, leisure, hobbies, material goods, appearance and their future, and assessed their importance.

Results
A total of 289 students signed the informed consent to participate, and completed the survey. 273 surveys were completed correctly. 3 persons were excluded from participating in the study due to their medical condition, as they had been prescribed PCE by psychiatrists. 270 students met all the criteria for inclusion in the study. The mean age of these was 21 (±/− 2.28) years.

4.8% (13) of the respondents confirmed that they had already used a prescription medicine that had not been prescribed for any disorder in order to improve their cognitive abilities. Mostly in order to improve focus, but the desire for creativity and alertness follows. The most commonly misused substances were, modafinil and armodafinil, which are among the most commonly used. (83%, 11%). 31% (4) purchased PCE from another person or from a foreign website (23%; 3).

The information that 46% (6) did not plan to misuse PCE anymore is reassuring, but 38% (5) had not yet decided about this. There was also a low proportion of those who would recommend it to others – only 15% (2). 69% (9) were aware that PCE is most likely to harm them, and 58% (7) said they should not be freely accessible.

Respondents were sorted into four groups: Those who had never heard about PCE (Group A), heard about it (B), knew someone who had tried PCE (C), or those who had tried PCE themselves (D). Such distribution of participants gave us a broader insight into students’ attitudes toward good grades and learning habits. There were no statistically significant differences in the analysis of other statements.

Grades had been identified to be associated positively with PCE misuse. The comparison of the groups showed the differences regarding the importance of good grades for their parents, and the importance of good grades to become what students want (Table 1).

Those who had heard of PCE felt that grades are more important to their parents.

When deciding for PCE misuse, parents’ attitude to grades also seemed to be important. Students who had heard of PCE consider the grades to be very important for their parents (compared to those who did not know PCE). Compared to those who had already tried PCE, students who had heard of PCE were more in favor of the claim that only with good grades can they become what they want (Table 2).

Differences between groups were also reflected in the students’ position on learning habits – learning during night time. Differences occurred between groups who were unfamiliar with PCE (who rarely learned at night), compared to students who had already tried PCE (Table 3).

Furthermore, students chose among 17 values relating to relationships with parents, friends, partners, careers, study obligations, leisure, hobbies, material goods, appearance and future, and assessed their importance. Regardless of the group they belonged to, young people cited the same values among the most important. Those who ranked love among the three most important factors placed it in the first place, regardless of the group to which they belonged. Those who had already tried PCE ranked love in a smaller proportion in the first place.

Students ranked their parents’ praise first or second if this value was important to them. None of them were from the group that had already tried PCE. Parental praise was most important to those who had not heard of PCE, but this difference did not prove statistically significant for further analysis.

Academic grades for students who had already heard of PCE, who knew someone who was taking it, or had already tried it on their own, appeared mostly in the first place, while those who had not heard of PCE, in most cases, ranked it in second place in importance. Although the observed differences proved to be statistically insignificant, they complement our findings significantly.

Students who valued consideration of their parents mostly put this value in 2nd place if they haven't heard of or known about PCE, in 3rd place if they knew someone who had already tried PCE, and in first place if they had tried them themselves. The observed differences between the groups did not prove to be statistically significant after further tests.

Students who care about not being bored ranked this value second in most groups (except for the group who knew someone taking PCE; in this group, the value was distributed evenly in 1st and 2nd places). Further analyses showed that the differences between the groups were not statistically significant.

Among students who valued hobbies and hobby activities highly, all groups ranked the latter in second place in most cases. Young people who ranked money among the three most important values, ranked the latter in most cases, regardless of the group to which they belonged. Few respondents ranked other material goods among the most important values; these, however, mostly covered second place. Sport, as an important factor, was ranked second in most cases.

No participant from the group who knew anyone taking PCE ranked appearance among the most important values. The number of young people for whom appearance was important was small; those unfamiliar with PCE mostly ranked it 2nd, those who had heard of PCE ranked it first, and those who had already tried PCE ranked it third. Differences between groups were not statistically significant.

Students who identified family relationships as an important factor in their lives, put them in second place in most cases, except in the group that had already tried PCE, and the problems took first place in the ranking. The chi-square test showed that there were no statistically significant differences between the groups.

The feeling of freedom and exits, in most cases, found themselves in 3rd place in terms of importance of factors. They were ranked higher by young people who did not know, or had only heard of PCE. The chi-square test showed that there were no statistically significant differences between the groups.
The possibility of employment was mostly ranked 3rd as an important factor in life (it appeared in 1st place only in the group that did not know PCE). The chi-square test showed that there were no statistically significant differences between the groups.

In the vast majority of cases, the future was ranked 3rd among young people who ranked it among the most important factors. It was ranked 1st only in the group that had already heard of PCE. The Chi-square test showed that there were no statistically significant differences between the groups.

We were also interested in the attitude towards illicit drugs. Those who had already tried PCE use marihuana often, and cocaine occasionally, while other drugs were present to a lesser extent (see also Vicario et al., 2020). The same students also consumed alcohol and smoked cigarettes more often.

In our research we followed the following research questions:

RQ1: What are the most important psychosocial factors among students PCE users? An analysis of 32 statements revealed differences in students and parents attitudes toward good grades and learning habits. There were no statistically significant differences in the analysis of other statements.

RQ2: What is the attitude among PCE users towards study, and what is the role of their parents? Academic grades had been identified to be associated positively with PCE misuse. The comparison of the groups showed the differences regarding the importance of good grades for their parents, and importance of good grades to become what students wanted. Those who had heard of PCE felt that grades were more important to their parents. When deciding for PCE misuse, parents’ attitudes towards grades also seemed to be important. Students who had heard of PCE considered the grades to be very important for their parents (compared to those who did not know PCE). Compared to those who had already tried PCE, students who had heard of PCE were more in favor of the claim that only with good grades can they become what they want. Differences occurred between groups were also reflected in the students’ position for learning habits – learning during the night time. Differences occurred between groups who were unfamiliar with PCE (who rarely learned at night), compared to students who had already tried PCE.

RQ3: Does the attitude towards psychosocial values differ from students who are users of PCE compared to other students? Students chose among 17 values relating to relationships with parents, friends, partners, careers, study obligations, leisure, hobbies, material goods, appearance and future, and assessed their importance. Regardless of the group they belonged to, young people cited the same values among the most important.

**Discussion And Conclusion**

This study examined the role of different behavioral and psychosocial factors (important are moral beliefs, attitudes and values [34], as predictors of student PCE misuse.

Good academic grades and parents’ opinions about them have proven to be among key factors in the context of PCE misuse. Findings were consistent with the conclusion of Li [35], who pointed out academic pressure as one of main sources of personal life pressure for adolescents. It seems PCE is not an academic shortcut for those who want to achieve better results, which our findings suggest. PCE users have a lower grade point average [22, 36]. Users of PCE have a history of heavy alcohol use and illicit drug involvement [10, 12, 21, 23, 24, 37], as also proved by our study. Perhaps also as a result of heavy drinking and drug misuse, students who engage in NPS for study purposes appear to be struggling academically [24, 37]. PCE misuse is also related to a higher level of stress or perceived pressure to perform [10, 21]. PCE misuse can be predicted in schools with overwhelming demands**, in institutions with more competitive admission criteria [26], and for students nearing the end of an undergraduate degree course or at postgraduate level [12, 23].

The results of this study should be interpreted in the light of some limitations. The study suggests that different behavioral and psychosocial aspects need to be considered within the PCE misuse research. Although a variety of behavioral and psychosocial predictors were included, other predictors could be tested as well, such as empathy, moral reasoning, creativity, and motivation [38]. The sample in this study was limited to a particular Faculty. The number of included students was too small to generalize their views on PCE misuse in general.

This research was the first study to examine the relation between PCE misuse and the role of different behavioral and psychosocial factors. The PCE misuse context remains relatively unexplored, and refers mainly to connections with academic success, history of alcohol use and illicit drugs, demographic characteristics, parental attitudes toward PCE, and competitive admission criteria in friendship. Regarding a better understanding of the trend, according to Tomazić and Kovačić [18], it is important to recommend that further research is needed, both in terms of the actual PCE’s neurophysiological effects, and the prevalence and socio-cultural specifics of their use by different populations of individual national environments. According to Bartolato [6], we suggest an additional study to investigate the effects of modafnil in remediating cognitive dysfunction in major depressive disorder.

**Declarations**

**Ethics approval and consent to participate**

All methods were carried out in accordance with relevant guidelines and regulations.

**Consent for publication**

An ethical statement to confirm that all experimental protocols were approved: 038-19-109/2021/3/FFUM.

**Availability of data and materials**

The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.
**Competing interests**

The authors declare that they have no competing interests.

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**Authors’ contributions**

TT drafted the manuscript and both authors contributed to the final manuscript. Both authors read and approved the final manuscript.

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**Tables**

**Table 1** Students’ attitude to academic grades.
| GROUPS | My grades are very important to parents | Only with good grades can I become what I want to be |
|--------|----------------------------------------|--------------------------------------------------|
| A      | N Valid 109                           | 110                                             |
|        | Missing 3                             | 2                                               |
|        | Mean 3.17                              | 2.34                                            |
|        | Std. Deviation 1.113                   | 1.229                                           |
|        | Minimum 1                              | 1                                               |
|        | Maximum 5                              | 5                                               |
| B      | N Valid 80                             | 80                                              |
|        | Missing 3                             | 3                                               |
|        | Mean 3.69                              | 2.56                                            |
|        | Std. Deviation 1.001                   | 1.135                                           |
|        | Minimum 1                              | 1                                               |
|        | Maximum 5                              | 5                                               |
| C      | N Valid 36                             | 37                                              |
|        | Missing 1                             | 0                                               |
|        | Mean 3.31                              | 2.27                                            |
|        | Std. Deviation 1.215                   | 1.239                                           |
|        | Minimum 1                              | 1                                               |
|        | Maximum 5                              | 5                                               |
| D      | N Valid 9                              | 13                                              |
|        | Missing 4                             | 0                                               |
|        | Mean 2.78                              | 1.62                                            |
|        | Std. Deviation 1.302                   | .650                                            |
|        | Minimum 1                              | 1                                               |
|        | Maximum 5                              | 3                                               |

**Table 2** Association of good academic grades and PCE misuse.

| Groups | N | Mean Rank | Sum of Ranks |
|--------|---|-----------|--------------|
| To what extent do you agree: Only with good grades can I become what I want to be |
| B      | 80 | 50.16     | 4013.00      |
| D      | 13 | 27.54     | 358.00       |
| Total  | 93 |           |              |

**Table 3** Students position for learning habits.
| GROUPS          | N    | Minimum | Maximum | Mean  | Std. Deviation |
|-----------------|------|---------|---------|-------|----------------|
| A               | 111  | 1       | 5       | 2.72  | 1.363          |
| Valid N (listwise) | 111  |         |         |       |                |
| B               | 81   | 1       | 5       | 3.05  | 1.303          |
| Valid N (listwise) | 81   |         |         |       |                |
| C               | 37   | 1       | 5       | 3.16  | 1.344          |
| Valid N (listwise) | 37   |         |         |       |                |
| D               | 12   | 1       | 5       | 3.83  | 1.337          |
| Valid N (listwise) | 12   |         |         |       |                |