

The Illicit Methylphenidate Use among College Students: Prevalence, Patterns, and Associated Factors

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Abstract

Introduction: Methylphenidate, as an indirect dopamine agonist, has a high potential for illicit use among college students. The current study was designed and conducted to assess the prevalence, patterns, and factors associated with the illicit methylphenidate use. **Materials and Methods:** In this cross-sectional study, 900 college students from the six major cities of Iran were selected using the multi-stage sampling method from June 2019 to December 2019 and were evaluated using the researcher-made information forms 1 and 2, symptom checklist 90, and adult ADHD self-report scale. **Results:** 261 participants reported oral illicit methylphenidate use, and only 10% of them were not diagnosed with ADHD. The most common cause of methylphenidate illicit use was improved concentration and academic performance (78.2%) and most participants got access to methylphenidate through friends and acquaintances (64.4%). Logistic regression analysis showed that marital status, education level, awareness of the legal consequences of illicit methylphenidate use, substance/medication use, history of mental health counseling, less-stigmatized attitudes towards mental illness and mental health could predict the illicit methylphenidate use. **Conclusion:** Considering the important role of friends and acquaintances in the supply of illegal methylphenidate, focusing on college students with ADHD and reducing their monthly allocation of methylphenidate is an effective intervention to control the illicit methylphenidate use. Moreover, improved awareness of the legal consequences of the illicit methylphenidate use, and periodic psychiatric visits to improve the mental health of college students will reduce the illicit methylphenidate use.

Keywords: Methylphenidate, Illicit use, College students

INTRODUCTION

Although some college students need psychiatric medications, some of them may illicitly use these medications. It is stated that some people think of psychiatric medications as performance-enhancing drugs that may be used to confront serious psychiatric symptoms, improve productivity, efficiency, and relaxation. Based on the National survey reports on Drug use and health in 2006, nearly one-third of 18 to 25 years old people have used prescription drugs illicitly.^[1] For example, methylphenidate as an indirect dopamine agonist has high potential for illicit use because of its effect on dopamine signaling in the amygdala, nucleus accumbens, ventral striatum, and prefrontal cortex. This drug can recuperate major symptoms of attention deficit hyperactivity disorder (ADHD) in 70% of children and adults by increasing dopamine concentration in the synaptic cleft.^[2] Yet, some people who are not suffering from ADHD illicitly use methylphenidate to control weight, sleeplessness, increased energy, improved concentration and educational, occupational, or athletic performance.^[3, 4] In this regard, the youth, especially high school and college students aging 18 to 25 years, are more

prone to illicitly use methylphenidate^[5, 6] with a reported prevalence ranging from 1.5 to 35 percent in different studies.^[3, 7-11] This group often uses methylphenidate to improve concentration and awareness in long exam sessions^[12-14] and sometimes for recreational use.^[15, 16] Yet, the illicit methylphenidate use is more often reported among students

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with substances/medications use^[12] which seems to be a compensatory fashion to improve their sub-standard academic performance.^[11] Recent studies reported oral, inhalant, and even intravenous methylphenidate administration among illicit users^[16, 17] which may be associated with dry mouth, anorexia, mood lability, jitteriness, depression, weight loss, dizziness, and other side effects.^[18-20] Additionally, previous studies on college students showed that methylphenidate illicit use may be related to some demographic factors such as age, gender, residence, marital status, years in college, awareness of methylphenidate side effects, legal consequences of illicit methylphenidate use,^[11, 21, 22] undiagnosed ADHD,^[10, 11, 23] mental health and less-stigmatized attitudes toward mental illness.^[1] In this regard, Habibzadeh et al evaluated 310 medical students in Iran from 2000 to 2007.^[21] They reported that contrary to their assumption, awareness of methylphenidate side effects is higher in illicit users compared with other college students. They also reported that men are more prone to illicit methylphenidate use compared to women (92% vs. 8%). No significant difference was observed between single and married college students. In Jain et al study, one-third of students with illicit methylphenidate use was undiagnosed ADHD cases.^[11] Moreover, students with illicit methylphenidate use were more aware of the side effects and less aware of the legal consequences of illicit methylphenidate use. On the other hand, Steven et al study proved that the mental illness-related stigma is associated with illicit drug use, which is to say, less-stigmatized attitudes toward psychiatric disorders may be associated with a higher risk of illicit drug use.^[1] Considering the findings of the mentioned studies, we tried in the present study to not only assess the prevalence, patterns, and the associated factors with the illicit methylphenidate use among college students, but also the etiology of this growing phenomenon, detect age groups at risk and predictors of illicit methylphenidate use among the more vulnerable group of the society.

MATERIALS AND METHODS

Study Design and Participants

In this cross-sectional study, 990 students from six major cities of Iran were selected using the multi-stage sampling method from June 2019 to December 2019. Considering the 8.7% prevalence of illicit methylphenidate use among college students and error level of 2% and confidence level of 95%, the calculated sample size was 762, which was to be increased to 990, assuming 30% risk of participant loss.^[21] Additionally, as for the inability to participate in the study, inappropriately filling the questionnaire was considered as the exclusion criteria for the study.

Measures

Information forms 1 and 2

These forms were self-reported anonymous questionnaire which was designed based on the clinical experience of the

study leader and the information obtained from relevant literature.^[6, 11, 21] Information form 1 included questions about age, gender, marital status, residence, income, level of education, and class. Information form 2 consisted of questions regarding level of awareness about the complications of illicit methylphenidate use, awareness of the legal consequences of illicit methylphenidate use, history of other substances/medications use, history of mental health counseling, attitude toward mental illness, history of illicit methylphenidate use, average daily consumption of methylphenidate (at each consumption), frequency of illicit methylphenidate use, age at first illicit methylphenidate use, methylphenidate consumption route, reasons for illicit methylphenidate use, side effects, and supply method. In a pilot study, 25 first-year medical students and 25 second-year medical students were randomly asked to answer information form 2. After this pilot study, some questions were rephrased for clarity and additional options were added to the questions to reassure that all possible choices were covered. Notably, the information of the pilot study did not enter the analysis process.

Symptom Checklist-90 (SCL-90)

This survey includes 90 items with a Likert 5-point scale, which assesses depression, anxiety, somatic, OCD, interpersonal sensitivity, hostility, phobic anxiety, paranoia, and psychotic subscales. The score of this scale ranges from 90 to 450. The reliability and validity of this scale are accepted in Iran (Cronbach's alpha 0.89).^[24]

Adult ADHD Self-Report Scale (ASRS)

This scale consists of inattention (questions 1 to 9) and hyperactivity/impulsivity (questions 10 to 18) with a Likert 5-point scale, which is compatible with DSM-5 criteria. The sensitivity and specificity of this scale in diagnosing adult ADHD symptoms were reported to be 96, and 98.3 to 99.5% respectively. The reliability and validity of the scale are accepted in Iran (Cronbach's alpha of 0.89 for inattention, and Cronbach's alpha of 0.87 for the hyperactivity scale). The cutoff score for severe adult ADHD is 50 from the summation of both parts.^[25]

Statistical Analysis

The descriptive Statistical method was used for data evaluation and the Kruskal-Wallis test and chi-square test were used for comparison between different groups. Binary logistic regression analysis was used to investigate the role of study variables in the prediction of the illicit methylphenidate use. Data Analysis was performed in SPSS software ver. 25 and the significance level was set below 0.05.

Ethical Considerations

The Research Ethics Committee of Zahedan University of Medical Sciences with IR.ZAUMS.REC.1398.155 code has evaluated this study. In compliance with the Helsinki declaration, an informed consent form was prepared and

signed by all the participants. In this study, participation was voluntary and participants could leave the study for any reason. Questionnaires were anonymous for the privacy of the participants.

RESULTS

In this study, 900 college students (411 men and 489 women) filled out questionnaires. Table 1 presents the demographic information of the participants and ADHD prevalence. Tables 2 and 3 compare the frequency of illicit use, average daily dose, and age at first illicit methylphenidate use based on demographic information and ADHD using the Kruskal-Wallis test. Based on these tables, 261 students (29%) reported the illicit methylphenidate use, which was significantly more common among students aged 24 or above ($\chi^2 = 6.029$, $df = 1$, $p < 0.05$), single students ($\chi^2 = 31.677$, $df = 1$, $p < 0.001$), students living away from their families ($\chi^2 = 10.193$, $df = 1$, $p < .01$), students with low income (below \$100) ($\chi^2 = 4.186$, $df = 1$, $p < .05$), non-doctoral students ($\chi^2 = 59.283$, $df = 1$, $p < 0.001$), an upperclassman ($\chi^2 = 9.618$, $df = 1$, $p < 0.01$). However, gender and ADHD did not significantly affect the illicit methylphenidate use. Daily methylphenidate use ranged from less than 10mg to 30mg per day. The most common dose was less than 10mg per day (74.7%) which was significantly more reported in students age 24 and below ($\chi^2 = 4.699$, $df = 1$, $p < 0.05$), men ($\chi^2 = 4.454$, $df = 1$, $p < 0.05$), and non-doctoral students ($\chi^2 = 6.168$, $df = 1$, $p < 0.05$). The most common frequency of use was once in lifetime use (54%) and during exams (32.2%). Also, only 5.3% of college students with illicit methylphenidate use were undiagnosed ADHD cases. The frequency of the illicit methylphenidate use significantly varied by age ($\chi^2 = 5.151$, $df = 1$, $p < 0.05$), gender ($\chi^2 = 7.081$, $df = 1$, $p < 0.01$), marital status ($\chi^2 = 31.635$, $df = 1$, $p < 0.001$), residence ($\chi^2 = 22.118$, $df = 1$, $p < 0.001$), income ($\chi^2 = 12.432$, $df = 1$, $p < 0.001$), and ADHD ($\chi^2 = 4.190$, $df = 1$, $p < 0.05$). In terms of age at first illicit methylphenidate use, the highest frequency belonged to 18 to 20 years (44.8%) ($\chi^2 = 88.103$, $df = 3$, $p < 0.001$). In addition, age at first illicit methylphenidate use was significantly related to gender ($\chi^2 = 4.550$, $df = 1$, $p < 0.05$), class ($\chi^2 = 21.428$, $df = 1$, $p < 0.001$), and ADHD ($\chi^2 = 6.083$, $df = 1$, $p < 0.05$). Table 4 presents a comparison of the frequency of substances/medications use, consumption route, supply route, and side effects of methylphenidate based on the level of education and class. The overall rate of substances/medications use among Iranian Students was reported to be 41.3% and the general prevalence of smoking, alcohol, opium, amphetamine, and other drugs (except methylphenidate) was 28.3%, 9.3%, 15.3%, 4.3%, and 20% respectively. According to Table 4, the overall rate of substances/medications use significantly differs from the level of education, that is to say, it is more prevalent among doctoral students ($\chi^2 = 42.759$, $df = 1$, $p < 0.001$). Moreover, smoking and alcohol consumption varied significantly by level of education (respectively, $\chi^2 = 6.626$, $df = 1$, $p < 0.05$; $\chi^2 = 7.095$, $df = 1$, $p < 0.01$), though this difference was

not significant based on class of students. Opium use showed a significant difference only based on the class of students ($\chi^2 = 32.791$, $df = 1$, $p < 0.001$), and other drugs use (except methylphenidate) only significantly varied by level of education ($\chi^2 = 23.734$, $df = 1$, $p < 0.001$). On the contrary, amphetamine use did not significantly differ by level of education and class of the students. Iranian college students merely used methylphenidate orally. Moreover, participants reported the following reasons for the illicit methylphenidate use: Improved concentration and high academic performance (the most common cause) (78.2%), Curiosity (13.8%), and imitation of friends (8%). Most college students with illicit methylphenidate use reported that they got access to the medication through friends and acquaintances (64.4%). Moreover, insomnia (45.3%), anxiety (37.2%), fatigue (32.6%), tachycardia or palpitation (30.2%), dry mouth (30.2%), headache (29.1%), anorexia (20.9%), agitation (19.8%), nervousness and irritability (7%), paresthesia in limbs (7%), irregular heartbeat (7%), and most instability (5.8%) were the reported side effects of illicit methylphenidate use among college students. In general, the prevalence of the side effects differed significantly by level of education, that is to say, the side effects were more highly reported by non-doctoral students compared to doctoral students. Only 10% of students with the illicit methylphenidate use reported no side effects.

Logistic regression was used to evaluate the role of study variables in the prediction of the illicit methylphenidate use, as the dependent variable. Age, gender, marital status, residence, income, level of education, class, awareness of complications, legal awareness of the illicit methylphenidate use, substances/medications use, substances/medications use in family, history of mental health counseling, less-stigmatized attitudes toward mental illness, mental health, and ADHD as independent variables. Table 5 shows the odds ratios (OR), 95% Confidence intervals (95% CI), and statistical significance. Age, gender, marital status, residence, income, level of education, and class entered the analysis in model 1. This model, while significant ($\chi^2 = 91.969$, $df = 7$, $p < .001$), explained 9.7 to 13.9% of the variance of the illicit methylphenidate use. Moreover, 20.7% of illicit methylphenidate users and 87.8% of non-users were classified correctly (overall accuracy of 68.3%). In this model, age (OR = 0.691, 95% CI = 0.496, 0.962, $p < 0.05$), marital status (OR = 2.839, 95% CI = 1.796, 4.448, $p < 0.001$), and level of education (OR = 2.322, 95% CI = 1.571, 3.433, $p < 0.001$) could predict the illicit methylphenidate use. In model 2, while controlling demographic variables, awareness of complications, legal awareness of the illicit methylphenidate use, substances/medications use, substances/medications use in family, history of mental health counseling, less-stigmatized attitudes toward mental illness, mental health, and ADHD were included in the analysis. This model, while significant ($\chi^2 = 655.606$, $df = 15$, $p < .001$), explained 51.7% to 73.9% of the variance of the illicit methylphenidate use. Moreover, 77% of illicit methylphenidate users and 94.8% of non-users were classified correctly (overall accuracy of 89.7%). In this

model, marital status (OR = 3.385, 95% CI = 1.584, 7.236, $p < 0.01$), level of education (OR = 2.839, 95% CI = 1.796, 4.448, $p < 0.001$), legal awareness of the illicit methylphenidate use (OR = 0.227, 95% CI = 0.112, 0.457, $p < 0.001$), substances/medications use (OR = 0.124, 95% CI = 0.056, 0.274, $p < 0.001$), history of mental health counselling (OR = 0.147, 95% CI = 0.081, 0.269, $p < 0.001$), less-stigmatized attitudes toward mental illness (OR = 0.101, 95% CI = 0.050, 0.204, $p < 0.001$), and mental health (OR = 0.948, 95% CI = 0.940, 0.956, $p < 0.001$) could predict the illicit methylphenidate use. In model 2, marital status and level of education affected positively while other variables affected negatively.

DISCUSSION

Results of this study, which was designed to assess the prevalence, patterns, and associated factors of the illicit methylphenidate use among college students, demonstrated that 29% of Iranian college students have at least once illicitly used methylphenidate. This data is consistent with the results of Wilens *et al* review article on the prevalence of the illicit methylphenidate use, which estimated its prevalence to be 5 to 35 percent. The data is inconsistent with the results of the Teter *et al* study, who evaluated 4580 college students and reported the prevalence of the illicit methylphenidate use to be 8.3%.^[7, 26] Notably, the small sample size of Wilens *et al* study (150 participants) may have caused overestimation. On the other hand, the stigma of illicit substances/medications use should be considered as a barrier toward correct self-report of the illicit methylphenidate use leading to an underestimation.

The illicit methylphenidate use was higher in college students, aging 24 years and above, which is consistent with the results of Johnston *et al* and Hall *et al* studies.^[5, 6] Also, its prevalence was significantly higher among singles, students living away from families, students with income lower \$100, non-doctoral students, an upperclassman, which was contrary to the study carried out by Habibzadeh *et al*.^[21] In Habibzadeh *et al* study, reports showed that illicit methylphenidate use was much higher among single college students, although the difference was not statistically significant. Contrary to the results of the study by Hall *et al*, Habibzadeh *et al*, and Simoni-Wastila, in which the illicit methylphenidate use was reported to be more common among men, our study showed no significant difference between men and women.^[6, 21, 27] This result is consistent with Teter *et al* study who did not report a significant difference between men and women.^[26] Of note, our study suggested that men tend to start the illicit methylphenidate use at younger ages, and their dose and frequency of consumption is higher. Inconsistent with Jane *et al*, McCabe *et al*, and Habibzadeh *et al* studies who reported a higher prevalence of the illicit methylphenidate use in second year or younger college students. In this study, the higher prevalence was reported in second year or older college students.^[11, 13, 14, 21] Considering this finding, it can be inferred that factors such as increased awareness of the

psychoactive effects of methylphenidate by peer group, compacted courses (especially associated with poor studying skills), formation of a competitive atmosphere among students, the stress of entering job market by reaching the last college years, and burnout in the college education years, increases the tendency to illicit methylphenidate use as a form of self-medication among college students.

The current study showed that methylphenidate daily use among college students ranged from less than 10mg to 30mg per day and the highest frequency was less than 10mg per day (74.7%). This dosage was significantly more common among college students aged below 24 years, men, and non-doctoral students. It seems that graduating from high school and entering college, poor studying skills, and sometimes perseverance among these college students potentiates them to an external motivation such as the illicit medications use. In terms of the frequency of the illicit methylphenidate use, the highest frequency was once in a lifetime use (62.2%) and exams period (31.1%) showing that students try to improve their academic results. Improved concentration and high academic performance are the most commonly reported motive of methylphenidate use among the participants of this study. Yet, Barrett *et al* were the only researchers who reported recreation as the most common motive of the illicit methylphenidate use.^[16] Furthermore, the frequency of methylphenidate use showed significant differences based on age, gender, marital status, residence, income, and ADHD, that is to say, that higher frequencies were reported among male students aged 24 years and above with undiagnosed ADHD.

The most common age at the first illicit methylphenidate use in this study was between 18 to 20 years (44.8%) which is relatively consistent with the results of Jane *et al* study.^[11] They stated that the most common age of onset of the illicit methylphenidate use is between 19 and 22 years (62.7%). Also, only 10% of college students with the illicit methylphenidate use were an undiagnosed ADHD case which is contrary to 30.2% of college students reported by Jane *et al*.^[11] This may be probably attributed to the difference in measures since Jane *et al* used a researcher-made questionnaire while in our study; ADHD was diagnosed by ASRS score above 50. The overall rate of substance/medication use was reported to be 41.3% among Iranian Students and the general prevalence of smoking, alcohol, opium, amphetamine, and other drugs (except methylphenidate) was 28.3%, 9.3%, 15.3%, 4.3%, and 20% respectively. This result differed from the results of Ahmadi *et al* study in 2002 on 501 Iranian college students.^[28] They reported that the prevalence of smoking, alcohol, opium, amphetamine, and other drugs that are used are 54.9%, 34.7%, 21.2%, 2.2%, and 2.1%, which is far higher than our results. These high reported rates in Ahmadi *et al* study may be attributed to lower sample size and limitation of participants to a single city, which may have caused overestimation. The overall prevalence of substances/medications use significantly differed with the level of education, that is to say, that it was higher in

doctoral students. This shows that their higher vulnerability to substances/medications use requires special attention from health policymakers. In the current study, methylphenidate was mostly provided by friends and acquaintances (64.4%) and, was used only orally. These results corresponded with the studies of Barrett *et al*, Habibzadeh *et al*, Teter *et al*, Dupont *et al*, and White *et al*.^[16, 21, 26, 29, 30] However, other methods of illicit methylphenidate use including intranasal, injection and smoking have been reported which were absent in our study.^[16, 21, 26, 29-31] Insomnia (45.3%), anxiety (37.2%), fatigue (32.6%), tachycardia or palpitation (30.2%), dry mouth (30.2%), headache (29.1%), anorexia (20.9%), agitation (19.8%), nervousness and irritability (7%), paresthesia in limbs (7%), irregular heartbeat (7%), and most instability (5.8%) were the reported side effects of illicit methylphenidate use among college students. Only, 10% of students with the illicit methylphenidate use reported no side effects. Results of this study were not consistent with the findings of Jane *et al* in which palpitation (37.2%), nervousness and irritability (33.3%), and irregular heartbeats (29.6%) were the most common side effects of illicit methylphenidate use.^[11] Also, they reported no side effects in 7% of college students. Also, Jane *et al* showed a significant difference in palpitation, irregular heartbeat, nervousness, and memory loss in terms of years in the university. While in our study, this significant difference was observed in complications such as insomnia, dry mouth, headache, mood instability, paresthesia of the limbs, irregular heartbeat, and tachycardia or palpitation. This difference may be explained by the difference in medication dose and frequency of use. For example, in this side effect study, non-doctoral students and upperclassmen reported more side effects in comparison with doctoral students and freshmen due to regular use of methylphenidate with higher dosages (10mg to 30mg per day).

Results of logistic regression analysis showed that marital status, level of education, legal awareness of illicit methylphenidate use, substances/medications use, history of mental health consulting, less-stigmatized attitudes toward mental illness, and mental health are the variables, which can predict the illicit methylphenidate use. In this regard, marital status and level of education show positive effects while other variables show negative effects. On the other hand, age, gender, residence, income, class, awareness of the side effects, substances/medications use in family, and ADHD did not play a role in the prediction of the illicit methylphenidate use among college students. Previously, Habibzadeh *et al* showed the role of lack of awareness of the legal consequences of the illicit methylphenidate use among college students which is consistent with the results of our study.^[21] Moreover, Steven *et al* found in their study that less-stigmatized attitudes toward mental illness are associated with increased illicit methylphenidate use or other substances/medications which is supported by the findings of the current study.^[1] Yet, the results of previous studies on the effect of class status on the illicit prescription stimulant use provide controversial results. For example,

Weyandt *et al* found that years in college does not predict the illicit stimulant use while McCabe *et al* demonstrated that seniors are at a higher risk of illicit medication use compared to freshman and sophomores.^[32, 33] It is obvious that considering the experiences during the collegiate years, this factor should be further analyzed.

In line with the data by Ford, which introduced other illicit drug use as the most powerful predictor of use among college students, the results of the current study also show that a history of substances/medications use can powerfully predict the illicit methylphenidate use in college students.^[34] On the other hand, the role of history of substances/medications use and mental health in the prediction of the illicit methylphenidate use confirms the shared vulnerabilities, which simultaneously increases the risk of psychiatric disorders and substance use conditions. Even if we think of a small number of shared etiologic factors by considering the diversity of associations between mental disorders, observing the association between primary mental disorder and the risk of later substance use provides prerequisite support for casual models of association reflecting self-medication and many other causal mechanisms. If these prospective associations were attributed to the causal influence of primary disorders, their early treatment or prevention may potentially reduce a great number of secondary substance use conditions.^[35]

Limitations

This study had limitations. Firstly, it was due to the nature of cross-sectional studies that we could not accurately estimate the frequency of a disorder. Self-reported scales, a high number of items, negative attitudes toward mental disorders, stigmatization, and fear of lack of confidentiality were barriers for accurate estimation of the frequency of a disorder, which may be resolved with designing longitudinal studies and individual interviews with the participants. Secondly, the low sample size of this study may have provided an inaccurate estimation of the illicit methylphenidate use, which may be resolved by conducting studies with higher sample sizes. Thirdly, the results of this study may not be generalized because the study population was limited to a geographical area (considering individual, social, political, and cultural differences). Thus, it was suggested that similar studies should be conducted all over the world. Lastly, no standardized assessments were available for some of the study variables, that is to say, that, some measures were merely designed specifically for this study and their psychometric properties were unknown.

CONCLUSION

The results of this study showed that friends and acquaintances are the major suppliers of illicit methylphenidate. Thus, focusing on ADHD students (as the only persons with legal access to methylphenidate) may be an effective intervention. On the other hand, reducing the monthly methylphenidate allocation to these patients by psychiatrists and pharmacists may be beneficial. Moreover,

increased awareness of the complications of illicit methylphenidate use and improving the mental health of medical students by periodic examinations and timely treatment of psychiatric disorders (especially ADHD, sleep disorders, depression, and anxiety) may help reduce the illicit methylphenidate use among college students. Relatively poor awareness of college students about methylphenidate reflects insufficient education in this regard in the faculty curriculums. Thus, people should be informed about this issue through access to textbooks, articles, seminars, specific educational courses. Additionally, the topic of stimulant drugs (including methylphenidate), pharmacology, toxicology, and psychiatry courses are suggested in the medical and paramedical curriculums and more generally in other fields of study. Destigmatization of mental illness remains a controversial issue since less-stigmatized beliefs regarding mental illness may be associated with positive beliefs on the efficacy of psychiatric medications and subsequently increase their illicit use.

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The authors declare that they have no conflicts of interest to disclose.

REFERENCES

- Stone AM, Merlo LJ. Attitudes of college students toward mental illness stigma and the misuse of psychiatric medications. *The Journal of clinical psychiatry*. 2011 Feb;72(2):134.
- Berger C, Müller-Godeffroy J, Marx I, Reis O, Buchmann J, Dück A. Methylphenidate promotes the interaction between motor cortex facilitation and attention in healthy adults: A combined study using event-related potentials and transcranial magnetic stimulation. *Brain and behavior*. 2018 Dec;8(12):e01155.
- Clemow DB. Misuse of methylphenidate. In: *Non-medical and illicit use of psychoactive drugs 2015* (pp. 99-124). Springer, Cham.
- Kadison R. Getting an edge—use of stimulants and antidepressants in college. *New England Journal of Medicine*. 2005 Sep 15;353(11):1089-91.
- Johnston LD, O'Malley PM, Bachman JG, Schulenberg JE. Monitoring the future national survey results on drug use, 1975-2006. Volume II: College students and adults ages 19-45.
- Hall KM, Irwin MM, Bowman KA, Frankenberger W, Jewett DC. Illicit use of prescribed stimulant medication among college students. *Journal of American College Health*. 2005 Jan 1;53(4):167-74.
- Wilens TE, Adler LA, Adams J, Sgambati S, Rotrosen J, Sawtelle R, Utzinger L, Fusillo S. Misuse and diversion of stimulants prescribed for ADHD: a systematic review of the literature. *Journal of the American Academy of Child & Adolescent Psychiatry*. 2008 Jan 1;47(1):21-31.
- Abbasi-Ghahramanloo A, Khodadost M, Moradpour F, Karimirad MR, Kamali R, Ziarati F. Prevalence of nonmedical use of prescription-type opioids, methylphenidate, and sedative-hypnotics among university students in the south of Iran: a regression analysis. *Electronic physician*. 2018 Jun;10(6):6981.
- Fond G, Gavaret M, Vidal C, Brunel L, Riveline JP, Micoulaud-Franchi JA, Domenech P. (Mis) use of prescribed stimulants in the medical student community: motives and behaviors: a population-based cross-sectional study. *Medicine*. 2016 Apr;95(16).
- Steyn F. Methylphenidate use and poly-substance use among undergraduate students attending a South African university. *South African Journal of Psychiatry*. 2016;22(1).
- Jain R, Chang CC, Koto M, Geldenhuys A, Nichol R, Joubert G. Non-medical use of methylphenidate among medical students of the University of the Free State. *South African Journal of Psychiatry*. 2017;23(1).
- McCabe SE, Teter CJ, Boyd CJ. The use, misuse and diversion of prescription stimulants among middle and high school students. *Substance use & misuse*. 2004 Jan 1;39(7):1095-116.
- McCabe SE, Teter CJ, Boyd CJ, Guthrie SK. Prevalence and correlates of illicit methylphenidate use among 8th, 10th, and 12th grade students in the United States, 2001. *Journal of Adolescent Health*. 2004 Dec 1;35(6):501-4.
- McCabe SE, Knight JR, Teter CJ, Wechsler H. Non-medical use of prescription stimulants among US college students: Prevalence and correlates from a national survey. *Addiction*. 2005 Jan;100(1):96-106.
- Clemow DB, Walker DJ. The potential for misuse and abuse of medications in ADHD: a review. *Postgraduate medicine*. 2014 Sep 1;126(5):64-81.
- Barrett SP, Darredeau C, Bordy LE, Pihl RO. Characteristics of methylphenidate misuse in a university student sample. *The Canadian Journal of Psychiatry*. 2005 Jul;50(8):457-61.
- Kollins SH, MacDonald EK, Rush CR. Assessing the abuse potential of methylphenidate in nonhuman and human subjects: a review. *Pharmacology Biochemistry and Behavior*. 2001 Mar 1;68(3):611-27.
- Kooij JJ, Burger H, Boonstra AM, Van der Linden PD, Kalma LE, Buitelaar JK. Efficacy and safety of methylphenidate in 45 adults with attention-deficit/hyperactivity disorder. A randomized placebo-controlled double-blind cross-over trial. *Psychological medicine*. 2004 Aug;34(6):973-82.
- Spencer T, Biederman J, Wilens T, Doyle R, Surman C, Prince J, Mick E, Aleardi M, Herzig K, Faraone S. A large, double-blind, randomized clinical trial of methylphenidate in the treatment of adults with attention-deficit/hyperactivity disorder. *Biological psychiatry*. 2005 Mar 1;57(5):456-63.
- Godfrey J. Safety of therapeutic methylphenidate in adults: a systematic review of the evidence. *Journal of psychopharmacology*. 2009 Mar;23(2):194-205.
- Habibzadeh A, Alizadeh M, Malek A, Maghbooli L, Shoja MM, Ghabili K. Illicit methylphenidate use among Iranian medical students: prevalence and knowledge. *Drug design, development and therapy*. 2011;5:71.
- Ghandfroosh Sattari, H. Evaluation of Drug Abuse among Students of Tabriz University of Medical Sciences. 2009. (Persian)
- Cohen YG, Segev RW, Shlafman N, Novack V, Ifergane G. Methylphenidate use among medical students at Ben-Gurion University of the Negev. *Journal of neurosciences in rural practice*. 2015 Jul;6(3):320.
- Modabernia MJ, Shojaie Tehranie H, Falahi M, Faghripour M. Normalizing SCL-90-R inventory in Guilan high-school students. *Journal of Guilan University of Medical Sciences*. 2010 Oct 15;19(75):58-65.
- Mokhtari H, Rabiei M, Salimi SH. Psychometric properties of the Persian version of adult attention-deficit/hyperactivity disorder self-report scale. *Iranian Journal of Psychiatry and Clinical Psychology*. 2015 Nov 15;21(3):244-53.
- Teter CJ, McCabe SE, LaGrange K, Cranford JA, Boyd CJ. Illicit use of specific prescription stimulants among college students: prevalence, motives, and routes of administration. *Pharmacotherapy: The Journal of Human Pharmacology and Drug Therapy*. 2006 Oct;26(10):1501-10.
- Simoni-Wastila L. The use of abusable prescription drugs: the role of gender. *Journal of women's health & gender-based medicine*. 2000 May 1;9(3):289-97.

28. Ahmadi J, Yazdanfar F. Current substance abuse among Iranian university students. *Addictive Disorders & Their Treatment*. 2002 Jun 1;1(2):61-4.
29. DuPont RL, Coleman JJ, Bucher RH, Wilford BB. Characteristics and motives of college students who engage in nonmedical use of methylphenidate. *The American Journal on Addictions*. 2008 May 6;17(3):167-71.
30. White BP, Becker-Blease KA, Grace-Bishop K. Stimulant medication use, misuse, and abuse in an undergraduate and graduate student sample. *Journal of American College Health*. 2006 Mar 1;54(5):261-8.
31. Low KG, Gendaszek AE. Illicit use of psychostimulants among college students: a preliminary study. *Psychology, Health & Medicine*. 2002 Aug 1;7(3):283-7.
32. Weyandt LL, Janusis G, Wilson KG, Verdi G, Paquin G, Lopes J, Varejao M, Dussault C. Nonmedical prescription stimulant use among a sample of college students: relationship with psychological variables. *Journal of Attention Disorders*. 2009 Nov;13(3):284-96.
33. McCabe SE, Cranford JA, Boyd CJ, Teter CJ. Motives, diversion and routes of administration associated with nonmedical use of prescription opioids. *Addictive behaviors*. 2007 Mar 1;32(3):562-75.
34. Ford JA. Nonmedical prescription drug use among college students: A comparison between athletes and nonathletes. *Journal of American College Health*. 2008 Sep 1;57(2):211-20.
35. Swendsen J, Conway KP, Degenhardt L, Glantz M, Jin R, Merikangas KR, Sampson N, Kessler RC. Mental disorders as risk factors for substance use, abuse and dependence: results from the 10-year follow-up of the National Comorbidity Survey. *Addiction*. 2010 Jun;105(6):1117-28.

Table 1: Demographic information and the prevalence of ADHD among participants

Variables		N (%)
Age	< 24 years	237 (26.3)
	≥ 24 years,	663 (73.7)
Gender	Male	411 (45.7)
	Female	489 (54.3)
Marital status	Married	386 (42.9)
	Single	514 (57.1)
Residence	living away from family	549 (61)
	With family	351 (39)
Income	≤ \$100	672 (74.7)
	> \$100	228 (25.3)
Level of education	Doctoral	580 (64.4)
	Others	320 (35.6)
Class	Freshman	159 (17.7)
	Upperclassman	741 (82.3)
ADHD	With	48 (5.3)
	Without	852 (94.7)
Total		900 (100)

Table 2: Compares the frequency of illicit methylphenidate use and its average daily dose according to the participants' demographic features and the incidence or absence of ADHD using the Kruskal-Wallis test.

Variables		Illicit methylphenidate use, n (%)	Average daily doses of methylphenidate, n (%)						
			< 10 mg/d	10-20 mg/d	20-30 mg/d	30-40 mg/d	40-50 mg/d	50-60 mg/d	> 60 mg/d
Age	< 24 years	54 (22.8)	34 (63)	15 (27.8)	5 (9.3)	-	-	-	-
	≥ 24 years	207 (31.2)	161 (77.8)	33 (15.9)	13 (6.3)	-	-	-	-
	Total	261 (29)	195 (74.7)	48 (18.4)	18 (6.9)	-	-	-	-
χ^2 (df)		6.029 (1)*				4.699 (1)*			
Gender	Male	126 (30.7)	87 (69)	27 (21.4)	12 (9.5)	-	-	-	-
	Female	135 (27.6)	108 (80)	21 (15.6)	6 (4.4)	-	-	-	-
χ^2 (df)		1.008 (1)				4.454 (1)*			
Marital status	Married	74 (19.2)	62 (83.8)	-	12 (16.2)	-	-	-	-
	Single	187 (36.4)	133 (71.1)	48 (25.7)	6 (3.2)	-	-	-	-
χ^2 (df)		31.677 (1)***				1.985 (1)			
Residence	living away from family	138 (25.1)	102 (73.9)	30 (21.7)	6 (1.1)	-	-	-	-
	With family	123 (35)	93 (75.6)	18 (14.6)	12 (9.8)	-	-	-	-
χ^2 (df)		10.193 (1)**				0.002 (2)			
Income	≤ \$100	207 (30.8)	153 (73.9)	48 (23.2)	6 (2.9)	-	-	-	-
	> \$100	54 (24)	42 (77.8)	-	12 (22.2)	-	-	-	-

χ^2 (df)		4.186 (1)*			0.037 (1)				
Level of education	Doctorate	118 (20.3)	97 (82.2)	15 (12.7)	6 (5.1)	-	-	-	-
	Others	143 (44.7)	98 (68.5)	33 (23.1)	12 (8.4)	-	-	-	-
χ^2 (df)		59.283 (1)***			6.168 (1)*				
Class	Freshman	30 (18.9)	24 (80)	6 (3.8)	-	-	-	-	-
	Upperclassman	231 (31.2)	171 (74)	42 (18.2)	18 (7.8)	-	-	-	-
χ^2 (df)		9.618 (1)**			0.781 (1)				
ADHD	With	9 (3.4)	9 (100)	-	-	-	-	-	-
	Without	252 (96.6)	186 (73.9)	48 (19)	18 (7.1)	-	-	-	-
χ^2 (df)		2.584 (1)			3.090 (1)				

*p < 0.05 is significant; **p < 0.01 is significant; ***p < 0.001 is significant.

Table 3: Compares the frequency of times of illicit methylphenidate use and age of the very first time of illicit methylphenidate use according to the participants' demographic features and the incidence or absence of ADHD using the Kruskal-Wallis test.

Variables	Times of illicit methylphenidate use, n (%)							Age of the very first time of illicit methylphenidate use, n (%)					
	Only once in a lifetime	Daily	Weekly	Monthly	During exams	and stressful	< 18	18-20	21-23	24-26	27-30	> 30	
Age	< 24 years	21 (38.9)	3 (5.6)	-	-	30 (55.6)	-	-	-	-	-	-	
	≥ 24 years	120 (58)	18 (8.7)	-	-	54 (26.1)	15 (7.2)	-	-	-	-	-	
	Total	141 (54)	21 (8)	-	-	84 (32.2)	15 (5.7)	81 (31)	117 (44.8)	48 (18.4)	-	-	15 (5.7)
χ^2 (df)													
Gender	Male	57 (45.2)	15 (11.9)	-	-	42 (33.3)	12 (9.5)	51 (40.5)	48 (38.1)	12 (9.5)	-	-	15 (11.9)
	Female	84 (62.2)	6 (4.4)	-	-	42 (31.1)	3 (2.2)	30 (22.2)	69 (51.1)	36 (26.7)	-	-	-
χ^2 (df)													
Marital status	Married	24 (32.4)	-	-	-	39 (52.7)	11 (14.9)	32 (43.2)	21 (28.4)	9 (12.2)	-	-	12 (16.2)
	Single	117 (62.6)	21 (11.2)	-	-	45 (24.1)	4 (2.1)	49 (26.2)	96 (51.3)	39 (20.9)	-	-	3 (1.6)
χ^2 (df)													
Residence	living away from family	87 (63)	21 (15.2)	-	-	30 (21.7)	-	48 (34.8)	42 (30.4)	33 (23.9)	-	-	15 (10.9)
	With family	54 (43.9)	-	-	-	54 (43.9)	15 (12.2)	33 (26.8)	75 (61)	15 (4.3)	-	-	-
χ^2 (df)													
Income	≤ \$100	123 (59.4)	21 (10.1)	-	-	48 (23.1)	15 (7.3)	63 (30.4)	96 (46.4)	33 (15.9)	-	-	15 (7.3)
	> \$100	18 (33.3)	-	-	-	36 (66.7)	-	18 (33.3)	21 (38.9)	15 (27.8)	-	-	-
χ^2 (df)													

Level of education	Doctorate	63 (53.4)	15 (12.7)	-	-	39 (33.1)	1 (0.8)	49 (41.5)	24 (20.3)	30 (25.4)	-	-	15 (12.7)
	Others	78 (54.5)	6 (4.2)	-	-	45 (31.5)	14 (9.8)	32 (22.4)	93 (65)	18 (12.6)	-	-	-
	χ^2 (df)	0.759 (1)						0.487 (1)					
Class	Freshman	15 (50)	3 (10)	-	-	12 (40)	-	3 (10)	12 (40)	-	-	-	15 (50)
	Upperclassman	126 (54.5)	18 (7.8)	-	-	72 (31.2)	15 (6.5)	78 (33.8)	105 (45.5)	48 (20.8)	-	-	-
	χ^2 (df)	0.017 (3)						21.428 (1)***					
ADHD	With	3 (33.3)	-	-	-	3 (33.3)	3 (33.3)	6 (66.6)	3 (33.3)	-	-	-	-
	Without	138 (54.8)	21 (8.3)	-	-	81 (32.1)	12 (4.8)	75 (29.8)	114 (45.3)	48 (19)	-	15 (5.9)	-
	χ^2 (df)	4.190 (1)*						6.083 (1)*					

*p < 0.05 is significant; **p < 0.01 is significant; ***p < 0.001 is significant.

Table 4: Compares the frequency of use for other substances/medications, how to use, reasons for use, how to access, and side effects of illicit methylphenidate use according to the level of education and class.

Variables	Total	Level of education		χ^2 (df)	Class		χ^2 (df)	
		Doctorate	Others		Freshman	Upperclassman		
		N (%)	N (%)		N (%)	N (%)		
Other substances/medications	Total prevalence	372 (41.3)	286 (49.3)	86 (26.9)	42.759 (1)***	75 (47.2)	297 (40.1)	2.710 (1)
	Cigarette	255 (28.3)	181 (31.2)	74 (23.1)	6.626 (1)*	54 (34)	201 (27.1)	3.010 (1)
	Alcohol	84 (9.3)	43 (7.4)	41 (12.8)	7.095 (1)**	9 (5.7)	75 (10.1)	3.075 (1)
	Opium	138 (15.3)	90 (15.5)	48 (15)	0.42 (1)	48 (30.2)	90 (12.1)	32.791 (1)***
	Amphetamine	39 (4.3)	21 (3.6)	18 (5.6)	1.996 (1)	6 (3.8)	33 (4.5)	0.146 (1)
	Illicit medications use (except methylphenidate)	180 (20)	144 (24.8)	36 (11.3)	23.734 (1)***	33 (20.8)	147 (19.8)	0.069 (1)
How to use methylphenidate illicitly	Oral	261 (100)	118 (20.3)	143 (44.7)	-	30 (18.9)	231 (31.2)	-
	Smoking	-	-	-	-	-	-	-
	Injection	-	-	-	-	-	-	-
	imitation of friends	21 (8)	15 (12.7)	6 (4.2)	-	3 (10)	18 (7.8)	-
	Recreational	-	-	-	-	-	-	-
	Curiosity	36 (13.8)	36 (30.5)	-	-	15 (9.4)	21 (9.1)	-
Reasons for use methylphenidate illicitly	Improve concentration and promote academic performance	204 (78.2)	67 (56.8)	137 (95.8)	52.999 (1)***	12 (40)	192 (83.1)	24.604 (1)***
	Loss of appetite or weight loss	-	-	-	-	-	-	-
	Reduce sleep and increase energy	-	-	-	-	-	-	-
	Others	-	-	-	-	-	-	-
	Medical prescription	18 (6.9)	-	18 (12.6)	-	-	18 (7.8)	-
	Friends and acquaintances	168 (64.4)	61 (51.7)	107 (74.8)	48.569 (1)***	12 (40)	156 (67.5)	16.533 (1)***
how to access methylphenidate illicitly	Illegal drug market	75 (28.7)	57 (48.3)	18 (12.6)	-	18 (60)	57 (24.7)	-

Side effects of illicit methylphenidate use	With	Insomnia	117 (45.3)	58 (50.4)	59 (41.3)	2.157 (1)	27 (90)	90 (39.5)	27.203 (1)***
		Anorexia	54 (20.9)	7 (6.1)	47 (32.9)	27.515 (1)***	6 (20)	48 (21.1)	0.18 (1)
		Dry mouth	78 (30.2)	16 (13.9)	62 (43.4)	26.096 (1)***	-	78 (34.2)	14.654 (1)***
		Headache	75 (29.1)	37 (32.2)	38 (26.6)	0.966 (1)	3 (10)	72 (31.6)	5.964 (1)*
		Nausea	15 (5.8)	1 (0.9)	14 (9.8)	9.227 (1)**	-	15 (6.6)	2.087 (1)
		Seizure	-	-	-	-	-	-	-
		Anxiety	96 (37.2)	42 (36.5)	54 (37.8)	0.042 (1)	12 (40)	84 (36.8)	0.113 (1)
		Jitteriness	51 (19.8)	18 (15.7)	33 (23.1)	2.207 (1)	9 (30)	42 (18.4)	2.232 (1)
		Fatigue	84 (32.6)	33 (28.7)	51 (35.7)	1.404 (1)	9 (30)	75 (32.9)	0.101 (1)
		Mood lability	15 (5.8)	-	15 (10.5)	12.758 (1)***	6 (20)	9 (3.9)	12.428 (1)***
		Nervousness and irritability	18 (7)	6 (5.2)	12 (8.6)	1.078 (1)	-	18 (8)	2.572 (1)
		Paresthesia in limbs	18 (7)	-	18 (12.6)	15.501 (1)***	6 (20)	12 (5.3)	8.837 (1)**
		Dizziness	-	-	-	-	-	-	-
		Irregular heartbeat	18 (7)	-	18 (12.6)	15.501 (1)***	6 (20)	12 (5.3)	8.837 (1)**
		Memory loss	-	-	-	-	-	-	-
		Erectile dysfunction	-	-	-	-	-	-	-
		Raised heart rate or palpitations	78 (30.2)	16 (13.9)	62 (43.4)	26.096 (1)***	-	78 (34.2)	14.654 (1)***
		Total	235 (90)	92 (78)	143 (100)	34.860 (1)***	30 (100)	202 (88.7)	3.736 (1)
		Without	26 (10)	26 (22)	0 (0)		0 (0)	26 (11.3)	

*p < 0.05 is significant; **p < 0.01 is significant; ***p < 0.001 is significant.

Table 5: Summary of logistic regression analysis to investigate predictive factors of illicit methylphenidate use among university students

Variables	Model 1		Model 2	
	OR	95% CI	OR	95% C.I.
Age	1.315	0.817, 2.116	0.940	0.440, 2.007
Gender	0.691*	0.496, 0.962	1.698	0.903, 3.194
Marital status	2.839***	1.796, 4.448	3.385**	1.584, 7.236
Residence	1.275	0.885, 1.836	0.799	0.407, 1.568
Income	1.394	0.845, 2.298	0.716	0.308, 1.664
Level of education	2.322***	1.571, 3.433	2.678**	1.396, 5.135
Class	1.436	0.863, 2.389	1.286	0.545, 3.039
Awareness of complications			0.501	0.234, 1.069
Legal awareness of illicit methylphenidate use			0.227***	0.112, 0.457
Substances/medications use			0.124***	0.056, 0.274
Substances/medications use in family			0.715	0.365, 1.399
History of mental health counseling			.147***	0.081, 0.269
Less-stigmatized attitudes toward mental illness			0.101***	0.050, 0.204
Mental health			0.948***	0.940, 0.956
ADHD			1.344	0.431, 4.188
Model χ^2	91.969***		655.606***	
Hosmer-Lemeshow χ^2	177.466***		31.831***	

*p < 0.05 is significant; **p < 0.01 is significant; ***p < 0.001 is significant.