Non-Medical Use of Prescription Stimulants for Treatment of Attention Disorders by University Students: Characteristics and Associations

Authors' Contribution:
Study Design A
Data Collection B
Statistical Analysis C
Data Interpretation D
Manuscript Preparation E
Literature Search F
Funds Collection G

ABCDEF 1 **Liat Korn**
CDEF 1 **Kineret Hassan**
CDEF 1 **Nadya Fainshtein**
CDEF 1 **Nizmit Yusov**
ACDEFG 2 **Nitza Davidovitch**

1 Department of Health Systems Management, School of Health Sciences, Ariel University, Ariel, Israel
2 Department of Behavioral Science, Faculty of Social Sciences and Humanities, Ariel University, Ariel, Israel

Corresponding Author:
Source of support:

Liat Korn, e-mail: Liatk@ariel.ac.il
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Background: Non-medical use of prescription stimulants (NPS) for treatment of attention deficit hyperactivity disorders (ADHD), which are considered narcotic substances and medical drugs, are used to treat learning and attention disorders. The purpose of this study was to investigate associations between misuse of medications for treatment of ADHD and various characteristics and problem behaviors, such as impulsivity, deviant behavior, and drug use.

Material/Methods: A total of 1280 undergraduate students (64% females; mean age 27; SD=6) completed an anonymous, structured, self-report questionnaire on health, well-being, and health risk behaviors.

Results: NPS for treatment of ADHD was significantly associated with cannabis AOR (adjusted odds ratio)=5.57, P<0.001, compared to non-users. Deviant behaviors were significantly more prevalent among students engaging in medical use of prescription stimulants for treatment of ADHD (P=0.01; 43.2% and misuse 51.1%) versus non-users (34.5%).

Conclusions: Social attention in needed and implementing of social policy to raise students' awareness of the problems involved in misuse of medications for treatment of ADHD, to form intervention programs tailored for students, and to refer students for appropriate counseling and diagnosis.

MeSH Keywords: **Attention Deficit and Disruptive Behavior Disorders • Cannabis • Prescription Drug Misuse • Risk-Taking • Students**

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Background

Methylphenidate (also known as MPH, Ritalin, and Concerta), considered a narcotic substance and a medical drug, is used to treat learning and attention disorders, as well as hyperactivity [1]. According to the chart of drugs and their effects published by the US National Institute on Drug Abuse, this drug is a stimulant that can be swallowed, snorted, smoked, injected, or chewed. Its main effects and possible harms are increased heart rate, blood pressure, and metabolism, sense of happiness and power, alertness, rapid or irregular heartbeat, reduced appetite, weight loss, heart failure, nervousness, sleeplessness, passivity, and addiction. A study that examined the effect of the drug on the brain's structure and activity found morphological changes in the brain and its manner of operation [2]. Discovery of the effect on the brain and the possibility of addiction to stimulants and similar substances caused the US Drug Enforcement Administration [3] and other legal authorities around the world to classify these drugs as Schedule II substances and to define them as narcotics that require prior diagnosis, prescription, and neurological supervision [4]. In Israel, the 2010 amendments to Israel's Dangerous Drugs Ordinance added several substances, including MPH, as stimulants from the methamphetamine family [5].

Attention and concentration disorders are the result of a combination of genetic, environmental, cultural, and hereditary factors, defined as developmental neurological disorders [6–8], known as attention deficit hyperactivity disorder (ADHD). These disorders are seen in children and adults in the form of a conspicuous lack of the neurotransmitters dopamine (NSDA) and norepinephrine (NSNE), which affect the functioning of the frontoparietal lobe, manifested in deficient judgment, occasional disquiet, lack of discipline, inability to maintain concentration over time, unwillingness and inability to complete tasks, difficulty with obeying authority and rules, and inability to assess danger. This disorder might be manifested in low academic grades, organizational difficulties, and avoiding preparation of homework and schoolwork.

Non-medical use of prescription stimulants for treatment of ADHD

Studies conducted at top universities around the world in recent years have tried to classify the use and misuse of medications for treatment of ADHD (sometimes expressed as non-medical use or illicit use) and found that methylphenidate stimulants are used by snorting, injecting, or oral ingestion of whole or crushed capsules [9,10]. Concern for schoolchildren, academic students, and staff who use stimulants to learn, particularly in times of increased academic pressure, is rising in educational systems around the world [11]. Medical use of prescription stimulants (MPS) has been proven efficient and safe for years

among those suffering from various attention and concentration disorders. Boys diagnosed with ADHD are reported to have disrupted patterns of eating behaviors, metabolically unfavorable nutritional status, and diminished physical activities [12]. Use of methylphenidate by healthy individuals with no attention disorder can enhances cognitive abilities, relaxing inhibitions in high executive functions when making essential decisions [13]. Its capacity to improve cognitive abilities has led to its wide use, and thus is a mental performance-enhancing drug used by academic students and faculty [14]. Its use raises concerns that do not end with one's student years, due to its continued association with problem behaviors in subsequent years. Despite the lack of any evidence of a causal relationship between methylphenidate and drug use, university students who are methylphenidate users showed a higher prevalence of using other substances, such as smoking tobacco, binge drinking, and use of cocaine [15–18], and another study found a greater disruption of sleep [19].

The theoretical setting outlined by this study attempts to identify non-medical use of prescription stimulants, or misuse of medications for treatment of ADHD (hereafter referred to as NPS), as a risk behavior that is associated with other risk behaviors. Risky behaviors include a multitude of factors that endanger health and social conditions and that can affect quality of life and even lead to sudden death [20]. The Problem Behavior Theory (PBT) concentrates on the existence of risk factors and protective factors in one's environment that contribute to risk behaviors, characterized by clustering. Jessor proposed a model that characterizes risk behaviors as connected in clusters and as inclined to be embraced in adolescence; however, due to their dangerous and addictive effects, they may endure for many years in adult life, long after the completion of academic studies, which is a matter of concern due to the negative social effects of long-term drug use.

Prevalence of use of prescription stimulants among students

Studies among US students suggested years ago that the proportion of students under age 24 years who reported using Ritalin for different reasons was significantly higher than the proportion of students over age 24 years, and that over 30% of the sample thought that methylphenidate is a commonly used addictive drug on campus [21]. Then, later, others indicated that the percentage of students who misuse methylphenidate-type stimulants (NPS) at least once ranges from 5% [22] to 34% [23] and the proportion of NPS males who misuse methylphenidate was higher than that of females [22]. In fraternity houses, 55% of all male students were found to use stimulants without a valid prescription at least once [23]. Among medical students, 11% reported using methylphenidate at least once [24], and among them, 32% misused methylphenidate

at least once because it was suggested by a friend. Among Italian university students, 11.3% reported using NPS at least once, with a higher percentage among working students [25].

Reasons for non-medical use of prescription stimulants

Researchers collected information on NPS, the reasons, how they were obtained, and how they were used, from several leading studies conducted in the USA in recent years [9]. Reasons for using stimulants were for studies/work purposes (35.8%), to celebrate (35.8%), for party (18.3%), and for maintaining alertness over time [22]. Clegg-Kaynok et al. [26] found studies/work reasons reported by 41.4% of the sample, concentration by 28.6%, and wishing to get high by 10%. McNiel et al. [27] found the reasons to be enhancing attention and concentration (70%), recreation (17%), and raising grades (13%). Garnier-Dykstra et al. [28] reported that, in the first year of higher education, use of stimulants for the purpose of studies was reported by 73.8% of the sample, a percentage that rose to 91.5% by the fourth year, suggesting that the academic institution helps maintain this behavior for purposes of adaptation.

Studies from the last decade have shown a rise in use of stimulants for cognitive enhancement (CE) and to improve academic abilities rather than for treatment of attention and concentration disorders [4,9,29], in light of price hikes and changes in the various educational systems, rapid technological developments, and the general competition in the global labor market [11], as well as to lose weight [30]. A study conducted by DeSantis et al. on students at a fraternity house of a university in the southeast USA from 2006 to 2008 found that stimulants were used for academic purposes – particularly during exams and finals to enhance alertness, maintain concentration over time, increase efficiency, and prevent disruptions, as well as for CE. Other non-academic reasons for use were also found, such as increased alertness at late hours and at parties, increasing the effect of alcohol without the depression that results from the diminishing influence of alcohol, and increasing sociability and interpersonal communication skills.

According to the DEA, stimulants such as MPH and Adderall were added to Schedule II of the drug classes, and these are available to the public only through a 30-day non-refillable prescription with a limited quota. Accordingly, availability and purchase ability were checked, showing that 4% of university students had an active valid prescription but students had no problem obtaining stimulants. In addition, the issue of external couriers to the academic institution was checked, finding that only 9% of students had purchased the stimulants from "strangers" [23]. The high availability of the stimulants stems from 3 main factors: The first is living in a shared residence with no privacy – students live in one building and share rooms. The second is the sense of brotherhood, which lowers inhibitions regarding requests that might be perceived as irregular or normative in a different environment. The third is that the existence of a dense social life at events lowers the pressure of obtaining substances for recreational purposes – "because there is always someone who has some" [4].

Purpose of the study

The purpose of the current study was to characterize MPS and NPS students with regard to the general prevalence of the phenomenon, among females and males, among those living in student dorms versus elsewhere, and the association with initial self-reported symptoms of attention disorder, impulsivity deviant behaviors, and other drug use. Research questions dealt with MPS and NPS as related to age, gender, university faculty, place of residence, initial self-reported attention disorder symptoms, impulsivity, deviant behaviors, alcohol use, and cannabis use. The hypotheses, compatible with the knowledge reviewed in the literature reviewed above, are that MPS and NPS students would include a higher prevalence of men than women; of younger than older participants; of residents of the university's dorms more than of other living arrangements; and with a higher prevalence of impulsivity, initial self-reported attention disorder symptoms, deviant behaviors, and substance abuse than among students who do not use prescription stimulants. Cannabis use is strongly associated with NPS. An important contribution of this article relates to examining whether risk factors for NPS observed in college student samples drawn primarily from the USA hold true among this Israeli sample as well, especially given some of the demographic differences between USA and Israeli college students (such as mean age).

Material and Methods

Procedure, population, and sample

Ethics Committee approvals from the University were obtained prior to data collection. The research was explained to participants before data collection, and students were advised that participation is completely voluntary. Completion of the questionnaire was considered an expression of informed consent. Of all undergraduate students studying at an academic institution (the research population), the research sample comprised 1280 students (64% women), constituting 20% of all undergraduate students and faithfully representing students at the institution's 4 faculties. All students who were present in the classrooms and who agreed to answer the questionnaire with informed consent participated in the study. The surveyors entered all classrooms of the 4 faculties: health sciences, natural sciences, social sciences, and engineering. There was no sampling process of classes- Classes were not selected to the

sample. The surveyors reached all the classes in the faculties list. The mean age of the participants was 27 years (SD=6). Percentage of responsiveness was 89.5% and 10 participants were dropped from the final sample for multiple values missing. The research sample represents the population of students who were registered, active, and present at classes in the various departments of the health sciences, natural sciences, social sciences, and engineering faculties in 1 university in Israel.

Research tool

The research tool utilized was a structured anonymous questionnaire, based on self-reports by the participants and deriving from 2 main sources: the study by Prof. Richard Jessor on risk and well-being behaviors of college students at the University of Colorado, USA [31] and the Israeli HBSC (Health Behavior of School Children) study [32]. The questionnaire includes questions on various health and social subjects, as follows: various sociodemographic questions; self-perceptions of health; mental stress; self- and body image; nutrition, diet, and eating habits; physical activity; smoking, alcohol drinking, and drug use; social support; and extra academic studies. The questionnaire constructed for the current study was comprised primarily of the USA questionnaire and was adapted for the population of Israeli students, checked for content validity, and has been previous used in a pilot study [33].

Description of the variables

MPS and NPS

Two questions on prescription stimulants use were employed in this study. 1. Participants were asked if they had ever used Ritalin (the familiar word used in Israel for methylphenidate [18]) (Yes/No) and 2. If they had used Ritalin with a prescription (MPS). Responses were: 1. Yes, I use Ritalin with a prescription, 2. I use Ritalin without a prescription, and 3. I do not use Ritalin at all.

Initial self-reported symptoms of attention disorder

In the current study, the first part of the Adult ADHD Self-Report Scale (ASRS-v1.1) [34] was used, following DSM-IV=TR criteria, and answers were provided to the following 6 questions: 1. Is it hard for you to attend to the small final details of a project after completing the challenging parts? 2. How frequently do you have difficulty putting things in order when performing a task that requires organization? 3. How frequently do you have difficulty remembering meetings or commitments? 4. When you are given a task that requires a great deal of thinking, how frequently do you avoid it or delay starting work on it? 5. How frequently do you squirm or move your hands or feet impatiently when you must remain seated for a lengthy period of time?

6. How frequently do you feel overly active or feel a need to do things as though driven by a motor? Respondents ranked their replies to these questions on a scale of 1 – "Never" to 5 – "Very often". A scale was constructed by summing the scores of all 6 variables, divided dichotomously by the median-low or high level of initial attention disorder symptoms. Students whose total score on the initial attention disorder symptoms was lower than 15 had a low level of initial attention disorder symptoms and students whose total score was above the median point had a high level of initial attention disorder symptoms (range 6–30; median 15; Cronbach's alpha=0.70).

Impulsivity

Participants answered 5 questions on impulsivity [35] and were asked to mark how true these statements for them: 1. I like to do things only for the thrill. 2. Sometimes I do crazy things just for fun. 3. I prefer friends who are exciting and unexpected. 4. I am so carried away by new exciting things and ideas that I don't think about what can go wrong. 5. I like wild uninhibited parties. Participants were asked to mark to what degree these statements are true of them. A scale was constructed by summing the scores of all 5 variables, divided dichotomously by the median – low or high level of impulsivity (range 5–10; median 8; Cronbach's alpha=0.69).

Deviant behaviors [33]

Participants' answers to questions on deviant behaviors were calculated similarly. They were asked how often in the past month they had: cheated on a test/cheated on home assignments/shoplifted/caused damage to property/deal in drugs/stolen valuables or hit someone because they didn't like what he or she had to say. Students who marked a frequency of once or more for any of these behaviors entered the calculation. A scale was constructed by summing the scores on all 8 variables, divided dichotomously by the median-low or high level of deviant behaviors (range 7–35; median 7; Cronbach's alpha=0.75).

Alcohol drinking and cannabis use

Questions were asked about binge drinking (5 shots of alcohol at a single event in the last month) [32] and drunkenness, with the range of frequencies from never to more than twice a week, divided dichotomously into ever and never. Ever experience with cannabis use responses ranged from 1 (no, never) to 3 (yes, more than once) and were divided dichotomously into ever and never.

Sociodemographic characteristics

Participants were asked to report their gender (male, female), year of birth (calculated by their age), current place of residence (dorms, at home with parents, rental apartment or

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own home, and others), and academic faculty (Health, Nature, Social, or Engineering).

Data analysis

The IBM SPSS Statistics 21 program was used for data analysis. Table 1 presents descriptive statistics of the percentage distribution using cross-tabulation frequency, as well as chi-square significance for differences between groups. The second model in Table 1 weighted the sample by gender (multiplied the number of males in the sample by 1.34 and the number of females by 0.79) to be weighed against their size in the general student population of Israel. As in Tables 1 and 2 presents substance use variables using cross-tabulation frequency and chi-square significance in 2 models. Table 3 explores associations between MPS and NPS to other research variables using multinomial logistic regression. The table presents adjusted odds ratios, with significance p value marked. For the regression analysis category, NPS was the focus value and the reference groups were never use and MPS.

Results

Table 1 presents the distribution of MPS and NPS by different variables in 2 models: the first model for the unweighted sample, and the second model weighted for gender. Since the database includes almost twice as many females as males, the second model makes it possible to observe the findings standardized for gender as matching the student population and the general population. The difference between the 2 models was not great and the direction of the differences was not reversed.

Table 2 presents the distribution of MPS and NPS by substance use variables in the 2 models, as shown in Table 1. Binge drinking and drunkenness were found to be significantly ($p<0.007$) higher among MPS and NPS versus those who do not use prescription stimulants at all, but for cannabis use the differences were even more significant ($p=0.000$) – significantly higher cannabis use was found among those who engage in NPS (74.5%) than among those engaging in MPS (61.3%) or those who do not use prescription stimulants at all (32.5%).

Table 3 presents adjusted odds ratios for associations between NPS to other research variables using a multinomial logistic regression controlling for gender, age, and place of residence. Findings show that, compared to the group that never used prescription stimulants, the probability of NPS use among participants is 2.73 higher ($p<0.001$) if they are female ($p<0.0001$), 5.57 higher if they used cannabis, 2.18 higher if they report impulsivity, and 1.09 times higher if they show initial self-reported symptoms of attention disorder. Compared to MPS, the chances

of being in NPS group are higher for females, those who use cannabis, and those who have experience with binge drinking.

Discussion

The main purpose of the present study was to characterize students who report non-medical use of prescription stimulants for treatment of attention disorders with regard to the prevalence of the phenomenon in the general student population, by gender, place of residence, and academic faculty, and its association with attention disorder initial self-reported symptoms, impulsivity, deviant behaviors, and drug use, as well as to explore associations between NPS and research variables. We hypothesized that NPS students would have a higher tendency to be male, living in the dorms, and display a higher prevalence of initial attention disorder symptoms, more impulsivity, a higher prevalence of deviant behaviors, binge drinking, drunkenness, and cannabis use than students who do not use prescription stimulants.

The findings of this study regarding the gender of NPS students refuted our initial hypothesis that NPS was higher in men and drew attention to the more prevalent use among females. MPS is more prevalent among males. Both attention disorders and NPS are known to be more prevalent among males [22]. Men are more capable of obtaining prescriptions, as seen in the findings or more frequently diagnosed and need a prescription. If methylphenidate helps misusers deal with fatigue and maintain alertness even with no diagnosis of attention disorder [22], and particularly if it helps lose weight [30], it is possible that women misuse it for these reasons more than for reasons of lack of concentration or distractions, which is its therapeutic aim. This means that they may use the substance for other reasons than those for which it is intended.

Examination of the research hypothesis regarding the age of NPS students showed that in the current study no significant differences were found by age, in contrast to the hypothesis and to the literature [21]. The age variable may be less relevant when the tested variable for MPS and NPS is about never used versus ever used, and not frequency of using. Students' place of residence is associated with the prevalence of methylphenidate use. The current study found that NPS is less prevalent among students who live at home and more prevalent among students who live in the dorms, but this difference was not significantly after gender-weighting procedures. The literature reviewed on fraternity houses also found a higher prevalence of NPS students who live on campus [23] as well as of those who begin using it following advice from friends [24]. Mediating factors not explored in this study appear to be social factors such as parental supervision and social influence of the peer group, as well as the greater availability of methylphenidate

Table 1. Distribution of MPS and NPS by different variables in a sample unweighted (Model 1) and weighted (Model 2) for gender.

| Variables | Values | Model 1 – Unweighted sample | | | | |
		MPS n=163	NPS n=60	Non-users n=1057	Total N=1280	Chi-square sig.
Gender	Females	53.4%	68.3%	65.4%	64.0%	P=0.009
	Males	46.6%	31.7%	34.6%	36.0%	
Age	Younger (below 24)	35.8%	30.5%	29.9%	30.7%	NS
	Older (24 and above)	64.2%	69.5%	70.1%	69.3%	
Current place of residence	Dorms (or student village)	27.0%	32.2%	22.2%	23.3%	P=0.039
	At home with parents	34.6%	16.9%	33.5%	32.8%	
	Other (rental/own home/other)	38.4%	50.8%	44.3%	43.8%	
Academic faculty	Health	25.8%	30.9%	37.3%	35.5%	P=0.022
	Nature	13.8%	16.4%	11.9%	12.4%	
	Social	33.3%	38.2%	33.7%	33.8%	
	Engineering	27.0%	14.7%	17.1%	18.3%	
Initial self-reported symptoms of attention disorder (6 items, α=.70)	Low level of symptoms	22.8%	43.1%	56.0%	51.0%	P=0.000
	High level of symptoms	77.2%	56.9%	44.0%	49.0%	
Impulsivity (5 items, α=.69)	Low impulsivity	62.0%	70.0%	43.2%	46.9%	P=0.000
	High impulsivity	38.0%	30.0%	56.8%	53.1%	
Deviant behaviors (7 items, α=.75)	Low deviance	56.8%	50.0%	66.9%	64.8%	P=0.005
	High deviance	43.2%	50.0%	33.1%	35.2%	
Variables	Values	Model 2 – Weighted for gender				
		MPS n=163	NPS n=60	Non-users n=1057	Total N=1280	Chi-square sig.
Gender	Females	40.4%	55.9%	52.8%	51.3%	P=0.008
	Males	59.6%	44.1%	47.2%	48.7%	
Age	Younger (below 24)	38.8%	31.6%	31.6%	32.5%	NS
	Older (24 and above)	61.2%	68.4%	68.4%	67.5%	
Current place of residence	Dorms (or student village)	27.5%	31.6%	22.3%	23.4%	P=0.074
	At home with parents	31.7%	17.5%	33.2%	32.3%	
	Other (rental/own home/other)	40.7%	50.9%	44.5%	44.3%	
Academic faculty	Health	22.2%	26.4%	33.7%	31.8%	P=0.009
	Nature	15.0%	17.0%	12.5%	13.0%	
	Social	28.7%	37.7%	31.1%	31.0%	
	Engineering	34.1%	18.9%	22.8%	22.8%	
Initial self-reported symptoms of attention disorder (6 items, α=.70)	Low level of symptoms	23.5%	42.1%	55.1%	50.1%	P=0.000
	High level of symptoms	76.5%	57.9%	44.9%	49.9%	
Impulsivity (5 items, α=.69)	Low impulsivity	64.6%	70.8%	44.4%	48.4%	P=0.000
	High impulsivity	35.4%	29.2%	55.6%	51.6%	
Deviant behaviors (7 items, α=.75)	Low deviance	56.8%	48.9%	65.5%	63.6%	P=0.014
	High deviance	43.2%	51.1%	34.5%	36.4%	

* p<0.05; ** p<0.01; *** p<0.001

Table 2. Distribution of MPS and NPS by substance use variables in a sample unweighted (Model 1) and weighted (Model 2) for gender.

Variables	Values	Model 1 – Unweighted sample				
		MPS n=163	NPS n=60	Non-users n=1057	Total N=1280	Chi-square sig.
Binge drinking	At least once in last month	49.7%	55.0%	38.3%	40.5%	P=0.001
	Not once in last month	50.3%	45.0%	51.7%	59.4%	
Drunkenness	At least once in last month	44.8%	40.0%	31.6%	33.7%	P=0.002
	Not once in last month	55.2%	60.0%	68.4%	66.3%	
Use of Cannabis	Ever	58.0%	75.5%	30.3%	36.1%	P=0.000
	Never	42.0%	24.5%	69.7%	63.9%	

Variables	Values	Model 2 – Weighted for gender				
		MPS n=163	NPS n=60	Non-users n=1057	Total N=1280	Chi-square sig.
Binge drinking	At least once in last month	51.7%	58.3%	40.6%	42.9%	P=0.001
	Not once in last month	48.3%	41.4%	58.4%	57.1%	
Drunkenness	At least once in last month	44.4%	41.4%	32.8%	34.8%	P=0.007
	Not once in last month	55.6%	58.6%	67.2%	65.2%	
Use of Cannabis	Ever	61.3%	74.5%	32.5%	38.5%	P=0.000
	Never	38.7%	25.5%	67.5%	61.5%	

Table 3. Adjusted odds ratios for predicting NPS from research variables (weighted for gender).

	NPS					
	AOR Never used (ref)	95% Confidence interval		AOR MPS (ref)	95% Confidence interval	
		Lower	Upper		Lower	Upper
Gender (0=male, 1=female)	2.73**	1.37	5.47	3.27**	1.52	7.01
Age (0=older, 1=younger)	0.75	0.37	1.51	1.05	0.49	2.27
Current place of residence (0= others, 1= dorms)	1.56	0.77	3.13	1.17	0.54	2.53
Symptoms of attention disorder (0=less, 1=more)	1.09*	1.00	1.18	0.88**	0.81	0.97
Impulsivity (0=less, 1=more)	2.18*	1.06	4.46	1.50	0.68	3.32
Deviant behaviors (0=less, 1=more)	1.36	0.71	2.58	1.57	0.77	3.22
Binge drinking (0=never, 1=ever)	1.99	0.94	4.18	2.17a	0.94	5.00
Drunkenness (0=never, 1=ever)	0.66	0.31	1.41	0.47	0.20	1.10
Use of Cannabis (0=never, 1=ever)	5.57***	2.63	11.78	2.41*	1.05	5.52
Adjusted R2 Nagelkerke			23.3%			
N			966			

* $p<0.05$; ** $p<0.01$; *** $p<0.001$

on campus. As stated, the dense social life at events reduces the pressure of obtaining substances for purposes of recreation "because there is always someone who has some" [4] and this stresses the important influence of social-environmental factors.

A significant and clear logical association was found between a high level of self-reports of initial attention disorder symptoms and use of methylphenidate, both with and without a prescription. The prevalence of initial attention disorder symptoms was higher among MPS (76.5%) than among NPS (57.9%) or those who do not use methylphenidate at all (49.9%). Consequently, more than half the NPS students display a high level of initial attention disorder symptoms, and they should be referred for diagnosis and their probability of having an attention disorder should be explored. However, NPS students who display a low level of initial symptoms of attention disorder (42.1%) probably use it for reasons other than distraction of attention and they would do well to increase their knowledge of the implications of this use. These findings raise questions about misuse of the substance, with possible harmful consequences for the student's health. Recent medical studies support providing various stimulants to those who suffer from different levels of attention and concentration disorders in order to enhance functioning (executive attention) and academic performance, but opinions on use of these substances as CE and to enhance academic performance among other students have remained vague and inconclusive [19].

The findings concerning the association with impulsivity showed an opposite relationship to that which was expected – a high level of impulsivity was significantly and meaningfully associated with not using methylphenidate. The impulsivity scale examined by Jessor et al. [31] included: liking to do things for the thrill/to do crazy things just for fun/to prefer exciting and unpredictable friends/to be carried away by new exciting things and ideas/iking wild uninhibited parties. These traits are more characteristic of men [33], such that use of methylphenidate may regulate these traits among users and thus their prevalence is lower. Deviant behaviors were found to be more prevalent among people who engage in MPS and NPS than among those who do not use methylphenidate at all. Behaviors such as cheating on tests or home assignments/ shoplifting/causing harm to property/drug dealing/stealing valuables or hitting someone when not liking what he or she said were found to be more prevalent among those who engage in NPS (51.1%) and MPS (43.2%) than among non-users (34.5%). These findings are not necessarily incompatible with impulsivity. This can be understood in the context of methylphenidate's influence on users. It is possible that when under the effect of methylphenidate, one has a low concept of impulsivity, and perhaps when there is no medication effect, the deviant behaviors are higher. As it is possible that medication is utilized in periods of study, at other times, when the user is not under the influence, there might be a greater tendency to engage in deviant behaviors. Moreover, another explanation of the findings may be that the frequency of methylphenidate use was not examined. Taking the medication at different frequencies, for example daily or only during exams, may result in biased findings.

As evident from the literature on NPS among students in various locations around the world [15–17], there is a common tendency to report other drug use as well, such as alcohol and cocaine abuse. This suggests that NPS may begin as a learning drug, but, due to the addictive effect and the association with use of other substances, it can also result in health and social deterioration and thus persevere over time, much beyond one's student years in subsequent life as adults.

Findings also show that among all variables tested in this study, compared to the group who never used methylphenidate, the probability for NPS is higher if they are females, use cannabis, report impulsivity, and they show initial symptoms of attention disorder. NPS was highly associated with cannabis use compared to non-users. This finding places this behavior among other risk behavior patterns showing an association between substance use, as was proved by Jessor's Problem Behavior Theory [20].

The present study has the following strengths: It presents data on methylphenidate use among students at a university in Israel by using a large representative sample of students at the institution. The study raises awareness of the fact that the phenomenon is characteristic of Israeli universities as well, and not only of those in the USA or Europe. The study also provides a wide view of a phenomenon on which there is insufficient knowledge in Israeli society regarding its social implications. However, our study has the following limitations: First, it is based on self-report of sensitive issues that might involve wish bias or social desirability bias, but studies in this field indicate that the potential resulting bias is miniscule [36]. Second, the data are based on the reports of students from 1 university, although 7 others currently exist in Israel, and this does not enable generalization of the findings to all students in Israel. One more limitation is that the frequency of use was not assessed, so different levels of misusers are collapsed into the same category. In addition, the study is quantitative and does not provide insight into the participating students' inner world and the reasons that led to NPS. Consequently, there is need first and foremost for more thorough investigation of this field of study at the university examined and in institutions of higher education in general, to facilitate better understanding of students at the institution, a different focus in subsequent studies, and preparation of an intervention program for the students.

Conclusions

Our findings indicate that NPS is more prevalent among women, more prevalent within dorms than among students who live at home, more prevalent in the faculty of social sciences, more prevalent among those who self-report a high level of initial attention disorder symptoms, less prevalent among people who display high impulsivity, and more prevalent among students who report deviant behaviors and drug use. Sixty students in the sample (4.6%) reported NPS, apparently with no medical diagnosis of attention disorder. More than half of these showed no high symptoms of the disorder and may use the substance for other reasons than those for which it is produced. The concern arising from the current study is that as a society we have a legitimate desire to improve study conditions and academic achievements, leading to assigning a positive nature to this drug when used appropriately, but this is also its danger, due to its perception as legitimate, the distinction between use and misuse receives extra importance. As a substance that might lead to dependency and addiction, and particularly due to its association with the use of other substances, there is need for attention on the policy level, through increasing awareness of the drug's negative effects by the student population, and on the research level in order to thoroughly understand the phenomenon and its implications. Including the substance in the Dangerous Drugs Ordinance of 2010 was an important step in discerning the drug's dangers and reducing its harmful effects, but this is not enough.

Social policy recommendations

In an era of constant improvement of the educational and academic systems in Israel and around the world, attempts are being made to tailor the systems to the students through progressive study techniques. A transition is underway from old individualist models of social location and use of social structure for learning to a study model based on the structure and dynamics of meta-cognition in developing cooperative study environments. Shared regulation combines individual and cooperative regulation in the desire to promote collective cognition for the purpose of learning, where each person strives to be stronger [37].

Methylphenidate as a drug used to enhance cognitive abilities can help those who need it but can also be an obstacle to those who misuse it. Hence, it would be useful to tailor the guidance provided to appropriate diagnoses in a counseling setting within academic institutions where learning problems may emerge. Key players, such as the Students' Dean, should be aware of the high prevalence of methylphenidate use and can combine appropriate counseling in a structured program and recommend and improve access to suitable manners of diagnosis. It is important to raise awareness of the implications of misuse among factors providing services to students in these institutions, and to indicate when information on use of additional substances or on undesired increase of methylphenidate dosages is evident. Moreover, it is important to raise students' awareness of the problematic implications of misuse of methylphenidate, to inform them of the drug's adverse effects, and to create tailored intervention programs for students to treat the phenomenon when necessary.

Conflicts of interest

None.

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