Survey on prescription stimulant use among university students in Wallonia and Brussels: prevalence, motives and perceived effects

Survey performed in October 2018

V01.2020

DG POST authorisation - Vigilance Division - Pharmacovigilance (human use)/Evaluation Entity - Project of Pharmacoepidemiology

Authors
Javier Sawchik (FAMHP)
Martine Sabbe (FAMHP)
Mégane Gräfe (Stagiaire ULB Faculté de Pharmacie)
Françoise Wuillaume (FAMHP)
Jamila Hamdani (FAMHP)
Hugues Malonne (FAMHP)

Acknowledgement

This survey was made possible thanks to the support of several stakeholders of the FAMHP who provided valuable advices and/or disseminated the questionnaire through their networks (in alphabetical order):

- Bertrand Blankert (Université Mons)
- Isabelle Consiglio (Université Mons)
- Sarah De Bruyn (University of Antwerp)
- Philippe Dubois (Université Mons)
- Dominique Duchateau (Université de Liège)
- Martin Desseilles (Université de Namur)
- Mégane Gräfe, stagiaire at the FAMHP (Université libre de Bruxelles)
- Bertrand Hamaide (Université Saint-Louis)
- Inter-University Committee for Medical Students (CIUM)
- Didier Lambert (Université catholique de Louvain)
- Alain Levêque (Université Libre de Bruxelles)
- Monique Marcourt-Defrene (Université de Liège)
- Isabelle Parmentier (Université Namur)
- Koen Ponnet (University of Antwerp)
- Pierre Van Antwerpen (Université libre de Bruxelles)
- Guido Van Hal (University of Antwerp)

The Vigilance Division of the FAMHP is very grateful for this collaboration and would like to thank those stakeholders for their valuable contribution.

Contact

French, English: Javier.Sawchik@afmps.be
Dutch, English: Martine.Sabbe@fagg.be

Contents

Abstract

- ### Background and objectives

Prescription stimulants such as methylphenidate (e.g. Rilatine®, Concerta®) are used for treating attention deficit hyperactivity disorder (ADHD) and narcolepsy. However, non-medical use to enhance academic performance has been reported among students. In Flanders, Belgium, surveys in students are conducted regularly to observe drug use patterns including use of prescription stimulants. The objective of this study was to estimate the prevalence of use of prescription stimulants in French-speaking university students in Belgium.

- ### Methods

A cross-sectional descriptive study was conducted in 2018 in six French-speaking universities in Belgium. All students aged 18 years or older were invited through e-mail to take an online survey. Sample size was approximately 89,000 students. Participation was voluntary and anonymous.

Students were asked about their use of prescription stimulants, medical and other reasons for use, age of onset of use, perceived negative and positive effects, route of administration and the use of recreational drugs.
The demographic characteristics of the respondents were statistically summarised. Proportions and 95 % confidence intervals were calculated for all variables.

- ### Results

A total of 12,144 subjects responded to the survey. The response rate was approximately 14 %.

The lifetime prevalence of use of prescription stimulants was estimated at 8.0 % and past-year prevalence at 5.8 %. The lifetime use in males was twice as high (9.8 %) compared to females (5.2 %). Methylphenidate was the most commonly used prescription stimulant. Non-medical use (66 %) was more prevalent than medical use (34 %). Lifetime prevalence of non-medical use was estimated at 4.8 %.

The most common reason for medical use was treatment of attention disorder. Reasons for non-medical use were mainly to enhance academic performance, e.g. for better concentration or to stay awake longer and study longer. Almost one in ten students who use prescription stimulants for medical reasons has also used these outside treatment purpose. In both medical and non-medical users of prescription stimulants, the most commonly perceived positive effects were linked to improved focus and increased energy for studying. Most frequently reported negative effects were sleep disorders, palpitations and emotional instability.

- ### Conclusions

This is the first report to investigate the use of prescription stimulants among students in French-speaking universities in Belgium. The prevalence was in line with similar studies conducted in Flanders and Europe. However, as long-term data on the efficacy and safety of prescription stimulants in adults are scarce, the need for treatment with medication should be reviewed regularly.

This study also confirms that, although uncommon, there is misuse of prescription stimulants to improve study performances. Students should be aware that to date, no medication has shown to be safe and effective for cognitive improvement.

Samenvatting

- **Achtergrond en doelstellingen**

Stimulerende geneesmiddelen zoals methylfenidaat (bv. Rilatine®, Concerta®) zijn goedgekeurd voor de behandeling van aandachtstekortstoornis met hyperactiviteit (ADHD) en narcolepsie. Niet-medisch gebruik is beschreven bij studenten om de academische prestaties te verbeteren. In Vlaanderen, België, worden op regelmatige tijdstippen bevragingen bij studenten gehouden om het patroon van het druggebruik, met inbegrip van het gebruik van stimulerende geneesmiddelen, te onderzoeken. Het doel van dit onderzoek was een schatting te maken van het gebruik van stimulerende geneesmiddelen bij Franstalige universiteitsstudenten in België.

- **Methode**

In 2018 voerde het FAGG een transversale beschrijvende studie uit in zes Franstalige universiteiten in België. Alle studenten van achttien jaar en ouder werden via e-mail uitgenodigd om deel te nemen aan een online bevraging. De omvang van de steekproef bedroeg ongeveer 89 000 studenten. De deelname was vrijwillig en anoniem.

Het FAGG vroeg de studenten naar hun gebruik van stimulerende geneesmiddelen, medische en andere redenen voor gebruik, leeftijd van beginnend gebruik, waargenomen negatieve en positieve effecten, wijze van toediening en het gebruik van recreatieve drugs.

De demografische kenmerken van de respondenten werden statistisch samengevat. Het FAGG berekende voor alle variabelen proporties en 95 % betrouwbaarheidsintervallen.

- **Resultaten**

In totaal reageerden 12 144 personen op de bevraging. De respons was ongeveer 14 %.

De prevalentie van gebruik van stimulerende geneesmiddelen op een bepaald moment in het leven werd geschat op 8,0 % en de prevalentie in het afgelopen jaar op 5,8 %. Het gebruik op een bepaald moment in het leven bij mannen was twee keer zo hoog (9,8 %) in vergelijking met vrouwen (5,2 %). Methylfenidaat was het meest gebruikte middel. Niet-medisch gebruik (66 %) kwam vaker voor dan medisch gebruik (34 %). De prevalentie van niet-medisch gebruik werd geschat op 4,8 %.

De meest voorkomende reden voor medisch gebruik was de behandeling van een aandachtstekortstoornis. Redenen voor niet-medisch gebruik waren voornamelijk om de academische prestaties te verbeteren, bijvoorbeeld voor betere concentratie of om langer wakker te blijven en langer te studeren. Bijna één op de tien studenten die om medische redenen gebruik maken van stimulerende geneesmiddelen heeft die ook buiten de behandeling om gebruikt.

Bij zowel medische als niet-medische gebruikers van stimulerende geneesmiddelen werden de meest voorkomende positieve effecten gekoppeld aan een betere focus en meer energie om te studeren. De meest gerapporteerde negatieve effecten waren slaapstoornissen, hartkloppingen en emotionele instabiliteit.

- **Besluit**

Dit is het eerste rapport waarin het gebruik van stimulerende geneesmiddelen bij studenten aan Franstalige universiteiten in België wordt onderzocht. De prevalentie lag in de lijn van gelijkaardige onderzoek in Vlaanderen en Europa. Aangezien de langetermijngegevens over de werkzaamheid en veiligheid van stimulerende geneesmiddelen bij volwassenen schaars zijn, moet de nood aan behandeling met geneesmiddelen regelmatig worden herzien.

Dit onderzoek bevestigt ook dat, hoewel ongebruikelijk, er misbruik wordt gemaakt van stimulerende geneesmiddelen om de studieprestaties te verbeteren. Studenten moeten zich ervan bewust zijn dat tot op heden geen enkel geneesmiddel veilig en doeltreffend is gebleken voor cognitieve verbetering.

Résumé

- **Contexte et objectifs**

Les médicaments stimulants tels que le méthylphénidate (p. ex. Rilatine®, Concerta®) sont utilisés pour traiter le trouble du déficit de l'attention/hyperactivité (TDAH) et la narcolepsie. Toutefois, une utilisation non médicale a été signalée chez les étudiants pour améliorer les performances académiques. En Flandre (Belgique), des enquêtes auprès des étudiants sont menées à intervalles réguliers pour examiner les habitudes de consommation de drogues, y compris la consommation de médicaments stimulants. L'objectif de cette étude était d'estimer la prévalence de l'utilisation de médicaments stimulants chez les étudiants universitaires francophones en Belgique.

- **Méthodes**

Une étude descriptive transversale a été réalisée en 2018 dans six universités francophones en Belgique. Tous les étudiants âgés de dix-huit ans ou plus ont été invités par e-mail à participer à une enquête en ligne. La taille de l'échantillon était d'approximativement 89 000 étudiants. La participation était volontaire et anonyme.

Les étudiants ont été interrogés sur leur consommation de médicaments stimulants, les raisons médicales et autres de leur consommation, l'âge de début de la consommation, les effets négatifs et positifs perçus, la voie d'administration et la consommation de drogues récréatives.

Les caractéristiques démographiques des répondants ont été résumées statistiquement. Des proportions et des intervalles de confiance de 95 % ont été calculés pour toutes les variables.

- **Résultats**

Un total de 12 144 sujets ont répondu à l'enquête. Le taux de réponse était d'approximativement 14 %.

La prévalence au cours de la vie de l'utilisation de médicaments stimulants était estimée à 8,0 % et la prévalence au cours de l'année écoulée à 5,8 %. L'utilisation au cours de la vie chez les hommes était deux fois plus élevé (9,8 %) que chez les femmes (5,2 %). Le méthylphénidate était le médicament le plus couramment utilisé. L'utilisation non médicale (66 %) était plus prévalente que l'utilisation médicale (34 %). La prévalence au cours de la vie de l'utilisation non médicale était estimée à 4,8 %.

La raison la plus courante de l'utilisation médicale était le traitement du trouble de l'attention. Les raisons de l'utilisation non médicale étaient principalement d'améliorer les performances académiques, par ex. pour une meilleure concentration ou pour rester éveillé plus longtemps et étudier plus longtemps. Presqu'un étudiant sur dix qui utilisent des stimulants sur prescription pour des raisons médicales a également utilisé ceux-ci en dehors des fins du traitement.

Tant chez les utilisateurs médicaux que non médicaux de médicaments stimulants, les effets positifs perçus les plus courants étaient liés à une meilleure concentration et à une énergie accrue pour étudier. Les effets négatifs les plus fréquemment notifiés étaient des troubles du sommeil, des palpitations et de l'instabilité émotionnelle.

- **Conclusions**

C'est le premier rapport qui étudie l'utilisation de médicaments stimulants chez les étudiants dans les universités francophones en Belgique. La prévalence était conforme à des études similaires menées en Flandre et en Europe. Toutefois, comme les données à long terme sur l'efficacité et la sécurité des médicaments stimulants chez les adultes sont rares, la nécessité d'un traitement médicamenteux devrait être réexaminée régulièrement.

Cette étude confirme également que, bien qu'il ne soit pas courant, il y a un mésusage de médicaments stimulants pour améliorer les performances en matière d'étude. Les étudiants

doivent être conscients que, à ce jour, aucun médicament ne s'est avéré sûr et efficace pour l'amélioration cognitive.

Abbreviations

ADD........ Attention Deficit Disorder
ADHD...... Attention Deficit Hyperactivity Disorder
BE .... Belgium
CI .... Confidence Interval
CIUM....... Comité Inter-Universitaire des étudiants en Médecine
CRef........ Conseil des Recteurs
FAMHP..... Federal Agency for Medicines and Health Products (FR= AFMPS - NL = FAGG)
GDPR ...... General Data Protection Regulation
PhEpi ...... Pharmacoepidemiology
IQR......... InterQuartile Range
UCLouvain Université catholique de Louvain
ULB......... Université libre de Bruxelles
ULiège..... Université de Liège
UMons..... Université de Mons
UNamur... Université de Namur
UPS......... Use of Prescription Stimulants
USL-B...... Université Saint-Louis - Bruxelles

Introduction

- ### Background

Prescription stimulants such as methylphenidate (e.g. Rilatine®, Concerta®) are authorised for treating attention-deficit/hyperactivity disorder (ADHD) and narcolepsy. However, parallel to the increase in prescriptions for these disorders, an increase in non-medical use has been reported [1]. In particular, misuse and abuse of prescription stimulants can be a concern for students who use these medicinal products for academic reasons (e.g. to enhance concentration and stay awake). Moreover, prescription stimulants can also be used in non-medical settings for losing weight or for recreational purposes.

- ### Rationale and aim of the study

In Belgium, the consumption of methylphenidate increased from 4.5 million defined daily dose (DDD) in 2004 to 10.3 million DDD in 2011 [2]. This increase can probably be explained by a greater awareness and attention for ADHD, however, there is no information about the number of diagnoses that have been made.

A survey conducted in university and high school students in Flanders estimated the lifetime prevalence of the use of prescription stimulants at 10.5 % in 2017 [3]. In addition, 8.5 % of students have ever used stimulating medication to improve their study performance without being part of a treatment. Medical students may be at a higher risk of using prescription stimulants for non-medical use due to the competitive climate which gives high stress levels [4]. The prevalence of use of prescription stimulants among French-speaking Belgian university students is unknown.

Those considerations led the FAMHP to design and conduct a survey in order to estimate the consumption of prescription stimulants by students in Belgian French-speaking universities.

The overall aim of the study was to estimate the level of prescription stimulants use among students enrolled in universities in Wallonia and Brussels. Additionally, the study aimed to add to the understanding of reasons for use, channels for procurement and perceived effects associated with using these medicinal products.

- ### Research question and objectives

The main research question is "What is the prevalence of use of prescription stimulants among students aged eighteen years or more enrolled in French-speaking universities in Wallonia or Brussels?"

- ### Primary objectives

- To assess the (lifetime and past year) prevalence of use of prescription stimulants among students enrolled in six universities in Wallonia and Brussels.
- To assess the prevalence of use of prescription stimulants by specific medication (e.g. methylphenidate, modafinil, atomoxetine, guanfacine, oxybate).
- To assess the prevalence of use of prescription stimulants for treatment purposes.

- ### Secondary objectives

- To describe respondents by their sociodemographic characteristics (gender, academic year, working status, field of study).
- To assess the prevalence of use of prescription stimulants among medical students.
- To describe patterns of first use according to age category (6-11 years, 12-17 years, > 18 years).
- To characterise the main time period(s) of use of prescription stimulants.
- To characterise the frequency of use of prescription stimulants.
- To describe the route of administration of prescription stimulants.
- To assess the reason of use (motives) of prescription stimulants.
- To assess perceived effects (positive and adverse events) of prescription stimulants.
- To assess how the prescription stimulants are purchased.
- To describe patterns of use of prescription stimulants according to student characteristics (gender, academic year, working status, field of study).

- To describe patterns of co-utilisation with other stimulants/drugs.

Methods

Study design and setting

This was a transversal, descriptive survey study using an online questionnaire as a data collection tool.

The target population consisted of students aged eighteen years or older enrolled at a French-speaking university (UCLouvain, ULB, ULiège, UMONS, UNamur or USL-B) in Belgium.

A study protocol was developed at the FAMHP based on a survey conducted by the University of Antwerp (UAntwerpen) [4] and available literature in collaboration with Mégane Gräfe (pharmacy student with internship at the FAMHP) and external experts (Guido van Hal, Sarah De Bruyn, Martin Desseilles and Pierre Van Antwerpen). The protocol is available upon request.

The questionnaire was made available from October until mid-November 2018.

The study was sponsored and financed by the FAMHP, and received approval from the Ethics Committee of the Hospital Erasme-ULB (Ref. P2018/447).

Research tool

The staff of the PharmacoEpidemiology (PhEpi) team of the FAMHP and Mégane Gräfe developed a questionnaire in French. The design of the questionnaire was based, in part, on previous studies on the use of prescription stimulants in students [4]–[6].

The SurveyMonkey® software was used to host the questionnaire and to collect answers. Participation was completely voluntary and anonymous and the respondents' IP addresses were not collected. Participants did not receive any payment or remuneration. Confidentiality of the data was also ensured by restricted access to individual data (reserved for qualified personnel) and by presenting only aggregated data in the study report.

The PhEpi staff, three FAMHP colleagues, and a convenience sample of students (10 university students ages 18 to 26) tested the questionnaire to assess the comprehension and clarity of the questions, as well as the proper operation of the skip patterns.

The questionnaire included thirty questions, but not all questions needed to be answered by all participants. The total number of questions presented to each participant varied between 15 and 29 because of the branching logic implemented for several questions. The main questions focused on use of prescription stimulants, including specific medicine (listed in Table 1), use frequency, motivations, routes of administration and associated perceived effects. Other questions collected sociodemographic data, use of other recreational substances, moods and emotions. The majority of the questions were closed-ended (multiple choice [single-answer] questions and checkboxes [multi-punch] questions) and defined as required. Opinion about competition (rivalry) among students as well as information on moods and emotions were collected using 5-point Likert items. The last question was open-ended for free comments. The questionnaire is available upon request.

Table 1. List of prescription stimulants

Which of these stimulants did you use? (several responses possible)
methylphenidate (Concerta®, Rilatine®, Medikinet®, Equasym XR®, Methylphenidate Retard Sandoz®, Methylphenidate Mylan®)
modafinil (Provigil®)
atomoxétine (Strattera®)
guanfacine (Intuniv®)
oxybate (Xyrem®)
other *(text)*

The time necessary to fill in the questionnaire was estimated to be approximately fifteen minutes.

The questionnaire was accompanied by a cover letter inviting students to participate, briefly describing the main aim of the survey, informing that the study had been approved by an ethics committee, stating that participation was absolutely voluntary, and guaranteeing confidentiality of the data.

- **Sample Selection**

The intention was to invite all the potential eligible subjects to participate in the study. No specific sampling techniques were used.

According to the Council of Rectors (CRef) statistics, the total number of students enrolled at Belgian French-speaking universities was approximately 89,000 for the 2013-2014 academic year, which can be considered as a rough estimation of the eligible population[7]. Participation was voluntary, so the attained sample size depended on the response rate. A response rate between 5 % and 7 % was judged feasible. Hence, the potential number of respondents was expected to be between 4,500 and 6,000 subjects. Assuming a prevalence of the use of prescription stimulants between 5 % and 15 %, the margin of error of the estimates was estimated to be around 0.5 %-1 %. Even assuming the most conservative scenario (i.e. prevalence of 50 %), the margin of error was near 1.5 which can be clearly considered as appropriate.

In an attempt to increase the potential response rate, two reminders were implemented. No financial incentives were provided.

- **Survey administration**

This survey was conducted using an electronic mode of administration. The academic authorities of each university were invited to disseminate by e-mail the invitation to participate to the survey to the students. All the students registered at the Catholic University of Louvain (UCLouvain), the Université libre de Bruxelles (ULB), the University of Liège (ULiège), the University of Mons (UMONS), the University of Namur (UNamur) and the University of St. Louis-Brussels (USL-B) were invited to participate in an e-mail sent by the administration of the vice-rectors. Student organisations, such as the Inter-University Committee for Medical Students (CIUM), reinforced the invitations by informing their members through e-mails or social networks.

- **Variables**

Survey responses were used to describe the study population in terms of sociodemographic factors (gender, age, academic year, main place of residence, working status) and to calculate the following proportions.

- **Primary variables**
- Proportion of respondents who have at one time used prescription stimulants (lifetime prevalence), overall and by medicine.
- Proportion of respondents who have used prescription stimulants in the past twelve months (past-year prevalence), overall and by frequency of use.
- Proportion of respondents who have used prescription stimulants for treatment purposes (hyperactivity, narcolepsy, attention disorder), overall and by treatment purpose.

- **Secondary variables**
- Proportion of respondents who have used prescription stimulants by age-class of first use (6-11 years, 12-17 years, > 18 years).
- Proportion of respondents who have used prescription stimulants by reason of use.
- Proportion of respondents who have used prescription stimulants by perceived adverse event.
- Proportion of respondents who have used prescription stimulants by perceived positive effect.

- Proportion of respondents who have used prescription stimulants by route of administration.
- Proportion of respondents who have used prescription stimulants by route of procurement.
- Proportion of respondents who have used prescription stimulants that also use other stimulants/recreational drugs.
- Proportion of medicine students respondents who have used prescription stimulants.

- **Data management**

Answers to the questionnaire were collected at the FAMHP. After the deadline for receiving completed questionnaires, the original raw database (CSV format) was locked and stored on a server at the FAMHP whose reading and writing rights are managed by its IT department. A working copy of the database was imported in SAS and used for data cleaning and analysis. The SAS programmes, SAS analysis datasets, SAS outputs, and log files were stored on the server. Excel files were made for questions containing free-text fields in order to perform quality checks. Only researchers responsible for the project at the FAMHP as well as an intern at the FAMHP had access to the database.

The answers from the open-ended questions (including specifications for the option “Other” in closed-ended questions that presented this category as an alternative) were reviewed. If meaningful information was provided, these answers were used for cleaning the data and to identify new categories for closed-ended questions.

- **Data analysis plan**

Data were analysed using SAS statistical software, version 9.3. Graphs were created using MS Excel.

First, the quality of collected data was checked by looking for logical inconsistencies. The answers to open-ended questions (e.g. items for other options) were scrutinised. In case of clear inconsistent responses, data were cleaned accordingly. For example, if a subject responded “Yes” to having taken prescription stimulants, but also responded “No” for every specific prescription stimulant, and specified a product not considered as a prescription stimulant in the item “Other” (e.g. dietary supplement), the answer to the first question was corrected as not having taken prescription stimulants.

The estimated overall response rate and response rate by university were calculated by dividing the number of respondents by the reference populations for the academic year 2013-2014 [7].

The completion rate was calculated by dividing the number of respondents who answered all relevant questions (with the exception of the open-ended questions) by the total number of respondents.

Demographic characteristics were analysed, overall and for medicine students. The study population was described according to age, sex, field of study, working status, family status, and current education. The age distribution was summarised using descriptive statistics (mean, standard deviation, quartiles, range). Descriptive data for all other variables were presented as frequency tables. Proportions were presented as percentages along with their associated 95 % confidence intervals (95 % CI). The 95 % CI were calculated using the exact Clopper-Pearson method. The numerators for the calculation of the proportions of interest were the number of respondents that had answered the specific questions. The denominator was the number of students who had participated to the survey and/or answered the question of lifetime use of prescription stimulants, as appropriate.

A sub-analysis was done for medicine students to compare findings with the survey conducted in Flanders [4].

Missing values were not imputed. Observations with missing values were not included in the denominator for the calculations of the proportions.

The potential association between the use of prescription stimulants (binary variable) and the student's characteristics (e.g. age, gender, grade, working status, housing status, field of study, use of recreational products) was studied. Categorical variables were reclassified as binary variables as follows: 1) gender (only male and female categories were considered), 2) school year (1st year bachelor vs. other), 3) working status (yes vs. no; yes including vacation job), 4) housing status (with parents/family vs. other), 5) field of study (medicine vs. other), and recreational drug use (≤ 1/month vs. > 1/month). Age was modelled as a continuous variable and only subjects younger than 44 years were included in this analysis. Independence between use of prescription stimulants and student's characteristics was tested with chi-square tests. Odds ratios and corresponding 95 % CIs were also calculated. A full multivariable logistic regression model was fitted. Multivariable odds ratios and 95 % CIs were calculated for the final model. It should be emphasized that this analysis was done only for exploratory reasons and no causal interpretation was made.

Finally, Likert items concerning competition, moods, and emotions were analysed using frequency tables and descriptive statistics (median, mode). The potential differences in mean ranks between medicine students and other students were tested using the nonparametric Wilcoxon rank test.

Results

• Response rate

A total of 12,144 subjects responded to the survey. The estimated response rate, calculated by dividing the number of respondents (12,144) by the total reference population (88,783 in 2013-2014), was 13.7 %. The response rate by university ranged from 6 to 22 % (Table 2). Responding to the questionnaire took about fifteen minutes.

Table 2. Response rate by university

University	Number of Responses	Number of students (2013-2014)	Response rate (%)
UCLouvain Saint-Louis - Bruxelles	893	2,761	32.3 %
Université catholique de Louvain	1,860	29,025	6.4 %
Université de Liège	3,503	20,452	17.1 %
Université de Mons	1,398	6,435	21.7 %
Université de Namur	775	6,236	12.4 %
Université libre de Bruxelles	3,152	23,874	13.2 %
Not responded or excluded	563		
Total	12,144	88,783	13.7 %

Potential differences between respondents and non-respondents could not be tested because of lack of information on non-respondents. However, based on administrative figures of gender distribution in the student population of interest, it seems the male subpopulation was underrepresented in the sample. We could not distinguish early and late respondents, so it was not possible to perform comparisons based on this distinction. A difference in prevalence of use of prescription stimulants was found between full completers and partial completers.

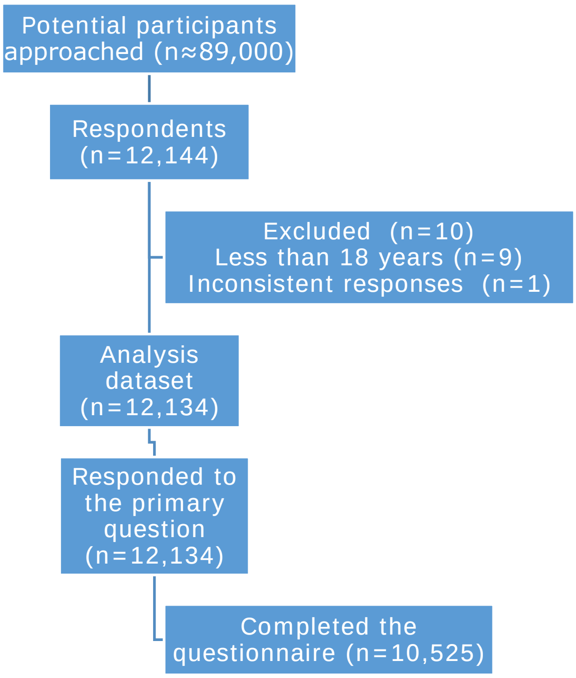
• Participant disposition

After inspecting responses to the last question of the questionnaire (comments, open-ended question, free text), it was clear that among the 12,144 subjects who responded to the survey, 9 were less than 18 years old. These subjects were excluded from the analysis. Additionally, one subject showing a partial and particularly inconsistent pattern of responses was also excluded from the analysis.

The final analysis dataset consisted of a total of 12,134 subjects.

A flow diagram depicting the progress through the phases of the study is presented in Figure 1.

Figure 1. Flow diagram



- **Completion rate**

A total of 10,525 subjects (86.7 %) were considered as full completers. A total of 747 subjects (6.2 %) did not respond to at least 3 of the following questions: age, sex, university, school year or working status.

- **Item non-response rates and distribution of missing values**

The number of missing values for each question is presented in Table 3. As can be expected in an extensive survey, the percentage of unanswered questions was correlated with the question's position in the questionnaire. Questions about recreational drug use (only alcohol consumption is shown as illustrative example in Table 3) were those with the highest level of non-response. These questions were considered as particularly sensitive, not essential for answering the main research question, not mandatory and were therefore placed at the end of the questionnaire.

Table 3. Frequency of item non-response

Number of missing observations by question	Frequency	%
Do you use stimulants as part of a treatment?	105	0.9
Do you use stimulants also outside your treatment?	109	0.9
At what age did you first use one of these stimulants?	125	1.0
Have you experienced any adverse reactions after using stimulants?	142	1.2
Have you experienced any positive effects after using stimulants?	148	1.2
By which route did you take stimulants?	156	1.3
How did you obtain stimulants?	169	1.4
Gender	497	4.1
Age	538	4.4
At which university are you a student?	553	4.6
What is your year of study?	753	6.2
Do you work during your studies?	802	6.6
Where do you live during the week?	841	6.9
How often do you return to your parents/family?	857	7.1
Which substances have you used in the last twelve months and how often: alcohol	998	8.2

The percentage of subjects with more than 5 unanswered questions was nearly 8 % (Table 4).

Table 4. Number of subjects by number of unanswered questions per questionnaire

Number of missing values by subject	Frequency	%
0	10,525	86.7
1	465	3.8
2	40	0.3
3	29	0.2
4	83	0.7
5	31	0.3
> 5	961	7.7

- ### Description of respondents

The mean age of the respondents was 22 years and the median age 21 years (Table 5). Of the respondents, 65.1 % were female, 9.9 % were medicine students, 44.6 % did not work, and 50.8 % lived with their parents or family. Sex distribution among respondents (Figure 2) did not reflect the expected distribution in the target population based on the data from the CRef (45.8 % men versus 54.2 % women in 2013-2014).

Table 5. Statistical summary of the characteristics of the study population (N=12,134)

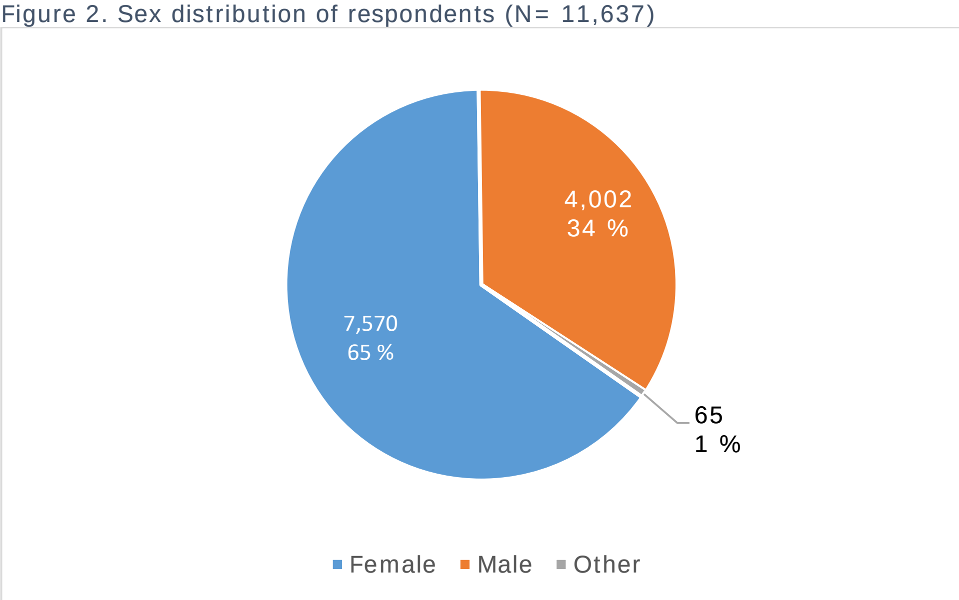
Characteristic	Value	Frequency	% [95 % CI]	Non-response
Age (years)				538
Mean (SD)	21.9 (4.8)			
Median [LQ, UQ]	21 [19, 23]			
Range	18, 70			
Sex				497
Female		7,570	65.1 [64.2, 66.0]	
Male		4,002	34.4 [33.5, 35.3]	
Other		65	0.6 [0.4, 0.7]	
University				553
UCLouvain		1,860	16.1 [15.4, 16.7]	
ULB		3,152	27.2 [26.4, 28.0]	
ULiège		3,503	30.1 [29.4, 31.1]	
UMons		1,398	12.1 [11.5, 12.7]	
UNamur		775	6.7 [6.2, 7.2]	
USL-B		893	7.7 [7.2, 8.2]	
School year				753
Bachelor (1st year)		3,554	31.3 [30.4, 32.1]	
1st registration		2,801	79.4 [78.1, 78.0]	
2 years[1]		587	16.6 [15.4, 17.9]	
> 2 years[1]		139	3.9 [3.3, 4.6]	
Bachelor (other)		3,421	30.1 [29.2, 30.9]	
2-3 years		2,741	80.6 [79.2, 81.9]	
4-5 years		610	17.9 [16.7, 19.3]	
> 5 years		52	1.5 [1.1, 2.0]	
Master		4,406	38.7 [37.8, 39.6]	
3 years		2,756	63.1 [61.6, 64.5]	
4-5 years		1,430	32.7 [31.3, 34.1]	
> 5 years		185	4.2 [3.7, 4.9]	
Study domain				582
Medicine		1,148	9.9 [9.4, 10.5]	
Health (other)		1,674	14.5 [13.5, 15.1]	
Sciences		2,746	23.8 [23.0, 24.6]	
Social sciences		5,969	51.7 [50.8, 52.6]	
Other/Unknown		15	0.1 [0.1, 0.2]	
Working status				802
No job		5,059	44.6 [43.7, 45.6]	
Vacation job		2,877	25.4 [24.6, 26.2]	

[1] Number of years of registration in the 1st year Bachelor

Job < 20 h/week		2,416	21.3 [20.6, 22.1]	
Job ≥ 20 h/week		980	8.7 [8.1, 9.2]	
Housing status				841
With parents/family		5,732	50.8 [49.8, 51.7]	
Flatsharing		3,284	29.1 [28.2, 29.9]	
Alone		1,891	16.7 [16.1, 17.5]	

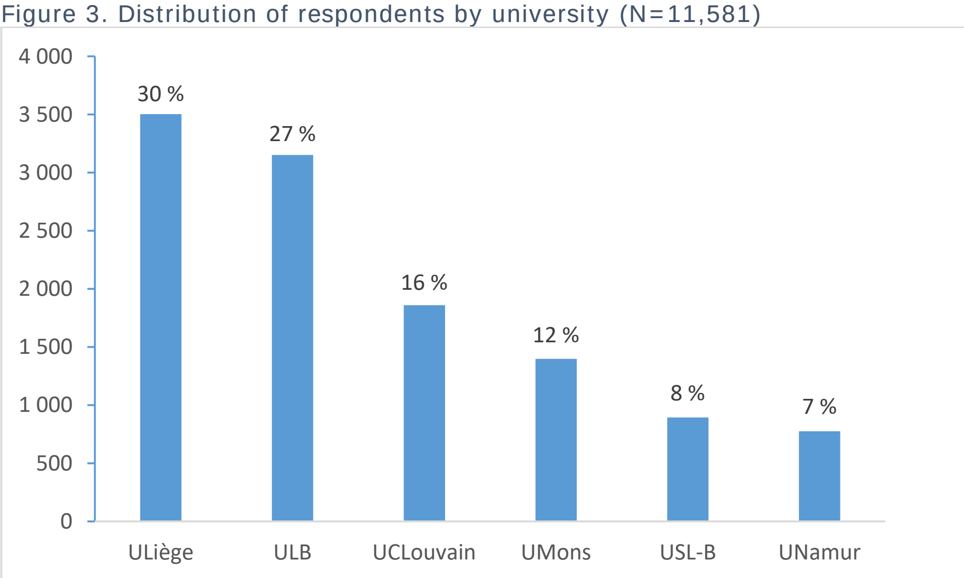
SD: standard deviation; LQ: lower quartile; UQ: upper quartile

Figure 2. Sex distribution of respondents (N= 11,637)



The distribution by academic year was relatively well balanced across the three considered categories. Approximately one quarter of the respondents were students of medicine or health sciences. Less than 10 % of the respondents reported having a job of more than 20 hours per week. Among the respondents, most represented universities were the ULiège (30.1 %) and the ULB (27.2 %) (Figure 3).

Figure 3. Distribution of respondents by university (N=11,581)

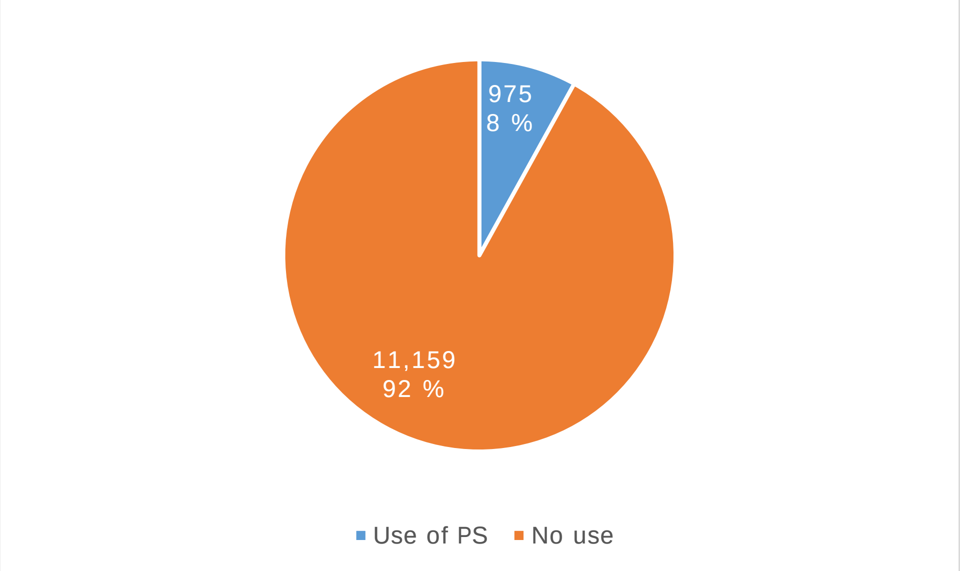


- **Analysis of primary variables**

1. Prevalence of use of prescription stimulants

A total of 975 subjects reported having used prescription stimulants at some point in their life. The lifetime prevalence, expressed as percentage [95 % CI], of use of prescription stimulants was estimated at **8.0 %** [7.6 %-8.5 %] (Figure 4).

Figure 4. Lifetime prevalence of the use of prescription stimulants (PS) (N=12,134).



Proportionally, more males (9.8 %) than females (5.2 %) were defined as prescription stimulant users.

It was noted that respondents who answered “Other” or did not answer the gender question (n=562) showed a significantly higher prevalence of prescription stimulant use (between 15 % and 35 %). When excluding these subjects, the prevalence of prescription stimulant users was 6.8 %. According to data from 2013-2014, of 88,873 university students, 54.2 % were women and 45.8 % were men. After weighting based on the distribution of gender in the student population, the prevalence of prescription stimulant use was 7.3 % [6.8 %-7.8 %].

In the population of respondents that indicated having used prescription stimulants at one time, 692 subjects reported having used prescription stimulants in the past year. After exclusion of the 150 individuals who did not answer to this question, the percent proportion of stimulant users who reported having used prescription stimulants in the past year was estimated at 83.9 % [81.2 %-86.3 %], which corresponds to a past-year use prevalence of 5.8 % [5.4 %-6.2 %].

Among non-users of prescription stimulants, 378 subjects (3.4 % [3.1 %-3.8 %]) reported having tried obtaining some.

2. Prevalence of use by prescription stimulant

Methylphenidate was by far the stimulant that was most often reported having been used (90 % of the prescription stimulant users population). Lifetime prevalence (expressed as percentage with associated 95 % CI) of specific prescription stimulant use among subjects who reported having used prescription stimulants at some time in their life is presented by medicine in Table 6. Some products cited as other included amphetamines, armodafinil, cocaine, fenethylline, ketamine, MDMA, piracetam, pseudoephedrine, and valproic acid.

Table 6. Frequency distribution of specific prescription stimulant use

Prescription stimulant	Frequency	%	95 % CI_L	95 % CI_U
Methylphenidate	788	90	88	92
Modafinil	84	9.6	7.7	12
Atomoxetine	38	4.4	3.1	5.9
Guanfacine	30	3.4	2.3	4.9
Oxybate	34	3.9	2.7	5.4
Other	62	7.1	5.5	9.0

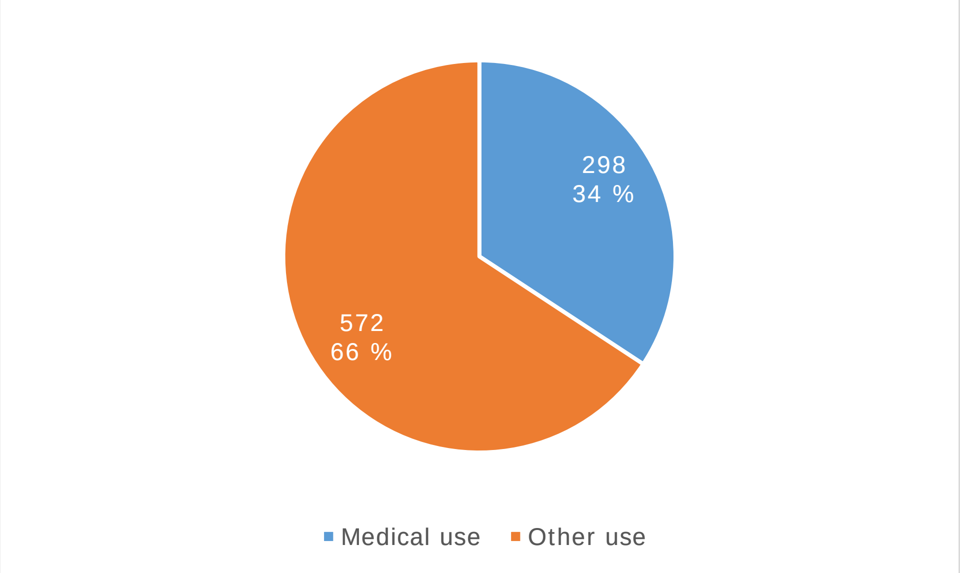
3. Prevalence of use of prescription stimulants for treatment purposes

Prescription stimulants can be used as part of treatment (medical use of prescription stimulants) or not (non-medical use of prescription stimulants). Non-medical users are students who have never used prescription stimulants in the context of treatment. Medical users reported prescription stimulant use for treatment purposes, however, it should be noted that these users also include those who also have used their medication for other (non-medical) reasons.

Among 975 users of prescription stimulants, a total of 298 subjects reported using them as part of treatment and 105 users did not respond to this question. The prevalence of medical use of prescription stimulants can be estimated at 34.3 % [31.1 %-37.5 %]. The majority of the subjects reported prescription stimulant use for non-medical reasons (n=572; 65.7 % [62.5 %-68.9 %]) (Figure 5).

Overall, it can be estimated that **4.8 %** (95 % CI 4.4–5.2 %) of students have used prescription stimulants for non-medical reasons at some time. Medical use can be estimated at 2.5 % (95 % CI 2.2–2.8 %).

Figure 5. Medical and non-medical use in users of prescription stimulants (N=870)



The majority (85.9 %) of medical users reported prescription stimulant use for treating an attention disorder. The prevalence (expressed as percentage with associated 95 % CI) of the medical use of prescription stimulants among users is presented by treatment in Table 7. Some of the indications cited as "Other" included autism, dyslexia, depression, epilepsy, hypersomnia, Lyme disease, myelopathy, psychosis, post-traumatic stress disorder, anxiety disorders and sleep disorders.

Table 7. Frequency distribution of indication for treatment with prescription stimulants

Treatment	Frequency	%	95 % CI_L	95 % CI_U
Attention disorder	256	85.9	81.4	89.7
Hyperactivity	116	38.9	33.4	44.7
Narcolepsy	26	8.7	5.8	12.5
Other	24	8.1	5.2	11.7

- **Analysis of secondary variables**

1. Description of the users of prescription stimulants

The median age of the subset of users of prescription stimulants was twenty two years (Table 8). The distribution by gender was balanced between females (49.6 %) and males (49.2 %). Regarding the status of working and housing, 39.2 % reported not having a job and 46.3 % did not live with their family/parents.

Table 8. Statistical summary of the characteristics of the subset of users of prescription stimulants

Characteristic	Value	Frequency	% [95 % CI]
Age (years)			
Mean (SD)	22.9 (4.8)		
Median [LQ, UQ]	22 [20, 25]		
Range	18, 70		
Sex			
Female		395	49.6 [46.0, 66.0]
Male		392	49.2 [45.7, 52.7]
Other		10	1.3 [0.6, 2.3]
Working status			
No job		306	39.2 [35.8, 42.8]
Holiday job		158	20.3 [17.5, 23.3]
Job < 20 h/week		202	25.9 [22.9, 29.1]
Job ≥ 20 h/week		114	14.6 [12.2, 17.3]
Housing status			
With parents/family		360	46.3 [42.8, 49.9]
Flatsharing		230	29.6 [26.4, 32.9]
Alone		22	21.2 [18.4, 24.3]

SD: standard deviation; LQ: lower quartile; UQ: upper quartile

Prescription stimulant use was significantly more prevalent among more senior students, with a lifetime prevalence of 7.9 % for master students compared to 4.9 % for first bachelor year students (Table 9).

Table 9. Frequency distribution by school year for the subset of users of prescription stimulants

School year	Frequency	%	95 % CI_L	95 % CI_U
Bachelor (1st year)	174	4.9	4.2	5.7
Bachelor other year or Master	605	7.7	7.1	8.3
Bachelor (other year)	255	7.5	6.6	8.4
Master	350	7.9	7.2	8.8

2. Patterns of timing and frequency of use of prescription stimulants

Frequency of prescription stimulant use by different time periods (examination period, all year, internships, student parties or sports competitions) is presented in Table 10. Percentages were calculated using the number of prescription stimulant users as denominator (N=975).

Of respondents who reported having used prescription stimulants in the past year, 64.8 % used them at least once a week and 49 % used them daily during examination or revision periods ("blocus"). In contrast, during the year use is much less, with 51 % of the students indicating not using this medication. The majority of the students reported no prescription stimulant use at parties, internships and sports competitions.

Table 10. Frequency distribution of prescription stimulant use in the past year by period of use for all users of prescription stimulants

Period of time	Frequency	%	95 % CI_L	95 % CI_U
Examination period/Revision break (Blocus)				
Never	146	18.3	15.7	21.2
≤ 1/month	89	11.2	9.1	13.6
< 1/week - > 1/month	45	5.7	4.2	7.5
≥ 1/week - < 1/day	127	16.0	13.5	18.7
1/day	226	28.4	25.3	31.7
> 1/day	163	20.5	17.7	23.5
All year				
Never	380	51.4	47.7	55.0
≤ 1/month	105	14.2	11.8	17.0
< 1/week - > 1/month	52	7.0	5.3	9.1
≥ 1/week - < 1/day	67	9.1	7.1	11.4
1/day	74	10.0	8.0	12.4
> 1/day	62	8.4	6.5	10.6
Internships				
Never	568	78.9	75.7	81.8
≤ 1/month	18	2.5	1.5	3.9
< 1/week - > 1/month	23	3.2	2.0	4.8
≥ 1/week - < 1/day	26	3.6	2.4	5.2
1/day	47	6.5	4.8	8.6
> 1/day	38	5.3	3.8	7.2
Student parties				
Never	616	86.2	83.4	88.6
≤ 1/month	39	5.5	3.9	7.4
< 1/week - > 1/month	11	1.5	0.8	2.7
≥ 1/week - < 1/day	12	1.7	0.9	2.9
1/day	20	2.8	1.7	4.3
> 1/day	17	2.4	1.4	3.8
Sports competitions				
Never	656	92.1	89.9	94.0
≤ 1/month	12	1.7	0.9	2.9
< 1/week - > 1/month	3	0.4	0.1	1.2
≥ 1/week - < 1/day	9	1.3	0.6	2.4
1/day	17	2.4	1.4	3.8
> 1/day	15	2.1	1.2	3.5

Distribution of use frequency for the subset of medical and non-medical users during the different time periods is presented in Table 11. Use frequency was grouped into a single category of "< 1/week" for respondents who ticked "≤ 1/month" or "< 1/week - > 1/month ". Respondents who indicated "≥ 1/week", "1/day" or "> 1/day" were combined into one category of ">= 1/week".

The majority of non-medical (56.6 %) and medical (81.4 %) users have used prescription stimulants at least once a week during the examination/revision period. A clear distinction of consumption is seen during the year: 59.8 % of medical users have used prescription stimulants at least once a week, compared to 8.7 % of non-medical users. One third of medical users indicated regular use (≥ 1/week) during internships. Among non-medical users, regular use during student parties (3.8 %) or at sports competitions (1.9 %) is limited.

Table 11. Frequency distribution of prescription stimulant use in the past year by period of use for students who use prescription stimulants for medical or non-medical reasons

Type of use	Non-Medical		Medical	
Period of time	Frequency	%	Frequency	%
Examination period/Revision break (Blocus)				
Never	103	19.4	43	16.3
< 1/week	128	24.1	6	2.3
≥ 1/week	301	56.6	215	81.4
All year				
Never	309	65.9	71	26.2
< 1/week	119	25.4	38	14.0
≥ 1/week	41	8.7	162	59.8
Internships				
Never	415	87.7	153	61.9
< 1/week	29	6.1	12	4.9
≥ 1/week	29	6.1	82	33.2
Student parties				
Never	417	88.4	199	81.6
< 1/week	36	7.6	14	5.7
≥ 1/week	18	3.8	31	12.7
Sports competitions				
Never	450	96.6	206	83.7
< 1/week	7	1.5	8	3.3
≥ 1/week	9	1.9	32	13.0

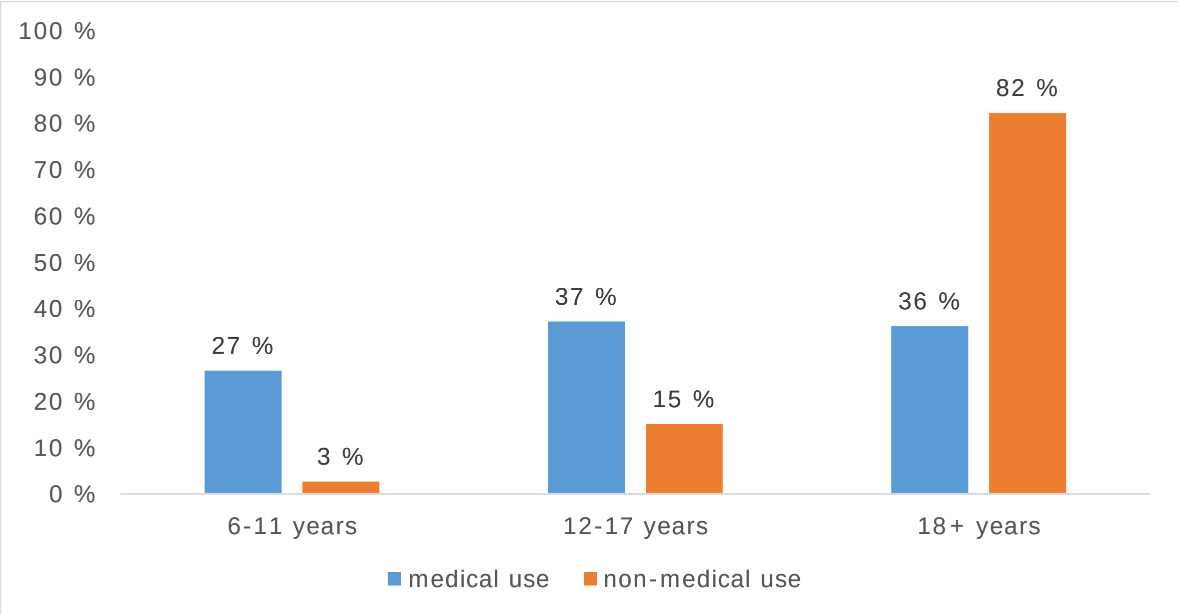
3. Age of first of prescription stimulant use

The majority of prescription stimulant users (66.4%) started using at 18 years old (Table 12). A total of 125 prescription stimulant users did not answer this question. Among non-medical users, 82 % [95 % CI; 78.8-85.3 %] started at the age of 18 years or older, compared to 36.2 % [95 % CI; 30.7-42.0 %] in medical users (Figure 6).

Table 12. Frequency distribution of age of first prescription stimulant use

Age of first use	Frequency	Percent	95 % CI_L	95 % CI_U
6-11 years	93	10.9	8.9	13.2
12-17 years	193	22.7	19.9	25.7
18+ years	564	66.4	63.1	69.5

Figure 6. Age of first prescription stimulant use in students who use prescription stimulants for medical or non-medical reasons



4. Non-medical reasons for prescription stimulant use

The most frequently cited reasons for using prescription stimulants other than for treatment, were, by far, academically related: to concentrate while studying, to stay awake and study longer, to improve intellectual/academic performance and to better memorise courses (Table 13). To a lesser extent, the willingness to try prescription stimulants was reported, a minority reported using them for partying, disconnecting from reality or to lose weight/reduce appetite.

Among the 298 subjects who use prescription stimulants for medical treatment, 29 (9,7 %) reported having used prescription stimulants for other purposes as well. There were 107 medical users of prescription stimulants who did not respond to this question.

Table 13. Frequency distribution of reasons to use prescription stimulants for purposes other than treatment (N=706)

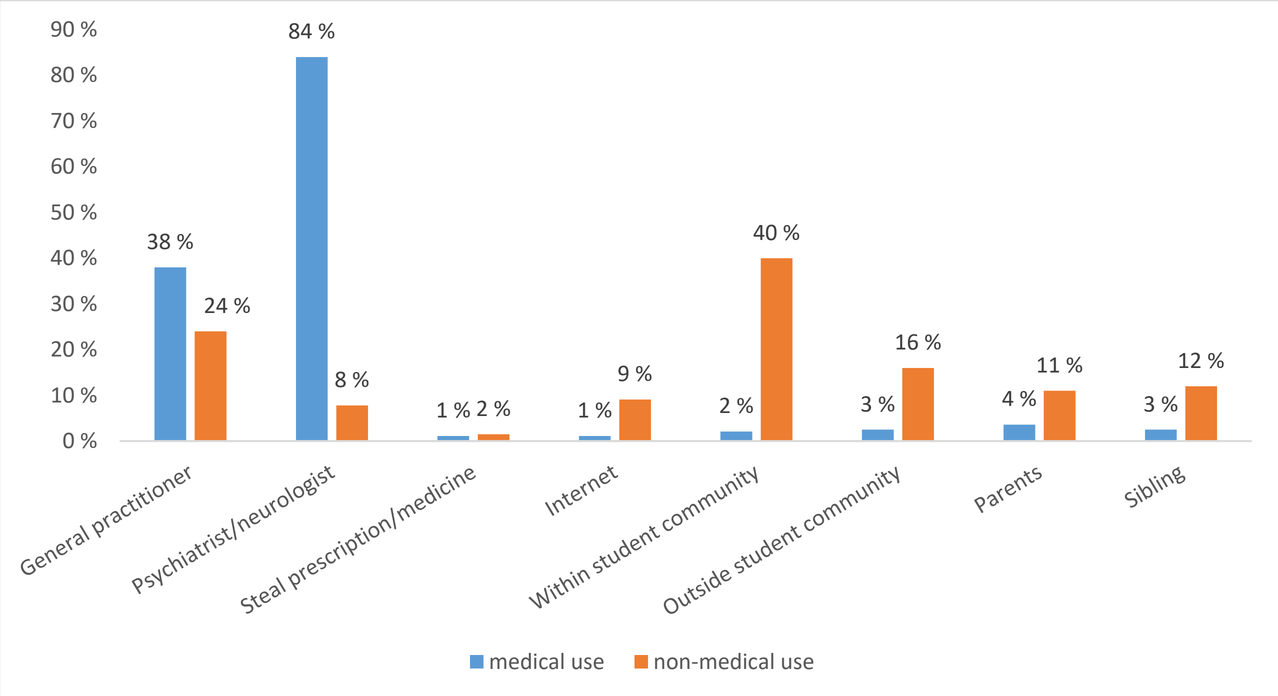
Purpose	Frequency	Percent	95 % CI_L	95 % CI_U
To concentrate while studying	456	77.6	74.0	80.9
To stay awake/study longer	306	52.4	48.3	56.5
To improve intellectual/academic performances	284	48.8	44.7	52.9
To better memorise courses	267	46.1	42.0	50.3
To try	125	21.9	18.6	25.5
To party	49	8.6	6.4	11.1
To escape/disconnect from reality	31	5.4	3.7	7.6
To lose weight/decrease appetite	30	5.2	3.6	7.4
To improve sports performance	20	3.5	2.1	5.3
To act like others/fashionable phenomenon	10	1.8	0.8	3.2
Other	38	6.7	4.8	9.0

5. Channels for obtaining prescription stimulants

The main route of purchase was through health care professionals (28.8 % through a general practitioner (GP) and 34.2 % through a neurologist or psychiatrist). The other major purchase route described was via friends or acquaintances of the student community (26.7 %). A minority was obtained through friends outside of the student community (11.2 %), prescription or medicine theft (1.4 %), the internet (6.3 %) or a family member (8.6 % through a parent and 8.4 % via a sibling).

Among non-medical users, the main channel for obtaining prescription stimulants is a friend or acquaintance within the student community (39.8 %) or a GP (24.0 %) (Figure 7). For medical users, the main channel is a psychiatrist, neurologist (83.6 %) or GP (37.7 %).

Figure 7. Channels for obtaining prescription stimulants for students who use prescription stimulants for medical or non-medical reasons.



6. Route of administration

The most frequently used route of administration was by far the oral route (99.0 %) (Table 14). Nasal administration was more commonly reported in nonmedical users (10%) compared to medical users (1.1%).

Table 14 Frequency distribution of route of administration used for taking prescription stimulants

Route of administration	Frequency	Percent	95 % CI_L	95 % CI_U
Oral	809	98.8	97.8	99.4
Nasal	58	7.1	5.5	0.09
Injection	13	1.6	0.9	2.6
Inhalation	20	2.4	1.53.7	3.2

The great majority of oral users reported taking prescription stimulants with water and/or fruit juice. The second most reported drinks were coffee/tea (Table 15).

Table 15. Frequency distribution of drinks used with oral consumption of prescription stimulants.

Drink	Frequency	Percent	95 % CI_L	95 % CI_U
Water/fruit juice	721	89.3	87.0	91.4
Coffee/tea	220	27.3	24.2	30.5
Energy drinks	114	14.1	11.8	16.7
Cola drinks	75	9.3	7.4	11.5
Other soft drinks	44	5.5	4.0	7.2
Alcohol	6	0.7	0.3	1.6

7. Perceived adverse events associated with prescription stimulant use

462 of 833 users (who responded to the relevant question) reported having experienced adverse events after using prescription stimulants. The estimated prevalence of perceived adverse events among prescription stimulant users was 55.5 % [52.0 %-58.9 %].

Prevalence (expressed as percentage with associated 95 %CI) of the specific events among subjects who responded having experienced side effects is presented in Table 16. More than half the respondents reported sleep disorders as adverse reactions. Other commonly reported adverse reactions (more than one third of respondents) included, in order of decreasing frequency, palpitations, emotional instability and agitation.

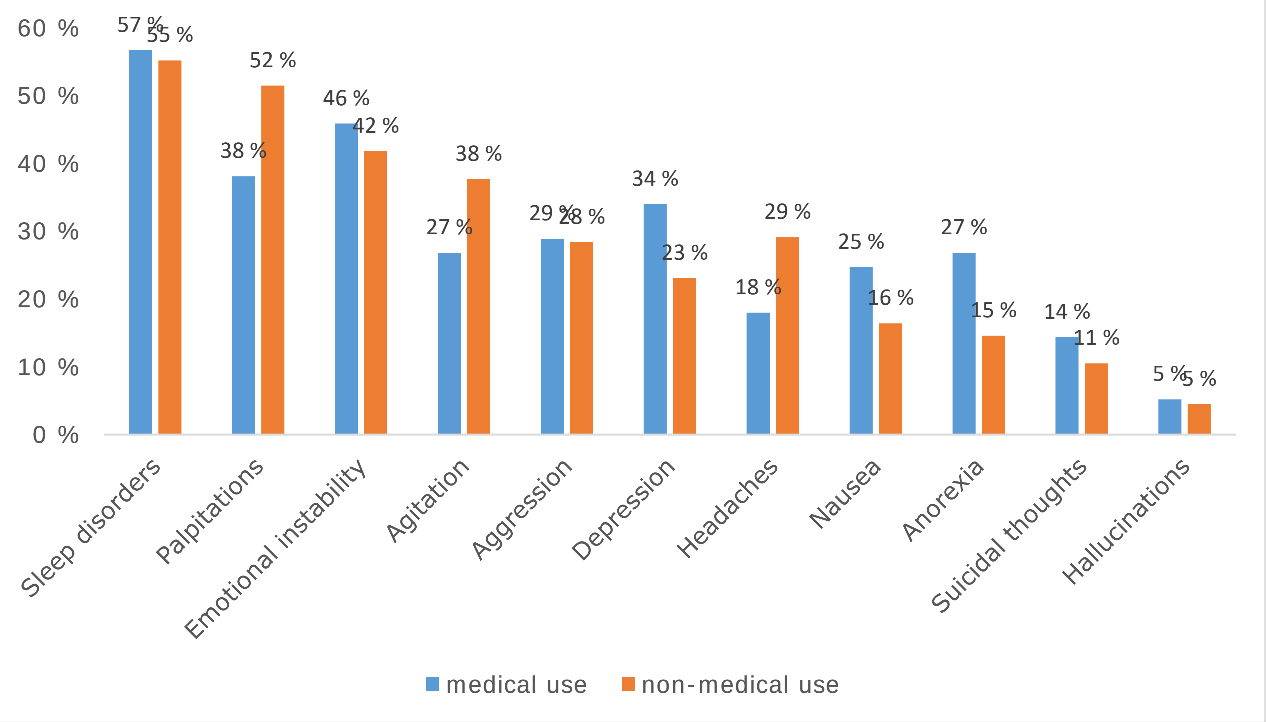
Table 16. Frequency distribution of experienced negative effects associated with prescription stimulant use (N=462)

Negative effects	Frequency	Percent	95 % CI$_L$	95 % CI$_U$
Sleep disorders	258	55.8	51.2	60.4
Palpitations	212	45.9	41.3	50.6
Emotional instability	201	43.5	38.9	48.2
Agitation	153	33.1	28.8	37.6
Aggression	132	28.6	24.5	32.9
Depression	128	27.7	23.7	32.0
Headaches	113	24.5	20.6	28.6
Nausea	92	19.9	16.4	23.9
Anorexia	91	19.7	16.2	23.6
Suicidal thoughts	56	12.1	9.3	15.5
Hallucinations	22	4.8	3.0	7.1

Other cited adverse reactions include fatigue, anxiety/stress, transpiration, acne, anhedonia, apathy, associability, increased hunger, ruminations, dry mouth, blurred vision, diarrhea, and withdrawal effects, among others.

In medical users, adverse events were reported more frequently compared to non-medical users, with 67.6 % [62.0 %-72.8 %] in medical users and 49.1 % [44.9 %-53.3 %] in non-medical users. Overall the type of perceived negative effects is similar in medical and non-medical users. Non-medical users more frequently reported palpitations and agitation while depression, nausea and anorexia seem to be more perceived by medical users (Figure 8).

Figure 8. Distribution of reported negative effects associated to prescription stimulant use in medical and non-medical users (N=462)



8. Perceived positive effects associated with prescription stimulant use

A total of 705 subjects among 827 users (who responded to the relevant question) reported having experienced positive effects after using prescription stimulants. The estimated prevalence of perceived positive effects among prescription stimulant users was 85.3 % [82.7 %-87.6 %].

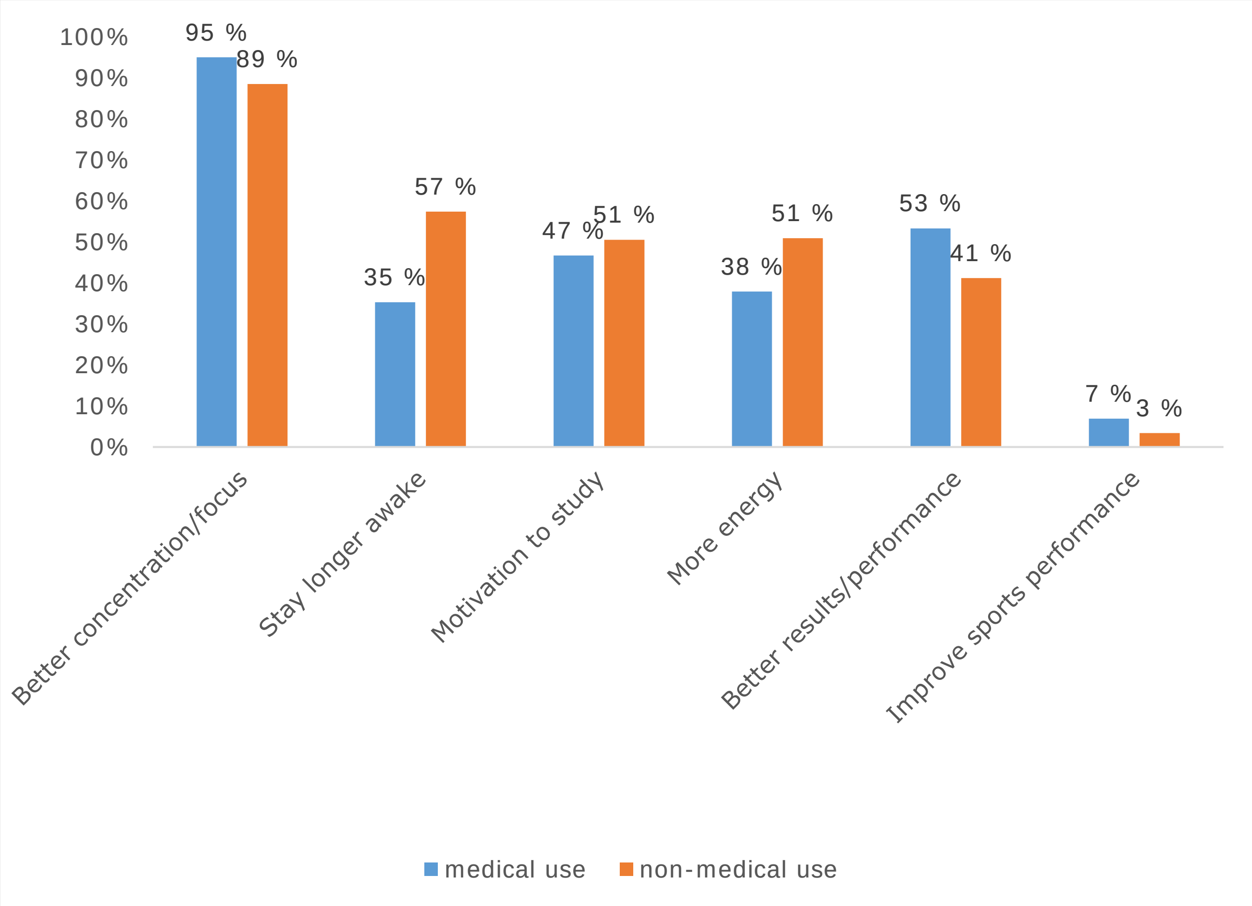
Prevalence (expressed as proportion with the associated 95 % CI) of the perceived positive effects among subjects who responded having experienced positive effects is presented in Table 17. The vast majority (> 90 %) of respondents reported improved concentration as a positive effect. Between 45 % and 50 % of the respondents reported positive effects related to the ability to stay awake, to study, to increase their energy, and to improve their performance.

Table 17. Frequency distribution of experienced positive effects associated to prescription stimulant use (N=705)

Positive effects	Frequency	Percent	95 % CI_L	95 % CI_U
Concentration/focus	641	90.9	88.6	92.9
Staying awake longer	347	49.2	45.5	53.0
Motivation to study	346	49.1	45.3	52.8
More energy	325	46.1	42.4	49.9
Better results/performance	322	45.7	42.0	49.4
Improved sports performance	33	4.7	3.2	6.5

In medical users, positive effects were reported slightly more often (91.3 % [87.4 %-94.0 %]) compared to non-medical users (82.1 % [78.6 %-85.1 %]). In non-medical users the effects of staying awake longer and having more energy were reported more frequently compared to medical users, whereas better concentration and better results were reported more by medical users (Figure 9).

Figure 9. Distribution of reported positive effects associated to prescription stimulant use in medical and non-medical users (N=705).



9. Prevalence of prescription stimulant use among medicine students

95 of 1,148 medicine students reported having used prescription stimulants at some point in their life. Lifetime prevalence, expressed as percentage [95 % CI], of prescription stimulant use was 8.3 % [6.7 %-10.0 %].

75 of 92 (81.5 %) medicine students who reported having used prescription stimulants at some point in their life also reported using prescription stimulants in the past year (three students did not respond to this question).

Among medicine students who use prescription stimulants, 74.7 % reported using them for non-medical reasons (other than treatment). The lifetime prevalence of non-medical use of prescription stimulants among medicine students is estimated at 6.2 % [4.9 %-7.7 %].

10. (Combined) use of other stimulants/products in the past year

Over one in ten students indicated not having consumed alcohol in the past year, while four in ten students drank alcohol once or more than once a week (Table 18). Energy drinks, nicotine and cannabis were consumed by 44.1 %, 25.5 % and 23.9 % of students respectively. To a much lesser extent, hypnotic, sedative or anxiolytic medicines and caffeine pills were used. Under 5 % of students used drugs like ecstasy, cocaine or amphetamines.

Table 18. Frequency distribution of the use of drugs for recreational reasons (past year)

Drug	Never		< 1x/week		≥ 1x/week		Non response
	Frequency	Percent	Frequency	Percent	Frequency	Percent	Frequency
Alcohol	1,848	16.6	4,689	42.1	4,599	41.3	998
Energy drinks	6,240	55.9	3,670	32..9	1,248	11.1	976
Nicotine	8,302	74.5	1,255	11.2	1,591	14.3	986
Cannabis	8,470	76.1	2,083	18.7	572	5.1	109
Hypnotics/ sedatives	10,055	90.3	758	6.8	326	2.9	995
Caffeine pills	10,374	93.4	409	3.6	324	2.9	1,027
Corticosteroids	10,727	96.3	305	2.7	106	1	996
XTC	10,742	96.7	339	3	23	0.2	1,030
Cocaine	10,832	97.5	241	2.2	32	0.3	1,029
Amphetamines	10,940	98.4	142	1.3	31	0.3	1,021

The estimated prevalence of prescription stimulant use combined with use of other recreational drugs (e.g. narcotics, alcohol, nicotine, stimulants, tranquilizers, hallucinogens) is presented in Table 19. As can be expected in this population, alcohol was the most prevalent recreational substance used (88 %), followed by energy drinks (64 %), nicotine (48 %), and cannabis (46 %).

Table 19. Frequency distribution of drug use for recreational reasons among prescription stimulant users

Drug	Frequency	Proportion	95 % CI_L	95 % CI_U	Non response
Alcohol	659	88.3	85.8	90.6	229
Energy drinks	476	63.7	60.2	67.2	228
Nicotine	360	47.8	44.2	51.4	222
Cannabis	345	46.1	42.5	49.8	227
Hypnotics/ sedatives	203	27.3	24.1	30.6	231
XTC	129	17.3	14.6	20.2	229
Cocaine	107	14.4	11.9	17.1	231
Caffeine pills	94	12.8	10.5	15.5	242
Amphetamines	79	10.6	8.5	13.0	228
Corticosteroids	77	10.4	8. 3	12.8	235
Other	67	9.0	7.0	11.3	229

The answers grouped as “Other” included LSD, magic mushrooms, ketamine, and methadone, among other substances.

Other analyses

1. Opinion on rivalry (competition)

Over 40 % of respondents disagreed with the statement that they feel rivalry among students over who gets the best results. About one third of the respondents agreed with this statement, and one third neither agreed nor disagreed (Table 20).

Table 20. Frequency distribution of the different answers to Likert question on rivalry

Characteristic	Frequency	Percent	95 % CI$_L$	95 % CI$_U$
Students compete to obtain the best results				
Strongly disagree	1,636	13.9	13.3	14.5
Disagree	3,464	29.4	28.5	30.2
Neither disagree nor agree	3,435	29.1	28.3	30.0
Agree	2,330	19.8	19.0	20.5
Strongly agree	930	7.9	7.4	8.4

In prescription stimulant users, feelings of rivalry (agree and strongly agree) were reported more frequently (36.9 % [33.6-40.4 %]) compared to students who did not use prescription stimulants (27,0 % [26.1-27.8 %]).

Statistically significant differences ($p < 0.0001$) were also detected between medicine students and other students. Medicine students reported feelings of rivalry more frequently (67.2 % [64.4 %-69.9 %]) compared to other students (23.2 % [22.4-24.1 %]) and had the highest rank mean values (as well as median values and modes). This suggests that medicine students were more likely to agree with the feeling that rivalry among students was present for getting the best results (Table 21).

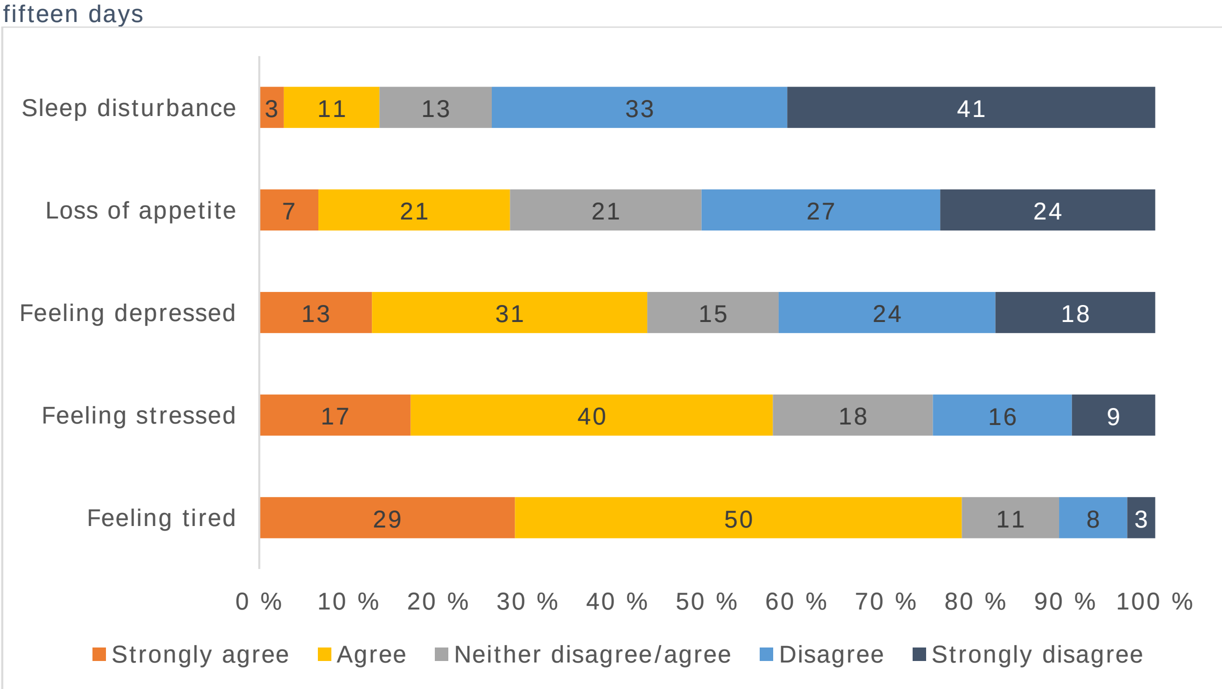
Table 21. Descriptive statistics of the Likert question on rivalry

Cursus	Mean	Median	Mode	Quartile range
Medicine	3.8	4	4	2
Other	2.7	3	2	1

2. Moods and emotions in the past fifteen days

The majority of students reported feeling tired (78.5 %) or stressed (57.3 %) in the past fifteen days (Figure 10). Just over 40 % of students reported feeling depressed in the past fifteen days. On the other hand, sleep disturbance and loss of appetite was less frequently reported.

Figure 10. Distribution of the different answers to Likert questions on moods and emotions in the past fifteen days



Feelings of fatigue were more pronounced among students who did not use prescription stimulant medicines with 79.5 % [78.7-80.2 %] versus 64.0 % [60.5-67.3 %] among prescription stimulant users. Conversely, sleep disturbances were more pronounced among users of stimulant medicines with 19.5 % [16.8-22.4 %] versus 13.0 % [12.3-13.6 %] among non-users.

Statistically significant differences ($p < 0.0001$) were also detected between medicine students and other students for feeling stressed. Concerning stress, medicine students had slightly higher rank mean values compared to other students. For feeling depressed and sleep disturbance, the rank mean values were slightly numerically lower in medicine students. No differences were observed for feeling tired and loss of appetite. As could be expected, the group of students other than medicine students tended to show a greater variability (in particular for the items stress and sleeping disturbances).

A descriptive summary of the rank values is presented in Table 22.

Table 22. Descriptive statistics of the Likert questions on moods and emotions

Characteristic	Mean	Median	Mode	Quartile range
Feel stressed				
Medicine	3.5	4	4	1
Other	3.4	4	4	2
Loss of appetite				
Medicine	2.6	2	2	2
Other	2.6	2	2	2
Feel tired				
Medicine	3.9	4	4	1
Other	3.9	4	4	1
Sleep disturbance				
Medicine	1.9	2	1	1
Other	2.0	2	1	2
Feel depressed				
Medicine	2.9	3	4	2
Other	3.0	3	4	2

3. Association between prescription stimulant use and other variables

The results of the univariable analyses showed statistically significant associations (at 0.01 level) between prescription stimulant use and the majority of considered predictors: gender, age, school year, working status, and use of recreational drugs (alcohol, nicotine, energy drinks, caffeine pills, hypnotics/sedatives, corticosteroids, cannabis, amphetamines, ecstasy, and cocaine). No statistically significant difference was found between medicine students and other students.

In the full multivariable logistic model, the following predictors showed highly statistically significant association ($p < 0.0001$) with prescription stimulant use: gender, age and use of nicotine, energy drinks, hypnotics/sedatives, corticosteroids, cannabis, and cocaine. Prescription stimulant users were more likely to be men, older and enrolled in school years other than the first bachelor year. Prescription stimulant users were also more likely to use drugs for recreational purposes. The Wald chi-square values (and associated p-values) and odds ratios (along with associated 95 % CI) are presented in Table 23. Male sex was associated with a 76 % increase in prescription stimulant use. The predictors that showed highest odds ratio values were the use of cocaine, corticosteroids, amphetamines, and hypnotics/sedatives.

Table 23. Chi-square test results and multivariable odds ratios for assessing the association between prescription stimulant use and different predictive variables

Covariate	Odds Ratio	95 % CI_L	95 % CI_U	Chi-square	P-value
Gender (M vs F)	1.76	1.49	2.07	44.05	< 0.0001
Age	1.07	1.04	1.07	37.31	< 0.0001
Energy drinks (> 1 month vs ≤ 1 month)	1.74	1.45	2.08	35.96	< 0.0001

Hypnotics / Sedatives (> 1month vs ≤ 1 month)	2.35	1.77	3.11	35.31	< 0.0001
Nicotine (> 1 month vs ≤ 1 month)	1.76	1.43	2.16	28.58	< 0.0001
Corticosteroids (> 1 month vs ≤ 1 month)	3.23	2.01	5.19	23.42	< 0.0001
Cannabis (> 1 month vs ≤ 1 month)	1.79	1.41	2.27	22.46	< 0.0001
Cocaine (> 1 month vs ≤ 1 month)	3.32	1.62	6.81	10.69	0.0011
Amphetamines (> 1 month vs ≤ 1 month)	2.87	1.27	6.48	6.41	0.0114
School year (other vs 1st year)	1.25	1.02	1.55	4.53	0.0333
Ecstasy (> 1 month vs ≤ 1 month)	2.10	0.81	5.44	2.33	0.1268
Courses (other vs medicine)	0.83	0.64	1.07	2.06	0.1511
Alcohol (> 1 month vs ≤ 1 month)	1.15	0.94	1.40	1.9194	0.1659
Caffeine pills (> 1 month vs ≤ 1 month)	1.20	0.85	1.69	1.10	0.2935
Working status (Y vs N)	1.08	0.91	1.29	0.86	0.3545
Housing status (other vs family/parents)	0.93	0.79	1.11	0.64	0.4228

4. Free comments

The last question of the survey was a free-text field reserved for comments. Overall, 1,340 respondents gave their state of mind and opinion on university life, their alternatives to prescription stimulants, as well as remarks on the questionnaire.

Most comments were related to academic stress (248). Regarding stress, nearly one third of respondents mentioned health problems that sometimes lead to using other medication (85) or depressive symptoms leading to using medication (36). According to 32 respondents, this stress is due to the insufficient pedagogical qualities of the teachers and a lack of awareness on their part. Due to perceived pressure, 32 respondents spontaneously stated they were tempted to buy prescription stimulants but that they didn't succeed in doing so. Some students mentioned burnout (11). Other sources of stress cited include the administrative system of university, funding and timing of exams that appear to be problematic (36).

Some wondered if the survey was really anonymous (4). Others mentioned that it could encourage substance use by quoting substances (6). Despite this, 49 respondents reported that they found the survey interesting or wanted to be informed on the results. Several students requested campaigns to raise awareness for prescription stimulants, alcohol consumption and energy drinks (33).

There were 113 students who mentioned that prescription stimulants are common in universities, particularly among medicine students (29). This generates feelings of injustice or of cheating (7). Some also mentioned, "organised trafficking" on the campus (14) as well as ease of purchase and prescription (10 and 14 respectively). Regarding alternatives to prescription stimulant use, some students mentioned a healthy lifestyle (17), sports (7), but also the use of stimulating drinks (122), food supplements (106) and sugar such as chocolate and candy (10).

Regarding stimulant drinks, more than half of the comments focused on coffee consumption, particularly during the examination period. One-quarter concerned energy drinks (34) and to a lesser extent tea (16). Food supplements are used for different reasons: fighting stress (32), fighting fatigue (12), to improve memory (10), for the three previous reasons (21) or for sleeping (9). All of these supplements are often mixed and used for optimal effect. Advertisers make extensive use of free distribution of vitamins and energy drinks. Some flyers distributed on the campus would promote the consumption of these substances by claiming to "help them succeed in their studies". These advertisements on university campuses were mentioned as problematic (4).

Discussion

Prevalence of use

To our knowledge, this is the first survey estimating the prevalence rate of prescription stimulant use among French-speaking university students in Belgium. Both lifetime, past-year and non-medical prevalence of prescription stimulants were similar to observations in Flanders.

Overall, we detected a lifetime prevalence of prescription stimulants of 8.0 %, with a past-year prevalence of 5.8 % and a non-medical lifetime prevalence of 4.8 %. Flemish university and college students (N = 36,041) reported a lifetime prevalence of 10.5 %, a past-year prevalence of 6.5 % and a non-medical lifetime prevalence of 8.5 % in 2017 [3]. Previous studies performed from 2005 to 2013 in the student population in Flanders did not indicate an increase in prescription stimulant use over the years [8].

The vast majority of international literature on prescription stimulant use in students focuses on its use for non-medical purposes. An American review study by Benson and colleagues [9] reports a lifetime prevalence between 8 % and 43 % of students who have used this medication for non-medical purposes. However, the percentages in Europe are much lower. For example, an European review study reports prevalences between 0.8 % and 16 % [1].

In a study in the UK and Ireland, less than 10 % of students reported a lifetime prevalence of prescription stimulant use for neuro-enhancement [10]. However, one third expressed an interest in experimenting with neuro-enhancement. In our study, 3.4 % who did not use prescription stimulants have tried to obtain some. The reasons for non-obtaining were not further questioned in our study, but in the UK, the main reasons were lack of availability and concerns about side effects.

For those students who used prescription stimulants for medical reasons, attention disorder was the most frequently cited indication. Noteworthy is that one out of ten of these medical users reported also non-medical use. Indeed, in up to a quarter of patients with ADHD, misuse of their prescribed medication has been observed, most likely by overusing it and consuming higher doses than prescribed [11].

Characteristics

In our study, lifetime use in males was twice as high compared to females and increased with age, confirming trends found in other studies. Several studies have reported higher rates of use and misuse among males than among females [1]. Also, older students are more likely to have tried prescription stimulants for neuro-enhancement [10], [12]. It should be noted, however, that there is no significant gender difference in the diagnosis of ADHD in adulthood, unlike in childhood when there is a higher prevalence among boys [13].

In students who did not answer the gender question or answered “other”, a higher prevalence of prescription stimulant use was noted. This could suggest another profile of respondents (not serious, desire for anonymity, rejection of binary classification). When this group is excluded, the overall prevalence drops slightly but tends to be gender-neutral.

In our study, the age of first use among medical users was equitably distributed into categories ranging from 6 years to over 18 years of age, with one third starting to use after the age of 18 years. According to a meta-analytic review, the overall prevalence of ADHD was higher in preschool (10.5 %) and elementary school samples (11.4 %), which then declined in samples of adolescents (8.0 %) [14].

In non-medical users, more than 80 % of respondents started after the age of 18. This is similar to results in Flanders, where 77.3 % of non-medical users took prescription stimulants for the first time after the age of 18 years [3].

Reasons for use

Among students who use prescription stimulants for medical reasons, attention disorder was the most frequently cited indication. Based on DSM-IV screening for ADHD in adults aged 18-44 years, the estimate of adult ADHD prevalence was 4.1 % in Belgium [15]. Recent studies suggest that ADHD in adults can be a different condition than in children: only a small minority of children with ADHD still had the diagnosis as young adults, while most adults with ADHD were never diagnosed as children [13], [16].

In our sample, 26 students (0.2 % of the respondents) noted narcolepsy as an indication for use of prescription stimulants and 34 respondents used oxybate, which is only indicated for narcolepsy with cataplexy in adults. According to the literature, narcolepsy is rare, occurring in 0.025 % to 0.050 % of the population, with a peak incidence between the ages of 10 and 19 years [17].

Prescription stimulant use for non-medical reasons was significantly more prevalent than use for medical reasons. In particular, use for academical reasons was highly prevalent. The main reasons for non-medical use of prescription stimulants in a US survey were also academical (improved concentration and help studying) [18], resembling our identified primary reasons for non-medical use. However, in the US survey, “to experiment” and “to get high” were reported by almost one-third of the respondents. In our study, we found that non-medical use as a party drug is rather limited (9 %), while “to try out” was reported in 22 %. Indeed, studies consistently indicate that the main motivation students report for misusing prescription stimulants is cognitive and academic enhancement [9], [19]. However, abuse of these medicines appears to be negatively associated with academic performance, indicating that abuse does not necessarily lead to academic improvement, despite students' perception of its benefits [9], [19].

Frequency of use

Overall, prescription stimulant use was more frequent during examination or revision periods, compared to the use during the year, when half of the users did not use any prescription stimulants at all. For medical users, consumption was more constant, regardless of the period. Only a small proportion of non-medical users also uses prescription stimulants at least weekly during the year, while use during internships, parties or sports competitions is even more limited. This pattern of use is similar to other studies in Flanders and in Europe [1], [20].

However, attention has to be paid to a minority of non-medical users, who use prescription stimulants frequently during exam periods, as this can lead to cardiovascular problems, insomnia and dependence [21]. Prolonged use has not been studied in adults, but past exposure to methylphenidate has been linked to an increased incidence in stress fractures and probable cardiovascular effects [21], [22]. Moreover, the use of methylphenidate in women aged > 18 years incurs a risk of exposition during pregnancy, with potential teratogenic effects.

As long-term data on the efficacy and safety of prescription stimulants in adults are scarce, the need for treatment with medication should be reviewed regularly. An annual reassessment is recommended in order to limit the use of methylphenidate in the long term and to manage and prevent medication side effects [23]. During the medication stop, the symptoms and functioning of the patient without pharmacotherapy should be re-evaluated, in order to determine whether further treatment is still necessary (so-called “drug holidays” or short-term interruption of the therapy during the weekend or holiday).

Channels for obtaining

Our study showed that friends within and outside of the student community are frequent sources of prescription stimulants for non-medical use. This implies that some patients who are medically treated for e.g. ADHD transfer their prescriptions to healthy friends who misuse them. This confirms the possibility of access to prescription stimulants for non-medical use, whether this is through the ability to arrange a prescription for oneself, or via social networks [1], [10].
Over one fifth of non-medical users reported obtaining these medicines through a GP. A survey among GPs in Belgium concluded that subjective norms and attitudes strongly influence physicians’ intention to prescribe methylphenidate for cognitive enhancement [24]. More particularly, GPs who perceived more social pressure from others in their lives, those with a more favourable attitude and those who perceived it is their own choice to prescribe methylphenidate were more likely to show the intention to prescribe methylphenidate to students for enhancing study performances. Novak et al. [25] reported that 20 % of non-medical users of ADHD medication seems to obtain fraudulent prescriptions by simulating symptoms or consulting medical doctors who were known for not asking too many questions.

In a US survey, only a small proportion of prescription stimulant users (1.8 %) reported obtaining the medication through the internet [26]. This is in contrast to our study, where almost one in ten non-medical users obtained stimulating medicines through the internet. These products do not always contain the right active ingredient, the right dosage or the right excipients and can be harmful.

Perceived effects

In line with the main motivation for using prescription stimulants, the most reported beneficial effect in our study was improved concentration. This effect was reported more frequently in medical users, along with better results and performance. A Cochrane systematic review concluded that in children and adolescents, methylphenidate may improve teacher reported symptoms of ADHD and general behaviour and parent reported quality of life with a diagnosis of ADHD [27]. However, given the risk of bias in the included studies, and the very low quality of outcomes, the magnitude of the effects is uncertain. A Cochrane review on methylphenidate in adults with ADHD was withdrawn after substantial criticism of its methods and flawed conclusions [28].

In our study, the prevalence of positive effects was over 80 % in non-medical users. In Swiss university students, 68 % of prescription stimulant users reported that such substances met expectations with regard to the anticipated effects on neuro-enhancement [12]. Students should be aware that, to date, no medicine has been proven to be safe and effective for cognitive enhancement. Previous studies have revealed that obtaining adequate amounts of sleep and using successful learning techniques effectively improve mental performance, whereas no academic advantage or benefit of non-medical use of prescription stimulants seems to exist [1], [29].

Adverse events are dose-dependent, and the most commonly reported side effects of prescription stimulants are decreased appetite, weight loss, headache, insomnia, abdominal pain, dizziness, nervousness, emotional lability, and dry mouth [30]. In our study, sleep disorders, palpitations and emotional instability were the most frequently reported adverse events. Palpitations and agitation were relatively more frequently reported in non-medical users compared to medical users. This could be due to dosing or consumption frequency in this population. In patients, the lowest effective dose should be sought by a weekly titration up to a dose that gives a maximum therapeutic effect with a minimum of undesirable effects [31].

Medical students

In our study, lifetime prevalence of non-medical use among medicine students was slightly lower (6.2 %) compared to a survey among medicine students in Flanders. De Bruyn et al. [4] reported that 8.7 % used stimulant medication during the exam period to enhance their study performances. A review study reports prevalence rates of methylphenidate use of up to 16 % among medicine students [32].

Contrary to French-speaking universities, an entrance exam has been established to access medicine studies at Dutch-speaking universities, which can have an impact on motivation and perceived competition. Indeed, among medicine students in Flanders, it was noted that higher perception of medicine school as being competitive, led to higher stress levels and more likely misuse [4].

In France, a survey among medicine students and young doctors showed a lifetime prevalence of medically prescribed stimulants of 6.7 % [33]. This included corticosteroids, amphetamine derivatives (methylphenidate and modafinil) and piracetam. In this survey, corticosteroids were the most commonly consumed by 4.5 %, ahead of methylphenidate (1.5 %) and modafinil (0.8 %). The authors hypothesise the low prevalence could be explained by the strong restrictions on prescription and delivery of methylphenidate and modafinil in France.

A study among psychiatrists, trainees, and doctors in the Netherlands (N = 422) revealed that 11 % reported occasionally using cognitive enhancers themselves [34]. This mainly included benzodiazepines or beta-blockers, while 2 % reported the use of methylphenidate. Noteworthy is that the majority of respondents thought that the use of cognitive enhancement should not be permitted without a medical indication.

Emotions and moods

At the beginning of the school year, more than three quarters of the students in our survey reported feeling tired and more than half of them reported feeling stressed. University students are under great pressure since expectations may be difficult to fulfil. Also, at the beginning of the academic year, there are more parties and activities students can attend, which could result in a lack of sleep.

It is not surprising that fatigue was more pronounced among non-users of prescription stimulants, while sleep disorders were more pronounced among users as this is a known adverse event. In general, feelings of competition or rivalry were only weakly present and even less among non-users of prescription stimulants. However, it was particularly high among medicine students. In interviews with medicine students in the UK, half of them reported that school is more competitive rather than cooperative [35]. In our study, feelings of stress were higher in medicine students compared to other students. This is in line with other studies indicating that stress levels among medicine students are high [36], [37].

Psychological distress and internal restlessness were shown to be associated with the non-medical use of prescription stimulants [38]. In particular, students who reported high levels of stress in academic and lifestyle-related contexts were more likely to report experiences with neuro-enhancement [4], [12], [39]. Non-medical use of prescription stimulants can be a strategy to cope with stress or to try to reduce the negative effects of stress-related affective disorders [40], [41].

Consumption of other substances

In accordance with previous research, non-medical prescription stimulant use was a small fraction of the use of other legally available substances such as caffeine and energy drinks. We confirmed that consumption of alcohol is high among students, with 83 % of respondents having consumed alcohol during the past year. In Flanders, over 90 % of all college or university students have drunk alcohol in the past twelve months [3]. Based on a survey performed in 2010 at the UCLouvain, student alcohol consumption was found to be higher compared to the same group in the general population (18-25 year old with higher education) [42]. These figures are striking, as alcohol is the fourth most important cause of mortality and morbidity in people aged 15 years and older in Belgium [43].

To a lesser extent, but affecting one in four students, cannabis and tobacco use are also present. Tobacco consumption is considered a threat to global public health as it is a leading cause of illness and kills up to half of the users [44]. Health effects of cannabis are impaired cognitive development (capabilities of learning) and psychomotor performance [45].

In our survey, prescription stimulant users were more likely to use drugs for recreational purposes. Studies on neuro-enhancement have consistently examined the positive relationship between neuro-enhancement and risky health behaviour such as recreational drug use [12]. In general, students experienced in neuro-enhancement were more likely to be engaged in the problematic use of legal and illegal products [25], [46]. However, these associations can lead to serious psychological, physical or even fatal complications [47]. A survey among college students in the US found that students with a higher level of perceived academic benefit of non-medical use of prescription stimulants and more frequent patterns of drinking and cannabis use were more likely to engage in this use of prescription stimulants [46]. The authors underscore the need for interventions that simultaneously correct misperceptions related to academic benefit and target alcohol and cannabis use to reduce non-medical use of prescription stimulants.

Strengths

The mode of diffusion of the survey seemed appropriate for the average subjects in the target population (young, highly educated, access to the internet, regular use of an e-mail address). Moreover, online surveys also may be less affected by social desirability effects for sensitive questions (like those associated with the use of stimulants). Furthermore, the fact that the questionnaire was distributed via the academic authorities of the participating universities could also have increased the level of confidence in the survey. The attained study size seems appropriate for obtaining relatively precise estimates.

The first question of the questionnaire measures the prevalence of prescription stimulant use (main research question). This question was answered by all the respondents and so, it was possible to estimate the prevalence of use of prescription stimulants for all the participants. The present study holds promise for both future research and practice. Further studies could examine and monitor trends of use of prescription stimulants. It could also be beneficial to examine the effectiveness of interventions if and when offered within academic settings.

Limitations

The cross-sectional design means that it is not possible to infer causal relationships between the use of prescription stimulants and other factors.

Non-response bias is an important potential source of bias in self-administered questionnaires. In this case, the effect of bias could act in two opposite directions when estimating the prevalence of prescription stimulant use: upwards bias (i.e. overestimated prevalence) because the most interested and concerned subjects may be participating more actively, and downward bias (i.e., underestimated prevalence) because of social desirability effects, concerns about confidentiality, and under-representation of the male population. Ideally, this sample should be validated either by resampling methods for non-respondents or by a more systematic study of non-respondents.

The prevalence of prescription stimulant use was negatively correlated with the level of completeness of the questionnaire. In other words, the estimated prevalence was numerically higher for full completers when compared to subjects that did not complete the questionnaire. It is difficult to evaluate which estimation is more accurate; participants that fully completed the questionnaire may be answering, on average, more conscientiously than those who did not answer all the questions. However, given that the questionnaire was rather long, it is also possible that a fatigue/boredom effect played a role, especially in subjects with some particular characteristics (e.g. more easily distracted, more concerned about anonymity).

It is not possible to determine whether the respondents accurately represent the target population. Online surveys are known to attract respondents with a particular interest in the subject under investigation. How this possible selection bias affects the results is not easy to evaluate. Previous studies have shown that non-response is usually associated with pathology and there is more likely to be an underreporting of problem behaviours [48]. On the other hand, as participation was voluntary, anonymous, and the survey was web-based, there is less reason to assume the data collection procedure would lead to socially desirable answers.

Generalisability of results

Sample representativeness may be a limitation of the present study. Although all students at all French-speaking universities in Belgium were invited to participate, only 13.7 % of them responded. The results may hence not be generalisable to the French-speaking university student population as a whole. Non-response bias could have an impact on the representativeness of the sample. In particular, male students seem to be less represented.

Conclusions

This survey conducted by the FAMHP was the first one to evaluate the prevalence of medical and non-medical use of prescription stimulants among university students in Brussels and Wallonia.

The results of the study show that the prevalence of prescription stimulant use is about 8 % in the study population. This prevalence is in line with similar studies conducted in Flanders and Europe. However, as long-term data on the efficacy and safety of prescription stimulants in adults are scarce, the need for treatment with medication should be reviewed regularly.

This study also confirms that, although uncommon, there is misuse of prescription stimulants to improve study performance. Students should be aware that to date, no medication has been shown to be safe and effective for cognitive improvement.

These findings have to be interpreted cautiously given the participation rate and potential non-response bias and may not be generalisable to the French-speaking university student population as a whole.

Ethics and disclosure

Consent

Participation to the survey was on a voluntary basis. This was clearly stated in the cover letter in the introductory e-mail sent to the students. No personal identifiers were collected. Implicit consent was assumed by voluntary completion of the questionnaire.

Sponsorship

The study was financed by the FAMHP.

Research ethics approval

The survey was submitted to and approved by the ethical committee of an academic teaching hospital (Hôpital Erasme-ULB).

Privacy commission

According to the Privacy Act and the General Data Protection Regulation (GDPR), personal data are all data that identify or can identify an individual directly (e.g. person's name, phone number and e-mail address). The current survey did not record any identifiable data to protect subject anonymity.

The FAMHP received the responses to the survey, without e-mail addresses or other personal identifiers. The FAMHP did not have access to students' e-mail addresses. Participants' IP addresses were not recorded in the dataset using the option for “anonymous responses” that disables the collection of IP addresses.

The information security consultant of the FAMHP reviewed the “privacy policy”, “security policy” and the GDPR-compliance of SurveyMonkey and concluded that these were in agreement with the Privacy Act and the GDPR.

References

[1] L. J. Maier and M. P. Schaub, “The use of prescription drugs and drugs of abuse for neuroenhancement in Europe: Not widespread but a reality,” *Eur. Psychol.*, vol. 20, no. 3, pp. 155–166, 2015.

[2] Superior Health Council, “Advice of the Superior Health Council nr. 8846. Good clinical practice for the diagnosis and treatment of ADHD for children, young people and adults.,” Superior Health Council, Brussels, Belgium, 2013.

[3] B. D. Joris Van Damme, Annelies Thienpondt, Johan Rosiers, Sara De Bruyn, Veerle Soyez, Maura Sisk, Guido Van Hal, *In hogere sferen?, volume 4: een onderzoek naar het middelengebruik bij vlaamse studenten. Brussel: Vereniging voor Alcohol- en andere Drugproblemen (VAD)*. Brussel, 2018.

[4] S. De Bruyn, E. Wouters, K. Ponnet, and G. Van Hal, “Popping smart pills in medical school: Are competition and stress associated with the misuse of prescription stimulants among students?,” *Subst. Use Misuse*, vol. 54, no. 7, pp. 1191–1202, 2019.

[5] S. E. Lakhan and A. Kirchgessner, “Prescription stimulants in individuals with and without attention deficit hyperactivity disorder: Misuse, cognitive impact, and adverse effects,” *Brain Behav.*, vol. 2, no. 5, pp. 661–677, 2012.

[6] I. Adhd *et al.*, "Méthylphénidate : données d ′ utilisation et de sécurité d ' emploi en France," *Drug Alcohol Depend.*, vol. 9, no. 3, pp. 1–12, 2018.

[7] Conseil des recteurs des institutions universitaires de la Fédération Wallonie-Bruxelles (CRef), “Annuaire Statistique 2014 (Statistical yearbook 2014),” 2014. [Online]. Available: http://www.cref.be/annuaires/2014/tab_1-1-1.pdf. [Accessed: 02-Aug-2019].

[8] J. H. P. van Wel, J. F. Rosiers, and G. Van Hal, “Changes in Drug Use Among Belgian Higher Education Students: A Comparison Between 2005, 2009, and 2013,” *Subst. Use Misuse*, vol. 51, no. 9, pp. 1232–1238, 2016.

[9] K. Benson, K. Flory, K. L. Humphreys, and S. S. Lee, “Misuse of Stimulant Medication Among College Students: A Comprehensive Review and Meta-analysis,” *Clin. Child Fam. Psychol. Rev.*, vol. 18, no. 1, pp. 50–76, 2015.

[10] I. Singh, I. Bard, and J. Jackson, “Robust resilience and substantial interest: A survey of pharmacological cognitive enhancement among university students in the UK and Ireland,” *PLoS One*, vol. 9, no. 10, 2014.

[11] A. M. Arria, K. M. Caldeira, K. E. O’Grady, K. B. Vincent, E. P. Johnson, and E. D. Wish, “Nonmedical use of prescription stimulants among college students: Associations with attention-deficit-hyperactivity disorder and polydrug use,” *Pharmacotherapy*, vol. 28, no. 2, pp. 156–169, Feb. 2008.

[12] L. J. Maier, M. E. Liechti, F. Herzig, and M. P. Schaub, "To Dope or Not to Dope : Neuroenhancement with Prescription Drugs and Drugs of Abuse among Swiss University Students,” *PLoS One*, vol. 8, no. 11, 2013.

[13] T. E. Moffitt *et al.*, “Is adult ADHD a childhood-onset neurodevelopmental disorder? Evidence from a four-decade longitudinal cohort study,” *Am. J. Psychiatry*, vol. 172, no. 10, pp. 967–977, 2015.

[14] E. G. Willcutt, “The Prevalence of DSM-IV Attention-Deficit/Hyperactivity Disorder: A Meta-Analytic Review,” *Neurotherapeutics*, vol. 9, no. 3, pp. 490–499, 2012.

[15] J. Fayyad *et al.*, “Cross-national prevalence and correlates of adult attention-deficit hyperactivity disorder,” *Br. J. Psychiatry*, vol. 190, pp. 402–9, 2005.

[16] J. C. Agnew-Blais, G. V Polanczyk, A. Danese, J. Wertz, T. E. Moffitt, and L. Arseneault, “Evaluation of the Persistence, Remission, and Emergence of Attention-Deficit/Hyperactivity Disorder in Young Adulthood.,” *JAMA psychiatry*, vol. 73, no. 7, pp. 713–20, 2016.

[17] S. Nallu, G. Y. Guerrero, J. Lewis-Croswell, and L. M. Wittine, “Review of Narcolepsy and Other Common Sleep Disorders in Children,” *Adv. Pediatr.*, vol. 66, pp. 147–159, Aug. 2019.

[18] C. B. Christian Teter, Sean McCabe, Kristy LaGrange, James Cranford, “Illicit use of specific prescription stimulants among college students: Prevalence, motives, and routes of administration,” *Pharmacotherapy*, vol. 26, no. 10, pp. 1501–1510, 2006.

[19] L. L. Weyandt *et al.*, “Prescription stimulant medication misuse: Where are we and where do we go from here?,” *Exp. Clin. Psychopharmacol.*, vol. 24, no. 5, pp. 400–414, 2016.

[20] S. Deline *et al.*, "Use of Neuroenhancement Drugs: Prevalence, Frequency and Use Expectations in Switzerland," *Int. J. Environ. Res. Public Health*, vol. 11, no. 3, pp. 3032–3045, Mar. 2014.
[21] T. Trenque, E. Herlem, M. Abou Taam, and M. Drame, "Methylphenidate off-label use and safety," *Springerplus*, vol. 3, no. 1, pp. 1–8, 2014.
[22] H. Schermann, I. S. Ben-Ami, A. Tudor, E. Amar, E. Rath, and R. Yanovich, "Past Methylphenidate Exposure and Stress Fractures in Combat Soldiers: A Case-Control Study," *Am. J. Sports Med.*, vol. 46, no. 3, pp. 728–733, Mar. 2018.
[23] K. Ibrahim and P. Donyai, "Drug Holidays From ADHD Medication," *J. Atten. Disord.*, vol. 19, no. 7, pp. 551–568, Jul. 2015.
[24] K. Ponnet, E. Wouters, G. Van Hal, W. Heirman, and M. Walrave, "Determinants of physicians prescribing behaviour of methylphenidate for cognitive enhancement," *Psychol. Heal. Med.*, vol. 19, no. 3, pp. 286–295, 2014.
[25] S. P. Novak, L. A. Kroutil, R. L. Williams, and D. L. Van Brunt, "The nonmedical use of prescription ADHD medications: results from a national Internet panel," *Subst. Abuse Treat. Prev. Policy*, vol. 2, no. 1, p. 32, Dec. 2007.
[26] L.-Y. Chen, E. C. Strain, R. M. Crum, C. L. Storr, and R. Mojtabai, "Sources of nonmedically used prescription stimulants: differences in onset, recency and severity of misuse in a population-based study.," *Drug Alcohol Depend.*, vol. 145, pp. 106–12, Dec. 2014.
[27] O. J. Storebø *et al.*, "Methylphenidate for attention-deficit/hyperactivity disorder in children and adolescents: Cochrane systematic review with meta-analyses and trial sequential analyses of randomised clinical trials.," *BMJ*, vol. 351, p. h5203, Nov. 2015.
[28] K. Boesen *et al.*, "The Cochrane Collaboration withdraws a review on methylphenidate for adults with attention deficit hyperactivity disorder.," *Evid. Based. Med.*, vol. 22, no. 4, pp. 143–147, Aug. 2017.
[29] A. M. Arria *et al.*, "Do college students improve their grades by using prescription stimulants nonmedically?," *Addict. Behav.*, vol. 65, pp. 245–249, Feb. 2017.
[30] L. L. Weyandt *et al.*, "Pharmacological interventions for adolescents and adults with ADHD: stimulant and nonstimulant medications and misuse of prescription stimulants.," *Psychol. Res. Behav. Manag.*, vol. 7, pp. 223–49, 2014.
[31] Belgisch Centrum voor Farmacotherapeutische Informatie (BCFI), "ADHD," Brussels, Belgium, 2015.
[32] G. Finger, E. R. da Silva, and A. Falavigna, "Use of methylphenidate among medical students: a systematic review," *Rev. Assoc. Med. Bras.*, vol. 59, no. 3, pp. 285–289, May 2013.
[33] G. Fond *et al.*, "(Mis)use of prescribed stimulants in the medical student community: Motives and behaviors a population-based cross-sectional study," *Med. (United States)*, vol. 95, no. 16, pp. 1–8, 2016.
[34] S. Timmer and G. Glas, "Pillen voor de psych(e); een exploratief onderzoek naar neuro-enhancement onder Nederlandse - Psychiaters en artsen," *Tijdschr. Psychiatr.*, vol. 54, no. 4, pp. 371–376, 2012.
[35] H. Lempp and C. Seale, "The hidden curriculum in undergraduate medical education: qualitative study of medical students' perceptions of teaching.," *BMJ*, vol. 329, no. 7469, pp. 770–3, Oct. 2004.
[36] M. Dahlin, N. Joneborg, and B. Runeson, "Stress and depression among medical students: a cross-sectional study," *Med. Educ.*, vol. 39, no. 6, pp. 594–604, Jun. 2005.
[37] V. Hope and M. Henderson, "Medical student depression, anxiety and distress outside North America: a systematic review," *Med. Educ.*, vol. 48, no. 10, pp. 963–979, 2014.
[38] L. L. Weyandt *et al.*, "Nonmedical prescription stimulant use among a sample of college students: relationship with psychological variables.," *J. Atten. Disord.*, vol. 13, no. 3, pp. 284–96, Nov. 2009.
[39] W. Wolff and R. Brand, "Subjective stressors in school and their relation to neuroenhancement: a behavioral perspective on students' everyday life "doping".," *Subst. Abuse Treat. Prev. Policy*, vol. 8, p. 23, Jun. 2013.
[40] J. Betancourt *et al.*, "Non-medical use of prescription drugs and its association with socio-demographic characteristics, dietary pattern, and perceived academic load and stress in college students in Puerto Rico.," *P. R. Health Sci. J.*, vol. 32, no. 2, pp. 89–94, Jun. 2013.

[41] P. Aselton, “Sources of Stress and Coping in American College Students Who Have Been Diagnosed With Depression,” *J. Child Adolesc. Psychiatr. Nurs.*, vol. 25, no. 3, pp. 119–123, 2012.
[42] “L’alcool en milieu étudiant. Etudes, actions et perspectives à l’UCL,” Louvain-la-Neuve, Belgium, 2016.
[43] Superior Health Council, “Advice of the Superior Health Council Nr. 9438. Risks of alcohol consumption,” 2018. [Online]. Available: https://www.health.belgium.be/nl/advies-9438-alcohol. [Accessed: 02-Aug-2019].
[44] World Health Organization, “Tobacco. Fact Sheet.” [Online]. Available: https://www.who.int/news-room/fact-sheets/detail/tobacco. [Accessed: 02-Aug-2019].
[45] World Health Organization, “Cannabis. Fact Sheet,” *WHO*, 2010. [Online]. Available: https://www.who.int/substance_abuse/facts/cannabis/en/. [Accessed: 02-Aug-2019].
[46] A. M. Arria *et al.*, “Perceived academic benefit is associated with nonmedical prescription stimulant use among college students,” *Addict. Behav.*, vol. 76, pp. 27–33, Jan. 2018.
[47] M. Nedahl, S. S. Johansen, and K. Linnet, “Postmortem Brain–Blood Ratios of Amphetamine, Cocaine, Ephedrine, MDMA and Methylphenidate,” *J. Anal. Toxicol.*, vol. 43, no. 5, pp. 378–384, Jun. 2019.
[48] F. A. Torvik, K. Rognmo, and K. Tambs, “Alcohol use and mental distress as predictors of non-response in a general population health survey: The HUNT study,” *Soc. Psychiatry Psychiatr. Epidemiol.*, vol. 47, no. 5, pp. 805–816, 2012.