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## The use of Methylphenidate as a Cognitive Enhancer by Health Sciences Students at a South African University: - A Pilot Study

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**Abstract: Background:** The incremental off-label use of methylphenidate by students to enhance cognitive performance has been widely described in international studies. Recent local media reports have suggested a similar trend in spite of its strict prescription requirements. Although a few South African researchers have started reporting on this peculiarity, data regarding the bona fide extent of stimulant misuse among South African students remains unexplored.

**Objectives:** To determine the incidence of methylphenidate use, methods of acquisition and perceived academic benefit among health sciences students at a South African university.

**Methods:** A quantitative cross sectional pilot study was conducted by administering a closed ended questionnaire to 160 students registered for various degrees in a Faculty of Health Sciences during August and September 2014. Student demographics, lifetime methylphenidate use, means and reasons of procurement, subjective assistance and experienced side effects were documented and analysed for trends and frequencies.

**Results:** Response rates varied considerably (1% - 40%) among students enrolled for different fields of study in the faculty of health sciences. Overall lifetime methylphenidate use was reported at 16.9%, with a noticeable 10% increase during examination periods. Enhancement in cognitive performance (81.5%) was the principle reason for use, although only 66.7% indicated a subjective academic benefit. The majority of respondents had a valid prescription (59.3%), of which 3.1% were justified by an attention deficit hyperactivity disorder diagnosis. Medical students accounted for 70% of methylphenidate users. Diversion of personal prescribed medication was expressed by 7.4% and the most frequently encountered side effects were anxiety (20%) and loss of appetite (17.8%).

**Conclusion:** The unjustified medical use of methylphenidate in South African students correlates well with documented literature from international reports, confirming a global trend. Medical practitioners appear to prescribe this substance more frequently for off-label use, rather than for its registered indications. Methylphenidate use increases during times of high academic stress. Appropriate multidisciplinary student support and education relating to the misuse and long term adverse effects need to be implemented by the medical community and relevant university structures.

**Keywords:** Methylphenidate; cognitive enhancement; students; South Africa; attention deficit disorder.

### INTRODUCTION

Attention deficit hyperactivity disorder (ADHD) is a neuro developmental disorder affecting 5% to 7% of children and adolescents between the ages of 6 and 16 years worldwide [1]. Diagnosis is based on certain criteria that principally include the inability to maintain concentration for sufficient periods of time, difficulty focussing in academic environments, inability to complete tasks and adversity in preparing for tests and exams [2]. Symptoms decline with age, but may persist into adulthood with a global prevalence of approximately 4% [3], necessitating extended pharmacological management with psychoactive agents [4]. Traditional psychoactive substances consist of central nervous system (CNS) stimulants (amphetamine derivatives and methylphenidate) and non-stimulant agents (atomoxetine). Psychoactive stimulants act as indirect catecholamine agonists by blocking the pre-synaptic re-uptake of noradrenaline and dopamine, while non-stimulant agents selectively inhibit the re-uptake of noradrenaline and serotonin. These neurotransmitters are all responsible for cognitive performance and spatial working memory [5].

Despite the decrease in ADHD incidence, international studies have shown an increase in prescription trends for stimulants, mainly methylphenidate (MPH), with at least

40% of the total use found in adults over the age of 18 years [6]. Information regarding the prescription of MPH to South African adults suffering from ADHD is limited, however pharmacoepidemiological surveys from medical aid administrators suggest an incidence of approximately 20%-25% [7]. Increasing public awareness of the use of MPH for the purpose of pharmacological neuroenhancement has resulted in this agent being used by students without medical justification [8]. Some reported academically motivated reasons include improvement in alertness, enhancement in concentration, augmented memorisation of facts, and the ability to study and work for prolonged periods of time [9]. Peer pressure, highly stressful academic circumstances and competitive environments have been cited as important contributors to this phenomenon [10]. The off-label uses of MPH are however not limited to enhancing cognitive performance. It is frequently abused for recreational purposes and taken in combination with other agents acting on the CNS to induce a sensation of euphoria and hallucinations [11].

Although most stimulant drugs, including MPH, are highly regulated and classified as a Schedule 6 substance under the South African Medicines and related substance act 101 of 1965 [12], students often perceive these drugs as being safe and easy to obtain. A multitude of studies evaluated by

DeSantis and co-workers, reported on unjustifiable physician prescription practices, medicine diversion and illegal selling practices by pharmacists [13]. Commonly occurring side effects include headache, abdominal discomfort, loss of appetite, sleep disturbances, anxiety and cardiac rhythm disturbances [14]. Long-term side effects have not been fully evaluated, but individual case reports suggest an increased risk for schizophrenia, mood instability, personality disturbances, addiction disorders and parkinsonism [15]. Despite these known potentially fatal and irreversible adverse effects, various local studies have shown that students continue to use and obtain MPH, disregarding the detrimental effect on their future health [16, 17].

#### **Objectives:**

The aim of the study was to determine the incidence and validity of statements contained in media reports regarding the off-label use of MPH by students to enhance cognitive performance [18]. Furthermore, the means and methods students employ in obtaining MPH were investigated.

#### **METHODS**

This was a quantitative cross-sectional pilot study using a closed-ended questionnaire to assimilate the use of MPH as a cognitive enhancer by students in a Faculty of Health Sciences at a South African tertiary academic institution. No inclusion criteria were specified and all registered students over the age of 18 years were allowed to participate. The study population consisted of 160 participants from all years enrolled for various degrees in health care. Students were informed and invited by the researchers to voluntarily participate in the study, and were assured of their anonymity. Bulk electronic communication and verbal requests to student groups were used as a recruitment strategy. Prospective participants had the choice of completing either an electronic version, or a paper-based questionnaire. Returned paper-based questionnaires were folded and placed in a container. Students preferring online participation clicked on a provided link directing them to the Google Docs® platform where the survey was hosted. Signed informed consent, which could be withdrawn at any time, was required prior to participation. No identifiable information was recorded and the study was conducted in accordance with the Declaration of Helsinki [19]. Data was collected in a two month period between 1 August 2014 to 30 September 2014. Participants were not remunerated for their efforts.

#### **Data collection tool:**

An adapted survey based on a validated questionnaire developed by the Swiss Research Institute for Public Health and Addiction was employed [20]. Questionnaires were in English, consistent with the university's language policy. Sample questionnaires were given to non-participating students and staff members from the Department of Pharmacology. No adjustments were required. The questionnaire consisted of 18 closed-ended questions which was divided into two sections. The first section related to

demographic characteristics (sex, age, field and year of study, ADHD diagnosis) and MPH use (past, current, type of product). The second section aimed at elucidating subjective comprehension and experiences regarding MPH use in participants. These included reasons, frequency and initial commencement of use, means of acquisition, occurrence and type of side effects experienced, and perceived benefit regarding academic performance.

#### **Ethical consideration and permission:**

Permission to conduct the study, including the approved clearance number (219/2014), was obtained from an accredited research and ethics committee registered by the South African National Health Research Ethics Council (NHREC) in terms of section 72 of the National Health Act of 2006. Permission was granted on condition of institutional non-disclosure as insisted by the Registrar of the undisclosed university and Faculty Dean in order to ensure anonymity in the reporting of results. Participants were provided with an information leaflet (stating the purpose and objectives of the study), researchers contact numbers and the ethical clearance certificate. All documents and questionnaires were available in printed and electronic format.

#### **Statistics and data analysis:**

Data analysis was of a descriptive nature and responses to questions were summarised by frequency counts and percentage calculations. The percentage calculations were based on non-missing values and rounded to 0.1%. Data from the paper-based questionnaires were captured manually in a spreadsheet. Completed online questionnaires returned by Google Docs® were exported and similarly integrated in the existing Microsoft Excel® document. Statistical analyses were performed on SAS (Statistical Analysis System, SAS Institute Inc, Cary, North Carolina, USA) release 9.4. Subgroups of students of particular interest were analysed using exploratory data analysis (EDA).

#### **RESULTS**

A total of 2659 undergraduate students were registered in the Faculty of Health Sciences during the 2014 academic year as illustrated in Table I. The survey was administered amid the mid-semester period in which no academic assessments or exams were conducted. The overall response rate was approximately 6%, and was equally distributed between male and female students, although the latter accounted for 71.3% of the study population. The mean age of the participants was 21.5 years (SD = 2.3 years), with the majority being between 18 and 21 years (54.4%). First year student responses accounted for 23.8% and 6th year students for 1.3%, while the predominant group were in their third year of study (34.4%). Only 3.4% of the respondents were older than 26 years. Response rates between the different fields of study varied considerably, with 40.4% of oral hygiene students responding, compared to only 1% of dentistry students.

Table I. Demographics, response rate and frequency of methylphenidate use per field of study

	Registered students n=2659 n (%)	Completed questionnaire n=160 n (%)	Response rate (%)	MPH <sup>®</sup> users n=27 n (%) completed questionnaire
<b>Gender</b>				
Male	755 (28.4)	46 (28.8)	6.1	10 (21.7)
Female	1904 (71.6)	114 (71.3)	6.0	17 (14.9)
<b>Field of study</b>				
B. Physio Therapy	217 (8.2)	21 (13.1)	9.7	3 (14.3)
B. Dietetics	150 (5.6)	15 (9.3)	10	1 (6.7)
B. Cur (Nursing)	234 (8.8)	16 (10)	6.9	2 (12.5)
B. Oral Hygiene	52 (1.9)	21 (13.1)	40.4	2 (9.5)
BSC (Hons) Pharmacology	20 (0.8)	4 (2.5)	20	0 (0)
MBChB (Medicine)	1566 (58.9)	78 (48.8)	5.0	19 (24.4)
BChD (Dentistry)	298 (11.2)	3 (1.9)	1.0	0 (0)
Audiology	122 (4.6)	2 (1.3)	1.6	0 (0)

At the time of conducting the survey, 6.9% of the respondents were taking MPH on a daily basis, of which 3.1% had a confirmed ADHD diagnosis, justifying its use. The total extent of use was calculated as 16.9% across the Faculty (CI 95% 11.9 – 23.4). The ratio of male vs female MPH users did not differ significantly ( $p = 0.177$ ) applying the one-sample location Z-test. Enhancement of cognitive function and improvement in academic performance was cited by 81.5% (CI 95% 63.3 – 91.8) of the participants as the preeminent reason for use. Among these users, 66.7% (CI 95% 47.8 – 81.4) subjectively indicated experiencing an advancement and benefit in their scholastic achievement. Other reasons for use, not related to academic performance, included recreational euphoria, increased wakefulness and appetite suppression in 18.5% of the MPH users. Although only 5% of medical students engaged in the survey, this subgroup accounted for 70.3% of the total cohort using MPH.

Of all the MPH users, almost 30% preferred using the more expensive long acting or sustained release formulations (Concerta® or Ritalin LA®), while the remainder favoured the less expensive conventional immediate release formulations (Ritalin® or Methylphenidate HCL Douglas®). MPH was obtained using valid prescriptions from Medical Practitioners by 59.3% of users. No evidence was found that MPH was acquired through the internet or dispensed from pharmacies without a valid prescription. Other means of procurement outside a pharmacy setting accounted for approximately 40.7%, and included friends (33.3%), family members (3.7%) or unknown individuals (3.7%). Likewise, 92.6% of MPH users indicated their unwillingness to divert their medication to third parties, although 59.3% stated they would not recommend it to fellow students.

The reported side effects experienced by students using MPH correlates with those described in the literature [14], and are depicted in Table II.

Table II. Adverse effects experienced by methylphenidate users

	Incidence n (%)
Headache	4 (8.9)
Anxiety	9 (20)
Depression	4 (8.9)
Aggression	2 (4.4)
Loss of appetite	8 (17.8)
Nausea / vomiting	2 (4.4)
Abdominal pain	1 (2.2)
Palpitations	7 (15.6)
Anorexia	3 (6.7)
Chest pain	2 (4.4)
Memory loss	1 (2.2)
Xerostomia	1 (2.2)
Drowsiness	1 (2.2)

## DISCUSSION

The low overall response rate close to 6% was expected, although a rate of 20-30% for external surveys would be more ideal [21]. This could be explained by the short time frame in which data was collected, the controversial study topic and perceived fear of the participants being identified, since the faculty has a “no drug” policy which could result in expulsion. Results from this study indicate that nearly 7% of students use MPH on a daily basis, with overall use extending to 17%. It can therefore be assumed that MPH use increases by 10% during examination periods. The lifetime incidence of MPH use correlates well with local and international data [8, 17]. Contrary to recent reports of MPH being obtained from internet sources and pharmacies without a valid prescription [13, 22], our study could not substantiate these claims. There was however a correlation with the number of valid prescriptions (55%-60%) issued by medical practitioners. The medically justified prescriptions (3.1%) for ADHD were lower than the globally acceptable pooled estimate of 7.2% [23]. This could indicate a potential underdiagnoses of ADHD in the study population, or undoubtedly illustrate a 56.2% off-label prescription pattern. Although more than a third of respondents obtained MPH

from friends and family, (which is affirmed by international reports [24]), the majority of participants indicated that they were unwilling to divert their medication. Conceivable explanations include the difficulty in obtaining prescriptions for MPH, or the heightened awareness of health sciences students to the strict prescribing regulations.

Our study showed that almost 80% of all respondents used MPH to enhance their cognitive performance, with only a third not reporting any benefit. In the absence of measurable baseline changes in academic performance, these observations remain subjective. The large extrapolated proportion (24.4%) of medical students indicating on lifetime use of MPH to improve alertness, concentration and wakefulness (CI 95% 16.2 – 34.9), is similar to observations made in the United States (18%) [25], but lower than those made in Europe (67%) [26].

## CONCLUSION

Prescriptions for MPH are often obtained without an ADHD diagnosis. There is a seemingly high prevalence in the off-label use of MPH among health sciences students to enhance cognitive performance, especially during times of heightened academic stress. Contrary to literature reports, MPH use for recreational purposes was low. Risks to healthy individuals using MPH have not been fully elucidated, since long term data is not readily available. Although various similar studies of this nature has been conducted elsewhere, such information regarding trends in developing countries are often lacking. This study therefore illustrates that a commonality exists between first and third world use of cognitive enhancement therapy.

## RECOMMENDATIONS

University management and lecturers should be aware of the potential misuse of academic performance enhancers. Students need to be educated on the possible health risks associated with the use of stimulant drugs, including the postulated long term side effects. Medical practitioners need to consider appropriate alternative therapy, life style adjustments and allow for a multi-disciplinary approach when confronted by students or parents demanding stimulant drugs during periods of high academic stress.

## LIMITATIONS AND FUTURE RESEARCH

Several limitations to this study were identified. Although anonymity was assured, students were legitimately hesitant to complete the questionnaire which resulted in a low response rate. Possible fear of personal identification could have deterred participants in divulging sensitive (and illegal) information. The quality control and validity of the intended method may be biased and subjective responses may affected the participant's degree of honesty or failure to complete the questionnaire. Notwithstanding the fact that this was a pilot study, a larger sample size is required to substantiate results with greater accuracy. Future studies need to include students from all faculties to exemplify institutional trends. A higher participant response rate may be achieved by using Internet Technology (IT) channels not associated with official university communication.

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## COMPETING INTERESTS

The authors declare that there was no reporting bias or prejudice in the representation of results. This project was presented at the annual congress of the South African Society for Basic and Clinical Pharmacology, held at the University of the Witwatersrand in September 2015. A conference abstract was published in a supplementary edition of the South African Journal of Infectious Diseases [27].

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