

Variable influence of the degree of smoking dependence on adult attention deficit/hyperactivity disorder in Iraqi medical students

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ABSTRACT

الأهداف: استكشاف وجود اختلاف في أعراض نقص الانتباه و فرط الحركة بين غير المدخنين، وقليل المدخنين، وشديدي التدخين.

الطريقة: أُجريت هذه الدراسة المقطعية في فرع الأدوية، كلية الطب، الجامعة المستنصرية، بغداد، العراق وذلك خلال الفترة من مارس إلى يونيو 2011م. شملت الدراسة 400 طالب من مختلف المراحل الدراسية، حيث وزع استبيان على المشاركين متكون من المقياس الذاتي لنقص الانتباه و فرط الحركة عند الكبار (الملخص)، ومقياس فاغريستروم لدرجة الاعتماد على النيكوتين. لقد اعتبرنا درجات المقياس الذاتي لنقص الانتباه و فرط الحركة عند الكبار الأكثر من أو تساوي 14 إيجابية، فيما اعتبرنا درجة الاعتماد على النيكوتين الأكثر من أو تساوي 6 تدخين شديد، والأقل من أو تساوي 5 تدخين قليل.

النتائج: لقد أكمل الاستبيان 361 طالب، وقد أظهر 16.6% من المرضى أعراض نقص الانتباه وفرط الحركة، 19.8% بين الطلاب، و12.1% بين الطالبات. ولقد كان 45% من المصابين بنقص الانتباه ومدخنين، وكان أكثر من نصفهم من شديدي التدخين (51.8%). وكان شهود الذهن عند شديدي التدخين أعلى من غير المدخنين وقليلوا التدخين وذلك بصورة واضحة من الناحية الإحصائية ($p=0.0001$). ولقد كانت درجة فرط الحركة عند قليلوا التدخين أعلى من غير المدخنين بصورة واضحة من الناحية الإحصائية ($p=0.041$). وكلما زادت درجة الاعتماد على التدخين كلما تدهور أكثر مقياس فرط الانتباه ($r=0.391, p=0.001$). على عكس فرط الحركة الذي لم يتأثر بصورة واضحة من الناحية الإحصائية ($r=0.153, p=0.117$).

خاتمة: أثبتت الدراسة بأن نقص الانتباه وفرط الحركة شائع بين طلاب الطب في العراق. وقد أظهر الطلاب المصابين نسبة ودرجة عالية من الإدمان على النيكوتين من غير المصابين. كما دهور التدخين الشديد ولم يقلل أعراض نقص الانتباه وفرط الحركة بين الطلاب المصابين به.

Objective: To demonstrate the differences in the patterns of adult attention deficit/hyperactivity disorder (ADHD) symptoms among non, light, and heavy smokers.

Methods: A cross-sectional study involving 400 medical students (representing first to sixth year students) was conducted in the Department of Pharmacology, University of Al-Mustansiriya, Baghdad, Iraq from March to June 2011. The medical students completed a questionnaire containing the adult ADHD self-report scale (ASRS-screener) and the Fagerström Test for Nicotine Dependence (FTND). An ADHD score ≥ 14 was considered positive. An FTND score ≥ 6 signifies heavy smokers, and an FTND score ≤ 5 signifies light smokers.

Results: Three hundred and sixty-one medical students completed the questionnaire, 16.6% reported ADHD symptoms (19.8% male, 12.1% females). Forty-five percent of ADHD adults were smokers; more than half of them were categorized as heavy smokers (51.8%). In comparison with non-smokers, heavy smokers displayed significant deterioration in their inattentive and total ASRS score ($p=0.0001$). Light smokers show significantly higher hyperactive symptoms in comparison with non-smokers ($p=0.041$). A high FTND score was associated with severer deterioration in inattentive ($r=0.391, p=0.001$) but not hyperactive symptoms ($r=0.153, p=0.117$).

Conclusions: The ADHD symptoms are highly prevalent among Iraqi medical students, and smoking among ADHD students is higher and heavier than non-ADHD controls. Heavy smoking tends to deteriorate rather than ameliorate (self-medicate) ADHD symptoms.

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Smoking is considered the foremost preventable cause of morbidity and mortality in the world, although it remains the main concern for public health.¹ In comparison with non-smokers, smokers have higher rates of cancer, heart disease, stroke, lung infections, and chronic lung disease, as well as decreased life expectancy.² Literature review exhibits that there is a significant relationship between smoking and mental disorders.³ Approximately 60% of mentally ill patients are smokers, in comparison with 25% in the general population;⁴ in fact, those patients comprise the heaviest smokers' entity among the general population.⁵ Attention deficit/hyperactivity disorder (ADHD) is a common psychiatric illnesses with early childhood occurrence. Such children suffer from symptoms of inattention, hyperactivity, or impulsivity.⁶ The disorder is also associated with a variety of adverse academic, social, and health insults. Recent evidence strongly suggests that symptoms of ADHD may continue until adulthood.⁷ Various population-based surveys have demonstrated a close linkage between ADHD and cigarette smoking.^{4,8,9} In addition, ADHD patients usually start smoking at an earlier age with more difficulty in quitting than non-ADHD people.¹⁰

Two population-based studies have shown that levels of ADHD symptoms predict levels of nicotine use and dependence among current regular smokers, and self-reported numbers of both hyperactive-impulsive and inattentive ADHD symptoms significantly predicted the number of cigarettes smoked per day.^{9,11} However, Pomerleau et al¹² and McClernon et al¹³ disagreed with these studies, and claim that there is no significant difference between adults with ADHD and non-ADHD controls regarding the level of nicotine dependence or the number of cigarette smoked per day. There are also reports that smoking dependence has variable effects on psychomotor performance and working memory capacity. Heavy smokers showed significant impairment in working memory capacity in comparison with non and light smokers. Similarly, the choice reaction time deteriorated in heavy smokers, although this did not reach a significant level due to the small sample size.¹⁴

This study aims to investigate whether there are differences in the pattern of ADHD symptoms among 3 groups (non-smokers, light smokers, and heavy smokers) in a sample of medical students.

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Methods. This cross-sectional study was conducted on students of different academic years from Al-Mustansiriya Medical College, Baghdad, Iraq, from March to June 2011. The study was carried out according to the Helsinki Declaration, and was approved by the local scientific committee in the Department of Pharmacology. Each student was fully informed of the study objectives, and verbal consent to participate was obtained. A self-rating questionnaire was administered to 400 medical students selected through stratified cluster sampling (Appendix 1). The students were first stratified into different academic years (first to sixth), and then from each year a section or group was randomly chosen. All students in the chosen cluster were included.

The questionnaire contained 2 parts in addition to the sociodemographic questions (age, gender, academic year). The first part was a short screening version of the adult ADHD self-report scale (ASRS). This is a 6 item screening test representing part A of the full scale, which is composed of 18 items.¹⁵ Four of the 6 items represent inattentive symptoms (wrapping up, getting things in order, remembering, and avoiding, or delaying get started) while the other 2 items represent hyperactivity symptoms (fidget or squirm and driven by a motor). For each item of the ASRS-screener, participants rate the frequency with which each symptoms occurred over the past 6 months on a 0-4 scale with points labeled as never, rarely, sometimes, often, or very often. To be easily understandable by the participants, the scale focused on the frequency rather than the severity of symptoms.¹⁶ Participants for whom total scores for these 6 items were 14 or higher, were considered ADHD positive, the internal consistency for the score ranged from 0.63 to 0.72 and test-retest reliability ranged from 0.58 to 0.77.¹⁷ The ASRS-screener is useful for follow up of ADHD patients, and it was found that a 30% reduction in total score was an indicator for treatment response.¹⁸

The second part of the questionnaire divided subjects based on having smoked at least one time (ever smoked) or having smoked in the past month (current smoker). Current smokers report the age of starting smoking, and then complete the 6 items of the Fagerström test for nicotine dependence (FTND). The scale includes 2 categorical variables (when after waking up do you take the first cigarette, and how many cigarettes per day), and 4 dichotomous variables (refrain in forbidden places, which cigarette would you most hate to give up, frequent smoking after waking up, and smoking while ill in bed).¹⁹ This score is useful in predicting the severity of nicotine craving and withdrawal. An FTND score of 6 or greater is considered indicative of high nicotine

Table 1 - Comparison between Iraqi male and female medical students regarding age, age of onset of smoking, Fagerström test for nicotine dependence (FTND) score, and adult attention deficit/hyperactivity disorder self-report scale (ASRS-screener).

| Variable | Male (n=212) | Female (n=149) | Class interval | P-value |
|-------------------------|--------------|----------------|----------------|---------|
| Age | 21.7±1.4 | 20.9±1.6 | 0.51-1.16 | 0.001 |
| FTND score | 3.8±3.03 | 0.67±1.2 | 0.59-5.60 | 0.016 |
| Age of onset of smoking | 17.7±2.2 | 19.2±2.3 | -0.56-3.28 | 0.144 |
| ASRS total score | 11.2±3.5 | 10.6±3.4 | -0.13-1.33 | 0.110 |
| Inattention | 4.9±2.5 | 4.6±2.3 | -0.25-0.77 | 0.132 |
| Hyperactivity | 6.3±2.2 | 5.9±2.1 | -0.10-0.78 | 0.325 |

Table 2 - Comparison between Iraqi medical students with symptoms of adult attention deficit/hyperactivity disorder (ADHD) with non-ADHD participants regarding Fagerström test for nicotine dependence (FTND) score, age of onset of smoking, and adult attention deficit/hyperactivity disorder self-report scale (ASRS-screener).

| Variable | ADHD (n=60) | Non-ADHD (n=301) | Class interval | P-value |
|-------------------------|-------------|------------------|----------------|---------|
| FTND score | 4.9±2.7 | 2.3±2.8 | 1.23-4.06 | 0.001 |
| Age of onset of smoking | 17.2±2.3 | 18.5±2.1 | 0.16-2.47 | 0.026 |
| ASRS total score | 16.6±1.7 | 9.8±2.6 | 6.00-7.38 | 0.001 |
| Inattention | 7.8±1.6 | 4.2±2.1 | 3.01-4.16 | 0.001 |
| Hyperactivity | 8.8±1.7 | 5.7±1.8 | 2.60-3.59 | 0.001 |

Table 3 - Comparison between non, light, and heavy smoking Iraqi medical students regarding Fagerström test for nicotine dependence (FTND) score, and adult attention deficit/hyperactivity disorder self-report scale (ASRS-screener).

| Variable | Non smokers (n=299) | Light smokers (n=41) | Heavy smokers (n=21) | P-value |
|-------------------------|---------------------|----------------------|----------------------|---------|
| FTND score | - | 1.6±1.5 | 7.2±0.9 | 0.001 |
| Age of onset of smoking | - | 18.8±2.2 | 16.4±1.5 | 0.001 |
| ASRS total score | 10.6±3.1 | 11.6±4.4 | 14.2±4.9 | 0.001 |
| Inattention | 4.6±2.3 | 4.8±2.7 | 7.1±3.1 | 0.001 |
| Hyperactivity | 6.1±2.1 | 6.8±2.2 | 7.1±2.6 | 0.020 |

Table 4 - Results of the post hoc analysis of the relationship between non, light, and heavy smokers and their adult attention deficit/hyperactivity disorder self-report scale (ASRS-screener).

| Variable | Non smokers versus light smokers | | Non-smokers versus heavy smokers | | Light smokers versus heavy smokers | |
|---------------------|----------------------------------|----------------|----------------------------------|----------------|------------------------------------|----------------|
| | P-value | Class interval | P-value | Class interval | P-value | Class interval |
| Total ASRS score | 0.085 | -0.14-2.10 | 0.0001 | 2.02-5.05 | 0.006 | 0.76-4.36 |
| Inattention score | 0.504 | -0.52-1.05 | 0.0001 | 1.47-3.59 | 0.001 | 1.0-3.53 |
| Hyperactivity score | 0.041 | 0.03-1.40 | 0.0340 | 0.08-1.94 | 0.605 | -0.82-1.40 |

dependence (heavy smoking), while a score of less than 6 is considered indicative of low/moderate nicotine dependence (light smoking). The FTND score showed high reliability levels with correlation coefficients of 0.92 for test-retest and 0.99 for inter-rater reliability with an internal consistency of the FTND score of $\alpha=0.68$.²⁰

Statistical analysis. The results were expressed as mean±SD for numerical variables, while expressed as number (%) for categorical variables. Statistical analysis was conducted using the Predictive Analytics Software (PASW) version 18 (SPSS Inc., Chicago, IL, USA). Regarding numerical variables, independent sample T-test was used for comparison between 2 groups, ANOVA test was used for comparison of more than 2 groups, followed by post hoc analysis by Tukey's test for the significance between groups. Correlation of the age of onset of smoking and FTND score with ASRS-Screener parameters were carried out with Pearson's correlation test. Categorical variables were analyzed using Pearson's chi square test. All *p*-values less than 0.05 were considered statistically significant.

Results. Three hundred and sixty-one medical students completed the questionnaire with a response rate of 90.3% (212 males; 149 females). Their age ranged from 18-25 with a mean of 21.4±1.61. The rate of smoking among medical students was 17.2%, and the prevalence of adult ADHD was 16.6%.

Comparison between male and female students. Smoking among male medical students was significantly higher than females (26.4% versus 4%, $p=0.001$). Table 1 displays a significant difference between groups regarding the age and the FTND score (female smokers reported to be light smokers). Male medical students show borderline significantly ($p=0.052$) higher rates of ADHD symptoms (19.8%) than their female colleagues (12.1%); nevertheless, no difference was found between groups regarding the ASRS score parameters (Table 1).

Comparison between ADHD and non-ADHD students. Adult students with ADHD symptoms smoke

at a significantly higher rate (45%) than non-ADHD (11.6%) colleagues ($p=0.001$). More than half of the ADHD smokers (51.8%) are reported to be heavy smokers. Table 2 illustrates that ADHD students usually start smoking at an earlier age, and have higher FTND scores than the non-ADHD students.

Comparison between non, light, and heavy smokers. Two-thirds (66.7%) of heavy smokers report symptoms of ADHD in comparison with 31.7% of light smokers, and 11% of non-smokers ($p=0.001$). They usually start smoking at an earlier age than light smokers (Table 3).

Post hoc analysis of the 3 groups revealed that heavy smoking is associated with significant deterioration in the inattentive and total ASRS scores in comparison with the non, and light smokers. While no significant difference was found between non, and light smokers regarding these parameters (Table 4). The hyperactivity symptoms scores significantly differ between non-smokers in comparison with light and heavy smokers, yet, no significant difference was reported between light and heavy smokers (Table 4).

Correlation of smoking and ASRS-screener parameters. The results show that students with a high FTND score tend to start smoking earlier ($r=-0.432$, $p=0.001$), and to have higher inattentive ($r=0.391$, $p=0.001$), and total ASRS scores ($r=0.330$, $p=0.004$); however, no significant correlation was seen between the FTND score and the hyperactive symptoms ($r=0.153$, $p=0.117$).

A non-significant correlation was reported between the age of onset of smoking and the total ASRS ($r=-0.196$, $p=0.068$), and inattentive score ($r=-0.205$, $p=0.059$). Additionally, the hyperactivity score displayed no significant correlation with the age of onset of smoking ($r=-0.120$, $p=0.182$).

Discussion. There are a small number of studies regarding adult ADHD in the Arab countries, most of them limited by a small sample size.²¹ One of the studies addressing the issue of adult ADHD was carried out in Lebanon as part of an international World Health Organization study, in which the prevalence of adult ADHD was 1.8%.²² The authors explained that the low rate of adult ADHD reported in this study was because of the use of a structural interview (associated with low rates), and due to the respondents under-reporting their symptoms in such interviews because of the stigma of mental illness in the Arab world.^{23,24}

There are more studies regarding ADHD in children and adolescents in Arab countries, and these shown a high prevalence of ADHD. The prevalence is reported as

6.4% in Oman, 7.48% in Egypt, 9.4% in Qatar, 10.5% in Iraq, 14.9% in the United Arab Emirates, and 16.4% in Saudi Arabia.²⁵⁻²⁷ Our present study reports a high rate of adult ADHD in medical students (16.6%) in comparison with a recently published study carried out by Das et al (6.2%) using the same ASRS-screener.²⁸

Regarding the difference between male and female ADHD symptoms (3:1), previous studies showed that the ratio between these populations vary between 2:1 to 9:1.²⁹ In addition, the discrepancy in smoking rates between males (26.4%) and females (4%) seems to be characteristic of most of the Eastern Mediterranean Region (EMR), and is attributed mainly to the social unacceptability of women's smoking in this region.³⁰

In our present study, 45% of adults with ADHD symptoms were found to be smokers, more than half of them documented to be heavy smokers, which is in harmony with previous studies carried out by Kollins et al⁹ and Upadhyaya et al³¹ who reported that 41-46% of adolescents and adults with ADHD were smokers. Our study replicates previous studies that show that severe smoking dependence (high FTND score) usually tends to be early onset smokers, who have more severe deterioration in their inattentive and total ADHD symptoms scores.^{8,32}

Potter et al³³ reported that transdermal nicotine applied to smokers and non-smokers with ADHD symptoms significantly improved self-rated vigor and concentration in both subjects. Others,³⁴ also demonstrated that 4 weeks nicotine administration to ADHD adults reduced clinician ratings of severity of symptoms and decreased self-reported symptoms of depression as well as variability of reaction times on a continuous performance task. Such associations between ADHD and smoking were explained as the 'self-medication' hypothesis, which posits that because nicotine has a stimulating effect on the CNS and can lead to improvements in attentional and cognitive processes, adolescents and young adults with ADHD may smoke to alleviate their symptoms.³⁵

However, a recent review of the literature regarding the association of smoking with ADHD indicates that the hypothesis of self-medication is not adequate because of inconsistencies regarding the concept and methodology.³⁶ The studies that demonstrate the beneficial effects of nicotine on cognition in smokers cannot differentiate between absolute effects of nicotine versus their benefits in alleviating withdrawal.³⁴ Furthermore, most of the small number of human studies that confirm beneficial effects of nicotine on attention, impulsivity, and ADHD symptoms in non-

smokers have small sample sizes and produced effects of relatively small magnitude.¹⁰

The association between smoking and ADHD can be explained as follows: first, the defect in executive function in patients with ADHD (problems of behavioral inhibition) makes them more susceptible to addiction, with a greater inability to stop.³⁶ Second, individuals with ADHD are hypothesized to have lower tonic dopamine, which may amplify the phasic dopamine response stimulated by nicotine.⁹

The implication from our results is that heavy nicotine intake tends to deteriorate rather than ameliorate the symptoms of adult ADHD. The support to our hypothesis is the many recent studies that showed the deleterious effect of smoking and/or chronic nicotine administration on cognitive function. Moreover, researchers illustrate that the balance between nicotine neuroprotection and toxicity depends on the dose, and chronic nicotine intake is associated with significant changes in gene expression and neuronal morphology in the prefrontal cortex, specifically during the adolescent period.³⁷ Additionally, nicotine action on attention and working memory, which was deteriorated in ADHD patients,³⁸ tends to follow an inverted U-shape,³⁹ therefore, high doses of nicotine may impair attention and working memory.⁴⁰

One of the major limitations of the study is the use of a self-rating scale as a substitute of measuring nicotine level, or the use of a psychiatric interview for the diagnosis of adult ADHD. Our sample is relatively small and involves medical students of a single college in a single place (not representative of the whole population). Prospective studies are required to further verify the relationship between smoking dependence and adult ADHD.

In conclusion, ADHD symptoms are highly prevalent among Iraqi medical students. The rate of smoking in ADHD adults was significantly higher than non-ADHD, most of the smoking ADHD students are documented to be heavy smokers. The high FTND score was associated with severer deterioration in inattentive, but not hyperactive symptoms, while the age of onset of smoking does not significantly influence the ASRS-screener parameters.

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Appendix 1 - Questionnaire on adult attention deficit/hyperactivity disorder and the degree of smoking dependence.

Age:

Gender:

Academic Year:

Part 1:

Please answer the questions below, rating yourself on each of the criteria shown using the scale on the right side of the page. As you answer each question, place an X in the box that best describes how you have felt and conducted yourself over the past 6 months.

| | Never | Rarely | Sometimes | Often | Very often |
|---|-------|--------|-----------|-------|------------|
| 1. How often do you have trouble wrapping up (finishing) the final details of a project, once the challenging parts have been done? | | | | | |
| 2. How often do you have difficulty getting things in order when you have to do a task that requires organization? | | | | | |
| 3. How often do you have problems remembering appointments or obligations? | | | | | |
| 4. When you have a task that requires a lot of thought, how often do you avoid or delay getting started? | | | | | |
| 5. How often do you fidget or squirm with your hands or feet when you have to sit down for a long time? | | | | | |
| 6. How often do you feel overly active and compelled to do things, like you were driven by a motor? | | | | | |

Part 2:

For smokers (having smoked in the past month):

Age at start of smoking:

1. How soon after you wake up do you have your first cigarette?
 - a. Within 5 minutes
 - b. 6-30 minutes
 - c. 31-60 minutes
2. Do you find it difficult to refrain from smoking in places where it is forbidden?
 - a. Yes
 - b. No
3. Which cigarette would you hate most to give up?
 - a. The first one in the morning
 - b. All others
4. How many cigarettes per day do you smoke?
 - a. 10 or fewer
 - b. 11-20
 - c. 21-30
 - d. 31 or more
5. Do you smoke more frequently during the first hours after waking than during the rest of the day?
 - a. Yes
 - b. No
6. Do you smoke even if you are so ill that you are in bed most of the day?
 - a. Yes
 - b. No