# Excessive Daytime Sleepiness in Adult Patients With ADHD as Measured by the Maintenance of Wakefulness Test, an Electrophysiologic Measure

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**ABSTRACT**

***Objective:*** To quantify the objective level of sleepiness in adult attention-deficit/hyperactivity disorder (ADHD) patients and to determine the relationship between excessive daytime sleepiness and simulated driving performance.

***Method:*** Forty adult ADHD patients (*DSM-IV* criteria) and 19 matched healthy control subjects were included between June 30, 2010, and June 19, 2013. All participants completed the Epworth Sleepiness Scale and the Manchester Driving Behavior Questionnaire. After nocturnal polysomnography, they performed 2 neuropsychological tests, a 4×40-minute Maintenance of Wakefulness Test, and a 1-hour driving session. The primary outcome measure was the mean sleep latency on the Maintenance of Wakefulness Test. ADHD patients were divided into 3 groups defined by their Maintenance of Wakefulness Test scores. Participants (patients and control subjects) were allocated as follows: sleepy ADHD (0–19 min), intermediate ADHD (20–33 min), alert ADHD (34–40 min), and control group (34–40 min). The driving performance outcome was the mean standard deviation of lateral position of the vehicle during the simulated session.

***Results:*** The group mean (SD) Epworth Sleepiness Scale score was higher in ADHD patients (12.1 [4.4]) than in controls (6.0 [2.7]) ($P < .001$). On the basis of the Maintenance of Wakefulness Test scores, 14 patients (35%) were in the sleepy group, 20 (50%) were in the intermediate group, and only 6 (15%) were in the alert group. Sleepy ADHD patients exhibited significantly deteriorated driving performance compared to the other 3 groups ($P < .01$).

***Conclusions:*** Our study shows that a significant proportion of adult ADHD patients exhibit an objective excessive daytime sleepiness, which, in addition, has an impact on simulated driving performance. Excessive daytime sleepiness, therefore, may be a key element needed to better evaluate these ADHD patients.

***Trial Registration:*** ClinicalTrials.gov identifier: NCT01160874

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Attention-deficit/hyperactivity disorder (ADHD) is a common psychiatric disorder with onset in childhood and is characterized by inappropriate levels of inattention, impulsivity, and hyperactivity.[1] Follow-up studies have documented the persistence of ADHD into adulthood, and impairing symptoms of ADHD may persist into adulthood in 50%–65% of cases.[2] It affects 8%–10% of children,[3] and the prevalence of ADHD in adults has been estimated at 4.4% in the United States.[4]

Sleep disorders have been investigated extensively in children with ADHD over the last 2 decades. Both subjective and objective studies have shown that they present significantly more impaired sleep compared to controls.[5–9] Excessive daytime sleepiness, defined as sleepiness that occurs in a situation when an individual would usually be expected to be awake and alert, is the primary complaint of many patients suffering from sleep disorders.[10] Using an objective tool (the Multiple Sleep Latency Test), 2 studies demonstrated that children with ADHD exhibited excessive daytime sleepiness in comparison with healthy subjects, although some of them had no sleep disorders on polysomnography.[8,11] Unlike in the pediatric field, research studies in sleep medicine in adults with ADHD are relatively scarce,[12] and the possible presence of an objective excessive daytime sleepiness has not yet been explored in this population. However, Oosterloo et al[13] found that 37% of ADHD patients met the criteria for subjective excessive daytime sleepiness. In addition, stimulant medication not only improves attention disorders but also is effective in treating excessive daytime sleepiness related to hypersomnia syndromes.[14–16]

ADHD is associated with impairments and adverse outcomes over one's life span[17,18] and has a substantial impact on a variety of domains, such as driving. ADHD subjects cause 3 to 4 times more accidents and commit twice as many traffic violations as control subjects.[18–20] The association between ADHD and impaired driving performance has been attributed to ADHD core symptoms (impulsivity, inattention). Nevertheless, sleepiness at the wheel has been identified as one of the major causes of traffic accidents and fatal crashes in patients suffering from sleep disorders and in healthy control subjects.[21–24]

According to the American Academy of Sleep Medicine (AASM), the Multiple Sleep Latency Test is indicated for the evaluation of excessive daytime sleepiness due to narcolepsy or idiopathic hypersomnia, while the Maintenance of Wakefulness Test may be used to assess an individual's ability to remain awake when his or her inability to remain awake constitutes a public or personal safety issue.[10] However, it also appears that patients suffering from sleep disorders with excessive daytime sleepiness may exhibit pathological scores on the MWT compared to healthy subjects.[25–28] Indeed, in

**Clinical Points**

- On the basis of scores on the Maintenance of Wakefulness Test, a significant proportion of adults with attention-deficit/hyperactivity disorder exhibit objective excessive daytime sleepiness. It is therefore crucial that excessive daytime sleepiness be screened in this population by psychiatrists or sleep specialists.
- Since excessive daytime sleepiness has an impact on simulated driving performance, it is important to screen and treat it. Psychostimulants may be effective within this context, but wakefulness-promoting drugs should be evaluated for this indication.

our previous studies, we have shown that a mean sleep latency below 20 minutes during a 4 × 40-minute Maintenance of Wakefulness Test correlated with impaired driving performance as measured both on a driving simulator[28] and in real driving conditions[27] in untreated patients with obstructive sleep apnea syndrome (OSAS). More recently, we demonstrated that the same cutoff predicted impairment in driving simulator performance in untreated and treated patients suffering from excessive daytime sleepiness due to OSAS or central hypersomnia.[26] Therefore, one could assume that, within a context of excessive daytime sleepiness, some adults with ADHD would display pathological Maintenance of Wakefulness Test scores, which would also be an objective marker of cognitive impairment.

Our hypotheses were that some patients with ADHD would exhibit excessive daytime sleepiness and that it would impact on performances. To confirm both hypotheses, we designed a study for which the objectives were (1) to explore objective daytime sleepiness with the Maintenance of Wakefulness Test in a population of adult patients with ADHD and (2) to relate Maintenance of Wakefulness Test scores to simulated driving performance.

## METHOD

### ADHD Patients and Healthy Control Subjects

Participants were included between June 30, 2010, and June 19, 2013. ADHD patients were recruited from the attentional disorders outpatient clinic at the Child and Adolescent University Psychiatry Department (Bordeaux, France), with ADHD diagnosis made according to the *DSM-IV* criteria.[1] Childhood ADHD symptoms and chronic course of ADHD symptoms from childhood to adulthood were established by a board-certified psychiatrist who carried out a clinical evaluation and administered a semistructured diagnostic interview (Conners' Adult ADHD Diagnostic Interview for *DSM-IV*).[29] We used the Conners' Adult ADHD Rating Scales (CAARS) in evaluating subjects.[30] We also used the French version of the Wender-Utah Rating Scale (WURS)[31] and the Brown Attention Deficit Disorder Questionnaire[32] to qualify the ADHD symptoms of our patients. We excluded all patients with any clinically relevant medical or psychiatric condition, including current affective or psychotic disorders, substance abuse within 1 year prior to screening, shift work, and long-term treatment with a benzodiazepine. Comorbid psychiatric disorders were assessed with the Mini-International Neuropsychiatric Interview (MINI 5.0.0.) for *DSM-IV*.[33] All patients were withdrawn from psychostimulant medication for a minimum of 72 hours before starting the study and were without other psychotropic medications for a minimum of 1 month.

Healthy control subjects were recruited among the general population. We excluded subjects with any psychiatric disorders plus any complaint of sleep disorder (reported on the Basic Nordic Sleep Questionnaire)[34] and subjective excessive daytime sleepiness based upon the Epworth Sleepiness Scale (score > 10). The presence of nocturnal sleep-disordered breathing (apnea-hypopnea index [AHI] > 10/h) and periodic limb movements (index > 15/h) were ruled out with ambulatory polygraphy that included an electromyogram channel on the anterior tibialis muscle of each leg. ADHD symptoms were ruled out in the control population with the Brown questionnaire, the WURS for ADHD, ASRS the 18-item Adult ADHD Self-Report Scale (ASRS),[35] and the CAARS self-evaluation.

All participants had their driving license and had to have attended secondary schooling up to the end of middle school.

### Study Design

Patients and controls were investigated in a similar way in our sleep laboratory (CHU Bordeaux). They underwent nocturnal polysomnography followed the next day by a 4 × 40-minute Maintenance of Wakefulness Test and 2 neuropsychological tests. The participants also had to complete 2 questionnaires: the Epworth Sleepiness Scale[36] and the Manchester Driver Behavior Questionnaire.[37] All subjects provided written informed consent, and the local ethics committee (Consultative Committee for the Protection of Persons Participating in Biomedical Research [CPP Sud-Ouest et Outre Mer III]) approved the study, which was declared as a clinical trial (ID RCB Number: 2009-A01276-51; ClinicalTrials.gov identifier: NCT01160874). The subjects were paid €100 for their participation.

### Polysomnography

The following parameters were monitored: electroencephalogram (EEG; F3/A2, C3/A2, O2/A1, from the International 10-20 System for the placement of electrodes), electro-oculogram, chin and leg electromyogram, electrocardiogram, and body position. Respiration was monitored with a nasal cannula and thoracic and abdominal belts. Oxygen saturation was recorded by pulse oximetry. Sleep and respiratory events were manually scored by an experienced sleep technician in 30-second epochs according to the recommendations of the *AASM Manual for the Scoring of Sleep and Associated Events*.[38,39]

### Objective Quantification of Daytime Sleepiness (MWT)

Four 40-minute Maintenance of Wakefulness Test trials were performed at 10:00 AM, 12:00 PM, 2:00 PM, and 4:00 PM, as recommended by the AASM practice parameters.[10]

The room was shielded from external light, and the only light source was positioned behind the patient's head. The test was administered by an experienced sleep technologist: an EEG (C3/A2, O2/A1), an electromyogram, and an electro-oculogram were obtained. Patients and control subjects were video-monitored throughout the test. They were not allowed to use any artificial strategy to stay awake such as moving continuously or singing. They were asked to fight against sleepiness in a soporific condition. Data were manually scored in 30-second epochs according to the recommendations of the AASM.[38] Sleep onset was defined as the first epoch of greater than 15 seconds of cumulative sleep in a 30-second epoch. The test was ended after 3 continuous epochs of stage N1 or 1 epoch of any other sleep stage to avoid interfering with the sleep homeostasis process.[10] The mean sleep latency of the 4 Maintenance of Wakefulness Test trials was then calculated. Participants who did not fall asleep during a trial were assigned a value of 40 minutes.

### Neuropsychological Tests

The vigilance subtest of the computerized Test Battery for Attentional Performance (TAP) (v2.2; Vera Fimm Psychogisches Testsysteme; Herzogenrath, Germany; 2012; http://www.psytest.net/index.php?page=TAP-2-2&hl=en_US) was performed at 8:30 AM, and the Wechsler digit symbol substitution test (DSST)[40] was performed at 11:00 AM. Subjects had not practiced the neuropsychological tests used for this study 1 year prior to the study to minimize any learning effect.

### Simulated Driving Performance

All participants performed a 1-hour driving session at 5:00 PM with a 3-dimensional driving simulator software (Compact Premium Driving Simulator, Oktal Company, Toulouse, France; oktal.fr). The driving track consisted of a monotonous scenario on a closed highway (15 km) with infrequent vehicles. Subjects were instructed to drive at a speed of 130 km/h and to stay in the right lane. The standard deviation of the vehicle position from the center of the road (standard deviation of lateral position [SDLP]) was calculated.

### Data Processing and Analysis

Data throughout are expressed as mean (SD). The patients were classified into 3 MWT groups: sleepy group (0–19 min), intermediate group (20–33 min), and alert group (34–40 min).[41]

A 1-way analysis of variance (ANOVA) with between-subject factor "attentional disorder" (ADHD patients, healthy control subjects) was conducted. A 1-way ANOVA with between-subject factor "Group" (0–19, 20–33, and 34–40 minutes and controls) was conducted to investigate the effects of Maintenance of Wakefulness Test mean sleep latency groups on driving performance. Planned comparisons were performed to localize statistical differences in significant main effect. Spearman ρ correlations were computed between ADHD symptoms (CAARS scores, subjective sleepiness scores, demographic and polysomnographic data, Maintenance of Wakefulness Test scores and driving performance). The α risk threshold was set at $P = .05$. *STATISTICA* for Windows version 9.1 (StatSoft, Inc) was used.

## RESULTS

### Patients and Healthy Controls

Forty-nine ADHD subjects were recruited, although 2 subjects did not agree to participate and 1 subject was not eligible (due to a presence of major depressive disorder). Forty-six ADHD subjects were included, but 5 ADHD subjects exhibited cybersickness on the driving simulator and the polysomnography was not correctly recorded for another ADHD subject. The sample thus consisted of 40 ADHD patients (mean age = 35.6 [8.5] years; range, 20–52 years; 19 men) and 19 age- and sex-matched healthy control subjects (mean age = 36.3 [10.5] years; range, 20–52 years; 9 men).

Among the 40 ADHD patients included in the present study, 20 (50%) had comorbid anxiety disorders (past or present) and 24 (60%) had a history of mood disorder. Twenty-eight (70%) presented with ADHD of the mixed subtype and 12 (30%), with the inattentive subtype. The mean CAARS ADHD index was 76.17 (9.92; range, 49–90). Scores on the other clinical ADHD scales were 97.2 (6.2; range, 35–187) on the WURS, 69.5 (3.7; range, 20–118) on the Brown scale, and 51.5 (1.8; range, 23–70) on the ASRS. The control group exhibited a mean CAARS ADHD index of 45.10 (6.54; range, 36–59). The results on the other scales were as follows: 12.8 (1.9; range, 1–27) on the WURS, 12.9 (2.3; range, 0–37) on the Brown scale, and 19.2 (1.7; range, 7–33) on the ASRS.

### Polysomnography and Maintenance of Wakefulness Test Sessions

Data on polysomnography and Maintenance of Wakefulness Test sessions are shown in Tables 1 and 2. Patients slept a mean of 404 (41.2) minutes during the night prior to the Maintenance of Wakefulness Test. The mean AHI was 5.1 (6.5) events/h (range, 0–30 events/h), and the mean index of periodic limb movements in sleep (PLMS) was 5.3 (12.8) events/h (range, 0–55 events/h). Three ADHD patients had an AHI above 10/h, and 5 ADHD patients had a PLMS index > 15 events/h One patient had both indexes above the pathologic cutoff. In ADHD subjects, the mean sleep latency on the Maintenance of Wakefulness Test was 24.7 (9.4) minutes. Classification of our patients into 3 groups according to their mean Maintenance of Wakefulness Test scores indicated that 35% of them were sleepy (14.2 [3.6] min), 50% were intermediate (28.0 [4.4] min), and 15% were alert (38.6 [2.2] min). In the sleepy group (14 ADHD patients), 3 subjects presented an AHI > 10 events/h and/or a PLMS index > 15 events/h. One patient had both indexes above the pathologic cutoff.

For the controls, the mean sleep latency on the Maintenance of Wakefulness Test was 39.0 (1.2) minutes.

**Table 1. Clinical and Polysomnographic Characteristics of the 4 Mean Maintenance of Wakefulness Test Sleep Latency Groups[a]**

| Variable | ADHD Patients (N = 40) Sleepy (0–19 min) | Intermediate (20–33 min) | Alert (34–40 min) | Healthy Control Subjects (34–40 min) |
|---|---|---|---|---|
| Participants, n | 14 | 20 | 6 | 19 |
| Male, n | 6 | 9 | 4 | 9 |
| Age, mean (SD) (range), y | 35.3 (7.9) (20–52) | 36.3 (9.1) (20–50) | 35.0 (8.9) (20–42) | 36.3 (10.5) (20–52) |
| BMI, kg/m$^2$ | 24.3 (3.3) | 24.2 (4.3) | 24.2 (2.5) | 23.7 (3.5) |
| CAARS Index | 78.5 (10.5) | 74.1 (9.2) | 77.6 (11.0) | 45.1 (6.5) |
| DBQ score | 62.5 (30.4) | 59.0 (27.5) | 70.8 (19.9) | 24.7 (13.6) |
| Anxiety, n | 5 | 9 | 4 | |
| AHI > 10 events/h, n | 1 | 2 | 0 | 0 |
| PLM > 15 events/h, n | 3 | 1 | 1 | 0 |
| TST, min | 405.7 (43.3) | 406.0 (38.8) | 403.8 (48.9) | 401.4 (43.5) |
| Sleep efficiency, % | 85.2 (8.9) | 85.1 (8.8) | 85.0 (9.6) | 84.8 (7.4) |
| ESS score | 13.2 (3.8) | 10.5 (4.2) | 15.2 (4.8) | 6.0 (2.7) |

[a]Values shown as mean (SD) unless otherwise noted.
Abbreviations: ADHD = attention-deficit/hyperactivity disorder, AHI = apnea-hypopnea index, BMI = body mass index, CAARS = Conners' Adult ADHD Rating Scales, DBQ = Driver Behavior Questionnaire, ESS = Epworth Sleepiness Scale, PLM = periodic limb movements, TST = total sleep time.

**Table 2. Sleep Latencies and Mean Sleep Latency on the 4 x 40-Minute Maintenance of Wakefulness Test (MWT) Trials (10:00 AM, 12:00 PM, 2:00 PM, and 4:00 PM) in ADHD Patients and Healthy Control Subjects**

| Mean MWT Sleep Latency Groups | Participants, % (n/N) | MWT Score, Mean (SD), min 10:00 AM | 12:00 PM | 2:00 PM | 4:00 PM | Mean Sleep Latency |
|---|---|---|---|---|---|---|
| Sleepy ADHD patients (0–19 min) | 35 (14/40) | 20.9 (8.3) | 13.1 (7.2) | 12.1 (9.1) | 10.7 (5.7) | 14.2 (3.6) |
| Intermediate ADHD patients (20–33 min) | 50 (20/40) | 30.5 (11.2) | 36.2 (8.5) | 18.6 (10.9) | 26.6 (12.8) | 28.0 (4.4) |
| Alert ADHD patients (34–40 min) | 15 (6/40) | 36.9 (7.5) | 39.7 (0.8) | 40.0 (0.0) | 37.8 (5.3) | 38.6 (2.2) |
| Healthy control subjects (34–40 min) | 100 (19/19) | 38.9 (4.7) | 40.0 (0.0) | 38.5 (4.5) | 38.7 (5.5) | 39.0 (1.2) |

Abbreviations: ADHD = attention-deficit/hyperactivity disorder.

### Neuropsychological Tests

On TAP vigilance (reaction time), ADHD patients were slower than controls (959 [170] versus 841 [93] ms; $F_{1,57} = 7.87$, $P < .01$). However, they did not have a higher mean number of omissions and commissions than controls.

On the Wechsler DSST, ADHD patients had a lower mean number of correct responses than controls (57.1 [11.9] versus 63.4 [8.5]; $F_{1,57} = 4.26$, $P < .05$).

### Epworth Sleepiness Scale

The mean Epworth Sleepiness Scale score was significantly higher in ADHD subjects (12.1 [4.4]; range, 0–23) than in controls (6.0 [2.7]; range, 1–10) ($P < .001$).

### Driving Behavior Questionnaire

The mean on the DBQ score was significantly higher in ADHD patients (62.1 [27.2]) than in controls (24.7 [13.6]) ($P < .001$).

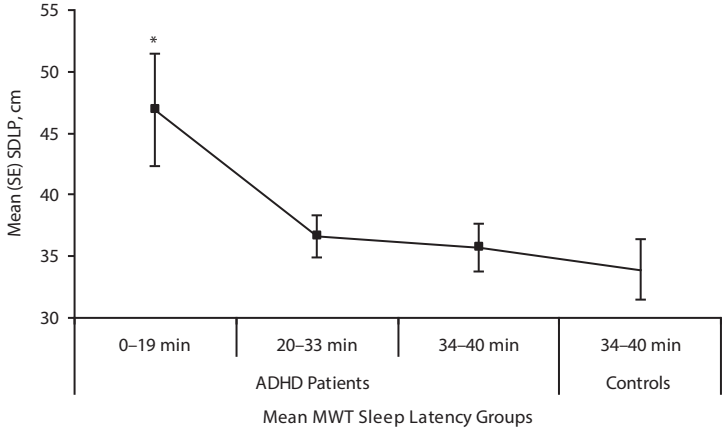
### Simulated Driving Performance

ADHD patients tended to have higher SDLP than controls (39.7 [1.7] versus 33.9 [2.5] cm; $F_{1,57} = 3.67$, $P = .06$, tendency). Simulated driving performance (mean SDLP) in ADHD patients did not correlate with the various clinical data (age, body mass index, ESS score, CAARS scores), nor with DBQ score or polysomnographic data.

### Relationships Between Driving Performance and Mean Maintenance of Wakefulness Test Sleep Latencies

SDLP differed in the different Maintenance of Wakefulness Test sleep latency groups in ADHD patients and controls (0–19 minutes: 46.8 [4.5] cm, 20–33 minutes: 36.6 [1.7] cm, 34–40 minutes: 35.7 [2.1] cm; controls: 33.9 [2.4] cm; $F_{3,55} = 3.94$, $P < .05$). The sleepy group (0–19 min) of ADHD patients had higher SDLP than the other Maintenance of Wakefulness Test groups of ADHD patients and the control group ($P < .01$). The control group did not differ from the intermediate group (20–33 min) or the alert group (34–40 min) of ADHD patients (Figure 1). Pearson correlations indicated that mean sleep latencies on the Maintenance of Wakefulness Test were correlated with mean SDLP in ADHD patients and controls (Spearman ρ: $r = -0.42$, $P < .01$). Moreover, mean sleep latency on the Maintenance of Wakefulness Test correlated with mean SDLP in ADHD patients (Spearman ρ: $r = -0.36$, $P < .05$).

**Figure 1. Mean (SE) Standard Deviation of Lateral Position (SDLP) During Simulated Driving in Mean Maintenance of Wakefulness Test (MWT) Sleep Latency Groups in ADHD Patients and Healthy Control Subjects**




*$P < .05$.
Abbreviation: ADHD = attention-deficit/hyperactivity disorder.

### Relationships Between CAARS Scores and Mean Maintenance of Wakefulness Test Sleep Latencies

Mean CAARS scores did not differ between the Maintenance of Wakefulness Test sleep latency groups in ADHD patients. However, we did not find any correlations between mean sleep latency on the Maintenance of Wakefulness Test and DBQ score in this population.

## DISCUSSION

This study demonstrates for the first time that a significant proportion of adults with ADHD exhibit objective excessive daytime sleepiness: one of the notable results is that 14 ADHD patients (35%) were severely sleepy as indicated by performance on the Maintenance of Wakefulness TestMaintenance of Wakefulness Test with a mean sleep latency of 14.2 minutes. Despite the different methods, our findings are in agreement with previous results in pediatric studies. Indeed, some children with ADHD were sleepier than controls as demonstrated by studies using the MSLT.[8,11]

Even if our study did not aim to relate excessive daytime sleepiness to a specific sleep disorder, another interesting result is that within this subgroup of sleepy adults with ADHD (n = 14), 11 were free of sleep-disordered breathing and/or periodic leg movements at a pathologic level. Therefore, one question is whether these sleepy ADHD patients represent a particular subgroup. Another question concerns the possibility of the central origin of their excessive daytime sleepiness: a "hypo-arousal state" (such as in narcolepsy) has been suggested by a few authors.[42] Beyond this physiopathologic issue, our study may have clinical implications. In fact, the use of wakefulness-promoting drugs (ie, modafinil treatment currently used in narcolepsy) rather than psychostimulants (methylphenidate) in this subgroup of subjects might be indicated. This new therapeutic strategy should be assessed in the future.

Importantly, public health studies have shown that sleepiness at the wheel is responsible for 5%–30% of road accidents, depending on the type of driver and/or road.[21–24] In addition, ADHD has been shown to be associated with a higher risk of motor vehicle accidents and impaired driving performance.[18–20] In this study, we investigated whether excessive daytime sleepiness could impact driving performance in a population of adults with ADHD. The sleepiest participants (Maintenance of Wakefulness Test score < 20 minutes) exhibited more impaired driving performance on the highway as compared to other ADHD patients and control subjects, and there were significant correlations between mean Maintenance of Wakefulness Test scores and mean SDLP within the ADHD group. Therefore, our results suggest that excessive daytime sleepiness could be an aggravating factor besides attentional disorders that is involved in the impairment of driving performance in this subgroup of ADHD subjects (ie, Maintenance of Wakefulness Test score < 20 min). As previously described by Reimer and colleagues,[43] ADHD patients were significantly more impaired than control subjects per the total DBQ score. These results demonstrate the usefulness of the DBQ for detecting differences in self-reported driving impairments between ADHD and control subjects. Nevertheless, DBQ scores did not correlate with simulated driving performance (mean SDLP) within ADHD patients, perhaps since these tools do not measure the same driving behaviors.

Several methodological limitations need to be considered. First of all, this study has a small sample size, limiting the generalizability of our findings. Another limitation is the presence of psychiatric comorbidities, so pathophysiologic correlates of excessive daytime sleepiness could not be identified. Comorbidity is the rule, with 66% of ADHD patients suffering from another psychiatric disorder.[44,45] All patients were recruited in an ADHD outpatient clinic, a setting where patients are likely to be more severely ill. In our work, we observed that 50% of ADHD patients presented with anxiety disorders and 60% presented with a history of mood disorders, although none of them presented with a current major depressive disorder. Anxiety disorders were distributed evenly in the 3 groups of patients. In addition, even if subjective data on regular sleep hygiene (BSNQ) and total sleep time prior to the Maintenance of Wakefulness Test (polysomnography) were documented, chronic sleep restriction, another major cause of excessive daytime sleepiness, could not be definitively ruled out. Finally, the duration of treatment by psychostimulants, a factor that may impact driving behavior, was not taken into account. The majority of the ADHD subjects were not treatment-naive and had stopped treatment 3 days before the laboratory tests, so there may

have been an "after effect" on cognitive tests and on driving behavior.

In conclusion, our study provides new evidence that a significant proportion of adults with ADHD exhibit objective excessive daytime sleepiness, which, in addition, impacts simulated driving performance. Excessive daytime sleepiness, a symptom objectively measurable by the Maintenance of Wakefulness Test, may be a key element to better evaluate these patients. Nevertheless, physiopathologic questions remain unanswered, so additional research is needed to evaluate how wakefulness-promoting drugs could improve cognition and behaviors in sleepy ADHD patients.

***Drug names:*** methylphenidate (Focalin, Daytrana, and others), modafinil (Provigil).

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