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# ADHD, methylphenidate and driving: does some legislation endanger public health?

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Driving a car requires a complex set of cognitive, perceptual and motor skills. Although it is practiced often and parts of driving become more or less automatic processes (e.g., using the gear), several other skills and abilities used during driving require active attention and concentration (e.g., anticipation of other traffic). In fact, the majority of traffic accidents are caused by driver inattention (Peden, *et al.*, 2004). Patients (and healthy people) often regard driving a car as a right and not a privilege (Beauregard, *et al.*, 1995). However, frequently legislation precludes driving under the influence of psychoactive drugs, with elevated blood alcohol or after using illicit drugs such as cannabis and stimulant drugs. This legislation is based on continuing research showing impairing effects of various drugs on driving performance. For example, various anxiolytic and hypnotic drugs have a negative effect on driving ability and patients who use these drugs have an increased likelihood of becoming involved in traffic accidents (Verster, *et al.*, 2005, 2006). The restrictive use of these drugs when it comes to participation in driving on public roads is warranted; however, this should not be applied if the prescribed medication has the potential of *improving* driving performance of a certain patient group.

Attention-Deficit Hyperactivity Disorder (ADHD) has the core symptoms of inattention, impulsivity and hyperactivity. ADHD is one of the most prevalent disorders in childhood, affecting about 3–10% of US school-aged children (Buitelaar, 2002). The prevalence of ADHD in adults is about 4%, present equally in men and women. With maturation hyperactive symptoms often diminish in patients with ADHD. However, attention deficits and impulsivity often persist and can have a significant impact on functioning. These symptoms become evident in almost all facets of daily life, including at school, at work and in interpersonal relationships (Biederman, *et al.*, 1996; Satterfield, *et al.*, 1997; Barbaresi, *et al.*, 2007; Nutt, *et al.*, 2007). Core characteristics of ADHD are reduced con-

centration and attention and increased impulsivity. It is understandable that these characteristics may compromise the driving ability of patients with ADHD, either by paying less attention to other traffic or by making risky (impulsive) decisions.

Official reports of citations and accidents and self-reports of number of motor vehicle accidents suggest that driving of untreated patients with ADHD is unsafe. Barkley and Cox (2007) recently reviewed these studies and underlined this conclusion. A meta-analysis of published studies (Jerome, *et al.*, 2006) reported that relative to controls, patients with ADHD reported more motor vehicle accidents (RR = 1.88, 95% CI: 1.42–2.50) and had more official reports of citations (RR = 1.35, 95% CI: 1.20–1.50). Also, patients with ADHD more often reported having driven without a valid driver's license (RR = 1.57, 95% CI: 1.34–1.84) or under the influence of alcohol (RR = 1.49, 95% CI: 1.19–1.88). The authors do acknowledge that self-reports are unreliable sources of data, especially in patients with ADHD (Knouse, *et al.*, 2005).

Driving simulator studies confirm the reports of patients with ADHD. Untreated driving performance is worse when compared with matched healthy controls (Barkley, *et al.*, 1996; Cox, *et al.*, 2000). More recently, Fischer, *et al.* (2007) compared young adults with and without ADHD while driving through city streets with a licensed driving instructor rating driving performance, unaware of the driver's diagnostic category. ADHD drivers were found to be significantly more impulsive behind the wheel.

Although the symptoms of inattention and impulsivity of those with ADHD apparently impair driving performance in general, the use of methylphenidate appears to improve, and possibly normalize driving performance of those with ADHD. Various studies performed in driving simulators reported a significant performance improvement after intake of methylphenidate (for an overview of these studies, see Jerome, *et al.*, 2006).

There have been two on-road evaluations of the benefits of long-acting methylphenidate on driving safety. Cox, *et al.* (2004) had ADHD adolescents drive their own car over a 25.7 km rural, highway and urban road course after taking no medication or after taking methylphenidate. A rater sat in the back seat, blind to the medication condition and rated consecutive 60 s epochs of driving behaviour using a standardized checklist. Inattentive driving errors were found to be reduced by 50% on medication. Cox, *et al.* (in press) followed a female and a male college student, both with ADHD, for 6 months with an in-car video system. When comparing video data for the 3 months while taking methylphenidate to the 3 months taking no medication, captured driving errors were reduced by two-thirds for the female and were eliminated for the male. This is currently being replicated in a larger randomized clinical trial.

Taken together, although using driving simulators and/or subjective ratings of driving performance, these studies do support the idea that methylphenidate significantly improves driving performance of patients with ADHD.

This issue of the *Journal of Psychopharmacology* features the results of the first naturalistic driving study performed on a 100-km public highway circuit during normal traffic examining driving ability of patients with ADHD after treatment with methylphenidate or placebo. We used objective measurements of driving performance including the weaving of the car (Standard Deviation of Lateral Position, SDLP) and speed variability, whereas patients were instructed to drive at a constant speed and steady position within the right hand lane. The results from our study confirmed in real life the outcomes of driving simulator studies; methylphenidate significantly improves driving performance of patients with ADHD.

#### Case 1. A 48-year-old male courier with ADHD

This patient works as courier to deliver packages throughout The Netherlands. On an average, he drives 70,000 km/year. A year ago, he was diagnosed ADHD. At this moment, he uses 30 mg methylphenidate daily, divided into three dosages of 10 mg, taken every 4 h. On the training day of the study (patient used methylphenidate), he was concentrated and made take-over manoeuvres at the right moment. He acknowledged all traffic signs and speed changes on the highway. On the first test day, the patient also received methylphenidate. He was relaxed, drove at the correct speed and followed all instructions. On the second test day, the patient received placebo. The patient was sleepy and concentrated less. He had difficulties taking over other vehicles and weaving of the car was much greater (SDLP of 16.05 cm after methylphenidate versus 20.91 cm after placebo).

Case 1 is a typical example of a driver with ADHD, with and without using methylphenidate. It illustrates that untreated patients with ADHD are easily distracted and pay less attention to the road. Their driving may be unpredictable for other drivers because they miss road signs, take over at the wrong moment or are speeding.

It is evident that driving performance of the courier was significantly improved by using methylphenidate. As a comparison, when he does not use his medication the weaving of the car (SDLP) increased by 4.86 cm, that is, an increment corresponding with that observed after drinking alcohol at a BAC > 0.10%.

In many countries including United States, United Kingdom, Germany and France, there is no specific driving legislation concerning ADHD or its treatment. Despite the absence of any data indicating methylphenidate impairs driving several countries have legislation that precludes the use of methylphenidate by drivers. The main reason for this is the fact that methylphenidate is classified among (illicit) stimulant drugs.

This is not the first time that patients who use medication that actually improves their driving ability are not allowed to participate in driving on public roads. For example, it is understandable that untreated epileptic patients should not participate in driving on public roads because they risk having a seizure behind the wheel. However, current anticonvulsant medication often successfully prevents seizures. Using anticonvulsants should, therefore, not disqualify an epileptic patient from participating in driving on public roads. Today, United Kingdom and The Netherlands allows driving of successfully treated epileptic patients when they are at least 12 months free of seizures.

Precluding driving by patients with ADHD when taking methylphenidate may encourage driving without the benefit of their therapeutic medication, and thus inadvertently promoting unsafe driving performance by such patients. This could not only place the patient and their passengers at increased risk of vehicular collisions but also other drivers on the road. In effect, such legislation could be endangering the public health. We, therefore, encourage legislators of such countries to reconsider such potentially dangerous and unfair legislation.

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