Adult attention deficit hyperactivity disorder and driving – risk, medication and fitness to drive

Ireland has been on the highway of improvement on road safety, where road deaths per million inhabitants have decreased from 107 in 2001 to 42 in 2014, sitting in the ninth place out of 27 European Union (EU) Member States. Then, the publication and recent renewal of Sláinte agus Tiomáint: Medical Fitness to Drive Guidelines have continued the pursuit with focuses on long-term health and disability-related conditions, with the recognition of recent traffic medicine studies which overcame the misconception that older drivers would have higher crash risk. On the psychiatric side, various recent studies on attention deficit hyperactivity disorder (ADHD) have provided rebuttal on different misconceptions, provoking issues on traffic medicine, including concerns on safety of ADHD drivers and adult ADHD medications which are not licensed for use in adults in Ireland, the United Kingdom (UK) and most European countries.

American Psychiatric Association (APA) defined ADHD in the text revision of the 4th edition of Diagnostic and Statistical Manual of Mental Disorders (DSM-IV-TR) as “a persistent pattern of inattention and/or hyperactivity-impulsivity that is more frequent and severe than is typically observed in individuals at a comparable level of development” and causes impairment in “occupational, social, and academic” aspects to the patient (the 5th edition is to be discussed later). ADHD used to be assumed as a childhood disorder, with its worldwide prevalence for children (18 years old or below) to be about 5.3%, given that geographic variability has limited effect on the prevalence of ADHD.

However, its occurrence among adults with long-term outcomes has caught increasing attention. Although it was once perceived that the symptoms and prevalence of ADHD would mitigate exponentially with chronological age, a meta-analysis on published follow-up studies of ADHD reported that the persistence rate of full diagnosis up to an age of 25 is about 15%, and the rate rises up to 65% if including partial remission with reference to APA DSM-IV-TR definition. Studies showed that the adult prevalence is around the range of 2.5-4.2%, but it could be underestimated because of the unclear validity of the APA DSM-IV-TR diagnostic criteria which targeted at children in school or playground settings. ADHD being a lifetime disorder is further supported by the discovery of the high degree of genetic predisposition and the greater significance of genetic influences than shared environmental influences. A study in life-course perspective showed that ADHD may even adversely impact elderly diagnosed later in life.

The symptoms of ADHD are suggested to arise from or be associated with deficiency in certain cognitive executive functions, such as working memory and response inhibition. ADHD is also associated with motor anomalies, such as unintentional and unnecessary overflow of movement.
The ability to drive highly relies on cognitive and motor functions. Driving involves three hierarchical levels of competencies which, from bottom to top, are “basic cognitive abilities necessary for driving (operational), actual skills for manoeuvring the vehicle in traffic (tactical), and the more executive, goal-directed aspects of driving (strategic)”, and incompetency in lower levels could affect higher levels but higher levels have minimal or no effects on lower levels. Operational abilities include attention, spatial perception, cognitive processing and motor coordination; tactical abilities include adaptation of speed and decisions related to other vehicles in traffic; and strategic abilities include choice of routes and sequences of trips.

Cognitive and motor impairments of ADHD could weaken the operational abilities to drive, while problems in tactical abilities are also found in studies, and hence affect driving behaviour. Some studies suggested inattention is the major cause to traffic crashes in general and for ADHD drivers.

Apart from cognitive and motor problems which have been long discussed, some recent ADHD studies have pointed to the substantial effect of the consequential emotional problems, including impulsiveness, instability and deficiency in self-regulation, in provoking unsafe driving behaviour.

The above findings of cognitive, motor and emotional problems have provided theories and explanations towards the presence of a higher risk for ADHD driving, while an aggregate and quantitative perspective on the scale of risk is also required to gain better understanding. The relative risk of traffic crashes has been found to be about 1.54-1.88 for ADHD drivers through meta-analyses. It has to be noted that an inaccurate assertion of a fourfold increase in risk relative to healthy individuals was made two decades ago, while the most recent meta-analysis stated the relative risk to be 1.36 without control for mileage (or 1.23 with control for mileage). This overall decrease in relative risk found over the decades, however, does not imply a reduced need of attention on the matter. The risk associated with ADHD is still above those for visual and hearing impairments. Instead, efforts should be made in future studies to improve accuracy and clarity to gain a deeper insight into the issue, as subsequently discussed.

Co-morbidities instead of ADHD alone have complicated the issue and have confused a lot of researchers. Oppositional defiant disorder (ODD) and conduct disorder (CD) are common co-existing psychiatric problems with ADHD. While one study has shown the prevalence of ADHD with ODD to be 67% and that with CD to be 46%, another study has displayed the prevalence of ADHD with ODD to be 44.3-59.3%, that with CD to be 13.5-26.8%. The inaccurate assertion of a fourfold increased risk mistakenly included the risk arising from co-morbid ODD and/or CD, and has been cited in many articles regarding ADHD driving risk, including some cited in this essay. Compared with those with ADHD alone, those with ADHD and co-morbid ODD and/or CD show more impairment in psychosocial and behavioural features and poorer performance in risk avoidance and resilience. The misleading statement could undermine the influences of ODD and CD and disrupt the effectiveness and preciseness of medications and traffic policies to tackle ADHD driving risk, as well as the risks of co-morbidities for.
Other sources of error may lie in the design of past experiments. Ecological validity of driving simulation in past studies could be challenged since crashes simulated in experiments are different from reality and the stress induced in the experimental setting could affect drivers’ performances. Some studies have adopted self-evaluation to assess driving performances, but it is also found that ADHD drivers tend to over-estimate their performances more than control drivers by making similar assessments in spite of higher rates of collisions and receiving speeding tickets and driving citations, as well as fewer safe behaviours found in reports and in simulator. Confounding factors in studies could also include driving mileage which is also not taken into control, as ADHD drivers are found to drive more than control drivers in many studies.

In response to the prevalence of adult ADHD and the risk for driving of ADHD drivers, better diagnosis of and treatment for adult ADHD are demanded. Studies have reviewed the unclear validity of the APA DSM-IV-TR diagnostic criteria, and have addressed the age-dependent change of the presentation of ADHD symptoms. Concerning the persistence of ADHD from childhood into adulthood, hyperactivity and impulsivity could decline; inattention could persist or even worsen; reaction has slowed down; and inner-restlessness such as irritability and depression could arise; so that this shift in symptoms could lead to premature discontinuation of treatment. Hence, American Psychiatric Association (APA), based on substantial published research since 1994, has revised the diagnostic criteria of ADHD in the 5th edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) in 2013 to more accurately incorporate the characteristics of adult ADHD with the recognition of difficulty of precisely recall childhood and with the provision of additional examples. It is particularly remarkable that a lower cut-off point for number of symptoms is adopted for the diagnosis criteria. An increase by 27% in adult ADHD prevalence is expected upon the change from DSM-IV-TR to DSM-5 diagnostic criteria which is reviewed to be more suitable for adults.

Medication is a common treatment for ADHD in children and there is an increasing urge for a reform in the management of treatment in adult ADHD. The guidelines on medical treatment of ADHD provided by UK National Institute for Health and Clinical Excellence (NICE) in 2000 recommended the cessation of medication on ADHD during adolescence, and then their guidelines published in 2008 have removed the recommendation. However, more has to be done. Currently, three drugs are prescribed for ADHD in children, including two stimulants, methylphenidate (MPH) and dexamfetamine (DEX), and a non-stimulant atomoxetine (ATX), in Ireland and the UK, but MPH and DEX are not licensed to treat adults with ADHD and ATX is only licensed for adults who are continuing medication from childhood.

Stimulants can stimulate certain parts of the brain to bring about reactions mentally and behaviourally. They are usually the first treatment for adult ADHD, with MPH more preferred. Although DEX is the least expensive among the three drugs to give its desired effect, its close
pharmacological relationship with illegal stimulants like methamphetamine has made it a choice after MPH. Placebo-controlled studies have strongly supported the substantial efficacy of MPH to treat ADHD in adults, alleviating symptoms in a safe and well-tolerated manner independent of gender, age and co-morbidity. Vigilance, reaction time, response inhibition and working memory improve under MPH treatment as well. In regard to traffic medicine, studies have adopted accurate approaches and have revealed that considerably beneficial effects from MPH on driving behaviours of ADHD drivers, including better driving performances in simulators, less speed variability, less incidence of speeding and less inappropriate use of brakes in simulated driving; fewer inattentive errors, less speed variability and smaller collision rate in real traffic. The possible drawbacks of MPH include small increases in blood pressure and heart rate. Few studies have examined the efficacy of DEX to treat adults with ADHD.

The non-stimulant ATX works as a selective noradrenaline uptake inhibitor, and is generally used as an alternative to the stimulants when the adult is in a co-morbid condition with contraindication or his body does not respond to the stimulants. Its effect may be smaller, as related studies could not find any significant improvement or could only reflect better self-assessments in simulated driving.

It is imperative for regulatory body and policymakers to license medications for adult ADHD as a protection to both patients and medical practitioners. The EU Directive 2001/83/EC states that drugs being unlicensed in Ireland imply that they are not authorised by the Health Products Regulatory Authority (HPRA) or are not granted market authorisation by EU, meaning that they are not supplied or distributed to the market. An exemption is allowed, provided that the unlicensed drug could be prescribed by an authorised medicine practitioner to his patient under his direct responsibility. Despite this exemption and the availability of medications for ADHD, many practitioners are not willing to prescribe ADHD medications to adults because of the possibility of medico-legal risks. Newly diagnosed adult patients may not receive adequate care and others with ADHD persisting from childhood may not be prescribed effective stimulants after discharged from paediatric care. The need is surging with the greater proportion of the population falling into the diagnostic criteria of ADHD.

The evaluation of the fitness of ADHD patients to drive in Sláinte agus Tiomáint: Medical Fitness to Drive Guidelines is that the disorder itself does not mean a restriction to acquire a license to drive a car or a motorcycle, with the recognition of that impulsivity and lack of awareness need to be considered. The future update of the guidelines may need to address issues on the previously underestimated prevalence in adults, the possibility of complex co-morbidities and the effect of medication. The guidelines are recommended to encourage ADHD drivers to receive medications, especially if the drugs are licensed for adults in the future and if drivers are diagnosed with other co-existing psychiatric conditions.

Doctors should be aware to the new ADHD diagnostic criteria which are expected to change with any new findings in the field, and to diagnose ADHD in children and adults based on professional judgments. General practitioners who are responsible for primary healthcare services may be in need of
training and screening tool for diagnosis of adult ADHD\textsuperscript{15}, so experts and experienced doctors in the field should try to fulfil their needs to enhance the efficiency in the diagnosis process. As the continuity of care is essential in patient management, regular follow-up consultations are needed to keep track of patients’ conditions, and change the dosage or medication if needed. Besides, doctors should assess the ability to drive of ADHD patients in compliance with the Guidelines in order to promote the safety of patients as well as other road users. In the case of failure in assessment, doctors should still try to alleviate the symptoms to enable the patient to drive in the future.

Besides, mental and social aspects are also important in the health of a patient\textsuperscript{66}. Doctors should be concerned with patients’ feelings especially when they failed to gain the permission to drive. ADHD patients have greater incidence rate of depression\textsuperscript{7,67}. Loss of the means of travelling by driving may also affect their social health, because their social engagement could be curtailed\textsuperscript{26}. Co-operation with counselling psychologists and social workers may be needed.

In order to ease the procedures of licensing ADHD medications and improving guidelines for assessing medical fitness to drive, researchers are recommended to follow the future research directions suggested by various studies. The true cause of ADHD and true mechanism of how the drugs work to improve ADHD symptoms are still not clearly known, so further research into ADHD pathogenesis, etiology and drug mechanisms could project an insight into the measures to improve treatment efficacy and safety\textsuperscript{51,55}. Future studies are recommended to adopt a longitudinal perspective, increase the sample size, diversify sample composition, lengthen the duration, and impose better control on confounding factors and co-morbidities\textsuperscript{35,37,39,55}. Researchers could also put more effort on non-pharmacological interventions, such as cognitive-behavioural therapy, which may potentially improve driving performance but little has been explored in studies\textsuperscript{35,62}.

One important suggested direction of future studies would be the cost-effectiveness of medications to adults, as no literature has been published about it. Related studies have shown the significant economic impact of ADHD to society in the United States (US) with an estimated annual cost of $42.5 billion\textsuperscript{68} and have proved the cost-effectiveness of medications to children and adolescents with ADHD to society in various countries\textsuperscript{69,70}. Medications for adults are licensed in the US\textsuperscript{7} but the US has a very different medical system from Ireland, so the data may not be applicable to Ireland. The implications of economic studies on healthcare issues, including ADHD medication, may involve some ethical discussion which is discussed later.

While medical students are preparing themselves to join the work force of the healthcare profession, they are entering adulthood and have the right to acquire a driving license to become road users, so issues in traffic medicine are related to them as well. It is suggested that medical schools should bring up topics about traffic medicine as part of medical education. Driving with ADHD could be included into the curricula of psychiatry and medicine sociology.
Ethical issues may include stigmatisation of ADHD patients. Stigmatisation refers to “the expression of a discrediting stereotype deriving from falsely assumed associations between a group of people and unfavourable characteristics, attributes, and/or behaviors”\(^7^1\). It is important to note that physicians and researchers could have stigma towards ADHD patients, but clinical mythology about ADHD should be overcome by rational evidence-based studies and assessments. Physicians and researchers could presume an exaggerated risk and severity of ADHD, possibly reflected as inaccuracy in assessing patients’ ability to drive and invalid experiment design. Rational findings could help the society understand ADHD sufferers more and improve social health of patients through reducing stigmatisation\(^7^2\).

Another ethical issue is the mutual trust between doctors and patients which could worsen on issues around the prescription of unlicensed drugs. The patient may feel helpless and disappointed if the doctor refuses to prescribe the unlicensed drugs. Another possible scenario is that patient could lose trust on the doctor’s ability if his symptoms have not improved, but this may be because of incorrect dosage or choice of drug. These ethical issues could be tackled with recommendations discussed earlier.

Cost-effectiveness analysis could be a convenient instrument in policy decisions, but probably not a perfect one, particularly from the perspective of ethics. Cost-effectiveness of adult medications in Ireland or in similar healthcare systems is still unknown and would not put policymakers into any dilemma if medications are proved to bring economic profit to society. However, if the cost incurred for adult medications is greater than the revenue brought to society, it is highly debatable that if, or how much, we could compromise health and lives of certain individuals in pursuit of smaller social cost. This complicated philosophical debate could involve many ethical, medical, political, legislative and economic factors\(^7^3,^7^4\), and should be discussed in further studies.

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