

The Unrecognised Adult ADHD Patient: accidents, brain injury and behaviour

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Abstract

Studies of accidents and traumatic brain injury in adults with ADHD reveal increased mortality associated with the traffic driving behaviours of this patient population. Evidence that accidents and traumas are increased in ADHD patients has ethical, legal, and regulatory implications, and any form of behavioural modification that supports technical accident prevention could decrease mortality rates. Crucially, this is a current unmet public health problem.

KEYWORDS: ACCIDENTS; ADHD; DIAGNOSIS; DRIVING; STIMULANTS; TREATMENT

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Introduction

Diagnosis of ADHD in adults remains challenging and many are likely to have been undiagnosed as children. A large proportion of patients are often hidden from daily clinical practice as they are more likely to be found in orthopaedic hospitals or trauma surgeries, but not in psychiatry. In this article, the question of whether accidents or traumatic injuries are increased in ADHD adolescents and adults is addressed, and if so, what the underlying mechanisms might be. Extensive literature exists to support how accidents and traumatic injury are increased in ADHD patients, and that ADHD increases the risk of unintentional injury.^{1,2}

Adult ADHD and accidents

In 2018, a meta-analysis of the risk of injury and accidents in children and adolescents with ADHD was completed using

data acquired from a number of studies.¹ Of these, four studies reported hazard ratios (HR) and 28 studies reported odds ratios (OR). The difference between both measures is in the timing of incidents; where HR looks across the whole timepoint, OR is more cross-sectional. The authors found a significantly higher risk of injury in ADHD patients compared with controls (OR, 1.53; 95% CI = 1.40, 1.67); these patients have a 50% higher risk of any unintentional injury across the spectrum of possible physical harm, inclusive of traffic accidents for adults. In the regression analysis, no confounding variables such as age, sex, or comorbid oppositional defiant disorder (ODD) had any significant influence on reported HR or OR values. Findings also showed that for traffic accidents, OR was approximately 1.4–1.5 or a 40–50% increased risk, and the clear conclusion from this data set is that ADHD is

significantly associated with increased risk for unintentional injuries in children and adolescents. The number of individuals used for these OR studies (350 938 ADHD patients and >4 million non-ADHD controls) demonstrate that these are huge population representative data sets and can be called clear evidence. A previous meta-analysis³ reported studies where the OR was higher at 1.96, and a possible reason for this was that the severity of ADHD in the 1990s was higher and data were preselected from severe cases. The possibility of other mental disorders being the reason for the accident data was unfounded. Only ADHD is related to studies of traffic accidents, and injuries and traumas seem to be specifically associated with ADHD, and not with other mental disorders such as depression or anxiety.²

Traumatic Brain Injury and ADHD – does one precede the other?

ADHD is associated with an increased risk for traumatic brain injury (TBI) and a meta-analysis reported OR 2.1 for mild TBI in ADHD.⁴ However, TBI also appears to be linked with secondary ADHD as shown in a recent study.⁵ This prospective study included young children hospitalised for either TBI or other orthopaedic injury (OI) as a control condition, e.g. fracture of limb. A total of 187 children were followed up longitudinally and then investigated using established rating scales. Secondary ADHD was defined as a condition with an elevated ADHD score on the Child Behaviour Checklist (CBCL); of the 187 children, 48 (25.7%) met the definition of secondary ADHD. In patients with moderate and more severe TBI, secondary ADHD was a consequence later in life. In determining whether TBI precedes ADHD or vice versa, a bidirectional effect was found – ADHD increases the risk towards TBI and TBI increases the risk for ADHD-like symptoms. Therefore, both might play a role if you look longitudinally into adulthood and it would be quite difficult to disentangle whether TBI or ADHD occurred first.

Traffic accidents and ADHD

A specific form of accident and traumatic injury associated with ADHD is traffic accidents, or more specifically, motor vehicle accidents. Another large population representative study – a retrospective cohort study from Pennsylvania – evaluated a cohort of almost 2500 ADHD young adults/ adolescents and 15 000 non-ADHD individuals.⁶ Here, the electronic health records were linked with driver licensing and crash databases. The main outcome was the first

involvement as a driver in a police reported crash. The authors were also interested in when these individuals had obtained their driver licence, and noted that ADHD patients of both genders acquired their driver licence later than controls. (Figure 1) They also obtained it to a lesser degree which may point to cognitive impairment, or to the fact that they tend to complete only 90% of the course. This may also explain why ADHD patients have an increased risk for driving without a licence. The survival plot in Figure 2 shows the proportion of crash-free drivers – ADHD patients again from both genders have significantly more crashes than non-ADHD individuals. The relative risk for crashes amongst drivers with ADHD was 1.4, again a 40% increased risk of traffic accidents or crashes in this particular data set.

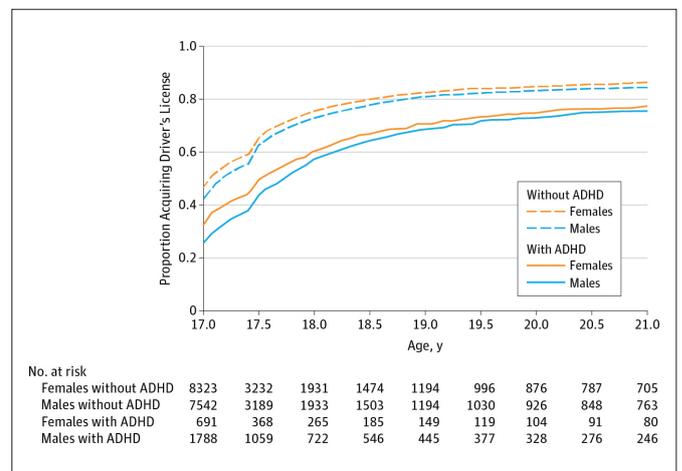


Figure 1. Inverse Kaplan-Meier Curves Depicting Cumulative Probability of Licensure by Sex and Attention-Deficit/Hyperactivity Disorder (ADHD) Status. Reproduced from: Curry et al. JAMA Ped 2017.

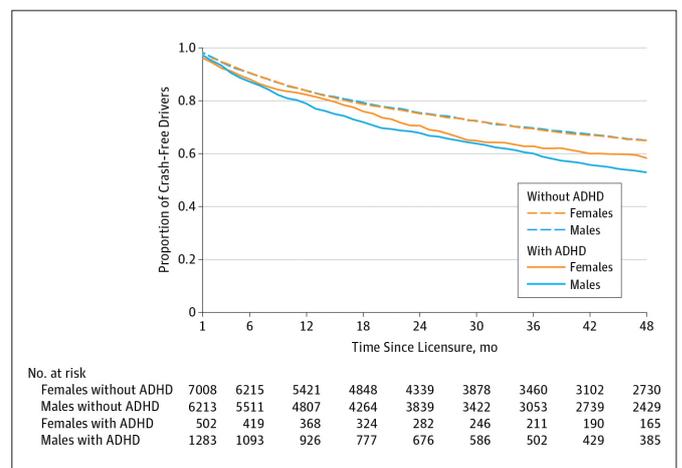


Figure 2. Kaplan-Meier Survival Curves of the Estimated Proportion Crash-Free Over Time by Sex and Attention-Deficit/Hyperactivity Disorder (ADHD) Status. Reproduced from: Curry et al. JAMA Ped 2017.

There are several outcomes related to traffic driving behaviour and ADHD which were previously assessed,⁷ and many events are seen to occur more often in ADHD patients than in non-ADHD patients. The former have more instances of traffic, highway, rear-ended, hit and run, and fatal accidents. Often the accidents will be their own fault and they have more citations for speeding, driving under the influence, convictions, licence suspensions, and reckless driving. There may be under-reporting by patients, but also over-reporting due to impulsive answering. More objective measures are therefore needed and the answer might lie in conducting driving simulation tests for these individuals. Again, in patients with ADHD, there are more collisions and crashes in the simulator, more speeding, and poorer speed control.

Interestingly, results reveal that if the driving simulator was a few years old, the results of the driving tests were worse; for the ADHD patient the older simulators are boring to operate and not that realistic. The more modern the driving simulators were, and the more realistic, the better the data. The best way to test driving capabilities is, of course, on-road testing. It cannot be as controlled but you can witness the driving behaviour very clearly. ADHD patients have more collisions and crashes, more speeding, more driving errors, and more instances of hard braking. However, in general, these data clearly show that individuals with ADHD have different and more adverse driving outcomes than individuals with no ADHD^{7,8} and poorer driving behaviour appears to be far more pronounced in young drivers than in older drivers. A young inexperienced driver needs all their executive control and a great deal of concentration and attention to the task. For older drivers, the task is a much more subcortically-controlled phenomenon which does not require as much active prefrontal control.

Reasons for accidents in ADHD

A major reason for accidents in ADHD is daytime sleepiness and something that clinicians may not consider enough. A study examined a large sample of 36 140 regular highway drivers who answered an intimate questionnaire exploring driving risks, sleep complaints, sleepiness and distraction at the wheel, and ADHD symptoms using the Adult ADHD Self-Report Scale (ASRS).⁹ During actual driving accidents and more pronounced near-miss driving accidents, sleepiness played an important role as did distraction, and

in this survey these were the most important risk factors for accidents; 20% of drivers with ADHD reported severe sleepiness at the wheel during daytime vs 7% of non-ADHD drivers. Distraction also appears to be a pertinent feature of driving accidents. A driving simulation experiment with a cohort of adolescents with and without ADHD (n=28 vs n=33, respectively) engaged in a simulated drive which was set under three experimental conditions:¹⁰

- No distraction
- A cell phone conversation
- Texting while driving

During each condition one unexpected event was introduced, such as sudden car braking or a pedestrian crossing in front of the driver's vehicle. Interestingly, adolescents with ADHD demonstrated more variability, generally with speed and lane position compared with controls. Unsurprisingly, texting negatively impacted the driving performance of all participants – ADHD patients as well as controls. The sample size is quite low but the results argue that texting is especially relevant in ADHD patients as they are unable to share their attention between both tasks. Using your cell phone while driving is a known danger for all drivers, but especially if you are an ADHD patient.

In an investigation of real life studies of 777 subjects – these were drivers involved in a motor vehicle crash and whether they were responsible for the crash – major risk factors were established as either external or internal distractions.¹¹ The interaction between ADHD and an external distraction such as cell phone use or texting was by far the most risky situation (adjusted OR, 5.79) and clearly shows that distraction is a relevant risk factor for the ADHD patient at the wheel of a motor vehicle.

Women, in general, have less motor vehicle accidents than men and in ADHD patients this is also the case, although the numbers are more equalised.¹² In the US, studies that compared male and female drivers with ADHD revealed no significant difference in the number of traffic citations issued, although numerically, females received less citations. For recorded collisions, young female drivers (16-24 years) with ADHD had higher collision rates than young male drivers, possibly due to the types of external distraction already mentioned. Male drivers over 25 years of age with ADHD

had significantly more collisions and citations than female drivers in the same age group, and although causal factors have not been established, it may be prudent for clinicians to ask questions about traffic collisions and citations when considering medication.¹²

A registry study in Swedish adults revealed an association between ADHD and serious transport accidents, and shows the increase in risk is the same for both males and females.¹³ The data suggest a significantly increased overall mortality rate in individuals with ADHD and a seminal study on a population representative data set shows the mortality rate is increased four-fold, especially when ADHD has been diagnosed at the age of 17-18 years or later; the mortality rate is mainly due to suicide and traffic accidents.¹⁴ These studies demonstrate that this is not a mere academic exercise, but has real relevance. It accounts for a substantial portion of the overall mortality increase in ADHD patients, and these are preventable deaths.

In the recent Prevalence of ADHD in Accident Victims (PRADA) study,¹⁵ the authors used very liberal inclusion criteria to examine patients who had suffered from many types of trauma, which included household injuries as well as traffic accidents. The study was conducted across two trauma surgery clinics in Frankfurt; patients were >18 years of age (N=905; males 64%, females 36%), admission to a clinic was due to a previous accident defined as a sudden unforeseen event with external influences which required medical treatment, and patients provided written informed consent. Exclusion criteria were an insufficient command of the German language and impaired consciousness, as no written consent could be obtained in these cases. The age range of the cohort studied was 18-92 years with a median age of 48 years (SD=16 years) although women were significantly older than men (median age: 51 years vs 45 years). All patients were screened using the ASRS questionnaire, and if a patient screened positive a detailed trauma or accident questionnaire was administered. The researchers also asked for the location of the accidents, whether the accident was self- or third-party-inflicted, and if the patient was under the influence of substances.

A total of 8.3% of these 905 trauma victims screened positive for ADHD in the ASRS (males 9.1%, females 7.9%) – much higher than the population representative screen which

would be approximately 6% in the German population.¹⁶ All patients who screened positive were offered a detailed diagnostic assessment and treatment, and 82% of screened positives were diagnosed as having ADHD. However, the number of patients willing to attend the clinic for an accurate diagnostic assessment was quite low and supports the notion that many of these patients are missed. These are likely to be patients who are not suffering from mental health conditions in addition to ADHD, but rather from physical comorbidities or other negative outcomes.

Most screened positive for combined type ADHD, and the remainder for inattentive type ADHD. No hyperactive subtype ADHD patients were found. Curiously, the ADHD patients were much younger than non-ADHD trauma victims with a difference of more than 10 years between them (39 years vs 50 years, respectively). Results also revealed the manner of how the accidents happened; ADHD patients reported that they were significantly more under stress before the accident, which is reasonable when considering an ADHD patient who has to divide his or her attention. The difference was quite significant (35% vs 11%), around half of patients felt under stress at the time of being interviewed, and >25% of patients experienced emotional events prior to the accidents compared with only 12% in the control group. ADHD patients had significantly more accidents in the past year with a higher rate of accumulative accidents over their lifespan. They were also found to be under the influence of drugs more often than controls, especially alcohol, and the difference is striking (17% vs 3%). These results suggest that if trauma accidents are screened in an unbiased way, ADHD patients who might require treatment would be more visible, more frequently. The data show that they experience accidents when they are under stress and under the influence of substances, but these are also patients who do not actively seek treatment. An analysis on distractions has yet to be completed.¹⁵

Effect of stimulants on trauma

Another large meta-analysis included several nationwide databases and three studies from insurance claim databases.¹⁷ The overall sample size was 2.3 million for between-individual and 0.25 million for within-individual analyses. All studies evaluated physical injuries as the main outcome and findings showed that stimulant use significantly reduced traumas and accidents in ADHD patients.

The effect was more pronounced in adults who had a 40% lower risk. Two other relevant studies^{13,18} suggest that up to 45% of accidents in ADHD could be prevented if patients used stimulant medication – the Swedish registry studies on 17 408 patients revealed a more pronounced HR for treated medicated men in the within-individual analysis vs between-individual analysis (HR, 0.4 vs 0.7, respectively).¹³ The follow up study¹⁸ used data from commercial health care claims in the United States (n=2.3 million) where it was found that women in the within-individual cohort had a 30% risk reduction comparable with men. It appears that stimulant medication was not only associated with an immediate risk reduction for accidents, but also with long term risk reduction for traffic accidents.

The stimulant medication, methylphenidate, is associated with reduced bone density and it might be assumed that there would be a higher fracture risk in patients treated with methylphenidate. Remarkably, methylphenidate may actually be protective against fractures – a study from Israeli military personnel that has been followed longitudinally over time convincingly shows that methylphenidate in a dose-dependent fashion reduced the risk for fracture in females and males providing more data arguing that treatment of ADHD reduces the risk of accidents.¹⁹ However, statistics show that ADHD patients have a higher risk of driving under the influence of substances with consequent accidents.²⁰⁻²² Whether or not stimulants would reduce the risk for substance and alcohol abuse in ADHD patients is a long standing controversial debate, but the recent literature²³ shows that similar treatment reduces the risk for alcohol abuse, therefore, stimulant use in ADHD patients might reduce the risk of accidents in the long term.

In another newly published article,²⁴ the researchers reviewed all evidence for the effect of stimulants on behavioural neuropsychiatric outcomes and found that stimulants reduce the risk for injuries, traumas, motor vehicle accidents, substance use disorder, and several other behavioural outcomes. The evidence shows, therefore, that accidents and traumas are increased in ADHD patients (OR, 1.4-1.5) and this evidence has ethical, legal, and regulatory implications. Screening of trauma victims seems reasonable and might provide a huge potential for secondary prevention. In the ADHD population, a substantial number of accidents could be prevented through administration of specific

medication and it is suggested that up to 40% of accidents could be reduced by adequate treatment,^{13,18} – a great deal of effort is spent in the area of technical accident prevention which is very important, but behavioural modifications are also crucial to prevent accidents and associated risks. The increased mortality rate in ADHD patients could be reduced and accidents prevented, and the fact that this is not done is a considerable unmet public health problem.

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