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Risk and prevention of unintentional injuries in children and young people with attention-deficit/hyperactivity disorder

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Abstract

Injuries among children and young people are a leading cause of morbidity and mortality in the UK and globally. Attention-deficit/hyperactivity disorder (ADHD) is an important neurodevelopmental disorder which can be present from preschool age but is generally under-recognised. Children and young people with ADHD are at increased risk of a variety of unintentional injuries. However, interventions to offer safety advice, assessments and safety equipment can help to improve home safety practices and reduce injuries. Clinician contacts with children and young people with ADHD are an important opportunity to recognise injury risk and offer appropriate advice and input. This article discusses the risks, mechanisms, costs and prevention advice for unintentional injuries in children and young people with ADHD.

Keywords: injury, unintentional injury, injury prevention, injury risk, attention-deficit/hyperactivity disorder, ADHD

Introduction

What is ADHD?

Attention-deficit/hyperactivity disorder (ADHD) is a neurodevelopmental disorder which is usually present from a preschool age. Children and young people (CYP) with ADHD have symptoms inclusive of inattention, hyperactivity and impulsivity. CYP will be expected to have symptoms in the school/education setting as well as at home. There are two main systems used to classify ADHD: the Diagnostic and Statistical Manual of Mental Disorders (DSM), which is favoured in North America and the International Classification of Diseases system (ICD), which is favoured more in the UK and Europe. In the UK, a diagnosis of ADHD is given by specialists in secondary care based on the National Institute for Health and Care Excellence (NICE) guidelines. Specialists in the UK may use a combination of DSM and ICD criteria in making the diagnosis and will also consult the CYP, carer and other services (such as education) in order to come to a clinical diagnosis. Most people with ADHD have this disorder from a young age. In fact, NICE guidelines state that the diagnosis is not appropriate until 3 years of age and the peak age for diagnosis is around 6 to 11 years old. However, some adults may have ADHD which was not present in childhood. This article will focus on childhood ADHD, which often persists into adult life.

ADHD is common. It affects 3-5% of CYP globally and accounts for around one fifth of psychiatric diagnoses in CYP in the community. The community prevalence is the number of CYP in a representative population who have ADHD according to predefined criteria. For example, the Diagnostic and Statistical Manual of Mental Disorders (DSM) or International Classification of Diseases (ICD) criteria. The community prevalence of ADHD has remained consistent over the last three decades according to a series of systematic reviews. However, the recognised prevalence of ADHD, which is the number of CYP in a representative population who have been diagnosed with ADHD according to their medical records, varies. The highest recognised prevalence of ADHD globally is in the United States of America (USA), with prevalence rates around 10%. With the exception of studies from the USA and Israel, the recognised prevalence of ADHD in the UK and globally is around 1%. There has been an increase in the recognised prevalence of ADHD over time but there is still a problem with under-recognition of ADHD in most health care systems outside the USA.

There can be long delays in diagnosis of ADHD in the UK and the reasons for this are complex. Reasons may include: delays in seeking help from parents, carers and teachers; failure from professionals to recognise ADHD symptoms and delays or barriers to accessing specialist services. Recognition of ADHD is important because ADHD can be treated. CYP with ADHD can be treated with behavioural and psychological interventions (including interventions for their families) and, for severe ADHD, there are effective medicines that may be prescribed. Stimulant medications (such as a methylphenidate) are commonly the drug of choice for CYP with severe ADHD and have some of the largest effect sizes in medicine. ADHD is associated with serious consequences if left untreated or undiagnosed. There is a trend for older CYP with ADHD of them stopping their medication after the age of

15 years. This is not always intentional and may lead to an increase in poor consequences. One of these poor consequences for CYP with ADHD is unintentional injuries.

How do we define injuries?

Injuries are a sudden unintentional physical damage which occurs due to energy. This energy may be mechanical, thermal, chemical or radiation. Injuries may occur if a foreign substance is introduced into the CYP's body, exceeding the threshold of physiological tolerance or the lack of a vital element, such as oxygen. Previous work estimating the risk of specific injuries in CYP with ADHD has focused on three common injury types: fractures, thermal injuries and poisonings. However, it is likely that CYP with ADHD are at an increased risk of a range of injuries.

Why are injuries important?

Injuries are a leading cause of morbidity and mortality in the UK and globally. The most recent mortality figures for England and Wales show that accidents are the leading cause of death among 10-19 year olds and the second leading cause, behind cancer, for children aged 1-4 years and 5-9 years.

However, it is not always easy to quantify the total number of injuries that occur in the population because there is a lack of published data or ongoing surveillance. However, estimates have been published using hospital admissions data and emergency department data. Most recent estimates for England report almost 100,000 hospital admissions in the year 2019-20 for unintentional injuries in CYP aged under 18. Injuries have a physical, psychological and economic burden on CYP as well as on their families and carers.

Estimates of injuries resulting in hospital admission in England are available from Hospital Episodes Statistics (HES) data. These data may be used to estimate hospital admissions resulting from injuries. However, such data will not include emergency department attendances or attendances to primary care services (such as general practitioners (GPs)) with injuries. They will therefore underestimate the true rate of injuries in the population because they exclude less severe injuries which do not result in a hospital admission. In the UK, estimating injury incidence using routine primary care data is currently the most inclusive source of data on injuries, as it will include information sent back to GPs from hospital admissions or emergency department attendances, as well as injuries only presenting to primary care. The added benefit of GP data is that it also gives a baseline population (denominator) from which to calculate an incidence rate.

Injury Risk in All Children

How do injuries vary in the general population of CYP?

The epidemiology of injuries varies by age group as CYP mature with age. There is a difference between boys and girls. Over the age of one year old, boys are more likely than

girls to have an injury, especially in teenage boys. Boys are more likely to die from injuries than girls, except in infancy.

Injuries in CYP vary by socioeconomic deprivation. For example, hospital admissions for serious injuries are greater in areas of greater deprivation, with a rate of injuries in the most deprived areas two to five times greater than the least deprived areas. Hospital admission rates are known to be higher for all injuries, including more severe injuries, within groups with higher deprivation levels. There is a higher gradient in under 4-year-old children compared to 5 to 14-year-old children, with children from more deprived areas sustaining more injuries. Although unintentional injury rates in children have decreased over the last 20-30 years, CYP in households in more deprived areas continued to sustain a higher incidence rate for injuries compared to less deprived households.

Deaths due to injuries in CYP have been declining in recent years. This is for a range of reasons. For example, there has been a reduction in road injuries due to improved car safety. There have been improvements in legislation, which are aimed at reducing the numbers of injuries, for example, fire safety and housing regulations. Despite these overall improvements in death rates, fatal injuries in the most deprived areas persist and can be as much as 13 times higher than in the least deprived areas.

The recognition of ADHD is also greater in more deprived areas, therefore the increased risk of injuries in CYP with ADHD is likely to be observed more often by clinicians working in areas of greater deprivation.

Three common injuries in the general population (fractures, thermal injuries and poisonings)

A fracture is defined as a break in a bone resulting from excessive force. A previous study based on GP medical records reported an overall incidence rate of fractures in CYP to be 180/10,000 person years at risk.[1] As with injuries overall, there is a difference between boys and girls. Younger teenage girls and older teenage boys are at greatest risk of fractures. There is an earlier peak in girls (around age 11 years old), compared to boys (around 14 years old). In the UK, there is a variation in the geographic incidence of fractures, with Northern Ireland and Wales having a higher incidence than the South East of England. These differences are not completely explained by differences in the deprivation of the regions. As with injuries overall, there is variation in the severity of fractures. Fractures of long bones (such as hip and femur) usually have a higher injury severity score and a longer length of hospital admission than other fractures.

A thermal injury (or thermal burn) is defined as exposure to a source of energy or substance that may cause damage to the skin or other body tissues. The incidence rate for thermal injuries in CYP is around 35/10,000 person years at risk, with a gradual decline by the age of 6 years to approximately 30/10,000 person years at risk.[1] Boys are more likely than girls to sustain a thermal injury overall. There is a peak in 1 to 4-year-old boys and under 1-year-old

girls. Children aged 5 to 9 –years have a similar rate in both sexes. CYP under 15 years old from the most deprived areas compared to the least deprived areas are three times more likely to sustain a thermal injury.

A poisoning is defined as the unintentional inhalation, ingestion, injection or absorption of an exogenous substance that results in harm to the body tissues. The incidence of poisonings is roughly 40/10,000 person years, with a peak at age 2 years old for both sexes and a second peak at aged 15-18 years old in girls and aged 18 years old in boys.[1] In a study in under 5-year-olds using UK primary care data, boys and girls under 5 years old had a similar rate for poisonings. However, in CYP under 14 years old, fatal poisonings (which included intentional poisonings) showed that boys were three times more likely to die of poisonings than girls, especially in the 1-4-year-olds (boys nine times more likely to die) and 10-14-year-olds (boys were three times more likely to die). In under 15-year-olds, CYP from the most deprived areas are three times more likely to experience a poisoning compared to the least deprived.

The cost of injuries

Injuries are costly to healthcare systems and to society. Previous estimates from the UK are that the National Health Service (NHS) spends £131 million per year on emergency hospital admissions due to unintentional CYP injuries. In under 5-year-olds, the short term average cost for an injury was estimated by Public Health England to be over £2,000. Data from the US, based on injuries in CYP aged less than 24 years old, estimated that the combined costs due to medical care and loss of work for fatal injuries, was $27.9 billion (£18.3 billion) per year, for non-fatal injuries was $39.9 billion (£26.3 billion) and for non-fatal injuries seen and treated in the emergency department was $65.4 billion (£43 billion).

Injury Risk in ADHD

The risk of injuries overall in CYP with ADHD is estimated at nearly double the risk for other CYP. Research describing the risk of injuries in CYP with ADHD often reports the risk of unintentional injuries without breaking down estimates for specific injury types and classifies injuries in different ways, making comparisons between studies difficult. Many previous studies reported hospital-based recording of injuries, which would be expected to estimate the risk of severe injuries but would not include less severe injuries not resulting in hospital admission. There have been previous research studies which identify CYP with symptoms of ‘overactivity’ but not necessarily meeting the clinical criteria for ADHD, which demonstrate an increase in the risk of injuries in these CYP. CYP aged under 2 years old who present to emergency services without a diagnosis of ADHD with a head injury or thermal injury are twice as likely as other CYP to be diagnosed with ADHD in later life. Since both ADHD and injuries are common in CYP and since ADHD is under recognised, it is important

to be aware of the risk of injuries in the population of CYP with ADHD or symptoms suggestive of ADHD.

A study of the risk of three common injuries in the population of CYP in England focussed on fractures, thermal injuries and poisonings. This study was conducted using electronic health records from 4% of the English population and used the CYP's linked hospital medical records. There were 15,000 CYP with ADHD and 260,000 without aged 3 to 17 years at diagnosis. CYP with ADHD sustained 30 fractures per thousand person years at risk vs. 20 for CYP without. They sustained 4 thermal injuries per thousand person years at risk vs. 2 for CYP without ADHD. CYP with ADHD had 6 poisonings per thousand person years at risk vs. 2 for CYP without. The increased risk of injuries in CYP with ADHD was as follows: 25% increased risk of fractures; double the risk of thermal injuries and almost four times the risk of poisonings.[2]

Aetiology of Injuries

With regard to the most common types of injuries studied in CYP with ADHD, mechanisms of injury will vary depending on age and injury type. For fractures, the most common mechanism of injury across the age ranges 0-14 years of age is a fall of some type.[1] For 15-18 year olds there are roughly equal numbers caused by road or traffic accidents as well as by falls.[1]

Thermal injuries in 0-9 year olds are most commonly caused by heat and hot substances, this would include things like hot drinks, hot water or hot pans. In 10-14 year olds, roughly equal numbers of injuries are caused by heat/hot substances as by smoke, fire and flames.[1] In 15-18 year olds, the most common mechanism of injury is smoke, fire and flames.[1] Thermal injuries have reduced over time due to the use of smoke detectors, regulation of hot water temperatures, flame resistant sleepwear and improvements in electrical wiring.

For poisonings, in CYP aged 0-9 years old the vast majority of injuries will be unintentional, most commonly caused by unsafe storage of medicines or harmful cleaning products and a child gaining access and ingesting them. If CYP observe adults taking medicines, they may be more likely to imitate them and sustain an unintentional injury. From the age of 10 upwards, a much greater proportion of poisoning events are reported to be intentional (primarily self-harm).[3] However, discussion of intentional injuries in CYP with ADHD is outside the scope of this article.

Strategies for Prevention of Unintentional Injuries

Strategies for preventing unintentional injuries in CYP with ADHD are primarily the same as strategies for preventing injuries in any CYP, as there is a lack of specific evidence relating to injury prevention interventions in populations of CYP with ADHD. However, there is limited

evidence that medication for ADHD (most commonly methylphenidate) reduces the risk of unintentional injuries for CYP who are prescribed it by around 10%, during the periods of time they are taking the medication, compared to periods of time they are off it.[4]

Contact with health services for CYP with ADHD, whether routine or acute, can provide excellent opportunities for giving injury prevention advice. For example, during attendance at the GP or family medicine service for injuries or hyperactivity symptoms. Healthcare professionals in emergency departments should be aware that CYP who attend with injuries may have unrecognised ADHD and feedback concerns to the GP (or family medicine physician). Healthcare professionals who are looking after in-patients should consider giving injury prevention advice during the admission or at the time of discharge. The increased risk of injuries should be communicated to CYP with ADHD, their parents or carers and their families at diagnosis, medication reviews, follow-up visits and during contacts with other professionals (such as paediatricians, GPs, nurses and pharmacists). If appropriate, further referrals should be made to other members of the healthcare team (e.g. public health nurses) for a more detailed home safety assessment, as outlined below.

Advice on preventing injuries will vary depending on the age, demographics and relevant risk factors for injury in any individual circumstance

In England, NICE has produced guidance documents on injury prevention in under 15s. One such document focuses on strategy, while the other two focus on interventions to reduce injuries in the home and on the roads respectively. For individual clinicians working with children and young people, elements around home safety are likely to be the most relevant within usual practice.

Home safety advice and the provision of home safety equipment has been shown to improve home safety practices. The evidence of most benefit from home safety advice is when it is provided to families living with higher levels of deprivation, in line with injury rates being higher in these groups.

Current advice centres on the need to carry out home safety assessments for children at highest risk of injury in the home, this would generally include CYP with ADHD. Home safety assessments may be offered by services who would commonly see children and their families in the home, such as public health nursing teams, social workers or potentially GPs. Assessments of risks in the home should be appropriate to the age and developmental stage of the child, but should also take into account factors such as whether or not a child or family member has a disability, cultural and religious beliefs, whether or not English is the first language, levels of literacy, the level of control people have over their home environment (particularly thinking of those with private landlords, where changes to the home environment may not be permitted), as well as the household's perception of, and degree of trust in, authority.

Within a home safety assessment, education and advice around safety equipment should be provided. Some local areas may offer the provision and installation of home safety

equipment, particularly for low income families. However, this will vary between different local areas.

Safety equipment that may be advised or offered could include smoke alarms, safety gates, fireguards, window restrictors, non-slip bath/shower mats, cupboard locks, corner cushions and blind cord shorteners.

With regard to specific types of injury, prevention advice should include:

- Poisonings – use of cupboard locks, most commonly in kitchen areas to protect against access to potentially harmful cleaning products or other chemicals by young children is important. Medicines should be stored in a high cupboard, at or above adult eye line, out of the reach of young children, or in a locked cupboard. It is important to be aware that some toddlers may be able to climb onto surfaces. Imitation behaviours can develop in children from around 18-24 months of age onwards. Therefore there are suggestions that it may be better for adults to avoid taking medications in front of children to avoid such imitation. When medication is prescribed to CYP with ADHD, or their household members, it is important to reiterate advice around safe storage of medicines.
- Thermal injuries – smoke alarms should be fitted in all housing and tested regularly. Where open or gas fires are in use fire guards should be used. Fitting thermostatic mixing valves to control water temperature is recommended. Parents should be aware of where children are while a bath is running. Adding cold water to a bath first is recommended to avoid a child jumping into a very hot bath. Hot drinks should be kept out of reach of children, and cooking pans should be kept on back burners where possible with handles turned inwards to keep them away from children's hands.
- Fractures – for young children safety gates should be fitted at the top and bottom of stairs and should be removed once a child reaches 2 years of age (due to the risks of climbing over a safety gate beyond this age). Window restrictors are advised to be fitted to upstairs windows. Non-slip bath or shower mats are also recommended. Furniture and play equipment should be well maintained and safety harnesses/barriers on things like swings, trampolines and other home play equipment should be fitted.
- Other common safety advice - Furniture that may fall if climbed should be securely fastened to a wall to avoid crush or other blunt trauma injuries. Blind cord winders/shorteners should be fitted to minimise the risk of unintentional strangulation. Socket covers should be fitted over unused sockets.
- Road safety – seatbelts should always be worn and child safety seats always used. When cycling or using other similar forms of transport, a helmet should always be worn. The visibility, especially of younger children, should be increased, for example by using high visibility clothing.
- Water safety – children should always visit open water sites with an adult and should never be allowed to swim in unsupervised areas such as quarries, canals, ponds or

rivers. Young people often over-estimate their swimming ability, particularly where there may be undercurrents, or in warmer weather when they may not appreciate the harmful effects cold water can have on their stamina and strength.

Conclusion

According to the United Nations (UN) Rights of the Child, children should have the right to be free from injury. For CYP with ADHD this is particularly pertinent as they are up to four times more likely to sustain certain types of injury than CYP without ADHD. Known risks in particular relate to an increased risk of fractures, thermal injuries and poisonings caused by a variety of mechanisms, primarily around the home in CYP up to the age of 14, but with road and traffic accidents becoming an important cause in older age groups.

Responsibility for reducing injuries occurs at many levels, including individuals, families, healthcare and education professionals, local and national governments.

All practitioners who regularly come into contact with CYP with ADHD should be aware of the increased risk of injury amongst this group and should be ready to offer simple home safety advice to CYP and their families, as well as more detailed home safety assessments where needed. These assessments should be offered to children at greatest risk, often this will include families living with higher levels of deprivation and will include families of children with ADHD.

Practice Points

- Injuries are amongst the most common causes of death among CYP across various ages, they also cause significant morbidity
- CYP with ADHD are at a 25% increased risk of fractures, double the risk of thermal injuries and almost four times the risk of poisonings than CYP without ADHD
- Practitioners should be aware that both ADHD and injuries are more common in deprived areas
- Individual practitioners should offer injury prevention advice and home safety assessments which have been shown to reduce injuries, while prescribing ADHD medication also reduces injury risk

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