

Energy Drinks Evidence Brief

February 2021

Energy drinks are beverages that contain high levels of caffeine in combination with other ingredients such as sugar and stimulant properties such as guarana, taurine or herbal substances. In its recent consultation on restricting the sale of energy drinks to young people, the Scottish Government define an energy drink as any drink, other than tea or coffee, which contains over 150mg of caffeine per litre.¹ This is the definition used by the UK Government, as well as the British Soft Drinks Association and the association of Convenience Stores

This brief summarises the current evidence on caffeinated energy drink (CED) consumption patterns in children and young people in the UK and Scotland and the impact on their physical and psychological health and behavioural outcomes based primarily on the evidence from a recent review of systematic reviews by Brunton et al. (2018)² commissioned by the UK Government. The brief draws out some of the specific UK based evidence from that review and supplements the review with more recent evidence published since the last review search date.

A rapid search for more recent evidence encountered no further reviews but nine relevant primary research studies. An overview of the search protocol is in Annex 1. Only two of these more recent studies encountered included data from UK populations. In general, there is a lack of data specific to UK young people and particularly those in Scotland.

Key Findings

Energy drinks consumption

Overall, current data would suggest that at a population level, caffeinated energy drink consumption is relatively low in children and young people in the UK, although there is reasonable evidence of a sub-group of high chronic or high acute users.

Current evidence suggests that between 5-11% of young people (11-17 year olds) consume CEDs daily, but there are also indications consumption levels are falling.

In their overview of systematic reviews, Brunton et al (2018) found reported prevalence rates of consumption for young people³ varied widely with no clear indication of what levels of consumption are:

¹ [Scottish Government \(2019\) Ending the sale of energy drinks to children and young people: consultation](#)

² [Brunton et al \(2018\) Caffeinated energy drink use and reported effects in young people: a rapid overview of systematic reviews](#) London: EPPI-Centre, Social Science Research Unit, Institute of Education, University College London

³ Definition of young people "those under the age of 18"

- between half and two thirds of all young people have tried CEDs at some point;
- up to nearly one third of young people report either frequent or heavy use (not defined);
- from the two UK studies included in reviews – data suggest that around 11% of surveyed young people (aged 10-17) consume CEDs on a daily basis.

A report by the European Food Safety Authority (EFSA)⁴ also found evidence of a subgroup of users who were regular drinkers or drank high volumes in one session. The report draws upon data collected from a European survey in 2012 and the UK sample included 843 adolescents (11-17 year olds) and 131 children (aged 6-10). They reported 69% of adolescents and 24% of children in the UK had consumed at least one CED during the last year compared with the EU average of 68% and 18%. The UK ranked 7th highest out of the 16 EU countries surveyed. Of those who had tried a CED in the past year, 19% of UK adolescents were classified as “high chronic” users (consume CED ‘4-5 days a week’ or more), higher than the EU average of 12%. Of those who had tried a CED in the past year, 13% of UK adolescents were classified as “high acute” consumers, drinking 1 litre or more of CED in a single session, broadly in line with the EU average of 12%. UK adolescents also consumed a higher volume of CED a month averaging 3.1 litres per month compared with the EU average of 2 litres⁵.

A secondary analysis of population-level datasets to understand the prevalence and impacts of CED consumption in children and young people was conducted by Brunton et al (2019)⁶ to address the gap in UK based studies. Five datasets were included, two of which were UK based and included data for young people in Scotland. Data collection ranged from 2008-2018. Their analysis found that the proportion of children reporting consumption of one or more CED per week is similar across the UK with up to a quarter of children aged 11-12 years consuming one or more CED per week compared to between a quarter and a third for those aged 13-14 and those aged 15-16. They also found that CED consumption appears to have fallen in recent years amongst all year groups when examining two data collection waves of one dataset between 2013-2018. However, these findings are indicative only due to some differences in the sampling frame between the data collection waves. Two data collection waves of one dataset (HBSC Wales 2013 and 2017) showed the total number of young people consuming CEDs once a week or more had fallen from 28.5% in 2013 to 21.1% in 2017. For those in year 9 (age 13-14) it had fallen from 32.4% to 24.2% and for those in year 11 (age 15-16) it had fallen from 29.3% to 22.9%.

The UK Department of Health and Social Care commissioned research that analysed data from the World Health Organisation Health Behaviour in School-aged

⁴ [EFSA NDA Panel \(2015\) Scientific Opinion on the safety of caffeine, EFSA Journal, 13\(5\):4102](#)

⁵ [Zucconi et al \(2013\) Gathering consumption data on specific consumer groups of energy drinks EFSA Supporting Publications 10: 394E](#)

⁶ [Brunton et al \(2019\) Caffeinated energy drinks and effects in UK young people: A secondary analysis of population-level datasets. London: EPPI-Centre, Social Science Research Unit, UCL Institute of Education](#)

Children (aged 11-15) (HBSC) Survey in England in 2015⁷. This study found that 14% of young people reported consuming energy drinks 2-4 times a week but only 5% of young people reported drinking energy drinks at least daily (compared to the 11% suggested from the Brunton et al. (2018) review). It is important to note that the HBSC survey contains data for those aged 11-15 while the 11% suggested in the Brunton review includes data on those aged between 11-17. Evidence suggest consumption increased with age and this may be able to explain the difference in consumption figures.

Though there is limited Scottish data, there is no evidence to suggest consumption is dissimilar to UK-wide data. The most recent HBSC data for Scotland⁸ from 2018 (sample size 5286) suggests 5% of children (aged 11-15) drink energy drinks every day. This is in line with the 5% of children (aged 11-15) reporting daily energy drink consumption in England, albeit in 2015. The data also showed around one in four (26%) young people in Scotland consume energy drinks at least once a week. The question on energy drink consumption has only been included in the Scottish HBSC survey once and therefore no trend data is available.

Differences in CED by gender, age and socio-economic status

There is emerging evidence to suggest that, in the UK, boys consume CEDs in higher levels and more frequently than females; consumption increases with age; and there is a small, limited association between CED use and receiving free school meals.

The Brunton et al. (2018) review reports consistent findings across reviews suggesting that boys may be more frequent or heavier consumers of CEDs. Of the two UK studies reported in the review, one found higher levels of consumption to be associated with males⁹. The secondary analysis by Brunton et al. (2019) also found boys consistently reporting higher use than girls. They found across all ages in England, 29% of boys consumed one or more cans per week compared with 18% of girls.

Differences in prevalence by age were also reported. Although patterns were less clear, an emerging pattern of higher CED use in older age groups was most often reported. This is in line with the data published by the European Food Safety Authority (EFSA) in 2013. This showed the highest prevalence of energy drink consumption was found within adolescent age groups, with older adolescents (aged 15-17) being 1.33 times more likely to be energy drink consumers than younger adolescents¹⁰. The secondary analysis of population-level datasets found CED consumption to increase with age. Children who use CEDs were more likely to be older (age 13-16) rather than younger (age 11-12).

⁷ [Brooks et al. \(2018\). *Young people and energy drinks consumption in England: Findings from the WHO Health Behaviour in School aged Children \(HBSC\) Survey 2015 Detailed Analysis on Findings Relation to Consumption of Energy Drinks by Young People*](#)

⁸ [Inchley et al \(2020\) *Health Behaviour in School-aged Children \(HBSC\) 2018 Survey in Scotland: National Report* MRC/CSO Social and Public Health Sciences Unity, University of Glasgow](#)

⁹ [Richards G, Smith AP \(2016\) *A Review of Energy Drinks and Mental Health, with a Focus on Stress, Anxiety, and Depression* Journal of caffeine research, 6\(2\), 49-63](#)

¹⁰ [Zucconi et al. \(2013\) *Gathering Consumption Data on Specific Consumer Groups of Energy Drinks*. Supporting Publications 2013:EN-394, 190](#)

Overall, there is limited evidence to suggest an association between lower socio-economic status and CED consumption. However, one of the UK-based studies¹¹ in the review by Brunton et al. (2018) identified a significant association between consuming CEDs once a week or more and being eligible for free school meals. In their secondary analysis, Brunton et al. (2019) found that consumption of CEDs was slightly more common among those eligible for free school meals than among those not eligible.

Effects of CED use in children and young people

Physical effects

The physical effects of CED consumption are the most commonly reported across studies. Evidence comes largely from cross-sectional studies, meaning causation cannot be inferred and associations observed between CED consumption and physical effects are correlational. Bi-directionality cannot be disregarded in cross-sectional studies, for example, an association between consumption of CED and being prone to headaches could be because those more prone to headaches are more likely to drink CEDs.

Brunton et al. (2018) concluded that there is weak evidence of an association between CED use and physical symptoms. Despite a consistent association shown in a large number of studies between CED consumption and physical effects, the strength of their conclusions is limited by the challenges of ascertaining casual relationships and by the methodological quality of the included reviews. More recent research has continued to add to the evidence of an association between CED consumption and adverse physical effects, however, it does not strengthen the evidence substantially.

In their review, Brunton et al. (2018) found consistent findings indicating CED consumption is associated with various physical symptoms including headaches, stomach aches, low appetite and negative effects on cardiovascular function such as fast heartbeat, tremors and chest pain. CED has also been found to be associated with sleep-related issues.

The secondary analysis by Brunton et al. (2019) also found children who drink CEDs had higher risk of experiencing multiple adverse physical symptoms such as headaches, dizziness; stomach aches and sleep issues.

A recent cross-sectional Canadian study on 2040 young people (aged 12-24) by Hammond et al¹² surveyed participants to ask about their consumption of CED and coffee and symptoms that followed consumption. More than half of the respondents who had consumed at least one CED reported experiencing at least one adverse effect following consumption. The most commonly reported adverse events included fast heartbeat, headaches, difficulty sleeping and feeling 'jittery/shaking.' Most who had reported these adverse events had consumed less than the recommended maximum 1 or 2 CED drinks. When compared with consumption of coffee, they

¹¹ [Richards G, Smith AP \(2016\) A Review of Energy Drinks and Mental Health, with a Focus on Stress, Anxiety, and Depression Journal of caffeine research, 6\(2\), 49-63](#)

¹² [Hammond et al \(2018\) Adverse Effects of Caffeinated Energy Drinks Among Youth and Young Adults in Canada: a Web-based survey. CMAJ Open, 6\(1\) 154](#)

found that respondents were significantly more likely to report adverse events after CED than compared with coffee.

In a study of 631 high school and college students in Hungary (mean age 19.2 ± 2 years) by Toth et al.¹³, 71.4% of respondents reported experiencing adverse effects following CED consumption. Similar to other studies, effects reported were tremors and fast heartbeat.

Mental and psychological effects

Overall, Brunton et al. (2018) concluded that there is very weak evidence of an association between CED use and mental and psychological effects. More recent research by Brunton et al. (2019) has found an association between CED consumption and psychological and overall wellbeing.

Brunton et al. (2018) found evidence across four systematic reviews that used cross-sectional research to suggest a link between CED consumption and poorer psychological well-being in terms of anger and greater irritation. Two of the systematic reviews found greater problems with executive functioning, including behaviour regulation and metacognition in those who consumed one or more CEDs per day. Three reviews found a relationship between CED use and attention deficit/hyperactivity disorder, inattention and hyperactivity.

Brunton et al. (2018) found mixed evidence on the relationship with depression, anxiety and stress with some studies demonstrating an association whilst others showed none. A UK longitudinal study covered by the review found no significant association between caffeine intake from CEDs and depression, anxiety and stress.¹⁴

In their secondary data-analysis, Brunton et al. (2019) found that children who consume CEDs on a daily basis are twice as likely to have low psychological wellbeing and four times as likely to have low overall wellbeing compared with children who do not consume CEDs. However, due to the cross-sectional nature of the research, it cannot be ruled out that those with low wellbeing seek to consume CEDs. They also found that children who reported feeling irritable more frequently were more likely to report weekly CED consumption than children who were rarely irritable.

Lifestyle and behavioural effects

A large number of studies have reported an association between CED consumption and a range of lifestyle behaviours. These studies find those who consume CEDs are more likely to be users of substances (alcohol, smoking and illicit drug use). Brunton et al. (2018) concluded that overall, there is weak evidence of an association between CED consumption and substance use and sensation-seeking

¹³ [Toth et al \(2020\) *Energy Drink Consumption, Depression and Salutogenic Sense of Coherence Among Adolescents and Young Adults*, International Journal Environmental Research and Public Health, 17\(4\) 1290](#)

¹⁴ [Richards G, Smith AP \(2016\) *A Review of Energy Drinks and Mental Health, with a Focus on Stress, Anxiety, and Depression* Journal of caffeine research, 6\(2\), 49-63](#)

behaviours. Further evidence of the association between CED consumption and substance use is supported by more recent research.

In their secondary data analysis, Brunton et al. (2019) found that high frequency consumers of CEDs (5+ cans in the past week) were more likely to have tried smoking and alcohol compared to regular consumers (1-4 cans in the past week) and those that did not drink CEDs in the past week.

In a study of 3,071 adolescents in German schools, Gallimov et al. (2020)¹⁵ showed CED use at baseline level was associated with alcohol use at the 12 month follow up. Similarly, they found this to be true for cigarettes and e-cigarettes.

In a prospective cohort study of 4,949 students aged 14-19 In Canada by Butler et al. (2019)¹⁶ they looked at the relationship between CED consumption, marijuana and cigarette use. The cohort were followed for three years and they found that smokers and marijuana users at follow-up were at greater odds of CED use regardless of baseline use.

Educational and social effects

Brunton et al. (2018) conclude that overall, there is very weak evidence of an association between CED use and educational and social effects. The limited evidence that exists though points towards a negative relationship with school attendance and attainment from a UK perspective. One longitudinal study of adolescents in the UK covered in the review found an association between consuming CEDs once a week or more and poorer school attendance amongst secondary-school students.¹⁷

Further evidence from Brunton et al. (2019) found children who have been excluded from school or truanted are more likely to be regular CED consumers than those who have not been excluded or truanted. Furthermore, they found that compared to those who never consume CEDs, those who consume them on a daily basis are four times as likely to have low educational wellbeing.

Evidence limitations

Brunton et al. (2018) note several limitations of the current evidence available in relation to CED consumption. Firstly, they identify the possibility of selective reporting of findings by review authors that could have potentially limited the reporting of findings in their overview. Moreover, all of the included reviews in their overview were rated to be of 'low' or 'critically low' methodological quality using AMSTAR 2 criteria. They note caution in considering the validity of the findings.

They also comment that the large reliance on cross-sectional study designs limits the ability to draw conclusions about cause and effect. Studies have relied on self-report

¹⁵ [Gallimov et al \(2020\) Association of Energy Drink Consumption with Substance-use Initiation Among Adolescents: A 12-Month Longitudinal Study, Journal of Psychopharmacology, 34\(2\) 221-228](#)

¹⁶ [Butler et al \(2019\) Caffeinated Energy Drink Consumption and Predictors of Use Among Secondary School Students Over Time in the COMPASS Cohort Study, Preventative Medicine Reports, 15\(1\) 100911](#)

¹⁷ [Richards G, Smith AP \(2016\) A Review of Energy Drinks and Mental Health, with a Focus on Stress, Anxiety, and Depression Journal of caffeine research, 6\(2\), 49-63](#)

of consumption and effects and in many cases the research is unable to attribute the physical symptoms solely to the CED. Most studies of effect did not have a comparison group of participants with lower or no CED use, therefore it is possible that findings are biased, potentially overestimating reported effects and not representative of the whole population.

The size of effect is unclear, along with the level of consumption that is required to produce these effects. It is also not clear whether adverse effects are short-lived or sustained or to what degree they impact on a young person's overall health and wellbeing.

There are also limitations with the current data available on levels of CED consumption. Studies report varying degrees of consumption and use a variety of different measures in collecting the data. For example, some studies apply a 24 hour dietary recall period whereas others record consumption over several days. Different definitions are used to classify high/low frequency consumers of CED. The measures of prevalence (ever drank, drank in the last year, drank in the last week etc) varied. Frequency and amount of consumption were also measured in overlapping ways. Within studies, differing age groups and age cut offs are included in samples. This all acts to weaken the ability to aggregate findings across studies and draw firm conclusions. There is a lack of data concerning UK-populations and a requirement for a consistent understanding and measure of high levels of consumption.

Conclusions

It is clear there are many limitations with the current evidence base on consumption patterns in children and young people in the UK and Scotland and the impact on their physical and psychological health and behavioural outcomes. Thus, caution is advised in drawing any firm conclusions.

Overall, based on the best available data, the indications are that energy drink consumption at a population level in children and young people in the UK is relatively low although there is reasonable evidence of a sub-group of high chronic or high acute users. There is some evidence to suggest that consumption is decreasing, however, these findings are indicative and a lack of trend data on consumption limits the ability to draw conclusions.

From the limited evidence in the UK, consumption of CEDs among young people appears to increase with age and boys consume CEDs more frequently and more heavily. The comparable extent of consumption at different ages is unclear.

There is considerable evidence and much of it consistent, that shows consumption of CED is associated with a range of adverse physical and mental effects, as well as possibly poorer school achievement and attendance. However, it is not clear whether those with poorer achievement are more likely to drink energy drinks or whether energy drink consumption leads to poorer educational outcomes. CED consumption also appears to be associated with other negative lifestyle behaviours such as drinking and smoking. However, given the limitations highlighted, further research is required to better understand the levels of consumption and potential negative impacts of varying levels of consumption of CEDs on children and young people. This should include research on attitudes and where young people source CED

ANNEX 1 – Rapid Updated Evidence Search Protocol

The evidence search strategy comprised of three approaches to finding relevant papers:

a) Initial search online via google and google scholar to gain an early understanding of the literature and prominent papers. A snowballing technique was also employed whereby the references of prominent papers were reviewed for additional evidence.

b) A literature search in July 2020 of the KandE database, IDOX, Web of Science and Knowledge network. Keywords used were caffeine, energy drink(s), children, adolescents, young people, education, school, behaviour, harms, benefits, side effects, consumption.

c) A search within title and abstract on three ProQuest databases. Table 1 below lists the search terms.

Keywords:

First, a generic search was conducted by combining substance and age groups, then a more specific search included the additional string.

Table 1: Search terms of Proquest Databases

| All searches | | Additional |
|---------------------------|---|---|
| Substance | Age groups | Outcomes |
| Caffeine AND energy drink | Young people OR adolescents OR 16 OR 18 OR 21 | Behaviour OR (school AND (behaviour OR performance) OR effects OR harm OR benefit |
| Energy drink | As above | As above |

Inclusion Criteria:

The following inclusion criteria was applied:

- Systematic review or primary study
- Written in English language
- Peer reviewed
- Published since 2018
- Reported a focus on children and/or young people up to and including age 21
- Reported findings on CED use OR examined the relationship between CED consumption and the effects on physical or mental health or behavioural or educational outcomes
- Research was conducted in the UK, Europe, USA, Canada, Australia and New Zealand

How to access background or source data

The data collected for this <statistical bulletin / social research publication>:

- are available in more detail through Scottish Neighbourhood Statistics
- are available via an alternative route <specify or delete this text>
- may be made available on request, subject to consideration of legal and ethical factors. Please contact Eilidh.shearer@gov.scot for further information.
- cannot be made available by Scottish Government for further analysis as Scottish Government is not the data controller.