

ENERGY DRINK BETWEEN POPULARITY AND DANGEROUSNESS.
AN INVESTIGATION AMONG TEENAGERS IN THE PROVINCE OF TARANTO

ENERGY DRINK TRA POPOLARITÀ E PERICOLOSITÀ.
UNA INDAGINE FRA GLI ADOLESCENTI DELLA PROVINCIA DI TARANTO



Mariarosaria Negri
Università Telematica Pegaso
Mariarosaria.negri@unipegaso.it



Francesco Paolo Romeo
Università Telematica Pegaso
francescopaolo.romeo@unipegaso.it



Alessandro Barca
Università Telematica Pegaso
alessandro.barca@unipegaso.it



Double Blind Peer Review

Citation

Negri, M., Romeo, F.P., & Barca, A. (2025). Energy drink between popularity and dangerousness. An investigation among teenagers in the province of Taranto. *Giornale Italiano di Educazione alla Salute, Sport e Didattica Inclusiva*, 9 (1).

Doi:

<https://doi.org/10.32043/gsd.v9i1.1485>

Copyright notice:

© 2023 this is an open access, peer-reviewed article published by Open Journal System and distributed under the terms of the Creative Commons Attribution 4.0 International, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

gsdjournal.it

ISSN: 2532-3296

ISBN: 978-88-6022-509-2

ABSTRACT

Energy drinks (EDs) are mainly marketed as tools to improve physical and cognitive performance. The consumption of these drinks is increasing among adolescents, who tend to underestimate the possible long-term consequences. The aim of this study is to investigate the use of ED among adolescents in a secondary school as a sociological phenomenon influenced by identity, cognitive and relational dynamics that should be addressed in schools and in contemporary society.

Gli Energy Drink (ED) vengono commercializzati principalmente come strumenti per migliorare le performance fisiche e cognitive. Il consumo di tali bevande è in crescente aumento tra gli adolescenti, che tendono a sottovalutare le possibili conseguenze a lungo termine. Lo scopo di questo studio è quello di indagare l'uso dell'ED tra gli adolescenti di una scuola secondaria come fenomeno sociologico influenzato da dinamiche identitarie, cognitive e relazionali da attenzionare a scuola e nella società contemporanea.

KEYWORDS

Energy drinks, teenagers, addiction
Energy Drink, adolescenti, dipendenza

Received 01/05/2025

Accepted 11/06/2025

Published 20/06/2025

Introduction

Energy Drink (ED) are beverage with high sugar and bioactive substances content, largely consumed worldwide, mainly among adolescents, because of their energizing and psychostimulant effects (De Sanctis V et al., 2017). However, the increasing popularity of these drinks is raising concerns about their potential long-term health effects, particularly on metabolism and brain function (Costantino A et al., 2023). Although the immediate effects are predominantly positive, long-term abuse of these drinks can cause both metabolic disorders and changes in the nervous system (Ajibo C et al., 2024). The health adverse effects of ED are mainly due to the high content of simple sugars and the presence of psychoactive substances such as caffeine, which characterize these drinks that, in addition to making them highly palatable, contribute to most of the stimulating effects (De Sanctis V et al., 2017). The aim of this study was to investigate the use of ED among adolescents in secondary school as a sociological phenomenon, with the aim of analysing the frequency and timing of use in order to correlate it with possible sleep-wake rhythm disturbances, changes in attention levels and metabolic disorders. In addition, the current study aims to explore short-term subjective perceptions, their likely variation over time, and possible links between ED use and academic performance.

1. Metabolic effects of ED

ED is undoubtedly characterized by a high content of simple sugars (e.g. glucose, sucrose, maltodextrin, ribose, fructose) which, once ingested, cause an immediate glycaemic peak which is translated into a physiological insulin response (Naveh G et al., 2024). It should be noted, however, that abuse of simple sugars can lead to several long-term metabolic complications, most notably insulin resistance. It is also well known that the habitual consumption of soft drinks, as is the case with the more common Western diet, contributes to the development of obesity, dyslipidaemia and cardiovascular diseases (Alsunni AA et al., 2015; Munteanu C et al., 2018).

In addition, the alteration of the sleep-wake rhythm caused by excessive consumption of psychostimulants such as caffeine at certain times of the day certainly has a strong influence on the onset of metabolic disorders related to the consumption of ED, which, especially in adolescents, when consumed in the evening hours, can contribute to the alteration of the physiological night-time rest and also have a strong impact on metabolic health (Tahara Y et al., 2024). It has

been widely demonstrated that alterations in the physiological wake-sleep cycle contribute significantly to the onset of metabolic disorders such as insulin resistance, increased adiposity and dysregulation of appetite hormones, all of which are commonly observed in individuals with poor sleep patterns (Shimizu I et al., 2016). Furthermore, these disturbances are often accompanied by an increase in inflammatory markers and oxidative stress, which can further impair glucose metabolism and increase the risk of cardiovascular disease. As a result, students habitually consume energy drinks and experience poor sleep are at increased risk of long-term health problems, including type 2 diabetes and obesity (Sanchez SE et al., 2013). In addition to their well-known metabolic effects, eating disorders exert a number of particularly worrying neurophysiological actions during adolescence, a critical period for both metabolic regulation and brain development. The interaction between metabolic health and neural function is increasingly recognised, with insulin resistance, sleep disorders and excessive sugar consumption contributing to impaired brain function and mental health.

2. Neurological effects of ED

The effects of ED on the nervous system vary, but are almost all due to the high levels of sugar and psychoactive substances. Although the immediate effects are identical across the general population, it is clear that the long-term effects on the nervous system can be significantly different in adolescents, where neurodevelopment is still ongoing (Tetteh-Quarshie S et al., 2023). Adolescence, the phase of life between late childhood and adulthood, is a crucial period of neurodevelopment, characterised by functional, structural and biochemical changes that are important for brain health (Larsen B et al., 2018). During this period, mental and emotional development occurs, through a profound reorganization of neural circuitry (Konrad K et al., 2013). Studies using neuroanatomical and functional imaging models have correlated the peculiar brain structure of adolescents with behaviour that is very often reward seeking and highly emotional, to the detriment of rational decision making (Konrad K et al., 2013). Adolescence is characterized by a strong neuroanatomical imbalance caused by the relatively early maturation of subcortical brain areas and the relatively delayed maturation of prefrontal control areas (Konrad K et al., 2013). This imbalance would reflect a greater maturation of the limbic and reward systems compared to the still relatively immature prefrontal control (Konrad K et al., 2013). In this context of neurodevelopment and the concomitant search for emotions, the

use of ED during adolescence poses a threat to the general health of young people, given the free access and use, and the potential subtle effects on metabolic and mental health. Caffeine, the most common psychoactive substance in ED, acts primarily in the brain by blocking adenosine receptors (De Sanctis V et al., 2017). Adenosine is a neuromodulator that promotes sleep and suppresses wakefulness, helping to regulate the sleep-wake cycle. By blocking adenosine receptors, caffeine increases the release of excitatory neurotransmitters such as dopamine and norepinephrine (De Sanctis V et al., 2017). Dopamine, often referred to as the "feel-good" neurotransmitter, plays a crucial role in reward processing and motivation. In the adolescent brain, increased sensitivity of the dopamine system can lead to increased pleasure and reward responses, which may reinforce behaviours such as frequent drug use (Ernst M et al., 2015). The release of dopamine, a neurotransmitter, has been shown to enhance mood and promote alertness. Additionally, it has been demonstrated to result in short-term cognitive enhancements, including improved attention and reaction times (Ernst M et al., 2015). However, these effects are transient and may be followed by a state of fatigue and irritability once the stimulant effect dissipates. The long-term consumption of caffeine by individuals diagnosed with eating disorders has been demonstrated to result in the development of tolerance. This, in turn, has been shown to precipitate an escalation in caffeine intake, with the objective of attaining the same desired effects (Burgalassi A et al., 2009). Nevertheless, this practice has the potential to exacerbate adverse effects, including dependency, withdrawal symptoms and disruption to the natural sleep-wake cycle. Moreover, taurine, the most abundant amino acid in the brain and the spinal cord, plays a crucial role in neurotransmission and cellular protection, is another building block of EDs (Curran CP et al., 2017). Taurine has been found to be involved in the modulation of gamma-aminobutyric acid (GABA) receptors, which are the main inhibitory neurotransmitters in the brain. GABA (Gamma-Aminobutyric acid) is a neurotransmitter that plays a crucial role in regulating neuronal excitability and maintaining the balance between excitation and inhibition in the central nervous system (Ochoa-de la Paz L et al., 2019). Recent studies have demonstrated that increasing GABAergic activity through taurine supplementation can result in anxiolytic effects, which may serve as a counteractive mechanism against the stimulatory effects of caffeine (Jangra A et al., 2019). Furthermore, taurine has been demonstrated to possess neuroprotective properties, particularly through its role in regulating calcium homeostasis within neurons. Maintaining a proper calcium balance is imperative for the proper functioning of neurons and synaptic plasticity in the developing adolescent brain (Jangra A et al., 2019). However, it is important

to note that excessive taurine ingestion might disrupt the delicate equilibrium between excitatory and inhibitory signals within the nervous system, which may result in long-term neurotoxic effects (Foos TM, Wu JY., 2002). Another biochemical effect of ED on the adolescent brain is attributable to the high content of simple sugars, which, in addition to causing a condition of peripheral insulin resistance, also affects brain health (Sánchez-Alegría K, Arias C, 2023). Furthermore, insulin resistance in adolescents has been linked to impaired function of the hippocampus, a brain region that is critical for learning and memory (Alberry B, Silveira PP, 2023). The hippocampus is involved in the encoding of new information, the formation of spatial memory, and the consolidation of short-term memories into long-term memory. Insulin resistance, a pathological condition characterised by an alteration of carbohydrate metabolism, impairs the ability of neurons to efficiently absorb glucose. This pathological condition has been shown to cause disruptions in synaptic plasticity and a reduction in cognitive performance thus negatively influencing academic performance (Sánchez-Alegría K, Arias C, 2023). The neurobiological vulnerabilities during adolescence, amplified by ED consumption, should be contextualised within the broader socio-educational structure in which adolescents live. This is particularly true in light of the COVID-19 pandemic, which has disrupted experiences that are fundamental to development and further increased the risk of maladaptive coping strategies. In this complex and dynamic landscape, local research conducted in the province of Taranto becomes essential to understand how widespread such behaviours are and how they can be addressed through educational, family and political interventions.

3. From research to questionnaire to develop food parenting skills

Initial data from research that will certainly continue in the coming years, aimed at investigating the popularity and effects of energy drinks (ED) among adolescents in the province of Taranto from various perspectives, paints an alarming picture that needs to be explored further, especially with a view to preventing the onset of possible, and at this stage unknown, addictions. It is well established in the literature, as Negri explained at the beginning of this article, that the energising and psychostimulant effects of energy drinks can, in the long term, alter brain function and metabolism in general, facilitate the onset of sleep disorders, further increase the risk of cardiovascular disease, generate unpredictable erectile dysfunction, and negatively affect adolescents' school learning. Since adolescence is a stage of life in which people usually experience considerable exploration of the world, sometimes even excessive and dangerous when driven by the need for socialisation, which

significantly reduces risk perception in groups (Blakemore, 2018), and since in the years since the start of the pandemic this vital need has been denied from the outset by adults through various social restrictions, but never fully satisfied at a later stage, it is clear that there is now an urgent need to deliberately address these new forms of addiction, which may further block their life plans, which are currently on hold. This was probably the most important discovery made by neuroscientists, only since the mid-1990s, thanks to brain-imaging technologies, i.e. the understanding that in adolescents, brain maturation and the development of related mental functions, especially the circuits related to emotions and their regulation, is primarily an 'experience-dependent' process that requires the constant presence of others, the group and the wider community in order to be fully realised (Greenough & Black, 1992). If, then, it is during this specific period of development that our awareness of ourselves and how we relate to others emerges to a large extent, if the physical distancing and social restrictions experienced in recent years and the subsequent inability of adolescents to access spaces for storytelling from which to start again more easily and within a conscious educational vision have thrown young and very young people into a condition of multi-deprivation never seen before (Istat, 2023; Unicef & Gallup, 2021; Romeo, 2024a; 2025), it is clear that youth policies and educational interventions need to be designed around the need to be-in-relationship, which is also important for experts in neural plasticity. Yet, observing groups of adolescents in our communities, it seems that the places of healthy growth that we so desire have often been replaced by snack and drink vending machines open all day long, which are stormed by young people, perhaps for the free internet connection. Just to mention a few of the symptoms, or reactions if you will, that have characterised pre-adolescents and adolescents in particular in the pandemic scenario and, unfortunately, still today, and referring the reader to more detailed works on the subject (Romeo, 2021), we can often observe the following in young people (18-35) during their developmental years and transition to adulthood: behaviour denoting a certain emotional detachment from events and superficial affectivity towards others and oneself, a generalised distrust, especially towards adults who are now considered no longer credible, an increase in compassionate and self-compassionate rather than empathetic reactions, a tendency to describe themselves as extremely vulnerable and incapable of perceiving themselves as resilient despite the hardships they have experienced over the last five years (contrary to the tendency to overestimate oneself observed in people's accounts) (Gottschall, 2014), excessive self-blame, which in some cases has turned into shame accompanied by anxiety (contrary to the self-absolving tendency of the narrative

(ibid.), continuing a consolidation of narrative closures and depressive ruminations, including suicidal ideation, feelings of a closed future and a fairly clear shift from group logic to more instinctive herd logic. Within this worrying scenario, we believe it is useful, among other things, to urge the families of adolescents to understand what is happening around their children, the suffering they have been experiencing lately, the state of stagnation that the pandemic has only amplified, new eating habits and the risks associated with the consumption of energy drinks, since the Italian Paediatric Society (2024) has recently linked their excessive consumption to a number of other addictions such as cigarette smoking, e-cigarettes, alcohol and 'binge drinking', i.e. the consumption of several alcoholic beverages and spirits in a short period of time. Together with a research group, the author has made this attempt through the joint construction of the so-called QEASCG, an acronym for Questionario Esplorativo Aree di Sviluppo delle Competenze Genitoriali (Romeo, 2024b), a tool for investigation and action capable of gathering the most relevant conceptualisations regarding the modern-contemporary family, especially after the pandemic, and proposing areas of development for parenting that could make it more cultured, if we may use the term, with regard to issues that concern it. In outlining the epistemological framework that forms the backdrop to a pedagogical tool that does not claim to express judgements or evaluations, as is the case in the forensic-expert field, but which, on the contrary, is open to interdisciplinary, inter- and chrono-systemic-ecological investigation, we started from the assumption of shared responsibility for the current educational-parental crisis, as a result of which we are certainly witnessing a weakening of family ties, albeit determined by multiple socio-cultural and political-institutional phenomena. The loss of a sense of community, the symbolic liquefaction of affectivity (Bauman, 2020), the reversal of the dynamics of trust-building (Romeo, Paparella & Tarantino, 2022) - so that from the feeling of trust and the confiding that derives from it as an individual and collective stance, we are now witnessing mistrust and challenges that are now global - and finally, today's multilevel crisis (environmental, migratory, health, war, economic, institutional, etc.) (Gjergji, 2021) have changed the family, often unknowingly distancing it from the developmental needs of its children, including their nutritional needs. With this theoretical background, the QEASCG has explored a specific parenting skill defined as 'food literacy', which in the second edition of the questionnaire will contain more detailed information on the excessive consumption of energy drinks, based on Barca's research on a sample of students in Taranto. Trying to summarise the key points of this specific competence and referring back to the first edition of the Questionnaire, Villano identifies the family as the most important environment for determining not only the quality of food,

but also the quantity, frequency of meals and trends towards more or less healthy eating habits in children (Ibidem, p. 67). Children imitate their parents and adopt healthy eating habits as well as experiencing positive emotions such as joy and pleasure, which are an essential part of the act of eating itself. We believe, in fact, that nutrition and affectivity are two sides of the same coin, linking nutrition with the emotional and affective dimension of the individual and their family culture. Without emotions, food risks becoming empty, as is increasingly the case in the broad spectrum of eating disorders, of the personal and shared meanings that distinguish it from culture to culture. The 30% increase in the onset of eating disorders in 2020 compared to the previous year confirms that adolescents' bodies manifest not only their personal fragilities but also those of their communities and the educational and school systems that should be more intentional in keeping them in mind. Parents therefore influence their children through their food choices, food purchases and preparation, but also by telling them what and how much to eat or by establishing dietary rules that are not always positive. For these reasons, the assessment of parents' general nutritional knowledge should also be included in the assessment of dietary skills. Another dietary skill is parental control, understood as food restriction, pressure to eat prepared food or the use of food as a reward, which, however, could have the opposite effect on a child's eating behaviour than the parent expects. Such control can in fact lead to children developing a preference for the food used as a reward and consuming more unhealthy foods and drinks (Vaitkevičiūt & Petrauskienė, 2019; Vollmer et al., 2017). Parental control over food should actually encourage a varied diet, promoting eating at home, as this is associated with increased consumption of vegetables, fruit, fish, starchy foods, dairy products, eggs and, to a lesser extent, meat, sweets and fizzy drinks (Suggs et al., 2018; Vaitkevičiūt & Petrauskienė, 2019). This is combined with parenting practices that encourage children to become familiar with food and its origins, stimulate cooking, but also growing vegetables at home, and recount family or cultural culinary traditions (Ibidem). Multi-component nutrition education interventions aimed at children, involving parents in experiential activities such as workshops and cooking demonstrations and direct interaction with external experts and teachers, thus make it possible to identify specific behaviours that need to be changed and to implement interventions tailored to the age of the children and the needs of the family with a greater likelihood of success (Murimi et al., 2018). In summary, it seems that parental feeding practices, which revolve around three important constructs: coercive control, structure and autonomy support, are essential to avert the dangers of excessive energy drink consumption (Vaughn et al., 2016). In other

words, non-coercive eating practices should be adopted, especially in the face of emotional reactions that should be managed in other ways, and healthier eating education that, for example, refocuses on the rituality of dining when parents and children come together in a meaningful emotional atmosphere to consume meals. Finally, support for autonomy includes nutrition education – with an increase in the complexity and completeness of the information provided that is proportional to the chronological and mental growth of the child – the involvement of the child in food choices and preparation, encouragement of new sensory experiences, reasonableness and negotiation. Only food literacy defined in this way can reverse the trend among young people and children to consume more and more energy drinks and prevent their negative impact on the psyche and the biological system as a whole (damage to the plasticity of the hippocampus, headaches, insomnia, anxiety, gastrointestinal and cardiovascular disorders, overweight, obesity, type 2 diabetes, metabolic syndrome and dental problems, etc.).

4. Results of the exploratory questionnaire

The aim of this study was to investigate the use of energy drinks among secondary school adolescents as a sociological phenomenon, with the aim of analysing the frequency and timing of use in order to correlate it with possible sleep-wake rhythm disorders, changes in attention levels and metabolic disorders.

The original population consisted of 46 participants attending a secondary school in Taranto.

After being informed about the reasons for the research project and after reading and accepting the electronic informed consent form, the participating students were able to complete the questionnaire. It was emphasised that participants were not obliged to complete the questionnaire and could withdraw at any time without justification, but above all that, if they intended to participate, no data would be saved and no personally identifiable information would be collected in order to guarantee anonymity. Each participant was asked to answer all questions truthfully, selecting only one answer. Participation was voluntary and without any form of compensation.

After a data cleaning procedure to remove cases where the participant had selected all options for one or more items, a dataset containing 24 valid cases was obtained. Although the sample is not significant and cannot be generalised to the inhabitants of other provinces or regions, nor to other populations of different ages such as adults or the elderly, it nevertheless provides interesting insights for future research.

A preliminary analysis shows that there is a prevalence of males (87.5%). The age range covered is 13 to 19 years; the most represented age is 18 with 58.3% (N= 14), followed by 17 with 25% (N=6), while the least represented is 16 with 4.2% (N= 1). The 13 to 15 age group is not represented.

When asked how long they had been consuming energy drinks, 45.8% (N=11) said they had been doing so for between 2 and 4 years, 33.3% (N=8) for more than 1 year and only 8.3% (N=2) for less than 1 year. Of the three subjects who have been consuming them for more than five years, two are 18 years old and one is 16.

Assuming that the entire sample consumes energy drinks, the frequency with which these drinks are consumed is high; 41.7% (N=10) claim to consume them more than three times a week, as do the other 10 subjects who, on the other hand, drink them 1 to 3 times a week. Only 16.7% (N=4) consume them less than once a month.

As for the time of day when they consume energy drinks most frequently, none consume them in the morning, 54.2% (N=13) consume them in the evening, 33.3% (N=8) in the afternoon and 12.5% (N=3) at night. Of the 13 evening consumers, the majority are 18 years old. The last energy drink for 37.5% (N=9) is consumed 6 hours before going to bed, for 29.2% 3 hours before going to bed.

When asked about the main reason for drinking energy drinks, 37.5% (N=9) said to stay awake and focused, 33.3% (N=8) because their friends drink them and 16.7% (N=4) to improve their sports performance; only 12.5% consume them because they like the taste. Among those who consume energy drinks to stay active and focused, there are mainly students between the ages of 17 and 18 who consume them in the afternoon and evening.

When asked when they drink energy drinks and in what situations they do so most often, 33.3% (N=8) said they drink them when out with friends or at parties to make themselves more desirable, 29.2% (N=7) when they feel tired or for no specific reason, 25% while studying or before an exam, and 12.5% (N=3) during sports activities.

Regarding the effects on their bodies after drinking energy drinks, none of the participants feel agitated, anxious or tired; 79.2% (N=19) say they feel more energetic and focused and 20.8% do not notice any particular effects.

Seventy-five per cent reported noticing an improvement in their concentration and memory, although 37.5% (N=9) said that this was short-lived, and only one student had never noticed any improvement. For 41.7% (N=10), this improvement lasts between 30 minutes and 1 hour, while for 33.3% (N=8) it lasts less than 30 minutes. 20.8% claim that the effect can last 2 hours and for 1 student more than two hours. 54.2% (N=13) experienced symptoms such as agitation, shortness of breath, nervousness, and excessive sweating, while 41.7% (N=10) never experienced them.

Only 16.7% are unaware of the possible negative effects associated with excessive consumption of energy drinks, 37.5% are aware of them and try to be careful, while 33.3% continue to consume energy drinks despite being aware of them.

41.7% (N=10) do not notice any changes in the quality of their sleep after consuming energy drinks, while 33.3% have difficulty falling asleep and 16.7% wake up during the night.

The most popular places to buy energy drinks are supermarkets (70.8%) and bars or vending machines at school and in the local area (20.8%). Energy drinks are mainly purchased by the students themselves (91.7%), 45.8% of whom say they do not want to replace energy drinks with any other beverage, while 33.3% (N=8) would replace them with tea or coffee and none with plain water.

Another interesting aspect is that 95.8% (N=23) believe that energy drinks should not be regulated or banned for minors, but that freedom of choice should be allowed.

Although brief, incomplete and superficial, this analysis reveals some interesting points, highlighting dynamics that deserve attention from both the educational and health sectors.

1. High prevalence and normalisation of consumption: The entire sample consumes energy drinks: this initial finding indicates that the consumption of such drinks is no longer perceived as an exception or marginal behaviour, but is now fully normalised in the daily lives of adolescents. The high frequency and duration of consumption (up to more than 5 years) suggest that exposure occurs at an early age (around 11-13 years).

2. Psychoactive function and self-regulation of performance: The main motivation reported ('to stay awake and focused') places energy drinks as tools for cognitive and mental self-regulation, used to improve attention or performance (academic, sporting, social). Students use these drinks as accessible 'pharmacological substitutes' to compensate for tiredness, energy slumps or performance pressure. This highlights a functional rather than recreational pattern of consumption.

3. Significant socio-relational component: An important finding is that one third of adolescents consume energy drinks due to emulation or social pressure ('because their friends drink them'). This reflects the relational nature of adolescent consumption, in which behaviours are strongly shaped by peer group norms. Energy drinks become symbols of inclusion, virility, or social conformity, especially in 'party' or 'going out with friends' contexts.

4. Conflict between positive subjective perception and real risk: 79.2% of participants report feeling 'more energetic and focused' after consumption, while none report immediate negative symptoms. However, more than half of the sample

also experienced, albeit rarely, physiological side effects (agitation, sweating, etc.). This shows a gap between subjective perception and actual biological awareness, probably due to an underestimation of bodily signals or a chronic habit that dulls their perception.

5. High autonomy and low risk perception: 91.7% of students decide independently to purchase energy drinks, and 95.8% oppose their regulation. This shows a high degree of perceived (illusory) self-efficacy and resistance to external intervention, despite poor awareness of long-term risks. The idea that 'everyone must decide for themselves' reflects an adolescent valuing of individual freedom, typical of this age but dangerous in contexts of potentially harmful consumption.

6. Lack of alternatives and poor nutrition education: One-third of students would replace energy drinks with tea or coffee, none with water, and almost half are unwilling to give them up. This indicates functional dependence and a low propensity for healthier choices, possibly linked to a lack of nutritional literacy and the normalisation of energy drinks in the media.

Energy drink consumption among adolescents is not simply a dietary behaviour, but a complex socio-cultural phenomenon influenced by identity, cognitive and relational dynamics. Although the sample is limited, the data collected clearly show the need for:

- Educational/teaching programmes to raise awareness of the risks associated with excessive consumption and promote healthy and proper nutrition.
- More attentive and aware school policies to regulate the sale of energy drinks in schools.
- Involvement of families to monitor and guide adolescents' consumption habits.
- Longitudinal studies to measure impacts on attention, performance, metabolism and assessment of long-term cognitive and psychophysical effects.

Author contributions

This contribution is the result of joint work by the authors; however, for the purposes of attributing individual parts, it is divided as follows: Abstract and Introduction are attributable to the three authors; Maria Rosaria Negri §§ 1-2; Francesco Paolo Romeo §§ 3; Alessandro Barca §§ 4.

References

- Ajibo C, Van Griethuysen A, Visram S, Lake A.A. (2024). Consumption of energy drinks by children and young people: a systematic review examining evidence of physical effects and consumer attitudes. *Public Health*. 227: 274-281.
- Alberry B, Silveira P.P. (2023). Brain insulin signaling as a potential mediator of early life adversity effects on physical and mental health. *Neurosci Biobehav Rev*. 153.
- Alsunni A.A. (2015). Energy Drink Consumption: Beneficial and Adverse Health Effects. *Int J Health Sci (Qassim)*. 9(4): 468-74.
- Bauman Z. (2020). *Modernità liquida*, Laterza, Roma-Bari.
- Blakemore S.J. (2018). *Inventare se stessi. Cosa succede nel cervello degli adolescenti*, Bollati Boringhieri, Torino.
- Burgalassi A, Ramacciotti CE, Bianchi M, Coli E, Polese L, Bondi E, Massimetti G, Dell'osso L. (2009). Caffeine consumption among eating disorder patients: epidemiology, motivations, and potential of abuse. *Eat Weight Disord*. 14(4).
- Costantino A, Maiese A, Lazzari J, Casula C, Turillazzi E, Frati P, Fineschi V. (2023). The Dark Side of Energy Drinks: A Comprehensive Review of Their Impact on the Human Body. *Nutrients*. 15(18): 3922.
- Curran CP, Marczynski CA. (2017). Taurine, caffeine, and energy drinks: Reviewing the risks to the adolescent brain. *Birth Defects Res*. 109(20): 1640-1648.
- De Sanctis V, Soliman N, Soliman AT, Elsedfy H, Di Maio S, El Kholy M, Fiscina B. (2017). Caffeinated energy drink consumption among adolescents and potential health consequences associated with their use: a significant public health hazard. *Acta Biomed*. 88(2): 222-231.
- Ernst M, Luciana M. (2015). Neuroimaging of the dopamine/reward system in adolescent drug use. *CNS Spectr*. 20(4): 427-41.
- Foos TM, Wu JY. (2002). The role of taurine in the central nervous system and the modulation of intracellular calcium homeostasis. *Neurochem Res*. 27(1-2): 21-6.
- Gjergji I. (2021). Istruzione 4.0: l'impatto della digitalizzazione sul lavoro dei docenti scolastici in Italia. *Socioscapes International Journal of Societies, Politics and Cultures*. 2.
- Gottschall, J. (2014). *L'istinto di narrare. Come le storie ci hanno resi umani*. Bollati Boringhieri.

Greenough W.T. e Black J.F. (1992), Induction of brain structure by experience: Substrates for cognitive development. In M.R. Gunnar e C.A. Nelson (a cura di), Minnesota symposia on child psychology. Developmental behavioral neuroscience, Hillsdale, NJ, Erlbaum: 55-200.

Istat (2023). Rapporto annuale 2023. La situazione del Paese, Roma.

Jangra A, Gola P, Singh J, Gond P, Ghosh S, Rachamalla M, Dey A, Iqbal D, Kamal M, Sachdeva P, Jha SK, Ojha S, Kumar D, Jha NK, Chopra H, Tan SC. (2024). Emergence of taurine as a therapeutic agent for neurological disorders. *Neural Regen Res.* 19(1): 62-68.

Konrad K, Firk C, Uhlhaas PJ. (2013). Brain development during adolescence: neuroscientific insights into this developmental period. *Dtsch Arztebl.* 110(25): 425-31.

Larsen B, Luna B. (2018). Adolescence as a neurobiological critical period for the development of higher-order cognition. *Neurosci Biobehav Rev.* 94: 179-195.

Munteanu C, Rosioru C, Tarba C, Lang C. (2018). Long-term consumption of energy drinks induces biochemical and ultrastructural alterations in the heart muscle. *Anatol J Cardiol.* 19(5): 326-323.

Naveh G, Mansour B, Bader M, Steckler R, Nasrallah E, Hujeirat H, Magzal F, Elias N, Horovitz O, Nimri L. (2024). Physiological Impacts of Energy Drink Consumption: A Clinical Analysis in Adolescents. *Nutrients.* 16(14).

Ochoa-de la Paz L, Zenteno E, Guliás-Cañizo R, Quiroz-Mercado H. (2019). Taurine and GABA neurotransmitter receptors, a relationship with therapeutic potential? *Expert Rev Neurother.* 19(4): 289-291.

Romeo F.P. (2025). Dalla vita “mortificata” al progetto di vita indipendente. Deprivazione giovanile contemporanea e politiche educative. Parte II. Educazione. *Giornale di Pedagogia critica*, 14(1).

Romeo F.P. (2024a). Dalla vita “mortificata” al progetto di vita indipendente. Deprivazione giovanile contemporanea e politiche educative. Parte I. Educazione. *Giornale di Pedagogia critica.* 13(2).

Romeo F.P. (2021). Gli adolescenti dell’era Covid. Emergenze, disagio esistenziale e immagini del domani, in A. Mongelli, (a cura), Altri modi di apprendere. Sociologia, Psicologia e Pedagogia in dialogo, Diogene Edizioni, Napoli.

Romeo F.P. (2024b)., (a cura di), *QEASCG. Questionario esplorativo aree di sviluppo delle competenze genitoriali*, FrancoAngeli, Milano.

Romeo F.P., Paparella N., Tarantino A. (2022). *Vulnerabilità e resilienza. Dispositivi pedagogici e prospettive didattiche per l'infanzia*, FrancoAngeli, Milano.

Sánchez-Alegría K, Arias C. (2023). Functional consequences of brain exposure to saturated fatty acids: From energy metabolism and insulin resistance to neuronal damage. *Endocrinol Diabetes Metab.* 6(1).

Sanchez SE, Martinez C, Oriol RA, Yanez D, Castañeda B, Sanchez E, Gelaye B, Williams MA. (2013). Sleep Quality, Sleep Patterns and Consumption of Energy Drinks and Other Caffeinated Beverages among Peruvian College Students. *Health (Irvine Calif)*. 5(8B): 26-35.

Shimizu I, Yoshida Y, Minamino T. (2016). A role for circadian clock in metabolic disease. *Hypertens Res.* 39(7): 483-91.

Società Italiana di Pediatria, *Energy drink, conoscere i rischi per la salute dei più giovani*, rintracciabile al sito internet: <https://sip.it/2024/10/29/energy-drink-conoscere-i-rischi-per-la-salute-dei-piu-giovani/> (consultato il 12/04/2025)

Tahara Y, Ding J, Ito A, Shibata S. (2024). Sweetened caffeine drinking revealed behavioral rhythm independent of the central circadian clock in male mice. *NPJ Sci Food.* 8(1): 51.

Tetteh-Quarshie S, Risher ML. (2023). Adolescent brain maturation and the neuropathological effects of binge drinking: A critical review. *Front Neurosc.* 16.

Unicef, Gallup (2021). The Changing Childhood Project. A multigenerational, international survey on 21st century childhood.