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Joint impact of acute stress and alcohol consumption on neurocognition and addiction vulnerability in adolescence and emerging adulthood: A preregistered systematic review

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ABSTRACT

Adolescence and early adulthood are developmental stages during which ongoing neurobiological maturation can shape long-term neurocognitive and behavioral trajectories. During this period, the refinement of stress-response systems coincides with the onset of alcohol use, a recognized challenge for brain development. Prominent neurobiological models of addiction have proposed a critical link between stress and alcohol-related processes; however, how these parallel processes may interact to influence neurobehavioral functioning during this sensitive developmental window remains fragmented and insufficiently understood. Following PRISMA guidelines, this systematic review synthesizes experimental research examining how acute stress influences alcohol-related outcomes and, conversely, how patterns of alcohol use may alter stress reactivity in adolescents and young adults. A systematic search of three databases (PsycINFO, PubMed, and Scopus) identified 24 studies based on experimentally induced stress paradigms and assessing alcohol use, physiological, or neurocognitive outcomes. The methodological quality of each study was evaluated, and potential differences associated with the type of experimental stress paradigm were examined. Overall, acute stress was most consistently associated with increased alcohol craving, particularly among individuals with heavier drinking patterns. Evidence linking acute stress to actual alcohol consumption was more heterogeneous and appeared to depend on methodological features such as the stress paradigm employed, individual drinking history, and contextual factors. Conversely, heavier alcohol use was associated with altered stress reactivity and reduced distress tolerance, suggesting a bidirectional relationship between stress systems and alcohol-related processes. These findings support dynamic stress-alcohol interactions and highlight the need for further research to clarify the neurobehavioral mechanisms underlying this relationship.

1. Introduction

1.1. Adolescence and the brain: a period of specific vulnerability

Adolescence is a critical period of brain maturation marked by rapid structural and functional changes, particularly in regions involved in executive control (Ferguson et al., 2021), emotion regulation (Huffman and Oshri, 2022), and reward processing (Cao et al., 2021; Casey et al., 2025; Van Leijenhorst et al., 2010). During this developmental stage, synaptic pruning, myelination, and the reinforcement of cortico-limbic connectivity support the progressive refinement of higher-order cognitive functions (Galvan, 2021; Larsen and Luna, 2018; Oldham and Fornito, 2019). The asynchronous brain evolution, characterized by an early maturation of subcortical reward and emotion systems (e.g., amygdala, striatum) contrasting with the slower maturation of prefrontal control regions, creates an imbalance between heightened motivational drive and limited top-down regulation (Casey et al., 2011, 2010; Lozano Wun et al., 2025). Additionally, adolescence is marked by significant shifts in hypothalamic-pituitary-adrenal (HPA) axis reactivity and heightened stress-induced hormonal responses (Romeo, 2013). As a result, adolescents typically display increased sensation-seeking, impulsivity, and emotional reactivity (Romer, 2010;

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Shulman et al., 2016; van Duijvenvoorde et al., 2016), making them particularly sensitive to environmental and psychosocial influences (Andrews et al., 2021; Somerville, 2013). Among these, excessive alcohol consumption and stress exposure are especially relevant, as both are prevalent during this developmental stage (Andersen, 2019; Spear, 2018) and can individually and synergistically interfere with ongoing neurodevelopmental processes (Elsayed et al., 2018; Sicher et al., 2022).

1.2. Alcohol use in adolescence/emerging adulthood and its impact on the brain

Binge drinking (BD) is the most common pattern of alcohol misuse during adolescence and emerging adulthood (Merrill and Carey, 2016), defined as consuming large amounts of alcohol in a short period (resulting in a blood alcohol concentration higher than 0.08 g/dL) to reach drunkenness (NIAAA National Institute on Alcohol Abuse and Alcoholism, 2004). A repeated BD pattern has been linked with neurocognitive and structural alterations (Carbia et al., 2018; Jones et al., 2018; Pérez-García et al., 2022), including altered grey (Sousa et al., 2017) and white matter (McQueeny et al., 2009), and alterations in functional connectivity (Arienzo et al., 2020; Crane et al., 2018; Herman et al., 2019; Sousa et al., 2019; Suárez-Suárez et al., 2025; Tong et al., 2021). Such brain modifications are related to documented neuropsychological difficulties in BDs, such as poor inhibitory control (Carbia et al., 2025; Lannoy et al., 2019), difficulties in episodic memory (Gierski et al., 2020), decision-making (Goudriaan et al., 2007) and alterations in emotional identification (Lannoy et al., 2021) and emotional regulation (Benzerouk et al., 2022). Other alcohol-consumption patterns frequently observed in adolescents and young adults have also been associated with cerebral and cognitive impairments, including heavy drinking (Cservenka and Brumback, 2017) or hazardous/harmful drinking (Claus and Hutchison, 2012; Stuke et al., 2016), identified through the Alcohol Use Disorders Identification Test (Saunders et al., 1993). As a whole, beyond BD, a neurocognitive impact has been reported in various excessive alcohol consumption patterns in youth.

Importantly, these alterations occur within brain networks that overlap with stress-sensitive regions such as the amygdala (Agoglia and Herman, 2018; Heilig and Koob, 2007), the prefrontal cortex (Lu and Richardson, 2014) or the hippocampus (Fan et al., 2023), suggesting that alcohol-related neuroadaptations may interact with (Koob, 2008) or exacerbate (Fan et al., 2023; Sánchez-Marín et al., 2022; Sicher et al., 2022) stress-induced changes during adolescence and emerging adulthood. There is also a huge overlap between reward-related areas, known to be key to explain adolescent motivated behavior and alcohol consumption, and stress-related regions (Koob et al., 2014). In turn, these interactions could lead to a self-reinforcing loop that promotes or perpetuates risky consumption and maladaptive behavioral patterns through difficulties to cope with stress (Merrill and Thomas, 2013; Stephens and Wand, 2012; Wand, 2008).

1.3. Stress during adolescence

Adolescence involves hormonal fluctuations and heightened HPA axis reactivity, with sex hormones and prolonged cortisol responses jointly influencing brain function and stress physiology (Romeo, 2013; Schulz et al., 2009). Heightened emotional reactivity and recalibration of the HPA axis are hallmark features of adolescent development, which together with still-maturing emotion regulation skills, may further amplify stress sensitivity (Casey et al., 2010; Romeo and Mcewen, 2006; Sisk and Gee, 2022). Individual variability in stress perception, biological reactivity, and coping strategies contributes to differential vulnerability to psychopathology, drug and alcohol abuse (Rapee et al., 2019; Tottenham and Galván, 2016)

A widely accepted definition conceptualizes stress as a psychophysiological state elicited by real or perceived challenges to an organism's homeostasis, engaging behavioral, autonomic, and neuroendocrine systems to promote adaptation (James et al., 2023; Mcewen, 1998). Although chronic stress exerts long-lasting effects on neurodevelopment and psychopathology risk, the majority of experimental studies capitalize on paradigms generating acute stress, due to their controllability and reproducibility, reliably eliciting HPA axis activation and allowing the precise assessment of physiological and cognitive stress responses within the laboratory (Allen et al., 2017; Brunyé et al., 2025; Swartz, 2022). Such paradigms provide a controlled framework to examine the mechanisms of stress reactivity and their interaction with alcohol use during adolescence.

Acute stress can disrupt key cognitive processes such as executive functions and memory (Shields et al., 2025, 2017). In particular, research on adolescents has shown diminished cognitive control under stress and alterations in decision-making, which might be more pronounced during adolescence than adulthood, due to immature top-down control (Galván and Rahdar, 2013; Uy and Galván, 2017). Overall, stress is especially relevant during adolescence, where ongoing maturation, heightened sensitivity and emerging alcohol use may converge to further disrupt developing regulatory systems.

1.4. Joint impact of stress and alcohol in adolescence and emerging adulthood

Substantial evidence from adult and clinical research indicates a robust, bidirectional relationship between stress and alcohol use (Blaine and Sinha, 2017; Sinha, 2022), producing additive or synergistic effects. Stress can precipitate the initiation and escalation of excessive alcohol consumption by increasing negative affect, which is a known predictor of alcohol use (Koob and Volkow, 2016; Ramchandani et al., 2018) or impacting alcohol sensitisation (Blaine et al., 2016; Uhart and Wand, 2009). Conversely, repeated alcohol exposure dysregulates stress response systems (i.e., blunted cortisol in patients with alcohol use disorder, AUD, see Chen et al., 2020 for a review on physiological responses), leading to maladaptive feedback loops that reinforce consumption (Goldfarb and Sinha, 2018; Sinha, 2012).

Studies in adults with AUD have demonstrated that acute stress increases craving, a key factor associated with excessive alcohol use and relapse risk (Blaine et al., 2016; Sinha, 2008; Sinha and Li, 2007; Thomas et al., 2011), and might promote motivation to drink (Blaine and Sinha, 2017). Interestingly, in real-life settings, Zaiser et al. (2025) demonstrated that, in AUD, subjective stress reactivity to an acute stress induction was the most reliable predictor of craving during both the experimental and ambulatory phases of the study. Similarly, Wemm et al. (2019) observed, in AUD patients, that during the first weeks of treatment, perceived stress predicted increases in craving, those increases themselves predicting alcohol drinking the next day. These results highlight the direct relevance of stress and craving on upcoming alcohol consumption. At the brain level, alcohol-cue tasks in AUD patients revealed consistent activation of a network including the insula, limbic and striatal regions and the prefrontal cortex, among others (Schacht et al., 2013). Interestingly, these regions are also implicated in stress reactivity (Berretz et al., 2021; Koob et al., 2014), and recent studies have shown their role in the relationship between stress, craving and relapse in AUD. For instance, neuroimaging studies in AUD reported that acute psychosocial stress elicited both increased insular and amygdala activations (Bach et al., 2024; Grodin et al., 2024), and decreased activity in the ventromedial prefrontal cortex and anterior cingulate cortex (Radoman et al., 2024; Seo et al., 2013). Lastly, research on subclinical adult drinkers identified an interaction between stress- and alcohol-related outcomes. Specifically, recent heavy drinking was associated with a higher increase in alcohol craving and consumption following acute stress, alongside a blunted cortisol response to the stressor (Blaine et al., 2019).

Studies with non-clinical adolescents and young adults with excessive drinking patterns start to point to similar interactions in young BDs. For example, a recent study demonstrated that college students may be

at greater risk for alcohol craving when confronted with stress (Glenn and Lau-Barraco, 2025). Also, Gullo & Stieger (Gullo and Stieger, 2011) demonstrated that anticipatory acute stress leads to rebalancing reward sensitivity in a decision-making task among heavy drinkers. Despite this theoretical convergence, empirical evidence in adolescents remains limited. Most studies examine stress and alcohol in isolation or in adult clinical populations, hindering developmental inferences. Therefore, and given that adolescence is the critical period during which both stress reactivity and alcohol experimentation peak, a better understanding of their joint influence is critical to identify mechanisms underlying early vulnerability to addictive states.

1.5. Aims of the current review

Despite clear evidence that stress and alcohol affect the brain's neurodevelopmental processes independently, little is known about their combined impact. Increasing our understanding of this joint effect could explain synergistic contributions to long-term vulnerability to AUD and psychopathology. This systematic review addresses this gap by synthesizing evidence on both the mutual/individual influences between acute stress and alcohol, and their combined effects in adolescence and emerging adulthood. More precisely, our aim is twofold:

A. Determine the mutual influence between stress and alcohol by exploring the influence of (A1) experimentally induced acute stress on alcohol-related factors, including craving, alcohol expectancies and motivation to drink, and (A2) excessive alcohol consumption on stress-related processes, encompassing stress reactivity and physiological responses (e.g., cortisol).
B. Explore the joint impact of excessive alcohol and experimentally induced acute stress on neurocognition, endocrine markers and alcohol-related outcomes. We will focus on studies investigating how co-occurring exposure to excessive alcohol use and acute stress affects neurocognitive functioning, including behavioral performance (e.g., decision-making, inhibitory control), and neural or physiological correlates measured through neuroscience approaches (e.g., EEG, MRI). Additionally, we will include studies that assessed neuroendocrine markers (i.e., cortisol), alcohol-related outcomes (e.g., craving, expectancies) and stress reactivity as dependent variables, to provide an integrated understanding of how stress–alcohol interactions shape adolescent brain and behavior.

To ensure that the conclusions drawn from the present review provide a clear and minimally confounded understanding of the combined effects of acute stress and alcohol use, we deliberately restricted its scope in two key respects: i) only studies with experimentally induced stress (i.e., laboratory-based) paradigms were included; ii) excessive alcohol consumption was operationalized as any drinking pattern that could be qualified as either binge drinking (NIAAA National Institute on Alcohol Abuse and Alcoholism, 2004), heavy drinking (Cservenka and Brumback, 2017), or hazardous/harmful alcohol use (Claus and Hutchison, 2012; Stuke et al., 2016), without AUD diagnosis (see 2.2 Eligibility criteria section).

Furthermore, findings will be discussed in the context of evidence from adult clinical populations with AUD to identify potential developmental continuities or divergences in stress–alcohol mechanisms. The review will also address current methodological limitations and outline directions for future research. By integrating insights from developmental neuroscience, stress physiology, and addiction research, we will advance a developmentally informed framework explaining the joint influence of acute stress and alcohol to pave the way for early prevention and intervention strategies before the escalation of alcohol misuse.

2. Methods

2.1. Search strategy and article selection

This systematic review was conducted following PRISMA guidelines (Moher et al., 2015). A detailed review protocol was pre-registered in the PROSPERO database (registration ID: CRD42023456348; https://www.crd.york.ac.uk/PROSPERO/view/CRD42023456348). A comprehensive literature search was performed across PubMed, Scopus and PsycINFO for articles published up to February 1, 2025. Search terms encompassed the three core domains of interest: stress, adolescence, and alcohol use. The initial search yielded a total of 2339 records: 776 from PubMed, 732 from Scopus and 831 from PsycINFO. The complete search strategy is available in the Supplementary Material.

Then, two authors (SS and CC) independently reviewed the retrieved articles through a 3-step procedure: First, duplicates were removed, leading to 1651 unique papers. Second, titles and abstracts were screened to exclude papers presenting any of the following criteria: a) Reviews & meta-analyses; b) animal research; c) no experimental data; d) absence of experimentally induced acute stress (or negative emotion related to stress); e) absence of a reliable measure of alcohol use. Third, we screened the 70 remaining papers through full-text reading, leading to the final inclusion of 24 articles. The main causes of exclusion in the full-text review encompassed: i) participants outside the adolescent/emerging adulthood age-range (13–30 years old); ii) alcohol not being the main substance consumed by participants; iii) no experimental manipulation of acute stress (e.g., observational or epidemiological studies) or no valid measures of alcohol consumption and stress; iv) no valid population (e.g., absence of excessive alcohol consumption pattern). Any discrepancies in article selection were resolved by consensus among the reviewing authors and, when necessary, with the assistance of the third author (PM). Screening and selection of the articles at all these three stages were conducted using Rayyan software for systematic reviews (Ouzzani et al., 2016). For a full disclosure of the selection procedure see Fig. 1.

2.2. Eligibility criteria

A set of inclusion criteria was set before the initial search, following the Population, Intervention/Exposure, Comparator, Outcome, Setting (PICOS, Liberati et al., 2009) procedure. Regarding the population, all studies must include human volunteers aged 13–30 years, without significant health problems (including psychiatric diagnosis). At least one group (for between-subjects studies) or a significant portion of the sample (studies based on a continuous approach) must have experienced an excessive alcohol consumption pattern. Excessive alcohol consumption, for this review, will be operationalized as engaging either in BD or heavy drinking or by presenting hazardous/harmful consumption, but without diagnosis of severe alcohol use disorder [i.e., by a score between 8 and 19 at the AUDIT; Saunders et al., (1993)]. Regarding the intervention/exposure, only studies that experimentally induced acute stress were included in the review. Regarding the comparator, articles were included if they ran comparisons between groups (including a group of excessive drinkers) or experimental comparisons within an excessive drinkers group (e.g., task performance in excessive drinkers when they were faced with neutral and stressful conditions). Also, articles proposing a main analysis related to alcohol measures were included. Regarding the outcome, we considered studies that proposed alcohol-related measures (e.g., craving, expectations towards drinks), behavioral performance (e.g., decision-making), and stress reactivity as dependent variables. Finally, the setting established that only empirical studies that experimentally induced acute stress (see Table 1 for a summary of the experimental stress induction procedures) would be included.

These criteria ensured compliance with key aspects of the review, such as: 1) Making sure that all papers refer to stress as acute stress

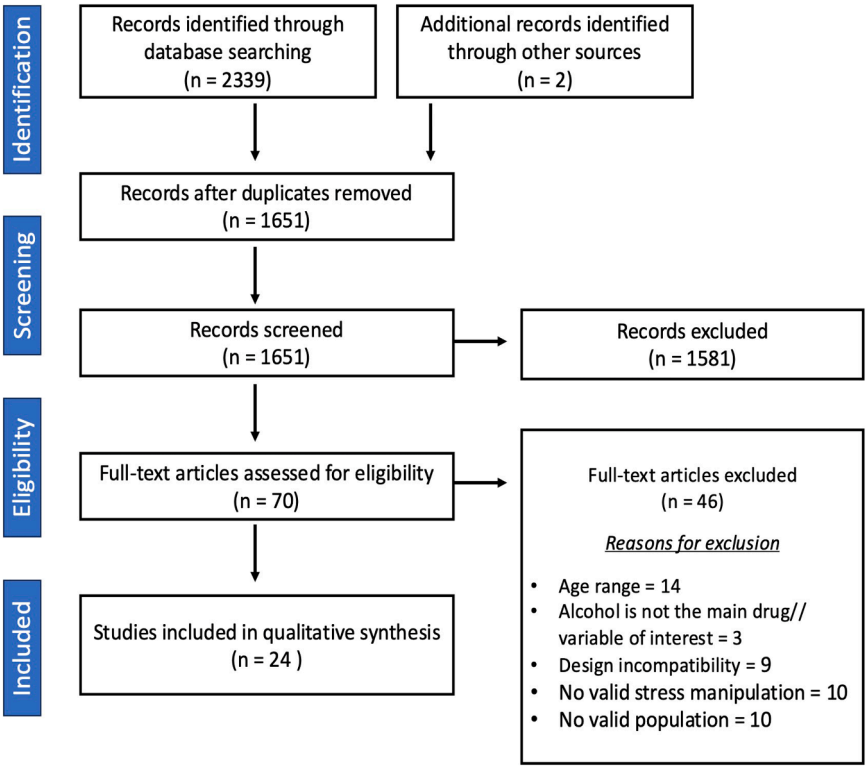


Fig. 1. PRISMA Flow chart of literature search.

(experimentally induced). This decision was made as acute and chronic stress have different effects on the stress response system, and, usually, chronic stress is more difficult to control and isolate from other confounding variables, such as socioeconomic status or psychiatric comorbidities, that can be more easily controlled with experimentally induced acute stress. This is also why we decided not to include studies that exclusively focused on measures of stress, such as epidemiological data, cortisol levels, or past-life events (trauma); 2) Setting a minimum alcohol consumption threshold to better understand the impact of alcohol consumption on stress response systems and cognitive processes; 3) Defining an age range to reduce the results to be discussed to those focused on adolescent and emerging adulthood as these periods of life are often described as critical periods during which the impact of alcohol/stress on maturational changes in stress response systems and cognitive networks can lead to an increase in vulnerability to develop a severe alcohol use disorder. Table 2 presents a detailed description of the inclusion criteria.

2.3. Data extraction

A standardized data extraction protocol was employed to characterize the included studies across five domains, adapted from the PICOS framework: (1) Population, including sample size, age range, gender distribution, and exclusion criteria; (2) Exposures, including measures of alcohol use, and potential comorbidities (e.g., psychopathology, substance use other than alcohol); (3) Comparator, comprising the presence and size of control groups and the use of matching variables; (4) Experimental Design, detailing the cognitive or behavioral processes assessed, experimental tasks, self-report measures, and types of stress paradigms; (5) Outcomes, including key conclusions drawn about the relationship between acute stress paradigms and alcohol use. The results of this extraction were synthesized in Table 3. Next, in the results section, the main characteristics of the quality assessment and the principal outcomes of the studies will be explored.

2.4. Quality assessment

For each of the 24 studies included in the review, we assessed their methodological quality using an adapted version of the Quality Assessment Tool for Observational Cohort and Cross-Sectional Studies, similarly to previous works (Bollen et al., 2022; Maurage et al., 2020b). This instrument was considered the most suitable for the studies included, although we introduced some modifications to fit our specific aims. Specifically, item 3 was excluded because it was not relevant for our purposes (i.e., item 3: 'Was the participation rate of eligible persons at least 50%?'), Item 4 was split into two different questions (i.e., 'Were all the subjects selected or recruited from the same or similar populations (including the same time period)?' and 'Were inclusion and exclusion criteria for being in the study prespecified and applied uniformly to all participants?') to better discriminate the relative weight of each of the questions in the quality assessment. The scale used here included 16 items with a binary answer options (Yes/No). Then, the overall quality score of each paper was calculated based on the percentage of items rated as 'Yes,' leading to 4 possible categories: poor: $\leq$50%; fair: 51–69%; good: 70–79%; very good: $\geq$ 80%. This criterion was applied in accordance with previous reviews (Black et al., 2017; Bollen et al., 2022). In order to boost the reliability of this procedure, two independent authors (CC and SS) assessed the selected studies. Assessment discrepancies were then discussed with a third author (PM). The results of this quality assessment are presented in Supplementary Table 1.

3. Results

3.1. Quality assessment (Supplementary Table 1)

Twenty-four empirical studies with adolescents and young adults (ages 14–30) examined the interplay among acute stress, alcohol use, and neurocognitive function. According to the assessment questionnaire criteria, two studies were classified as very good, four as good, 13 as fair, and five as poor. All studies clearly defined the stress manipulation

Table 1
Overview of the experimental paradigms used to induce acute stress in the included studies.

Paradigm	Description
Trier Social Stress Test(TSST, n = 5)	The TSST (Kirschbaum et al., 1993) is a standardized laboratory procedure considered the gold standard for inducing acute psychosocial stress. The protocol begins with an anticipation period of approximately 10 min, during which participants prepare for a task (free speech) without notes. This is followed by a test phase (≈10 min) in which they deliver a free speech (often framed as a mock job interview) and perform challenging mental arithmetic problems in front of an evaluative panel. The combination of social-evaluative threat and uncontrollability reliably triggers robust psycho-physiological stress responses.
Anticipation of social evaluation (n = 3)	This is a variation or modified version of the TSST using anxiety induction procedures based on the anticipation of social evaluation during a public speech.
Musical mood induction (n = 4)	These procedures rely on the exposure to music tracks to evoke positive and negative moods. Some of the studies included self-selected music tracks while other opted for previously categorized tracks to use the same song for every participant. On top of music exposition these studies tend to instruct participants to try to engage in a certain mood through active reflection or by recall of autobiographical events emotionally congruent with the mood.
Mood induction with visual materials (n = 2)	Similarly to the musical mood protocols, this procedure employed a set of pictures from the IAPS to elicit through active viewing positive, neutral and negative moods.
The Velten Mood Induction (n = 1)	In the same direction than previous mood inductions, this protocol (Velten, 1968) is based on the reading of self-referent statements that can be depression-related, neutral or positive ones to induce different moods.
Paced Auditory Serial Task (PASAT-C) (n = 2)	In this version of the protocol (Lejuez et al., 2003), participants hear a continuous series of digits and must add each new digit to the one immediately preceding it under increasing time pressure. The task is designed to be highly demanding, often eliciting anxiety, irritability, and bodily discomfort. In addition to task performance, participants rate their affective state (e.g., anxiety, concentration difficulty, discomfort) on a 0–100 visual analog scale.
Elevated plus-maze (EPM) virtual reality set up (n = 2)	This protocol uses virtual reality setups to recreate modified versions of the elevated plus-maze. In both experiments feelings of stress and discomfort were elicited through exposure to height.
Noise stress (n = 1)	Noise stress induction based on a 2 min noise exposure to a loud industrial noise of 70 db.
Cyberball game (n = 1)	Virtual computer-based ball-tossing game in which participants believe they are playing with two other individuals, though the other 'players' are in fact computer-controlled (Williams et al., 2000). The paradigm allows participants to be either included or excluded from the game, thereby reliably inducing feelings of social exclusion an psychosocial stress.
Impossible Anagram Task (n = 1)	Participants are asked to solve a series of anagrams of varying difficulty, including unsolvable items. Their performance is evaluated against an expectation of 'normality' (e.g., being told that most people complete the set in under three minutes), while time constraints are imposed to heighten pressure. This design reliably elicits frustration when participants encounter impossible anagrams, and it has been defined as a behavioral measure of distress tolerance and frustration.
No-Predictable-Unpredictable (NPU) threat-of-shock task (n = 1)	The NPU-threat task is a startle reactivity procedure based on the unpredictability of electric shocks. Typically, it includes three conditions: no shock (N), predictable shock (P), and unpredictable shock (U). In the predictable condition, shocks are signaled by a cue, whereas in the unpredictable condition shocks can occur at any time. Thus, this paradigm allows for the differentiation of fear responses (predictable threat) and anxiety/stress ones (unpredictable threat).
Breath holding task (n = 1)	This paradigm (Zvolensky et al., 2001) is a behavioral measure of physical distress tolerance. For this task participants are instructed to hold their breath for as long as possible, usually involving two or more trials of breath-holding.

procedure and analyzed outcomes based either on stress reactivity or alcohol-related measures. Most studies clearly defined their alcohol consumption measures, although a significant number did not characterize participants' drinking habits based on standardized measures or previously defined patterns (e.g., binge drinkers, heavy drinkers), simply referring to the sample as "social" or "normal" drinkers.

Also, a majority of the studies (n = 17) did not control for, or did not include as exclusion criteria, critical potential confounding variables, such as the consumption of other substances, the presence of psychopathological conditions, past trauma, or general medical conditions that may bias the results. Most studies also omitted sample size justification (n = 21), although reporting of effect-size estimates was relatively common (n = 15). Additionally, even if the sample of all studies was sufficient to meet our cut-off threshold (≥10 participants per group), some articles reported secondary analyses with groups below this threshold, which might have compromised statistical power.

It should also be underlined that only three studies were longitudinal, highlighting the need for more longitudinal studies, especially given the ongoing developmental changes of adolescence and young adulthood. In general, both the relatively low number of papers included in the review and the significant percentage (21%) of "poor" studies underlines the need of addressing the identified methodological limits in future studies.

3.2. Main results

Studies explored the relationship between acute stress, alcohol use/expectancies, physiological reactivity and cognitive performance using different experimental approaches. For the sake of clarity, studies are classified into two main categories: a) mutual influence of stress and alcohol (n = 21) and b) joint impact of alcohol and stress on neurocognition (n = 6). Moreover, the first category was split into: A1 – Influence of stress on alcohol-related factors and A2 – Influence of alcohol on stress-related processes, which will be summarized next to highlight the main findings in each of them.

3.2.1. Influence of acute stress on alcohol-related factors (A1)

Most of the studies focused on the potential impact of acute stressors on immediate alcohol-related factors like craving, alcohol consumption, or implicit and explicit cognitions towards alcohol (n = 14) (Bacon et al., 2015; Bernstein and Wood, 2017; Bollen et al., 2023; Clay et al., 2018; Field and Powell, 2007; Glenn and Lau-Barraco, 2025; Grant and Stewart, 2007; Herchenroeder et al., 2023; Keough et al., 2016; McGrath et al., 2016; Moreno-Fernández et al., 2023; Wardell et al., 2012; Willner et al., 1998; You et al., 2023) although the consistency of the results varied slightly depending on the measured outcome, namely craving,

Table 2
Inclusion criteria.

1. Articles must be in English, French or Spanish.
2. Articles must be peer-reviewed.
3. Articles must be published before 1st February 2025.
4. Articles must be human studies.
5. Articles must be empirical studies (i.e., reviews, commentaries, and case studies are excluded)
6. Articles must have a minimum sample size of 10 participants per group.
7. Participants must be in the age range of 13–30 years old
8. At least one group of participants must have experienced excessive alcohol consumption without a severe alcohol use disorder (sAUD) or other substance use disorder (SUD).
9. Articles must explore the relationships between acute stress, alcohol-related measures (e.g., craving, expectations, consumption), behavioral performance, brain structure/function and stress reactivity (e.g., skin conductance).
10. Articles must not be based on cortisol levels, past-life events (trauma), or epidemiological data.
11. Articles must not aim to evaluate chronic stress, baseline biological markers of stress, psychiatric disorders, or to determine the effects of other conditions (such as acute ethanol effects) or the impact of polysubstance use.

alcohol consumption or implicit and explicit cognition towards alcohol. Among these, the relationship between acute stress and craving was explored by seven studies that consistently found significant increases in alcohol craving following the stress manipulation procedure (Bollen et al., 2023; Clay et al., 2018; Field and Powell, 2007; Glenn and Lau-Barraco, 2025; Moreno-Fernández et al., 2023; Willner et al., 1998; You et al., 2023). Additionally, Glenn and Lau-Barraco (2025) highlighted that the increase in state anxiety after the stress paradigm did not universally raise the craving levels across the whole sample. Instead, this greater craving was moderated by drinking habits, with students with more frequent BD episodes reporting a higher craving increase in response to the acute stressor. Similarly, You et al. (2023) reported that this increase was observed explicitly among young social drinkers presenting high "drinking to cope with negative affects" motives.

This is by far the most consistent finding of the current review and the most extensively tested relationship. Among these seven studies, three of them used the TSST (Clay et al., 2018; Field and Powell, 2007; Glenn and Lau-Barraco, 2025), three a form of musical mood induction (Bollen et al., 2023; Willner et al., 1998; You et al., 2023) and the remaining one opted for a virtual reality setting (Moreno-Fernandez et al., 2023).

Regarding acute stressors and alcohol consumption in the laboratory, five papers reported mixed findings, three of them showing a positive relationship between stress and alcohol consumption (McGrath et al., 2016; Wardell et al., 2012; Willner et al., 1998) and another two showed a negative association (Bacon et al., 2015; Bernstein and Wood, 2017). McGrath et al. (2016) reported a positive association between exposure to the stressor (TSST) and alcohol consumption, while Willner et al. (1998) observed a similar pattern where stress increased alcohol consumption, especially for women, highlighting a potential gender effect. Interestingly, this increase in craving was followed by a reduction in the liking of the alcohol sip in the taste task for women in the stress condition, pointing to potential differential associations between stress, craving and actual consumption. Next, Wardell et al. (2012) found an increase in alcohol consumption after exposure to an acute stressor (mood induction via IAPS), explained through changes in positive expectancies towards alcohol consumption (see next paragraph). Also, they found that this association was present for both stress and positive mood inductions, suggesting arousal as a more probable mechanism for the increase of consumption than stress per se. Lastly, two studies (Bacon et al., 2015; Bernstein and Wood, 2017) reported a reduction in ad libitum drinking after exposure to an acute stressor. More specifically, Bacon et al. (2015) employed the Cyberball task to induce social stress via ostracism, whereas Bernstein and Wood (2017) adopted a paradigm similar to the TSST, eliciting anticipatory stress through the preparation of a public speech. Notably, Bacon et al. (2015) was the only paper to use a social ostracism task as the acute stressor (namely, a paradigm generating the deliberate exclusion of the participant from a group, resulting in social rejection feelings, see Table 1), which may have produced distinct effects on the relationship between stress and alcohol consumption. Also, an additional factor that may account for the reduced consumption reported by Bacon et al. (2015) is that this effect was specific for women, which could be linked to gender-specific effects (Willner et al., 1998). This finding, as previously mentioned, suggests that craving and consumption may respond differently to acute stressors, at least within controlled laboratory settings. Next, in the study by Bernstein and Wood (2017), the timing of the alcohol taste task may have significantly influenced the results. Unlike most studies in which the taste task follows the stress induction, this study focused on anticipatory stress, offering participants access to alcohol before delivering uncomfortable speech. As the authors noted, this design may have led participants to intentionally withhold their consumption due to expectations of compromised performance if they got intoxicated. Furthermore, another relevant aspect discussed by authors as a potential differential factor from other studies was the exclusive use of placebo beverages, as this may have masked potential pharmacological effects of alcohol on drinking behavior.

Finally, four papers (Grant and Stewart, 2007; Herchenroeder et al., 2023; Keough et al., 2016; Wardell et al., 2012) explored the relationship between stress and implicit cognitions such as expectancies and drinking motives. Among these, three studies (Grant and Stewart, 2007; Keough et al., 2016; Wardell et al., 2012) reported that an anxious mood elicited higher positive alcohol expectancies and how drinking motives (i.e., enhancement, and coping motives) and BAS/BIS factors could moderate this association. Also, Wardell et al. (2012) reported that altered mood, irrespective of its valence (positive or stressful), moderates the relationship between positive expectancies towards alcohol, as measured by response time in an implicit positive alcohol expectancy task, and alcohol consumption. Next, the fourth study in this category showed how acute stress increased positive ratings of alcohol-related stimuli, as measured by an increase of alcohol-related images in a forced-choice task where participants must select either an alcohol or a food-related picture (Herchenroeder et al., 2023).

In summary, studies revealed that acute stress reliably elevates alcohol craving and that this link is especially present among individuals with frequent binge drinking habits and coping motives, whereas its effects on actual alcohol consumption are still mixed and seem to depend on factors such as the type of stressor, task timing, and gender. Finally, the findings also suggest that acute stress more consistently sensitizes positive alcohol-related cognitions (expectancies, motives, implicit evaluations) than drinking behavior itself.

3.2.2. Influence of alcohol on stress-related processes, encompassing stress reactivity and physiological responses (e.g., heart rate, cortisol) (A2)

Eight papers investigated the relationship between alcohol consumption and stress system reactivity (SR), indicating that adolescent excessive drinking can be linked to altered stress responses (Evans et al., 2012; Gorka et al., 2023; Hagan et al., 2019; Holzhauer et al., 2017; Moreno-Fernández et al., 2023, 2024; Wemm et al., 2013; Winward et al., 2014). More specifically, alcohol consumption seems to be linked with lower resting heart rate (HR; Evans et al., 2012) and higher peak HR in women -but not men- during acute stress (Moreno-Fernandez

Table 3 Comprehensive synthesis of the reviewed studies.

AUTHORS	Population				Exposures		Comparator		Design			Outcomes
	Sample (n)	Age	Gender (female %)	Exclusion Criteria	Alcohol Consumption (mean; SD)	Comorbidities	Control Group	Matching Variables	Processess Measured	Task	Stress Paradigm	Conclusions
Bacon et al., (2015)	40 social drinking college students	age range: 21–26. mean age= 22 years; SD= 1.64	55%	Age under 21, absence of alcohol consumption in the last month and absence of beer consumption in the last 3 months, history of allergic reactions to alcohol, illegal drug use, pregnancy, use of medication (except contraceptives) in 24 h prior to the experiment, and problematic alcohol use (AUDIT score ≥ 15)	Drinking Motives Questionnaire; AUDIT-C; Rutgers Alcohol Problems Index-short form (RAPI); Beer consumption in the taste test, Breath alcohol concentration (BrAC) after the taste task. AUDIT-C (4.85; SD = 2.25); Drinking to cope (9.12; 4.52); Alcohol use problems (RAPI, 5.5; 3.83)	not reported (NR)	CON group: matched the experimental group in characteristics and criteria. 20 participants were randomly assigned to the inclusion condition, receiving the ball as often as the other players (33% of tosses)	Same pool of participants randomly assigned to one of two social ostracism conditions.	ad-lib alcohol consumption; Breath alcohol concentration (BrAC); Positive and Negative Affect Scales (PANAS); Aversive Impact Index (AII); AUDIT; Drinking Motives Questionnaire-Revised (DMQ-R)	Ad libitum alcohol consumption in the form of mock taste test for beer after the stress induction.	Cyberball game, virtual ball-loss game designed to induce social exclusion and psychosocial stress.	Social ostracism ↓ alcohol consumption in women but not in men, suggesting gender-specific responses to social stress. These results challenge the assumption that stress ↑ drinking and underscore the complexity of the alcohol–stress relationship.
Bernstein and Wood, (2017)	127 students with different levels of alcohol consumption	54.6% of the sample were 18 years old; Neither mean nor age range are reported	65.4	Not consuming alcohol in the past three months, be pregnant, received alcohol/drug treatment, consider that the drinks provided during the experiment were not alcoholic drinks	Daily alcohol drinking questionnaire (DDQ) for the past three months; amount of placebo drinks consumed during the experiment (ad-lib "alcohol" consumption)	NR	Control and Stress Condition no differences in terms of alcohol consumption	Age; sex; alcohol consumption	post condition assignation STAI state short form (stress vs control); DDQ; ad-lib "alcohol" consumption	NA (ad libitum confederate alcohol consumption)	Acute anticipatory stress to a public speech	Participants in the stress group consumed less alcohol than controls. Higher weekly intake predicted greater laboratory consumption. Also, heavy drinkers (> 17 weekly drinks), tend to drink more in the stress condition.
Birch et al., (2008)	**Experiment 1:** 81 undergraduate students; 41 Enhace drinking motive (28 females); 40 Cope drinking motive (31 females);	**Experiment 1:** mean age = 19.3 years; SD = 1.7; **Experiment 2:** mean age = 19 years; SD = 2.6	**Experiment 1:** 72.8; **Experiment 2:** 68.3	Participants had to meet specific screening criteria tailored to their respective motive groups, ensuring a refined selection process for both EM and CM groups.	Drinking Motives Questionnaire; Rutgers Alcohol Problem Index; Weekly alcohol consumption (standard drinks)	NR	Random assignment to either the positive mood or the negative mood condition was performed.	Age; sex; year of university; annual family income	Implicit alcohol cognitions (behavioral task) post mood induction; pre- post-VAS mood scales;	**Experiment 1:** Alcohol Stroop task; **Experiment 2:** Extrinsic Affective Simon Task	Musical Mood Induction Procedure (2 conditions, positive and negative)	Experiment 1: Post-mood Stroop task only EM drinkers in the positive mood condition showed a significantly bias toward

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AUTHORS	Population				Exposures		Comparator		Design			Outcomes
	Sample (n)	Age	Gender (female %)	Exclusion Criteria	Alcohol Consumption (mean; SD)	Comorbidities	Control Group	Matching Variables	Processess Measured	Task	Stress Paradigm	Conclusions
	Experiment 2: 79 undergraduate students; 38 Enhace drinking motive (25 females); 41 Cope drinking motive (29 females)											alcohol cues. Experiment 2: Post-mood induction, only EM drinkers in the positive mood condition were faster to associate alcohol with reward than with relief.
Bollen et al., (2023)	**Experiment 1:** 80 undergraduate students; 48 Binge drinkers (31 females); 32 Light drinkers (20 females); **Experiment 2:** 77 undergraduate students; 48 Binge drinkers (31 females); 29 Moderate drinkers (19 females)	Experiment 1: mean age = 19.3 years; SD = 1.7; Experiment 2: mean age = 19 years; SD = 2.6	**Experiment 1**: 63.75; **Experiment 2**: 65	History of severe alcohol use disorder, current psychological or neurological disorder, non-corrected vision difficulties, not being fluent speaking French, not having beer as preferred alcoholic beverage.	Craving: Visual analogue scale (VAS); BD score [(4*consumption speed) + drunkenness frequency + (0.2*drunkenness percentage)]. 3 groups based on alcohol habits, BDs = BD score > 24, 2–3 drinking occasions per week, units x occasion > 6, BD episodes x week > 1. See Control Group column for the other groups.	NR (see exclusion criteria)	**Experiment 1** light drinkers: BD score < 12, drinking occasions per week = 0.25–1, units x week < 3, units x occasion < 3, no BD episodes. **Experiment 2** moderate drinkers: binge drinking score < 12, drinking occasions x week > 1, units x week < 22, units x occasion < 3, no BD episodes.	Same exclusion/ inclusion criteria as the Binge drinking group except for alcohol consumption levels.	Craving, Implicit alcohol expectancies (e.g., reaction time, first fixation, dwell time), mood (PANAS)	Visual Probe Task with Eye-Tracking: Participants viewed pairs of images (beer vs. non-alcoholic beverages) and responded to probes replacing these images.	Self-selected Musical Mood Induction Procedure (3 conditions, positive, negative neutral)	After the stressor, BDs reported higher craving and negative mood than both light and moderate drinkers. Also, among binge drinkers with high craving, negative mood ↑ their Attentional Bias towards alcohol pictures in comparison with control groups.
Clay et al., (2018)	31 undergraduate students (21 female)	mean age = 21.68 years; SD = 3.4	64,5	Depression; Anxiety; Undergoing Treatment for AUD	AUDIT (m=12; SD = 1.86); Units per day (M=5.37; SD= 2.68)	NR	No control group, continuous approach	not applicable (NA)	Craving, Impulsivity and Risk-Taking behaviors under acute stress	Conners Continuous Performance Test (CPT)// impulsivity test; Balloon Analogue Risk Task (BART)// risk-taking task	Trier Social Stress Test (TSST)	Acute stress ↑ craving for alcohol in young social drinkers, and this ↑ in craving is positively correlated with risk-taking as measured by the BART test.

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AUTHORS	Population				Exposures		Comparator		Design			Outcomes
	Sample (n)	Age	Gender (female %)	Exclusion Criteria	Alcohol Consumption (mean; SD)	Comorbidities	Control Group	Matching Variables	Processess Measured	Task	Stress Paradigm	Conclusions
Emery and Simons, (2015)	100 college students	mean age = 19.85 years; SD = 1.45	61%	NR	DDQ (at least 1 drinking episodes during the last 90 days)	NR	Between-subject design for the mood induction (Negative condition, n = 33; Positive, n = 34; Neutral n = 33)	NR	Alcohol Attentional Bias; Mood manipulation (PANAS) and craving (DMQ-R)	Alcohol attentional bias measured by the visual dot-probe task	Mood induction procedure based on picture-slide presentation with images from the IAPS (positive, neutral, negative) and mood-congruent music	The study found that alcohol-related attentional biases (AAB) are associated with alcohol consumption in men but not women. However, attentional biases did not vary as a function of neither positive nor negative mood.
Evans et al., (2012)	275 adolescents	age range: 14–20; mean age = 17.22 years; SD = 1.31	57.5	ex-smokers	Composite score made of self-reported questions regarding the number of days per week where the participants usually drunk alcoholic beverages and the average number of drinks per occasion	Tobacco smoking	Between-subject design with three drinking levels: Low drinkers 3 alcoholic drinks per week (n = 93); Medium drinkers 3 and < 6 alcoholic drinks per week (n = 88); and high drinkers > 7 alcoholic drinks per week (n = 69)	NR	Self-reported perceived stress and Average Heart rate both measured in 3 periods (rest, task and recovery).	NA	Modified version of the TSST with a mental arithmetic task, a public speaking task (8 min speech preparation and 6 min public speaking) and a computer task.	Higher alcohol consumption was associated with ↓resting heart (HR) rate but those adolescents with higher alcohol consumption did not show a signficantly ↓ HR response to acute stress.
Field and Powell, (2007)	44 undergraduate students divide in two groups (n = 22 each).	mean age = 19.14 years; SD = 1.17	81.81	NR	Craving measures: Desires for Alcohol Questionnaire (DAQ) scores before and after manipulation; Timeline Follow-Back (TLFB); Drinking Motives (DMQ); AUDIT (stress group, m = 14.4, SD = 3.62;	NR	Between-subject design for the stress paradigm (stress, n = 22; Control, n = 22). All 44 participants were heavy drinkers who consume more than 14 (females) or 21	same pool of participants randomly assigned to one of two stress conditions (matching variables include age, gender ratio, weekly alcohol	Craving measures and state anxiety before and after stress induction (STAI), attentional bias through probe task.	Visual Probe Task: Measured attentional bias for alcohol-related cues using picture pairs and response probes	Anxiety induction through anticipation of social evaluation, similar to the Trier Social Stress Test. Participants were told that they would have to give a	The authors informed that stress ↑ both subjective anxiety and alcohol craving among heavy social drinkers. Stress also induced a significant

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AUTHORS	Population				Exposures		Comparator		Design			Outcomes
	Sample (n)	Age	Gender (female %)	Exclusion Criteria	Alcohol Consumption (mean; SD)	Comorbidities	Control Group	Matching Variables	Processess Measured	Task	Stress Paradigm	Conclusions
					control group, m = 17.36, SD = 5.47).		(males) standard drinks per week.	consumption, AUDIT scores, and DMQ scores).			speech about their views on the war in Iraq, which would be recorded and evaluated by psychologists.	attentional bias towards alcohol-related cues, but only among those drinkers with high coping motives for drinking.
Geyer et al., (2023)	208 undergraduate students	mean age = 19.0 years; SD = 1.9	76.9	NR	AUDIT total score (25% of the sample scored between 8 and 15);	NR	No control group, continuous approach	NA	Anxiety sensitivity (ASI-3); emotional Distress tolerance scale; physical distress tolerance; Panic symptoms (PDSS-SR and IDAS-II)	NA	Online breath-holding task to measure physical distress tolerance (longer time during the breath-holding condition == greater distress tolerance)	For individuals with low physical distress tolerance, higher anxiety sensitivity was associated with higher panic symptoms which was also associated with greater alcohol use problems measured by the AUDIT.
Glenn and Lau-Barraco, (2025)	129 college students	age range: 18–25; mean age = 19.9 years; SD = 2.1	83.7	Diagnosis of alcohol use disorder or social anxiety disorder.	Alcohol once per month	NR	CON group: Same characteristics and criteria than the experimental one with the exception that they were not exposed to the stress procedure, instead they underwent a control condition.	Age, sex, alcohol consumption habits	measures of state anxiety and craving before and after the social stress test or the control condition.	NA	Online TSST	The TSST did raise the state-anxiety, but this effect didn't translate universally to an ↑ in alcohol craving. More specifically, the relationship between acute stress exposure and craving was moderated by drinking habits, with students who usually drink larger

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AUTHORS	Population				Exposures		Comparator		Design			Outcomes
	Sample (n)	Age	Gender (female %)	Exclusion Criteria	Alcohol Consumption (mean; SD)	Comorbidities	Control Group	Matching Variables	Processess Measured	Task	Stress Paradigm	Conclusions
												amounts and more frequent BD episodes showed ↑ cravings in response.
Gorka et al., (2023)	Startle models 95 participants fMRI models 91 participants	age range: 17–19; mean age = 18.4; SD = 0.7	Startle models 70.5 fMRI models 69.2	Lifetime history of alcohol use disorder (AUD) or any substance use disorder (SUD), major medical or neurological illness, psychosis, active suicidal ideation, deafness, traumatic brain injury, recent psychotropic medication use, contraindications for fMRI, and pregnancy.	Calendar-based TLFB of the last 90 days; days with 5 or more (men) or 4 or more (female) drinks were considered binge drinking episodes (m=0.6; SD= 1.8). At follow-up 47% of the sample reported at least one binge drinking episode in the past 90 days.	NR (see exclusion criteria)	No control group, prospective continuous approach	NA	Startle reactivity and fMRI scans during the NPU task	No-Predictable-Unpredictable (NPU) threat-of-shock task	NPU threat task. This task involves three conditions: no shock (N), predictable electric shock (P), and unpredictable electric shock (U).	Greater baseline startle reactivity and ↑ activation in the anterior insula and dorsal anterior cingulate cortex to uncertain threats were associated with an ↑ probability of BD one year later.
Grant and Stewart, (2007)	47 undergraduate students; 25 Enhace drinking motive (16 females); 22 Cope drinking motive (18 females)	mean age = 18.7 years; SD = 0.7	72.3	Consuming alcohol or marijuana on testing day; inclusion criteria specifying a minimum of one standard deviation higher than the mean of all screened students' scores on either EM or CM-anxiety. Additionally, participants had to meet specific screening criteria to their respective motive groups.	Drinking Motives Questionnaire; Rutgers Alcohol Problem Index; Alcohol Craving Questionnaire; Weekly alcohol consumption (standard drinks)	NR	Random assignment to either the positive mood condition (12 EM, 13 CM) or the anxious mood condition (13 EM, 9 CM) was performed	Age; sex; year of university; annual family income, level of alochol-related problems	Explicit alcohol-related cognitions (Alcohol Craving Questionnaire subscales: Anticipation of reward; and Anticipation of Relief) pre a and post mood induction; pre-post- VAS mood scales;	Alcohol Stroop Task (part of a different study see Birch et al. 2008)	Musical Mood Induction Procedure (2 conditions, positive and anxious)	Both EM and CM drinkers showed an ↑ in explicit expectancies of relief towards alcohol after the anxious mood condition but none after the positive mood induction.
Hagan et al., (2019)	160 emerging adults; Longitudinal study with three assessments (9–12 years old; 15–18 years old, 24–27 years old)	age range: 24–28; mean age = 22.55 years; SD = 1.22	46.9	Pregnancy or breast feeding; smoking within 30 min of saliva sample; mental health disorders; score > 17 on the Children's Depression Inventary or 97th percentile on the	Binge drinking episodes during the last 2 weeks (20.5% of participants during adolescence, 15–18 years old, and 44.4% during adulthood, 24–27 years old, reported at least 1 BD episode	Tobacco smoking(?); child externalizing problems at baseline (9–12 years old)	No control group, continuous approach	NA	Self-reported stress levels; Cortisol response measured 4 times across the experimental manipulation	NA	TSST	Greater binge drinking during adolescence was associated with a significantly lower cortisol stress-response in young

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AUTHORS	Population				Exposures		Comparator		Design			Outcomes
	Sample (n)	Age	Gender (female %)	Exclusion Criteria	Alcohol Consumption (mean; SD)	Comorbidities	Control Group	Matching Variables	Processess Measured	Task	Stress Paradigm	Conclusions
				Externalizing subscale of the Child Behavior.	during the last 2 weeks).							adulthood to psychosocial stressor
Herchenroeder et al., (2023)	278 university students	mean age = 20.22 years; SD = 1.75	56.5	Outliers (>3.5 SD) and unrealistic performance in the alcohol choice task (100% alcohol choices)	AUDIT (four different groups with no differences in the mean scores that ranged from 11.36 to 12.70; and SD ranging from 5.82 to 7.07)	NR	Factorial design with 4 groups: stress only, breath counting, distraction, no-stress.	All groups were matched in age, alcohol consumption habits (AUDIT scores) and sex	Alcohol choice task; Desires for Alcohol Questionnaire-Brief (DAQ measures alcohol craving); Drinking Motives Questionnaire-Revised (M-DMQ-R focused on drinking to cope); AUDIT; Annoyance scale (as measure of stress induced by the noise exposure).	Alcohol choice task where participants were forced to choose between alcohol and food images.	Noise stress induction; 2 min noise exposure to a loud industrial noise with no strategy (stress only), or actively engaging in breath counting or distraction (cross counting)	Stress ↑ alcohol-seeking as showed the higher choice of alcohol-related images. Both breath counting and distraction significantly ↓ the stress induced ↑ alcohol choice only in the stress group.
Holzhauer, Wemm and Wulfert, (2017)	91 college students	age range: 17–28; mean age = 21.5 years; SD = 2.16	100	NR	Binge drinking episodes during the last two weeks (m = 2.15; SD = 1.24); Calendar-based TLFB over the last 4 weeks; Young Adult Alcohol Consequences Questionnaire (YAACQ); 47.3% of the sample met criteria for risky drinking.	Occasional Marijuana smoking (n = 2 regular marijuana smokers) and Tobacco smoking	No control group, continuous approach	NA	Self-reported Distress Tolerance (before, during and after the PASAT-C); behavioral distress tolerance (time spent before quitting the PASAT-C); physiological stress reactivity (skin conductance reactivity, SCR); YAACQ	Arithmetic task as part of the PASAT-C	Paced Auditory Serial Task (PASAT-C)	Women with low physiological reactivity (SCR) and low subjective distress tolerance (Regulation subscale) experienced significantly more adverse consequences from drinking
Keough et al., (2016)	110 undergraduate students	age range: 18–25; mean age = 21.4 years; SD = 2.6	68	Not fluent in English; Abstaining from alcohol use; Very heavy drinking (> 35 drinks/week)	Weekly alcohol consumption during past month; AUDIT; Alcohol-related Problems (YAACQ)	NR	No control group, continuous approach	NA	BIS and BAS level (MFT);Implicit alcohol cognitions (SC-IAT); Explicit alcohol cognitions (alcohol cravings questionnaire); VAS mood scales	Motivational Flanker Task to assess BIS and BAS; Implicit Association Test (SC-IAT). Two IATs were given pre- and post-stress paradigm one to assess alcohol implicit tension reduction and other to assess	TSST	BAS moderated the effects of BIS on implicit and explicit alcohol cognitions. BIS demonstrated a modest association with implicit negative alcohol cognition, particularly when BAS

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AUTHORS	Population				Exposures		Comparator		Design			Outcomes
	Sample (n)	Age	Gender (female %)	Exclusion Criteria	Alcohol Consumption (mean; SD)	Comorbidities	Control Group	Matching Variables	Processess Measured	Task	Stress Paradigm	Conclusions
										implicit alcohol enhancement, Tasting task (alcohol or water)		levels were low. Moreover, post-stress reward and relief expectancies showed a positive correlation with alcohol misuse.
McGrath et al., (2016)	100 participants recruited among students and staff at the University of Liverpool	mean age = 20.86 years; SD = 3.93	52	History of alcohol problems, attention deficit hyperactivity disorder, depression-or anxiety-related disorders, < 18 years old.	Weekly alcohol consumption, AUDIT, craving measures (AAAQ).	NR	Between-subject design for the stress paradigm (stress, n = 50; Control, n = 50). All 50 participants were heavy drinkers who consume more than 14 (females) or 21 (males) standard drinks per week.	same pool of participants randomly assigned to one of two stress conditions (matching variables include age, gender ratio, weekly alcohol consumption, AUDIT scores, and DMQ scores).	Stop Signal Reaction Time (SSRT), Craving, ad-lib alcohol consumption	Stop signal task and ad libitum alcohol consumption	Stress induction through anticipation of social evaluation, similar to the TSST.	Acute stress ↑ alcohol consumption in heavy drinkers, but not through impaired inhibitory control.
Moreno-Fernández et al., (2023)	70 university students; 33 Healthy Controls (21 females); 27 alcohol use (24 females); 10 Alcohol use + Cannabis (5 females)	age range: 18–25; mean age = 19.2 years; SD = 0.1	70	Diagnosis of substance use disorder; comorbid psychopathological conditions (such as, anxiety-related disorders, major depression, psychotic disorders…); AUDIT score > 19; and altered consciousness or prescription drugs affecting the CNS the day of the test; fear of heights and/or claustrophobia.	AUDIT, mean control group = 3.15 (SD = 0.33), mean alcohol use group = 10.71 (SD = 0.81)	NR (see exclusion criteria)	CON group: < 6 in the AUDIT's score, no history of drug abuse, including alcohol and nicotine	Age, sex	Self-reported anxiety provoked by the virtual reality task, STAI-state; Alcohol craving; Psychophysiological measures (electrodermal activity, heart-rate, salivary cortisol and salivary Alpha-amylase	Elevated plus-maze (EPM; virtual reality set up)	EPM	Problematic alcohol use (AU) was related with fewer entries, less time in open arms and delayed recovery in electrodermal activity and higher stress biomarker ratio, compared to controls during a virtual reality EPM.
Moreno-Fernández et al., (2024)	43 university students; 23 Healthy Controls (11 females); 20	age range: 18–25; CN mean age = 21.45	53.5	Diagnosis of substance use disorder; comorbid psychopathological	AUDIT, mean control group = 5.14 (SEM = 1.66), mean BD group = 8.64	NR	CON group: < 1 in the AUDIT's third item (BD	Age, sex	Behavioral variables during the task: percentage of time spent walking	Virtual reality Richie's Plank Experience	EPM	Binge drinkers spent significantly less time

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AUTHORS	Population				Exposures		Comparator		Design			Outcomes
	Sample (n)	Age	Gender (female %)	Exclusion Criteria	Alcohol Consumption (mean; SD)	Comorbidities	Control Group	Matching Variables	Processess Measured	Task	Stress Paradigm	Conclusions
	Binge Drinkers (12 females)	years; SEM = 0.54; BD mean age = 21.98 years; SEM = 0.54		conditions (such as, anxiety-related disorders, major depression, psychotic disorders…); AUDIT score > 19; and altered consciousness or prescription drugs affecting the CNS the day of the test; fear of heights and/or claustrophobia	(SEM = 1.61); AUDIT-3 (BD frequency) mean control group = 0; mean BD group = 1.54 (SEM = 0.21)		frequency), no history of drug abuse, including alcohol and nicotine		forward and backward, latency to walk forward, and time spent looking down on the plank edge; EEG measures before and after the task; HR and electrodermal activity before, during, and after VR task; Salivary cortisol			walking forward and more time walking backward in the virtual reality task. Significant sex-related differences were observed. BD women displayed a higher peak HR response to stress than men.
Wardell et al., (2012)	146 college students (67 female) with heavy drinking habits	mean age = 21.45 years; SD = 0.73	45,9	< 21 > 24 years of age; not liking beer; endorse less than 1 item of the Positive Alcohol expectancies scale	Calendar-based TLFB of the last 30 days; number of self-reported weekly alcoholic drinks (m=17.87; SD=12.05); number of heavy/binge drinking episodes (m=7; SD=4.27)	NR	No control group, although sex differences (female n = 67 vs male n = 79) and mood induction differences between conditions (neutral n = 43; positive n = 54; negative n = 54).	NA	Self-reported mood changes in arousal and valence (Affect grid); Past 30-days drinking habits (TLFB); *ad-libitum* alcohol consumption (volume of beer drunk and alcohol blood concentration)	Implicit positive alcohol expectancies task (ETASK) and ad libitum alcohol consumption	Mood induction procedure based on picture-slide presentation with images from the IAPS (positive, neutral, negative)	Altered mood (regardless of its valence) moderates the association between positive alcohol expectancies and immediate ad lib alcohol consumption in men.
Wemm et al., (2013)	88 female college students with different levels of alcohol consumption (social drinkers = 61, among them 49 were binge drinkers)	mean age = 20 years; SD = 4.6	100	Tobacco	Drinking days, average drinking per session, and binge drinking episodes; Young Adult Alcohol Consequences Questionnaire (YAACQ)	NR	No control group, continuous approach	NA	Self-reported and Physiological response to acute stress (cortisol and DHEA), Drinking habits, Drinking Motives, Drinking Consequences	NA	Impossible Anagram Task	Problematic drinking was associated to ↑ basal levels of cortisol and DHEA and ↓ distress tolerance during the impossible task, while the stress response to frustration during the

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AUTHORS	Population				Exposures		Comparator		Design			Outcomes
	Sample (n)	Age	Gender (female %)	Exclusion Criteria	Alcohol Consumption (mean; SD)	Comorbidities	Control Group	Matching Variables	Processess Measured	Task	Stress Paradigm	Conclusions
												task remained flat.
Willner et al., 1998	144 university students; 72 heavy drinkers and 72 light drinkers	age range: NR; mean age = 20.7 years; SD = 0.2	50	NR	Heavy drinkers defined as ≥ 28 units of alcohol (8 g) in males or ≥ 21 units in females per week (m=46.3; SD=4.3 for males, and m=28.8; SD=1.5 for females)	NR	Light drinkers (alcohol consumption below threshold for being classified as heavy drinker) (m=12.1; SD=0.8 alcohol units per week for males, and m=9.4; SD=0.6)	Age, sex, education level	2 (drinker status: heavy, light) x 2 (gender) x 2 (alcohol test: test, abstinence) x 3 (mood: depressed, neutral, elated). Self-reported mood, desires for alcohol questionnaire (DAQ),number of responses emitted/ number of sips of alcohol in the progressive ratio task.	Alcohol taste task, in the form of progressive ratio schedule (participants had to press the spacebar on a computer to get small amounts of their preferred drink)	Musical mood induction protocol to induced depressed mood (and neutral and elated conditions), n = 48 participants in the depressed condition	Depressed mood ↑ alcohol craving across most measures. Depressed mood also ↑ the number of responses in the tasting task, although effects differed by gender with abstinent women and cued men showing the strongest responses. Finally, only women reported a significantly ↓ liking of the reinforcer (alcohol sip) when assigned to the depressed mood.
Winward et al., (2014)	46 adolescents; 23 heavy episodic drinking youth (HED) and 23 demographically matched non-drinking teens (CON)	age range: 16–18; mean age HED = 17.7 years; SD = 0.2; mean age CON = 17.7 years; SD = 0.1;	50	**Criteria across groups:** history of alcohol dependence, nonalcohol-related DSM-IV Axis I or II disorder; neurological condition; serious medical illness; prenatal alcohol/ drug exposure; use of psychoactive medications; **HED group:** > 50 lifetime marijuana episodes; and > 15 lifetime drug use.	Heavy drinking episodes (defined as ≥ 5drinks in males or ≥ 4 drinks in females within a 2-hour period);	Occasional Marijuana smoking	CON group: < 5 drinking episodes, no history of heavy drinking or alcohol withdrawal symptoms, no previous marijuana or other drug use.	Family history of alcohol dependence and family history of major depression; 4 weeks abstinence period for both groups	pre- and post-test mood (measured with the PANAS); pre- and post-test Independent Visual Analogue Scales for Frustration, Irritability and Happiness; Behavioral Performance and distress tolerance in the PASAT	NA	Paced Auditory Serial Task (PASAT-C)	Adolescents who engage in heavy drinking exhibited ↑ emotional reactivity and ↓ distress tolerance when faced with a demanding task in the early stages of abstinence.

(*continued on next page*)

(*continued*)

AUTHORS	Population				Exposures		Comparator		Design			Outcomes
	Sample (n)	Age	Gender (female %)	Exclusion Criteria	Alcohol Consumption (mean; SD)	Comorbidities	Control Group	Matching Variables	Processess Measured	Task	Stress Paradigm	Conclusions
You et al., (2023)	150 college student with alcohol consumption habits. 36.7% of the sample were Binge Drinkers.	age range: 18–28; mean age = 19 years;SD = 1.3	34.7	< 18 years of age; not drinking alcohol on a regular basis.	Craving measures (PACS & ACQ-SF), Daily Drinking Questionnaire (DDQ), AUDIT (m=6.9; SD=4.5)		No control group, continuous approach	NA	Craving measures, Emotion Regulation Questionnaire (ERQ), Depression Anxiety Stress Scale (DASS).	NA	The Velten Mood Induction protocol.	Higher use of drinking to cope and less use of cognitive reappraisal predicted greater craving following negative mood induction, but not after the neutral condition.

et al., 2024), whereas Moreno-Fernandez et al. (2023) informed of higher electrodermal activity during the stressor followed by a slower recovery in alcohol users than in the control group. Holzhauer et al. (2017) found lower skin conductance reactivity in alcohol users following the stress manipulation in a women-only sample. Furthermore, both Moreno-Fernandez et al., (2023) and Wemm et al. (2013) reported higher salivary Alpha-amylase (sAA) to salivary cortisol levels (AOCg index) and higher basal levels of cortisol and DHEA, respectively. However, Hagan et al. (2019), in a longitudinal design, showed that greater BD during adolescence was associated with a significantly lower cortisol response during a social stress paradigm, but Moreno-Fernandez et al. (2024) did not find significant differences in cortisol levels between BD and control participants. Additionally, the prospective design from Gorka et al. (2023) identified greater reactivity to a threat during the NPU-Threat task as a vulnerability marker for future BD.

Lastly, a set of studies observed how drinking habits and alcohol-related problems were associated with lower distress tolerance (Geyer et al., 2023; Wemm et al., 2013; Winward et al., 2014). In this regard, Geyer et al. (2023) reported that greater alcohol consumption and alcohol-related problems, as measured by the AUDIT, were related to lower physical distress tolerance. Similarly, Wemm et al. (2013) informed that problematic drinking was linked with lower distress tolerance during the impossible anagram task. Interestingly, based on a longitudinal design, Winward et al. (2014) observed how heavy drinkers showed greater emotional reactivity (i.e., irritation, frustration) and lower distress tolerance to the stress manipulation procedure in the first assessment, followed by significant reductions of the irritability and the frustration elicited by the stress induction (PASAT-C) in the last assessment, showing how prolonged abstinence in young heavy drinkers can have a positive effect on stress reactivity.

To summarize, the reviewed studies in this category show a clear link between adolescent and young adult drinking and altered stress system responses, including both autonomic changes (e.g., lower resting HR, heightened HR and electrodermal reactivity) and dysregulated neuroendocrine markers (elevated basal cortisol/DHEA and sAA-to-cortisol ratios). Converging evidence also links excessive drinking with lower distress tolerance and greater threat reactivity, while longitudinal data suggest the robust links between high threat sensitivity and BD. However, cortisol reactivity findings are mixed, and the high number of variables reported within the limited number of studies calls for caution when interpreting these results.

3.2.3. Joint impact of alcohol and stress on neurocognition (B)

Finally, six papers (Birch et al., 2008; Bollen et al., 2023; Clay et al., 2018; Emery and Simons, 2015; Field and Powell, 2007; McGrath et al., 2016) measured the joint impact of acute stress and alcohol consumption on cognitive performance. Interestingly, only three papers focused on classical cognitive tasks such as the stop signal (McGrath et al., 2016), the Stroop and Simon tasks (Birch et al., 2008) and the Balloon Analogue Risk Task (BART; Clay et al., 2018), while the remaining ones explored implicit attentional bias through the visual probe task. In terms of cognitive control, negative affect induction did not have a significant effect on inhibition and conflict monitoring, neither with an alcohol-Stroop nor a Simon task (Birch et al., 2008). Also, McGrath et al. (2016) did not find an association between acute stress and altered inhibitory control (stop signal task), despite an increase in alcohol consumption (measured through an alcohol taste test) following the stress procedure. Next, regarding decision-making, Clay et al. (2018) found that risk-taking, measured with the BART, was positively associated with an increase in craving experienced by social drinkers after stress induction.

Beyond cognitive control and decision-making, the exploration of attentional bias was the most common paradigm. Among the studies that used the visual probe task, both Field and Powell (2007) and Bollen et al. (2023) found that excessive drinkers expressed an increased attentional bias toward alcohol-related pictures after the stress manipulation, while

Emery and Simons (2015) found no significant effects of the stress procedure on the attentional bias measures. In this regard, the absence of significant associations between acute stress and attentional bias reported by Emery and Simons (2015) could be explained by three main factors: a) the lack of additional moderators/mediators to explain the link between alcohol, stress and attentional bias; b) the lack of a well-defined alcohol consumption pattern among drinkers, together with lower drinking levels than those reported in the other two studies; and c) contrary to the other two studies that used the visual probe task, the one from Emery and Simons (2015) relied on the passive viewing of standardized images as the procedure to induce a negative affect among participants. Despite the relative convergence of results, Field and Powell (2007) and Bollen et al. (2023) proposed slightly different mechanisms to explain the relationship between stress and attentional bias. For instance, Field and Powell (2007) showed that the increased attentional bias emerged only among heavy drinkers with strong coping motives, suggesting that drinking motives may moderate the relationship between stress and attentional performance. More recently, Bollen et al. (2023) showed how stress induced increased attentional bias was mediated (indirect effect) by the increase in craving levels among BDs following mood induction. Interestingly, BDs showed higher negative mood before and after the mood induction, as well as higher craving, suggesting that specific alcohol consumption patterns can have effects on baseline levels of negative mood and craving that may explain the differences related to attentional bias observed in this population.

Neuroscience approaches have also been used in three studies to explore the joint impact of acute stress and alcohol on different behavioral tasks. First, Gorka et al. (2023) showed how hyper-activation of salience network areas (i.e., anterior insula and dorsal anterior cingulate cortex) to uncertain threats (U-threat task) was linked to an increased probability of BD one year later. Next, Moreno-Fernandez et al. (2024) did not find any significant differences between the BDs and control groups in EEG measures that could explain the anxiety-elicited differences observed across participants (see Section **3.2.2 A2**). Finally, Bollen et al. (2023) used eye-tracking measures as a behavioral index of attentional bias to increase the reliability of the visual dot-probe task. More specifically, dwell time – the sum of fixation times on one specific stimulus during the whole trial – provided a reliable measure of the attentional bias toward alcohol stimuli. This attentional bias score was positively associated with craving scores that were predicted by negative mood increases following the stress manipulation procedure in BDs compared with light/moderate drinkers.

In summary, the study of the joint impact of stress and alcohol on neurocognitive function points towards a greater alcohol-related attentional bias and riskier decision-making under stress, among excessive drinkers. This is particularly observed among those with stronger coping motives and larger stress induced increases in craving, while conflict monitoring and inhibitory control, together with some EEG indices, often remain unchanged. Additionally, converging behavioral and neuroimaging evidence suggests that stress-related hyper-responsivity may represent a vulnerability marker for binge drinking, with individual differences in baseline negative mood and craving shaping the magnitude of these cognitive biases.

3.2.4. Gender-specific effects on the relationship between acute stress and alcohol

Nine studies included either gender as a covariate or gender-specific analyses (Bacon et al., 2015; Emery and Simons, 2015; Evans et al., 2012; Glenn and Lau-Barraco, 2025; Gorka et al., 2023; Hagan et al., 2019; Moreno-Fernández et al., 2024; Wardell et al., 2012; Willner et al., 1998) to explore potential differential effects.

These studies included all three categories of the mutual influences between stress and alcohol (A1, A2) and their combined effects on neurocognition (B). First, in terms of the influence of stress on alcohol-related factors, Willner et al. (1998) reported gender-specific patterns in alcohol consumption following an acute stressor. Among men, increased consumption emerged only in those exposed to an alcohol-cue condition before the stress manipulation. In contrast, women showed increased craving and consumption when they were assigned to an abstinent condition previous to the stress manipulation. Also, for the participants assigned to the stress condition, only women reported a significant reduction in liking of the alcohol sip (alcohol taste task), despite exhibiting increased consumption. This pattern points towards a potential gender-specific dissociation in how stress influences motivational components of alcohol use, such as the wanting and the liking of alcohol. A second study examining the impact of stress on alcohol expectancies and subsequent alcohol consumption (Wardell et al., 2012) found that positive alcohol expectancies were a significant predictor of volume of beer consumption and blood alcohol concentration for males in the negative mood condition but not for women. Similarly, Bacon et al. (2015) reported that women assigned to the stress condition (i.e., social exclusion) consumed significantly less beer than both socially included women and excluded men.

Regarding papers that explored the impact of alcohol on stress reactivity (A2), two of them reported gender-specific effects. Evans et al. (2012) found that women exhibited higher heart rate changes when transitioning from rest to stress periods during the experimental task. This was interpreted as a greater response to the psychosocial stress procedure in women compared to men. Consistent with this finding, Moreno-Fernández et al. (2024) reported that women displayed a higher peak for the heart rate response to the stressor, and that heart rate changes were greater in binge drinking women than men. Additionally, Holzhauer et al. (2017) only included women and found that lower skin conductance reactivity following the stress manipulation was associated with greater alcohol-related problems.

Additionally, a study examining the joint effect of stress and excessive drinking (B) on alcohol-related attentional bias (Emery and Simons, 2015) found only in men a positive association between attentional bias and alcohol consumption measured via the Modified Daily Drinking Questionnaire (MDDQ; (Dimeff, 1999), despite the general lack of a significant interaction between negative mood and alcohol expectancies (see Section 3.2.1 A1). Finally, several studies did not find any significant effect of gender-covariates on their results (Hagan et al., 2019; Glenn and Lau-Barraco, 2025; Gorka et al., 2023).

3.2.5. Experimentally induced stress paradigms

This final section of the results aims at underlining the substantial heterogeneity in the stress manipulation procedures employed, with up to 12 distinct paradigms use in the 24 studies (Fig. 3). In fact, only two paradigms (i.e., Trier Social Stress and mood induction) were used in four or more papers (Table 1), which could hinder the convergence of results across studies. To reduce heterogeneity and try to better understand some of the described divergent results, we decided to explore the effects of distinct stress manipulation by grouping the different procedures into six categories: a) social evaluative stress (i.e., TSST/public speaking); b) social exclusion; c) mood induction procedures (musical and/or memory recall); d) cognitive/physical distress (e.g., PASAT-C, breath holding task); e) aversive stimuli (i.e., noise or threat of shock); and f) virtual reality settings. This classification revealed that social (anticipatory) evaluative stress was the most common paradigm category (n = 8; Bernstein and Wood, 2017; Clay et al., 2018; Evans et al., 2012; Field and Powell, 2007; Glenn and Lau-Barraco, 2025; Hagan et al., 2019; Keough et al., 2016; McGrath et al., 2016), followed by negative mood induction procedures based either on passive exposure to music or images, or on active recall of mood-congruent memories (n = 7; Birch et al., 2008; Bollen et al., 2023; Emery and Simons, 2015; Grant and Stewart, 2007; Wardell et al., 2012; Willner et al., 1998; You et al., 2023). Cognitive/physical distress tolerance, including the elevated maze paradigm in a virtual reality setting, was assessed in six studies (Geyer et al., 2023; Holzhauer et al., 2017; Moreno-Fernández et al., 2023, 2024; Wemm et al., 2013; Winward et al., 2014). Finally, only two studies used aversive stimuli as a reliable stress induction

paradigm (Gorka et al., 2023; Herchenroeder et al., 2023), while only one used social exclusion (Bacon et al., 2015). Also, among the different stress manipulations, only two studies implemented online methods (Geyer et al., 2023; Glenn and Lau-Barraco, 2025) while the remaining ones opted for laboratory set-ups. Although sample size and scalability of these procedures can be challenging, it is also uncertain how reliable online methods are, especially those based on distress tolerance, if there is not a strict control of participants' involvement in the task, which can be difficult to ensure in online settings.

Then, based on our classification of studies on the relationship between stress and alcohol (A1 and A2) and their joint impact on neurocognition (B), we grouped the most relevant stress paradigms for each category (see Fig. 2). Although the reduced number of studies per category limits our capacity to infer links between the experimental paradigm and the direction of the results, some stress manipulation procedures seem to elicit more convergent results than others (Fig. 3).

4. Discussion

In this review, we provided the first quantitative and qualitative synthesis of the current research on the mutual influences of acute stress and alcohol consumption in adolescent and young excessive drinkers, as well as the joint impact that stress and alcohol consumption have on neurocognitive processes. First, among the 24 reviewed studies, the most consistent evidence is the positive relationship between exposure to an acute stressor and the increase in craving, particularly among persons who engage in BD and/or score high in stress sensitivity. This association is further supported by findings showing that acute stress can enhance positive alcohol-related cognitions, such as expectancies, motives, and implicit evaluations. Additionally, stress reactivity differences, including heightened autonomic responses and altered neuroendocrine markers, are consistently observed both as a predictor of or as a result of excessive drinking, suggesting a reciprocal relationship between SR dysregulation and risky drinking behavior. We thus provide sound support to the proposal that adolescence is characterized by a specific vulnerability to acute stress (Casey et al., 2010; Romeo and Mcewen, 2006; Sisk and Gee, 2022), that can promote factors favoring excessive consumption (craving, motives, expectancies, negative mood; Blaine et al., 2016; Koob and Volkow, 2016; Zaiser et al., 2025) and hence increase alcohol consumption per se. However, findings were quite mixed regarding the direct link between acute stress and alcohol consumption, with some studies showing increased drinking following stress, particularly in men or in interaction with alcohol-related cues, while others reported unchanged or even reduced consumption, especially among women. These seemingly contradictory outcomes likely depend on task parameters (e.g., timing of consumption relative to the stressor), type of stress induction (social-evaluative vs. mood-based vs. physiological), and gender, with some studies reporting sex-specific patterns in both stress responses and drinking outcomes. Taken together, the findings suggest that acute stress may contribute to adolescent alcohol vulnerability primarily through motivational, affective, and cognitive mechanisms rather than through a uniform direct effect on alcohol consumption itself.

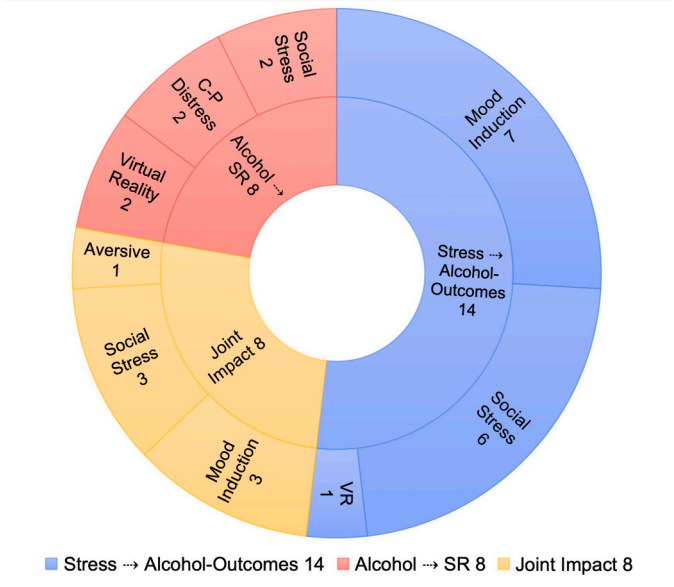


Fig. 2. Category of studies per stress paradigm used. The figure includes the three most prevalent stress paradigms for each category; the numbers indicate the sum of studies for each category. C-P Distress: Cognitive or Physical distress tasks; SR: Stress reactivity; VR: Virtual reality settings.

A second key insight from the present review is the fact that the available results confirm in adolescent and young populations the link, already observed in adults (Chen et al., 2020) between excessive drinking and altered stress system responses, including autonomic changes and dysregulated neuroendocrine markers. Although results regarding modifications in cortisol reactivity among heavy drinkers remain mixed, consistent with what is described in adult populations (e.g. Weckesser et al., 2025). These results point to the installation of a potential vicious circle through feedback loops that further promote alcohol consumption (Goldfarb and Sinha, 2018; Ruttle et al., 2015; Sinha, 2012).

The influence of excessive alcohol consumption on altered acute stress response is also supported by studies showing that excessive drinking patterns in adolescence and emerging adulthood promote increased reactivity to stressful/threat events, together with a reduced ability to cope with the distress generated by these events, hence increasing the deleterious psychological impact of acute stress. Third and finally, regarding the joint impact of acute stress and excessive alcohol consumption on neurocognitive functioning, the studies included in the present review centrally explored two main categories of processes frequently measured in AUD, namely the over-reactivity of the reward system (as indexed by attentional biases towards alcohol) and the reduced efficiency of the control/inhibitory system (as measured through classical neuropsychological tasks). The available results clearly show that the joint influence of stress and alcohol promotes increased attentional biases (notably through craving increase), known as a strong predictor of excessive alcohol consumption through the over-activation of the reward system. A notable pattern across studies is the stronger consistency of stress effects on craving than on actual alcohol intake. This dissociation may indicate that acute stress preferentially amplifies motivational salience and subjective urge to drink, whereas whether this urge translates into consumption depends on contextual, task-related, and individual factors. Such a distinction is theoretically important because it suggests that stress may act more reliably on proximal mechanisms of vulnerability like craving than on immediate drinking behavior in laboratory settings. Conversely, the impact on the control system is less clear. Although combined acute stress and uncontrolled decision-making are associated with an increase in alcohol craving (Clay et al., 2018), consistent impairments in cognitive control and inhibitory abilities have not been established in young risky drinkers. In the same line, the few studies exploring the modifications of brain functioning (mainly through electrophysiology) among adolescents and young adults combining acute stress and excessive drinking did not identify massive alterations. However, these conclusions must be interpreted with caution due to the reduced number of studies published in this domain. For instance, only three studies (n = 3) were identified that directly examined the joint effects of acute stress and alcohol use on classical cognitive processes (i.e., inhibitory control and decision-making), and just other three used any form of neuroimaging or physiological measure to assess brain function during cognitive tasks. This limited evidence base substantially constrains the strength of the

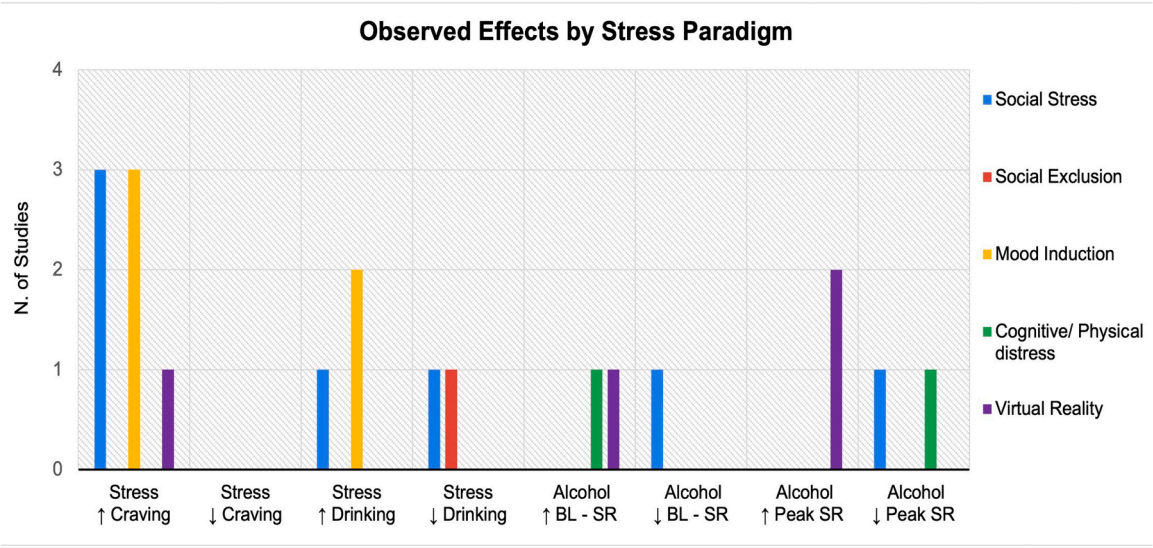


Fig. 3. Relationship between stress and alcohol-related outcomes depending on the stress manipulation procedure. The figure summarizes the number of studies per stress paradigm and its relationship with different dimensions of alcohol and stress. BL: Baseline; SR: Stress reactivity.

review's conclusions and highlights a clear need for future research specifically designed to test these combined effects. This gap is particularly striking given that, when studied separately in adolescents and young adults, both acute stress (e.g., Galván and Rahdar, 2013; Shields et al., 2017; Uy and Galván, 2017) and risky alcohol use (Carbia et al., 2018; Cservenka and Brumback, 2017; Spear, 2018) have been shown to exert significant impacts on neurocognitive performance.

As a whole, the reviewed evidence supports (1) a reciprocal influence between acute stress and excessive alcohol consumption in adolescence and emerging adulthood: acute stress enhances alcohol-related cognition and motivation, while alcohol conversely modulates the reactivity of the stress system, thus supporting the idea of a strong overlap between stress and AUD at the behavioral and cerebral levels (e.g., (Herman, 2012; Schwarze et al., 2024; Sinha, 2022, 2008); (2) a combined influence of acute stress and excessive alcohol consumption on cognitive and cerebral functioning, here again reinforcing studies in AUD that notably documented their joint impact on the neurobiological pathways involved in emotion and reward (Blandino et al., 2025; Grodin et al., 2024).

Despite these insights, key shortcomings related to the available literature limit the extension of this research field. A first limitation is the heterogeneity of samples and, in some cases, the limited control over alcohol consumption habits themselves. In this regard, some of the reviewed papers recruited social drinkers and conducted subgroup analyses only later on participants with higher levels of use. In this regard, there is a clear imbalance between the number of studies that explored the effects of binge and heavy drinking on neurocognitive function and brain structure and the far fewer studies that explored how these specific drinking patterns interact with acute stress. A second obvious limitation is the lack of longitudinal studies, hampering to precisely map the evolution of the stress-alcohol interactions throughout adolescence and early adulthood, as well as identifying the key factors moderating their influence on behavioral and brain processes. Despite the valuable evidence from prospective designs (e.g., Gorka et al., 2023), future studies should thus use longitudinal approaches to identify the causal relations postulated between acute stress and excessive alcohol use (e.g., Elsayed et al., 2018; Evans et al., 2016), and notably to model how these relations shape the vulnerability towards chronic stress and substance use disorders in later adulthood through neurobiological alterations (Sicher et al., 2022). Particularly, in view of the current scarcity of studies using neuroscience techniques in adolescence, there is an urgent need to determine the neurobiological correlates of the stress-alcohol synergetic effects. Third, most studies included did not propose a mechanistic exploration as they focused on the description of the correlational links between stress and alcohol use. Indeed, beyond linking these variables, future work should generate a model of their interactions, notably identifying how acute stress and alcohol shape craving and attentional biases increases, and how this over-reactivity of the reward system in stressful condition, combined with an impact on the control system, generates dysregulated alcohol consumption in the long run. It would, for example, be of particular interest to integrate stress-related variables in the dual-process perspective (proposing that excessive alcohol consumption is generated by the combination of an over-activation of the reward system and an under-activation of the control frontal system), renewing these theoretical frameworks. In the same line, while stress is already an important part of some dominant models (e.g., Koob and Volkow, 2016) a perspective for upcoming research would be to explore how stress can enrich existing models, for example by exploring, in adolescent populations, its differential links with liking/wanting processes related to the incentive sensitization theory (Robinson and Berridge, 1993, 2025). For instance, Willner et al. (1998) notably suggested that stress could reduce liking but promote wanting towards alcohol, particularly among women, but these results have not yet been deepened and integrated into theoretical frameworks.

A fourth shortcoming is the very limited exploration of the influence of moderating factors on the stress/alcohol relation. Variables like gender, drinking motives, baseline mood or personality have only been scarcely measured, and their specific influence should be further determined. Furthermore, differences between specific paradigms to elicit acute stress may partly account for inconsistent findings on the stress alcohol relationship. Distinct procedures appear to engage different psychological and physiological processes: for example, social exclusion tasks such as the Cyberball paradigm have sometimes reduced alcohol desirability (especially among women), whereas socially evaluative stressors like the TSST have been associated with increased craving and greater ad libitum consumption (see 3.2.5 section). These contrasts suggest that the type, intensity, and social meaning of the stressor appear to shape alcohol-related responses. This relates to a more global heterogeneity across the studies reviewed: as mentioned in the results section, a high variability has been observed, limiting the inter-study comparability and the possibility to integrate all results in a coherent perspective. The diversity of stress paradigms likely engages partially distinct neurobiological systems (e.g., social-evaluative threat, negative affect induction, cognitive stress), which may contribute to

variability in alcohol-related outcomes across studies. This should hence encourage future studies to standardize their approach, in terms of stress induction paradigms: the TSST appears as the more specific and reliable protocol to induce acute stress, while the mood induction studies included here appear as producing less specific/intense acute stress. In view of the quite limited ecological validity of the available tools, the development of closer to real-life or ambulatory stress induction paradigms is also a promising avenue (e.g., Everaerd et al., 2020; Vikoler et al., 2025). Such standardization should also encompass the inclusion criteria (e.g., uniformizing the definition/measure of BD consumption patterns, e.g., Maurage et al., 2020a) and the measurement tools for the key variables (e.g., craving, Miele et al., 2023). Finally, it is worth noting that although the exclusive focus on experimentally induced acute stress allows for greater experimental control and clearer interpretation of the findings, it may also provide an incomplete representation of the complex relationship between stress and alcohol use. In this regard, both early-life stress and chronic stress are strongly associated with alcohol misuse and altered stress mechanisms. For instance, early-life stress has been consistently associated with a greater risk of later AUD (Lichtenstein et al., 2025) and with blunted cortisol responses to acute challenges (Bunea et al., 2017; Lichtenstein et al., 2025). Interestingly, similar patterns of blunted physiological stress responses have been observed in patients with a history of chronic alcohol consumption (Chen et al., 2020; Sinha, 2012) and in binge drinkers (Blaine et al., 2019), suggesting partially overlapping neurobiological mechanisms. Likewise, chronic stress exposure is usually linked to persistent dysregulation of the HPA axis, increased allostatic load and heightened vulnerability to alcohol misuse (Clay et al., 2023; Koob and Schulkin, 2019; Sinha, 2022), potentially through sustained emotional dysregulation that could lead to maladaptive coping strategies. As highlighted by Pucci and colleagues (2019), drinking following an acute stressor may be primarily driven by the immediate reduction of anxiety or negative affect, whereas drinking associated with chronic stress may be more strongly linked to long-term emotional dysregulation, depressive symptomatology and enduring neurobiological adaptations in stress and reward-related brain systems. Thus, the present findings should be interpreted in conjunction with previous reviews on early-life and chronic stress (e.g. Bunea et al., 2017; Lichtenstein et al., 2025; Pucci et al., 2019).

In sum, the evidence reviewed here points to a dynamic (and potentially reciprocal) link between acute stress and excessive alcohol use during adolescence and emerging adulthood, a developmental period characterized by heightened neurobiological vulnerability to long-term imbalances, with increased emotional reactivity and still-maturing regulatory control. The most reliable finding is that acute stress amplifies craving, appears to sensitize alcohol-related cognitions, and shows more heterogeneous effects on ad-libitum alcohol consumption. These effects are particularly strong in excessive drinkers and youth who drink to cope, while repeated alcohol consumption is linked to anomalies in the stress system, potentially creating a self-reinforcing cycle of vulnerability. When considered, its combined effect on cognitive processes, stress and alcohol appears to overactivate reward processes and bias decision-making toward risk, even if consistent impairments in cognitive control were not found.

Yet the field is still limited by a small number of integrative and longitudinal studies. Future research must clarify causal pathways, standardize methods, and develop mechanistic models that explain how stress driven reward sensitization interacts with emerging control systems. From a prevention standpoint, these findings argue for a shift in focus: identifying stress reactive adolescents early and targeting coping motives and distress tolerance may be more effective than interventions centered on reducing alcohol consumption, as acute stress may contribute to adolescent alcohol vulnerability primarily through motivational, affective, and cognitive mechanisms.

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Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at doi:10.1016/j.neubiorev.2026.106763.

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