Chapter 36

Heavy Episodic Drinking or Binge Drinking: A Booming Consumption Pattern

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Abbreviations

AUD Alcohol use disorder
AUDIT Alcohol Use Disorders Identification Test
BAC Blood alcohol concentration
BD Binge drinking
BDNF Brain-derived neurotrophic factor
BMI Brief motivational intervention
CNS Central nervous system
ERP Event-related potentials
ESPAD European School Survey Project on Alcohol and Other Drugs
fMRI Functional magnetic resonance imaging
NIAAA National Institute on Alcohol Abuse and Alcoholism
PFC Prefrontal cortex
PM Prospective memory

INTRODUCTION

In recent decades, a new pattern of intermittent alcohol consumption has emerged involving binge intake, which happens in sessions lasting just a few hours, usually during weekend evenings and carried on by groups of peers. This pattern, known as heavy episodic drinking or binge drinking (BD), is found especially among adolescents and young adults in Western cultures.

BD involves the consumption of alcoholic beverages with the primary intention of reaching a marked intoxication, with low perception of risk and a tendency to equal intake in men and women (Parada et al., 2011a). Intoxication is characterized by a blood alcohol concentration (BAC) of at least 0.08 g/l. The practice of BD is increasing and expanding worldwide, and it has been recently labeled as a new culture of intoxication.

Epidemiological research has provided very variable data on the prevalence of BD according to the country and the sample studied. In the United States, where it has been most researched, BD is responsible for more than half of the deaths due to excessive alcohol intake, and it is the most prevalent alcohol use disorder (AUD). The data show that more than half of 12- to 17-year-olds consume alcohol with a BD pattern. Approximately 90% of the ethanol consumed under age 21 is as BD, and 70% of BD episodes involve adults aged 26 and older (Thiele, 2012).

A study conducted among 15- to 16-year-old adolescents in 35 European countries, the European School Survey Project on Alcohol and Other Drugs (ESPAD), showed that BD is found not only in Scandinavian countries, England, and Ireland—which are typically characterized as having BD problems (Pedersen & von Soest, 2013)—but in Mediterranean countries as well. The BD phenomenon has extended and appears to be on the rise in Mediterranean countries (Portugal, France, Italy, Spain), which had been traditionally characterized by a pattern of higher per capita consumption, most of which derived from daily consumption of wine during meals. On average, 43% of the ESPAD students reported heavy episodic drinking during the previous 30 days (Hibell et al., 2009).

In this chapter, we revise the concept of BD, which is still ambiguous nowadays, together with the risk and/or protection factors associated with the rise and maintenance of this pattern of alcohol intake. We highlight some consequences on health and its impact on neuropsychological functioning, in addition to possible early markers or endophenotypes for future use.

DEFINITION OF BINGE DRINKING

The Monitoring Future Study, carried on in the 1970s, proposed considering the pattern of BD as the consumption of five or more alcoholic drinks in one event, whether in men or women (Bachman, Johnston, & O’Malley, 1981). This has been and still is the criterion used in many studies on this topic.

The Harvard School of Public Health’s College Alcohol Study, in the 1990s, proposed using different criteria according to sex. The concept of BD was established as the consumption of ≥5 alcoholic drinks for men and ≥4 drinks for women, in one single event and at least once in the previous 2 weeks (Wechsler, Davenport, Dowdall, Moeykens, & Castillo, 1994). This change of threshold...
in women was justified because women generally have a smaller stature and physiologic differences in the absorption and distribution of alcohol. In 2004, the National Institute on Alcohol Abuse and Alcoholism (NIAAA) Advisor Council endorsed the sex consideration in the definition of BD. The consumption of ≥5 drinks for men and ≥4 drinks for women in approximately 2 h produces a BAC of 0.08 g/dl or greater, taking into account that in the USA a standard drink has 14 g of alcohol. The new gender-specific definition increased the prevalence of women with BD pattern, due to the change in the criteria and not to actual changes in drinking behavior (Chavez, Nelson, Naimi, & Brewer, 2011).

There are significant differences in the amount of pure ethanol grams in a standard drink in different countries of the world, as published by the International Center for Alcohol Policies (2010). As Table 1 shows, the NIAAA criteria may be valid in Portugal, whereas in England the pattern of BD must be defined as the intake of ≥8 drinks for men and ≥6 drinks for women. In the countries where a standard drink contains 10 g of ethanol, the cutoff may be set to ≥6 drinks for men and ≥5 drinks for women (Parada et al., 2011a).

However, because teenagers may drink much larger amounts than those considered in the general definition, it has been proposed to consider several degrees of BD. Thus, the concept of extreme BD has emerged, with two subcategories: ≥10 drinks and ≥15 drinks (Patrick et al., 2013). In the USA, from the total percentage of high school seniors with BD, 10.5% were assigned to the first extreme category (≥10 drinks) and 5.6% to the second (≥15 drinks).

Regarding the timeframe to determine the presence of BD, there is also little agreement. Most of the studies set the frequency unit as 2 weeks, while others set it as 1 week and still others use time frames of 1–3 months or even 1 year. The timeframe of 1 or 2 weeks may be underestimating the prevalence of BD, while a long interval may overestimate it. The preferred and recommended criterion seems to be the occurrence of one episode of BD every 2–4 weeks.

The Alcohol Use Disorders Identification Test (AUDIT; Saunders, Aasland, Amundsen, & Grant, 1993) is the self-administered instrument most frequently used to detect a pattern of BD. Using its third question (How frequently do you drink six or more alcoholic beverages in one single event?), a cutoff line can be established different from that proposed by the NIAAA. However, no distinction between sexes is made, nor does it allow quantification of extreme intakes.

Another element to be taken into account is the BD trajectory in teenagers, from these possible four: accelerating (early onset and increased frequency), steep increase (delayed onset and rapid escalation), slow growth (delayed onset and gradual increase), and stable low (abstinence). High levels of alcohol intake and more physical health problems characterize the accelerating trajectory (Modecki, Barber, & Eccles, 2014).

### TABLE 1 Grams of Pure Ethanol in a Standard Drink According to Country

<table>
<thead>
<tr>
<th>Country</th>
<th>Ethanol (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>England</td>
<td>8</td>
</tr>
<tr>
<td>Australia, Austria, France, Hungary,</td>
<td>10</td>
</tr>
<tr>
<td>Ireland, Netherlands, New Zealand,</td>
<td>11</td>
</tr>
<tr>
<td>Poland, Spain</td>
<td>13.6</td>
</tr>
<tr>
<td>Finland</td>
<td>12</td>
</tr>
<tr>
<td>Denmark, Italy, South Africa</td>
<td>14</td>
</tr>
<tr>
<td>Canada</td>
<td>19.75</td>
</tr>
<tr>
<td>Portugal (unofficial), United States</td>
<td>13</td>
</tr>
</tbody>
</table>

The definition of binge drinking based on standard drinks consumed is troublesome, because there is no international agreement on how many grams of pure ethanol there should be in a standard drink. Measures of standard units currently used in research can range from 8 g (England) to 19.75 g (Japan) of ethanol, making comparisons across studies difficult. Data were revised from the International Center for Alcohol Policies (2010), based on official government definitions.

### CONSEQUENCES ON HEALTH AND POSSIBLE EARLY MARKERS

BD in the United States, Europe, and most developed countries is regarded as a major health and social concern that is associated with significant social and personal costs. BD elevates mortality risk (Plunk, Syed-Mohammed, Cavazos-Rehg, Bierut, & Grucza, 2014) and is related to physical injury, motor vehicle accidents, sexually transmitted diseases, unintended pregnancy, and medical complications, as pointed out by the NIAAA (2000). Table 2 summarizes the main effects on health that BD may cause.

The number of drinks and the BAC are good predictors of negative alcohol-related consequences (blackouts, physical fights, and getting physically sick) in first-year college students (Barnet et al., 2014). The BD adolescents show more risky sexual behavior (with the exception of non-condom use) and violent behavior (Stickley, Koyanagi, Koposov, Razvodovsky, & Ruchkin, 2013; Townsend, Kamouropoulos, Griffin, Hunt, & Milani, 2014; Xing, Ji, & Zhang, 2006), with there being a strong association with the number of BD days.

In healthy young binge drinkers, alterations have been found in macro- and microcirculation; these may represent early clinical manifestations of cardiovascular risk that should be considered in preventive actions (Goslawski et al., 2013). A study on rats shows that BD directly causes insulin resistance, which is a major risk factor to develop metabolic syndrome and type 2 diabetes (Lindner et al., 2013). Alcohol appears to disrupt insulin-receptor signaling by causing inflammation in the hypothalamus, a nucleus of the central nervous system (CNS), which also participates in coronary artery disease and stroke.

Many studies have shown a link between psychological distress, such as anxiety and depression, and alcohol abuse (Balogun, Koyanagi, Stickley, Gilmour, & Shibuya, 2014; Cheng & Furnham, 2013; Wellman, Contreras, Dugas, O’Loughlin, & O’Loughlin, 2014). Alcohol BD is more severe among individuals with mental health problems and excessive alcohol consumption, which can in turn increase psychological distress. Suicide ideation and attempted suicide are also more prevalent in BD adolescents (Xing et al., 2006). Young BD adults had several sleep problems (trouble falling sleep, trouble staying asleep, and snoring/sleep apnea), independent of
psychiatric conditions, in a dose–response relationship (Popovici & French, 2013). While insomnia seems to be significantly associated in both sexes, the snoring/sleep apnea is related to BD only in males.

Ethanol also increases neuroinflammation in the CNS, and research has also observed persistent neuroimmune activation in BD, which could contribute to neurocognitive dysfunction in the prefrontal cortex (PFC) (Vetreno & Crews, 2012), as well as in myelination and white matter integrity (Jacobus, Squeglia, Bava, & Tapert, 2013). Brain-derived neurotrophic factor (BDNF) is a molecule identified as a major regulator of structural changes and inflammation processes in the brain related to alcohol use. The chronic BD pattern produces a decrease of BDNF, which correlates with lower survival and neuronal differentiation of cells in the hippocampus and the development of a depressive phenotype during the withdrawal period (Briones & Woods, 2013).

Moreover, a critical role of the corticotropin-releasing factor type 1 receptor in excessive ethanol intake has been observed related to stress response, in both models of BD and alcohol dependence (Kaur, Li, Stenzel-Poore, & Ryabynin, 2012). There is also evidence that BD upregulates the group 1 metabotropic glutamate receptor signaling throughout the amygdala (Cozzoli et al., 2014).

### TABLE 2 Main Negative Consequences on Health and Neuropsychological Performance of Binge Drinking

<table>
<thead>
<tr>
<th>Acute negative consequences</th>
<th>Death by ethyl intoxication</th>
<th>Physical injury</th>
<th>Motor vehicle accidents</th>
<th>Physical fights</th>
<th>Unplanned sex</th>
<th>Unintended pregnancy</th>
<th>Violent behavior</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiovascular and metabolic diseases</td>
<td>Coronary artery disease</td>
<td>Stroke</td>
<td>Insulin resistance</td>
<td>Metabolic syndrome</td>
<td>Type 2 diabetes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Psychological distress and mental disorders</td>
<td>Anxiety</td>
<td>Depression</td>
<td>Alcohol dependence</td>
<td>Suicide (ideation and attempts)</td>
<td>Insomnia (trouble falling sleep and staying asleep)</td>
<td>Snoring/sleep apnea (only men)</td>
<td></td>
</tr>
<tr>
<td>Neurological diseases</td>
<td>Neuroinflammation</td>
<td>Persistent neuroimmune activation</td>
<td>Dysfunctions in myelination</td>
<td>Alterations in the white matter integrity</td>
<td>Maladaptive response to stress</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neuropsychological deficits</td>
<td>Sustained attention</td>
<td>Memory (declarative, semantic, prospective and working)</td>
<td>Associative learning</td>
<td>Inhibitory control</td>
<td>Decision making</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The consequences are those evidenced by the research on adolescents, young adult, and adult participants with a consumption pattern of binge drinking.

Both mechanisms may be keys in the neurobiological mechanisms that underlie the transition from BD to ethanol dependence.

### RISK AND PROTECTION FACTORS ASSOCIATED WITH BD

Drawing an explicative model of BD behavior is a highly complex task because there is a wide variety of interrelated factors in different domains, which in turn depend on the country, the sample, and the factors to be studied. Tables 3 and 4 show the main risk and protection factors associated with BD, respectively.

Most works have found a higher prevalence of BD and more drink intake in one single episode in males (Chavez et al., 2011; Hibell et al., 2009; Pedersen & von Soest, 2013). Moreover, there are differences between men and women in BD relating to their expectations towards drinking and to positive alcohol metacognitions. Women’s expectations are related to improving their sociability and sexual ability, while men’s are geared to reducing stress (Balodis, Potenza, & Olmstead, 2009). The positive alcohol metacognitions about cognitive self-regulation are a significant predictor of weekly levels of alcohol use in BD males (Clark et al., 2012). It is highly relevant to take into account the specific features associated with sex in the study of BD and the design of possible interventions.

Regarding age, the range and cutoff points used in different studies condition the data available. However alcohol intake

### TABLE 3 Risk Factors Associated to Binge Drinking (BD) Behavior in Adolescents and Young People

<table>
<thead>
<tr>
<th>Individual characteristics</th>
<th>Sex (men)</th>
<th>Adolescents and young</th>
<th>Early pubertal timing</th>
<th>Evening-type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social and educational</td>
<td>Easy alcohol access</td>
<td>Cheap alcohol</td>
<td>Low socioeconomic status</td>
<td>Adverse socioeconomic conditions</td>
</tr>
<tr>
<td>Family, parents, and peers</td>
<td>Parental alcohol consumption</td>
<td>Parental BD</td>
<td>Friends alcohol use</td>
<td></td>
</tr>
<tr>
<td>Other drug consumption</td>
<td>Smoking</td>
<td>Marijuana use</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Activities, beliefs, cognitions</td>
<td>Unaware of the risk of BD</td>
<td>Unauthorized absence from the school (truancy)</td>
<td>Sport involvement</td>
<td>Use of products to enhance physique muscular</td>
</tr>
<tr>
<td>Personality traits</td>
<td>High impulsivity</td>
<td>High novelty seeking</td>
<td>High extraversion</td>
<td>Low agreeableness</td>
</tr>
</tbody>
</table>

The factors are those obtained in the studies revised, related to the practice of binge drinking and/or which are predictors of sustained BD behavior.
with BD behavior is a huge concern in all countries where there are statistics on the topic. In the United States and England, the prevalence among college students ranges from 43% to 58.5% in men and 32% to 54% in women (Howell et al., 2013). In Spain, a survey on this type of alcohol intake among teenagers and young adults (Spanish Observatory on Drugs, 2013) reported an increase of BD, which taking into account the previous 30 days was 35% in men and 20% in women aged 20–24.

The study of predictors of sustained BD in young adults shows similar determinants, being higher in males with no college/university studies (Pedersen & von Soest, 2013; Wellman et al., 2014). BD is related to parents and peers who also drink alcohol (Weitzman, Nelson, & Wechsler, 2003; Pedersen & von Soest, 2013; Strickly et al., 2013). Higher parental education is a protective factor for extreme BD, but it is a risk factor when considering BD for ≥5 drinks (Patrick et al., 2013).

College students more exposed to “wet” environments—defined as social, residential, and market surroundings where drinking is prevalent and alcohol is cheap and easily accessed—are more likely to engage in BD (Strickly et al., 2013; Weitzman et al., 2003). Moreover, girls and boys who practice BD are more prone to engage in all forms of substance use, with frequent poly-consumption. Tobacco and marijuana consumption are the most frequent (Stickley et al., 2013) and are predictors of the intensity of BD (Patrick et al., 2013). BD is a risk factor in the development of alcohol dependence (Balodis et al., 2009; White et al., 2011). Moreover, binge drinkers tend to be unaware of the risks of BD (Strickley et al., 2013).

It is very important to perform longitudinal studies to assess the correlates of adult BD. In this sense, we want to highlight a study by Cheng and Furnham (2013), who investigated the association of several variables as predictors of BD in 50-year-old adults from England. The results showed that individuals who come from lower parental social class with adverse socioeconomic conditions tend to develop more alcohol abuse behavior; in addition, childhood intelligence, educational achievement, and occupational levels were negatively associated with hazardous adult BD. Another variable related to BD in adolescents is school attachment, with truancy (unauthorized absence from the school) being a risk factor (Stickley et al., 2013). Frequent BD precedes long-term unemployment, but only in women; this result has little support for the social causation hypothesis because it appears after controlling for many potential confounder factors (Backhans, Lundin, & Hemmingsson, 2012). Social exclusion is also another consequence related to BD in the long term (Viner & Taylor, 2007).

A longitudinal study by Pedersen and von Soest (2013) in Norway found that the frequency of alcohol consumption and BD in parents predicted BD in their offspring at age 28, independently of sex. This study also observed that parental monitoring (control and supervision) and support with alcohol measures is of particular importance as a protective factor in adolescence.

In adolescents with accelerating BD trajectory, there is an early pubertal timing, low socioeconomic status, and more sport involvement compared to those classified as “stable low” (Modecki et al., 2014). However, participation in organized school or nonschool activities for early maturers protects against development of a “steep increase” trajectory. In addition, there is a higher probability for starting BD behavior in males who are highly concerned about masculinity and use supplements and other products to enhance their physique (Field et al., 2013).

Finally, it is important to highlight that a large majority of adolescents and young adults continue the BD behavior despite their knowledge of health risk (Zwaluw, Kleijnan, Lemmers, Spijkerman, & Engels, 2013). This may be explained by the theory of cognitive dissonance, which means that the drinkers’ existing attitudes and cognitions will be modified to match the BD behavior. This suggests that, although knowledge and attitudes are treated in prevention, these may be inefficient on BD behavior.

**PERSONALITY TRAITS, CIRCADIAN TYPOLOGY, AND BD**

The study of personality traits associated with BD has confirmed consistently the presence of higher impulsivity (White et al., 2011; Townsend et al., 2014) and novelty seeking (Wellman et al., 2014) in youths, with both features being predictors of maintenance in the BD pattern. Both personality dimensions are also related to several nonadaptive behaviors and mental disorders, mainly substance use disorders (Marquez-Arrico & Adan, 2013).

Most personality questionnaires include an impulsivity dimension, although there are also specific instruments to measure it. The Dickman Impulsivity Inventory (DII, Dickman, 1990) may be highlighted because it proposes the existence of functional impulsivity as the tendency to make quick decisions when required by the situation to favor the person, in contrast to dysfunctional impulsivity, which is related to quick but irreflexive decisions that lead to negative consequences. Youths with BD, especially men,

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**TABLE 4** Protective Factors Associated to Binge Drinking (BD) Behavior in Adolescents and Young People

<table>
<thead>
<tr>
<th>Individual characteristics</th>
<th>High intelligence</th>
<th>morning-type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Social and educational</td>
<td>Educational achievement</td>
<td>Higher school grades</td>
</tr>
<tr>
<td></td>
<td>Stronger policy environment</td>
<td></td>
</tr>
<tr>
<td>Family, parents, and peers</td>
<td>Parental monitoring (control and supervision)</td>
<td>Higher parental education (only for extreme BD)</td>
</tr>
<tr>
<td></td>
<td>Family oriented leisure</td>
<td></td>
</tr>
<tr>
<td>Activities, beliefs, cognitions</td>
<td>School attachment</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Participation in school and non-school activities</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Religious involvement</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Belief that alcohol produces cognitive self-regulation (only men)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Belief that alcohol enhances sociability and sexuality (only women)</td>
<td></td>
</tr>
<tr>
<td>Personality traits</td>
<td>Low impulsivity</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Low novelty seeking</td>
<td></td>
</tr>
<tr>
<td></td>
<td>High conscientiousness</td>
<td></td>
</tr>
</tbody>
</table>

The factors are those obtained in the studies revised, related to the practice of non-binge drinking and/or not maintaining that behavior over time.
obtain higher scores only in dysfunctional impulsivity compared to controls (Adan, 2012), as Figure 1 shows.

Impulsivity is the most consistent personality trait related to early use of drugs, repetition of intake, and progression to addiction, and it is a condition promoted with consumption that also favors relapse (Perry & Carroll, 2008). The data available on novelty seeking, defined as the need for adventure and excitement, preference for risk and strong emotions, boredom susceptibility, and disinhibition, point in the same direction (Castellanos-Ryan, Rubia, & Conrod, 2011). The disinhibition dimension is the best BAC predictor in both sexes (Legrand, Gomà-i-Freixanet, Kaltenbach, & Joli, 2007). Impulsivity and novelty seeking may explain the poor performance in executive tasks seen in teenagers (Castellanos-Ryan et al., 2011) and in addiction disorders (Dolan, Bechara, & Nathan, 2009).

Using the “Big Five” model of personality traits (extraversion, emotionality/neuroticism, conscientiousness, agreeableness, and intellect/openness) in a longitudinal birth cohort study, Cheng and Furnham (2013) observed that high extraversion and low agreeableness were significant predictors of BD. In other research, low conscientiousness also appears as a predictor of weekly levels of alcohol in BD university students (Clark et al., 2012). Perhaps not only one but the combination of several personality traits may configure in the future an endophenotype for the onset and maintenance of BD.

Circadian typology (morning-type, neither-type, and evening-type) is an individual difference that affects our biological and psychological functioning—not only in health, but also in disease (Adan et al., 2012 for a review). Morning-type subjects go to bed early and wake up early, and achieve their peak mental and physical performance in the early part of the day. In contrast, evening-type subjects go to bed and wake up late, and perform at their best toward the end of the day and evening hours. The evening-type, especially teenagers and young adults, show a personality pattern of higher impulsivity, novelty seeking, extraversion, and activity, and lower conscientiousness and harm avoidance. All the existing data also suggest that circadian typology is related to the consumption of all types of drugs and BD, with morning-type being a protective factor and evening-type a risk factor (Prat & Adan, 2011).

NEUROPSYCHOLOGICAL IMPACT OF BD

The study of the possible cognitive impact of BD is recent and the existing studies are difficult to compare due to methodological aspects that may influence the results (small samples, several definitions and duration of BD, use of different tasks, variable ages, etc.). The lack of control of the educational level, the consumption of other substances, the presence of psychopathological traits, and personality traits may greatly affect the results. The available data suggest that there are deficits in the cognitive performance in sustained attention tasks and memory and PFC activity tasks similar to those found in long-term alcohol abuse subjects, although to a lesser extent and with more mixed results.

In considering the neuropsychological impact of BD, we should distinguish between the effects of a single episode (next day) and those that may come from a sustained BD behavior over time (see Table 2). In both cases, the assessments are carried out with a zero BAC.

Effects of a Single Episode of BD

Neurocognitive impairment are found in subjective alertness, memory retrieval processes (delayed recall), and reaction time, while performance in attention tasks is not significantly impaired (McKinney, Coyle, & Verster, 2012; Verster, van Duin, Volkerts, Schreuder, & Verbaten, 2003). The pattern of impulsive acting, objectively assessed with inhibition tasks, also increases independently from individual differences in the impulsivity trait (McCarthy, Niculete, Treloar, Morris, & Bartholow, 2012).

Effects of BD on Learning and Memory Tasks

Studies have focused on retrospective memory in which learning, retention, and retrieval are evaluated. The existence of memory deficits under chronic alcohol consumption is well established, linked to alterations in the hippocampus and PFC. BD students perform worse in declarative memory tasks, both in immediate and delayed recall (Parada et al., 2011b). BD young adults present behavioral impairments in sustained attention, working memory, and associative learning (Parada et al., 2012; Scaife & Duka, 2009; Stephens and Duka, 2008).

For working memory, at an early age in young binge drinkers without AUD or mental comorbidity, the performance at a behavioral level is adequate. However, hypoactivation of the right anterior PFC was obtained using combined event-related potentials (ERP) and exact low-resolution brain electromagnetic tomography (Crego et al., 2010). Using functional magnetic resonance imaging (fMRI), higher bilateral activity in the supplementary premotor area was observed in a BD condition, as well as a
positive correlation between the number of drinks consumed per event and the activity in the dorsomedial PFC and the cerebellar-thalamic-insular regions (Campanella et al., 2013).

The assessment of prospective memory (PM), conceptualized as the cognitive ability to remember to carry out some activity at some future point in time, is a crucial aspect of everyday cognitive function, and it is sensible to exhibit neuropsychological sequels associated with BD. Adolescents and young adults with BD showed impairments in a task of PM with fewer location-action combinations to recall (Heffernann, Clark, Bartholomew, Ling, & Stephens, 2010) and reduced function on time-based tasks (Heffernann & O’Neill, 2012) when compared with non-binge drinkers.

Effects of BD on Executive Functions

In BD university students, deficits in behavioral inhibition tasks have been observed, reflecting impulsivity and poorer decision making (Field, Schoenmakers, & Wiers, 2008; Scaife & Duka, 2009). This is more evident in high BD than in low BD subjects (Townshend et al., 2014), in men, and in those who engage in heavy BD at an early age (Goudriaan, Grekin, & Sher, 2011). The assessment of decision-making using the Iowa Gambling Task has found a pattern of “short-sightedness” for future consequences in BD, similar to that in addiction patients, and which implies impulsive behavior with lower inhibitory control (Johnson et al., 2008).

Heavy binge drinkers performed worse on a battery of tasks of executive functions compared with light social drinkers (Montgomery, Fisk, Murphy, Ryland, & Hilton, 2012). They generated significantly fewer words in a word fluency task (access to semantic memory), had worse random letter generation (inhibitory control), and had greater switch cost on a random letter task (switching), as shown in Figure 2.

In the revision by Stephens & Duka’s (2008), BD deficits in executive functions were found underlie functional hyperactivity impairments in the PFC and the amygdala, which may cause neurotoxicity with time. Because the PFC and other brain areas involved are subject to development and maturation during adolescence and emerging adulthood, BD until the age of 24 poses a bigger harm to executive functioning than in later stages of life (Hermens et al., 2013).

The appearance of alterations in brain functions when effects in behavioral neurocognitive performance are not yet observable points at early cerebral disturbances, which should be studied in the future to check whether they persist when the BD habit ceases, as well as the possibility that they may be considered endophenotypes of the progression from BD to AUD. In this direction, the longitudinal study by Dager et al. (2013) using fMRI has identified that an amplified cue-elicited brain response was the most significant predictor of the emergence of BD and subsequent AUD. The overactivated regions were linked to habit formation, decision making, motivation, and attention.

FUTURE RESEARCH ON PREVENTION AND/OR TREATMENT ON BD

Countries affected by BD should set it as a priority to promote actions to reduce the number of persons practicing BD and the intensity of the associated intoxications. Some strategies that have proven effective in reducing alcohol consumption involve limiting the availability of alcohol, raising its price, promoting substance and alcohol-free environments (Naimi et al., 2014), and blocking legal access to alcohol to a later age. Although we might acknowledge that alcohol consumption may continue and that it is not realistic to advocate abstinence, promoting less harmful drinking patterns and their frequency is an advisable harm reduction strategy (Plunk et al., 2014).

Preventive and therapeutic approaches should take into account circadian rhythmicity. Involving chronobiology in prevention implies not only promoting healthy leisure activities or “what to do,” but also placing such activities in appropriate daytime temporal moments or “when to do” them (Adan et al., 2012). Chronobiological therapeutic strategies such as to establish regular time patterns of sleep-wake, meals, and daily activity with a tendency towards a morning-type functioning, and exposition to light therapy and melatonin administration, may also be effective.

Few works have assessed the efficacy of interventions aimed at reducing dependence or intensity of BD in the population. The brief motivational intervention (BMI) is one of the few effective strategies for diminishing alcohol consumption. A single face-to-face session of BMI in a BD group was found to reduce alcohol use among subjects who experienced one or more alcohol-related adverse consequences (19% less drinking), whereas no preventive effect was obtained in control subjects (Daeppen et al., 2011). More research is needed in this area in the near future.

To conclude, research on pharmaceutical targets to avoid the health consequences of BD and the progression to AUD will hopefully offer knowledge to be applied in the clinic in the future, based on the promising findings from behavioral genetic approaches, such as the reduction of the BDNF or the upregulation of glutamate receptors in BD.
APPLICATIONS TO OTHER ADDICTIONS AND SUBSTANCE MISUSE

As we have seen in this chapter, the pattern of alcohol BD involves significant risks to both the immediate and short-term health outcomes of those who practice it. BD is more dangerous in the case of adolescents because the toxic amounts of alcohol in their bodies under maturation process aggravate the risks. The possible changes in gene expression and in a wide variety of neurotransmission systems should be noted, among which stands out the reinforcement dopaminergic pathway. These changes significantly increase biological vulnerability to progress towards the development of a substance use disorder, not just for alcohol or other substances with depressant pharmacological profile but in general. Similarly, these effects on the CNS can participate in the development of other mental disorders, such as depression and anxiety with and without comorbidity to the addictive disorder. The need to improve the knowledge about evidence-based treatments should be emphasized. However, efforts should prioritize developing preventive strategies starting in childhood in order to enhance the protective factors of BD practice.

DEFINITION OF TERMS

Attention Attention is a complex concept that represents a cohesive set of processes, which include sensory, motor, and cognitive processing.

Binge drinking Binge drinking is an intermittent pattern of heavy alcohol consumption of ≥5 drinks for men and ≥4 drinks for women, in one single event and at least once in the past two weeks.

Circadian typology This individual difference (morning-, neither- and evening-type) affects our biological and psychological functioning in health and in disease. Morning-types go to bed early and wake up early, and achieve their mental and physical peak performance in the early part of the day, in contrast to the evening-types.

Endophenotype This is an internal, inheritable, and measurable trait marker of vulnerability to develop a particular disease.

Executive functioning This set of cognitive skills is mainly linked to the functioning of the brain frontal lobe, which includes mental flexibility, planning and abstract reasoning abilities, self-regulation, and task monitoring, which determine goal-directed behavior.

Functional impulsivity Functional impulsivity is a tendency to make quick decisions to one’s benefit when required by the situation.

Inhibition This mechanism prevents the entrance of nonpertinent information into working memory and suppresses information that has become irrelevant for a current task.

Impulsivity or dysfunctional impulsivity This personality trait is defined as the tendency to act with lack of prevision, making quick and irreflexive decisions that lead to negative consequences.

Novelty seeking This personality trait is characterized by a need for adventure and excitement, preference for risk, and strong emotions by the mere fact of living them, boredom susceptibility, and disinhibition.

Prospective memory This is the cognitive ability to remember to carry out some activity at some future point in time.

Working memory Working memory is the ability to hold and manipulate information in the mind over short periods of time—a mental workspace that is used to store important information in the course of our everyday lives.

KEY FACTS OF NEUROPSYCHOLOGY IN BINGE DRINKERS

- Assessing cognitive performance is more difficult than assessing biological aspects, because even in simple cognitive tasks there are several skills involved in their resolution (attention, motor control, etc.).
- BD behavior increases neuroinflammation in the CNS, which may contribute to dysfunction in PFC, myelination, and white matter integrity related to neuropsychological deficits.
- In healthy young binge drinkers, deficits have been found in sustained attention, learning, memory (declarative, semantic, prospective and working), and executive functions (inhibition control and decision making).
- Early cerebral disturbances measured by ERPs or fMRI in brain activity may be detected when effects on behavioral performance are not yet observable.
- Until the age of 24, BD behavior poses a larger harm than in later stages of life, because the brain areas implicated in the observed cognitive impairments (PFC, hippocampus and amygdala) are subject to development and maturation during adolescence and emerging adulthood.
- Future research should control factors that have a notorious influence on cognitive performance and that have been related to BD (level of education, consumption of other substances, personality traits, etc.) in order to reach more robust conclusions in this area.

SUMMARY POINTS

- This chapter focuses on the findings, mainly during the last decade, on the impact of BD.
- BD in the United States, Europe, and most developed countries is a major health and social concern, with significant social and personal costs.
- Mortality risk and comorbidity with physical (cardiovascular diseases, diabetes, metabolic syndrome, neurodegeneration) and mental (anxiety, depression, suicide, sleep disorders) pathologies are more prevalent in binge drinkers.
- Adolescents and young binge drinkers show neurocognitive impairments similar to those found in long-term alcohol abuse, although to a lesser extent and with more mixed results.
- The presence of high impulsivity and novelty seeking in young people are the best personality traits to predict the appearance and maintenance of the BD pattern.
- Circadian typology is a remarkable individual difference in BD and all addictive behaviors, with the morning-type being a protective factor and the evening-type being a risk factor.
- We need more systematic research on the effects of BD, preferably longitudinal studies incorporating biological and behavioral measures.
- Prevention and therapeutic interventions should give priority to BD, promoting protective factors and reducing risk factors known to affect its appearance and maintenance.

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