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UPDATE ARTICLE

Use of psychoactive substances by adolescents: current panorama

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Adolescence is a period of vulnerability to substance use disorders (SUDs). Epidemiological studies indicate that about 23% of Brazilian adolescents use drugs, with alcohol being the most widely consumed substance. The etiology of SUDs is complex, influenced by an interaction of genetic risk, individual development, environmental factors, context of use, and substance used. Clinicians should consider diagnostic criteria and be aware of behavioral changes that may indicate drug use and its consequences in various aspects of adolescent life. Identification and treatment of comorbid conditions is critical to the management of SUDs in this age group. Interventions should restrict access to drugs and facilitate prompt recognition of initial use, preventing progression to serious patterns of abuse or dependence. Intervention should be broad, including academic and occupational activities as well as social relationships and leisure, which are critical to the reestablishment of normal adolescent development.

Keywords: Substance use; substance-related disorders; adolescent; adolescent behavior; therapeutics

Introduction

Adolescence is a period of identity formation in which new activities, including social, emotional, and sexual relationships, are experienced. Legal and illicit substances are frequently used during adolescence[1]: approximately 72% of U.S. teens[2] and 65.2% of students in Brazil[3] reported having tried alcohol. Alcohol and drug use tends to increase in late adolescence and early adulthood, but decreases as individuals age (tobacco use is an exception, tending to remain in adulthood), a phenomenon called maturing out.[4] However, substance use may lead to academic issues and move adolescents away from activities important to their cognitive and emotional development - for example, it hinders vocational choices and interferes with the development of skills to deal with emotions.[5] According to the World Health Organization (WHO),[6] 1.7 million teenagers worldwide lose their lives every year, mostly because of traffic accidents, suicide and homicide, often associated with the consumption of alcohol or other drugs. Investing in prevention is an essential aspect of delaying initial contact with alcohol and drugs, since early experimentation is associated with higher odds of shifting to regular use and dependence.[5]

The objective of the present article is to provide data on the prevalence of general substance use in adolescence, assess the risk and protective factors involved in the etiology of substance use disorder (SUD) in this population, and address its clinical aspects, diagnosis, prevention, and treatment.

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Epidemiology

According to the United Nations Office on Drugs and Crime (UNODC),[7] it is estimated that between 153 and 300 million people aged 15 to 64 years used illicit substances at least once in 2010, which corresponds to 3.4 to 6.6% of the world population in this age group. The UNODC also estimates that 12% of this population (15.5 to 38.6 million) is composed of problematic drug users, including individuals with addiction and other SUDs. Furthermore, illicit drug use accounted for roughly 99,000 to 253,000 deaths worldwide in 2010, which represents 0.5 to 1.3% of all causes of death. These numbers increase further if legal drugs, especially alcohol and tobacco, are also taken into account. WHO estimates that 2.5 million people die annually because of harmful use of alcohol, whereas 5.4 million deaths are caused by tobacco use.[8]

In the United States, the use and abuse of alcohol occurs on average at 14 years of age, and the use of other drugs, at age 15. In late adolescence, 78.2% of adolescents have consumed alcohol and 42.5% have already used at least one illicit drug.[9,10] In a study involving elementary and high school students from 27 Brazilian state capitals, the prevalence of drug use was 22.5%. The proportion of users increases with age, but it is worrisome that 12.7% of students aged 10 to 12 years have already used some psychoactive substance at least once in their lives.[3] Table 1 compares the findings of

Table 1 Lifetime prevalence of substance use among students (%)

Substances	Brazil[3]	Chile[11]	Venezuela[12]	Paraguay[12]	United Kingdom[13]	Italy[13]	Greece[13]	U.S.[2]
Alcohol	65.2	78.6	65.5	66.9	91.0	82.0	91.0	72.7
Tobacco	24.9	75.0	31.8	37.3	58.0	64.0	50.0	47.1
Inhalants	15.5	7.9	2.7	0.7	12.0	6.0	15.0	11.1
Cannabis	5.9	21.6	1.0	4.3	38.0	27.0	6.0	42.3
Cocaine	2.0	3.7	1.0	1.6	3.0	3.5	1.0	8.5
Anxiolytics	4.1	9.1	15.8	15.0	2.0	6.0	4.0	10.3
Amphetamine	3.7	5.8	6.4	5.9	8.0	2.6	1.0	*
Opioids	0.3	1.3	*	*	*	*	2.0	1.4
Hallucinogens	0.6	1.9	*	*	*	*	*	8.3
Illicit drugs	19.4	17.1	*	*	47.0	35.0	9.0	48.2

* Not available.

epidemiological research conducted in Brazil and other countries, illustrating the influence of socioeconomic and cultural differences on drug use.

Brazilian data are consistent with the international literature and rank SUD as the fourth most prevalent mental health problem among adolescents (11.4%),[14] with alcohol consumption as the leading cause.[15] Involvement with drugs occurs in stages, beginning with experimental use, usually in a social context, moving to casual use and a gradual intensification in frequency (recreational use, regular use), increasing the risk of developing SUD (abuse and addiction).[4] Drug initiation and the sequence of drug use progression often varies on a case-by-case basis. Substances that are legal for adult consumption, such as alcohol and tobacco, tend to precede and increase the risk of using illegal drugs.[16] Heavy use of alcohol is associated with use of other drugs, such as solvents (26.5%), cannabis (17.3%), tobacco (14.2%), anxiolytics (10.5%), amphetamines (8.1%), and cocaine (7.2%).[17] Early use of alcohol is associated not only with drug abuse, but also with delinquency, antisocial behavior in adulthood, and school failure.[18] Moreover, the first use of a heavier drug often occurs along with alcohol, tobacco, or cannabis.[19]

Alcohol is the most commonly used substance by youth worldwide, and initiation of alcohol consumption is occurring at increasingly early ages.[20] In 2004, the average age at first drug use among Brazilian students was 12.5 years for alcohol, 12.8 for tobacco, 13.9 for cannabis, and 14.4 for cocaine. This information is important to the implementation of preventive strategies, which should begin around the age of 10 and focus on alcohol and tobacco, with the goal of delaying first exposure to drugs.[21]

In Brazil, alcohol is the most commonly consumed and abused drug during the life course, followed by tobacco and cannabis.[22] Although 66% of teenagers surveyed have declared themselves teetotal, 13% had a pattern of heavy alcohol consumption, 10% consumed alcohol 1-3 times per month, and 5% reported binge drinking or drinking to the point of intoxication. Another alarming fact is that among adolescent binge drinkers, 45% binge at least once a month and 18% once a week or more. In short, a minority of teenagers exhibit a high frequency and intensity of alcohol use. The United States has the highest rates of binge drinking, drug use, and violent deaths in the Western world,[23] and binge drinking accounts for 90% of all alcohol consumed by people under 21 in the country.[24] Around 37.9% of U.S. high school girls use alcohol, of whom 54.6% reported binge drinking (19.8% of all students).[25] In Europe, the average rate of lifetime alcohol use is 88%; England, where the frequency of binge drinking in high school girls was 54%, leads the European ranking.[26]

Use of alcohol and tobacco during youth is a predictor of their use in adulthood and of substance-related disorders.[27] In a systematic review of the literature on the use of alcohol and tobacco by adolescents aged 10 to 19 years, Barbosa Filho et al. found that the prevalence of current tobacco use (at the time of survey or in the preceding month) ranged from 2.4 to 22.0%, averaging 9.3%.[28] In a study about smoking among adolescents aged 13 to 15 years in the Brazilian cities of Florianopolis, Curitiba, and Porto Alegre,[29] the authors found a predominance of smoking behavior in girls compared to boys. This finding is similar to those reported in other countries surveyed by WHO, except in Europe.[30] Although the risk of onset of tobacco use by adolescents is higher when parents are smokers,[31] there are other family factors associated, such as parenting practices of low acceptance and low behavioral control of children.[32] In addition to the implications of tobacco use on adolescent health, it bears noting that concomitant use of tobacco and cannabis is common.[33]

Cannabis is the most widely used illicit substance worldwide, with 119 million to 224 million users.[7] A 2005 survey found that cannabis was the illicit drug with the highest rate of lifetime use among Brazilian adolescents aged 12 to 17 (4.1%), followed by solvents (3.4%).[22] Among students of public schools, the proportion of cannabis use was even greater (5.9%), but solvent use was most common overall (15.5%). Socioeconomic and cultural factors associated with this low-income population may explain the higher proportion of solvent users, as solvent consumption is higher in underdeveloped and developing countries.[34] It is noteworthy that the prevalence of self-reported drug use may be underestimated because of the difficulty of measuring illegal behaviors.

The use of energy drinks has also been measured in recent epidemiological surveys. These drinks are widely consumed in combination with alcohol to increase their excitatory effect.[35] Among Brazilian students, the lifetime

prevalence of energy drink consumption (combined or not with alcohol) was 12%.[3] In the United States, about 6% of adolescents and young adults use energy drinks daily.[36] Use of anabolic steroids has also increased, reaching 6.6% of adolescent males in Brazilian high schools; the risk of use is two- to threefold higher among boys compared with girls,[37] and is most likely among sponsored athletes. The average age at first use is 14 years, but use before the age of 10 has been reported.[38]

Rates of cocaine and crack use among Brazilian adolescents (2.0 and 0.7% respectively) are lower than those of alcohol, tobacco, inhalants, and cannabis. The proportion of American adolescents who use cocaine is much higher (8.5%); however, only 0.1% of adolescents use crack in the country.[2,39] The severity of psychiatric, family, and social problems is far greater among users of crack and cocaine: higher rates of antisocial personality disorder in adulthood (25%) and occupational, family and legal problems, including violent activities such as theft and robbery (23%)and threats and assault (32%), have been reported.[40]

The environment and life context exert great influence on substance use. In a survey of Brazilian children and adolescents living on the streets, 47.7% used drugs heavily or frequently, and 74.2% used multiple drugs.[41] Street children and adolescents without family bonds and not attending school (25.7% of the sample) were at even greater risk, with86.4% using drugs heavily or frequently.

Etiology and risk factors

The etiology of drug use is multifactorial, and identifying its various determinant factors is a complex task. For didactic purposes, this article examines some subdivisions of etiologic factors, namely neurobiological aspects and social, genetic, and psychiatric comorbidities. However, this division into topics is artificial, because the causative factors of drug use are interrelated, each factor modifying the clinical expression of others.[42-44] The genetic aspect is triggered by environmental factors (epigenetics) or behavioral factors in response to environmental aspects. Knowledge of these factors is necessary to identify possible targets for intervention.

Adolescent neurobiology and risk of drug experimentation

The reward system (RS) is the brain structure responsible for feelings of pleasure that can lead to repeat behaviors. This system is triggered by activities related to survival, such as sexual desire and feeding, but also by drugs of abuse. The main pathways of the RS are the mesolimbic and mesocortical pathways, and numerous projections of the amygdala, prefrontal cortex and hippocampus reach the nucleus accumbens, which plays an important role in regulating emotion, motivation, and cognition. The main neurotransmitter released in this system is dopamine, the repeated release of which leads to learning the behavior of obtaining and using the drug. When consumption persists, a sensitization phenomenon occurs in mesolimbic pathways by synaptic plasticity, leading to a more intense and persistent consumption.[45]

Recent research has shown that the brain undergoes structural and functional changes during its development. The brain regions responsible for the so-called social brain are the last to develop[46] and various structures that are part of the RS are still developing in adolescence. From the beginning to the end of adolescence, the nucleus accumbens undergoes several changes and about 30% of its dopamine receptors are lost. This change may be associated with greater feelings of boredom and attempts to search for stronger sensations in this age group. In this context, drugs can fulfill a biological need for dopamine; hence, the high risk of drug use during this period.[47]

During adolescence, the frontal cortex (responsible for working memory, impulse control, and abstract reasoning), loses gray matter while white matter increases.[48,49] Making decisions with an emotional component is a function of the orbitofrontal cortex, one of the last regions to mature, and its operational deficit is associated with drug use in early adolescence.[50] The predominant pattern of novelty-seeking in childhood is a risk factor for drug use in adolescence.[51,52]

Adolescents have full capacity for abstract thinking; they have many ideas and the energy to put these into practice. However, their ability to assess risks, consequences and temporally organize causal relations is still immature, especially when influenced by emotions and by the desire for immediate gratification. These characteristics make teenagers more vulnerable to drug experimentation, especially if access to drugs is easy and if their environment accepts this behavior. Therefore, these aspects related to neurocognitive and emotional development in this age group should be considered when assessing the risk and protective factors to which teenagers are exposed.[53,54]

Social factors

Social factors are important determinants of the risk of drug experimentation, regular drug use, and addiction in adolescence. Interestingly, protective factors are less often investigated. Weiland et al. found that individuals with greater potential for resilience (defined as a combination of factors that promote conditions to face and overcome problems and adversities), indirectly measured through neuropsychological findings corroborated by neuroimaging, had lower levels of substance use.[55] Another study found that high scores on scales of resilience were associated with a more significant protective factor in adolescent females than in males. In turn, risk factors, such as family dysfunction or being friends with offenders, were more decisive in the overall intensity of drug use in males than in females.[56] Other studies have found that religiosity[57,58] and effective parental monitoring[59-62] are important protective factors.

Risk factors for drug experimentation include: drug use by parents and friends[63]; unsatisfactory academic performance[64]; bad relationship with parents[65]; low self-

esteem[66]; depressive symptoms[67]; history of stressful events[68]; and early use of alcohol and cigarettes.[69] The onset of alcohol use has a strong positive correlation with family influence, since studies show that when teens have parents who also use alcohol, experimentation with legal substances in the family context is frequent.[63,70]

Factors related to adolescent personality traits, such as a high tendency to seek novelty and low avoidance of harm, as well as high reward dependence,[71] are associated with increased risk of experimental substance use. The main predictors of progression to the next stages of consumption are the intensity of use at an earlier stage and the influence of environmental factors - drug availability, cost, and cultural influences, from the media and - especially - peer influence.[16] In turn, drug use at one stage does not imply progression to the next, but generally requires involvement with drugs at the previous stage. Differences, especially regarding the first drug consumed and the progression to the next stages, once again reflect the influence of the previously mentioned environmental factors - mainly peer influence. Ease of access to drugs and the opportunity to use them are important factors in the initiation of use. A study of cannabis, cocaine, hallucinogens, and heroin demonstrated a 1-year interval between the first opportunity to use and the first use.[72] The rates of use opportunities were comparable to the prevalence of drug use, and there was no difference between genders in use after the first opportunity to do so. However, females had fewer opportunities to use drugs, and this applied to all of the drugs studied.

In terms of continuous use and progression to other drugs, adolescents' internal factors - behavior, individual resilience, presence of psychiatric comorbidities, low self-esteem, difficulties in implementing and defining their social identity - are important influences.[72] Continuous use of drugs is also related to environmental factors, not only because of the previously mentioned issues of peer influence and family, but also through conditioning processes involved in addiction, related to the development of tolerance, withdrawal, relapse, and overdose.[73] In this sense, some environmental characteristics (such as place of use, partners, time and proper handling of the drug) elicit compensatory effects in the body. The effect is felt, for example, as an intense increase in willingness to use when in that context (craving) and as a progressive decrease of the sensations produced by the drug, requiring greater and greater amounts (tolerance).[74]

Genetic factors

Genetic factors have been widely studied and play an especially important role in the use of alcohol, cigarettes, and illicit drugs in adulthood.[34,42,75] Heredity for abuse and addiction is complex, indicating the involvement of genetic influences that may be more relevant than environmental factors, especially for heavy use.[76] Twin studies have shown that genetic factors are more importantly associated with substance addiction in girls than in boys.[77] A systematic review of twin studies indicates a concordance of about 50% for experimentation and frequent use of cannabis in teens.[76] The same proportion of 50% was found in review studies that evaluated the heritability of alcohol addiction.[78] However, children of alcoholics appear to have four times the risk of developing alcoholism, even if raised by non-alcoholics.[79]

Psychiatric comorbidities

A study of 1,285 subjects aged 9 to 18 years found that the presence of anxiety disorders, mood disorders, oppositional defiant disorder (ODD), and conduct disorder (CD) was related to later use of alcohol, cigarettes, and illicit drugs.[80] Another study of 497 attention-deficit/hyperactivity disorder (ADHD) patients estimated a relative risk of 1.47 for drug use in adolescence after a follow-up of 10 years. In the same study, patients with comorbid ODD or CD had a relative risk of 2.74 and 2.21 respectively.[81] However, a meta-analysis of 1,000 individuals found that ADHD alone might not be an independent risk factor for substance use (RR = 1.35 [0.90-2.03]) when CD and ODD are excluded.[82]

Panic disorder predicts alcohol use in adolescence and adulthood, while social phobia is associated with alcohol and cannabis.[83,84] Bipolar disorder and depression are important risk factors, and they often precede substance use in childhood and adolescence.[85,86]

Therefore, the etiology of substance abuse is complex and multifactorial. Both genetic and environmental factors contribute to the development of SUDs. Adolescence is a period of higher odds of developing high-risk behaviors - including substance use - because the neurocognitive systems responsible for risk assessment, impulsivity control, and social interaction are still under development. The risk of developing SUD increases when comorbidities are present. Generally, the greater the number of risk factors present, the greater the risk of developing more severe addiction.[87-90] Hence, the importance of investing in prevention programs and early diagnosis.

Diagnostic criteria

The psychiatric nosology of the two main SUDs, abuse and dependence, evolved largely because of epidemiological studies of alcohol-dependent adults. Table 2 presents the current diagnostic criteria according to the Diagnostic and Statistical Manual of Mental Disorders, fourth edition, text revision. However, in adolescence, abuse and dependence can be a one-dimensional construct.[91] Therefore, the categories shown in the table have limitations in the assessment of adolescents.

Given the peculiar characteristics of adolescence, the imprecision of diagnostic criteria can lead to increasing levels of severity of substance use. Some authors propose to evaluate the levels of use over a spectrum, ranging from experimentation to addiction.[93] Cohen & Estroff point out that diagnosis of substance abuse in young people depends more on clinical sensitivity than on set criteria.[94] In an attempt to improve clinical perception, Nowinski suggests five stages for substance use pro-

Table 2 Diagnostic criteria for substance abuse and dependence (adapted from DSM-IV-TR)[92]

Criteria for substance abuse (1 of 4 criteria in 1 year)
- Recurrent use of the substance(s), resulting in failure to fulfill most obligations
- Recurrent use of the substance(s) in situations where they pose a hazard to physical integrity
- Recurrent substance-related legal problems
- Continued use of the substance(s) despite persistent social problems due to its/their use
Criteria for substance dependence (3 of 7 criteria in 1 year)
- Tolerance*
- Withdrawal*
- Use in larger amounts and/or over a longer period
- Unsuccessful efforts to cut down or control use
- Great deal of time spent in activities necessary to obtain the substance(s) or recover from its effects
- Important social, occupational, or recreational activities are no longer carried out because of the use
- Continuous use of the substance(s), despite knowledge of medical or psychological problems due to its/their use

* With physiological dependence.

gression in adolescents: 1) experimental: use is motivated by curiosity and/or risk-taking; 2) social: use is related to social events; 3) instrumental: use has the purpose of manipulating emotions and behaviors, such as seeking pleasure or dealing with stress or dysphoria; 4) habitual: accommodation - the user's lifestyle becomes centered on use as a means of coping and recreation, and former interests are abandoned; 5) compulsive disorder: total preoccupation with use; all activities revolve around the use of drugs, and global functioning deteriorates.[93]

In short, clinicians should be alert not only to diagnostic criteria, but also to changes in behavior that may indicate the use of drugs, as well as to their consequences. Thus, preventive measures and interventions can be implemented, minimizing contact with drugs and, in the case of use, preventing the progression of consumption.

Clinical assessment

The following data should be collected for each substance: 1) age at first use; 2) age of progression to regular use; 3) maximum use; 4) current use (over the past month); and 5) last use. The DSM-IV-TR diagnostic criteria for abuse or dependence should then be applied. Other important information includes: triggers for eagerness (craving) and use, context of use (e.g., with particular peers, at school, or before school); perception about motivation for use, and positive and negative consequences of using, as well as the current motivational stage and the goals of treatment.[95] All these data are essential for the assessment of SUD severity and planning of necessary therapeutic interventions. It is worth stressing that a teenager who reports regular use of any psychoactive substance should be treated with the aim of preventing the progression of use.

Often, in adolescence, there is a normal stage of substance experimentation; however, in susceptible individuals - especially in adolescence, in which the central nervous system (CNS) is still in development - this experimentation carries the risk of major neuropsychiatric consequences. Intoxication usually manifests itself through changes in mood, cognition, and behavior. Mood can range from euphoric to depressed, with suicidal ideation or suicidal acts. Patients may experience periods of anxiety or panic attacks, paranoia, or acute psychosis. Changes in cognition include poor concentration, decreased attention, and apparent changes in perception or thinking (e.g., delusions). Behavioral manifestations include lethargy, hyperactivity, agitation, disinhibition, drowsiness, hypervigilance,[96] and changes in sleep and appetite.[97] Most symptoms indicative of problematic substance use are related to psychosocial and academic function (Table 3).

Some physical characteristics suggestive of SUDs include unexplained weight loss, intense malaise, hypertension, nasal irritation, conjunctival irritation, hoarseness, chronic cough, hemoptysis, chest discomfort, wheezing, scratch marks, needle marks, blank stares, excessive acne, testicular atrophy,[97] odor of cannabis or other substance on clothing, and excessive use of mouthwash and aftershave/perfume to mask the odor of alcohol or drugs.[98]

The neurological consequences of psychoactive substance use vary according to the quantity, duration of use, and type of substance used (Table 4). Prolonged cannabis use can result in cognitive deficits,[97] including impaired integration of complex information in attention and memory.[99] Cognitive impairment is also seen in cocaine[100] and inhalant abuse in the long term.[101] Seizures may occur after using cocaine and high doses of stimulants, and chronic use of these substances is also associated with the development of tremors.[97]

Adolescents rarely exhibit physical signs of withdrawal from alcohol and other sedative-hypnotics. When these do occur, they may experience tremors in the extremities. The occurrence of seizures indicates severe withdrawal syndrome, with risk of developing delirium tremens, but in adolescents this is often associated with other clinical problems (e.g., traumatic brain injury and metabolic

Table 3 Academic and psychosocial indicators of substance use[97]

Academic
Impaired attention and judgment
Frequent absences and tardiness
Dropout
Conflict with teachers
Suspension or expulsion from school
Psychosocial
Lying
Stealing
Promiscuity
High-risk sexual behavior
Conflict with teachers and other authorities
Poor hygiene
Drug-using peers
Decreased or absent interest in extracurricular activities
Social withdrawal
Frequent unexplained injuries
Identification with drug culture (clothing, music, movies)

Table 4 Major neurological and cognitive impairments associated with drug use

Drug	Cognitive and neurological deficits
Alcohol	Attention, memory, learning, mental flexibility, executive function, visual-spatial organization, psychomotor problems, impulsivity, and decision making.[97,102] Tremors and convulsions may occur during withdrawal from alcohol and other sedative-hypnotic drugs.[100]
Cannabis	Prolonged use can result in cognitive deficits,[97] including impairment in integration of complex information, attention and memory, manual dexterity, learning, and decision making.[99]
Cocaine and psychostimulants	Impairments in attention, concentration, memory, visual and verbal learning, verbal fluency, visual-motor integration, executive functions and decision making.[100] Seizures may occur after use of cocaine[97] and high doses of stimulants. Adolescents who chronically abuse amphetamines and other stimulants can develop tremors.[97]
Solvents	Impairments in attention/concentration, memory, psychomotor retardation, visual-spatial functions, acquiring new information, executive functions, planning and manual dexterity. Peripheral neuropathy and tremor can develop as the result of chronic inhalant use or abuse, often due to direct damage to the nervous system.[101]
LSD	Impairments in attention, abstraction, mental flexibility, memory, learning, executive functions, and visual-spatial orientation.[103]
Ecstasy (MDMA)	Impairments in complex attention, problem solving, verbal and visual memory, working memory, and executive functions.[103-105]

MDMA = 3,4-methylenedioxy-N-methylamphetamine.

disorders), which must be investigated.[98] Teenagers who chronically abuse inhalants may exhibit tremors and are at risk of developing peripheral neuropathy due to direct damage to the nervous system.[101] High doses of stimulants can cause stroke,[100] and cerebrovascular disease may be aggravated by chronic alcohol use. The occurrence of stroke in young patients greatly increases the suspicion of drug abuse.[97]

So far, recovery from these deficits cannot be ensured. In general, recovery depends on several factors, such as deficit severity, sex, age, abstinence time, premorbid cognitive level, and cognitive stimulation.[106] Such deficits, if untreated, can lead to progressive loss of cognitive functions, and may not only increase the likelihood of relapse but also hamper treatment.[107] Therefore, especially in adolescents, a careful clinical and neuropsychological assessment is essential so that any existing deficits may be identified and treated early.

Differential diagnosis and comorbidities

The Methods for the Epidemiology of Mental Disorders in Children and Adolescents (MECA) study found the following prevalence rates for psychiatric comorbidities associated with SUD in adolescents for the previous 6 months: 76% for any comorbidity, 68% for any disruptive behavior disorders, 32% for any mood disorder, and 20% for any anxiety disorder.[99] Many individuals suffer from both SUD and other psychiatric disorders. The main differential diagnosis should identify abuse or addiction to one or more substances and comorbid conditions. Externalizing disorders occur often in comorbidity with SUD, usually secondary to drug use, and both have common symptoms: lying, problems at school, and involvement in illegal activities. Likewise, mood swings are frequent and even schizophreniform states can arise from the use of cocaine or cannabis. In turn, internalizing disorders, especially depression and social anxiety/phobia, may precede SUD. Drug use would occur later as a way to relieve the characteristic symptoms of these disorders. The association between SUDs and comorbidity has direct implications for treatment.[96]

Laboratory tests

The use of additional tests to confirm the use of harmful substances requires prior consent from the teenager. Substance use monitoring has more practical relevance when used to encourage the patient to remain abstinent, rather than imposing drug tests as a punitive measure. Drug testing in urine and blood can greatly aid in the treatment of intoxication with major clinical impairment, in which the teenager's report is unreliable. The breath test (breathalyzer) and saliva testing are commonly used in the legal setting to prove intoxication, but must be complemented by more specific tests.[108]

Sweat tests have been approved by the FDA to detect cocaine, opioids, and amphetamines, but they have also been successfully used to detect alcohol, methadone, methamphetamine, nicotine, and phencyclidine. Although a sweat test can detect drugs used within 1 to 4 weeks, its use is limited by the difficulty of collecting sweat and by the potential risk of contamination.[108] Hair tests can be used to detect drug use over a period of 4 to 6 months, since drug metabolites are absorbed into the hair follicle 1 week after use of the substance.[108] These tests have little applicability in the clinical setting.

Blood tests can accurately detect substances within 12 to 24 hours, but they are invasive, expensive, and restricted to recent use. They are used primarily to detect accidents involving drugs and in medical emergencies.[108]

Treatment

One of the major focuses in treating adolescent drug users is abstinence. This can be understood as a way to achieve the ultimate goal of treatment - the resumption of normal adolescent development. Adolescents should be offered the chance to make a global change in their lifestyle, giving them the opportunity to develop their skills

in an environment free from drugs. The main points of treatment are: 1) promoting abstinence; 2) maintaining abstinence; 3) evaluating and treating other associated psychiatric disorders; and 4) addressing related personal and family factors. Adolescents should be encouraged to participate in social and leisure activities that help then build the required skills for appropriate cognitive and emotional development, thus keeping them busy and away from drugs.[109]

Each patient should receive individual treatment, and physicians are responsible for defining the need for different treatment modalities.[109] Essentially, a multimodal treatment is needed, and family involvement is critical. Some aspects of this treatment are shown in Table 5.

The legal system is often involved in this context of treatment, through such agencies as the Ministry of Justice, Guardianship Councils, the Children's Court, services that protect teenagers at risk of death, institutions for young offenders and others, especially in the case of children and adolescents at social risk.[111]

Types of interventions

Non-pharmacological approaches

The existing literature rarely clarifies which therapeutic approach was employed, reporting only the type of therapy (group, family, individual, multidimensional) without specifying the actual intervention studied.[112] A 2013 meta-analysis concluded that approaches targeted to families and group-based interventions had the greatest influence on response to treatment (greater effect size),[113] but the therapeutic approaches used in different studies assessed are not clear. Brief interventions, such as motivational interviewing for adolescents, have a small but significant effect size, which remains over time and has the greatest impact on reducing the use of illicit substances.[114,115]

Studies using new methodologies could help corroborate clinical results, such as studies linking neuroimaging to brain changes resulting from psychotherapeutic interventions.[116] Studies describing the approach and interventions used throughout the therapeutic process in greater detail are needed to enable proper comparative analysis of the effectiveness of different types of available therapies.

Pharmacological treatments

Pharmacological treatments for substance abuse in adolescents are not yet established due to a paucity of data focusing on this age group.[117] Suggested pharmacological treatments focus on the key symptoms of addiction, such as decreasing cravings, replacement therapy, and treating comorbidities. Generalizing the results of research conducted with adults to the adolescent population is a high-risk practice, since the potential adverse effects and the therapeutic response are different due to neurobiological differences.[118]

The FDA has not approved any medications for the treatment of addiction in teenagers; therefore, treatment of comorbidities remains the focus of psychopharmacology in this age group.[119] A recent clinical study showed promising results with the use of N-acetylcysteine at a dose of 1,200 mg per day for adolescent cannabis users, increasing the odds of abstinence 2.4 times with minimal side effects.[120]

Some medication classes should be avoided due to the risk of interaction with alcohol and drugs of abuse, such as tricyclic antidepressants (risk of cardiac arrhythmias and anticholinergic effect, which may potentiate hallucinatory effects); anticholinergic medications; benzodiazepines (risk of decreased level of consciousness through interaction with alcohol); and psychostimulants (risk of cardiac arrhythmias).

Types of treatment

The ideal model of treatment for adolescents with SUD has been widely discussed. Models range from voluntary, involuntary, or compulsory inpatient treatment to outpatient treatment, including community service centers, day hospitals, and open and closed therapeutic communities.

Defining the most appropriate treatment through an individualized assessment makes it possible to advance treatment according to the improvement achieved with initial interventions.[121] Identification and appropriate treatment of comorbidities is essential for the prognosis of SUD in adolescents, as seen previously. The greater the number of comorbidities, the worse the prognosis for this population.[68]

Outpatient treatment is the first therapeutic approach, especially when the teenager is still involved in productive educational, recreational, or social activities. In the outpatient setting, techniques for achieving abstinence and for conflict resolution are discussed, and the adolescent is encouraged to develop new activities unrelated to drug use without being removed from his

Table 5 Aspects of the treatment of adolescents with substance use disorder*

- Psychoeducation for patients and their parents about the different aspects of the disorder, such as relapses and the need for treatment
- Improvement of communication within the family environment; motivating parents to become interested in all aspects of their children's development (e.g., their tastes and leisure activities) instead of focusing only on substance use
- Identification of precipitating factors of drug use and early intervention
- Improvement of self-control with cognitive-behavioral therapy
- Group therapy and social skills training can be used
- Contingencies management therapy
- Outpatient/day hospital/therapeutic communities
- Consider the need for inpatient treatment in more complex cases (aggression, suicidal behavior, risk of clinical complications, failure of outpatient treatment)
- Medications may be used in the treatment of comorbid disorders or for key symptoms

* Adapted from Stubbe.[110]

or her environment. However, youths frequently minimize the severity of their condition and are poorly engaged in treatment. In these cases, or when there is a hazard to their physical integrity - either because of uncontrolled use of drugs or involvement in illegal activities - hospitalization becomes a necessary resource. For users of crack or other drugs where abstinence is admittedly difficult, inpatient treatment may be the first therapeutic resource to be employed.[122]

The indications for inpatient treatment are: 1) risk of self- or hetero-aggressive behaviors or suicidal behavior; 2) risk of developing withdrawal symptoms or other clinical complications; 3) need for treatment of other psychiatric comorbidities; and 4) failure of outpatient treatment attempts.[121]

However, no scientific evidence proving the specific indication of these different therapeutic modalities has been found. In Brazil, laws that determine the involuntary commitment of children and adolescents and the principles of the Child and Adolescent Statute may have different interpretations, leading psychiatrists to adopt subjective criteria when deciding on the intervention to be conducted.[123] Comparisons between surveys using different models diverge in terms of their methodology, which hampers effective comparative analysis.

Prevention

Whereas the main approaches for prevention of harmful use of psychoactive substances (both legal and illegal) involve general principles of mental health promotion, some protective factors are listed in Table 6.

Throughout the child development process, the daily lives of children includes not only family but also the school environment. Therefore, preventive strategies for mental health in childhood and adolescence need to include training of education and health care professionals in order to be effective.[125] In addition to general approaches to prevent the harmful use of psychoactive substances, the following preventive strategies are needed:

- Training of mental health professionals and teachers in primary health care (e.g., primary health care and family health programs);
- Inclusion of courses that address mental and behavioral disorders in the school curriculum (primary and secondary education);
- Implementation of media-wide campaigns to combat the stigma against people with mental and behavioral disorders;
- Establishment of partnerships between schools and the primary health care network to identify cases that need to be referred to specialized services;
- Preparation of manuals for parents and teachers, containing notes on psychiatric disorders in childhood and adolescence;
- Creation of parent support groups that can provide guidance for families raising children;
- Administration of interventions that are proven effective in a school setting[100] (basic principles of cognitive-behavioral and motivational therapy) by facilitators (teachers, school counselors, education specialists) to students exhibiting personality traits associated with a high risk of substance use (hypersensitivity to anxiety, hopelessness, impulsiveness, novelty-seeking).[51,52]

Table 6 Protective factors[124]

Stable environment	High degree of motivation and engagement in healthy activities
Strong parent-child bond	Parental supervision and consistent discipline
Contact with prosocial institutions	Association with nonuser friends

Conclusions

Drug experimentation occurs in approximately 65 to 70% of adolescents and may be part of the normal process of youth development. However, it exposes teenagers to various hazards, from accidents and unsafe sex to multiple other high-risk behaviors. Adolescents with SUD should be viewed as individuals in development, with specific demands, which reflect on the need for specific treatment. While treating adolescents with SUD, proper diagnosis and treatment of comorbidities, identification of factors that lead to drug use, and active family involvement in the therapeutic process are of the utmost importance. In addition to abstinence of all psychoactive substances, treatment should focus on areas such as academic and vocational activities, vocational counseling, the environment and social relationships, as well as leisure activities, all of which are critical to the reestablishment of normal adolescent development. Strategies for the prevention and treatment of SUDs in adolescence are justified by the risk of serious consequences caused by substance use at this age, such as increased risk of developing psychiatric disorders and progression to addiction in adulthood.

Disclosure

The authors report no conflicts of interest.

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