Substance Use Disorders and Adolescent Psychopathology

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ABSTRACT

Adolescence is a vulnerable developmental stage where significant changes occur in a youth's body, brain, environment and socialization, which may increase vulnerability to substance use, development of addiction, and psychiatric disorders. A co-occurrence of mental and behavioral disturbances with drug involvement in adolescence is common, as reflected in both a high risk for drug use in youth with mental illness and a high frequency of psychopathology among drug users. In this review we provide a broad and basic overview of some of the research evidence indicating a strong co-occurrence of drug use disorders (abuse and dependence) with externalizing and internalizing disorders, as well as a few other serious mental health conditions among adolescents. Increasing awareness and knowledge of the high probability of the co-occurrence of mental and behavioral disturbances with drug involvement informs the understanding of the etiology, course, and treatment of psychiatric problems among adolescents.

Key Words: adolescence, comorbidity, substance use disorder, psychiatric disorder

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INTRODUCTION

Adolescence is a critical and vulnerable stage of development where significant changes occur in a youth's body, brain, environment and

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socialization, which may increase vulnerability to substance use, development of addiction and psychiatric disorders. The onset of substance use and mental and behavioral disturbances occurs for many during the adolescent years. Alcohol and nicotine obtained via the use of tobacco products are often the first and most frequently used substances among youth. Nicotine is frequently used repeatedly on a daily basis and risky or excessive alcohol consumption is a problem for some. Cannabis is one of the most commonly used illegal drugs among youth in the United States and in other countries, but rates of nonmedical use of prescription (pain relievers, tranquilizers, stimulants, and depressants) and over-the-counter medications are also alarming.[1] For many, substance use transitions into developing problems associated with the use. The National Comorbidity Survey-Adolescent Supplement (NCS-A) conducted in the US between 2001 and 2004 estimates that approximately 36.6 percent of adolescent drug users meet criteria for substance abuse with or without dependence,[2] 19.6 percent of smokers meet criteria for nicotine dependence,[3] and 27.5 percent of adolescent regular alcohol users developed alcohol abuse with or without dependence.[2] This same survey also estimates that nearly half of American youth meet lifetime criteria for at least one psychiatric disorder, with half of these associated with severe impairment.[4] Anxiety disorders were the most common condition (31.9%), followed by behavior disorders (19.1%), mood disorders (14.3%), and substance use disorders (SUDs) (11.4%).

Involvement with substances and mental and behavioral disturbances often co-occur among adolescents as reflected in both a high risk for substance use in youth with mental illness and a high frequency of psychopathology among substance users. One literature review of community studies estimated that 60 percent of youths involved with drugs had a comorbid psychiatric diagnosis.[5] In addition, the evidence from extensive study of comorbidity of SUDs and psychiatric disorders among adult samples highlights the importance of the need to understand the onset and progression of psychiatric and substance use problems and disorders among youth.[6-8]

In this review we describe a framework often used for psychiatric disorders among adolescents, and then address some of the strengths and weaknesses of the research currently being used to study the comorbidity of SUDs and other psychiatric disorders. We then follow with a broad overview of some of the research evidence indicating a strong co-occurrence of SUDs with externalizing and internalizing disorders, as well as a few other serious mental health conditions among adolescents. After briefly describing some possible explanations for the comorbid condition, this review ends with recommendations for continued research to aid prevention and intervention efforts. The goal of this review is not to be exhaustive but to highlight the

complexity of issues faced by researchers and the importance of the need to understand the phenomenon of comorbidity during the stage of life when these disorders emerge. Increasing awareness and knowledge of the high probability of the co-occurrence of mental and behavioral disturbances with substance use involvement can inform the understanding of the etiology, course, and treatment of psychiatric problems among adolescents.

DISCUSSION

One common theoretical framework for understanding psychiatric disorders among adolescents is the internalizing and externalizing model.[9] Internalization is the propensity to express distress inwards. Common internalizing disorders during adolescence include mood disorders such as major depressive disorder (MDD), dysthymia, and anxiety disorders including generalized anxiety disorder, separation anxiety disorder, phobias, and obsessive-compulsive disorder. Conversely, the propensity to express distress outwards is known as externalization. Disruptive behavior disorders such as attention-deficit/hyperactivity disorder (ADHD), oppositional defiant disorder, and conduct disorder (CD) are common externalizing disorders during adolescence. SUDs also fall under the category of disruptive behavior disorders, but for this review we address the comorbid condition co-occurring with one or more of other externalizing or internalizing disorders, thus known as a dual diagnosis. Factor analytic studies suggest distinctions between internalizing and externalizing disorders,[10-13] however, evidence also suggests a high co-occurrence between as well as among these disorders in adolescence.[11-14] It appears that psychopathology cannot be reduced to a simple structure. Patterns are influenced by gender, age, persistence, and the constellation of diagnoses included.[15,16] These inconsistent patterns might be a key to understanding the associations and sequencing across disorders.[17]

Since comorbidity implies that two disorders occur in the same individual simultaneously or sequentially, and that the interactions between the two disorders can affect the course and prognosis of either disorder, many studies have attempted to quantify and establish the temporal ordering of the comorbidity between SUDs and psychiatric disorders among youth. However, differences in the research design, samples, the assessment procedure and criteria used to identify 'cases', and other assessment issues (e.g., different informants, timeframe captured) often result in a wide variation of estimates and a limited depiction of the interplay and sequencing of symptoms and disorder development. Below we highlight some of the research issues faced by those studying comorbidity in adolescents and illustrate the diversity of research approaches taken by several selected studies.

Research designs and samples

The most common study design used in the field of comorbidity research is the cross-sectional study. Cross-sectional studies report a strong positive association between substance use and psychiatric disorders but rely heavily on accurate recall or use participants of different ages to estimate the probable inter-relatedness and temporality. Retrospective lifetime prevalence may under-estimate how common psychiatric disorders are.[18] Therefore, ideally to determine the comorbid relationship and order of onset of the disorders, researchers need to use prospective, longitudinal studies, in which adolescents are followed over long periods of time and monitored for the development of the disorders under investigation. A disadvantage to studying comorbidity using cohort studies is that they must be very large and have long follow-up time to accrue a sufficient numbers of cases.

The context of where the sample is drawn from and sample characteristics are important to consider in interpreting results and of course extremely important for generalization purposes. Policy and other environmental and social factors (e.g., taxation, minimum age laws, cultural morals and sanctions) can influence the availability and access to substances, thus patterns of specific substance use and SUD trajectories can vary among youth in different countries and even regions of a country. In addition, differences in the co-occurring rates and patterns of substance use and mental health problems have been found to vary by sex and age.[19-22]

Adolescents with comorbid disorders can be easily found in treatment facilities; an estimated 70 to 80 perent of youth seeking substance abuse treatment have one or more comorbid disorder.[23] Strengths of studies coming from clinical sites often include the rigorous assessments of not only a broader array of disorders, but also, of diagnoses that conform to the structure of the International Classification of Diseases (ICD) and Diagnostic and Statistical Manual of Mental Disorders (DSM) systems. They are especially useful when exploring comorbidity with less common specific disorders (e.g., Obsessive-Compulsive Disorder). However, clinical samples cannot provide unbiased rates or estimates of risk factors for comorbidity as many youth do not receive treatment or are not treated in clinical settings. Individuals seeking help often have more severe symptomology, and more impairment than those who do not seek treatment. To reduce the potential for selection biases, it is also important to evaluate the comorbid relationship in general population samples.

Many population based epidemiologic studies conducted in the US, including some prospective longitudinal studies, have utilized regional samples, and findings may not be generalizable to the general adolescent

US population (e.g., Great Smokey Mountains Study of Youth; Oregon Adolescent Depression Project; Teen Health 2000).[19,24-26] Indicators of mental health are included in several US national surveys of youth,[27-31] however the range of psychiatric disorders and identification of SUD, not only use, has been limited until recently. A main objective of the NCS-A was to provide empirical data of a wide range of psychiatric disorders from a nationally representative sample of US children and adolescents.[32]

Researchers from other countries have also shed evidence on the co-occurrence of mental health issues and substance use among adolescents. Some examples include the Ontario Health Study which was a cross-sectional community survey of children four to 16 years of age,[33] two famous New Zealand cohorts with long term follow-up: Christchurch Health and Development Study[34] and the Dunedin Multidisciplinary Health and Development Study,[35] and the Early Developmental Stages of Psychopathology Study that is following youth from Munich, Germany and surrounding areas over time and whose design features include linkage with a family supplement and neurobiological laboratory studies of high-risk subjects.[36]

Assessment issues

There are various approaches to assessing mental health conditions among youth; using instruments based on taxonomy or symptom scales. A psychiatric disorder diagnosed via the ICD or DSM schema requires specific criteria and signs of impairment. Issues can arise in how different studies apply and operationalize the criteria (not to mention that the DSM criteria have changed over time). For example, the NCS-A study has been criticized for using substance abuse symptoms to screen for dependence; as a result, it does not capture information on youth who meet criteria for dependence but never met criteria for abuse.[37] Also worth noting is that meeting disorder criteria does not necessarily imply functional impairment nor capture a severity threshold. On the other hand, clinically significant symptoms below the count necessary to warrant a diagnosis can be associated with functional impairment and are often the precursor of an emerging disorder and subthreshold diagnoses of substance use problems have been associated with psychiatric symptoms.[38,39]

Other common approaches used to screen for psychopathology among youth utilize lists of symptoms that often map onto DSM criteria.[40] Instead of classifying the presence or absence of a diagnosis, symptom scales are used to rank the probability of having emotional and behavioral problems that might require further evaluation, clinical services or preventive interventions.

Though only approximating a psychiatric diagnosis, they may be useful in detecting syndromes and subclinical symptoms. Studies using data obtained from one such tool, the Youth Self-Report (YSR) developed by Achenbach,[41] find emotional and/or behavioral problems to be associated with substance use.[42-44] Problem behaviors have also been associated with a rapid development of nicotine dependence among youth who recently initiated smoking[45] and with both single and multiple SUDs in early adulthood.[46]

It takes time and resources to assess a variety of psychiatric and SUDs. The number and array of diagnoses one wishes to assess accurately creates challenges for the design and administration and adds to the respondent burden. Lay interviewers can administer structured instruments to assess psychiatric disorders but training is required. Assessing the various substances youth can become involved in, especially as they become older and have increased opportunities and access to illicit as well as non medical prescription type drugs, as well as mapping abuse and dependence criteria for each substance type can easily become daunting. Many studies, instead of describing SUD ascribed to specific substances, use an 'any' SUD approach. However, the choice of what substance one uses to define the SUD may influence comorbidity patterns as different substances have different effects (e.g., stimulant versus depressive) and the reasons for use may also vary between individual (e.g., seeking a high versus self medicating). Comorbid associations between SUDs and externalizing disorders are often the strongest and the association between marijuana dependence and other psychiatric disorders is often weaker than those with alcohol or other drugs.[19] Because of the low prevalence of many specific psychiatric disorders as well as SUDs resulting from certain substances, large sample sizes are needed for such specificity.

A controversial point in assessing substance use and psychiatric disorders is whether it is sufficient to rely only on adolescent self-reports. A youth's knowledge of their own behavior and emotions makes them a potentially important contributor to the assessment process; however, comorbidity patterns among emotional and behavioral syndromes have been found to vary with the informant and there may be differential reporting by parents and youth by ethnic groups.[19,47] Studies may use different informant sources such as parent reports only, youth report only, or a combination. Algorithm diagnoses cannot replace clinical judgment of the significance and impairment attributed to the diagnoses, but studies suggest that the general patterns of comorbidity are not affected by whether the data is put together by a clinician or by means of a computer algorithm scoring a structured interview.[21]

Regardless of who the respondent is, another concern is how well does one distinguish and recall symptoms (potentially overlapping ones) over time.

Recall is also an extremely important limitation to establishing a greater understanding of the temporal sequencing, persistence and even re-occurrence of disorders. To avoid recall bias and have more immediate clinical relevance for treatment purposes, assessments tend to capture symptom experiences over a short time frame (i.e., a point prevalence of previous 30 days, 3 month or 12 month period). Surveys, on the other hand, often inquire about cumulative lifetime experiences. Retrospective recall bias may be less of an issue among adolescents because they are reflecting back upon fewer accumulated years of life than adults, but special probes as those used in the NCS-A that have been found to help increase recall among adults might still be useful in helping the youth to recall their experiences more reliably.[48]

Another cautionary note relates to a limitation of the term comorbidity, as it does not distinguish between a multitude of different temporal relationships among disorders. Angold and colleagues suggested differentiating concurrent from successive comorbidity.[14] In concurrent comorbidity, even if the time of onset and offset are not coterminous, the disorders must have at some point in time been present concurrently (or if not in time in phenomenology). This type of comorbidity is often captured in studies that have assessed point (current) prevalence. On the other hand, studies assessing lifetime prevalence may not determine if the disorders ever occurred simultaneously, suggesting that the term successive comorbidity may be more appropriate. Thus, when comparing results across studies comorbidity rates can be very different, probably because lifetime comorbidity although capturing a longer time period relays heavily on recall. However, lifetime prevalence based on retrospective age-of-onset reports from cross sectional studies may be used to help capture the development of comorbidity by distinguishing the onset versus the persistence of the disorders.[17]An even stronger design would be to study the temporal sequencing of lifetime and current disorders in a longitudinal cohort of adolescents as with the Early Developmental Stages of Psychopathology Study.[49]

Finally, caution must also be taken not to artificially elevate the rates for psychiatric disorders because of a tendency to establish a diagnosis before some of the psychiatric symptomatology secondary to the substance use abates. A diagnosis of a substance-induced mental disorder may be averted by observing the adolescent for a minimum of four weeks after discontinuing drug use. For example, cocaine-induced states need to be clearly differentiated from schizophrenia, mood disorders, and anxiety disorders. Ruling this out may be difficult for adolescents to establish on their own when they are self reporting symptoms on a survey with fewer probes than what might occur in a clinical assessment as they may not recognize the connection.

As seen from the brief review of research issues above, the complexity of the subject matter increases the need for sophistication in how we study and understand it. It does not necessarily mean the literature is flawed, but caution should be taken when making inferences and generalizations based upon findings from different studies. Instead of relying on deductions about the onset of comorbidity obtained from adult studies fraught with recall biases, we need to obtain a clearer picture of what is happening during the developmental stages of youth as symptoms and behaviors onset to determine trajectories of persistence and severity. Evidence already suggests there are specific features of substance use and the psychiatric condition that merit attention and detailed prospective monitoring. Therefore, future research should, whenever possible, focus on longitudinal study designs that start collecting data in early childhood of representative samples of youth in order to disentangle premorbid pathways that lead to comorbid SUD and psychiatric disorders.

Research Evidence

Next our review highlights some of the evidence on the magnitude and the kinds of co-occurring psychiatric and SUDs reported in some selected clinical samples as well as population-based studies of adolescents. A search of the PubMed, PsychInfo and Scopus databases identified several clinical and general population studies published in the past 15 years that specifically included adolescent samples with comorbid substance use and psychiatric disorders. Search terms included specific internalizing and externalizing disorders (e.g., ADHD, anxiety, depression) and SUD (including substance abuse, substance dependence, drug abuse, drug dependence, alcohol abuse, alcohol dependence). A preference was given for studies using diagnoses obtained via structured interviews and epidemiologic studies that used probability/representative sampling. In addition, because our main focus was on SUDs, studies focusing on comorbid substance use/drug use and psychiatric disorders were excluded. We observed a tendency for some research teams to strictly focus (or at least only publish) on either externalizing or internalizing disorders, not always both, as well as often limiting the assay of substance disorder to the more commonly used substances (e.g., alcohol and cannabis).

Globally, national estimates of the overall occurrence of comorbidity are generally lacking as not all studies of adolescent samples focus on one of the comorbid disorders being SUDs per se, nor are structured diagnostic assessments routinely used to assess both the substance use and mental health status. In the US, the Oregon Adolescent Depression Project found that twice as many adolescents with a SUD also had a psychiatric disorder

(66.2%) compared to those with a psychiatric disorder who had a SUD (31.3%).[50] More recently, the NCS-A study reported 40 percent of adolescents with one class of disorder also met criteria for another class of lifetime disorder.[4] Hopefully, future publications of the NCS-A will provide greater distinction of specific comorbid patterns as the 40 percent is likely an over estimation of the kind of comorbidity we are focusing on (substance use and psychiatric disorders), as comorbidity between other internalizing and externalizing disorders where SUDs are not present also occurs. In the meantime, findings from a study of a probability sample of youth enrolled in a health maintenance organization provide some interesting insights. The patterns of comorbidity suggest that the comorbid relationship between a SUD and psychiatric disorder may vary by the type of substance (e.g., less with marijuana), by the type of SUD (e.g., less with abuse versus dependence), and by the type of psychiatric disorder (e.g., strongest for behavioral disorders).[19] Some of these patterns have also been seen in adult data and may also extend to subthreshold disorders as well.[50,51]

The type of psychiatric paychopathology most commonly diagnosed in adolescents with SUDs are the externalizing disorders.[53] Clinical studies document a high degree of co-occurrence of ADHD and CD among adolescent samples with SUDs (Table 1). Since many of the samples were derived from treatment programs a wide array of substances were included under the any SUD classification as youth having problems with one substance type often are using other substances as well. The sample variation in age, sex and other factors, such as racial mix, inner city versus rural setting, or type of program or center in which the research was performed result in a wide range of comorbid rates. However, these clinical studies indicate the importance of exploring subgroup variation. For example, gender differences were often greater among those with comorbid ADHD and alcohol disorder than with comorbid CD and alcohol disorder. Additionally, race/ethnicity differences were observed among youth with SUD, indicating that Whites, Hispanics, individuals of mixed race, and individuals endorsing "other" race exhibited greater rates of either ADHD or CD than did African Americans or American Indian/Alaskan Natives with SUD.

Congruent with findings from clinical studies, evidence from epidemiologic studies of various designs indicate the comorbidity between externalizing disorders and SUDs in adolescents exists in the general population as well (Table 2). These studies also show that in addition to ADHD and CD, oppositional defiant disorder (ODD) commonly co-occurs with SUD in the adolescent population. [22,54-58] Many of the SUD disorders are substance specific or the any SUD is based on the more commonly used substances at younger ages: nicotine, alcohol and cannabis. Several of the

Table 1

Selected clinical studies illustrating the co-occurrence of externalizing disorders and SUDs in adolescence

Study	Country/ Region	N	Sample age	Setting*	Assessment tool**	Substance Use Disorder (SUD)	Co-occurring Psychopathology***
Chan et al. 2008[20]	USA 77 treatment centers throughout country	916	<15 years	Variety of substance treatment programs	GAIN (past year)	Any SUD - alcohol, amphetamine, cannabis, cocaine (including crack), hallucinogens, inhalants, opioids (including heroin), phencyclidine (PCP), sedatives, and other drug use (e.g., over-the-counter drugs)	ADHD (74.2%), CD (63.6%)
Chisolm et al. 2009[140]	USA	9,030	12-17 years	Several residential and outpatient drug treatment programs	GAIN (past year)	Any SUD - alcohol, amphetamine, cannabis, cocaine (including crack), hallucinogens, inhalants, opioids (including heroin), phencyclidine (PCP), sedatives, and other drug use (e.g., over-the-counter drugs)	Race/ethnicity differences: Overall, ADHD or CD (71%); Whites (73%), Hispanics (71%), Mixed race (77%), and Other race (72%) exhibited higher rates of ADHD or CD than African Americans (59%) or American Indians/Alaskan Natives (60%)
Clark et al. 1997[141]	USA Pittsburgh, PA	251	Mean age: 14 years	Hospital-based treatment program	SCID and The Lifetime History of Alcohol Use Interview (lifetime)	Alcohol dependence	Gender differences: ADHD present in 16% of females and 37% of males, CD present in 75% of females and 88% of males

Table 1 Contd.

Study	Country/ Region	N	Sample age	Setting*	Assessment tool**	Substance Use Disorder (SUD)	Co-occurring Psychopathology***
Crowley et al. 1998[96]	USA Denver , CO	229	13-19 years	Residential (males) and outpatient (females) substance treatment program	CIDI-SAM, DISC, CASI (lifetime)	Any SUD – cannabis, alcohol, tobacco, hallucinogens, amphet-amines, cocaine, inhalants, sedatives, opioids	ADHD (14.8%), CD (82.1%)
Grella et al. 2001[70]	USA 23 programs in Pittsburgh, PA Minneapolis, MN Chicago, IL Portland, OR	992	60% were 16 and older	Residential, short term inpatient and outpatient drug treatment programs	DISC-R (CD: lifetime; ADHD: past few months)	Any SUD – cannabis cocaine, alcohol	ADHD (13%), CD (59%)
Langenbach et al. 2010[142]	Germany metropolitan and rural clinics	151	Mean age: 16.95	Inpatient treatment referrals	CIDI, K-SADS-PL, FTND (lifetime and last 6 months)	Alcohol, cannabis, amphet-amines, Ecstasy, tobacco, hallucinogens, cocaine, opiates, inhalants	Lifetime ADHD (20.0%), CD (60%)
Molina et al. 2002[143]	USA Pittsburgh, PA	395	14-19 years	Inpatient and outpatient substance treatment program	SCID, K-SADS (lifetime)	Alcohol use disorder (AUD)	Gender differences: ADHD present in 17% of females and 37% of males, CD present in 63% of females and 82% of males

Table 1 Contd.

Study	Country/ Region	N	Sample age	Setting*	Assessment tool**	Substance Use Disorder (SUD)	Co-occurring Psychopathology***
Tims et al. 2002[144]	USA 4 metropolitan areas	600	12-18 years	Outpatient drug treatment programs and research facilities	GAIN (current and lifetime)	Cannabis use disorder	ADHD (38%), CD (53%)
Whitmore et al. 1997[145]	USA Denver, CO	367	15-16 years	Residential (males) and outpatient (females) substance treatment program	CIDI-SAM; DISC-2.1; CASI-A (CD: lifetime; ADHD: 6-month)	Any SUD – cannabis, alcohol, tobacco, hallucinogens, amphetamines, cocaine, inhalants, PCP, opioids, sedatives	No gender differences: ADHD present in 10% of females and 11% of males, CD present in 80% of males and females

* The adolescent was the informant in all these studies.

** Global Assessment of Individual Needs (GAIN); Composite International Diagnostic Interview-Substance Abuse Module (CIDI-SAM); Diagnostic Interview Schedule for Children (DISC-2.1); Comprehensive Addiction Severity Index-Adolescents (CASI-A);The Structured Clinical Interview for DSM-III-R (SCID); Schedule for Affective Disorders and Schizophrenia for School-Age Children (K-SADS), Present and lifetime (K-SADS-PL); Diagnostic Interview Schedule for Children (DISC), Revised (DISC-R); Comprehensive Addiction Severity Index (CASI), Fagerstrom Test for Nicotine Dependence (FTND).

*** ADHD = Attention Deficit Hyperactivity Disorder, CD = Conduct Disorder, ODD = Oppositional Defiant Disorder.

Table 2

Selected epidemiologic studies of general population samples illustrating the co-occurrence of externalizing disorders and SUDs in adolescence

Study	Country/ Region	N	Sample age	Assessment tool*	Informant	Disorder based on what substance	Co-occurring Psychopathology**
Surveys							
August et al. 2006[54]	USA Minnesota	200	High school senior or 1 year post-graduation	BASC-PRF and BASC-TRF, DICA-R (lifetime, past year)	Adolescents, parents, and teachers	Alcohol, marijuana, and "other" (sum across all 12 drug categories)	Among adolescents with ADHD plus CD/ODD, 46.4% had an alcohol use disorder, 54.8% marijuana use disorder, 11.9% another SUD
Chong et al. 1999[146]	Taiwan 1 urban, 1 suburban, 1 rural area	774	9th grade	Chinese K-SADS-E (current, lifetime)	Adolescents	Any SUD – alcohol, betel, tobacco	ADHD (12.3%), CD (44.0%)
Disney et al. 1999[147]	USA Minnesota	1252	17 years	DICA-A; CIDI (lifetime)	Adolescents	Any SUD – nicotine, alcohol, cannabis	Any SUD was present in 62.5% of females with ADHD+CD, 52.5% of females with CD, 29.2% of females with ADHD, 46.0% of males with ADHD+CD, 38.8% of males with CD, and 14.3% of males with ADHD
Feehan et al. 1994[148]	New Zealand	930	18 years	DIS; Denver Youth Survey Youth Interview Schedule (current and past-year)	Adolescents and significant other	Any SUD – alcohol, marijuana, and any SUD	Among individuals with substance dependence, 49% also had CD

Table 2 Contd.

Study	Country/ Region	N	Sample age	Assessment tool*	Informant	Disorder based on what substance	Co-occurring Psychopathology**
Kandel et al. 1999[55]	USA Connecticut, Georgia, Westchester County, NY, Puerto Rico	401	14-17 years	DISC-2.3; DISC-C for adolescents and DISC-P for caregivers (current)	Adolescent and one adult caregiver	Alcohol, marijuana, and other	Among individuals with SUD, 68% had a current disruptive behavior disorder (ADHD, CD, ODD) or antisocial personality disorder
Kessler et al. 2012[17]	USA National	10148	13-17 years	CIDI (lifetime)	Adolescents and parents	Any SUD doesn't specify what substances	Among individuals with pure substance use disorders (i.e., those without other disorders) 50% had CD
Randall et al. 1999[56]	USA Charleston, SC	118	12-17 years, juvenile offenders	DISC-2.3 (current)	Adolescents and primary caregivers	Any SUD – alcohol, cannabis, "other" (cocaine, amphetamines, Quaaludes, barbiturates, LSD, other psychedelics, tranquilizers, heroin, other narcotics, inhalants)	Any externalizing disorder (ADHD, CD, ODD) present in 27%
Roberts et al. 2007[19]	USA Houston, TX HMO	4175	11-17 years	DISC-IV (past year)	Adolescents and one caregiver	Alcohol, cannabis, other, and any SUD	Females had increased odds for ADHD with alcohol and marijuana dependence
Rohde et al. 1996[57]	USA Oregon	1709	14-18 years	K-SADS-E and K-SADS-P (lifetime)	Adolescents	Alcohol use disorder (AUD)	Any disruptive behavior disorder (ADHD, CD, ODD) present in 25.5%

Table 2 Contd.

Study	Country/ Region	N	Sample age	Assessment tool*	Informant	Disorder based on what substance	Co-occurring Psychopathology**
Sartor et al. 2006[149]	USA	1269	12-28 years, mean age 20.1 years	SSAGA-II (lifetime)	Adolescents, young adults, adults, and mothers	Alcohol dependence	CD associated with future alcohol dependence (ORs only, no proportions)
Vreugdenhil et al. 2003[150]	Netherlands	313	12-18 years, incarcerated males	DISC-2.3; YSR (lifetime)	Adolescents	Any SUD – alcohol, cannabis, "other"	Alcohol dependence, cannabis abuse and dependence, and poly-substance abuse and dependence associated with externalizing disorders (ORs only, no proportions)
Prospective Studies							
Costello et al. 1999[22]	USA rural North Carolina	1420	9-13 at baseline 16 at follow up	CAPA (substance use: ever and past 3 months; psychopathology past 3 months)	Adolescents and one biological parent	Any SUD – tobacco, alcohol, cannabis, cocaine, crack, amphetamines, ice, inhalants, heroin, other opioids, LSD, PCP, psylocibin, sedatives, steroids, other substances	Stronger effect of conduct problems on substance use in girls than boys Among adolescents with ADD, CD, or ODD, 26.2% of females had an SUD, 11.3% of males had an SUD
Elkins et al. 2007[59]	USA Minnesota	3024	11 at baseline 18 at follow up	CIDI-SAM, DICA-A (baseline lifetime; follow-up the interval between interviews)	Adolescents and mothers	Nicotine dependence, alcohol use disorder, cannabis use disorder	CD at age 11-14 predicted nicotine dependence, alcohol use disorder, and cannabis use disorder at age 18 (ORs only, no proportions)

Table 2 Contd.

Study	Country/ Region	N	Sample age	Assessment tool*	Informant	Disorder based on what substance	Co-occurring Psychopathology**
Fergusson et al. 2007[34]	New Zealand	977	Birth cohort followed up until age 25	DISC & CIDI (past month, past year)	Children, adolescents, and young adults	Nicotine dependence, alcohol dependence, cannabis dependence, other illicit drug dependence	ADHD at age 14-16 predicted nicotine, alcohol, cannabis, and other illicit drug dependence at age 18, 21 or 25 (betas only, no proportions), CD at age 14-16 predicted cannabis dependence at age 18, 21, or 25 (betas only, no proportions)
Griesler et al. 2011[94]	USA Chicago, IL	814	6th-10th graders, followed up 2 years later	DISC-IV-Y; DISC-IV-P (lifetime)	Adolescents and mothers	Nicotine dependence	At baseline, among individuals with nicotine dependence, 2.1% had ADHD, 11.4% had ODD, and 14.2% had CD; At final follow up (2 years later), 2.9% had ADHD, 14.2% had ODD, and 21.2% had CD
Lambert et al. 1998[151]	USA San Francisco Bay Area, CA	492	Kindergarten-5th grade, followed up until adulthood	QDIS-III-R, CAAS (SUD: current and lifetime; psychopathology: lifetime)	Children, parents, teachers	Daily cigarette smoking	By age 17, the proportion of participants with ADHD (46%) who were smokers exceeded that of age-mate controls (24%)

Table 2 Contd.

Study	Country/ Region	N	Sample age	Assessment tool*	Informant	Disorder based on what substance	Co-occurring Psychopathology**
Molina et al. 2007[60]	USA Pittsburgh, PA	604	5-17 years at baseline, followed up on average 8 years later at ages 11-28	SCID & DBD (current and lifetime)	Adolescents, parents, and teachers	Alcohol use disorder	Among adolescents with ADHD, 14.6% lifetime alcohol abuse and 11.1% lifetime alcohol dependence
Wittchen et al. 2007[58]	Germany Munich	1395	14-17 at baseline 24-27 at follow up	Munich-CIDI (current, time period between interviews, lifetime)	Adolescents	Cannabis use disorder (CUD)	Reciprocal pathways: Cross-sectional analyses – Among individuals with CUD at baseline, 4.2% had ADHD and 4.4% had ODD Prospective analyses - Among individuals with baseline ADHD and ODD, 6.5% and 7% developed CUD at follow up, respectively

* Behavioral Assessment Scale for Children:Parent Report Form (BASC-PRF) and Teacher Report Form (BASC-TRF); Child and Adolescent Psychiatric Assessment (CAPA); Quick Diagnostic Interview Schedule, third edition, revised (QDIS-III-R); Children's Attention and Adjustment Survey (CAAS); Epidemiologic version of the Schedule of Affective Disorders and Schizophrenia (KSAD-E) and the Present Episode version (K-SADS-P);Structured Clinical Interview for DSM-IV (SCID); Diagnostic Interview for Children and Adolescents-Revised (DICA-A); Diagnostic Interview Schedule for Children (DISC); Composite International Diagnostic Interview (CIDI); Substance Abuse Module (CIDI-SAM); Parent and Teacher Disruptive Behavior Disorder (DBD) Rating Scale; Semi-Structured Assessment for the Genetics of Alcoholism (SSAGA-II); modified Fagerström Tolerance Questionnaire (mFTQ).

** ADHD = Attention Deficit Hyperactivity Disorder, ADD = Attention Deficit Disorder, CD = Conduct Disorder, ODD = Oppositional Defiant Disorder.

epidemiologic studies include information obtained from other informants when making diagnostic classifications. Evidence from several of the longitudinal studies analyzing the co-occurrence prospectively find that the onset of externalizing psychopathology tends to precede the development of SUDs.[34,59,60]

In addition to descriptions of categorical classifications of externalizing psychopathology, a body of literature exists that describes how specific components or symptoms and personality traits are associated with substance use and SUDs in adolescence. In particular, many studies find that aggressive behavior, a component of CD, and violence accompany and often precede adolescent substance use and SUD.[61-64] Additionally, impulsivity, one of the components of ADHD, is often associated with initiation of alcohol use in adolescence,[65] while hyperactivity in childhood is associated with a greater likelihood of being arrested in young adulthood for charges stemming from illegal drug possession, use, and sale.[66] Furthermore, it is possible that reciprocal relationships exist between psychopathological symptoms and substance use behaviors, as certain drugs, such as alcohol, anabolic steroids, benzodiazepines, and cocaine can escalate the development of aggression and violent behavior.

Evidence of a high prevalence of a co-occurrence between internalizing disorders and SUDs is also shown in both clinical and epidemiologic studies.[53,67] A review found evidence that comorbidity rates are higher in samples of adolescents where SUD appeared first than among youth where internalizing disorders preceded the onset of other disorders.[67] Table 3 provides some examples of clinical-based research where high rates of internalizing disorders, particularly MDD, are often found among adolescent samples who are in treatment for SUDs. On the other hand, adolescents in treatment for psychiatric disorders also have comorbid SUDs.[68] Modest rates of anxiety disorders, especially posttraumatic stress disorder, are also often found among youths with SUDs, ranging from six percent to 38 percent.[69,70] Studies also find comorbidity between SUD in adolescence and bipolar disorder.[71,72] As seen in the clinical studies of externalizing disorders, the substances included in the disorder category vary across studies, as do sample characteristics. Gender differences were noted by a few of the studies where females tend to have higher rates of comorbidity between SUDs and internalizing disorders than males.

Numerous epidemiologic studies find mood and anxiety disorders strongly associated with SUDs in more general population samples of adolescence (Table 4). In many of these studies the SUD disorders are substance specific but in some studies the SUD includes other illegal drugs that are sometimes not specified as to what particular type of substances

Table 3

Selected clinical studies illustrating the co-occurrence of SUDs and internalizing disorders in adolescence

Study	Country/Region	N	Sample age	Setting*	Assessment tool**	Substance Use Disorder (SUD)	Co-occurring Psychopathology***
Clark et al. 1997[141]	USA Pittsburgh, PA	1333	14-18 years	Inpatient, Outpatient, Juvenile justice and residential treatment programs	SCID and K-SADS (lifetime and past 6 months)	Alcohol dependence	Gender differences: MDD present in 69% of females and 29% of males and PTSD present in 13% of females and 7% of males
Crowley et al. 1998[96]	USA Denver, CO	229	13-19 years	Residential (males) and outpatient (females) substance treatment program	CIDI-SAM, DISC (lifetime, past year)	Cannabis use disorder	MDD (17.5%)
Deykin et al. 1987[152]	USA Massachusetts	223	15-19 years	Residential treatment for substance use disorders	DIS (lifetime and current)	Alcohol and any drug dependence (unspecified)	MDD (24.7%)
Grella et al. 2001[70]	USA 23 programs in Pittsburgh, PA Minneapolis, MN Chicago, IL	992	60% were 16 and older	Residential, short term inpatient and outpatient drug treatment programs	DISC-R (lifetime)	Alcohol, cannabis and cocaine dependence	MDD (15%)

Table 3 Contd.

Study	Country/Region	N	Sample age	Setting*	Assessment tool**	Substance Use Disorder (SUD)	Co-occurring Psychopathology***
Hannesdóttir et al. 2001[153]	Iceland	103	12-18 years	Detoxification treatment for any SUD	Youth Self-Report (YSR) and hospital records (ICD-10 and DSM-IV diagnosis)	Alcohol and cannabis dependence and any substance abuse (unspecified)	MDD (28%), Anxiety disorder (6%) and PTSD (11%)
Langenbach et al. 2010[142]	Germany metro and rural clinics	151	Mean age: 16.95	Inpatient treatment referrals	CIDI, K-SADS-PL, FTND (lifetime and last 6 months)	Alcohol, cannabis, cocaine, opiates, inhalants	Lifetime Mood (21.9%) and Anxiety disorder (26.5%), PTSD (7.9%) Gender difference: females more PTSD (18.9% vs 4.4%), Anxiety (40.5% vs 21.9%) and somatoform disorders (32.4% vs 8.8%)
Lubman et al. 2007[71]	Australia Melbourne	100	16-22 years	Urban youth drug treatment services (unspecified if in or outpatient)	SCID for DSM-IV (lifetime and current)	Cannabis, Opiate Alcohol, Amphetamine, volatile substance, sedative, hallucinogen, cocaine and polysubstance use disorder	Current mood disorders (MDD: 22.6% and Bipolar I disorder: 1.9%) and Anxiety disorders (Panic: 3.8% and PTSD 18.9%)

Table 3 Contd.

Study	Country/Region	N	Sample age	Setting*	Assessment tool**	Substance Use Disorder (SUD)	Co-occurring Psychopathology***
Rowe et al. 2004[154]	USA Miami	182	12-17 years	Outpatient drug treatment program	DISC (current)	Alcohol dependence, cannabis abuse and dependence and other substance dependence (unspecified)	Mood (30%) and Anxiety (38%) disorders
Wise et al. 2001[72]	USA South Carolina	91	13-18 years	Residential drug treatment program retrospective record review	DSM-IV diagnoses as assessed by a child psychiatrist at admission to treatment (unspecified)	Polysubstance abuse/ dependence (most common were alcohol, cannabis and cocaine)	MDD (24%) and Bipolar disorder (3.3%)
Wu et al. 2011[68]	USA Durham, NC	11457	13-17 years	Electronic health records database of inpatients and outpatients of large university-based hospital	Medical records of DSM-IV diagnoses based on treatment visits	Alcohol, cannabis, cocaine, opioid/ heroin and sedative use disorders (most prevalent was cannabis use disorder)	Among adolescents with Mood and Anxiety disorders: 13.5% had one SUD and 11.7% had 2 or more SUDs. Among adolescents with a SUD: 28.6% had a Mood disorder and 9.1% an Anxiety disorder

* The adolescent was the informant in all these studies.

** Diagnostic Interview Schedule for Children (DISC), Revised (DISC-R); Diagnostic Interview Schedule (DIS); Composite International Diagnostic Interview (CIDI); Substance Abuse Module (CIDI-SAM);Schedule of Affective Disorders and Schizophrenia (KSAD).

*** MDD =Major depressive disorder; PTSD =Post Traumatic Stress Disorder.

Table 4

Selected epidemiologic studies of general population samples illustrating the co-occurrence of SUDs and internalizing disorders in adolescence

Study	Country/ Region	N	Sample age	Assessment tool*	Informant	Disorder based on what substance	Co-occurring Psychopathology**
Surveys							
Chong et al. 1999[146]	Taiwan 1 urban, 1 suburban, 1 rural area	774	14-16 years	Chinese K-SADS-E (current, lifetime)	Adolescents	Alcohol, tobacco, betel nut and illegal drugs (unspecified)	Among those with SUD 11.1 % had concurrent Mood disorders and 7.4% Anxiety disorders
Kandel et al. 1999[55]	USA sample of adolescents with SUDs in the community	401	14-17 years	DISC-2.3; DISC-C for adolescents and DISC-P for caregivers (current)	Adolescents and caretakers	Alcohol, cannabis, and other illegal drug use disorders (unspecified)	Current SUD associated with concurrent Mood (32%) or Anxiety (20%) disorder
Lansford et al. 2008[155]	USA Knoxville and Nashville, TN Bloomington, IN	585	18 years	DISC (past-year)	Adolescents	Cannabis, amphetamines, cocaine, opiates, sedatives, inhalants, hallucinogens, PCP	Sometimes Mood (10%) and Anxiety (9%) disorders alone associated with SUD but 21% had all three disorders
Lewinsohn et al. 1997[156]	USA Oregon	1507	14-18 years	K-SADS (lifetime and past-year)	Adolescents	Alcohol and illegal drugs (unspecified)	Lifetime comorbidity: Among those with Anxiety disorders 11.9% had an AUD and 66.2% had any SUD

Table 4 Contd.

Study	Country/ Region	N	Sample age	Assessment tool*	Informant	Disorder based on what substance	Co-occurring Psychopathology**
Roberts et al. 2007[19]	USA Houston, TX HMO	4175	11-17 years	DISC IV (past year)	Adolescents and one caregiver	Alcohol, cannabis and other illegal drugs (stimulants, cocaine, crack, heroin, PCP, opiates, hallucinogens, inhalants, sedatives, amyl nitrite/poppers and steroids)	SUD associated with Mood and Anxiety disorders
Rohde et al 1991[157]	USA Oregon	1710	14-18 years	K- SADS (lifetime and present episode)	Adolescents	Alcohol and illegal drugs (unspecified)	Current and lifetime comorbidity SUD preceded MDD: 14% with current MDD had a current SUD and 19.9% with current MDD had history of lifetime SUD
Rohde et al. 1996[57]	USA Oregon	1507	14-18 years	K- SADS (lifetime and present episode)	Adolescents	Alcohol	Lifetime comorbidity MDD in 47.9% of those with AUD and 27.1% of females with AUD had anxiety disorders
Prospective Studies							
Copeland et al. 2011[73]	USA rural North Carolina	1420	9-13 at baseline, 21 at follow-up	CAPA until age 16, YAPA after age 16 (past 3 months)	Adolescents and one parent (83% biological)	Alcohol	Psychiatric disorders preceded SUD Childhood/adolescent MDD (11.2%) and anxiety disorder (9.2%) associated with persistent AUD

Table 4 Contd.

Study	Country/ Region	N	Sample age	Assessment tool*	Informant	Disorder based on what substance	Co-occurring Psychopathology**
Costello et al. 1999[22]	USA rural North Carolina	1420	9-13 at baseline. 16 at follow up	CAPA (substance use: ever and past 3 months; psychopathology past 3 months)	Adolescents and one parent (83% biological)	Tobacco, alcohol, cannabis, cocaine, crack, amphetamines, ice, inhalants, heroin and other opioids, LSD, PCP, psilocybin, sedatives, steroids and other substances (unspecified).	Psychiatric disorders preceded SUD SUD found in 34.7% of girls with MDD and 29.9% of boys with MDD
Sung et al. 2004[158]	USA rural North Carolina	1420	9-13 at baseline, 16 at follow-up	CAPA (substance use: ever and past 3 months; psychopathology past 3 months)	Adolescents and one parent (83% biological)	Tobacco, alcohol, cannabis, cocaine, crack, amphetamines, ice, inhalants, heroin and other opioids, LSD, PCP, psilocybin, sedatives, steroids and other substances (unspecified).	Psychiatric disorders preceded SUD MDD associated with future SUD in boys, Anxiety disorders associated with future SUD in girls (only ORs, no proportions)
Fergusson et al. 2011[75]	New Zealand, urban birth cohort	953	Birth cohort 25 at follow up	CIDI (past month, past year)	Adolescents	Alcohol, tobacco (nicotine) and illegal drugs (unspecified)	Comorbidity between depression and anxiety disorders with nicotine dependence, alcohol use disorder and illegal drug use disorder. nicotine dependence preceded anxiety disorders, reciprocal pathways between anxiety disorders and AUD

Table 4 Contd.

Study	Country/ Region	N	Sample age	Assessment tool*	Informant	Disorder based on what substance	Co-occurring Psychopathology**
Sonntag et al. 2000[74]	Germany Munich	3021	14-24 at baseline 18-24 at follow-up	Munich-CIDI (baseline) and 12-month change	Adolescents	Nicotine	Psychiatric disorders preceded Nicotine Dependence Among baseline non-smokers with at least one social fear but no social phobia diagnosis 3.7% developed nicotine dependence as opposed to 1.1% without social fears; similar pattern among nondependent smokers 11.3% as opposed to 7.4%
Behrendt et al. 2011[159] Zimmermann et al. 2003[160]	Germany Munich	3021	14-24 at baseline 18-24 at follow-up	Munich-CIDI (baseline) and 12-month change (current, time period between interviews, lifetime)	Adolescents	Alcohol	Psychiatric disorders preceded SUD Social phobia and Panic disorder predicted subsequent AUD (15% incident cases of AUD and 58% of persistent cases of AUD)
Wittchen et al. 2007[58]	Germany Munich	1395	14-24 at baseline 18-24 at follow-up	Munich-CIDI (baseline) and 12-month change (current, time period between interviews, lifetime)	Adolescents	Cannabis	Reciprocal pathways In cross-sectional analyses, among those with CUD at baseline: 23.9% had MDD, 8.4% dysthymia, and 12.9% bipolar disorder. Among those with MDD at baseline 12.8% developed CUD, 5.9% of those with bipolar disorder developed CUD, 18.5% of those with any specific phobia developed CUD and 3.9% of those with GAD developed CUD.

* Child and Adolescent Psychiatric Assessment (CAPA), Young Adult Psychiatric Assessment (YAPA); Composite International Diagnostic Interview (CIDI); Epidemiologic version of the Schedule of Affective Disorders and Schizophrenia (KSAD); Diagnostic Interview Schedule for Children (DISC).

** MDD =Major depressive disorder; PTSD =Post Traumatic Stress Disorder; GAD =Generalized Anxiety Disorder, AUD =Alcohol Use Disorder.

were included. A few of the studies included information obtained from a caregiver in addition to reports by the adolescent when deriving disorder classifications. Many of the longitudinal studies indicate that the onset of internalizing disorders precedes the onset of SUDs,[22,73,74] while others argue for reciprocal pathways between SUDs and internalizing disorders.[58,75]

Late adolescence and early adulthood are also peak periods for the onset of other serious mental illnesses and abnormal/maladaptive behavior. Excessive use of drugs and/or alcohol are very common among youth with schizophrenia.[76,77] Cannabis, amphetamine, cocaine, and to a lesser extent alcohol, are associated with psychosis.[78-80] Eating disorders are frequently associated with substance use and are common among adolescents having SUDs.[81,82] It has been speculated that young women with anorexia may initiate drug use in an effort to lose weight and that those with bulimia nervosa may be turning to substances to dampen purging symptoms and behaviors.[83] SUDs and sleep disorders also often co-occur and have a significant negative effect upon normal development and are associated with deleterious effects on mood, attention, and behavior.[84,85]In addition, there is accumulating evidence from clinical and epidemiological studies on the link between drug use and suicide among adolescents,[86,87] with comorbidity increasing the risk for suicidal behaviors.[88] Alcohol abuse and dependence, cigarette smoking and cannabis use have been found to be associated with suicide attempts among adolescents.[89,90] The intoxicating effects of drug use might lead to impairments in judgment or changes in mood which then increase risk for suicidal ideation and attempt[91] and alcohol-specific effects such as disinhibition and emotional or behavioral problems (dysphoria, impulsivity, and aggression) have been implicated in suicidal behaviors.[92]

While a goal of many studies is to make available evidence on the temporal order and sequencing of onset of substance use and disorder and the various psychiatric disorders, publications often do not include descriptives of the ages of onset. Table 5 summarizes the age of onset for major disorder groups described by several adolescent studies. Whereas sequencing can vary on an individual basis, the evidence appears to indicate that on average anxiety and behavior disorders precede SUDs, while there is less time differential between mood disorders and SUDs. On average, psychiatric disorders also precede nicotine dependence by at least two years.[22,93,94] Paths to comorbidity have been noted to differ by sex.[22] In addition, sensitivity to distinct trajectories may be warranted as externalizing disorders typically have onset in childhood or adolescence and then may persist into adulthood or decrease with age, while the onset of internalizing disorders occurs over the life course with their cumulative prevalence generally increasing with age.

Table 5

Estimated onset of psychiatric and SUDs as established by several adolescent studies

US Study:	**Costello et al. 1999[22]**	**Merikangas et al. 2010[4] and Swendsen et al. 2012[2]**	**Griesler et al. 2011[94]**
Design/sample:	Rural longitudinal cohort	National survey	Urban longitudinal cohort
Measure:	Age first symptom	Median ages	Mean ages
Anxiety Disorder	3.8	6	10.7
Behavior Disorder	5	11	10.6
Mood Disorder	10.1	13	11.7
Substance Abuse/ Dependence	14.5	14-15*	14.7**

* Includes Alcohol and other drugs.
** Tobacco dependence.

In summary, numerous studies establish a comorbid association, but population estimates of how many, the when, and which youth are affected are scarce. In addition, more childhood and adolescent studies on the sequencing of the disorders, as well as how and the conditions under which the behaviors and mood conditions develop, are needed to obtain a greater understanding of the trajectories that will inform opportunities for prevention and intervention.

Possible explanations

There are several possible explanations of why there is a connection between substance use and mental illness. Empirical research supports the existence of risk factors from multiple domains hypothesized in the social development model,[95] such as one's individual attributes, attitudes and opportunities, family or household structure and recent life events. Problem behavior syndrome and an array of complementary conceptual models link externalizing type behaviors such as aggression, rule breaking, and other socially maladaptive behaviors with tobacco use and drug-taking.[96-100]

The co-occurrence adds a complexity to understanding the intricate relationship and etiology. Understanding the sequencing behind the high prevalence of co-occurrences of drug abuse and psychopathology is not simple; one cannot assume just because one appeared first that it caused the other. Often emotional and behavior problems are found to precede drug use.[101-103] Externalizing behaviors have been associated with the progression

of drug use, whether progression in stage of use within a particular drug[104] or becoming involved with other drugs, such as marijuana and inhalants.[105,106] This suggests some youth may be using drugs to self medicate. However, evidence that drug use precedes mental health outcomes also exists. Substance use and drug-related problems have both been shown to relate to disruptive behavior diagnoses.[107,108] Mood changes are a common feature during withdrawal from several drugs of abuse.[109] The shared liabilities of drug use disorders and other mental illnesses may also be due to genetic as well as environmental influences.[110-114] Family-genetic studies provide evidence of linkage between depression and drug abuse and substance disorders.[115,116] Alterations in reward and motivational processes might play a central role in the manifestation of core symptoms of both drug and psychiatric disorders.[117,119]

Many theories and models of comorbidity have been postulated. These models often include multiple domains and highlight that there may be several different mechanisms and routes leading to comorbidity. New collection efforts should also seek to incorporate genetic as well as environmental influences that may impact the onset of comorbidity and allow study of the complex genetic interactions between a wide array of environmental factors.

RECOMMENDATIONS

The presence of high co-occurrence of externalizing and internalizing disorders among youth abusing drugs and alcohol deserves attention to detect and provide appropriate treatment and referral for these problems as the burden of this comorbidity is significant. Previous reviews of adolescent outcomes found strong evidence that this comorbid combination was associated with truancy, rebelliousness, academic problems, and school drop out.[14,24] In addition, other studies point to the added economic and psychosocial burden of having comorbid disorders, and less overall well being, including higher levels of psychopathology, suicidal ideation, and greater functional impairment.[19,120-122] Further substantiating the importance of the need for prevention and early intervention among the adolescent years is the continued impact of comorbidity on young adult roles and behaviors. Comorbidity has been found to be associated with arrests, continued drug use, and reductions in work productivity[49,123] and among HIV-infected individuals with decreased odds of highly active antiretroviral therapy (HAART) utilization and viral suppression.[124] Having both psychiatric and SUDs increases impairment and results in poorer prognosis.

Complications of co-occurring disorders on treatment outcome are also well-documented, as the complexity of problems may impair an adolescent's ability to effectively engage in treatment[125] and can increase the rate and rapidity of relapse.[126] Findings have shown that many substance abuse treatment clients with less serious psychiatric disorders do well with traditional substance abuse treatment methods, while those with more serious psychiatric disorders need intervention modifications and additions to enhance treatment effectiveness.[127] The US Center for Substance Abuse Treatment has published best-practice guidelines for treating and recognizing the high overlap of psychiatric disorders among both substance abuse and mental health treatment clients.[127]

Pharmacological advances over the past few decades have produced more effective psychiatric medications with fewer side effects that allow individuals with serious and persistent psychopathology to participate in treatment instead of being institutionalized, thus increasing the demand for integrated treatment. However, the development of integrated treatment requires both an understanding of psychopathology and addiction and the means to integrate and modify traditional treatment approaches in both the mental health and addiction treatment fields.[128] Several strategies found to have promise for dual treatment of substance use and psychiatric disorders include: Motivational Interviewing, Contingency Management, Cognitive-Behavioral Therapy, Relapse Prevention, Assertive Community Treatment, and Intensive Case Management.[127] Randomized control trials are beginning to provide evidence that pharmacologic and psychological interventions are effective.[129,130] Research is providing information on client factors as well as treatment facility facilitators and barriers to strengthen the integrated dual disorder treatment model.[131-134] Continuity of care is necessary to guide individuals between service systems and continuing support and aid obtained via self help approaches is needed in the community for long term success.

Understanding the complexity between psychopathology and drug abuse, including the sequencing between both, would help guide us to knowing what to target and when to intervene.[135] For example, for a young adolescent with CD or ADHD who began using drugs at an early age, an intervention program could have an effect on future drug disorders by reducing current drug use, or by ameliorating current disruptive problem behaviors, or both. A program that targets only the drug use might have little effect on youth at risk for future SUDs because of their history of behavioral problems, while a program targeting only the behavioral problems might have little effect on youth put at risk because of their early drug use. An example of a universal behavioral intervention provided at a very young age, as children enter the educational system, that has been tested in

community randomized control trials has shown that non-pharmaceutical approaches of prevention may be possible. Teachers use classroom behavior management strategies to socialize children to the student role and reduce aggressive and disruptive behaviors. This strategy, the Good Behavior Game,[136] has been found to lower the rate of school-based service use (being placed in a special school or special classroom for problems with behavior, feelings, or drug or alcohol; receiving special help in the regular classroom; and receiving other counseling or therapy in school)[137] and reduce drug and alcohol abuse/dependence disorders, regular smoking, and antisocial personality disorder among males.[138] Behavior-influence procedures offer a unique opportunity for the prevention of substance use and psychiatric disorders at a public-health level.[139]

Studies pursuing influences and the identification of the mechanisms behind the high co-occurrence of SUDs and psychiatric disorders among youth are needed. We must continue to disentangle the complex temporal relationship. It is important to optimize the research design and methods in order to collect and analyze data that can make further contributions in depicting the interplay and sequencing of symptoms and disorder development.

SUMMARY

There is strong evidence from clinical and population based studies that SUDs co-occur with externalizing and internalizing disorders, as well as other serious mental health conditions among adolescents. The ramifications and consequences of having comorbid disorders, as opposed to unitary conditions of drug abuse separate from emotional and other behavioral problems, are complex. Traditional treatment and prevention approaches for adolescent well being require modifications to broaden their assessments to detect comorbid conditions. Not only should drug using adolescents be screened for psychopatholgy, but visa versa. In addition the identification and evaluation of comorbid disorders should not be limited to concurrency defined only by one point in time but take into consideration the history of drug involvement and mental health over the entire developmental lifespan. It is imperative that researchers continue to develop a better understanding of the co-occurrence (pre existing or consequential) of substance use and mental illness among youth in hopes of forestalling significant morbidity and mortality, such as disfunctionality or suicide.

Acronyms List:
ADHD = attention-deficit/hyperactivity disorder

CD = conduct disorder
DSM = Diagnostic and Statistical Manual of Mental Disorders
ICD = International Classification of Diseases
MDD = major depressive disorder
NCS-A = The National Comorbidity Survey-Adolescent Supplement
SUD = substance use disorder

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