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Epidemiology of Substance Use Disorders

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Abstract

Epidemiological studies of substance use and substance use disorders (SUDs) have provided an abundance of data on the patterns of substance use in nationally representative samples across the world (Degenhardt et al. 2008; Johnston et al. 2011; SAMHSA 2011). This paper presents a summary of the goals, methods and recent findings on the epidemiology of substance use and disorders in the general population of adults and adolescents and describes the methods and findings on the genetic epidemiology of drug use disorders. The high 12 month prevalence rates of substance dependence in U.S. adults (about 12% for alcohol and 2–3% for illicit drugs) approximate those of other mental disorders as well as chronic physical disorders with major public health impact. New findings from the nationally representative samples of U.S. youth reveal that the lifetime prevalence of alcohol use disorders is approximately 8% and illicit drug use disorders is 2–3% (Merikangas et al. 2010; Swendsen et al. in press, SAMSHA, 2011). The striking increase in prevalence rates from ages 13 to 18 highlight adolescence as the key period of development of substance use disorders. The application of genetic epidemiological studies has consistently demonstrated that genetic factors have a major influence on progression of substance use to dependence, whereas environmental factors unique to the individual play an important role in exposure and initial use of substances. Identification of specific susceptibility genes and environmental factors that influence exposure and progression of drug use may enhance our ability to prevent and treat substance use disorders.

Keywords

Substance Use; Epidemiology; Prevalence; Adolescent; Adult; U.S. population

The application of the tools and methods of epidemiology to the alcohol and drug field have yielded abundant data on patterns of use of substances in nationally representative samples across the world. The goals of this paper are: (1) to summarize the most recent data on the epidemiology of substance use and dependence from key prospective studies on drug use and cross-sectional surveys on the prevalence and correlates of substance use disorders; and (2) to describe the methods and findings on the genetic epidemiology of drug use disorders.

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EPIDEMIOLOGY

Epidemiology is defined as the study of the distribution and determinants of diseases in human populations. Epidemiologic studies are concerned with the extent and types of illnesses in groups of people and with the factors that influence their distribution. Epidemiologists investigate the interactions that may occur among the host, agent, and environment (the classic epidemiologic triangle) to produce a disease state. The important goal of epidemiologic studies is to identify the *etiology* of a disease in order to prevent or intervene in the progression of the disorder. To achieve this goal, epidemiologic studies generally proceed from studies that specify the amount and distribution of a disease within a population by person, place, and time (that is, *descriptive* epidemiology), to more focused studies of the determinants of disease in specific groups (that is, *analytic* epidemiology) (Gordis 2000).

Descriptive epidemiologic studies are important in specifying the rates and distribution of disorders in the general population. These data can be applied to identify biases that may exist in treated populations and to construct case registries from which persons may serve as probands for analytic epidemiologic studies. Such attention to sampling issues is a major contribution of the epidemiologic approach, as individuals identified in clinical settings often constitute the biased tip of the iceberg of the disease and may not be representative of the general population of similarly affected individuals with respect to demographic, social, or clinical characteristics. Associations that are identified at the descriptive level may then be tested systematically with case-control designs that compare the relationship between a particular risk factor or disease correlate and the presence or absence of a given disease, after controlling for relevant confounding variables. Case-control studies involve a retrospective design to investigate these particular associations. Researchers then proceed to prospective cohort studies, which can formally test the temporal direction of such associations to define targets of intervention and potential etiologic mechanisms.

Prospective Studies of Substance Use

There are also numerous prospective studies of population based samples of youth and young adults across the world that have provided compelling evidence regarding the risk factors for use and advancement into problematic patterns (Patton et al. 2007; Fergusson et al. 2008). Some studies have examined the extent to which adolescent alcohol and drug use predicted subsequent problematic use of alcohol (McCambridge et al. 2011), whereas others have examined the potent role of cannabis use patterns and subsequent progression of licit and illicit drugs (Swift et al. 2011), testing the classic gateway theory on the progression of drug use (Kandel et al. 1992). Fergusson and colleagues (2008) have identified developmental antecedents of drug use over a 25 year period.

Several other shorter term longitudinal studies have shed light on predictors of transition of use and polysubstance use (Patton et al. 2007). These studies identify cannabis, nicotine and alcohol as substances commonly used together and in conjunction with other drugs of abuse (Bailey 1992; Barrett et al. 2006; Everett et al. 1998; Fergusson et al. 2008; Patton et al. 2007). Adolescents who engage in heavy episodic use of cannabis are at greater risk of subsequent illicit drug use (Patton et al. 2007), and heavy use of alcohol and nicotine use is

also often accompanied by use of illicit substances (Bailey 1992). It is important to understand more about the characteristics of polysubstance users, because these individuals are also more likely to have substance use disorders (Merikangas, Dierker, et al., 1998). While many people with substance use disorders are also polysubstance users, to date there has been little research that focuses on their causal/temporal relationship. Other studies have provided valuable information on consequences of drug use, such as the increased risk of incident psychosis among cannabis users (Hall and Degenhardt 2011). Descriptive studies are important to provide understanding of both normal and problematic levels of substance use. As substance use becomes more severe, impairment and negative life consequences can also arise, indicating a substance use disorder (SUD).

The National Institute of Drug Abuse (NIDA), National Institute on Alcohol Abuse and Alcoholism (NIAAA) and the Services Administration for Mental Health and Substance Abuse (SAHMSA) have devoted substantial resources to track patterns of drug use, abuse and its consequences for several decades. A detailed description of the methods and findings of these rich resources are beyond the scope of this paper, but these data have had major impact on establishment of policy and prevention programs for drug use in the U.S. The most important ongoing descriptive study of drug use in American youth is the Monitoring the Future (MTF) survey. This survey, sponsored by NIDA since 1975, provides information on annual trends in adolescent substance use via an anonymous paper-and-pencil questionnaire in nationally-representative cross-sectional school-based samples of 8th, 10th and 12th graders (Johnston et al. 2011). The most recent MTF study, conducted in 2010, included 46,482 participants (Johnston et al. 2011). The survey focuses on overall substance use rather than diagnostic information (i.e. abuse and dependence). Key findings from the most recent study include increases in the overall rate of illicit drug use for all grades (Johnston et al. 2011). Older students in the study (12^{th} graders) showed increases in the use of marijuana and high rates of alcohol use (Johnston et al. 2011). Information garnered from the MTF receives national attention and has helped to guide public policy related to substance use in the U.S. Despite its contribution to our understanding of substance use patterns in youth, MTF does not assess problematic substance use. As described below, there are several recent studies of both adults and adolescents in the U.S. that provide information on the magnitude and correlates of drug abuse and dependence.

Prevalence Rates of Substance Use Disorders in the U.S.

Adults—Three nationally representative surveys that collect data on substance use prevalence in adults have been conducted in the U.S. in the past decade. They include: the National Comorbidity Survey Replication (NCS-R) (Kessler et al. 2004), the National Epidemiologic Survey on Alcohol and Related Conditions (NESARC) (Grant et al. 2004), and the National Survey on Drug Use and Health (NSDUH) (SAMHSA 2011). These studies also provide information on the prevalence rates of substance abuse and dependence as defined by the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV and DSM-IV-TR). Each survey, while sampled to mimic the characteristics of the U.S. population, has slightly different aims and limitations based on the type of information collected. The National Comorbidity Survey Replication (NCS-R) used a nationally representative multi-stage clustered area probability sample of households (Kessler et al.

2004). The NCS-R diagnoses are based on the World Mental Health Survey Initiative Version of the World Health Organization Composite International Diagnostic Interview (WMH-CIDI) (Kessler and Üstün 2004), a fully structured lay-administered diagnostic interview that generates both *International Classification of Diseases, 10th Revision* (WHO 1992), and *DSM-IV* (APA 2000) diagnoses. A total of 9,282 adult participants, aged 18 and older, completed a face-to-face in their homes between 2001 and 2003 (Kessler et al. 2004). The NCS-R collected information on a number of health-related variables, including substance use, psychological diagnoses, treatment history, etc. The NSC-R is the flagship study for the World Mental Health Initiative that has conducted population based surveys in more than 22 countries. Lifetime prevalence rates of substance use disorders across 18 participating countries ranged from a low of 1.3 (Italy) to high of 15.0 (Ukraine), with a median of 7.0 (Demyttenaere et al. 2004; Kessler et al. 2007).

The National Epidemiologic Survey on Alcohol and Related Conditions (NESARC) is a longitudinal study of patterns alcohol use and socio-demographic correlates. This study included two waves of data collection (Wave 1 and Wave 2), using a multistage stratified design of U.S. housing units (Grant et al. 2007; Hasin et al. 2007). The first wave was conducted in 2001–2002 and included 43,093 respondents ages 18 and older (Grant et al. 2007). Wave 2 included 34,653 of the Wave 1 participants who were re-contacted in 2004–2005 to participate in the follow-up survey (Grant et al. 2007). The diagnostic interview was the National Institute on Alcohol Abuse and Alcoholism Alcohol Use Disorder and Associated Disabilities Interview Schedule–*DSM-IV* Version (AUDADIS-IV). This structured interview, designed for lay interviewers, was developed to advance measurement of substance use and mental disorders in large-scale surveys. Computer diagnostic programs implemented the *DSM-IV* criteria for the disorders using AUDADIS-IV data. Another nationally representative survey of substance use disorders in the U.S. is the National Survey on Drug Use and Health (NSDUH), which has conducted several annual surveys on the patterns of drug and alcohol use in nationally representative samples of adolescents and adults (age 12 and older) in the U.S. The survey interviews approximately 67,500 persons each year (SAMHSA 2011).

Table 1 displays the 12 month and lifetime prevalence rates of alcohol and drug abuse and dependence from the NESARC and NCS-R surveys. As expected, the lifetime rates are substantially greater than the 12 month rates in both studies. The prevalence rates of alcohol use disorders in the NESARC study (4.7% and 3.8% for 12 month, and 17.8% and 12.5% for lifetime, for abuse and dependence, respectively) were substantially greater than those estimated in the NCS-R survey (3.1% and 1.3% for 12 month, and 13.2% and 5.4% for lifetime, for abuse and dependence, respectively), most likely attributable to differences in the criteria for assessing dependence in the latter study. However, the estimates of drug use disorders were quite comparable in the two studies. These findings demonstrate the high prevalence of substance use disorders across the lifetime of U.S. adults, with comparable magnitude to prevalence rates of other major psychiatric disorders including depression and anxiety.

Youth—Despite the importance of documentation of trends in substance use, there has been limited data on patterns of substance use disorders in a nationally representative sample of

U.S. adolescents. This information is critical to identify early onset SUD which is related to adverse outcomes, including continued substance use, comorbid psychological disorders and negative life consequences (Bakken et al. 2004; Larm et al. 2010). Furthermore, individuals who develop serious problems with substance use in adolescence are more likely to have these problems persist into adulthood (Grant and Dawson 1997; Rohde et al. 2001). The National Comorbidity Survey – Adolescent Supplement (NCS-A) provides a unique opportunity to study the dynamics and correlates of early substance use disorders in adolescents ages 13–18. The NCS-A is a supplement to the NCS-R, and shares similar methods and questions with its adult predecessor (Kessler et al. 2009).

Table 2 presents the lifetime rates of alcohol use disorders and of drug use disorders in U.S. adolescents from the NCS-A. More than half of adolescents in the U.S. report alcohol use, and nearly one fourth report exposure to illicit drugs. The prevalence rates of both alcohol and drug dependence (1.3% and 1.8% respectively) are about one-fourth the magnitude of abuse (5.2% and 7.1%, respectively). Taken together, the lifetime prevalence rates of substance use disorders are 6.5% for alcohol and 8.9% for illicit drugs (Merikangas et al. 2010). These rates are equivalent to the 12 month prevalence rates derived from the most recent NSDUH survey of U.S. adolescents that reported 12 month prevalence rates of 4.5% for alcohol abuse/dependence and 7.3% for drug abuse/dependence (SAMHSA 2011). The lifetime and 12 month prevalence rates are similar because both studies are capturing the development of problematic substance use at the time of their initial onset in adolescence.

Sociodemographic Correlates—Because the NSDUH (2011) is unique in including the full age spectrum from adolescence through adulthood, patterns of prevalence can be investigated by age group and sex. The age and sex-specific 12 month prevalence rates of substance use disorders in the NSDUH are shown in Table 3. This table shows that males have nearly double the rates of both alcohol and drug use disorders than females, a finding that is highly consistent across studies. SUDs were also about 2 times more prevalent among adult men than women in both the NESARC, with greater gender differences for alcohol than for drug use disorders (Compton et al. 2007). The gender difference also becomes more pronounced in adults than in adolescents, in whom males are only 1.3 times more likely to have a substance use disorder than females (Merikangas et al. 2010). While substance abuse in general is more common among males than females (Cotto et al. 2010), females have greater rates of abuse of some specific substances. For example, data from the most recent NSDUH revealed that females had greater rates of dependence on cocaine and psychotherapeutic drugs (Cotto et al. 2010). Additionally, alcohol use disorders were found to be more persistent in females than males in another 14 year follow up study (Edens et al. 2008).

The findings from Table 3 also reveal that the peak period of prevalence of both alcohol and illicit drug use disorders occurs in late adolescence and early adulthood, with a substantial reduction in substance use disorders after age 26. The combined NCS-R and NCS-A data confirm this trend (Merikangas et al. 2010; Swendsen et al. in press), as does the finding from the NESARC study that found peak prevalence in the age range from 20–29 compared to older age groups (Grant et al. 2008). Research on the onset of substance abuse has shown that there is a strong relationship between the age at which SUD symptoms begin and

symptom persistence later in life. Individuals who develop SUD in adolescence are more likely to have those symptoms persist into adulthood (Grant and Dawson 1997; Rohde et al. 2001). However, there is also a substantial percentage of people with SUDs who do not demonstrate problematic use in adolescence, but develop symptoms in early adulthood. Although these sociodemographic factors are associated with differential exposure and use of alcohol and illicit drugs, progression of use to regular use and dependence is related to other individual and familial factors. Below we review the application of the tools of genetic epidemiologic to identify genetic and environmental factors associated with drug abuse and dependence.

GENETIC EPIDEMIOLOGY

With advances in identifying genes for complex disorders, there is increasing interest in employing the tools of the field of genetic epidemiology that seeks to identify the contribution of genetic and environmental factors underlying complex diseases. Genetic epidemiology is distinguished from its parent disciplines of epidemiology and human genetics in three specific ways: (1) its focus on population-based research; (2) its goal of detecting the joint effects of genes and environment; and (3) the incorporation of the underlying biology of a disease into conceptual models (Merikangas and Risch 2003).

The field of genetic epidemiology focuses on the role of genetic factors that interact with other domains of risk to enhance vulnerability or protection against disease. Genetic epidemiology employs traditional epidemiologic study designs to identify explanatory factors for aggregation in groups of relatives ranging from twins to migrant cohorts. Since epidemiology has developed sophisticated designs and analytic methods for identifying disease risk factors, these methods have been extended to include both genes and environmental factors as gene identification proceeds (Kuller 1979; MacMahon 1996). In general, study designs in genetic epidemiology either control for genetic background while letting the environment vary (e.g., migrant studies, half siblings, separated twins) or control for the environment while allowing variance in the genetic background (e.g., siblings, twins, adoptees-non-biologic siblings). Investigations in genetic epidemiology are typically based on a combination of study designs including family, twin and adoption studies.

Challenges in the Epidemiology of Substance Abuse

There are numerous challenges to investigation of the role of the genetic risk factors underlying substance use disorders. First, it is difficult to operationalize the thresholds of the various stages of substance use including regular use, abuse and dependence and the clinical characteristics of these stages have been widely debated. The criteria for substance use disorders within the *DSM-IV* are often marked by significant overlap, which calls into question whether these diagnoses really account for two fundamentally distinct disorders or whether it may be better explained by gradations of a single disorder on a continuum of severity (O'Brien 2011; West and Miller 2011). Phenotypic definition becomes especially problematic when studies use different measurement tools to reach diagnoses. For example, twin studies of smoking have examined diverse components of smoking including use, frequency, quantity, age at onset, continued use, current use, current frequency, dependence, severity, and ability to quit (Heath and Madden 1995), however, the consistency of these

measures vary greatly by study. In the proposed DSM-IV revision, the DSM-5, the diagnostic characteristics of substance use will be simplified and characterized by severity rather than by distinctions between abuse and dependence. This change has the potential to create more consistency across studies in defining and assessing the socio-demographic and genetic risk factors.

Another complication in the identification of the genetic risk factors underlying substance use disorders is the degree of shared vulnerability that substance use disorders share with mental disorders. Comorbidity between substance use with nearly all classes of psychiatric disorders has been well documented in numerous community studies over the past decade (Compton et al. 2007). Previous epidemiologic and family studies have shown increased odds of having a mood, anxiety, personality, and behavior disorders among those with substance use disorders (Grant 1995; Grant et al. 2008; Regier et al. 1990; Schulden et al. 2009; Swendsen et al. 2010). Results from both family and with studies suggest that substance use and mental disorders also co-aggregate among families, where relatives of substance abusers were at increased risk for developing substance and mental disorders (Brook et al. 2010; Clark et al. 2004; Hill et al. 2011; Merikangas and Avenevoli 2000). However, prospective studies are essential to identify the ordinal associations among these disorders. Most studies examining order of onset of these comorbid disorders suggest that individuals develop substance use disorders subsequent to mental disorder onset (Grant et al. 2008; Merikangas et al. 2008; Swendsen et al. 2010). As mental disorders and substance disorders have a great deal of shared vulnerability, there is also a possibility that these disorders share genetic etiology. At this point, the specific genetic influences for both substance and mental disorders remain unclear. Consequently, we are unable to determine if these disorders are proverbial branches from the same genetic tree, or genetically distinct.

Because environmental exposure to a drug is inherent to the development of substance use disorders, studies of the genetics of substance use disorders must account for gene-environment interaction as a major source of complexity of this phenotype. Numerous environmental factors related to drug exposure including family dynamics, peer interaction, temperament features, socioeconomic related factors, and cultural norms have been identified. These factors interact with the individual's genetic makeup to influence phenotypic expression (Avenevoli et al. 2005; Merikangas and Conway 2009). However, because of the overlap in the role of genetic and environmental factors underlying vulnerability to substance use disorders, it may not be fruitful to devote substantial effort to determining whether risk factors fall on the environmental or genetic side of the risk equation. For example, an individual's genotype may influence his/her use of drugs (gene-environment correlation) and many putative environmental factors such as exposure to family violence may actually result from genetic factors common to disinhibition, aggression, and substance abuse.

Family and Twin Studies

Family Studies—Despite the challenges in the study of substance use epidemiology, the family-study design has been the major source of evidence that genetic factors may underlie substance use disorders. The familial aggregation of alcoholism has been well-established

through decades of comprehensive study (for reviews of alcoholism see McGue 1994; and Merikangas 1990). Although there has been less systematic research on the familial aggregation of drug use disorders, the results of controlled studies of first-degree relatives of substance abusers (Bierut et al. 1998; Merikangas et al. 1998; Nurnberger et al. 2004) demonstrate consistently that the rates of substance use disorders are elevated among relatives of drug abusers compared to that of controls. For example, the largest family study of specific subtypes of drug use disorders found an eight-fold increased risk of drug disorders among relatives of probands with drug disorders compared with relatives of psychiatric and unaffected controls (Merikangas et al. 1998).

Studies of offspring of parents with alcoholism and substance abuse or dependence have also shown substantial increases in the rates of substance use disorders when compared to those of non-substance. In an 8-year follow-up study, offspring of substance abusers were at 2-fold increased risk for any substance use disorder and a 3-fold risk for alcohol and marijuana abuse or dependence compared to offspring of control parents (Merikangas and Avenevoli 2000). Hopfer, Stallings, Hewitt, and Crowley (2003) also reported parent-child transmission for marijuana use, abuse, and dependence. Some studies have reported specificity for substance use, such that adolescents are particularly likely to use the same illicit drug as their parents (Fleming 1997; Hoffmann and Cerbone 2002). High-risk studies are particularly informative for prevention efforts as they aid in the identification of premorbid vulnerability factors that serve as sources of identification for children at risk for particular disorders. Likewise, Tarter and colleagues (Tarter et al. 2003; Tarter et al. 2004) similarly supports a common neurobehavioral disinhibition factor underlying the risk for drug abuse and dependence, which includes a prominent component of impaired executive decision-making in youth at risk for drug abuse.

Twin Studies—The aggregate twin study data on substance abuse are remarkably consistent in demonstrating that genetic factors play a far greater role in the etiology of more severe patterns of drug use, particularly that which meets diagnostic criteria for abuse or dependence, than initial use or early stages of use, which appear to be more strongly determined by environmental influences (Merikangas and Conway 2009). Studies have examined drug use, abuse, and dependence in general, as well as a diverse range of specific drugs including nicotine, caffeine, tranquilizers, sedatives, cannabis, cocaine, stimulants, hallucinogens, and opiates (e.g., Haberstick et al. 2011; Heath et al. 1993; Heath 1995; Kendler et al. 2000; Kendler and Prescott 1998a, b; Kendler et al. 2003; Kendler et al. 2007; Kendler et al. 2006; Pedersen 1981; True et al. 1997; True et al. 1999; Tsuang et al. 1998). Likewise, cross national comparisons in twin concordance reveal similar heritability estimates despite large differences in prevalence estimates [e.g., Norway (low illicit drug use) vs. United States and Australia (high illicit drug use)], thereby suggesting that heritability is unaffected by drug availability (Kendler et al. 2006).

A recent review provided the following summary of the estimates of the heritability of substance dependence from twin and adoption studies: 44% (males) and 65% (females) for cocaine; 43%; (males) for opiates; 33% (males) and 79% (females); for marijuana; 53% (males) and 62% (females) for; tobacco; and 49% (males) and 64% (females) for alcohol (Swendsen and Le Moal 2011). Heritability estimates ranged from 0–87% in males and 0–

77% in the females, with a median of 53% and 55% for males and females, respectively. However, the extent of genetic influence differed according to the trait definition employed, and the age, sex, and source of the sample. The approximately two-fold larger correlation between monozygotic compared to dizygotic twins reflects the contributions of genetic factors to the specific drug phenotype (Swendsen and Le Moal, 2011). Surprisingly, the influence of common environmental factors is low in most studies, whereas unique environmental factors play a major role in drug abuse/dependence in these samples. These studies demonstrate the complex interplay (both interactions and correlations) between genetic and environmental factors in the etiology of drug abuse.

The *specificity* of familial aggregation of particular types of substance dependence has been examined in both family and twin studies (Bierut et al. 1998; Merikangas et al. 1998; Tsuang et al. 1998). The results of these studies yield remarkably similar trends towards specificity of etiologic factors for particular drugs. Data from the Yale Family Study of Comorbidity of Substance Abuse and Psychopathology examined the specificity of familial aggregation of the predominant drug of abuse among adult relatives of probands with similar classification. The results revealed a remarkable degree of specificity for familial aggregation of opiates, cannabis and alcohol, and to a lesser extent for cocaine (Merikangas et al. 1998). Patterns of concordance for specific drugs in twins from the Vietnam Era Twin Registry (Tsuang et al. 1998) also revealed a significant degree of specificity. In summary, the aggregate findings of the twin and family studies provide evidence for common familial and genetic factors underlying substance use disorders in general, as well as substantial components that are unique for specific drugs.

Adoption and Migration Studies

Adoption Studies—The classic adoption studies of Cadoret et al (1986; 1992; 1995, 1996) have also been highly informative in elucidating the role of genetic factors in the development of drug use and abuse. Although data on biologic parents are often limited with respect to specific patterns of drug use and abuse, their studies provide the strongest evidence to date that genetic factors play an important role in the liability to drug abuse. The work identifies two major biologic/genetic pathways to the development of drug abuse in adoptees: one which is driven by substance abuse in the biologic parent and is limited to drug abuse/dependence in the adoptee; and another which appears to be an expression of underlying aggressivity and related to antisocial personality disorder (ASPD) in the biologic parent (Cadoret et al. 1995, 1996). Moreover, adopted-away offspring of fathers who are *antisocial* addicts (compared to either antisocial or addicted) are at especially elevated risk for substance abuse (Langbehn et al. 2003).

Migration Studies—The migrant study design is one of the most powerful approaches to identify cultural and environmental risk factors for a disease. Migration studies have been used to understand the degree biological/genetic factors emerge as environmental factors change. This suggests that substance use disorders may result from biologic factors involved in drug preference, response and metabolism (Merikangas et al. 1998). Recent findings from a migration study of adolescent offspring of Puerto Rican migrant parents compared to non-migrant parents revealed greater rates of alcohol use among the island Puerto Ricans as

compared to the Mainland Puerto Rican children (47. 7% vs. 28.9%, respectively), whereas the use of illicit drugs was far greater among mainland compared to island Puerto Rican youth (15.0% vs. 6.9%, respectively) (Merikangas et al. 2009). Investigation of the explanations for greater illicit drug use among migrant youth may yield information on the environmental factors that contribute to substance use and abuse. These findings highlight the importance of country or culture-specific influences on patterns of substance use.

SUMMARY AND IMPLICATIONS

The application of the tools of epidemiology has provided valuable information regarding the magnitude of substance use and disorders across the world. The accumulation of international data on drug use patterns has facilitated cross-cultural comparisons that have highlighted the universal nature of substance abuse, and its major public health impact (Degenhardt et al. 2008). Recent findings from several studies of nationally representative samples of the U.S. reveal that the lifetime prevalence of alcohol use disorders is approximately 8%, and illicit drug use disorders is 2–3% (Merikangas et al. 2010; Swendsen et al. in press). These studies also highlight adolescence as the key period of development of substance use disorders, with striking increases in substance use disorders across adolescents into early adulthood. Recent advances in genetic and epidemiological methods and the application of those methods to substance use will only advance our understanding of these disorders that affect individuals world-wide. Recent examples from diabetes and other fields provide models of estimation of the combined risk of family history, specific environmental and biologic risk factors and genetic markers (Thorsby et al. 2009). Application of these study designs will be increasingly important with progress in identifying the genetic pathways that underlies substance use and disorders (Bierut 2011).

There are a number of avenues that researchers can pursue to advance our knowledge in this field. Five of the major applications of genetic epidemiology in order to advance our understanding of substance use disorders are: (1) the establishment of *population-based registries* of substance use disorders that will be increasingly valuable in validating the numerous genetic tests that will emerge from advances in human genetic research and the Human Genome Project; (2) identification of *more homogeneous subtypes* of complex disorders through family and high risk research investigating both biologic and contextual factors (3) investigation of familial patterns among affected and unaffected probands to *estimate strength and mode of genetic transmission*; (4) *quantification of risk* at the levels of the individual and population (i.e., absolute risk; relative risk, attributable risk); and (5) development of a richer conceptualization of *environmental factors* that may be important mediators of expression of genetic risk for substance use disorders through integration of the tools of genetic epidemiology, behavioral neuroscience, developmental psychology, and neuroscience.

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Table 1

12 Month and Lifetime Prevalence Rates of Alcohol and Drug Abuse and Dependence in U.S. National Surveys

	STUDY			
SUBSTANCE	NESARC[1]		NCS-R[2]	
	12 month	Lifetime	12 month	Lifetime
Alcohol				
Abuse	4.7 (0.2)	17.8 (0.5)	3.1 (0.3)	13.2 (0.6)
Dependence	3.8 (0.1)	12.5 (0.4)	1.3 (0.2)	5.4 (0.3)
Drug				
Abuse	1.4 (0.1)	7.7 (0.2)	1.4 (0.1)	7.9 (0.4)
Dependence	0.6 (0.1)	2.6 (0.1)	0.4 (0.1)	3.0 (0.2)

[1] National Epidemiologic Survey of Alcohol and Related Conditions-Wave 1 (Compton, W.M., et. al. 2007; Hasin et al, 2007; Grant, B.F. et. al. 2004)

[2] National Comorbidity Survey Replication (Kessler, R.C., Chiu, W.T., et. al. 2005)

Table 2

Lifetime rates of alco hol use disorders and of d rug use disorders in U.S. adolescents[1] (n=10,123)

	Any alcohol use		Abuse without dependence		Abuse with Dependence	
	n	% (SE)	N	% (SE)	n	% (SE)
Total	**5866**	**59.8 (1.4)**	**560**	**5.2 (0.4)**	**112**	**1.3 (0.1)**
Age group						
13–14	1598	42.5 (1.6)	37	0.7 (0.2)	13	0.6 (0.2)
15–16	2459	64.9 (1.7)	205	5.3 (0.5)	35	1.1 (0.3)
17–18	1809	78.2 (1.5)	318	12.4 (1.1)	64	2.7 (0.4)
Sex						
Female	2952	60.1 (1.7)	242	4.7 (0.5)	48	1.1 (0.2)
Male	2914	59.4 (1.3)	318	5.7 (0.5)	64	1.5 (0.2)

	Use of illicit drugs		Abuse without dependence		Abuse with Dependence	
	n	% (SE)	N	% (SE)	n	% (SE)
Total	**2380**	**24.4 (1.5)**	**683**	**7.1 (0.5)**	**186**	**1.8 (0.2)**
Age group						
13–14	348	9.6 (0.7)	82	2.4 (0.4)	19	1.0 (0.4)
15–16	1036	27.5 (1.8)	291	8.1 (0.7)	67	1.6 (0.3)
17–18	996	42.5 (2.6)	310	12.7 (1.1)	100	3.7 (0.7)
Sex						
Female	1108	23.3 (1.5)	279	6.2 (0.5)	86	1.8 (0.3)
Male	1272	25.5 (1.7)	404	7.9 (0.6)	100	1.9 (0.3)

[1] National Comoribidity Survey Adolescent Supplement (NCS-A) Merikangas et al, 2010

Table 3

Age and Sex Specific 12 – Month Rates of Alcohol and Illicit Drug Use Disorders[1]

	ABUSE OR DEPENDENCE (%)		
	Alcohol	**Illicit Drugs**	**Alcohol or Drugs**
TOTAL	2.8	7.4	8.9
AGE GROUP			
12–17	4.3	4.6	7.0
18–25	7.7	16.0	20.0
≥ 26	1.8	6.3	7.3
SEX			
Male	3.8	9.9	11.9
Female	1.9	5.0	6.1

[1] National Survey of Drug Use and Health (Substance Abuse and Mental Health Administration, 2011)