Published in final edited form as:

Drug Alcohol Depend. 2007 April ; 88(Suppl 1): S4–13.

Comorbidity of Substance Use Disorders and Other Psychiatric Disorders Among Adolescents: Evidence from an Epidemiologic Survey

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Abstract

This paper extends our knowledge of comorbidity of substance use disorders (SUDs) and other psychiatric disorders by examining comorbidity of specific types of SUDs and risk of comorbidity separately for abuse and dependence. The research question is whether there is specificity of risk for comorbidity for different SUDs and whether greater comorbidity is associated with dependence. Data are presented from a probability sample of 4,175 youths aged 11-17 assessed with the NIMH DISC-IV and self-administered questionnaires. SUDs outcomes are alcohol, marijuana and other substances in past year. Mean number of other comorbid disorders ranged from 1.9 for marijuana abuse to 2.2 for other substance abuse and 1.9 for marijuana dependence to 2.8 for other substance dependence. None of the abuse SUDs does not increase risk of anxiety disorders, but dependence does. Both abuse and dependence increased risk of comorbid mood disorders. Similar results were observed for disruptive disorders. Patterns of comorbidity varied by substance, by abuse versus dependence, and by category of other psychiatric disorders. In general, there was greater association of comorbidity with other disorders for dependence vs. abuse. Marijuana is somewhat less associated with other disorders than alcohol or other substances. The strongest association is for comorbid disruptive disorders, regardless of SUD category. Having SUDs and comorbid other psychiatric disorders was associated with substantial functional impairment. Females with SUDs tended to have higher rates of comorbid disorders, as did older youths. There were no differences observed among ethnic groups. When comorbidity of SUDs with other disorders was examined, controlling for other non-SUDs disorders for each specific disorder examined, the greater odds for dependence versus abuse essentially disappeared for all disorders except disruptive disorders, suggesting larger number of comorbid non-SUDs in part account for the observed effects for dependence.

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Keywords

adolescents; comorbidity; disruptive disorders; etiology; gender difference

1. Introduction

Comorbidity has emerged as one of the keys to understanding the etiology, natural history, and treatment of psychiatric disorders among children and adolescents (see reviews by Abikoff and Klein, 1992; Achenbach, 1990; 1995; Angold and Costello, 1993; Angold et al., 1999; Caron and Rutter, 1991; Hinshaw et al., 1993; Kendall et al., 1992; Klein and Riso, 1993; Loeber and Keenan, 1994; Nottelmann and Jensen, 1995; Rutter, 1997).

One particular form of comorbidity that has been examined is that between substance use disorders and other psychiatric disorders. Data from large-scale, epidemiologic studies of adults have reported high rates of comorbidity between substance use disorders (SUDs) and other disorders (see Regier et al., 1990; Kessler et al., 1996; 1997; Swendsen et al., 1998).

While studies have documented comorbidity between psychiatric symptoms or disorders and use of various substances among children and adolescents (see Biederman et al., 1998; Brook et al., 1998; Federman et al., 1997; Henry et al., 1993; Kandel et al., 1997) few studies have examined such comorbidity focusing on SUDs per se.

The few papers that have examined SUDs and comorbid other disorders report there is substantial comorbidity between SUDs and other disorders among children and adolescents (particularly the latter) and this comorbidity is strongest for SUDs and the disruptive disorders (see the review by Angold et al., 1999; papers by Lewinsohn et al., 1993; Fergusson et al., 1993; Rohde et al., 1996; Kandel et al., 1997; Costello et al., 2003). From this body of evidence, admittedly meager, there are virtually no data on comorbidity between specific types of substance use (alcohol, marijuana, etc.) and other psychiatric disorders. Nor are there data examining the comorbidity of substance use and dependence considered separately in regard to other psychiatric disorders. While the data are clear on the increased risk of other psychiatric disorders among those meeting diagnostic criteria for any substance abuse or dependence, the literature on children and adolescents is essentially silent on the question of whether specific SUDs entail greater risk than others. The same is true for the question of whether and how the risk of comorbidity is affected by abuse versus dependence. Given the DSM-IV diagnostic criteria for dependence, it should follow that risk of comorbidity is increased for dependence, compared with abuse (American Psychiatric Association, 2000). Likewise, the literature provides little information on implications of comorbidity for severity among youths who also meet diagnostic criteria for both SUDs and other DSM psychiatric disorders. That is, are youths who meet diagnostic criteria for both SUDs and other disorders more impaired than those who suffer only from the former? As noted by a number of researchers (Costello et al., 1997; Simonoff et al., 1997; Narrow et al., 1998; Roberts et al., 1998), adjusting prevalence rates for functional impairment substantially reduces rates. Kessler et al. (2005) have reported severity (in terms of impairment) is strongly related to comorbidity among adults, with greatest severity for those with 3 or more comorbid diagnoses.

Given the dearth of literature on the epidemiology of SUDs and comorbid psychiatric disorders, it should come as no surprise that we also know little about the role of factors commonly examined as predictors or covariates such as age, gender or socioeconomic status. None of the papers we reviewed examined the role of socioeconomic status. Only 4 papers examined gender differences, with 1 reporting differential gender effects for SUDs and comorbidity (Costello et al., 1999b) and 3 reporting no gender effects (Bird et al., 1993; Rohde et al., 1996; Fergusson

et al., 1996). Only 2 papers have examined age effects on SUDs and comorbid other disorders directly (Rohde et al., 1996; Costello et al., 1999b) and the results reported are somewhat different. Thus, at this point, we still have little understanding of the epidemiology of SUDs and associated other psychiatric disorders, either the prevalence of such comorbidity or the role of factors associated with such comorbidity.

In view of the above discussion, the purpose of our research is to reexamine risk of comorbidity associated with SUDs. We do this by extending prior research in four ways. First, we examine risk of comorbidity for specific types of SUDs. Second, we examine risk of comorbidity separately for substance abuse and dependence. Third, we examine functional impairment among youths with SUDs and comorbid other DSM-IV disorders. This strategy permits examination of one of the central hypotheses regarding causes of comorbidity: the role of underlying deficits or functional impairment of two comorbid disorders (see Rhee et al., 2005). Fourth, we investigate whether the prevalence of this type of comorbidity varies by age, gender, and ethnic status. These extensions should provide greater specificity for the role of SUDs in the epidemiology of comorbid psychiatric disorders. Examination of these questions is made possible by data from an epidemiologic survey of over 4,000 youths, Teen Health 2000 (TH2K).

2. Methods

2.1 Participants

The sample was selected from households in the Houston metropolitan area enrolled in local health maintenance organizations. One youth, age 11-17 years, was sampled from each eligible household, oversampling for African Americans (AA) and Mexican Americans (MA). The HMOs made their subscriber household data available for sampling, including the age and gender of children. Since ethnic status was not available from the HMOs, a sampling fraction was used to generate completed overall baseline target sample of 4,500 (1,500 in each of 3 ethnic groups). Because there were proportionately fewer minority subscriber households encountered, we developed sample weights which were adjusted by poststratification to reflect the age, ethnicity, and gender distribution of the 5-county Houston metropolitan area in 2000. The total population was 4,669,571, of which 515,736 were 11-17 years of age. Of these, 94,498 were African, 166,821 were Latino and 220,410 were European Americans. The precision of estimates are thereby improved and sample selection bias reduced to the extent that it is related to demographic composition (Andrews and Morgan, 1973). Chi-square tests were used to compare ethnicity, gender and age distributions between census data for the 5-county area and sample data after the weighted procedure. No difference was identified between the two distributions with respect to the three demographic factors of age, gender and ethnic group ($\chi^2=0.02$, $df=6$, $p=0.99$; $\chi^2=0.01$, $df=1$, $p=0.93$; $\chi^2=0.005$, $df=2$, $p=0.99$). In other words, the weighted sample represents the 5-county area population composition (age, gender and ethnicity) after post-stratification adjustment.

Data were collected at baseline from sample youths and from one adult caregiver using computer-assisted personal interviews and self-administered paper questionnaires. The youth computerized interview contained the structured psychiatric interview (see below), demographic data on the youths and the household as well as queries about stress exposure. The interviews were conducted by trained, lay interviewers and took on average 1-2 hours, depending on the number of psychiatric problems present. The questionnaires were scannable booklets which contained questions on a broad array of risk and protective factors. These took about 30 minutes to complete. Interviews and questionnaires were completed with 4,175 youths (66% of eligible households). All youths and parents gave written informed consent prior to participation in this study. All study forms and procedures were approved by the University of Texas Health Sciences Center Committee for Protection of Human Subjects.

The sample was diverse (see Table 1). The youth cohort was 51.1% male at baseline. In terms of age distribution at baseline, 27% were 12 or younger, 48.1% were 13-15, and the rest were 16 or older. Our sampling strategy selected families with youths 11-17, but a few (40 or 1%) had turned 18 by the time interviews were done (9.8% were 17). In terms of ethnic status, the sample was 35.5% European American, 35.4% African American, 24.6% Latino American, and 4.5% Other American.

2.2 Assessments

Psychiatric disorders were assessed with the Diagnostic Interview Schedule for Children, Version 4 (DISC-IV), a highly structured instrument (Shaffer et al., 2000) designed to be administered by lay interviewers. Here, we include these DSM-IV disorders: anxiety disorders (agoraphobia, generalized anxiety, panic, social phobia, post-traumatic stress disorder), mood disorders (major depression, dysthymia, mania, hypomania), disruptive disorders (conduct, oppositional defiant), attention-deficit hyperactivity disorder, and substance use disorders (alcohol, marijuana and other substance disorders excluding tobacco). Our measure of presence of mental or behavioral problem is at least one DSM-IV disorder in the previous 12 months. In Wave 1, 17.1% of the youths met diagnostic criteria for one or more disorders in the past year.

The prevalence of one or more substance use disorders in the past 12 months was 5.3%. There were sufficient numbers of youths reporting substance abuse or dependence in the preceding 12 months that we could analyze comorbidity for alcohol abuse, alcohol dependence, marijuana use, marijuana dependence, and other substance abuse or dependence. The “other” category included stimulants, cocaine or crack, heroin, PCP, opiates, hallucinogens, inhalants, sedatives, amyl nitrite or poppers, and steroids.

To examine comorbidity of SUDs with other psychiatric disorders, we focused on four broad classes of disorders: affective, anxiety, disruptive and attention deficit-hyperactivity disorders. Five anxiety disorders were included, as noted above, four affective disorders, and two disruptive disorders. Because there is evidence (Costello et al., 1999b; Costello et al., 2003; review by Armstrong and Costello, 2002) that there may be a higher probability of comorbid oppositional defiant and conduct disorders among youths with SUDs than for ADHD, we examine ODD/CD and ADHD separately.

The prevalence of any anxiety disorder in the past year was 6.9%. Prevalences were 3.0% for affective and 6.5% for disruptive/behavioral disorders.

To estimate overall functional impairment, we used the Child Global Assessment Scale (CGAS) administered by trained lay interviewers. We used the CGAS score two ways. We examined the mean score for those who met diagnostic criteria, with and without comorbid disorders. We then scored as impaired those below the mean to estimate odds ratios for comparisons of functional impairment among those with and without comorbid disorders. The CGAS has been shown to have good psychometric properties (Shaffer et al., 1983; Bird et al. 1990; Green et al., 1994). The other factors examined are gender and age. Following our strategy in previous analyses of the TH2K data, age is categorized as 12 or younger, 13-15, and 16 or older.

2.3 Analyses

Our analytic strategy was as follows: First, we estimate past year prevalences of SUDs, separately for abuse and dependence. Then we estimate the number of comorbid diagnoses of non-SUDs disorders by SUD categories, and proportion of those with CGAS scores of 69 or less. Third, we estimate the odds of comorbid mood disorders, anxiety disorders, and

disruptive/behavioral disorders (ODD/CD and ADHD separately) for each SUD class. We then estimate impairment for the previous set of contrasts. Then we extend this last set of analyses, controlling for concurrent comorbid other SUDs when making estimates of comorbidity and impairment for youths who meet diagnostic criteria for a specific SUD and a class of DSM-IV non-SUD diagnosis.

For generation of confidence interval for prevalences and odds ratios, the survey mean (svymean) and survey logistic regression (svylogit) procedure in STATA V8.0 (StataCorp., 2006) were employed. These procedures use Taylor series approximation to compute the standard error. Lepkowsky and Bowles (1996) have indicated that the difference in computing standard error between this method and other repeated replication methods such as jackknife is very small.

3. Results

Table 2 presents the prevalence of youths who met DSM-IV diagnostic criteria for SUDs in the past year. As can be seen, 5.3% of youths 11-17 met formal diagnostic criteria for any SUDs, whether abuse or dependence. Prevalence of marijuana abuse or dependence was only slightly higher than alcohol abuse or dependence (n.s.). There were, as expected, rather dramatic gender effects in prevalence, particularly for alcohol and marijuana, with rates much higher for males. The exception was for Other Substances, where there were no differences for abuse or dependence (data not shown). We also examined age effects, and found prevalence of abuse or dependence increased dramatically with age. There was a clear linear effect, with those 16 or older having the highest rates, those 13-15 intermediate, and those 12 or younger the lowest rates. In fact, very few youths 12 or under met diagnostic criteria for either abuse or dependence (data not shown).

As can be seen in Table 3, comorbidity was common in this sample of adolescents. The mean number of comorbid diagnoses for adolescents with a DSM-IV diagnosis of SUD in the past year ranged from 1.7 to 2.8 diagnoses. There is a clear pattern of increased comorbidity for dependence compared with abuse. The mean for abuse was 2.0 and for dependence was 2.5. This pattern was most evident when examining those with 4 or more diagnoses (data not shown). Prevalence ratios for dependence versus abuse are 3.3 for alcohol, 1.2 for marijuana and 1.9 for other SUDs. For any SUDs, the prevalence ratio was 3.0. There was no gender difference in risk of SUDs and number of comorbid other disorders. There were virtually no age differences as well (data not shown).

We also examined comorbidity and impairment (below the mean CGAS). There was no clearly consistent pattern of increased impairment with increasing numbers of comorbid disorders when we examined these with 0, 1, 2, 3 or 4+ comorbid disorders (data not shown). When we examined the odds of impairment with and without comorbid diagnoses by SUD category in Table 3, the overall pattern was for those with at least 1 comorbid disorder to have more impairment. However, only 2 were statistically significant – alcohol abuse and any substance abuse. There was little difference between those with abuse versus dependence overall.

In addition, we examined comorbidity among SUD categories (data not shown). There was significant comorbidity among different classes of SUDs. For example, alcohol dependence increased the odds of marijuana dependence 35-fold and other substance dependence 27-fold. Marijuana dependence increased the odds of other substance abuse 100-fold and other substance dependence 75-fold. Given alcohol abuse, the odds of marijuana abuse was 21.0, of marijuana dependence 16.8, other substance abuse 7.9 and other substance dependence 50.3.

Table 4 quantifies the association with other psychiatric disorders by SUDs using odds ratios. There was no increased odds of anxiety disorders associated with any category of SUDs abuse.

By contrast, for SUDs dependence, the odds of anxiety disorders significantly increased for alcohol and any substance dependence. The odds of comorbid mood disorders increased significantly for every SUDs category, whether the diagnosis was abuse or dependence, or the two combined. Unlike anxiety disorders, there seems to be no greater comorbidity associated with dependence compared with abuse for mood disorders. The sole exception was for alcohol use, where the odds of a mood disorder for alcohol dependence is almost twice that for abuse. For conduct/oppositional disorders, odds are higher for dependence than for abuse. The pattern is also similar to that for mood disorders, in that odds of CD/ODD disorders was significantly increased in every SUDs category, whether the diagnosis be abuse or dependence. We observed no increased odds for ADHD for any SUDs category, be it abuse or dependence.

We also examined odds of disorders comorbid with SUDs by gender, age, and ethnic status. While the overall pattern of odds ratios for comorbid disorders was highly similar for males and females, there was a pattern of increased risk for females contrasted with males. For example, the odds of a mood disorder, given alcohol dependence, was 80% for females and 3.7 for males. For disruptive disorders and alcohol dependence the odds were 9.3 for males and 19.2 for females. For other substance dependence and disruptive disorders, however, the odds were 40.9 for males and 15.6 for females. Only females showed increased odds for SUDs and ADHD – alcohol dependence (3.4) and marijuana dependence (1.7) (data not shown). In terms of age, there was a clear pattern for those 13-15 to have much higher odds of comorbid mood, anxiety, disruptive and ADHD disorders for virtually every SUD category, either abuse or dependence, than those 12 and under. There were no notable differences in patterns of comorbidity by ethnic group.

We also examined risk of impairment, given a SUD diagnosis and a particular comorbid diagnosis in Table 4. As can be seen, in general, odds of a comorbid mood disorder and impairment was not greater for abuse than dependence, and odds of greatest impairment were for alcohol abuse and other substance use. This pattern was reversed for anxiety disorders, with greater odds for dependence. For disruptive disorders, alcohol and other substance dependence had the strongest associations, with little difference between abuse and dependence for other SUDs. Odds for impairment were significant for alcohol and marijuana dependence and ADHD.

When we examined gender differences, there were few. Given alcohol abuse, odds of a mood disorder were 29 for females compared with males and 10 for alcohol dependence. The only other difference involved disruptive disorders, where odds of these disorders given a SUD were 3 for males with alcohol abuse, 9 for marijuana dependence, 3 for any substance abuse, and 5 for any substance dependence (data not shown). There were even fewer age effects. Younger youths were at increased risk of depression, given marijuana dependence, and for disruptive disorders given alcohol abuse and any substance abuse.

Two strategies have been suggested for use in our attempts to understand the epidemiology of comorbidity. The goal of the first is to test for the effects of confounders by using multivariate procedures to control for effects of covariates (Caron and Rutter, 1991; Fergusson et al., 1996). The goal of the second is to examine comorbidity between any 2 disorders, controlling for the presence of other comorbid conditions, given the sometimes large numbers of comorbid disorders individuals may manifest (Costello et al., 2003). Table 5 presents results for the latter strategy.

Controlling for other comorbid disorders made some differences in patterns of comorbidity. For example, mood disorders were only significantly associated with alcohol abuse and any substance abuse. For anxiety disorders, none were significant. For the disruptive disorders (conduct/oppositional), all of the odds ratios remained significant except one – other substance

abuse. For ADHD, we were not able to estimate comorbidity with SUDs for most categories due to very small numbers when other comorbid disorders were controlled. Thus, the results are essentially the same as Table 4.

The patterns for impairment associated with comorbid SUDs and other disorders, where there were sufficient cases for analyses in Table 5, are quite similar to those in Table 4. A few prevalences went down, a few went up. However, overall impairment, particularly for the disruptive disorders, remains unchanged.

We then explored the association between SUDs and other disorders using multivariable analyses. These results are presented in Table 6. The strongest association is clearly between alcohol use and mood disorders. However, there was no association between marijuana or other substance use and mood disorders. (Abuse and dependence are combined due to collinearity.) There was no association between anxiety disorders or ADHD and substance use. There was an association between alcohol use and marijuana use and conduct/oppositional disorders.

4. Discussion

4.1 Findings

Our analyses confirm that patterns of comorbidity between SUDs and other psychiatric disorders tend to vary by type of substance, by abuse versus dependence on SUDs, and by category of other psychiatric disorders. In general, there was greater odds of comorbidity between SUDs and other psychiatric disorders for dependence than for abuse. This was true for anxiety and disruptive disorders. For mood disorders, only alcohol dependence entailed greater odds for comorbid other disorders than did alcohol abuse. However, both marijuana abuse and dependence significantly increased the odds for other disorders. Dependence on any of the substances examined in general did not increase odds of anxiety disorders.

Patterns of comorbidity were clearest for disruptive disorders. That is, there was a consistent pattern of greater odds for comorbidity among those dependent on SUDs, across SUDs categories, and for every SUDs category. Both abuse and dependence increased risk of comorbidity significantly for disruptive disorders. Our results in this regard are consistent with the conclusions by Armstrong and Costello (2002) based on their extensive review of the literature.

When we examined comorbidity of SUDs with other psychiatric disorders, controlling in each contrast for other comorbid disorders, there no longer was the clear pattern for dependence versus abuse. These results suggest that substance dependence is more likely associated with multiple comorbid other psychiatric disorders compared with abuse. The exception was disruptive disorders, where there still were greater odds for dependence to be associated with comorbidity. Clearly, there is a strong association between substance use, particularly dependence, and multiple comorbid other disorders.

When we further examined the comorbidity between use of each of three broad classes of substances (alcohol, marijuana, other substances) in multivariable models, controlling for the other two classes, the pattern that emerged was that alcohol and mood disorders are highly comorbid, but not other substance use. Anxiety disorders and ADHD did not demonstrate higher odds of comorbidity with any of the substance use groups. ODD/COD, on the other hand, did have increased odds of comorbid alcohol and marijuana use.

How do these results compare to those from other studies of adolescents using data from community-based samples? As noted earlier, there have been no community samples of youths large enough to permit examination of the odds of comorbidity separately for abuse and

dependence or separately by type of SUDs. Accordingly, we must limit our comparisons to abuse or dependence, combined for any SUDs. We found no increased odds for SUDs and anxiety disorders. Previous studies have reported mixed results, 2 reporting an association (Fergusson et al., 1993; Lewinsohn et al., 1993) and 2 no association (Costello et al., 2003; Kandel et al., 1999). We found little evidence for increased odds for SUDs and mood disorders. The other studies cited all found that SUDs increased odds of comorbid mood disorders. We found significant comorbidity between SUDs and the disruptive disorders. The evidence from other studies is mixed, 2 reporting higher odds for disruptive disorders (Fergusson et al., 1993; Kandel et al., 1999) and 2 not finding this association (Costello et al., 2003; Lewinsohn et al., 1993). This may be due to the fact that some authors do not consider ADHD separately from conduct and oppositional defiant disorders.

While there have been no studies of children or adolescents reporting risk of comorbidity separately for SUDs abuse and dependence, our results are similar to those reported for adults. Using data from the National Comorbidity Survey, Kessler et al. (1996) found that the odds of comorbidity was higher for SUDs dependence than for abuse for any DSM-III-R disorder, any mood disorder, and any anxiety disorder. Data were reported for past 12 months and lifetime diagnoses, and the results were the same for both. Thus, our data for adolescents are consistent with those reported for adults.

It is interesting to note that the data on diagnostic comorbidity also appear to extend to subthreshold disorders. Lewinsohn et al. (2004) report that 40% of those with subthreshold disorders had a comorbid subthreshold disorder and 36% also had a full syndrome. They also observed that the odds of other subthreshold disorders, given a subthreshold SUD, were higher for disruptive disorders.

4.2 Limitations

Although our sample was relatively large ($n=4,175$), given the low base prevalence rates for most DISC DSM-IV disorders, we were not able to examine comorbidity between some types of SUDs (such as cocaine use) and specific types of other disorders (such as PTSD) because the numbers of subjects were too few for analyses. Our study was designed originally to focus on mood and anxiety disorders. To reduce respondent burden, which was substantial (full assessments were 2 hours on average), some DISC-IV modules were dropped. These included tobacco abuse and dependence.

We were not able to examine temporal sequence using the Wave 1 data from the TH2K study, since Wave 1 was a prevalence study. We did collect data on both lifetime and past 12 month disorders. However, we believe estimating the timing of comorbid disorders using lifetime retrospective recall is problematic methodologically (see Simon and VonKorff, 1995; Kandel et al., 1999) and therefore chose not to attempt such estimates (see also Wells and Horwood, 2004; Fergusson et al., 2000).

In addition, the measures of SUDs were not validated by biological assays. However, as noted by Kandel and colleagues (1999), such assays may have little utility when the time frame is longer than the half-life of most substances. The shortest time frame in our study was past year. We should note that none of the other studies of adolescents cited here included biological assays, either. That is the norm in general epidemiologic surveys of adolescent psychopathology.

Questions might arise from our sample design. We did not select an area probability sample (we sampled from large diverse HMOs). In an attempt to compensate for this design effect, we post-stratified the TH2K sample to approximate the age, gender, and ethnic distribution of the 5-county metropolitan area in which all of our study households were located. The high

concordance between our overall prevalence rates and other studies discussed above provide strong evidence for the external validity of our results (Roberts, Roberts, & Xing, 2006).

Third, we should note that our overall response rate was 66%. While this is lower than reported in some studies, it is comparable to other studies in the literature. (e.g., see Lewinsohn et al., 1993; Kessler et al., 2005).

Another issue is that we did not interview parents about the DSM-IV disorders assessed by youth interview. As noted by Roberts et al. (1998), a substantial proportion of studies through 1996 relied on either parent or youth report, but not both. And while there is argument that data from multiple informants is desirable, many studies have demonstrated considerable discordance in parent-child reports of psychopathology (Roberts et al., 2005a; 2005b), so much so that a number of authors have presented results separately by informant. We should note that our overall prevalence for the past year was 17.1%, highly comparable to rates for 9-17 year olds in Puerto Rico (17.3%) and the Great Smoky Mountains Study (17.7%), as reported by Canino et al. (2004). We also should note that we have examined differential reporting by parents and youths by ethnic groups in our sample. Using rating scales on various dimensions of psychological functioning, there was little difference in youth reports across ethnic groups. However, minority parents reported substantially fewer problems in their children than did majority group parents (Roberts et al., 2005a; 2005b). These results suggest that using only youth reports may in part minimize the effects of response bias across groups.

4.3 Conclusions

There remain important issues in regard to the epidemiology of comorbidity of psychiatric disorders, among the more important of which is temporal sequence of the comorbidity (see Kessler et al., 1996; Angold et al., 1999; Armstrong and Costello, 2002). Given the focus of this special issue, we chose to focus on comorbid other DSM-IV psychiatric disorders, given substance abuse or dependence. Clearly this is somewhat arbitrary, and not necessarily a reflection of temporal sequence in comorbid psychiatric disorders. Unfortunately, the overwhelming majority of research on comorbidity among adults and among children and adolescents has been done using cross-sectional designs. Thus, data on the sequence of comorbid disorders is estimated using reports of lifetime and current episodes of disorder (see Simon and VonKorff, 1995; Kandel et al., 1999; Wells and Horwood, 2004; for a discussion of the limitations of such studies). However, there have been several studies of adolescents which have used prospective designs to address this question. Data from these prospective studies present mixed results, with SUDs preceding other disorders, on the one hand, and other disorders preceding SUDs on the other (Brook et al., 1998; Rohde et al., 1991; 1996; Costello et al., 2003).

As Kandel et al. (1999) note, order appears to vary by disorder and gender across studies in research reported to date, although the overall pattern is for other disorders to precede SUDs (Armstrong and Costello, 2002). The best evidence for temporal sequence comes from the work of Costello et al. (1999b; 2003; see also Sung et al., 2004) in which the GSMS prospective study suggests that other psychiatric disorders precede the development of substance abuse and dependence. The Oregon Adolescent Depression Project (Rohde et al., 1991; 1996) and the Christchurch Health and Development Study (Fergusson and Horwood, 2001; Fergusson et al., 2005) also report similar results.

There is rather strong evidence for associations between SUDs and other psychiatric disorders on factors such as low self-esteem, anti-social behavior, rebelliousness, aggressiveness, truancy, poor school performance, school dropout, and suicidal behaviors (for reviews, see Angold et al., 1999; Costello et al., 2003). The extent to which comorbidity contributes further to increased functional impairment remains an empirical question, from an epidemiologic

perspective. Theoretically, and logically, we would expect increased impairment and poorer prognosis for those with comorbid disorders, whether the effects are additive or multiplicative in nature, and in fact we found such an effect.

There is also evidence that the clinical consequences of comorbidity are substantial (Costello et al., 1999a). That is, youths with comorbid disorders have been reported to have higher rates of treatment, impaired role functioning, suicide attempts, and academic problems (Lewinsohn et al., 1995). Do youths who have both SUDs and other psychiatric disorders have differential risk of such adverse outcomes? Our data indicate that comorbidity increase odds of functional impairment as measured by CGAS scores.

Our results provide further specification of the association between SUDs and other psychiatric disorders, in particular the role of abuse versus dependence in the risk of such comorbidity and associated functional impairment. We should note, in conclusion, that there have been at least 13 alternative hypotheses formulated concerning the etiology of comorbid psychiatric disorders (see Neale and Kendler, 1995; Rhee et al., 2005). Virtually none of these have been examined using data for children or adolescents drawn from epidemiologic surveys. This is clearly one line of investigation which should be the focus of future research.

Our next step is to examine the natural history of SUDs comorbidity and its consequences for future functioning of adolescents. Available research suggests patterns of both homotypic and heterotypic trajectories of comorbidity (Angold et al., 1999; Costello et al., 2003; Kim-Cohen et al., 2003). These results need to be replicated and the functional consequences of different types of continuity explored, in particular the impact on clinical and social outcomes.

Acknowledgements

This research was supported, in part, by Grant No. MH49764 and Grant No. DA16977 from the National Institutes of Health.

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Table 1
Unweighted Sample Characteristics, Teen Health 2000

Characteristics		Wave 1 Sample N=4175	Wave 1 cohort N=3134	Wave 2 cohort N=3134
		%	%	%
Gender of Youth	Male	51.1	50.8	50.8
	Female	48.9	49.2	49.2
Age of Youth	16 +	24.9	23.4	40.4
	Between 13 and 15	48.1	49.7	48.6
Ethnicity of Youth	12 or less	27.0	26.8	11.0
	European American	35.4	37.0	37.0
	African American	35.4	34.6	34.6
	Latino American	24.6	23.6	23.6
	Others	4.7	4.8	4.8
Family Income	\$65,000 +	35.3	37.8	40.7
	\$ 35,000 - \$ 64,999	40.7	39.9	39.2
	< \$35,000	24.0	22.3	20.1
Parental Marital Status	Married	75.7	76.3	76.1
	Others	24.3	23.7	23.9

Note1: No significant differences were found comparing distribution for each characteristic of W1 sample and W1 cohort.

Note2: Age (W1 cohort vs W2 cohort) : $p < 0.0001$

Income (W1 cohort vs W2 cohort): $p = 0.03$

Table 2
Weighted Wave I Prevalence(%) of Past Year Substance Use Disorders in Teen Health 2000

Disorder	%	95% C.I
Any Substance Use Disorder	5.3	(4.5 , 6.1)
Alcohol Abuse	2.1	(1.6 , 2.6)
Alcohol Dependence	0.8	(0.5 , 1.1)
Alcohol Abuse or Dependence	2.9	(2.3 , 3.5)
Marijuana Abuse	2.0	(1.5 , 2.5)
Marijuana Dependence	1.4	(1.0 , 1.8)
Marijuana Abuse or Dependence	3.4	(2.8 , 4.0)
Other Substances Abuse	0.4	(0.2 , 0.6)
Other Substances Dependence	0.5	(0.2 , 0.7)
Other Substances Abuse or Dependence	0.9	(0.6 , 1.2)
Any Substance Abuse	3.9	(3.2 , 4.6)
Any Substance Dependence	2.2	(1.7 , 2.7)
One or More Diagnoses*	17.1	(15.8 , 18.3)

* Subject met DSM-IV diagnostic criteria for at least one of 17 psychiatric disorders in the past year.

Table 3
Overall Numbers of Comorbid Diagnoses and Functional Impairment for Youths with SUD Diagnoses in Past Year, Teen Health 2000

DSM-IV Diagnosis	Number of Comorbid Diagnoses					$\bar{x}$
	Mean CGAS Score	No Dx ***	% $\leq$ Mean CGAS Score	Mean CGAS Score	1 + Dx ***	
Alcohol Abuse	70.7	80.8	37.6%	64.2	41.0%	1.9
Alcohol Dependence	68.9	73.0	46.1%	66.6	42.2%	2.7
Marijuana Abuse	67.6	68.8	54.8%	66.7	47.9%	1.9
Marijuana Dependence	68.7	71.6	72.1%	68.1	49.3%	1.9
Other Substance Abuse	68.4	70.5	48.3%	68.0	66.8%	2.2
Other Substance Dependence	62.0	0	0	62.0	62.2%	2.8
Any Substance Abuse	70.0	73.8	50.1%	66.3	51.4%	1.7
Any Substance Dependence	68.4	72.0	58.2%	66.7	49.5%	2.0

Bold font: Comparison of Mean CGAS Score between No Dx and 1+Dx is significant($p<0.05$)

** Number of any non-substance-related DSM-IV disorders cooccurring with SUDs in past year.

*** Dx= Diagnosis using DSM-IV criteria.

Table 4

Weighted Crude Odds Ratios and 95% Confidence Intervals for Comorbid Past Year Psychiatric Disorder by Substance Abuse and Dependence Diagnosis and Functional Impairment, Teen Health 2000

		Mood Disorders		Anxiety Disorders		Conduct/Oppositional Disorders		ADHD-Any Type Disorders	
		OR, 95% CI	≤ Mean CGAS Score	OR, 95% CI	≤ Mean CGAS Score	OR, 95% CI	≤ Mean CGAS Score	OR, 95% CI	≤ Mean CGAS Score
Alcohol Abuse	Yes: No	7.8 (3.9 – 15.6)	49.5 (17.2 – 142.7)	0.7 (0.2 – 2.0)	4.8 (0.6 – 37.3)	7.9 (4.5 – 14.0)	51.3 (17.7 – 149.0)	1.4 (0.3 – 7.5)	41.3 (4.8 – 355.3)
Alcohol Dependence	Yes: No	12.3 (4.8 – 31.7)	11.5 (2.5 – 53.7)	2.8 (1.0 – 7.6)	124.8 (16.6 – 939.1)	12.6 (5.5 – 28.5)	106.9 (24.2 – 471.5)	3.2 (0.7 – 13.9)	2.6 (0.3 – 19.7)
Marijuana Abuse	Yes: No	3.1 (1.3 – 7.3)	7.7 (2.2 – 26.8)	0.6 (0.2 – 2.1)	1.0 (0.1 – 7.3)	11.8 (6.8 – 20.3)	66.8 (27.1 – 164.5)	2.0 (0.5 – 8.6)	10.8 (1.4 – 84.2)
Marijuana Dependence	Yes: No	3.1 (1.2 – 8.1)	0.7 (0.1 – 5.3)	2.2 (0.9 – 4.8)	13.1 (2.8 – 61.3)	14.0 (7.6 – 25.6)	60.0 (23.6 – 152.6)	2.8 (0.8 – 9.1)	3.1 (0.7 – 13.2)
Other Substances Abuse	Yes: No	10.3 (3.2 – 33.7)	73.3 (15.5 – 346.8)	2.1 (0.5 – 9.5)	4.3 (0.5 – 34.1)	10.0 (3.3 – 30.7)	344.5 (37.3 – 3179.8)	4.5 (0.9 – 22.9)	5.2 (0.6 – 44.0)
Other Substances Dependence	Yes: No	6.7 (1.8 – 24.5)	29.6 (5.8 – 151.5)	3.1 (0.9 – 11.4)	133.0 (17.7 – 1000.7)	18.0 (6.2 – 52.2)	48.1 (12.1 – 191.2)	2.7 (0.3 – 20.5)	4.0 (0.5 – 31.4)
Any Substance Abuse	Yes: No	6.3 (3.6 – 11.0)	33.4 (14.6 – 76.3)	0.7 (0.3 – 1.5)	5.3 (1.8 – 16.2)	9.7 (6.4 – 14.8)	64.0 (31.3 – 131.1)	1.6 (0.6 – 4.6)	4.2 (0.8 – 23.6)
Any Substance Dependence	Yes: No	5.1 (2.4 – 10.9)	6.8 (2.1 – 22.3)	2.2 (1.2 – 4.3)	15.0 (4.9 – 46.3)	14.0 (8.4 – 23.4)	80.0 (33.5 – 191.2)	1.7 (0.5 – 5.7)	1.9 (0.5 – 8.0)

Bold font: $p \leq 0.05$

Table 5

Weighted Odds Ratios* and 95% Confidence Intervals for Past Year Psychiatric Disorder by Substance Abuse and Dependence Diagnosis and Functional Impairment, Adjusting for Comorbid Other Non-SUD Disorders, Teen Health 2000

	Mood Disorders		Anxiety Disorders		Conduct/Oppositional Disorders		ADHD-Any Type Disorders	
	OR, 95% CI	≤ Mean CGAS Score	OR, 95% CI	≤ Mean CGAS Score	OR, 95% CI	≤ Mean CGAS Score	OR, 95% CI	≤ Mean CGAS Score
Alcohol Abuse	Yes : 11.7 (5.2 – 26.5)	77.8 – (21.8 – 278.5)	0.5 (0.1 – 1.9)	8.1 (1.0 – 64.3)	6.1 (3.1 – 11.8)	38.3 (11.8 – 123.7)	NA [†]	NA ^{**}
Alcohol Dependence	Yes : 5.3 (0.7 – 40.1)	NA ^{**}	0.8 (0.1 – 5.6)	NA ^{**}	9.4 (3.6 – 24.3)	NA ^{**}	NA [†]	3.7 (0.5 – 28.7)
Marijuana Abuse	Yes : 2.0 (0.5 – 8.4)	NA ^{**}	0.5 (0.1 – 2.1)	1.3 (0.2 – 9.2)	11.3 (6.3 – 20.3)	53.9 (20.5 – 141.9)	1.5 (0.2 – 11.3)	NA ^{**}
Marijuana Dependence	Yes : 1.4 (0.2 – 10.5)	NA ^{**}	1.6 (0.6 – 4.5)	11.2 (1.4 – 89.3)	15.7 (8.2 – 30.0)	85.7 (32.6 – 225.3)	NA [†]	5.1 (1.2 – 22.3)
Other Substances Abuse	Yes : 4.6 (0.1 – 1.9)	49.3 (5.3 – 454.6)	2.7 (0.6 – 12.3)	5.2 (0.7 – 41.8)	5.0 (0.9 – 26.4)	111.4 (16.5 – 752.0)	NA [†]	NA ^{**}
Other Substances Dependence	Yes : NA ^{**}	NA ^{**}	1.1 (0.1 – 8.4)	78.8 (7.6 – 812.6)	12.7 (3.9 – 41.6)	56.6 (13.2 – 243.6)	NA [†]	6.1 (0.8 – 47.6)
Any Substance Abuse	Yes : 7.4 (3.5 – 15.4)	40.3 (12.7 – 127.8)	0.6 (0.3 – 1.6)	7.9 (2.3 – 27.1)	8.4 (5.4 – 13.9)	60.0 (26.3 – 135.3)	0.8 (0.1 – 5.6)	NA ^{**}
Any Substance Dependence	Yes : 2.9 (0.6 – 12.9)	5.5 (1.01 – 30.3)	1.0 (0.4 – 2.8)	12.0 (2.6 – 54.0)	15.0 (8.6 – 26.2)	126.3 (50.6 – 315.4)	NA [†]	2.9 (0.7 – 12.3)

Bold font: $p \leq 0.05$

* Analysis was conducted by univariate models, the outcome disorders were controlled each other in this table.

** ORs are not available since nobody has both risk factors and disorders/Impairments.

[†] ORs are extremely small or large due to the low incidence of having both risk factors and disorders/Impairments.

Weighted Multivariable Analysis for Past Year Psychiatric Disorder by Substance Abuse or Dependence Diagnosis, Adjusting for Comorbid Other disorders, Teen Health 2000

Table 6

Mood Disorders		Anxiety Disorders		Conduct/Oppositional Disorders		ADHD-Any Type Disorders	
	OR, 95% CI		OR, 95% CI		OR, 95% CI		OR, 95% CI
Alcohol Abuse/Dependence	Yes : 12.7 No (4.8 – 33.5)						
Marijuana Abuse/Dependence	Yes : 0.5 No (0.1 – 3.0)	0.5 (0.1 – 1.5)		2.2 (1.02 – 4.8)		NA [†]	
Other Substances Abuse/Dependence	Yes : 0.7 No (0.03 – 13.8)	0.9 (0.4 – 2.1)		12.6 (7.0 – 22.5)		1.5 (0.2 – 11.5)	
		2.7 (0.7 – 10.4)		0.7 (0.2 – 2.2)		NA [†]	

Note: Each outcome disorder, Alcohol Abuse/Dep, Marijuana Abuse/Dep and Other Substances Abuse/Dep was added to the multivariate model, adjusting for each of the others. The association represented by the odds ratios for each SUD category controls for the effects of the other two SUD categories.

Bold font: $p \leq 0.05$

[†] ORs are extremely small or large due to the low incidence of having both risk factors and disorders/Impairment.