

# Disordered Eating and Substance Use in an Epidemiological Sample: I. Associations Within Individuals

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Accepted 19 June 2001

**Abstract: Objective:** *This study examined the strength of associations between disordered eating and eating disorders and substance use and substance use disorders (SU/SUDs) in an epidemiological sample. **Methods:** 672 adolescent girls and 718 women completed structured interviews of lifetime eating disorders and substance use and misuse, as well as self-reported current disordered eating attitudes and behaviors. **Results:** Although effect sizes were small, eating attitudes and disorders were associated modestly with nicotine, alcohol, and drug use, and with nicotine dependence in adolescent girls. Alcohol use and misuse were related to eating attitudes and pathology in women. SU/SUDs were associated with restricting and bulimic behaviors and no prominent differences in associations were observed between substance classes. In contrast to findings in clinical populations, these community-based results were positive but generally weak, suggesting there is no strong, overarching relationship between eating and substance use problems. **Discussion:** These results have implications for the addiction model of eating disorders. © 2002 by Wiley Periodicals, Inc. *Int J Eat Disord* 31: 389–403, 2002.*

**Key words:** *substance use and misuse; disordered eating attitudes; eating disorders*

## INTRODUCTION

Studies have demonstrated that patients with eating disorders (ED) exhibit alcohol and drug problems at rates elevated over normal controls or population base rates (for reviews, see Holderness, Brooks-Gunn, & Warren, 1994; Wilson, 1991). Particularly strong associations with substance abuse have been noted in those who engage in bulimic behaviors of binge eating and purging, such as individuals with bulimia nervosa (BN) or

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Published online in Wiley InterScience (www.interscience.wiley.com). DOI: 10.1002/eat.10050

with the binge eating/purging type of anorexia nervosa (ANB).<sup>1</sup> Substance abuse or dependence has been reported in up to 55% of patients with BN and in up to 23% of patients with anorexia nervosa (AN; Eckert, Goldberg, Halmi, Casper, & Davies, 1979; Holderness et al., 1994). Alcohol and stimulants were the substances reported as most commonly abused. By comparison, results from the epidemiological National Comorbidity Survey (NCS) indicate that the lifetime prevalence of substance abuse in women ranges between 4% (drug abuse only) and 18% (abuse or dependence of drugs or alcohol; Kessler et al., 1994). Some studies have documented an elevated prevalence of substance use disorders (SUDs) among ED patients, particularly among bulimics.

ED and disordered eating attitudes and behaviors (DE) also tend to occur significantly more often in SUD patients than in the general population (Higuchi, Suzuki, Yamada, Parrish, & Kono, 1993; Suzuki, Higuchi, Yamada, Mizutani, & Kono, 1993; Taylor, Peveler, Hibbert, & Fairburn, 1993) or in psychiatric control groups (Grilo et al., 1995). A review of 21 studies found a median of 20% of drug abusers reported a lifetime history of BN or bulimic behaviors (range 8%–41%) and a median of 5% reported a lifetime history of AN (range 2%–10%; Holderness et al., 1994). These figures greatly exceed the population base rates for BN and AN of 1% and 0.1% of women, respectively (Hsu, 1996).

In addition to associations between EDs and SUDs, studies have demonstrated links between substance use (SU) and DE. Studies have reported high rates of alcohol, cocaine, and nicotine use in individuals with ED/DE (Hudson, Pope, Jonas, & Yurgelun-Todd, 1983; Lavik, Clausen, & Pedersen, 1991), particularly in those with BN (Wiederman & Pryor, 1996). Median rates of alcohol use were 23% (range 11% – 89%) and street drug use were 26% (range 5%–100%) in BN patients and median rates of alcohol use were 5% (range 0%–34%) and street drug use were 12%–19% in restricting AN (ANR) patients (Holderness et al., 1994).

Fewer studies have investigated the relationship between DE and SU/SUDs in non-clinical samples. Selection biases can lead to misleadingly high rates of comorbidity in treatment-seeking samples. For example, Berkson's bias arises because individuals with multiple disorders can seek treatment for any or all disorders and thus tend to receive treatment more often than those with only one disorder. As a result, disproportionately more persons with comorbid disorders are included in clinical samples than in epidemiological samples (Berkson, 1946). Representative community samples are essential because they can help to clarify whether an association between EDs and SU/SUDs is genuine or an artifact of the clinically ascertained samples studied.

Most community-based investigations have reported higher rates of alcohol use and dependence among participants with BN compared with nonbulimic controls (Garfinkel et al., 1995; Kendler et al., 1991; Killen et al., 1987; Striegel-Moore & Huydic, 1993; Timmerman, Wells, & Chen, 1990). Weak, positive correlations between SU and problem eating or ED "risk" have been reported in female high school and college samples using self-report measures (Kashubeck & Mintz, 1996; Watts & Ellis, 1992). However, one study reported mixed results: BN individuals reported significantly more illicit drug use than psychiatric and normal controls but similar rates of alcohol use (Welch & Fairburn, 1996). Another found no link between alcohol and nicotine use and indices of EDs disorders (Xiniris & Boland, 1990). It is difficult to draw firm conclusions from the extant literature

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<sup>1</sup>Note that a controlled study of women with binge eating disorder (BED), a proposed diagnostic category in the 4th ed. of the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV, American Psychiatric Association [APA], 1994), did not find elevated rates of lifetime substance abuse (Telch & Stice, 1998).

about the strength of relationships between eating and substance problems in the general population.

Observations regarding the frequent comorbidity of EDs and SU/SUD have led to a number of hypotheses regarding possible shared causation (for a review, see Wolfe & Maisto, 2000). Szmukler and Tantam (1984) have conceptualized AN simply as an addiction to starvation. Several theories have been proposed to account for the observed link between BN and SU/SUD, including the possibility that addictive or impulsive personality characteristics are central to both problems (Vandereycken, 1990). A related theory posits the existence of a "multi-impulsive" subtype of BN, characterized by substance abuse and other forms of behavioral disinhibition, such as self-injurious behaviors and suicide attempts (Lacey & Evans, 1986). Finally, we speculate that the face validity of an addiction model of EDs may help explain why 12-step, addiction-based treatment programs have proliferated in the absence of empirical evidence to support their effectiveness in treating EDs.

A first step in examining more closely the addiction model is to evaluate the strength of associations of eating problems and substance use and misuse in a community sample. This study, the first of a series to investigate links between DE and SD/SUDs in an epidemiological sample, examined relationships of DE and ED with SU/SUD within individuals. Methodological limitations of earlier studies were addressed in the present study and two age cohorts—teenaged girls and adult women—were included. Specific methodological strengths of this study were that (1) it involved an epidemiological sample, so results were not subject to Berkson's bias and are more broadly generalizable than studies of clinical samples, (2) it included individuals with both bulimic and restricting eating problems, and (3) it was the first study to evaluate comprehensively associations between a range of severity of eating disturbances, including EDs, and the use and misuse of various psychoactive substances.

This investigation addressed the following three questions: (1) How strong are associations between DE/ED and SU/SUD? (2) Are associations between DE/ED and SU/SUD stronger in those with bulimic rather than with restricting ED behaviors? (3) Are associations of DE/ED consistent across different classes of psychoactive substances? Previous findings suggest that associations between bulimic behaviors and SU/SUD are strongest (Holderness et al., 1994). Results showing that associations between bulimic behaviors and SU/SUDs are greater than associations between nonbulimic eating disturbances and SU/SUDs would provide evidence consistent with the addiction model of bulimia.

## METHOD

### Participants

Our study included 672, 17-year-old female twins (hereafter referred to as "adolescents") and 718 mothers of 11 and 17-year-old female twins ("adults") participating in the population-based, longitudinal Minnesota Twin Family Study (MTFS). The MTFS, which comprises two age cohorts of twin children and their parents, has been described elsewhere (Iacono, Carlson, Taylor, Elkins, & McGue, 1999). The present study examines a new research question using participants drawn from the same sample. The twin participants were treated statistically as individuals for the purposes of this study. Because EDs are uncommon in children and males, data from 11-year-old twins and fathers were not included.

All female, same-sex twins born in Minnesota from 1975 through 1979 and from 1981 through 1984 were identified through birth records; twin families were then located and recruited to participate in the MTFs when the twins were about 17 or 11 years old. Approximately 91% of the twin pairs born in these years were located. Thirty-two percent of twin families were excluded from study participation because they lived farther than a day's drive from Minneapolis, had a mental or physical handicap that precluded completing our day-long intake assessment, or had been adopted by nonrelatives. Among those eligible, approximately 17% refused to participate. Families were paid for their participation. When assessed families were compared with the subset of 83% of the nonassessed families who were willing to complete a brief assessment, minimal differences were found in socioeconomic status indicators and no differences in rates of self-reported parental psychopathology (Iacono et al., 1999). Relative to their nonassessed counterparts, assessed mothers and fathers reported significantly more years of education (13.4 vs. 13.7 years; 13.8 vs. 14.0 years). Participating mothers also had modestly, but significantly, higher occupational status than nonparticipating mothers, but occupational status did not differ between assessed and nonassessed fathers. These findings suggest the MTFs sample is broadly representative of the population of twin families in Minnesota born in the years sampled.

The average age of the adolescent participants was  $17.5 \pm 0.5$  years (range 16.0–18.5 years) and their mean body mass index (BMI) was in the average range ( $22.8 \pm 4.0$  kg/m<sup>2</sup>; Brownell, 1995). The average age of adult participants was  $41.8 \pm 5.4$  years (range 28.1–59.6 years) and their mean BMI was approximately 20% above ideal weight ( $28.2 \pm 7.0$  kg/m<sup>2</sup>). The majority of adolescent (94.7%) and adult (97.2%) participants were Caucasian. The biological mothers of adolescent participants had an average of  $13.6 \pm 2.0$  and biological fathers  $13.9 \pm 2.4$  years of education. The adult participants in the present study had an average of  $13.7 \pm 2.0$  years of education. Average occupational status, as assessed by the Hollingshead system, was  $4.2 \pm 2.0$  for mothers and  $3.7 \pm 1.8$  for fathers of adolescent participants. For adult participants, average occupational status was  $3.8 \pm 1.8$ . The Hollingshead occupational status scale (Hollingshead & Redlich, 1958) ranges from 1 (professional occupations that require advanced degrees) to 7 (unskilled labor); a Hollingshead code of 4 corresponds to jobs such as sales clerk and bank teller.

### Measures

Participants completed all measures, including structured interviews and self-report instruments, during a day-long assessment at the MTFs research offices.

### Psychiatric Diagnoses

Symptoms of eating disorders (AN, BN, and BED) were assessed with the Eating Disorder Questionnaire (EDQ), a version of the Structured Clinical Interview for DSM-III-R (Spitzer, Williams, Gibbon, & First, 1987) modified to include coverage of BED symptoms. Probes and questions were added to ensure comprehensive assessment of eating pathology. In addition to reporting on their own ED symptoms, mothers were interviewed about their daughters' symptoms with a modification of the EDQ.

Substance use and misuse were assessed in all participants with a modified version of the expanded substance abuse module (Robins, Babor, & Cottier, 1987) of the Composite International Diagnostic Interview (Robins et al., 1988). Substances assessed were

nicotine, alcohol, and illicit drugs, which included cannabis, amphetamines, barbiturates, tranquilizers, cocaine, heroin, opiates, PCP, psychedelics, inhalants, and other miscellaneous illicit drugs.

Trained interviewers or advanced clinical psychology graduate students administered the interviews. They coded each symptom as present, subthreshold (in severity, frequency, or pervasiveness), or absent. Lifetime diagnoses were made by consensus by teams of two or more advanced clinical psychology graduate students who reviewed the structured interviews for each case, as well as interview audiotapes when necessary. Criteria outlined in the 3rd Rev. ed. of the Diagnostic and Statistical Manual of Mental Disorders (DSM-III-R; American Psychiatric Association [APA], 1987) were used to define all disorders except BED, a newly proposed category in DSM-IV (APA, 1994). Best-estimate diagnoses, derived by combining daughter's and mother's reports on the daughter's ED symptoms and applying DSM-III-R or DSM-IV diagnostic algorithms to symptoms obtained, were used for adolescents' EDs. Diagnoses were made at three levels of certainty: definite (full diagnostic criteria met as outlined in DSM-III-R); probable (one criterion fewer than the minimum definite definition); and possible (two criteria fewer than the minimum definite definition). For example, DSM-III-R lists four symptoms of AN and five symptoms of BN. If any one symptom was absent, the diagnosis was probable; if any two were absent, the diagnosis was possible. In each case, for the diagnosis to be given at any certainty level, defining symptoms (i.e., weight loss in AN and binge eating and purging in BN) and duration were required to be at least subthreshold. Hence, the probable BN category includes participants who did not meet the frequency criterion of binge eating twice a week for 3 months, or who denied overconcern with weight and shape, but who met all other criteria in full for the diagnosis.

Kappa coefficients were calculated to assess degree of agreement between consensus teams. Self-reported ED diagnosis kappas ranged from .68 (AN) to .71 (BED); kappa was .61 for mother's report of daughter's AN. Study kappas exceeded .90 for SUD diagnoses.

### **Disordered Eating (DE)**

Information on eating attitudes and behaviors was gathered with the MTFS revision of the Eating Disorders Inventory (EDI). We included this self-report instrument in addition to lifetime ED diagnostic information because it provided a means to assess a broad range of current DE, specifically including questions regarding binge eating and compensatory behaviors. It was of particular interest to assess current, subsyndromal eating problems in adolescent participants, who were in the midst of the age of risk for developing an ED (Hsu, 1996) and thus might exhibit symptoms but fall below the threshold for a diagnosis. This measure is a version of the EDI (Garner, Olmsted, & Polivy, 1983) that was abbreviated, simplified for use with study participants ranging from 10 years old to adults, and expanded to broaden the assessment of compensatory behaviors. The revised EDI consists of 30 true-false items. Details regarding psychometric properties of the revised EDI were reported in Klump, McGue, and Iacono (2000). In brief, four subscales, each composed of six to eight items, were obtained through factor analysis: Body Dissatisfaction (assesses discontent with body shape and size), Weight Preoccupation (measures concern about weight, eating, and dieting), Binge Eating (assesses binge eating, secretive eating, and preoccupation with food), and Compensatory Behaviors (taps the use of self-induced vomiting, laxatives, and other compensatory behaviors to control weight). Adequate reliability and stability of this measure have been demonstrated (Klump et al., 2000).

Further, EDI total scores were higher for adolescents with a diagnosis of probable or definite AN or possible, probable, or definite BN or BED ( $M = 14.5 \pm 6.4$ ) than those without ( $M = 8.8 \pm 5.8$ ),  $t(1,625) = 6.6$ ,  $p < .001$ . Similar significant group differences in EDI scores were found for adult participants with and without EDs.

### **ED Symptom Groups**

Broad diagnostic groupings were devised. A strategy involving broader groups is useful when lifetime psychopathology is assessed because it accommodates for poor memory of specific symptoms when one is not currently symptomatic or in treatment. Moreover, subthreshold BN differs in severity but not quality from clinical BN (Kendler et al., 1991).

On the basis of evidence that ANB individuals are consistently more impulsive than ANR individuals (for review, see DaCosta & Halmi, 1992) and to evaluate previous findings of particularly strong links between bulimic behaviors and SUDs (Holderness et al., 1994), we classified participants with a history of clinically significant ED behaviors into one of two groups: Bulimic ED, characterized by recurrent binge eating and/or purging, or Restricting ED, characterized by symptoms of restrictive eating. These groups were based on preliminary analyses evaluating differences in EDI total score means for groups of participants divided by ED diagnosis certainty level. Participants were classified with a Bulimic ED if they had a possible, probable, or definite BN or BED diagnosis, and participants were classified with a Restricting ED if they had a probable or definite AN diagnosis. To ensure that the latter group would include only the restricting subtype, the minority of participants with AN who also had a lifetime diagnosis of BN or BED or any binge eating symptoms ( $n = 7$  adolescents;  $n = 5$  mothers) were placed in the Bulimic ED group.

### **SU Groups**

For the adult cohort, nicotine use was defined as a positive answer to the question, "Did you ever smoke every day for at least two weeks?" Few adolescents (20%) reported having smoked daily for 2 weeks. To be sensitive to the possibility that even low levels of nicotine use are significant in adolescence, especially because they have less freedom to smoke regularly than adults, nicotine use was defined for adolescents as a positive answer to the question, "Have you ever tried any form of tobacco?" For both age groups, alcohol use was defined as a positive response to the question, "Have you ever been intoxicated (drunk)?" and illicit drug use was defined as a positive response to "Have you ever tried any of these drugs?" The participant was then read and shown a list of the 11 types of illicit drugs described above.

### **Substance Misuse Groups**

Substance misuse groups were defined by the presence or absence of the following diagnoses: definite nicotine dependence for both cohorts; definite alcohol abuse or probable or definite dependence in the adolescent group or definite alcohol dependence alone in the adult group; and definite illicit drug abuse or dependence for both groups. Because an alcohol abuse diagnosis in an adolescent girl indicates more severe pathology than the same diagnosis in a middle-aged adult woman, the threshold differed for determining alcohol misuse for the two age groups. Furthermore, probable drug dependence was included in the definition of drug misuse for adolescents only.

## Statistical Analyses

The relationship between the EDI subscales and substance use and misuse was investigated through a series of one-way multivariate analyses of variance (MANOVAs). MANOVAs were completed separately for each substance and separately in the adolescent and adult samples. The dependent variables in these analyses were the four EDI subscales; the independent variable was the substance use or misuse classification. Significant MANOVA results were followed up with univariate *F* tests to detect group differences in individual subscale scores. Because the EDI total score could not be analyzed together with its component subscales, we also completed one-way analyses of variance (ANOVAs) with the EDI total score as the dependent variable and substance use or misuse grouping as the independent variable.

The relationship between ED diagnoses and substance use and misuse was assessed with tetrachoric correlations, which were computed separately in the adolescent and adult samples and separately for each possible combination of ED diagnosis by substance use or misuse classification. To obtain a quantitative estimate of the strength of effect that was comparable to the tetrachoric correlations used in assessing relationship with the ED diagnoses, we determined the biserial correlations between the EDI scales and the substance use and misuse classifications.<sup>2</sup> In addition, odds ratios (ORs) were calculated to assess the comorbidity of ED and SUD diagnoses. The significance of ORs was evaluated with *z* tests.

To reduce the possibility of inflated Type I error that might result from the large number of correlational analyses as well as because twin participants were used, *a priori* we set the significance level for analyses at .01.

## RESULTS

### Adolescents

Twenty-seven (4.0%) of the adolescent participants met lifetime criteria for Restricting ED and 28 (4.2%) for Bulimic ED. Of the adolescent cohort, 380 (56.4%) had used tobacco, 306 (45.4%) had been drunk, and 163 (24.2%) had used an illicit drug. Ninety-three adolescents (13.8%) had definite nicotine dependence, 85 (12.6%) had definite alcohol abuse or probable or definite alcohol dependence, and 44 (6.5%) had definite drug abuse or probable or definite drug dependence. Among both adolescents and adults, the most commonly used and misused illicit drug was cannabis, with amphetamines a distant second, followed by hallucinogens. Due to missing data, the sample sizes included in certain data analyses are somewhat smaller.<sup>3</sup>

We used several approaches to analyze the relationship between eating problems and substance use and misuse. First, we analyzed whether girls who used and misused

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<sup>2</sup> Correlations were obtained using Prellis, Versions 1.20 and 2.20 (Joreskog & Sorbom, 1991, 1998). Joreskog & Sorbom, 1991 The computation of variances for correlations is believed to be most accurate when all variables are of the same type, such as all ordinal or all continuous (S. du Toit, personal communication, May 28, 1998). Therefore, to obtain the most accurate standard errors for biserial correlations, continuous variables were divided into categories, each with approximately even numbers of participants. Dichotomous variables were not altered. Because tetrachoric correlations involve variables of the same type (i.e., dichotomous), it was not necessary to transform these variables to obtain accurate standard errors.

<sup>3</sup> Although complete data are available for diagnostic interview data, some individuals were unable to complete all self-report forms during their day-long assessment, resulting in missing EDI data for some adolescents and adults.

substances tended to report more current eating difficulties than those denying substance use or abuse. Figure 1 presents means and standard deviations of EDI scores for each adolescent SU participant groups and Figure 2 presents mean EDI scores for substance

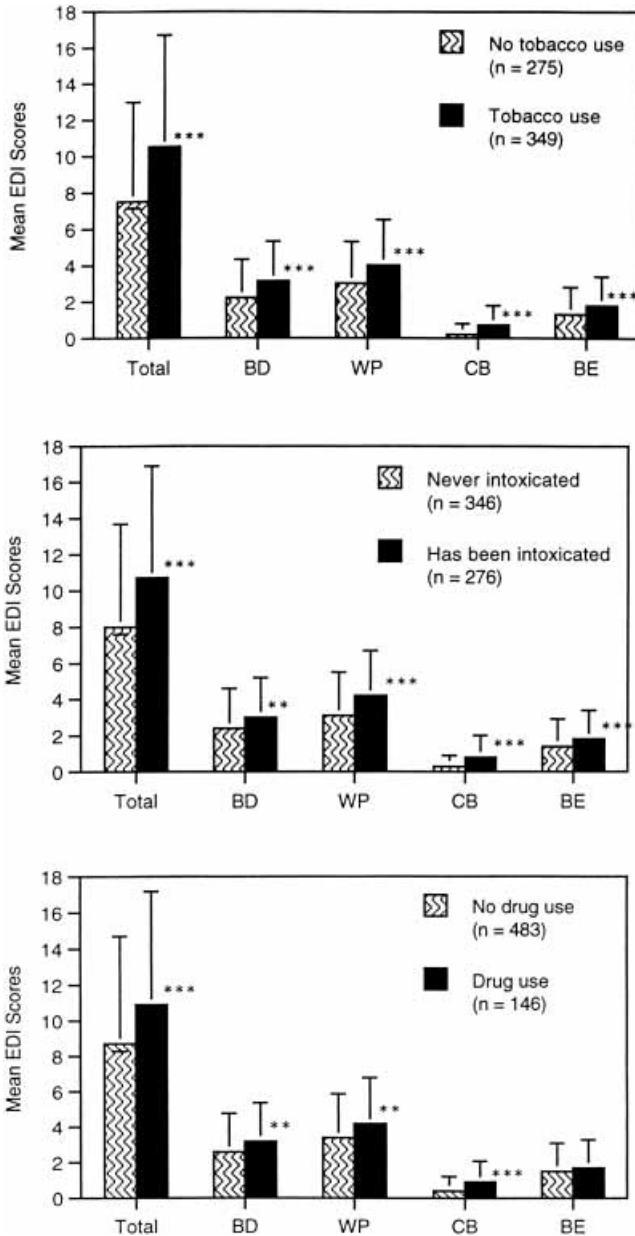


Figure 1. Mean Eating Disorder Inventory (EDI) scores (+ SD) and significant group differences as identified by analysis of variance (ANOVA) or multivariate analysis of variance (MANOVA) for nicotine use, alcohol use, and illicit drug use groups in adolescent girls. Total = EDI Total score. EDI subscales: BD = Body Dissatisfaction; WP = Weight Preoccupation; CB = Compensatory Behaviors; BE = Binge Eating. Significant differences between groups are indicated as follows: \*\*\*  $p < .001$ . \*\*  $p < .01$ .

misuse groups. Differences in EDI scores were noted in all SU groups total score ANOVAs (nicotine:  $F = 41.5, p < .001$ ; alcohol:  $F = 32.1, p < .001$ ; illicit drug:  $F = 14.4, p < .001$ ) and subscale MANOVAs (nicotine:  $F = 14.2, p < .001$ ; alcohol:  $F = 15.1, p < .001$ ;

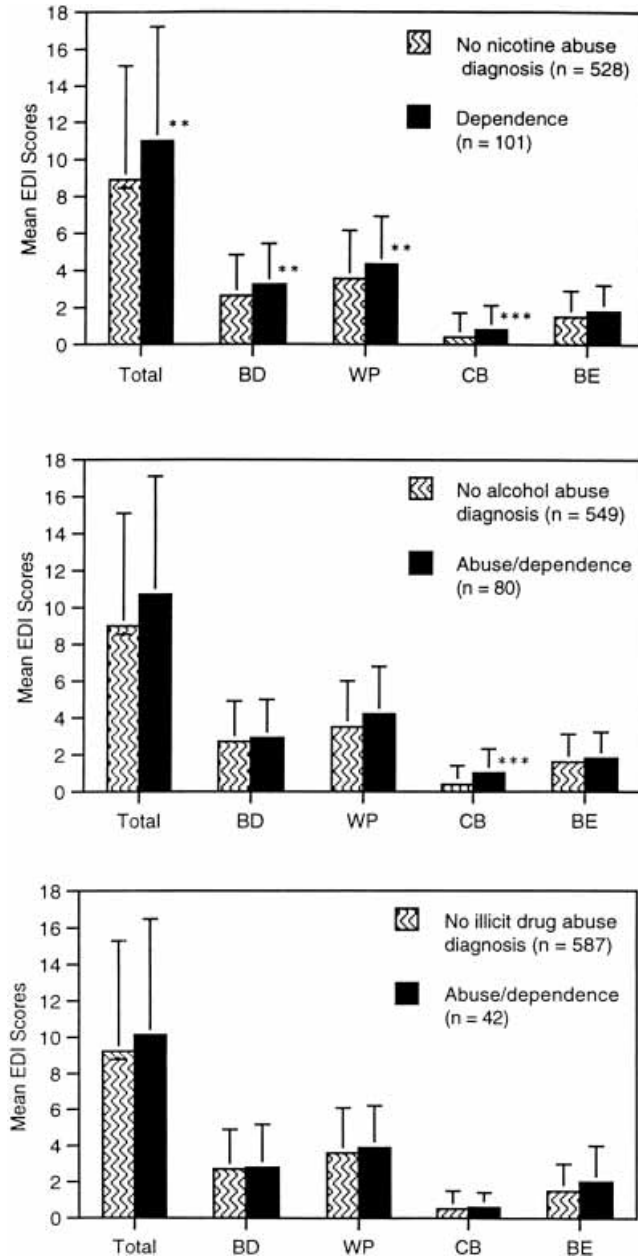


Figure 2. Mean Eating Disorder Inventory (EDI) scores (+ SD) and significant group differences as identified by analysis of variance (ANOVA) or multivariate analysis of variance (MANOVA) for nicotine misuse, alcohol misuse, and illicit drug misuse groups in adolescent girls. Total = EDI Total score. EDI subscales: BD = Body Dissatisfaction; WP = Weight Preoccupation; CB = Compensatory Behaviors; BE = Binge Eating. Significant differences between groups are indicated as follows: \*\*\*  $p < .001$ . \*\*  $p < .01$ .

illicit drug:  $F = 9.8, p < .001$ ). Fewer significant differences were noted in substance misuse groups, with only one significant total score ANOVA (nicotine:  $F = 11.1, p < .01$ ; alcohol:  $F = 5.5, p > .01$ ; illicit drug:  $F = 0.9, p > .01$ ) and two significant subscale MANOVAs (nicotine:  $F = 4.2, p < .01$ ; alcohol:  $F = 7.4, p < .001$ ; illicit drug:  $F = 0.8, p > .01$ ). Overall, adolescents who endorsed substance use and misuse tended to report higher EDI scores than adolescents who did not use or misuse substances. However, illicit drug use and nicotine misuse groups did not differ in their endorsement of binge eating and alcohol misuse groups differed only in their endorsement of compensatory behaviors. Relatively few group differences were observed in the endorsement of binge eating, but consistent group differences were noted in compensatory behavior symptoms.

Next, we examined biserial correlations between DE and substance use and misuse and found positive associations of varying strength (Table 1). Associations were strongest at the level of SU. With a few exceptions, nicotine and alcohol use and misuse were correlated weakly to modestly with indices of DE. Illicit drug use correlated weakly with most DE scores; by contrast, drug misuse was uncorrelated with most DE symptoms.

We evaluated the strength of association between ED diagnoses and substance use and misuse using tetrachoric correlations, which revealed similar patterns as the preceding analyses (Table 1). Correlations were weak to moderate in strength and positive, ranging from .05 to .30. Overall, substance use and misuse categories were associated modestly with Bulimic ED. Nicotine use and alcohol misuse were correlated moderately with Bulimic ED; weak but significant, positive associations were evident between most other ED diagnoses and SU group combinations.

ORs evaluating the strength of association of adolescent SU and ED groups were nonsignificant at the conservative .01 level, although several ORs approached significance. (Recall that we set the significance level at .01 a priori for all analyses.) Specifically, an adolescent with a Bulimic ED was 2.65 times as likely to have used nicotine as an adolescent without a Bulimic ED (99% confidence interval [CI]: .75, 9.39,  $p < .05$ ). For those with a Restricting ED, the OR for nicotine use was 2.13 (.79, 5.81,  $p < .05$ ) and the OR for drug use was 2.07 (.82, 5.21,  $p < .05$ ). Table 2 lists ORs for ED and SU groups, none of which approached significance for this age cohort.

Table 1. Correlations (and SE) of Eating Disorder Inventory scores and eating disorder diagnoses with substance use and misuse in adolescent girls

Group	Eating Disorder Inventory Scales <sup>a</sup>					Eating Disorder Diagnoses <sup>b</sup>	
	Total	BD	WP	CB	BE	Bulimic ED	Restricting ED
Nicotine use	.32** (.05)	.26** (.05)	.27** (.05)	.35** (.05)	.19** (.05)	.30** (.12)	.12** (.12)
Alcohol use	.28** (.05)	.15** (.05)	.28** (.05)	.34** (.05)	.18** (.05)	.16** (.11)	.11** (.11)
Illicit drug use	.22** (.06)	.18** (.06)	.18** (.06)	.29** (.06)	.06 (.06)	.11* (.12)	.18** (.12)
Nicotine misuse	.19** (.06)	.15** (.06)	.18** (.06)	.20** (.07)	.11* (.06)	.14** (.12)	.11** (.13)
Alcohol misuse	.15** (.07)	.07** (.06)	.14** (.07)	.28** (.07)	.08 (.06)	.21** (.13)	.05 (.14)
Illicit drug misuse	.08 (.07)	.04 (.08)	.06 (.07)	.04 (.09)	.11* (.09)	.05 (.17)	.14** (.15)

Note: Subscales: BD = Body Dissatisfaction; WP = Weight Preoccupation; CB = Compensatory Behaviors; BE = Binge Eating; Bulimic eating disorders (ED) = bulimia nervosa, binge eating disorder, or binge eating/purging type of anorexia nervosa; Restricting ED = restricting anorexia nervosa diagnosis.

<sup>a</sup>Biserial correlations.

<sup>b</sup>Tetrachoric correlations.

\* $p < .01$ .

\*\* $p < .001$ .

Table 2. Odds ratios (and 99% confidence intervals) for diagnoses of eating disorders and substance misuse in adolescent girls and women

Group	Adolescent girls ( <i>n</i> = 672)		Women ( <i>n</i> = 710)	
	Bulimic ED	Restricting ED	Bulimic ED	Restricting ED
Nicotine misuse	1.83 (.55, 6.11)	1.70 (.59, 4.85)	1.85 (.88, 3.90)	2.68 (.75, 9.58)
Alcohol misuse	1.99 (.55, 7.12)	1.60 (.50, 5.10)	2.78 <sup>†</sup> (1.11, 7.03)	1.62 (.27, 9.68)
Illicit drug misuse	1.59 (.27, 9.30)	1.60 (.35, 7.29)	1.27 (.46, 3.46)	3.26 (.84, 12.81)

Note: Bulimic eating disorders (ED) = bulimia nervosa, binge eating disorder, or binge eating/purging type of anorexia nervosa; Restricting ED = restricting anorexia nervosa  
<sup>†</sup>*p* < .01.

In summary, among adolescent girls, use of substances was consistently associated positively with problem eating, both lifetime and current. Misuse of substances was inconsistently related to DE/EDs, however, with nicotine dependence showing the strongest, most reliable association with current and lifetime DE.

### Adults

Of the adult participants, 11 (1.5%) reported a lifetime history of Restricting ED, whereas 53 (7.4%) met criteria for Bulimic ED. As expected, the broad definition of the two ED classes studied resulted in higher prevalence than the population base rates of approximately 1% for AN and 2% for BN among women (Fairburn & Beglin, 1990; Hsu, 1996). Of the adults, 354 (49.2%) had smoked daily for 2 weeks, 588 (81.8%) had been drunk, and 355 (49.4%) had used an illicit drug. Two hundred thirty five (32.7%) women reported definite nicotine dependence, 71 (9.9%) had definite alcohol dependence, and 95 (13.2%) had definite illicit drug abuse or dependence.

In contrast to the adolescent cohort, no significant differences were found among adult participants in mean EDI scores for the three substance use and misuse groups. Consistent with these nonsignificant MANOVA and ANOVA results, substance use and misuse and EDI scores were weakly correlated or uncorrelated in adult participants. Biserial correlations ranged from  $-.15$  to  $.20$  and only five correlations attained statistical significance. Nicotine use ( $r = -.11$ ) and illicit drug use ( $r = -.15$ ) were associated negatively with body dissatisfaction. Alcohol misuse was correlated positively with overall DE ( $r = .16$ ), weight preoccupation ( $r = .20$ ), and binge eating ( $r = .15$ ).

Tetrachoric correlations of ED diagnostic groups and substance use and misuse were weak to modest and ranged from  $-.02$  to  $.27$ . Whereas Bulimic ED was uncorrelated with SU, it was correlated significantly with misuse of nicotine ( $r = .20$ ) and alcohol ( $r = .27$ ). By contrast, Restricting ED was uncorrelated with misuse of nicotine and alcohol. Restricting ED was associated significantly with use of nicotine ( $r = .24$ ), alcohol ( $r = .16$ ), and illicit drugs ( $r = .15$ ), and misuse of illicit drugs ( $r = .21$ ).

Table 2 presents ORs for adult ED/SU groups. A woman with a Bulimic ED was almost three times as likely to report alcohol misuse as a woman without a Bulimic ED. The following associations approached significance ( $p < .05$ ). Women with a Bulimic ED were almost twice as likely to have misused nicotine as those without a Bulimic ED. Women with a Restricting ED were two and a half times as likely to have misused nicotine and more than three times as likely to have misused illicit drugs as those without a Restricting ED.

In summary, among women, the most consistent finding to emerge involved an association between Bulimic ED symptoms, current and past, and alcohol misuse. Other analyses revealed few reliable patterns of results.

## DISCUSSION

The goal of the present study was to evaluate relations between eating and substance use and misuse in two cohorts of female, community-based participants. The strongest finding to emerge from this study, consistent across data analytic methods, was that eating attitudes and disorders were associated modestly with nicotine, alcohol, and drug use, and nicotine dependence in adolescent girls. ORs of ED and SU, although not statistically significant, generally support these results. Female adolescents with eating problems—both bulimic and restricting types—were more likely to have a history of SU and nicotine dependence than those without eating problems. This finding is consistent with previous research demonstrating high rates of SU among individuals with DE (Holderness et al., 1994).

No consistent associations between EDs and misuse of alcohol and illicit drugs were found in the adolescent sample. However, in one set of analyses, Bulimic EDs were associated with alcohol misuse and Restricting EDs were associated with illicit drug misuse among adolescent girls. As they were not replicated with a second data analytic strategy, these results should be interpreted with caution, but they support previous findings of elevated rates of alcohol problems among individuals with bulimia (Garfinkel et al., 1995; Kendler et al., 1991; Killen et al., 1987; Striegel-Moore & Huydic, 1993; Timmerman et al., 1990) and elevated rates of drug abuse among individuals with AN (Holderness et al., 1994).

In the adult sample, few trends in associations between eating attitudes and disorders and substance use and misuse were noted. Both correlational and OR results indicated that alcohol use and misuse were related to eating attitudes and pathology, as previous research has found with bulimia (Garfinkel et al., 1995; Kendler et al., 1991; Killen et al., 1987; Striegel-Moore & Huydic, 1993; Timmerman et al., 1990). However, it is important to note that the observed significant effects were not substantially larger than those associations that did not attain significance, suggesting these are relatively weak effects. Significant findings in the adult cohort that were not consistent across analytic strategies (i.e., eating problems as assessed both diagnostically and as disordered attitudes and behaviors) included associations between Restricting EDs and nicotine, alcohol, and illicit drug use and illicit drug misuse, and between Bulimic EDs and nicotine dependence. This inconsistency may have occurred in part because women were more likely to report past eating problems, assessed via diagnostic interviews of lifetime pathology, than current DE, assessed with the EDI. Unlike the adults, the adolescents sampled were close to the peak age of risk for developing an ED (Hoek et al., 1995), so the adolescent girls were more likely than the women to endorse current DE symptoms.

The first study question asked: How strong are associations between DE/ED and SU/SUD? Few patterns of associations were noted between eating problems and use and misuse of nicotine, alcohol, and illicit drugs across age groups, suggesting that there is no overarching relationship between these two types of problem behaviors. With the exception of previously noted associations between SU and eating behavior among adolescents, the present results are not consistent across analyses and effects are small even when statistically significant. Our findings suggest that although certain limited associ-

ations between EDs and substance use and abuse may exist, these two types of behaviors are not related strongly in this non-treatment-seeking sample.

Are substance use and misuse more strongly associated with bulimic behaviors than with nonbulimic behaviors, as previously reported (Holderness et al., 1994)? OR CI for substance misuse diagnoses overlapped across the Restricting and Bulimic ED groups in both age cohorts, indicating that the strength of the relationships was similar for both ED types. Significant associations with SU and nicotine dependence were found for adolescents with Restricting and Bulimic EDs; among adults, no pattern of associations between bulimic eating problems, rather than restricting eating problems, and substance use or misuse emerged. Thus, the present findings are inconsistent with the addiction model that posits a specific relationship between bulimia and substance abuse. However, the present results converge with a growing body of research suggesting that EDs and substance abuse have different etiologies, including twin study results indicating that genetic and environmental risk factors for alcoholism were distinct from those for a group of disorders including BN (Kendler et al., 1995).

Which classes of psychoactive substances manifest the strongest relationships with problem eating? All three substance classes assessed—nicotine, alcohol, and illicit drugs—exhibited significant associations with ED/DE, although these relationships varied in strength and differed for adolescents and adults. Among adolescents, all three substance classes were associated with both ED diagnostic classes. However, consistent with previous research (Watts & Ellis, 1992), associations with illicit drug misuse were weakest and least consistent. Among adult women, the strongest relationships involved alcohol: alcohol intoxication and dependence were associated with Restricting EDs and Bulimic EDs, respectively. No patterns of association emerged with the two other substance classes. The OR CIs for all three substance classes overlapped for both adolescents and adults, suggesting no prominent differences in associations between substance classes.

To our knowledge, this is the first study to examine comprehensively substance use and misuse and bulimic and restricting eating problems all at once in a community sample. Nevertheless, several limitations of this study merit mention. The cross-sectional nature of this study does not enable us to draw inferences about causation. Although a strength of this study lies in its epidemiological sampling, a resultant limitation is that because base rates of EDs are low, the numbers of participants with ED diagnoses were small, which restricted the power of data analyses to detect small effects. As a result, nuances in relationships between eating and SUDs may have been overlooked. Also, we did not examine associations between individual illicit drugs and DE, and so cannot determine if particular relationships were of greater importance than others were. For example, Watts and Ellis (1992) found that inhalant and amphetamine use were the substances most consistently correlated with DE risk in their sample. The fact that the adolescent sample was composed of twins may limit the generalizability of those findings to nontwin samples, as twins may differ from nontwins in relevant respects (Klump, Keel, Leon, & Fulkerson, 1999). However, other research has demonstrated similar rates of psychiatric diagnosis in singletons as in twins, and similar rates in monozygotic and dizygotic twins (Kendler, Pedersen, Farahmand, & Persson, 1996), supporting the generalizability of twin-based findings regarding psychopathology. Furthermore, the present findings are generally consistent with previous studies, as previously noted.

This study adds to a growing body of research indicating that associations between eating problems and substance use and abuse exist, although it departs from previous research in suggesting that these associations may not be as strong as previously

believed. Further research is needed to unravel the role of psychiatric comorbidity, whether etiologic or not, in ED-spectrum disturbances. Research is needed that examines the causal nature of these relationships, such as studying longitudinal patterns of association, including temporal patterns. An alternate strategy, which is taken in the second paper in the present series, involves examining familial patterns of association of substance use and misuse and DE. A better understanding of the processes that underlie DE and how they act and interact to result in eating problems is essential for the development of effective treatment and prevention strategies.

The Minnesota Twin Family Study, an ongoing project conducted at the Department of Psychology of the University of Minnesota, is supported by grants from the National Institute on Alcohol Abuse and Alcoholism (AA 09367) and from the National Institute on Drug Abuse (DA 05147). This research was supported by a doctoral dissertation fellowship from the University of Minnesota Graduate School to Dr. von Ranson. Portions of this research were presented at the Eighth International Conference on Eating Disorders (April 1998) and at the annual meeting of the Society for Adolescent Medicine (April 1999). The first author is grateful to dissertation committee members James E. Mitchell, M.D., Auke Tellegen, Ph.D., Dorothy Hatsukami, Ph.D., and Scott Crow, M.D., for their guidance and thoughtful comments regarding this study.

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