Are There Subgroups of Bulimia Nervosa Based on Comorbid Psychiatric Disorders?

Alexis E. Duncan, MPH[1,2]
Rosalind J. Neuman, PhD[1]
John Kramer, PhD[3]
Samuel Kuperman, MD[3]
Victor Hesselbrock, PhD[4]
Theodore Reich, MD[1]
Kathleen K. Bucholz, PhD[1,2]*

ABSTRACT

Objective: The current study sought to determine whether there are subtypes of bulimia nervosa (BN) differentiated by comorbid psychiatric disorders.

Method: Data on comorbid psychiatric diagnoses in female relatives of probands and controls in the Collaborative Study of the Genetics of Alcoholism (COGA) who met criteria for BN (as outlined in the 3rd Rev. ed. of the Diagnostic and Statistical Manual of Mental Disorders) were analyzed using latent class analysis. Resulting latent classes were compared on a variety of variables related to impulsive behaviors and psychological functioning.

Results: The best-fitting solution, a two-class model, yielded one class (72%) characterized by substance dependence, depression, antisocial personality disorder (ASPD), and anxiety disorders, and another characterized by depression. The highly comorbid class had more suicidality, more daily smokers, sought help for emotional problems, and had lower Global Assessment of Functioning (GAF) scores compared with those in the comorbid depression only class.

Discussion: Latent class findings suggest the existence of two classes of BN differentiated by substance dependence, impulsive behaviors, and poorer psychological functioning. © 2004 by Wiley Periodicals, Inc.

Keywords: bulimia nervosa; COGA; substance dependence; poor psychological functioning

(Int J Eat Disord 2005; 37:19–25)

Accepted 7 January 2004

The Collaborative Study on the Genetics of Alcoholism (H. Begleiter, State University of New York, Health Sciences Center at Brooklyn [PI]; L. Bierut, Washington University, H. Edenberg, Indiana University, V. Hesselbrock, University of Connecticut, B. Porjesz, State University of New York, Brooklyn [Co-PIs]) includes 9 different centers where data collection, analysis, and/or storage take place. The 9 sites and PIs and Co-PIs include: University of Connecticut (V. Hesselbrock); Indiana University (J. Nurnberger Jr., P.M. Conneally, H. Edenberg, T. Foroud); University of Iowa (R. Crowe, S. Kupeman); State University of New York, Brooklyn (B. Porjesz, H. Begleiter); Washington University (L. Bierut, A. Goate, J. Rice); University of California, San Diego (M. Schuckit); Howard University (R. Taylor); Rutgers University (J. Tischfield); and Southwest Foundation (L. Almasy), Lisa Neuhold, NIAAA Staff Collaborator.

In memory of Theodore Reich, M.D., Co-Principal Investigator of COGA since its inception and one of the founders of modern psychiatric genetics, we acknowledge his immeasurable and fundamental scientific contributions to COGA and the field.

This national collaborative study is supported by the NIH Grant U10AA08403 from the National Institute on Alcohol Abuse and Alchoholism (NIAAA).

**Correspondence to:* Kathleen K. Bucholz, PhD, Department of Psychiatry, Washington University School of Medicine, 40 N. Kingshighway, Suite 2, St. Louis, MO 63108. E-mail: kkb@wustl.edu

[1] Department of Psychiatry, Washington University School of Medicine, St. Louis, Missouri

[2] Department of Community Health, St. Louis University School of Public Health, St. Louis, Missouri

[3] Department of Psychiatry, University of Iowa College of Medicine, Iowa City, Iowa

[4] Department of Psychiatry, University of Connecticut School of Medicine, Farmington, Connecticut

Published online in Wiley InterScience (www.interscience.wiley.com). DOI: 10.1002/eat.20066

Introduction

Evidence from previous studies has established that more than one half of women with eating disorders (ED) suffer from comorbid psychiatric disorders (Braun et al., 1994; Brewerton et al., 1995; Bulik, Sullivan, & Kendler, 2000; Godart Flament, Lecrubier, & Jeammet, 2000; Schuckit et al., 1996). Affective disorders are the most common comorbid disorders among women with bulimia nervosa (BN), with prevalence ranging from 65% to 75% in clinical samples (Braun et al., 1994; Brewerton et al., 1995). Rates of comorbid alcohol and/or drug dependence in women with BN have ranged from 13% to 52%, with studies using clinical samples consistently reporting higher substance dependence comorbidity rates than those using population-based samples (47%–52% vs. 13%–31%, respectively; Braun et al., 1994; Bulik, Sullivan, Carter, & Joyce, 1996, 1997; Dansky, Brewerton, & Kilpatrick, 2000; Garfinkel et al., 1995; Kendler et al., 1991). Anxiety disorders and cluster B personality disorders have also been found to be elevated in women with BN (Braun et al., 1994; Brewerton et al., 1995; Diaz-Marsá, Carrasco, & Sáiz, 2000; Godart et al., 2000; Milos, Spindler, Ruggiero, Klaghofer, & Schnyder, 2002; Selby, & Moreno, 1995).

Several studies using clinical samples have examined the role played by substance use disorders (SUDs) in the elevated prevalence of psychiatric

comorbidity in women with BN. In a sample of psychiatric inpatients, Grilo et al. (1995) found no differences between ED patients with and without SUDs in terms of Axis I psychiatric disorders, but they found that women with ED and SUD were more likely to have cluster B personality disorders and those without SUD were more likely to have cluster C personality disorders. In contrast, Lilenfeld et al. (1997) found that among women with BN, those with a lifetime history of alcohol or drug dependence had excess rates of social phobia, conduct disorder, as well as cluster B and C personality disorders, compared with their counterparts without a history of SUD. Bulik et al. (1997) found that women with purging type BN and a lifetime diagnosis of alcohol dependence (AD) were more likely to have any anxiety disorder, simple phobia, other substance dependence, any childhood externalizing disorder, and conduct disorder. In 22 Japanese female inpatients with BN and alcoholism and 22 age-matched BN patients with BN only, Suzuki, Higuchi, Yamada, Komiya, and Takagi (1994) found that women with BN and alcoholism were more likely to have borderline personality disorder than their nonalcoholic counterparts. Findings from these and other studies suggest a BN subtype characterized by impulsive behaviors and increased comorbid pyschopathology (Bulik et al., 1997; Grilo et al., 1995; Lilenfeld et al., 1997; Suzuki et al., 1994).

In a latent class analysis of 11 psychiatric diagnoses obtained in a general population sample of female twins, Sullivan and Kendler (1998) observed a class of modest size (3%) that was dedicated to ED, with marked elevations of anxiety disorder, alcoholism, and nicotine dependence. The endorsement probabilities of ED in the other five classes were modestly elevated (Sullivan & Kendler, 1998). We are, however, not aware of a comorbidity analysis among women with a diagnosis of BN. The objective of the current study was to determine whether subtypes of lifetime BN existed based on comorbid psychiatric diagnoses in a nonclinical sample. In light of previous findings regarding differences in women with BN with and without SUDs, it was hypothesized that there would be a substance-dependent class of bulimia with higher levels of psychopathology, which would support the idea of an impulsive subtype of BN.

Methods

Collaborative Study of the Genetics of Alcoholism (COGA)

Data from female relatives of alcoholic probands and from female controls who participated in the multisite COGA were analyzed. Briefly, COGA is a multicenter family study of alcoholism in which probands ascertained from treatment facilities at each of six centers in the United States and their family members were interviewed with the Semi-Structured Assessment for the Genetics of Alcoholism (SSAGA), a comprehensive structured psychiatric diagnostic instrument. For inclusion in COGA, probands had to satisfy lifetime criteria for both AD (using criteria defined in the 3rd Rev. ed. of the Diagnostic and Statistical Manual of Mental Disorders [DSM-III-R]; American Psychiatric Association [APA], 1987) and Feighner alcoholism at the definite level (Feighner et al., 1972). All first-degree relatives of the probands were sought for interview in Stage I. In families that had at least two first-degree relatives of the proband who met lifetime criteria for AD, additional relatives were recruited for the study. These individuals were also assessed with a neurophysiologic protocol and were invited to donate a blood sample for DNA analysis (Stage II). Control families were selected from a variety of sources, including drivers' license records, individuals attending medical/dental clinics, and advertisements and questionnaires mailed to randomly selected subjects at a university. The COGA protocol was approved by the institutional review boards at all six COGA centers, and written informed consent was obtained from all subjects before the protocol was administered. Longitudinal follow-up 5 years after the initial assessment was part of the COGA protocol, but these data are still being collected and were not analyzed in the current study.

Assessment

The assessment interview for the first phase of COGA, the SSAGA-I, is a reliable and valid interview that elicits both lifetime and current information for a comprehensive range of psychiatric disorders, including anorexia nervosa (AN) and BN (Bucholz, et al., 1994, 1995; Hesselbrock, Mesa, Bucholz, Schuckit, & Hesselbrock, 1999). The SSAGA-I is based on the DSM-III-R classification system, although other classification systems are covered for some diagnoses. Reliability data for individual diagnoses, including AD, other drug dependence, and depression, have indicated good to excellent reliability, with kappa values exceeding .60 for most diagnoses studied (Bucholz et al., 1994; Hesselbrock et al., 1999). Unfortunately, reliability data for BN are not available.

Diagnostic Definition of BN

To qualify for a diagnosis of BN under the DSM-III-R classification system, an individual must engage in binge eating episodes averaging two or more a week for at least 3 months, feel a lack of control over eating behavior during these binges, regularly engage in inappropriate compensatory behaviors to prevent weight gain (e.g.,

self-induced vomiting, use of laxatives or diuretics, strict dieting, fasting or vigorous exercise), and report persistent overconcern with body shape and weight.

Because the purpose of the SSAGA is to obtain psychiatric diagnoses, once it is clear that it is not possible for an individual to meet diagnosic criteria, he or she is skipped to the next section of the interview. In the case of ED, subjects who indicated that they had never binged, defined as "eating a large amount of food in a short period of time (usually less than 2 hours)," or did not meet the frequency criterion for BN, defined as twice a week for at least 3 months, were skipped out of further questions in the BN section. As well, the structure of the binging questions precluded use of a broader indication of frequency. Therefore, it was not possible to use a less strict binging criterion of once per week as other studies have done (Bulik, Sullivan, & Kendler, 1998; Bulik, Wade, & Kendler, 2000; Walters et al., 1992).

Lifetime diagnoses of AD (as defined in the 4th ed. of the Diagnostic and Statistical Manual of Mental Disorders [DSM-IV]; APA, 1994) and DSM-III-R cocaine dependence, marijuana dependence, antisocial personality disorder (ASPD), major depression, obsessive-compulsive disorder (OCD), social phobia, agoraphobia, and panic disorder were used in these analyses. Because OCD, social phobia, agoraphobia, and panic disorder were not highly prevalent, these diagnoses were collapsed into one diagnostic grouping labeled anxiety. (Other anxiety disorders, such as generalized anxiety disorder and posttraumatic stress disorder, were not included in the SSAGA-I.) Nicotine dependence was not assessed in the SSAGA-I.

Of 4,650 female relatives of probands (N = 4,110) and female controls (N = 540) who were interviewed, 122 (2.6%) met full criteria for lifetime BN. The prevalence among male relatives and controls for BN was negligible (0.84%). Therefore, analyses in the current study focus on females only. Latent class analysis (LCA) was applied to the lifetime comorbid psychiatric diagnoses of the women to discern subtypes of BN that might be distinguished by patterns of comorbid psychiatric disorders, which could be used to guide further research in the etiology and nosology of these disorders.

LCA

LCA is a statistical method that is based on the assumption that frequencies with which different item endorsement profiles occur in a dataset can be explained by the existence of a small number of mutually exclusive respondent classes or subtypes, m, with each class having a distinctive "profile" of item endorsement probabilities (IEP) that is constant for all members of that class. A critical assumption of LCA is that within a class, the probabilities of endorsing different items are statistically independent (Clogg, 1995). This is the principle of local independence, that is, the relations between two variables are predicated on a third, unobserved—"latent"—variable, so that once this latent variable is taken into account, the observed measures are no longer related.

For a given model, parameter estimates include class membership probabilities (which may be thought of as class prevalence estimates) and class-specific IEP. In the current study, "items" represent formal diagnoses. IEPs reflect the probability that an individual will have a given response on an item, conditional on being in that class. In the case of psychiatric data, where diagnoses are typically dichotomized as present or absent, these parameters reflect the probability that the item is endorsed by the individual, given membership in that class. Classes are characterized by the IEPs for each item, as well as by their estimated prevalence. Assignment of individuals to classes was based on maximum likelihood methods using the EM algorithm (Dempster, Laird, & Rubin, 1977) as operationalized by the Latent Class Analysis Program (LCAP) software program (Neuman, et al., 1999). The model with the lowest bayesian information criteria (BIC) was considered to be the best fitting model (Schwarz, 1978).

Ninety-five percent confidence intervals (95% CI) were derived for class membership probabilities and IEPs using the program LCAP-BOOT (http://hardy.wustl.edu), a bootstrapping program that is a companion to LCAP. Bootstrapping is a method in which a new sample is randomly chosen from the original dataset, and a new LCA is performed. For these analyses, this process was repeated 1,000 times, using sampling by family unit rather than by individual to account for the familial nature of our sample. We computed 95% CI by taking the 2.5th and 97.5th percentiles of the distribution of each set of 1,000 bootstrapped probabilities.

External Validators

Resulting latent classes were compared on several variables from the SSAGA related to psychological functioning as well as on other ED-related variables, which served as external validators of the latent classes. Included in these analyses was the Global Assessment of Functioning (GAF) score, which was assigned by the interviewer at the time of assessment. Variables regarding suicidality (e.g., suicide ideation, suicide ideation for 7+ days, suicide plan, suicide attempt, and number of suicide attempts) were taken from the suicide section of the SSAGA, which was independent of the depression assessment. Smoking variables (e.g., ever a daily smoker, smoking duration, number of cigarettes, ever smoke more than one pack per day) were taken from the SSAGA smoking section. The variables for body mass index (BMI) and ever having spoken to a professional about emotional problems were taken from the demographic and somatization sections of the SSAGA, respectively. Age of binging onset and

method of compensatory behavior (purging vs. nonpurging) were assessed in the SSAGA ED section.

Results

Characteristics of the Sample

Demographic and other characteristics of the sample are shown in Table 1. Of the 4,110 female relatives of cases and 540 female controls, 122 (2.6%) met full DSM-III-R criteria for BN. Most of the BN women came from case families (*N* = 115 [94.3%]). One control family and 8 case families had 2 women with BN, and 1 case family had 3 women with BN. All other women came from separate families. The mean age of the sample was 34.7 years (*SD* = 10.3). The majority of the sample was Caucasian and had a household income less than $40,000 per year. Forty-five percent of the women were married at the time of interview, 35.3% had never been married, and 19.7% were no longer married. The largest proportion of the sample (37.7%) had some college education, although only 17.2% had a college degree. Only 4% of the sample also had a lifetime diagnosis of AN. The most prevalent comorbid lifetime psychiatric disorder among the women in the sample was major depressive disorder (72.1%), followed by AD (38.5%), any anxiety disorder (social phobia, panic disorder, agoraphobia, or OCD: 20.5%), cocaine and marijuana dependence (both 19.7%), and ASPD (12.3%). Thirteen percent (13.1%) had no other non-eating disorder lifetime diagnoses.

TABLE 1. Characteristics of 122 female relatives of alcoholic probands and controls with and BN in the COGA study

	Number	%
Control family member	7	5.74
Caucasian race	98	80.33
Household income < $40,000	77	64.71
Marital status		
Single	43	35.25
Married	55	45.08
Separated	18	14.75
Divorced	5	4.10
Widowed	1	0.82
Education		
Some high school	24	19.67
High school graduate	31	25.41
Some college	46	37.70
College graduate	21	17.21
Age group (years)		
<30	41	33.61
30–49	70	57.38
50+	11	9.02
Mean age (*SD*)	34.74 (10.30)	
Anorexia nervosa	5	4.10
Additional lifetime diagnoses		
Major depressive episode	88	72.13
Alcohol dependence	47	38.52
Cocaine dependence	24	19.67
Marijuana dependence	24	19.67
Anxiety disorder[a]	25	20.49
Antisocial personality disorder	15	12.30
No additional diagnosis	16	13.11

Note: BN = bulmia nervosa; COGA = Collaborative Study on the Genetics of Alcoholism.

[a]Social phobia, panic disorder, agoraphobia, or obsessive-compulsive disorder.

LCA

One- through five-class solutions were investigated. Lifetime diagnoses used for the LCA were DSM-III-R cocaine and marijuana dependence, ASPD, major depressive episode, anxiety disorder (social phobia, panic disorder, agoraphobia, and/or OCD), as well as DSM-IV AD. A two-class solution was the best fitting model. Table 2 displays the symptom endorsement probabilities for each class along with the overall class membership probabilities. There were 32 unique symptom profiles for the 122 women with BN. The majority (58%; 95% CI: 0.44, 0.90) of the sample fell into Class A membership, which featured a high IEP for depression, but low IEPs for other disorders. The remaining 42% (95% CI: 0.11, 0.56) of the sample was assigned to Class B, which was more severe in terms of comorbid psychiatric diagnoses, with high IEPs for depression and all SUDs.

Compared with Class A, Class B had markedly higher IEPs for every diagnosis except depression, for which the IEP was only nominally higher (.73 vs. .72; 95% CI: 0.52, 0.94, 0.57, and 0.84, respectively). IEPs were elevated for AD (.68; 95% CI: 0.54, 1.00), marijuana dependence (.47; 95% CI: 0.27, 0.81), cocaine dependence (.45; 95% CI: 0.23, 1.00),

TABLE 2. Class membership and class-specific symptom endorsement probabilities of psychiatric comorbidity in women with DSM-III-R bulimia nervosa

	Class A (*N* = 74)		Class B (*N* = 48)	
Diagnosis	IEP	95% CI	IEP	95% CI
Alcohol dependence	.168	.000, .356	.681	.537, 1.000
Cocaine dependence	.000	.000, .132	.465	.226, 1.000
Marijuana dependence	.012	.000, .167	.448	.273, .805
Antisocial personality disorder	.004	.000, .072	.285	.148, .763
Major depressive episode	.716	.574, .842	.729	.524, .939
Anxiety disorder[a]	.148	.024, .279	.283	.110, .550
Class prevalence	.577	.441, .896	.423	.105, .559

Note: IEP = item endorsement probability; DSM-III-R = 3rd Rev. ed. of the Diagnostic and Statistical Manual of Mental Disorders.

[a]Social phobia, panic disorder, agoraphobia, or obsessive-compulsive disorder.

ASPD (.29; 95% CI: 0.15, 0.76), and anxiety disorder (.28; 95% CI: 0.11, 0.55). In contrast, IEPs for Class A of the BN group were elevated only for major depression (.72). The IEPs for AD, ASPD, and anxiety disorder were modestly elevated, with only the IEP for anxiety disorder differing significantly from 0. The IEP for cocaine dependence in Class A was null.

External Validators

The comprehensive coverage of the SSAGA permitted comparison of the two classes on a variety of measures that may be thought of as potential external validators. Results of these analyses are displayed in Table 3. As might be expected from the characterizations of the two classes, Class B had significantly worse daily functioning, manifested in lower GAF scores assigned by the interviewer, who was blind to the diagnostic status of the respondents (although obviously aware of the symptoms expressed). Despite similar IEPs for depression, Class B members had more suicidal ideation, persistent suicidal ideation, were significantly more likely to have a suicide plan, and more likely to have made a suicide attempt. Class B members also had more suicide attempts than Class A members, although this difference did not meet conventional levels for statistical significance. Class B members were significantly more likely to have ever spoken to a health professional about emotional problems. Although Class B members were more likely to be daily smokers, no other differences in smoking history were noted as measured by duration of daily smoking, average number of cigarettes smoked daily, and proportion smoking a pack or more per day. In terms of nondiagnostic characteristics of BN, no differences between the two classes were observed in proportion with purging-type behaviors or in age of onset of binging behavior. Finally, BMI at interview was the same for women in classes A and B.

Discussion

In the current study, we examined clustering of comorbid psychiatric disorders for women with BN from a nonclinical sample, making this a rarity in the literature on BN, which has focused more heavily on clinical samples. The two-class solution from LCA indicated a large class of BN women characterized by depression only and a smaller second class with not only an equally high prevalence of depression, but also with concomitant alcohol, cocaine, and marijuana dependence, as well as ASPD and anxiety disorder. These results can be interpreted in one of two ways. The solution may reflect a severity continuum for psychopathology, because no discrete subtypes were observed. An alternative explanation is that there are two classes of BN, one with comorbid substance dependence and the other without. Given that the more comorbid class contained almost all the cases of alcohol, cocaine, and marijuana dependence, the latter interpretation is a plausible one. Furthermore, the possibility that this class represents an impulsive subgroup of BN is high. Not only does this class have higher rates of substance dependence, it also has a significant proportion of women with ASPD, and members were more likely to be daily smokers and to show greater suicidal tendencies, all of which could be considered to reflect higher impulsivity. These results support

Table 3. External validators by latent class in 122 female COGA participants with bulimia nervosa

External Validators	Class A (N = 74)	Class B (N = 48)	Test Statistic	p Value
Suicide ideation	54.05	75.00	5.43	.02
Suicide ideation for 7+ days	9.59	33.33	10.61	<.01
Suicide plan	24.3	41.67	4.08	.04
Suicide attempt	13.5	35.42	8.11	<.01
Number of suicide attempts	.20 (.55)	1.45 (4.65)	−1.83	.07
Ever daily smoker	54.05	77.08	6.63	.01
Smoking time/month	166.78 (122.22)	194.14 (113.83)	−1.01	.31
Number of cigarettes/day	15.60 (7.79)	19.35 (12.26)	−1.59	.12
Smoked 1 + pack/day	42.50	59.46	2.21	.14
Spoken to professional about emotional problems	71.62	87.50	4.26	.04
BMI	26.89 (7.50)	25.61 (6.11)	.98	.33
Purging type bulimia	64.86	66.67	.42	.84
Age binging onset	21.30 (9.56)	19.74 (9.18)	.88	.38
GAF score	74.82 (10.66)	67.80 (12.50)	3.27	<.01

Note: COGA = Collaborative Study on the Genetics of Alcoholism; BMI = body mass index; GAF = Global Assessment of Functioning. The data shown are proportions or mean (*SD*). The test statistic is χ^2 for categorical variables and the t statistic for continuous variables.

findings from previous studies that women with BN and SUD have higher rates of comorbid psychopathology and associated impulsive behaviors (Bulik et al., 1997; Grilo et al., 1995; Lilenfeld et al., 1997; Suzuki et al., 1994). In addition, these results are not at odds with the LCA by Sullivan and Kendler (1998), in which women with EDs fell into three different classes based on their comorbid psychology profiles.

The current study is not without limitations. Because COGA was designed to study alcoholism, not EDs, the assessment protocol did not include all psychiatric diagnoses that have been found to be elevated in women with EDs, including personality disorders (Braun et al., 1994; Diaz-Marsá et al., 2000). Although the prevalence of BN (2.5%) is comparable to that reported from population-based studies in the literature (Dansky et al., 1991; Wade, Heath, Abraham, Treloar, & Martin, 1996), it is important to note that the rates of psychiatric comorbidity in our sample are more similar to those observed in previous studies based on clinical samples (Braun et al., 1994; Brewerton et al., 1995; Godart et al., 2000) than on population-based samples (Bulik, Sullivan, & Kendler, 2002; Dansky et al., 2000; Garfinkel et al., 1995). The higher rates of comorbidity may also reflect the fact that the majority of women in the sample had a relative with AD. Relatives of alcoholics have been found to have higher rates of alcoholism, depression, and anxiety disorders (Merikangas & Angst, 1995; Preisig, Fenton, Stevens, & Merikangas, 2001). Therefore, the results presented in the current study may be more applicable to relatives of alcoholics than to the general population. The degree to which these results are generalizable to a general population sample is still in question. Data from a general population sample of twins are being investigated. Finally, because the COGA interview is based on retrospective data from a wide age range of women, there is a possibility that some older women in the sample may not have been able to accurately recall their eating behaviors when they were younger. An attempt to replicate these findings, however, is underway using data from the Missouri Adolescent Female Twin Study (MOAFTS), which is not bound by the above limitations.

These results support the existence of a separate, substance-dependent type of BN. The relation between substance dependence and BN could be the result of underlying impulsive tendencies. There is a need for these associations to be further explored using different methods and samples. Elucidation of the roles that substance dependence and impulsiveness play in the etiology of BN and other EDs could lead to more successful treatments.

References

American Psychiatric Association. (1987). Diagnostic and statistical manual of mental disorders (3rd Rev. ed.). Washington, DC: Author.

American Psychiatric Association. (1994). Diagnostic and statistical manual of mental disorders (4th ed.). Washington, DC: Author.

Braun, D.L., Sunday, S.R., & Halmi, K.A. (1994). Psychiatric comorbidity in patients with eating disorders. Psychological Medicine, 24, 859–867.

Brewerton, T.D., Lydiard, R.B., Herzog, D.B., Brotman, A.W., O'Neil, P.M., & Ballenger, J.C. (1995). Comorbidity of Axis I psychiatric disorders in bulimia nervosa. Journal of Clinical Psychiatry, 56, 77–80.

Bucholz, K.K., Cadoret, R., Cloninger, C., Dinwiddie, S.H., Hesselbrock, V.M., Nurnberger, J.I., Reich, T., Schmidt, I., & Schuckit, M.A. (1994). A new, semi-structured psychiatric interview for use in genetic linkage studies, a report of the reliability of the SSAGA. Journal of Studies on Alcohol, 55, 149–158.

Bucholz, K.K., Hesselbrock, V.M., Shayka, J.J., Nurnberger, J.I., Jr., Schuckit, M.A., Schmidt, I., & Reich, T. (1995). Reliability of indivudual diagnostic criterion items for psychoactive substance dependence and the impact on diagnosis. Journal of Studies on Alcohol, 56, 500–505.

Bulik, C.M., Sullivan, P.F., Carter, F.A. & Joyce, P.R. (1996). Lifetime anxiety disorders in women with bulimia nervosa. Comprehensive Psychiatry, 37, 368–374.

Bulik, C.M., Sullivan, P.F., Carter, F.A., & Joyce, P.R. (1997). Lifetime comorbidity of alcohol dependence in women with bulimia nervosa. Addictive Behaviors, 22, 437–446.

Bulik, C.M., Sullivan, P.F., & Kendler, K.S. (1998). Heritability of binge-eating and broadly defined bulimia nervosa. Biological Psychiatry, 44, 1210–1218.

Bulik, C.M., Sullivan, P.F., & Kendler, K.S. (2000). An empirical study of the classification of eating disorders. American Journal of Psychiatry, 157, 886–895.

Bulik, C.M., Sullivan, P.F., & Kendler, K.S. (2002). Medical and psychiatric morbidity in obese women with and without binge eating. International Journal of Eating Disorders, 32, 72–78.

Bulik, C.M., Wade, T.D., & Kendler, K.S. (2000). Characteristics of monozygotic twins discordant for bulimia nervosa. International Journal of Eating Disorders, 29, 1–10.

Clogg, C.C. (1995). Latent class models. In G. Arminger, C.C. Clogg, & M.E. Sobel (Eds.), Handbook of statistical modeling for the social and behavioral sciences (pp. 311–359). New York: Plenum.

Dansky, B.S., Brewerton, T.D., & Kilpatrick, D.G. (2000). Comorbidity of bulimia nervosa and alcohol use disorders: Results from the National Women's Study. International Journal of Eating Disorders, 27, 180–190.

Dempster, A.P., Laird, N.M., & Rubin, D.M. (1977). Maximum likelihood from incomplete data via the EM algorithm. Journal of the Royal Statistical Society B, 39, 1–38.

Diaz-Marsá, M., Carrasco, J.L., & Sáiz, J. (2000). A study of temperament and personality in anorexia and bulimia nervosa. Journal of Personality Disorders, 14, 352–359.

Feighner, J.P., Robins, E., Guze, S.B., Woodruff, R.A., Winokur, G., & Munoz, R. (1972). Diagnostic criteria for use in psychiatric research. Archives of General Psychiatry, 26, 57–63.

Garfinkel, P.E., Lin, E., Goering, P., Spegg, C., Goldbloom, D.S., Kennedy, S., Kaplan, A., & Woodside, D.B. (1995). Bulimia nervosa in a Canadian community sample: Prevalence and comparison of subgroups. American Journal of Psychiatry, 152, 1052–1058.

Godart, N.T., Flament, M.F., Lecrubier, Y., & Jeammet, P. (2000). Anxiety disorders in anorexia nervosa and bulimia nervosa: Co-morbidity and chronology of appearance. European Psychiatry, 15, 38–45.

Grilo, C.M., Becker, D.F., Levy, K.N., Walker, M.L., Edell, W.S., & McGlashan, T.H. (1995). Eating disorders with and without substance use disorders: A comparative study of inpatients. Comprehensive Psychiatry, 36, 312–317.

Hesselbrock, M.N., Mesa, C.E., Bucholz, K.K., Schuckit, M.A., & Hesselbrock, V.M. (1999). A validity study of the SSAGA: A comparison with the SCAN. Addiction, 94, 1361–1370.

Kendler, K.S., MacLean, C., Neale, M., Kessler, R.C., Heath, A.C., & Eaves, L. (1991). The genetic epidemiology of bulimia nervosa. American Journal of Psychiatry, 148, 1627–1637.

Lilenfeld, L.R., Kaye, W.H., Greeno, C.G., Merikangas, K.R., Plotnicov, K., Pollice, C., Rao, R., Strober, M., Bulik, C.M., & Nagy, L. (1997). Psychiatric disorders in women with bulimia nervosa and their first-degree relatives: Effects of comorbid substance dependence. International Journal of Eating Disorders, 22, 253–264.

Merikangas, K.R., & Angst, J. (1995). Comorbidity and social phobia: Evidence from clincial, epidemiologic, and genetic studies. European Archives of Psychiatry and Clinical Neuroscience, 244, 297–303.

Milos, G., Spindler, A., Ruggiero, G., Klaghofer, R., & Schnyder, U. (2002). Comorbidity of obsessive-compulsive disorders and duration of eating disorders. International Journal of Eating Disorders, 31, 284–289.

Neuman, R.J., Todd, R.D., Heath, A.C., Reich, W., Hudziak, J.J., Bucholz, K.K., Madden, P.A.F., Begleigter, H., Porjesz, B., Kuperman, S., Hesselbrock, V.M., & Reich, T. (1999). The evaluation of the ADHD typology in three contrasting samples: A latent class approach. Journal of the American Academy of Child and Adolescent Psychiatry, 38, 25–33.

Preisig, M., Fenton, B.T., Stevens, D.E., & Merikangas, K.R. (2001). Familial relationship between mood disorders and alcoholism. Comprehensive Psychiatry, 42, 87–95.

Schuckit, M.A., Tipp, J.E., Anthenelli, R.M., Bucholz, K.K., Hesselbrock, V.M., & Nurnberger, Jr., J.I. (1996). Anorexia nervosa and bulimia nervosa in alcohol-dependent men and women and their relatives. American Journal of Psychiatry, 153, 74–82.

Schwarz, G. (1978). Estimating the dimension of a mode. Annals of Statistics, 6, 461–464.

Selby, M., & Moreno, J.K. (1995). Personal and familial substance misuse patterns among eating disordered and depressed subjects. International Journal of the Addictions, 30, 1169–1176.

Sullivan, P.F., & Kendler, K.S. (1998). Typology of common psychiatric syndromes: An empirical study. British Journal of Psychiatry, 173, 312–319.

Suzuki, K., Higuchi, S., Yamada, K., Komiya, H., & Takagi, S. (1994). Bulimia nervosa with and without alcoholism: A comparative study in Japan. International Journal of Eating Disorders, 16, 137–146.

Wade, T.T.M., Heath, A.C., Abraham, S., Treloar, S.A., & Martin, N.G. (1996). Structure of disordered eating in a twin community sample. International Journal of Eating Disorders, 19, 63–71.

Walters, E.E., Neale, M.C., Eaves, L.J., Heath, A.C., Kessler, R.C., & Kendler, K.S. (1992). Bulimia nervosa and major depression: A study of common genetic and environmental factors. Psychological Medicine, 22, 617–622.