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Do Mortality Rates in Eating Disorders Change over Time? A Longitudinal Look at Anorexia Nervosa and Bulimia Nervosa

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Abstract

Objective—Although anorexia nervosa has a high mortality rate, our understanding of the timing and predictors of mortality in eating disorders is limited. The authors investigated mortality in a long-term study of patients with eating disorders.

Method—Beginning in 1987, 246 treatment-seeking women with anorexia nervosa or bulimia nervosa were interviewed every 6 months for a median of 9.5 years to obtain weekly ratings of eating disorder symptoms, comorbidity, treatment participation, and psychosocial functioning. From January 2007 to December 2010 (median follow-up of 20 years), vital status was ascertained with a National Death Index search.

Results—Sixteen deaths (6.5%) were recorded (lifetime anorexia nervosa, N=14; bulimia nervosa with no history of anorexia nervosa, N=2). The standardized mortality ratio was 4.37 [95% CI=2.4-7.3] for lifetime anorexia nervosa and 2.33 [95% CI=0.3-8.4] for bulimia nervosa with no history of anorexia nervosa. Risk of premature death among women with lifetime anorexia nervosa peaked within the first 10 years of follow-up resulting in a standardized mortality ratio of 7.7 [95% CI=3.7-14.2]. The standardized mortality ratio varied by duration of illness and was 3.2

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[95% CI=0.9-8.3] for women with lifetime anorexia nervosa for 0-15 years (4/119 died), and 6.6 [95% CI=3.2-12.1] for women with lifetime anorexia nervosa for >15-30 years (10/67 died). Multivariate predictors of mortality included alcohol abuse (p<0.0001), low body mass index (p=0.0005), and poor social adjustment (p=0.0090).

Conclusions—These findings highlight the need for early identification and intervention and suggest that a long duration of illness, substance abuse, low weight, and/or poor psychosocial functioning raise the risk for mortality in anorexia nervosa.

Mortality rates are higher in anorexia nervosa than in other psychiatric disorders (1), but few studies have examined when in the course of the eating disorder death is more likely to occur. Most commonly, rates of premature death are described by the standardized mortality ratio, calculated as the number of observed deaths during a given period in a specific population of interest divided by the number of deaths expected in the general population, matched for age, race, and gender. A meta-analysis of 25 studies of patients with anorexia nervosa found a standardized mortality ratio of 5.9 in studies with a mean follow-up duration of 12.8 years (1). A similar standardized mortality ratio of 6.2 over 13.4 years of follow-up has been reported recently (2). Although both are elevated, there was considerable variability in standardized mortality ratios across studies included in the meta-analysis (1) and these standardized mortality ratios are lower than those reported in studies with shorter follow-up periods (3,4). Such variability across studies might be accounted for by ascertainment rates, sample size, severity of illness, and length of follow-up, which may differ substantially from study to study. Thus, it would be instructive to examine the standardized mortality ratio in relation to both the duration of follow-up as well as the length of illness to understand whether there are high-risk periods for premature death in eating disorders.

Six longitudinal studies, including three in adolescents (5-7) and three in adults (8-10), have examined mortality rates over time. All investigations assessed anorexia nervosa at inpatient admission and again at multiple varying time points, ranging from 2 years to 20 years after admission. Four of these studies found that the number of deaths increased with increasing duration of follow-up, with greater consistency in the adult than the adolescent studies. However, it is unclear whether risk of death remains constant during follow-up, because at least three studies (5, 9, 10) detected a majority of recorded deaths earlier in the follow-up period.

In the literature it remains unknown at what point in the progression of the disorder death is more likely and whether there are differences between those with anorexia nervosa who die relatively early in the follow-up period (or early in the course of the disorder) and those who die later (after a more protracted or chronic course). These two variables, timing of follow-up assessment and duration of disorder, are distinct; individuals with eating disorders do not necessarily come in for treatment or enter a study exactly when they meet full diagnostic criteria. To clarify this distinction, the present study examined standardized mortality ratios at two points in this longitudinal study and also at varying years of duration of the illness. Such data might be informative as to whether there is a peak period for death in eating disorders.

The second aim of this study was to examine factors that might increase the vulnerability to premature death. Recent studies indicate that older age at admission, longer duration of eating disorder, history of attempted suicide, use of diuretics, more severe eating disorder symptoms, desire for lower weight at admission, repeated admission, and psychiatric comorbidity predict mortality (2-4, 11). We address the question of which variables predict mortality when examined at a later follow-up point in this longitudinal study. Predictor variables covered eating disorder symptoms, comorbidity, treatment, and psychosocial functioning assessed both at intake and via interviews conducted over the study period.

Method

Participants

The sample comprised females recruited for participation in the Massachusetts General Hospital Longitudinal Study of Anorexia and Bulimia Nervosa between 1987 and 1991. Most were seeking outpatient treatment for their eating disorder. Women meeting the following inclusion criteria were invited to participate: (1) DSM-III-R diagnosis of anorexia nervosa or bulimia nervosa; (2) female; (3) minimum age of 12 years; (4) residence within 200 miles of Boston; (5) English speaking; (6) no evidence of organic brain syndrome or terminal illness. Intake diagnoses were based on DSM-III-R criteria, as DSM-IV criteria had not been established at the time the study began. Participants were reclassified according to DSM-IV criteria, resulting in 51 with anorexia nervosa-restricting subtype, 85 with anorexia nervosa-binge/purge subtype, and 110 with bulimia nervosa. Of the 294 women who met participation criteria, 250 (85%) agreed to participate; four subjects dropped out after their intake interview, resulting in a sample size of N=246. Of these, 186 (76%) were identified as having lifetime presence of anorexia nervosa, defined as: (1) diagnosed at study intake with anorexia nervosa (n=136); (2) a history of anorexia nervosa prior to intake into the study (n=26); or (3) developed anorexia nervosa over the course of the study (n=24). Given our previous observation that those with lifetime anorexia nervosa who die continue to be at risk even when not actively ill and our prior analyses suggesting that deaths observed in individuals with intake diagnoses of BN might be attributable to their lifetime diagnosis of anorexia nervosa (11), we chose to analyze mortality by lifetime presence (not just intake diagnosis) of anorexia nervosa in the current study.

Procedure

This study was approved by the Institutional Review Board at Massachusetts General Hospital. Following brief telephone screening, individuals were scheduled for a face-to-face interview to confirm eating disorder diagnoses, assess other psychiatric disorders and treatment history, and measure height and weight. Follow-up interviews were conducted every 6-12 months until 2000.

Measures

During intake interviews, participants' lifetime Axis I psychiatric history was assessed using the Schedule for Affective Disorders and Schizophrenia – Lifetime Version (12), modified to include DSM-III-R diagnostic criteria for anorexia nervosa and bulimia nervosa. The

1983 Metropolitan Insurance Company (13) height and weight norms were used to calculate percent ideal body weight.

Over the course of the study, the Longitudinal Interval Follow-up Evaluation adapted for Eating Disorders (14) was used to assess eating pathology, treatment, and comorbid psychiatric disorders. Once the diagnosis was determined, the course of psychopathology was coded on a week-by-week basis using the Psychiatric Status Rating scale, with scores ranging from 1 (no symptoms) to 6 (full diagnostic criteria). Major depressive disorder and substance abuse/dependence disorders were rated similarly.

Psychosocial functioning was assessed longitudinally using semi-structured interviews to examine interpersonal relationships, functioning at work, in household chores, and recreational activities, as well as global life satisfaction and overall functioning (15, 16). Ratings were made on a 1 (severe impairment) to 5 (no impairment) scale. In the present study, the global score measuring overall psychosocial functioning is referred to as the "social adjustment score." The Global Assessment of Functioning Scale was used to evaluate overall level of symptom severity and impairment, with higher scores indicating better functioning. Further study details are presented elsewhere (17).

Ascertainment of Vital Status

Vital status was ascertained in 2010 by searching the National Death Index (18). This index represents a branch of the National Center for Health Statistics, and was updated through December of 2008 at the time of this investigation (19). Cause of death was obtained from death certificates, and whenever possible, interviews were conducted with the deceased participant's relatives to collect data concerning the participant immediately prior to her death.

The median time from study intake to last study visit was 9 years (range: 13 weeks - 12 years), and from last study visit to ascertainment of vital status was 11 years (range: 9 weeks - 11 years), resulting in a median total follow-up time of 20 years (range: 13 weeks – 23 years).

Statistical Methods

To summarize mortality, we calculated crude mortality ratios, annual mortality rates (deaths per person-years), and standardized mortality ratios quantifying the excess number of deaths in our study population compared with what would be expected after adjusting for age, sex, and duration of follow-up. The expected number of deaths for a general white, female population, adjusted for age, was derived from United States decennial life tables for Massachusetts from 1989-1991 (20). Fisher's exact 95% confidence intervals around the standardized mortality ratios were calculated using chi-square centile cut-offs (21). We examined how risk of death changed over time by comparing the standardized mortality ratio by years of follow-up (0-10 vs. >10-20 years), and by total duration of the eating disorder (from full onset eating disorder through last study visit, excluding weeks with full eating disorder recovery; analyzed as 0-15 vs. >15-30 years). Formal comparison of the standardized mortality ratios by years of follow-up was not conducted because the ratios are not independent, and comparison by duration of illness is not recommended because

standardized mortality ratios were obtained by indirect standardization (due to the small number of deaths).

Cox Proportional Hazards regression was used to identify predictors of mortality. The proportional hazards assumption and functional form of the continuous covariates were verified using the methods of Lin, et al. (22). Because mortality status was ascertained for many women after the last study measurement of the course variables, use of time-varying covariates was not possible. Instead, we summarized the variability in course variables using mean scores for continuous covariates, and percentage of weeks below or above a cut-off for ordinal or categorical covariates. Table 2 lists all covariates analyzed.

Univariate analyses were conducted first to ensure relationships were not obscured by collinearity among the covariates; consistent with methods used previously (11) we conservatively applied a Bonferroni-corrected significance level of α=0.0011, adjusting for the 46 individual comparisons made. Significant covariates were then entered into multivariate models, and stepwise variable selection (with α=0.01 to enter and α =0.05 to remain) was used to identify a final model. To facilitate comparison with cross-sectional studies that examined only intake covariates, we performed automated selection separately on variables measured at intake, over the course of the study, and at last visit. All analyses were conducted using SAS version 9.3 (SAS Institute, Cary, NC).

Results

Overall, 16 deaths (6.5%) were observed among the 246 participants (Table 1). Among the 186 women with a lifetime history of anorexia nervosa, 14 (7.5%) died, which translated to an annual mortality rate of 3.87 deaths per 1000 person-years. After adjusting for age, gender, and race, the standardized mortality ratio and 95% exact confidence interval for women with lifetime anorexia nervosa was 4.37 [2.4-7.3]. Among the 60 women with bulimia nervosa and no history of anorexia nervosa, 2 (3.3%) died, which translated to an annual mortality rate of 1.63 deaths per 1000 person-years, and a standardized mortality ratio [95% exact confidence interval] of 2.33 [0.3-8.4]. When standardized mortality ratios were calculated by intake diagnosis rather than presence of lifetime anorexia nervosa, findings were consistent in that patients with anorexia nervosa at intake had significantly elevated mortality (6.2 times the expected rate), while those with an intake diagnosis of bulimia nervosa did not (1.5 times the expected rate, with the confidence interval overlapping 1.0). Given the small number of deaths in the bulimia nervosa group, and the fact that the confidence interval for the standardized mortality ratio includes 1.0 (no elevated mortality), additional analyses focused primarily on participants with lifetime anorexia nervosa.

Of the 16 deaths, 4 occurred by suicide (all with anorexia nervosa). We previously reported the standardized mortality ratio for suicide in our sample to be 56.9 (11). With no new completed suicides in the sample, but an increased number of expected suicides in the demographically matched population since our last analysis, the standardized mortality ratio for suicide among women with lifetime anorexia in this sample is now substantially lower, calculated to be 25.2 (95% confidence interval = 6.9 - 64.5).

Risk of premature mortality appeared to decrease over time among women with lifetime anorexia nervosa. Within the first 10 years of follow-up, the annual mortality rate was 5.49 deaths per 1000 person-years, compared to 1.13 deaths per 1000 person-years thereafter among women with lifetime anorexia nervosa. The standardized mortality ratio also varied substantially by follow-up time: the standardized mortality ratio was 7.7 [3.7-14.2] for follow-up years 0-10 (10/186 died), and 0.7 [0.2-1.7] for follow-up years >10-20 (4/176 died). When we examined the standardized mortality ratio by illness duration, we again found considerable variation: standardized mortality ratio= 3.2 [0.9-8.3] for women with an eating disorder for 0-15 years (4/119 died), and standardized mortality ratio= 6.6 [3.2-12.1] for women with an eating disorder for >15-30 years (10/67 died). In other words, the standardized mortality ratio was higher within the first decade of the study compared to the second decade, and for those with a longer duration of illness. Specifically, as can be seen in Table 1, 7 of the 10 patients with longer duration of illness died in the first decade of the study, although 3 of the 4 patients who died in the second decade of the study also had longer duration of illness. Thus the 10 patients who died in the first decade of the study were not the same 10 patients with >15 years of an eating disorder, suggesting that these covariates capture somewhat different information.

The number of changes in eating disorder diagnosis over the course of the study is presented in Table 2. Our previous work indicated that over time, the majority of those with an intake diagnosis of anorexia nervosa in the entire sample experienced crossover between the anorexia nervosa subtypes and/or from anorexia nervosa to bulimia nervosa; crossover was recurrent and bidirectional with the subtypes (23, 24). In contrast, crossover from bulimia nervosa to anorexia nervosa in those individuals without history of anorexia nervosa at intake was less common (23). It is of note that 2 of the 3 individuals with an intake diagnosis of bulimia nervosa who died had never met criteria for anorexia nervosa during the course of follow-up, nor had a history of anorexia nervosa at intake. It is possible that associations between mortality and eating disorder diagnoses may depend on when in the course of the patient's illness diagnostic status is assessed. Importantly, however, an examination of diagnostic crossover in the predictor analyses indicated that it was not a significant predictor of mortality.

Values of covariates ascertained at intake and course variables examined as predictors of mortality are summarized in Table 2. Although the mean age at eating disorder onset was similar between the two groups, women still alive at last follow-up entered the study at a much earlier age than those who died prematurely, indicating that those who died had a longer duration of illness prior to study intake, which may reflect delays between disorder onset and seeking treatment.

As shown in the survival curve (Figure 1), whereas those without lifetime anorexia nervosa were more likely to die later in the study, most deaths among patients with lifetime anorexia nervosa occurred at varying times within the first 10 years of follow-up. Furthermore, while lifetime anorexia nervosa appears to confer greater risk of mortality, the overall mortality rate is still quite low in both groups (survival at 20 years after study intake among individuals with and without lifetime anorexia nervosa was 92% and 97%, respectively).

Significant univariate predictors (before and after Bonferroni correction) are presented in Table 3. After applying automated model selection separately to the significant intake, course, and last visit variables, duration of illness was the only significant *intake* variable to predict mortality. Among *course* variables, percent of weeks with alcohol abuse and percent of weeks with low body mass index (<16) remained in the model. Among *last visit* covariates, alcohol abuse, body mass index, and social adjustment score remained significant. To determine which of the intake, course, and last visit variables together best predicted mortality we conducted one final automated stepwise selection, which resulted in three variables remaining significant: percent weeks with alcohol abuse, body mass index at last visit, and social adjustment at last visit. Finally, to account for the fact that, by definition, the last study visit was closer to the time of death than to the time of last follow-up for those still alive, we forced age at intake into the final model to account for the passage of calendar time. Both the significance and direction of effect of the covariates were maintained in the final model after adjusting for age.

To understand the factors captured by the social adjustment score, we compared social adjustment components at last visit by mortality status. Women who died had moderate to severe impairment in employment ($t = -4.92$, $df = 160$, $p<0.0001$), mild to moderate impairment in household functioning ($t = -4.24$, $df = 174$, $p<0.0001$), fair to poor interpersonal relationships with friends ($t = -2.96$, $df = 184$, $p = 0.0034$) and siblings ($t = -2.35$, $df = 184$, $p = 0.020$), and were more likely to be single (Fisher's exact $p = 0.069$). They also had fair to poor enjoyment of recreational activities ($t = -3.00$, $df = 184$, $p = 0.0031$) and low global satisfaction ($t = -2.88$, $df = 184$, $p = 0.0044$). There were no significant differences in interpersonal relationships with partners or with parents.

Discussion

Our analyses revealed that patients with lifetime anorexia nervosa had higher premature mortality rates than the general population, and that risk of premature death was highest in the first 10 years of follow-up, and among patients with the longest duration of illness. This finding may be explained by the fact that most of the women who died came into the study with a long duration of illness. With one exception, women who died reported an illness duration spanning 7-25 years before entry into the study. It may be that their deaths tended to come early in the study because they had already suffered a long period of time with an eating disorder. Thus, while mortality rates in anorexia nervosa varied based on when in the course of this longitudinal study mortality was assessed as well as by the duration of the disorder, it seems likely that chronicity is a crucial factor in premature death.

In some (25), but not all studies (26, 27), the standardized mortality ratio for bulimia nervosa has been reported to be lower than that for anorexia nervosa. Interestingly, however, 2 of the 3 women with bulimia nervosa in our study who died had never been diagnosed with anorexia nervosa. Future research might investigate causes of death in bulimia nervosa, as well as potential predictors, by combining datasets in order to achieve adequate sample sizes.

The age and cause of death in this sample of patients with anorexia nervosa are of note. All deaths occurred in middle adulthood, with all but three deaths occurring between ages of 35-48 years, suggesting that for women with longstanding histories of eating disorders, middle adulthood is a particularly high risk period for dying. Further, causes of death, with a few exceptions (e.g., amyotrophic lateral sclerosis), may have been related to eating disorder symptoms, although given the time lapse between the last interview and death, we are not able to speak definitively on this issue. In the case of the four suicides, the causes of death represent extreme methods with high lethality (28).

Although a number of predictor variables were significant in univariate analyses, alcohol abuse over the course of the study, and body mass index and social adjustment at the last interview remained significant in multivariate analyses. Our earlier report at the 10-year follow-up found that longer duration of illness at intake and severity of alcohol use disorder during follow-up increased risk of mortality (11). Over the longer follow-up period, the degree of low weight and the social adjustment score at the last visit also emerged as significant multivariate predictors of mortality.

Social adjustment has been linked to mortality in depression and substance abuse (29, 30). While it is difficult to know in what ways poor social adjustment may be related to mortality, i.e., directly, in concert with comorbidity, or a reflection of eating disorder severity, our findings indicate that assessing the quality of relationships, the capacity for work and play, and the degree of impairment in psychosocial functioning is vital when working with patients with anorexia nervosa. Recent efforts examining the care of those with long-term anorexia nervosa are important, given how little is known about how to treat those with a chronic eating disorder (31, 32).

Strengths of the study include the large well-maintained sample, the long duration of follow-up, and the careful assessment of diagnoses. Limitations include that the assessment of comorbidity was limited to substance abuse and depression and that no longitudinal data were available between the last study visit and the assessment of mortality, which constituted a lengthy period in some cases. Thus it is possible that mortality was affected by unobserved life events that occurred between the last study visit and death. Furthermore, the National Death Index search does not report deaths that occur outside the U.S.

In conclusion, anorexia nervosa continues to be a disorder with high mortality rates and one for which effective treatment remains elusive (33). Our findings highlight the need for early identification and intervention and suggest that among those with a long duration of illness, particularly where substance abuse, low weight, and/or poor psychosocial functioning are also present, the risk for mortality increases substantially.

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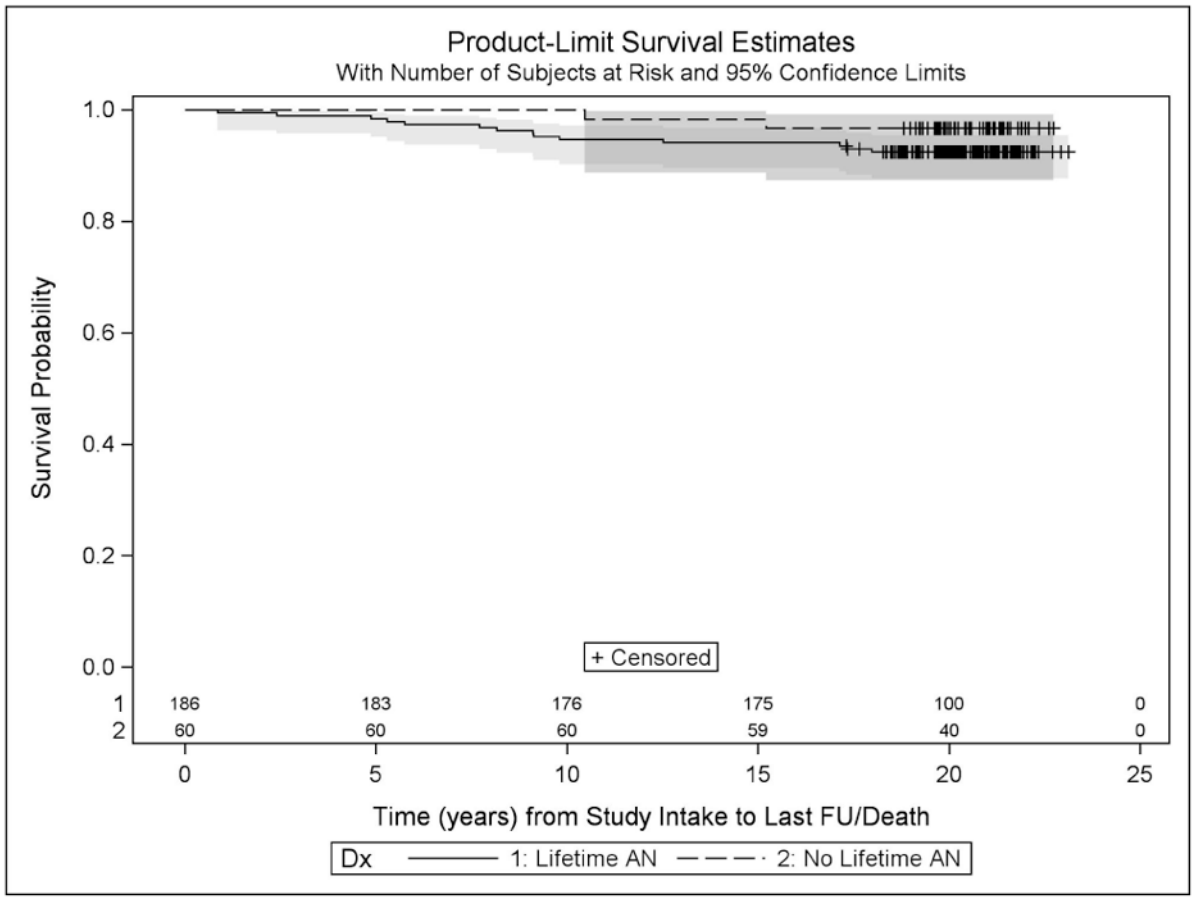

Figure 1. Survival Curve comparing individuals with and without lifetime history of anorexia nervosa

Table 1

Characteristics of Subjects who Died

ID	ED Dx at Intake / Lifetime AN?	Age at Intake (years)	Age at Death (years)	Years of ED at Intake	Total Years of ED	# Changes in ED Dx	% below IBW at Last Visit	Years from Intake to Death	Years from Last Visit to Death	Cause of Death
1	ANR / Yes	39	39	19.9	20.4	0	30-39%	0.8	0.4	Suicide
2	ANR / Yes	32	44	20.6	22.1	0	21-29%	12.5	11.0	Complications of resuscitated cardiac arrest; acute methadone, diazepam, and chloral hydrate intoxication
3	ANR / Yes	21	29	0.9	5.7	6*	6-9%	8.2	0.7	Suicide
4	ANR / Yes	43	52	7.4	15.4	0	≥40%	9.1	1.1	Respiratory failure due to amyotrophic lateral sclerosis (ALS)
5	ANR / Yes	29	36	9.7	17.0	0	10-14%	7.7	0.5	Suicide
6	ANR / Yes	26	43	11.0	19.5	0	21-29%	17.1	8.7	GI hemorrhage, esophageal ulceration
7	ANR / Yes	30	48	13.2	21.5	0	10-14%	18.0	9.7	Anoxic brain injury, septic shock
8	ANBP / Yes	29	38	15.3	23.6	2	10-14%	9.1	0.9	Fungal pneumonia
9	ANBP / Yes	20	24	8.1	10.6	1	6-9%	4.9	2.4	Cardiac arrhythmia, seizure disorder
10	ANBP / Yes	43	45	24.9	27.2	2	21-29%	2.4	0.2	Acute ethanol intoxication
11	ANBP / Yes	30	39	12.9	14.0	2*	10-14%	9.8	0.3	Cardiopulmonary arrest, cardiovascular disease, diabetes mellitus
12	ANBP / Yes	30	35	16.8	20.1	1	≥40%	5.3	2.0	Suicide
13	ANBP / Yes	33	38	17.6	22.9	1	≥40%	5.8	0.5	Cardiorespiratory failure, hepatic failure, cirrhosis
14	BN / Yes	18	35	2.5	2.5	1**	6-9%	17.3	9.1	Chronic ethanol abuse with early cirrhosis of liver
15	BN / No	20	35	0.9	10.2	0	6-9%	15.2	6.0	Acute broncho pneumonia; cerebral glioma
16	BN / No	30	40	20.2	29.7	0	6-9%	10.5	1.0	Mitral valve prolapse

ED = Eating disorder; Dx = Diagnosis; IBW = Ideal body weight; Recov = Full ED recovery; AN = Anorexia nervosa; ANR = Anorexia nervosa restricting type; ANBP = Anorexia nervosa binge purge type; BN = Bulimia nervosa

*Subjects had recovered from ED during follow-up, but subsequently relapsed

**Subject had recovered from ED by the time of their last study visit

Table 2
Summary of Women with Lifetime Anorexia Nervosa

Intake Covariate	ALIVE (n=172)	DEAD (n=14)
Age (years) at ED onset [Mean (SD)]	17 (4.6)	17 (5.9)
Age (years) at intake [Mean (SD)]	24 (6.7)	30 (7.7)
Years of ED prior to intake [Mean (SD)]	7 (5.7)	13 (6.9)
BMI [Mean (SD)]	19 (3.2)	16 (3.4)
Percent of ideal weight [Mean (SD)]	84% (14.0%)	74% (15.9%)
ED Diagnosis, ANR [N (%)]	44 (26)	7 (50)
ED Diagnosis, ANBP [N (%)]	79 (46)	6 (43)
ED Diagnosis, BN [N (%)]	49 (28)	1 (7)
History of hospitalization for ED [N (%)]	77 (45)	9 (64)
History of alcoholism [N (%)]	25 (15)	4 (29)
History of drug use/abuse/dependence [N (%)]	19 (11)	4 (29)
History of bipolar disorder [N (%)]	13 (8)	2 (14)
Any suicidal gestures/attempts [N (%)]	49 (28)	7 (50)
Course Covariate		
Years from intake to last visit [Mean (SD)]	9 (2.0)	6 (3.1)
Years from last visit to last follow-up/death [Mean (SD)]	12 (1.7)	3 (4.2)
Total years of ED [Mean (SD)]	13 (6.8)	17 (7.0)
ED Diagnosis, # changes [Mean (SD)]	2 (2.0)	1 (1.6)
Anorexia PSR score, % weeks ≥5 [Mean (SD)]	23% (32.7%)	54% (42.3%)
Anorexia PSR score, last visit [Mean (SD)]	2.3 (1.9)	4.3 (1.8)
Weight loss, % weeks≥21-29% below IBW [Mean (SD)]	20% (32.6%)	50% (43.4%)
BMI, % 13-week periods <16 [Mean (SD)]	2% (5.8%)	9% (12.1%)
Last Visit Covariate		
BMI, last visit [Mean (SD)]	21 (3.0)	17 (3.9)
Alcohol PSR Score, % weeks ≥3 [Mean (SD)]	2% (6.6%)	18% (29.3%)
Alcohol PSR Score, last visit [Mean (SD)]	0.2 (0.5)	0.9 (1.2)
MDD PSR Score, % weeks≥5 [Mean (SD)]	12% (19.5%)	28% (32.5%)
MDD PSR Score, last visit [Mean (SD)]	2 (1.6)	3 (2.0)
Manic PSR Score, last visit [Mean (SD)]	0.1 (0.4)	0.3 (0.8)
Social Adjustment Score, average during study* [Mean (SD)]	3 (0.7)	4 (1.0)
Social Adjustment Score, last visit* [Mean (SD)]	3 (0.9)	4 (1.1)
GAF Score, average during study [Mean (SD)]	56 (9.0)	43 (11.7)
GAF Score, last visit [Mean (SD)]	57 (10.4)	42 (12.2)

ED = Eating disorder; BMI = Body mass index; ANR = Anorexia nervosa restricting type; ANBP = Anorexia nervosa binge eating/purging type; BN = Bulimia nervosa; PSR = Psychiatric status rating; IBW = Ideal body weight; MDD = Major depressive disorder; GAS = Global Assessment of Functioning

*1=Very good, 2=Good, 3=Fair, 4=Poor, 5=Very poor

Other course variables analyzed included the percent of study weeks meeting the following criteria: Bulimia Psychiatric Status Rating (PSR) score ≥5 (% weeks dichotomized as above vs. at/below median), Binging, Purging (includes Vomiting, Laxative use, and Diuretics use), Other compensatory behavior (includes Diet pills use, Fasting, and Vigorous exercise), Drug abuse PSR score ≥3, Hospitalized for an ED, Suicidal gestures/attempts). We also analyzed Sessions of individual therapy received (mean over time), and Marital Status at last visit (Single vs. Married/Living with partner vs. Separated/Divorced/Widowed).

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Table 3

Significant Univariate Predictors of Mortality among Women with Lifetime Anorexia Nervosa

Univariate Predictor	Time Period	Estimate	Standard Error	Hazard Ratio	95% CI	p-value	
Age (years)	Intake	0.10	0.031	1.68	[1.2 – 2.3] *a*	0.0009	**
ED Diagnosis	Last visit	--	--	--		0.035	*
ED Diagnosis	Last visit (BN vs. ANR)	-2.15	1.049	0.12	[0.02 – 0.9]	0.041	*
ED Diagnosis, Last Visit	Last visit (Full recovery vs. ANR)	-2.38	1.049	0.092	[0.01 – 0.7]	0.023	*
Years of ED	Intake	0.13	0.036	1.94	[1.4 – 2.8] *a*	0.0002	**
Years of ED	Total	0.078	0.034	1.47	[1. 0 – 2.1] *a*	0.025	*
Anorexia PSR	% weeks ≥5	0.020	0.0065	1.22	[1.1 – 1.4] *b*	0.0019	*
Anorexia PSR	Last visit	0.64	0.20	1.89	[1.3 – 2.8]	0.0015	*
Bulimia PSR	% weeks ≥5 – above vs. at/below median (6.5%)	-1.33	0. 65	0.27	[0.1 – 0.9] *b*	0.043	*
Percent IBW	Intake	-5.68	2.17	0.57	[0.4 – 0.9] *b*	0.0088	*
Weight Loss	% weeks ≥ (21-29)% below IBW	0.019	0.0063	1.21	[1.1 – 1.4] *b*	0.0030	*
Weight Loss	Last visit	--	--	--		0.037	*
Weight Loss	Last visit; (6-9)% vs. (21-29)% below IBW)	-2.01	0.69	0.13	[0.0 – 0.5]	0.0036	*
BMI	Intake	-0.29	0.10	0.75	[0.6 – 0.9]	0.0052	*
BMI	% 13-week periods<16	0.077	0.022	2.15	[1.4 – 3.3] *b*	0.0004	**
BMI	Last visit	-0.39	0.084	0.68	[0.6 – 0.8] *b*	<0.0001	**
Alcohol PSR	% weeks ≥3	0.048	0.0096	1.61	[1.3 – 1.9] *b*	<0.0001	**
Alcohol PSR	Last visit	0.94	0.24	2.55	[1.6 – 4.1]	<0.0001	**
MDD PSR	% weeks ≥5	0.021	0.0082	1.23	[1.0 – 1.4] *b*	0.011	*
MDD PSR	Last visit	0.44	0.14	1.56	[1.2 – 2.0]	0.0013	*
Social Adjustment	Average during study	1.41	0.31	4.10	[2.2 – 7.5]	<0.0001	**
Social Adjustment	Last visit	1.29	0.27	3.64	[2.21 – 6.2]	<0.0001	**
GAF score	Average during study	-0.11	0.027	0.32	[0.2 – 0.5] *b*	<0.0001	**
GAF score	Last visit	-0.11	0.023	0.34	[0.2 – 0.5] *b*	<0.0001	**

CI = Confidence interval; ED = Eating disorder; BN = Bulimia nervosa; ANR = Anorexia nervosa restricting type; PSR = Psychiatric status rating; IBW = Ideal body weight; BMI = Body mass index; MDD = Major depressive disorder; GAS = Global Assessment of Functioning

[a] Hazard Ratio is calculated for a 5-year increase in the covariate

[b] Hazard Ratio is calculated for a 10-unit increase in the covariate

* Significant at alpha=0.05 level;

** Significant at Bonferroni corrected alpha=0.0011 level