Psychological Medicine, 2004, **34**, 671–679. © 2004 Cambridge University Press
DOI: 10.1017/S0033291703001168 Printed in the United Kingdom

Relapse in anorexia nervosa: a survival analysis

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ABSTRACT

Background. Knowledge about factors that predict relapse in anorexia nervosa (AN) is needed for the development of effective relapse prevention treatments and may also advance understanding of the psychopathology of AN. The aim of the present study was to examine the rate, timing and prediction of relapse in AN following weight restoration in a specialized in-patient treatment programme.

Method. Fifty-one consecutive first-admission AN patients who were weight-restored following in-patient treatment participated in the study. Follow-up assessments were conducted a median of 15 months post-discharge. Relapse of AN was defined as a body mass index $<17{\cdot}5$ for 3 consecutive months. Data were analysed using Kaplan–Meier survival analysis and Cox regression.

Results. The overall rate of relapse was 35% and the mean survival time was 18 months. The highest risk period was from 6 to 17 months after discharge. Several significant predictors of relapse were identified: a history of suicide attempt; previous specialized treatment for an eating disorder; severity of obsessive–compulsive symptoms at presentation; excessive exercise immediately after discharge; and residual concern about shape and weight at discharge.

Conclusions. There continues to be a significant risk of relapse among AN patients who remain well for the first year post-discharge. Several variables were shown to be associated with an elevated risk of relapse. These findings have implications for the development of initial treatments and relapse prevention strategies for AN.

INTRODUCTION

More than a century after anorexia nervosa (AN) was first described in the medical literature (Gull, 1874), its understanding and treatment remain a challenge. Effective weight-restoration treatments have been established (e.g. Touyz *et al*. 1987; Bowers & Andersen, 1994; Woodside *et al*. 2003*a*), but the effects are often not maintained and relapse is common. It is not clear as to whether this is a consequence of problems in the initial treatment or in less than adequate prevention of relapse strategies. Relapse prevention treatments for AN are just beginning to be studied (e.g. Pike *et al*. 2003). One possible reason for the limited progress with the development of relapse prevention treatments for AN to date is a lack of knowledge about specific predictors of relapse. Knowledge about factors that predict relapse may also advance understanding of the psychopathology of AN and affect the development of initial treatments.

There have been seven previous studies of relapse in AN. Based on different definitions of relapse and varying lengths of follow-up, relapse rates ranging from 9% (Strober *et al*. 1997) to 42% (Eckert *et al*. 1995) have been reported. Studies that have examined the timing of relapse have generally found that the highest risk is during the first year after discharge (Isager *et al*. 1985; Herzog *et al*. 1999). Five of the studies followed a series of adult patients (Touyz & Beumont, 1984; Isager *et al*. 1985; Deter & Herzog, 1994; Eckert *et al*. 1995; Herzog *et al*. 1999). The duration of follow-up ranged from 1 to 11 years across the five studies and in most

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cases relapse was defined exclusively in terms of weight loss. Most of the studies had a relatively modest sample size. The average rate of relapse across the studies was approximately 30%. In addition, there have been two studies of adolescent samples (Martin, 1985; Strober *et al.* 1997). Both reported a relapse rate of approximately 9%.

In the only randomized, controlled follow-up study to date, Eisler *et al.* (1997) reported 5-year follow-up data on 80 patients who had been randomly assigned to receive either family therapy or individual supportive therapy for 12 months following weight-restoration in a hospital-based programme. The sample was comprised of both adolescents and adults. Approximately one-third of the 28 patients (35%) who were classified as having a 'good outcome' at the end of treatment remained well at follow-up according to Morgan & Russell criteria (1975; Morgan & Hayward, 1988). Younger patients with a shorter duration of illness had a better outcome with family therapy.

Few specific predictors of relapse have been identified to date. Deter & Herzog (1994) found that shorter duration of illness, younger age at presentation and lower purging frequency was associated with a lower risk of relapse. Strober *et al.* (1997) reported that excessive exercisers were more likely to relapse. The remaining follow-up studies did not identify specific predictors of relapse. Further knowledge about factors that distinguish those who remain well from those who relapse is needed for the development of effective treatment and relapse prevention strategies. The aim of the present study was to examine the rate, timing and prediction of relapse in AN following weight-restoration in a specialized in-patient treatment programme.

METHOD

Participants

The participants were 51 consecutive female patients who met DSM-IV criteria for AN and were weight-restored to a body mass index (BMI; kilograms/metre^2) of at least 20 following in-patient treatment at the Toronto General Hospital. None of the patients had previously received in-patient treatment at the Toronto General Hospital but 27 (53%) had prior intensive treatment at another institution. The programme has been described in detail elsewhere (Woodside *et al.* 2003*a*). It is an intensive group therapy programme that is primarily directed at the normalization of eating and the restoration of body weight. Of 82 consecutive admissions to the programme between October 1997 and August 2000, 53 (65%) achieved a BMI of 20 and were therefore eligible to participate in the follow-up study. Compared to patients who became weight-restored, programme dropouts were more likely to be of the binge/purge subtype (65% *v.* 26%), had lower restraint scores and reported more intense concern about weight at admission (Woodside *et al.* 2003*b*). The two groups did not differ in terms of age, duration of illness, or admission BMI. Two of the 53 weight-restored patients refused to participate in the follow-up study yielding a participation rate of 94%. Participants took part in one follow-up interview a median of 15 months post-discharge.

Definition of relapse

Relapse was examined in terms of: (1) weight status; and (2) binge eating and purging behaviour. At follow-up, patients were classified as having relapsed if their BMI dropped below 17·5 for a period of at least 3 consecutive months over the follow-up period. This definition was based on the DSM-IV weight criterion for AN. Overconcern about shape and weight is also a core feature of AN. Our decision to omit this feature from the definition of relapse in the present study was based on the rationale that the study relied on retrospective recall over the previous 6 to 24 months. Patients with eating disorders have been shown to be highly accurate in terms of self-reported weight (McCabe *et al.* 2000). However, it would be unrealistic to expect participants to accurately rate their level of shape and weight concern retrospectively over a 6- to 18-month period as this is a complex concept that has been shown to be difficult to assess reliably (Cooper *et al.* 1989). We also examined relapse in terms of resumption of regular binge eating and purging behaviour. Based on the DSM-IV criteria, this was defined as binge eating and/or purging at least weekly for a 3-month period.

Assessment protocol and measures

Patients were assessed at admission to and discharge from the in-patient programme and again

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at follow-up. Each assessment lasted approximately 90 min. At the beginning, a complete description of the study was provided and written informed consent was obtained. Key eating disorder symptoms were assessed using the diagnostic items of the Eating Disorder Examination (EDE) (Fairburn & Cooper, 1993). Measures derived from this interview included the frequency of binge eating, self-induced vomiting, laxative and diuretic misuse and intense exercise; degree of concern about shape and weight; and dietary restriction. Other eating disorder features were measured using the fourth edition of the self-report version of the EDE (EDE-Q4) (Fairburn & Beglin, 1994) and the Eating Disorder Inventory (EDI) (Garner *et al*. 1983). The EDE-Q produces four subscale scores: Shape Concern, Weight Concern, Eating Concern and Restraint. The EDI is composed of eight subscales: Drive for Thinness, Bulimia, Body Dissatisfaction, Ineffectiveness, Perfectionism, Interpersonal Distrust, Interoceptive Awareness and Maturity Fears. In addition, weight and height were measured in order to calculate BMI. Aspects of general psychopathology were measured using the Beck Depression Inventory (BDI) (Beck *et al*. 1961) and the Rosenberg Self-esteem Scale (RSES) (Rosenberg, 1965). At admission and discharge, patients completed the Padua Inventory (PI) (Van Oppen *et al*. 1995), a measure of obsessive–compulsive symptoms, and the Coping Strategies Inventory (CSI) (Tobin *et al*. 1984, 1989), which is designed to assess coping thoughts and behaviours in response to a specific stressor. In addition, the follow-up assessment also included a semi-structured interview designed for this study. This interview asked about historical and clinical variables, eating disorder symptoms, weight, psychosocial and vocational functioning as well as treatment contacts over the follow-up period. Weight and eating behaviour were assessed using the same format as the EDE with an extended time-frame.

Statistical analyses

Mixed model 2 (relapsed *v*. non-relapsed) × 3 (admission *v*. discharge *v*. follow-up) repeated measures analysis of variance (ANOVA) was used to examine changes in clinical and psychometric variables using SAS version 8.02. Multiple comparisons for significant interactions were controlled for by using the Tukey–Kramer adjustment, and the adjusted *P* values are reported for those comparisons. The rate, timing and prediction of relapse were examined with Kaplan–Meier survival analysis using SPSS version 11.0.1. The Mantel–Cox log-rank test was used to examine the equality of the survival distributions for categorical predictor variables and the Cox proportional hazards regression model was used to test the effect of continuous predictor variables on the hazard function. The Cox regression derives a hazard ratio (HR) that denotes the percentage change in hazard for each unit increase in the covariate. If a predictor variable is related to the hazard function, this will be associated with a shift up or down of the hazard curve. The major assumption of the proportional hazards model is that for any two cases the ratio of their hazards is a constant across all time points (Luke, 1993). Based on a review of prognostic variables identified in previous studies, the following predictor variables were examined: age, marital status, employment status and living situation (alone *v*. with others) at admission; presence or absence of a history of self harm or suicide attempt(s); age of onset of the eating disorder, duration of illness, previous specialized treatment for an eating disorder, BMI at admission, AN subtype (binge/purge *v*. restricting), severity of eating disorder symptoms according to EDE interview (i.e. frequency of binge eating, purging and intense exercise); and subscale scores on the psychometric measures (EDE-Q, EDI, BDI, RSES, PI and CSI). Alpha was set at 0·05 for all analyses.

RESULTS

Participant characteristics

At admission to the in-patient unit, the 51 participants had a mean age of 26·9 years (S.D. = 9·0) and a mean BMI of 15·1 (S.D. = 2·1). The mean duration of illness was 6·2 years (S.D. = 6·8 years). The average length of stay in treatment was 14·0 weeks (S.D. = 5·2) and the mean weight gain was 13·9 kilograms (S.D. = 5·3). All participants had a BMI $\geqslant$20 at the time of discharge. Seventy-one per cent were single, 22% were married, and 7% were separated or divorced. The majority were unemployed (58%), while 18% were employed and 24% were students.

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Of the 40 participants who provided information about their race, 85% were Caucasian, 10% were Asian and the remaining 5% were either Native Canadian or Hispanic. Twenty participants (39%) met DSM-IV criteria for the binge-eating/purging subtype of AN according to the EDE interview.

Rate of relapse

The average length of follow-up for the 51 remitted patients was 15·6 months (S.D. = 4·5, range 6–27 months). During the follow-up period, 35% (18/51) of the patients met the study definition of relapse (i.e. BMI < 17·5 for at least 3 consecutive months). The remaining 33 patients (65%) were classified as 'non-relapsed'. There was no difference in the average length of follow-up between the relapsed (mean = 17·0, S.D. = 4·1) and non-relapsed (mean = 15·0, S.D. = 4·6) patients ($t(48) = -1·55$, $P = 0·129$). Both relapsed and non-relapsed patients had significantly higher BMIs at follow-up as compared with admission (see Table 1 for means: relapsed $t(11) = 3·20$, $P = 0·008$; non-relapsed $t(14) = 13·81$, $P < 0·0001$). Eighteen per cent (9/51) of participants maintained a BMI of at least 19·5 for the entire follow-up period; 16% (8/51) maintained a BMI of at least 18·5; and 10% (5/51) maintained a BMI of at least 17·5. Overall, 22 (43%) maintained a BMI of at least 17·5 for the entire follow-up period.

Time to relapse

Fig. 1 presents the survival curve and hazard profile for the 51 remitted patients. The mean survival time was 18 months (95% CI = 16–20). From months 4 to 17 there was a steady decrease in the probability of survival. After approximately 17 months, the survival curve levels off and the risk of relapse drops to zero. Six months after completion of the treatment program the cumulative survival rate was 88%, at 1 year it was 70·1% and 18 months after treatment the survival rate had decreased to 56·6%.

Comparison of relapsed and non-relapsed patients

At admission, the relapsed and non-relapsed groups did not differ in terms of age, marital status, admission BMI, age at onset, duration of illness or AN subtype. At discharge, the two groups did not differ in terms of the number of weeks in the treatment programme or discharge BMI. As well, there were no significant differences between the relapsed and non-relapsed patients at the time of their admission in their levels of depression or self-esteem, or in eating disorder psychopathology as measured by the eight EDI subscales and the four EDE-Q subscales (see Table 1).

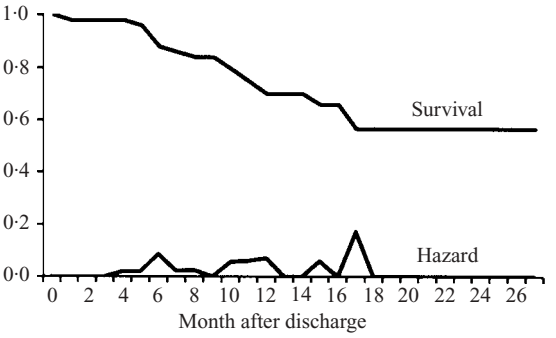

FIG. 1. The Kaplan–Meier survival function and hazard profile describing the risk of relapse for 51 weight-restored patients with anorexia nervosa.

The mixed model repeated measures 2 (relapsed *v.* non-relapsed) × 3 (admission *v.* discharge *v.* follow-up) ANOVAs indicated a statistically significant group by time interaction for the following EDI subscales: Bulimia, Interoceptive Awareness, Perfectionism, Ineffectiveness and Maturity Fears (see Table 1). Both groups showed a significant reduction in Ineffectiveness (relapsed $P = 0·004$; non-relapsed $P = 0·0001$), Interpersonal Awareness (relapsed $P < 0·0001$; non-relapsed $P = 0·001$) and Maturity Fears (relapsed $P < 0·0001$; non-relapsed $P = 0·01$) from admission to discharge, but these scores increased significantly from discharge to follow-up among relapsed patients ($P = 0·003$; $P = 0·003$; $P = 0·008$ respectively). The Bulimia and Perfectionism scores for both groups did not change from admission to discharge, but the scores for the relapsed group increased significantly from discharge to follow-up ($P = 0·019$; $P = 0·017$). Only the Eating Concern subscale of the EDE-Q showed a statistically significant interaction. Both groups reported a decrease in concern about eating from admission to discharge (relapsed $P < 0·0001$; non-relapsed $P < 0·0001$) but the relapsed group's Eating Concern scores increased

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Table 1. *Characteristics of the relapsed and non-relapsed patients at admission, discharge and follow-up*†

	Relapsed ($N=18$)			Non-relapsed ($N=33$)			
	Admission	Discharge	Follow-up	Admission	Discharge	Follow-up	
	Mean (S.D.)	Mean (S.D.)	Mean (S.D.)	Mean (S.D.)	Mean (S.D.)	Mean (S.D.)	Test statistic‡
BMI	14·9 (2·4)	20·36 (1·0)	16·8 (2·5)	15·4 (1·8)	20·5 (0·4)	20·6 (2·2)	$F(2, 96)=15{\cdot}25$***
EDI subscale scores							
Drive for thinness	14·1 (6·9)	7·5 (4·8)	11·9 (7·6)	14·0 (6·7)	8·8 (6·2)	8·4 (6·1)	$F(2, 74)=2{\cdot}32$
Bulimia	2·6 (4·7)	0·1 (0·4)	3·4 (5·7)	3·0 (4·3)	1·4 (2·8)	1·2 (3·6)	$F(2, 76)=3{\cdot}10$*
Body dissatisfaction	17·6 (8·3)	18·1 (7·8)	15·3 (8·5)	20·1 (7·9)	19·6 (6·7)	18·3 (9·1)	$F(2, 70)=0{\cdot}13$
Ineffectiveness	17·0 (9·1)	8·2 (7·8)	16·9 (10·4)	17·0 (9·2)	10·5 (7·6)	10·7 (8·2)	$F(2, 68)=4{\cdot}25$*
Perfectionism	9·6 (5·3)	6·4 (3·7)	9·9 (5·6)	9·0 (5·5)	7·7 (4·6)	6·9 (4·2)	$F(2, 71)=3{\cdot}79$*
Interoceptive awareness	15·8 (7·6)	6·1 (3·9)	12·9 (8·8)	13·3 (8·6)	8·8 (8·3)	6·7 (7·9)	$F(2, 69)=5{\cdot}95$**
Interpersonal distrust	6·9 (5·7)	3·1 (4·3)	5·1 (4·3)	7·8 (5·2)	4·7 (3·9)	4·8 (3·9)	$F(2, 68)=0{\cdot}96$
Maturity fears	10·8 (7·8)	2·6 (2·2)	7·4 (6·2)	7·1 (5·9)	4·4 (4·4)	3·8 (3·7)	$F(2, 71)=4{\cdot}44$*
EDE-Q subscale scores							
Restraint	4·5 (1·7)	1·0 (0·9)	3·0 (2·3)	5·0 (4·3)	1·6 (1·4)	1·3 (1·3)	$F(2, 64)=1{\cdot}02$
Shape concern	5·0 (1·2)	4·5 (1·7)	4·0 (2·2)	5·0 (1·5)	4·5 (1·2)	3·3 (1·6)	$F(2, 53)=0{\cdot}42$
Eating concern	4·0 (1·5)	1·2 (0·8)	2·5 (1·8)	3·7 (1·4)	2·0 (1·3)	1·5 (1·1)	$F(2, 52)=3{\cdot}14$*
Weight concern	4·2 (1·8)	3·4 (1·7)	3·9 (2·4)	4·4 (1·8)	3·0 (1·7)	2·1 (1·8)	$F(2, 51)=2{\cdot}17$
Self-esteem (RSES)	18·1 (5·9)	23·4 (5·2)	19·6 (7·0)	19·0 (6·0)	22·4 (4·8)	23·1 (6·3)	$F(2, 74)=1{\cdot}66$
Depression (BDI)	34·7 (12·1)	22·0 (13·5)	30·6 (16·0)	32·5 (13·8)	19·9 (11·9)	16·6 (11·5)	$F(2, 72)=4{\cdot}37$*

† Group numbers vary due to random missing data.
‡ F statistic is presented for the Group by Time interaction term only.
* $P<0{\cdot}05$; ** $P<0{\cdot}01$; *** $P<0{\cdot}001$.

significantly from discharge to follow-up ($P=0{\cdot}041$). As shown in Table 1, there was also a statistically significant group by time interaction for the BDI. Once again, both groups reported a significant decrease in depression scores from admission to discharge (relapsed $P=0{\cdot}007$; non-relapsed $P<0{\cdot}0001$), but there was a significant increase in BDI scores in the relapsed group from discharge to follow-up ($P=0{\cdot}05$).

Binge eating and purging behaviour

Of the 20 patients who met criteria for the binge/purge subtype of AN at admission, 19 (95%) were abstinent from binge eating and purging over the previous 4 weeks at the time of discharge. Of these 19, only one (5·6%) reported binge eating/purging at least once weekly over the previous 3 months at follow-up. None of the participants reported regular binge eating and purging for at least 3 months during the follow-up period.

Predictors of relapse

A number of significant predictors of relapse were found. The first was a history of suicide attempt(s) (Mantel–Cox $\chi^2=4{\cdot}85$, df = 1, $P=0{\cdot}028$). Patients were classified based on whether or not they reported any previous suicide attempt(s). The mean survival time for patients with a history of attempted suicide was significantly shorter (11 months, 95% CI = 7–16) as compared with patients who had no history of suicide attempts (19 months, 95% CI = 17–21).

A second predictor variable, previous specialized treatment for an eating disorder, approached statistical significance (Mantel–Cox $\chi^2=3{\cdot}75$, df = 1, $P=0{\cdot}05$). On average, patients who had received specialized treatment for their eating disorder in the past tended to have a shorter mean survival time (15 months, 95% CI = 12–17) compared with those who had not (21 months, 95% CI = 18–24).

Post-treatment predictors of relapse included scores on the Washing Compulsions (HR = 0·79, 95% CI = 0·6–1·0, $P=0{\cdot}038$) and Rumination (HR = 1·23, 95% CI = 1·0–1·5, $P=0{\cdot}030$) subscales of the PI. Higher discharge scores on these subscales were associated with a higher probability of relapse.

In addition, change in EDE-Q Eating Concern (HR = 0·18, 95% CI = 0·01–0·7, $P=0{\cdot}018$),

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Shape Concern (HR = 0·39, 95% CI = 0·2–0·9, $P = 0·035$) and Weight Concern (HR = 13·1, 95% CI = 2·2–17·1, $P = 0·004$) scores from admission to discharge was significantly associated with the probability of relapse indicating that decreases in scores on these subscales was associated with a lower risk of relapse. In addition, change in Problem Avoidance scores on the CSI from admission to discharge significantly predicted (HR = 0·75, 95% CI = 0·6–1·0, $P = 0·034$) relapse with decreases in problem avoidance being associated with a lower risk of relapse.

Finally, high-level exercise during the first 3 months after discharge as determined by the follow-up interview was significantly associated with the probability of relapse (Mantel–Cox $\chi^2 = 4·87$, df = 1, $P = 0·027$). The definition of high-level exercise was based on the work of Davis *et al*. (1997). To be classified as a high-level exerciser, patients had to engage in an average of 6 hours or more of intense exercise to control weight or shape (EDE definition) per week for an average of 3 months. Exercise data were averaged over the first 3 months after discharge because all patients were classified as remitted during this time period based on the definition of relapse described previously. The mean survival time was significantly shorter for high-level exercisers (12 months, 95% CI = 7–16) as compared with moderate exercisers (19 months, 95% CI = 17–22).

Several other variables showed no significant effect on the cumulative survival probability. These included: AN subtype, marital status at admission (single *v*. married), employment status (employed *v*. unemployed), living situation (alone *v*. with others), age of onset of the eating disorder, duration of illness, age at admission, BMI at admission and the frequency of binge eating/purging behaviour in the 3 months prior to admission.

Treatment seeking

During the follow-up period, 61% (11) of the relapsed patients received some form of specialized treatment for their eating disorder. In the non-relapsed group, 42% of patients (14 of 33) received some form of out-patient (typically group) follow-up treatment.

Four of the 18 relapsed patients subsequently gained enough weight to increase their BMI to >19·5 during the follow-up period, but only while receiving treatment in either an in-patient or intensive out-patient programme.

DISCUSSION

The purpose of this study was to examine the rate, timing and prediction of relapse in AN following specialized in-patient treatment. A particular strength of the study was that the participation rate among weight-restored patients (94%) was high. A second strength was that the data were analysed using survival analysis. Unlike traditional methods for studying event occurrence (e.g. regression analysis), survival analysis takes censored cases into account in calculating the risk of relapse. Another strength of survival analysis is that it allows an examination of how risk varies over time and when relapse is most likely to occur.

The 35% rate of relapse observed in the present study is comparable to the relapse rates found in prior studies of adult samples (e.g. Deter & Herzog, 1994; Eckert *et al*. 1995; Herzog *et al*. 1999). The two previous studies of adolescent samples found substantially lower rates of relapse (Martin, 1985; Strober *et al*. 1997). Among those who did not meet the definition of relapse in the present study (i.e. BMI <17·5 for 3 consecutive months), the majority maintained a sub-optimal weight (i.e. BMI <20). This is consistent with the findings of Touyz & Beumont (1984) who reported that only 36% of their sample maintained a weight of at least 90% of ideal body weight at follow-up. Over half of the sample in the present study did not relapse during the study period and were therefore censored cases. It is not known how many of these cases relapsed beyond the period of study.

With regard to the timing of relapse, the highest risk period for relapse appears to be from 6 to 17 months after discharge and the mean survival time was 18 months. This indicates that some participants relapsed after remaining well for the first year. It is of note that the time to follow-up was variable and some patients had follow-up assessments before the mean time to relapse. This may have positively skewed the survival curve. Further study is needed to investigate the period beyond 1 year in order to assess the longer-term process of recovery.

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Several predictors of relapse emerged. A history of suicide attempt(s) and high levels of obsessional symptomatology at discharge, may be indicative of personality disturbance, although the presence or absence of Axis II comorbidity was not assessed in this study. An alternate explanation is that individuals with higher levels of impulsivity, as indicated by suicide attempts, may be at higher risk of relapse.

Previous specialized treatment for an eating disorder was also shown to predict relapse. This finding is consistent with previous studies that have similarly found chronicity to be associated with a poorer response to treatment (Rosenvinge & Mouland, 1990; Herzog *et al.* 1997; Steinhausen, 2002). Prior failed treatment attempts may contribute to relapse by decreasing self-efficacy and confidence about maintaining the changes achieved during treatment. Further research is required to clarify what type of supports would benefit those individuals who are weight-restored after multiple attempts at treatment.

Residual concern about weight, shape and eating from pre-treatment to post-treatment also predicted relapse. This finding is consistent with the cognitive model of the maintenance of eating disorders (Fairburn, 1997). According to this model, the 'core psychopathology' in eating disorders is an overconcern with body shape and weight such that self-worth is judged largely or even exclusively in terms of satisfaction with weight and shape. Fairburn and colleagues (1993) have similarly shown that residual attitudinal disturbance concerning the importance of shape and weight following successful treatment of bulimia nervosa predicts relapse at 12-month follow-up (Fairburn *et al.* 1993). Reduction in scores on a measure of problem avoidance predicted a better outcome suggesting that enhanced coping strategies may be associated with a lower risk of relapse.

Consistent with the findings of Strober *et al.* (1997), high-level exercise was associated with relapse. This finding is in line with the work of Davis *et al.* (1997) who argue that high-level exercise plays an important role in the development and maintenance of eating disorders. Food restriction in combination with excessive physical activity increase circulating levels of endogenous opiates that activate dopamine in the brain's mesolimbic reward centres and are therefore experienced as highly reinforcing. In addition, excessive exercise has been shown to be related to addictive personality traits and obsessive–compulsive personality traits in patients with eating disorders (Davis & Claridge, 1998). Consequently, Davis (1999) contends that excessive exercise may reflect personality traits that puts this subgroup at a higher risk of relapse. Another way that excessive exercise may perpetuate the eating disorder is by directly enhancing these individuals' sense of self-control. A need for self-control is a central maintaining factor in AN (Fairburn *et al.* 1999).

A number of studies have found the presence of bulimic symptoms to be associated with an unfavourable prognosis (e.g. Theander, 1970; Halmi *et al.* 1973; Beumont *et al.* 1976; Martin, 1985; Fichter & Quadlieg, 1999). In contrast, patients of the binge/purge subtype were no more likely to relapse in the present study, although they were significantly less likely to complete the treatment programme successfully.

One of the limitations of the current study design was that it was retrospective rather than prospective. The follow-up assessment results were therefore subject to retrospective recall bias and the psychometric properties of the assessment instrument are not known. In addition, the sample size was relatively small and there was a large number of censored cases. There was also variability in the time to follow-up and this may have skewed the survival curve. The retrospective nature of the study methodology necessitated a focus on body weight in the definition of relapse. This is a limitation since over-concern about shape and weight is another core aspect of the psychopathology of AN. We are in the process of conducting a prospective follow-up study that will address some of these shortcomings.

The study findings have a number of clinical implications related to the design of both treatment and relapse prevention programmes for AN. First, long-term follow-up care aimed at preventing relapse in AN is needed following weight-restoration treatment. Patients in this study continued to be at risk of relapse well beyond the first year post-discharge. Those who had received previous specialized treatment appear to be at particular risk of relapse and for an extended period of time. Secondly, relapse

prevention programmes need to target excessive physical activity since the presence of high-level exercise immediately after discharge is a significant risk factor for relapse. Thirdly, skill building aimed at enhancing coping strategies may be an important element of treatment programs for AN. Finally, as predicted by the cognitive model of the maintenance of eating disorders, these findings suggest that it is essential that treatments for AN target cognitive distortions concerning the significance of shape and weight.

This study was supported by an operating grant from the Canadian Institutes of Health Research (MOP-44041). The authors gratefully acknowledge the statistical advice of Diana Worts. Marion Olmsted, Traci McFarlane and Gary Rodin provided helpful comments on an earlier version of this article.

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