

Rate of Inpatient Weight Restoration Predicts Outcome in Anorexia Nervosa

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ABSTRACT

Objective: To examine weight restoration parameters during inpatient treatment as predictors of outcome in anorexia nervosa (AN).

Method: Adolescent and adult females admitted for inpatient eating disorder treatment were recruited for an ongoing longitudinal study. This analysis examined several weight restoration parameters as predictors of clinical deterioration after discharge among participants with AN.

Results: Rate of weight gain was the only restoration parameter that predicted year 1 outcome. Clinical deterioration occurred significantly less often among participants who gained ≥ 0.8 kg/week (12/41, 29%) than those below this

threshold (20/38, 53%) ($\chi^2 = 4.37$, $df = 1$, $p = .037$) and remained significant after adjustment for potential confounders.

Conclusion: Weight gain rate during inpatient treatment for AN was a significant predictor of short-term clinical outcome after discharge. It is unclear whether weight gain rate exerts a causal effect or is rather a marker for readiness to tolerate weight restoration and engage in the recovery process. © 2008 by Wiley Periodicals, Inc.

Keywords: anorexia nervosa; body weight; follow-up studies; prognosis; treatment outcome

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Introduction

Inpatient weight restoration is important in the treatment of anorexia nervosa (AN).¹ The need for inpatient treatment is principally driven by the extent of emaciation, whereby achieving some targeted level of restoration is crucial in determining readiness to progress to a lower level of care. Although there is no accepted gold-standard threshold for weight restoration in absolute terms of body mass index (BMI), there is some agreement concerning the underlying clinical goals. The first goal is to achieve medical stabilization, which can potentially involve every major organ system.² If inpatient treatment is available beyond this point, the goal shifts toward maximizing the likelihood of

successful maintenance or continuation of weight restoration during the transition to an outpatient setting.

Although evidence is rather limited, the weight restoration parameter most consistently predictive of postdischarge outcome is discharge BMI.^{3–8} Interestingly, the significant threshold for discharge BMI identified by these studies has ranged from 15.5 to 19 kg/m².^{3–8} This suggests that more extensive weight restoration is always better, at least within the range of BMI values typically achieved by these programs. Other commonly studied parameters, including absolute weight gain and length of stay, have generally not been associated with outcome.^{3–5,7,9} An additional parameter, rate of weight gain, is not commonly studied but was a significant predictor of outcome in at least one study.⁹ Clarifying the impact of these parameters on outcome is of clear benefit to clinicians involved in the treatment of AN. Weight restoration parameters may demonstrate utility in determining admission criteria, early-stage treatment compliance, and discharge criteria. Therefore, the objective of this study was to extend the literature concerning weight restoration parameters as predictors of outcome in patients with AN.

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Method

Participants

Female adolescents and adults between the ages of 13 to 64 years were recruited from consecutive new inpatient admissions to the Laureate Eating Disorders Program to participate in an ongoing prospective longitudinal study. All participants met DSM-IV-TR criteria for an eating disorder.¹⁰ This analysis involved longitudinal study participants admitted to the treatment program between January 2005 and February 2007. Of new admissions during this period, 83.2% chose to participate in the longitudinal study. After complete description of the study, written informed consent was obtained from all adult participants and written assent with parental permission was obtained from adolescents. This study was approved by the Saint Francis Health System Institutional Research Ethics Board.

Participants included in this analysis were selected from the longitudinal study sample based on three criteria. First, participants were required to have a weight restoration goal of at least 8 pounds (3.6 kg) over their admission weight. This minimum threshold was imposed to exclude patients who did not have weight restoration as a main focus of the treatment plan, regardless of eating disorder diagnosis. Eight pounds was selected as the threshold because the distribution of weight gain goals was bimodal and the minimum between peaks occurred at approximately 8 pounds. Of an initial pool of 153 participants, 41 were excluded because they failed to meet the minimum weight restoration criterion. The second inclusion criterion required a lifetime DSM-IV-TR diagnosis of AN with or without amenorrhea, which resulted in the exclusion of four participants. The amenorrhea criterion was waived for this analysis to be consistent with recent literature in AN¹¹ and is based on the replicated observation that individuals with and without amenorrhea do not differ in meaningful ways.^{12,13} The final inclusion criterion required complete discharge and year 1 follow-up information. No participants were lost to follow-up, but 29 were excluded from the analysis due to missing follow-up information. These included six participants who withdrew and 23 who failed to complete follow-up. All six withdrawals occurred before completing the baseline assessment at enrollment. One withdrawn participant wanted to focus on treatment, one found the interview process too anxiety provoking, and the remaining four did not offer a specific reason. After applying these three selection criteria, a total of 79 participants were available for analysis.

Assessments

Assessments were obtained at enrollment and repeated at discharge and 1 year following admission. The primary outcome measure was evidence of clinical

deterioration from discharge to the year 1 follow-up visit. Clinical deterioration was operationally defined as an increase (worsening) in the Clinical Global Impression-Severity (CGI-S) score for the eating disorder during this time period.¹⁴ The clinical information used to generate CGI-S scores was gathered with the Structured Interview for Anorexia and Bulimia, which was administered at both discharge and year 1 follow-up.¹⁵ Weight restoration parameters collected during the inpatient treatment phase were then used to predict the likelihood of subsequent clinical deterioration after discharge. These parameters included admission BMI, discharge BMI, weight gained, length of stay, and rate of weight gain.

Several assessments were included in the analysis to adjust for potential confounding factors in the relationship between weight restoration parameters and outcome. Eating disorder psychopathology and general psychological maladjustment at the time of discharge were assessed by self-report using the Eating Disorder Inventory-3.¹⁶ Lifetime psychiatric comorbidity was assessed at the time of enrollment using the Structured Clinical Interview for DSM-IV-TR Axis I Disorders¹⁷ and the Structured Clinical Interview for DSM-IV Axis II Disorders.¹⁸ All psychiatric interviews were conducted by Masters or PhD level mental health professionals and DSM-IV-TR disorders were established by consensus review with a study psychiatrist. The interviewers and study psychiatrist were research staff members and were not involved in the clinical care of the patients.

Clinical Treatment

All participants received standard clinical treatment as patients of the Laureate Eating Disorders Program. The program encourages weight restoration and reduction of psychological distress through a collaborative, multidisciplinary approach involving medical management, psychotherapy, and dietary intervention. Weight restoration goals are individualized to the specific needs of each patient but generally adhere to the following guidelines for both adults and adolescents. The initial goal for weight gain is 2–3 pounds per week with a target BMI of 20–21 kg/m² at discharge. In conjunction with controlled physical activity, patients are generally started with 100% oral feedings and monitored with meal plan changes occurring in 200–400 kcal increments every 3–4 days until a steady weight trajectory is achieved.

Refusal to adhere to meal plan requirements results in a series of potential interventions. If a patient does not complete an individual meal they are offered alternative supplementation options to complete the meal. If these are refused, additional alternatives are offered at the next snack or meal time. Consistent food refusal or difficulty in completing meals results in a thorough review in which the patient and treatment team create a collaborative action plan to satisfy nutritional needs while

TABLE 1. Weight restoration parameters during inpatient eating disorder treatment as predictors of clinical outcome after discharge

Weight restoration parameter	Values		Analysis ^a		
	Mean	SD	χ^2	df	<i>p</i>
Admission BMI (kg/m ²) ^b	16.3	1.7	0.16	1	.690
Discharge BMI (kg/m ²)	20.8	1.1	0.13	1	.716
Length of stay (days)	103.4	38.7	0.79	1	.373
Weight gained (kg)	12.2	4.7	<0.01	1	.964

^a Association between individual weight restoration parameters and outcome using simple logistic regression.

^b BMI, body mass index.

attempting to address the patient's fears, concerns, or other issues that are interfering with meal plan adherence. Continued nonadherence, particularly during the first week of admission, may result in further activity level restriction and potentially nasogastric tube feeding.

Analysis

The primary goal was to determine whether weight restoration parameters during the course of inpatient admission predicted clinical deterioration from discharge to year 1 follow-up. Threshold effects in predicting outcome have been reported for discharge BMI and rate of weight gain, suggesting that these two parameters may be better modeled as dichotomous rather than as continuous variables.³⁻⁹ Therefore, receiver-operating characteristic (ROC) analysis was used to identify threshold effects for discharge BMI and rate of weight gain in predicting clinical deterioration.¹⁹ An optimal threshold of 0.8 kg/week was identified for weight gain rate, so this parameter was coded as a dichotomous variable based on this threshold. There was no evidence of a threshold effect for discharge BMI, so this parameter was coded as a continuous variable. The remaining weight restoration parameters, admission BMI, length of stay, and weight gained, were coded as continuous values. Simple logistic regression was used to test for an association between clinical deterioration and each of the five weight restoration parameters.

Multiple logistic regression was used to adjust for important potential sources of confounding. Confounding variables included age, eating disorder history and psychopathology, and psychiatric comorbidity. Eating disorder psychopathology included the eating disorder risk and general psychological maladjustment composite scores generated from the EDI-3.¹⁶ Eating disorder history included duration of illness and number of prior hospitalizations for primary eating disorder treatment. Both eating disorder history variables had highly skewed distributions and were coded as three-level ordinal variables for statistical analysis. Duration of illness was categorized as less than 1 year, 1-3 years, and 3 or more

TABLE 2. Rate of weight gain during inpatient eating disorder treatment as a predictor of clinical outcome after discharge^a

Weight gain rate	Clinical Deterioration at 1 Year	
	Present	Absent
≥0.8 kg/week	12	29
<0.8 kg/week	20	18

^a $\chi^2 = 4.37$, *df* = 1, *p* = .037; odds ratio (95% CI) = 0.37 (0.15, 0.94).

years. The number of prior hospitalizations was categorized as none, one, and two or more. Psychiatric comorbidity included separate indicator variables for the following disorder categories: major depressive disorder, other mood disorder, posttraumatic stress disorder, obsessive-compulsive disorder, other anxiety disorder, substance use disorder, and personality disorder. All statistical analyses were conducted with SAS version 9.1 using two-tailed tests with a *p*-value of .05 considered statistically significant.

Results

A total of 79 female participants were available for analysis. The mean age was 21.6 (SD = 7.7) years and ranged from 13 to 51 years. The majority of participants met full lifetime DSM-IV-TR criteria for AN, 35 (44%) with restricting type and 34 (43%) with binge-eating/purging type. The remaining 10 participants met all AN criteria except for amenorrhea, and would be classified by standard DSM-IV-TR as having eating disorder not otherwise specified (*n* = 7, 9%) or bulimia nervosa (*n* = 3, 4%). The mean duration of eating disorder illness was 4.8 (SD = 6.3) years but the distribution was highly skewed, where more than half (54%) had a duration of less than 3 years. Almost half of participants (48%) had no prior hospitalizations for eating disorder treatment, 22% had one hospitalization, and the remaining 30% had two or more prior hospitalizations.

Clinical deterioration from discharge to year 1 follow-up was observed in 32 (41%) participants. None of the continuous weight restoration parameters were significant predictors of clinical deterioration (**Table 1**). In contrast, rate of weight gain was significantly associated with outcome (**Table 2**). Participants above the threshold of 0.8 kg/week were significantly less likely to experience clinical deterioration (12/41, 29%) than those below the threshold (20/38, 53%). This association was

unaffected by adjustment for several potentially important confounders including age, eating disorder history and psychopathology, and psychiatric comorbidity, either as primary effects or as two-way interactions with rate of weight gain. In addition, there was no evidence for selection bias as the rate of weight gain did not differ significantly ($t = 0.8$, $df = 100$, $p = .421$) between the final analysis sample (0.85 kg/week) and those participants excluded for missing follow-up information (0.90 kg/week).

Conclusion

Among patients with AN undergoing weight restoration in a controlled inpatient setting, the rate of weight gain, but not other weight restoration parameters, was significantly associated with short-term clinical outcome after discharge. Patients gaining 0.8 kg/week or more were significantly less likely to experience a clinically meaningful worsening of eating disorder symptoms. Importantly, this relationship remained significant after adjusting for confounding factors. The direct interpretation is that maintaining sufficient weight gain trajectory during inpatient treatment helps to bring about the necessary physiological and psychological changes necessary to equip patients to be successful after discharge. However, the inverse causal relationship is also plausible. That is, slow weight gain merely reflects resistance to treatment or difficulty maintaining compliance, which is ultimately the real causal factor underlying poor outcome after discharge. Even without a full understanding of the causal mechanism, weight gain rate may find utility as a clinical marker during the first weeks of treatment to identify patients at risk for poor outcome, such that appropriate interventions could be instituted.

At least one prior study has reported a significant association between weight gain rate and outcome, where poor outcome was defined as rehospitalization within 12 months after discharge.⁹ The critical threshold for gain rate was ≥ 1.05 kg/week, which is generally consistent with our finding of 0.8 kg/week. However, at least two prior studies have failed to identify an association between weight gain rate and outcome.^{5,7} Substantial differences in methodology concerning patient population, duration of follow-up, outcome definition, and analysis strategy make direct comparison of these findings difficult.

A somewhat unexpected finding in the current study was the lack of significant association between discharge BMI and outcome, which is the most consistently reported weight-related predictor of outcome.^{3-6,8} Although there are many potential explanations, we hypothesize that this is explained by the extensive weight restoration achieved in this patient sample. The mean discharge BMI was 20.8 kg/m² and only 13 (16.5%) participants were discharged at a BMI <20 kg/m². The highest discharge BMI threshold previously shown to predict outcome was 19 kg/m².⁵ Therefore, an intriguing possibility is that achieving discharge BMI values of approximately 20 kg/m² eliminates the association with postdischarge outcome. In other words, additional weight gain beyond this point ceases to confer additional clinical benefit, which is the definition of an optimal weight restoration goal in the treatment of AN. It should not be inferred that achieving such a threshold would guarantee a successful outcome. Rather, that achieving the BMI goal marks the end of the weight restoration component of treatment. However, this observation clearly requires replication before any specific clinical recommendation can be made.

Several important limitations must be considered. Foremost is the potential for unmeasured confounding factors which may have produced an apparent, but noncausal, relationship between rate of weight gain and clinical outcome. Although several important confounders were eliminated by statistical means, there is always the possibility that such factors exist but were not measured. Of specific relevance are factors that may have explained variability in rate of weight gain, particularly factors related to low rates. Rate of weight gain was tightly controlled by the treatment program. Nearly all participants fell between the range of 1-3 pounds/week, with only one participant falling below this range. Although this precludes our findings being explained by a subgroup of highly nonadherent patients, it does not eliminate the possibility of more subtle levels of treatment resistance among slower gainers. Ultimately, statistical control in observational studies can only go so far and a controlled study involving randomized assignment to low and high gain rate groups, where all unmeasured confounders are distributed equally between groups by design, is required to determine causality. An additional limitation is incomplete follow-up data. Although the follow-up rate was more than 70%, it is possible that the omission of these participants could have affected the results. The greatest threat would arise if participants lacking follow-up data were systematically different in both

clinical outcome and weight gain rate. Fortunately, the latter can be ruled out because weight gain rates were not different for participants excluded for incomplete follow-up. However, it is impossible to rule out the possibility that these individuals had systematically different clinical outcomes, which could impact the effect size, and therefore statistical significance, of the primary finding. Finally, there is the limitation of generalizability. Although the participants in the study are probably similar to patients undergoing inpatient eating disorder treatment at other sites, it is unclear whether our findings are unique to the treatment environment and model of care delivered in this specific setting.

Clinical Implications

This study extends the knowledge base concerning weight restoration parameters as predictors of outcome in patients with eating disorders. There were two important findings with potential implications for clinical practice. First, maintaining a rate ≥ 0.8 kg/week during inpatient weight restoration was associated with improved postdischarge outcome. This threshold is consistent with the American Psychiatric Association guideline to restore 2–3 pounds (0.9–1.4 kg) per week during inpatient eating disorder treatment.¹ Even if it does not exert a causal effect to improve outcome, failure to exceed this threshold may find utility as a clinical marker to identify patients at risk for poor outcome, such that more rigorous interventions could be instituted. Second, the lack of association between clinical outcome and discharge BMI in this highly weight restored sample suggests that achieving a discharge BMI of approximately 20 kg/m² may represent an important clinical threshold for optimizing outcome. Replication of these findings is required before definitive clinical recommendations can be made. Opportunities for continued research include a more precise examination of weight restoration trajectory throughout the course of hospitalization, as well as examination of the impact of achieving discharge BMIs in excess of 20 kg/m².

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