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Early Predictors of Treatment Outcome in

a Partial Hospital Program for Adolescent Anorexia Nervosa

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1   **Abstract**

2   **Objective:** Previous research supports the relevance of early symptom

3   change in eating disorder (ED) treatment; however, few studies have

4   distinguished early weight change from early change in ED

5   psychopathology, particularly in higher levels of care. Thus, the present

6   study examined whether early change in weight and ED psychopathology

7   predicted outcome for adolescents with anorexia nervosa (AN) in a partial

8   hospitalization program. **Method:** Adolescents with AN (n = 99)

9   completed assessments at admission, one-month after treatment

10 admission, discharge, and 6-month follow-up. **Results:** Higher admission

11 percent expected body weight (%EBW), greater early change in %EBW,

12 longer duration of treatment, shorter length of illness, and earlier age of

13 onset predicted greater change in %EBW at discharge, but not follow-up.

14 Greater ED psychopathology at admission and greater early change in ED

15 psychopathology predicted later change in ED symptoms at discharge, but

16 not follow-up. Neither early change in %EBW nor ED psychopathology

17 predicted likelihood of remission at discharge and follow-up. **Discussion:**

18 Results support the importance of early change in predicting later change

19 in the same ED outcome variables and suggest that early change in both

20 %EBW and ED psychopathology in adolescents may be an important area

21 for future research.

22

23 **Keywords**: eating disorders, anorexia nervosa, partial hospital program,

24 early change, adolescent

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1 **Introduction**

2   While 22-49% of adolescents with anorexia nervosa (AN) remit

3 following outpatient treatment (Lock & Le Grange, 2019), a substantial

4 proportion remain ill. Thus, a better understanding of treatment

5 mechanisms and prognostic factors is critical in improving outcomes

6 during and beyond treatment. This is particularly true in higher levels of

7 care, such as day treatment or partial hospital programs (PHPs), where

8 treatments are often adapted and less is known about predictors of

9 outcome (Friedman et al., 2016).

10   In outpatient settings, early treatment response is an important

11 prognostic indicator for eating disorder (ED) outcomes. Indeed, a recent

12 meta-analysis in adolescents and adults demonstrated that patients who

13 responded more quickly early in treatment exhibited large effect size

14 improvements at end-of-treatment ($r = 0.51$) and moderate

15 improvements at follow-up ($r = 0.35$; Vall & Wade, 2015). Several studies

16 in adolescents have demonstrated that early weight gain (e.g., first four

17 weeks) predict improvements in ED psychopathology through 1-year

18 follow-up (Accurso, Ciao, Fitzsimmons-Craft, Lock, & Le Grange, 2014) and

19 greater likelihood of remission at discharge (Doyle et al., 2010; Le Grange

20 et al., 2014; Madden et al., 2015; Martin-Wagar, Holmes, & Bhatnagar,

21 2019; Van Huysse et al., in press) and 1-year follow-up (Lock, Couturier,

22 Bryson, & Agras, 2006; Madden et al., 2015), However, other studies have

23 failed to find this effect, particularly through follow-up (Le Grange et al.,

24 2014; Le Grange, Lock, et al., 2012).

1   To our knowledge, no studies have examined the impact of early

2   changes in ED psychopathology in adolescents with AN in non-outpatient

3   settings. The limited focus on early ED psychopathology change may

4   reflect that cognitive symptom remission is posited to occur secondary to

5   weight restoration (Accurso et al., 2014). However, understanding how

6   early change in ED psychopathology impacts outcome has implications for

7   helping improve treatments. For adults with EDs, early change in ED

8   psychopathology during treatment predicts improvements in ED

9   psychopathology (Danielsen & Rø, 2012) and remission (Thompson-

10   Brenner, Shingleton, Sauer-Zavala, Richards, & Pratt, 2015), but not

11   improvements in weight (Danielsen & Rø, 2012) at treatment discharge.

12   Thus, the present study sought to examine whether early change in

13   weight and ED psychopathology in AN predict treatment outcome in PHP,

14   both at discharge and at 6-month follow-up. We hypothesized that early

15   improvements in body weight and ED psychopathology would predict

16   improvements in weight, ED psychopathology, and remission at discharge

17   and follow-up.

18   **Methods**

19   **Participants and Procedure**

20   Participants were 99 adolescents (n = 96 females, n = 3 males) with

21   DSM-5 diagnoses of AN and an estimated body weight (EBW) of 85% or

22   less, who underwent PHP treatment for at least one month between

23   October 2012-September 2019. Diagnoses were determined by four

24   licensed child and adolescent psychiatrists using an unstandardized semi-

25   structured interview at admission. Participants were approximately 15.82

1   years old (*SD* = 1.56; range = 11-19 years). Most participants self-

2   identified as White (67.7%), with a minority of participants identify as

3   Asian (9.1%) or "Other" (19.2%). 16.2% of participants identified as

4   Hispanic.

5   Participants completed surveys within 14 days of treatment

6   admission, one-month post-admission (month 1), treatment discharge,

7   and 6-month follow-up. 25.3% (n = 25/99) of participants were missing

8   data at discharge and 58.6% (n = 58/99) of participants were missing

9   data at follow-up. Treatment discharge was typically recommended when

10   participants reached their expected body weight (EBW) and ED behaviors

11   were markedly reduced or eliminated. Consistent with an intent-to-treat

12   approach, participants were included in analyses if they provided data at

13   any time point. All study procedures were approved by the Institutional

14   Review Board.

15   **Program Description**

16   The PHP uses a blend of family-based treatment (FBT) and

17   dialectical behavior therapy (DBT) adapted for intensive treatment

18   settings (Anderson et al., 2015). Patients received treatment 6-10

19   hours/day, 6 days/week, including individual, family, group, and multi-

20   family therapy, nutritional counseling, psychiatric care, and medical

21   monitoring. Nutritional counseling is provided to parents on an as-needed

22   basis. Average duration of treatment was 92.89 days (SD = 45.44; range

23   = 29-281).

24   **Measures**

1   **Percent EBW (%EBW).** EBW was calculated using the BMI

2   percentile method (%EBW = BMI/50th percentile BMI for age and height x

3   100; Le Grange et al., 2012). Objective measurements were used at

4   admission and discharge and self-report at month 1 and follow-up. While

5   the use of self-reported weight is a limitation, self-reported and objective

6   weight were significantly correlated at admission, $r(83) = .69$, $p < .001$,

7   and discharge, $r(73) = .84$, $p < .001$.

8   **Eating Disorder Examination – Questionnaire (EDE-Q;**

9   **Fairburn & Beglin, 1994).** The EDE-Q is a 28-item self-report

10   questionnaire used to evaluate the severity of ED psychopathology during

11   the previous 28 days. Behavioral frequencies of objective binge eating,

12   fasting, and purging were used to determine remission status. The EDE-Q

13   has demonstrated good internal consistency, construct validity, and 2-

14   week test-retest reliability (Berg, Peterson, Frazier, & Crow, 2011).

15   Internal consistency in the present study was strong ($\alpha = .97 - .98$).

16   **Remission Criteria.** Criteria for full remission used a stringent

17   definition employed in past adolescent treatment trials (Le Grange et al.,

18   2014; Lock et al., 2010). Full remission was defined as achieving 95%

19   EBW, no fasting or binge eating/purging within the past month, and EDE-Q

20   global scores within one standard deviation of adolescent norms (Carter,

21   Stewart, & Fairburn, 2001).

22   **Statistical procedure**

23   Data were examined and conformed to assumptions of normality.

24   Little's MCAR test was significant, $X^2(78) = 99.70$, $p = .049$, suggesting

25   that data were *not* missing completely at random (i.e., *not MCAR*).

1 Participants with missing data did not differ from participants without

2 missing data on age, race, ethnicity, diagnosis, gender, duration of

3 treatment, length of illness, age of onset, admission weight or admission

4 eating pathology at discharge (all ps > .17) or follow-up (ps > .08; see

5 Supplement). As data were not MCAR and there was no evidence of biased

6 attrition, this suggests that data were missing at random (MAR). Recent

7 research suggests that multiple imputation (MI) produces unbiased

8 estimates for analyzing data MAR (Graham, 2009; Enders, 2011; Madley-

9 Dowd et al., 2019). Thus, MI was conducted in SPSS 25.0, using 20

10 imputed datasets. Within-subjects repeated measures ANOVA evaluated

11 changes in outcomes over time.

12   Pooled multiple linear regression models were run to determine

13 whether early change in weight (e.g., change score in %EBW, admission

14 to month 1) and ED psychopathology (e.g., change score in EDE-Q,

15 admission to month 1) predicted outcomes at discharge and follow-up

16 (%EBW, EDE-Q). All analyses controlled for admission %EBW and EDE-Q

17 scores to account for pre-treatment differences when using change scores

18 (Hayes & Rockwood, 2017). Analyses also controlled for duration of

19 treatment, length of illness, and age of onset. Admission outcomes were

20 included at Step 1, covariates at Step 2, and early change variables at

21 Step 3 (see Table 2). Logistic regression analyses were run for remission

22 status. Tolerance values were acceptable (>.50), minimizing concerns

23 regarding multicollinearity.

24   **Results**

1   Table 1 describes means and correlations between variables over

2   time. Early change in %EBW was associated with %EBW at month 1. Early

3   change in EDE-Q scores was associated with EDE-Q scores from admit

4   through discharge. Duration of treatment was associated with higher EDE-

5   Q scores at admit and month 1 and with %EBW at discharge. Older age of

6   onset was associated with lower %EBW at discharge and shorter length of

7   illness. Global scores significantly decreased from treatment admission

8   through 6-month follow-up (F[1.81, 177.73] =55.77, p <.001, partial η^2

9   =.36). The same pattern was observed for %EBW (F[2.04, 199.45]

10   =246.59, p <.001, partial η^2 =.72).

11   Table 2 presents pooled results from regression analyses examining

12   early change in weight and ED psychopathology as predictors of outcome

13   at discharge and 6-month follow-up. Regarding weight outcomes, higher

14   %EBW at treatment admission, longer duration of treatment, shorter

15   length of illness, and younger age of onset predicted higher %EBW at

16   discharge. Greater early change in %EBW was associated with higher

17   %EBW at discharge, above and beyond EDE-Q scores. There were no

18   significant predictors of weight at 6-month follow-up.

19   Regarding ED psychopathology, higher EDE-Q scores at treatment

20   admission predicted higher EDE-Q scores at discharge. Greater early

21   change in EDE-Q scores was associated with lower EDE-Q scores at

22   discharge, above and beyond changes in %EBW. At 6-month follow-up,

23   there were no significant predictors of EDE-Q scores.

24   Regarding remission, at discharge, 25.3% of patients met criteria for

25   remission (n=22/87) and 17.8% of patients met criteria for remission at 6-

1   month follow-up (n=13/73). No significant predictors were found for

2   remission status at discharge or at 6-month follow-up.

3   **Discussion**

4   The present study examined whether early changes in body weight

5   and ED psychopathology predicted treatment outcomes for adolescents

6   with AN in PHP treatment. Overall, we found support for early change

7   predicting later change in the same outcome variables. Specifically, for

8   weight change over time, higher admission weight, longer duration of

9   treatment, shorter length of illness, younger age of onset, and greater

10   early change in weight were associated with higher weight at discharge,

11   but not at 6-month follow-up. Regarding ED psychopathology, lower

12   admission ED psychopathology and greater early change in ED symptoms

13   predicted lower ED psychopathology at discharge, while no significant

14   predictors were found for symptoms at follow-up. No predictors of

15   remission at discharge or 6-month follow-up were found.

16   Consistent with previous findings in outpatient and higher levels of

17   care (Doyle et al., 2010; Le Grange et al., 2014; Madden et al., 2015;

18   Martin-Wagar, Holmes, & Bhatnagar, 2019; Van Huysse et al., in press),

19   greater early weight gain predicted higher weight at discharge, although

20   this did not impact change in ED psychopathology or remission status at

21   any time point. While several studies support the prognostic utility of early

22   weight change, other studies have failed to find support in predicting

23   remission (Le Grange et al., 2014). Although no studies in adolescents

24   have examined early change in ED psychopathology as a predictor, our

25   findings are consistent with previous research in adults in predicting

1   change in ED psychopathology, but not weight (Danielsen & Rø, 2012).

2   Given that cognitive ED symptoms are often less responsive to treatment

3   (Murray et al., 2019), early ED psychopathology response may indicate a

4   subset of patients that may be more likely to improve later. Indeed, early

5   change in ED psychopathology and weight were not significantly

6   correlated, suggesting that these may reflect distinct early change

7   groups. Future research should explore concordance between early

8   weight and ED psychopathology change. Replication is needed before

9   forming definitive conclusions.

10   These results have important clinical implications. Admittedly,

11 patients with better long-term prognosis may achieve early weight gain

12 and cognitive change independently of intervention type. However, in the

13 interest of refining treatment efforts, these results validate many

14 clinicians' efforts to prioritize early weight gain and underscore the

15 potential importance of attending to change in ED psychopathology early

16 on. This may also help treatment providers make decisions about

17 treatment course when early change does not occur.

18   Although early change has been a robust predictor of treatment

19 outcome in outpatient settings, the current study is the first in the

20 literature to show the predictive role of early improvement in both weight

21 *and* ED psychopathology for underweight adolescents with AN in PHP. This

22 investigation has several strengths, including a relatively large sample

23 and the inclusion of follow-up data. Several limitations are noteworthy.

24 The overall amount of variance explained by the models was rather small.

25 Given the multiple treatment strategies used, results obtained may not

1 replicate in treatment centers using other approaches. Alongside many

2 PHP outcome studies, there was a lack of systematic data collection on

3 treatment received following discharge from PHP; thus, outcomes at

4 follow-up may be influenced by other treatments. Additionally, the amount

5 of missing data was substantial (up to 58.6%). While data imputation was

6 used, this does not ensure that results would replicate with complete

7 data. Missing data is a common, but unsolved confound that frequently

8 plagues naturalistic outcome studies at higher levels of care (Friedman et

9 al., 2016).

10   While early change is a robust predictor of treatment outcome in

11 outpatient settings, this study extended these results for both weight and

12 ED psychopathology, but not remission, for adolescents with AN in PHP.

13 Data support that early change in symptoms predicts later change in the

14 same symptoms and underscore the importance of continuing to examine

15 and target early symptom change across treatment settings.

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1   Table 1

2   *Pooled Means and Correlations between Body Weight and Eating Disorder Psychopathology over Time*

3

Pooled Correlations	%EBW Admit	%EBW Month 1	%EBW Discharge	%EBW Follow-up	Δ %EBW Admit to Month 1	EDE-Q Global Admit	EDE-Q Month 1	EDE-Q Discharge	EDE-Q Follow-up	Δ EDE-Q Admit to Month 1	Duration of Treatment (Days)	Length of Illness (Years)	Age of Onset
%EBW Admit	--	.71***	.39***	.20	-.06	.27**	.18	.20	.25	.10	-.06	.17	-.12
%EBW Month 1		--	.44**	.23	.66***	.12	.15	.20	.39*	-.04	-.07	.21	-.21
%EBW Discharge			--	.49**	.22	.14	.19	.08	.31*	-.07	.37***	-.10	-.26*
%EBW Follow-up				--	.12	.14	.01	<.01	-.15	.14	.26	-.07	-.27
Δ %EBW Admit to Month 1					--	-.12	.02	.08	.29	-.17	-.03	.11	-.17
EDE-Q Global Admit						--	.66***	.41***	.20	.39**	.22*	.03	-.17
EDE-Q Month 1							--	.66***	.23	-.44***	.41**	-.02	-.03
EDE-Q Discharge								--	.47**	-.32**	.16	.01	-.01
EDE-Q Follow-up									--	-.05	.15	-.06	-.20
Δ EDE-Q Admit to Month 1										--	-.24	.06	-.10
Duration of Treatment											--	-.15	-.01
Length of Illness												--	-.54***
Age of Onset													--
Pooled Means	79.23	86.25	94.18	94.34	7.02	3.13	2.41	1.78	1.66	0.72	92.89	2.17	13.67

4

1 *Note.* *p < .05, **p < .01, ***p < .001. %EBW = Percent Expected Body Weight; EDE-Q = Eating Disorder Examination
2 Questionnaire – Global Score. For comparison purposes, M(SD) for community samples of female adolescents on the EDE-Q =
3 1.60 (1.40; Carter, Stewart, & Fairburn, 2001).

1   Table 2

2

3   *Pooled Regression Analyses of Predictors of Change in Weight, Eating Disorder Psychopathology, and Remission at Treatment*
4   *Discharge and 6-Month Follow-Up*

Variable	%EBW at Discharge		%EBW at Follow-Up		EDE-Q at Discharge		EDE-Q at Follow-Up		Remission at Discharge		Remission at Follow-up	
	B	*p*	B	*p*	B	*p*	B	*p*	Exp(B)	*p*	Exp(B)	*p*
Step 1												
Admit %EBW	0.67	**<.001**	0.54	.34	0.03	.40	0.08	.29	1.07	.28	1.13	.24
Admit EDE-Q	0.18	.70	0.70	.63	**0.34**	**<.001**	0.15	42	1.29	.14	1.00	.99
Step 2												
Admit %EBW	**0.79**	**<.001**	0.67	.23	0.04	.37	0.09	.21	1.08	.27	1.10	.36
Admit EDE-Q	-0.46	.24	-0.13	.93	**0.33**	**<.001**	0.10	.59	1.24	.22	0.94	.79
Duration of Treatment	**0.06**	**<.001**	0.07	.16	0.00	.42	0.00	.53	1.00	.60	1.00	.93
Length of Illness	**-1.71**	**.001**	-2.53	.18	0.03	.84	-0.25	.24	0.80	.27	0.87	.64
Age of Onset	**-1.72**	**<.001**	-3.04	.09	0.05	.62	-0.27	.19	0.69	.05	0.78	.39
Step 3												
Admit %EBW	**0.82**	**<.001**	0.76	.17	0.03	.37	0.09	.14	1.09	.23	1.11	.37
Admit EDE-Q	-0.40	.42	-1.14	.49	**0.58**	**<.001**	0.17	.37	1.12	.59	0.71	.33
Duration of Treatment	**0.07**	**<.001**	0.10	.13	0.00	.26	0.00	.65	1.01	.31	1.01	.57
Length of Illness	**-1.72**	**<.001**	-2.44	.18	0.00	.98	-0.27	.20	0.80	.28	0.77	.44
Age of Onset	**-1.51**	**<.001**	-2.59	.13	0.02	.84	-0.22	.25	0.69	.07	0.68	.26

Δ%EBW Admit to Month 1	**0.45**	**.04**	0.57	.39	0.02	.60	0.12	.11	1.05	.52	1.02	.88
ΔEDE-Q Admit to Month 1	0.20	.79	2.70	.30	**-0.63**	**<.001**	-0.08	.74	1.40	.19	1.78	.30
Total Adjusted R^2/Total X^2 Range across Imputations	.33 - .53		.19 - .58		.31 - .54		.14 - .39		8.90 – 16.17		2.88 – 10.90	

Note. Bolded values represent significant predictors of outcome at $p < .05$. %EBW = Percent Expected Body Weight; EDE-Q = Eating Disorder Examination Questionnaire – Global Score.