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Stability of Neuropsychological Performance in Anorexia Nervosa

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Abstract

Background—We investigated the stability of neuropsychological performance and eating disorder (EDO) symptoms before, immediately after, and 2 years after inpatient treatment. We also examined relationships between neuropsychological and EDO measures.

Methods—Sixteen women who were admitted for inpatient treatment of anorexia nervosa participated in three evaluations: (1) at admission to the hospital, (2) at discharge, and (3) at a follow-up exam approximately two years after discharge.

Results—Body mass index increased significantly from each testing session to the next. Endorsement of eating disorder symptoms was significantly decreased at discharge and at follow-up compared to admission. In terms of cognitive performance, total scores on a brief neuropsychological battery (RBANS) were significantly greater at follow-up than at admission. We found no relationships between EDO symptoms and cognitive function at follow-up.

Conclusions—The current findings suggest that EDO symptoms and cognitive performance in anorexia nervosa patients can show improvement as long as two years after hospitalization, but there is no evidence that EDO symptoms are related to neuropsychological performance at that time.

Keywords

anorexia nervosa; neuropsychological functioning; body mass index

INTRODUCTION

In addition to causing a range of life-threatening medical problems, there is evidence that eating disorders (EDOs) can impair neuropsychological functioning. Impairment has been demonstrated in anorexia nervosa (AN) in the domains of verbal and visual memory, visuospatial ability, attentional skills, and executive functioning (1-8). Cognitive dysfunction may be associated with poor long-term weight maintenance (3) and has clear implications for quality of life and response to treatment.

Given the potential implications of cognitive decline, it is prudent to investigate whether cognitive impairments noted in AN resolve with treatment. Although not all studies have demonstrated a relationship between treatment and neuropsychological recovery (9), there is ample evidence to suggest that cognitive deficits associated with AN do improve with treatment. For instance, several researchers have shown that attentional skills improve following inpatient treatment for AN (4, 7, 10) and others have shown additional improvement in learning and visuospatial abilities (7). Moser et al (11) examined

neuropsychological functioning in 28 patients at admission to an inpatient eating disorders program and again at discharge from the program. The intake evaluation revealed subtle neuropsychological dysfunction in the AN patients, and this dysfunction resolved – at least partially – with treatment. The authors noted a clinically and statistically significant improvement over the course of treatment in the total score for a neuropsychological screening instrument (Repeatable Battery for the Assessment of Neuropsychological Status), with significant improvement in the Immediate Memory domain and on a test of psychomotor processing speed.

It is less clear whether the gains achieved during treatment are maintained at long-term follow-up. Lauer et al. (4) demonstrated improvements in information processing speed and problem solving abilities 8 weeks after the termination of inpatient treatment. However, no study has examined long-term neuropsychological performance, years after inpatient treatment has stopped.

In order to investigate the long-term neuropsychological performance after cessation of inpatient treatment, we conducted an extension of the Moser et al. study (11), which examined neuropsychological functioning in 28 patients at admission and discharge from an inpatient eating disorders program. In the current study, we examined neuropsychological functioning and eating disorder symptoms in a group of patients approximately two years after discharge from an inpatient eating disorders program for the treatment of AN. Data from neuropsychological assessment at admission to and discharge from the program were available for comparison. Specifically, we investigated the stability of eating disorder symptoms and of neuropsychological performance over the course of treatment and two years after its termination. We also examined the relationship between neuropsychological performance and EDO symptoms at follow-up.

METHODS

Study Design

The present study was a partly retrospective study in which we identified 71 people who had undergone treatment and neuropsychological testing at the University of Iowa Hospitals and Clinics between March 2000 and December 2001. We invited these patients to enroll in the current study, which involved conducting follow-up assessments to be compared to their admission and discharge data. That is, patients described in the current study were evaluated three times: (1) at the time they were admitted to the hospital (admission), (2) immediately before they were discharged from the hospital (discharge), and (3) approximately 2 years after they were discharged from the hospital (follow-up). The first two evaluations were completed as part of routine patient care, and the final evaluation was conducted in the service of this research project. This research was reviewed and approved by the University of Iowa Institutional Review Board, and appropriate consent was obtained from the participants.

At each of the three evaluations, we obtained demographic data (e.g., educational level, gender, age) along with information about medications and body-mass index. At the follow-up session, we gathered information regarding the patients' participation in psychotherapy, activities of daily living, and general medical events since discharge. The follow-up information was obtained through a semi-structured interview (i.e., the SCID) (12).

Participants

We identified 71 participants who were eligible for the study because they had previously undergone treatment for AN at the University of Iowa Hospitals and Clinics. Of those candidates, 25 could not be reached, 30 declined to participate and 16 participated. Informed

consent was obtained at the time of follow-up testing. Follow-up assessments for the 16 women occurred an average of 2.1 years (SD = .62) after hospital discharge. Descriptive data were as follows: age: mean = 29.50 years, SD = 13.58, median = 24, range = 18-68; education: mean = 14.00 years, SD = 1.59, median = 14, range = 11.00 – 16.00. At follow-up, 11 participants (69%) were receiving psychotherapeutic treatment, 14 (88%) were on psychotropic medications, and they had a lifetime average of 3.44 psychiatric hospitalizations (SD = 3.05, range = 1 – 10). Participants were paid ($80) for their participation in the follow-up assessment (approximately four hours).

Neuropsychological Assessment

Participants were administered several cognitive measures. They underwent the Repeatable Battery for the Assessment of Neuropsychological Status (RBANS) (13) at all three testing sessions. This is a brief neuropsychological battery that is useful for screening patients with suspected cognitive impairments, and provides an overall cognitive function score (RBANS total scale score). The RBANS includes subtests for the domains of immediate and delayed memory, visuospatial skills, linguistic ability, attention, and working memory. It has two equivalent alternate forms. Administration of these two forms was counterbalanced across subjects at the admission evaluation. In order to minimize practice effects, presentation of the two forms was alternated during the remaining testing sessions such that no participant received the same form at two consecutive testing sessions. Participants were also administered the Wechsler Adult Intelligence Scale, 3rd Edition (WAIS-III) (14) at admission and at follow-up. This commonly used intelligence test is composed of several subtests. Performances on these subtests reflect abilities including attention to detail, working and remote memory, social reasoning, visuoconstructive abilities, abstraction, and organization.

In order to assess mood, participants were administered the Beck Depression Inventory, 2nd Edition (BDI-II) (15) at admission and at follow-up. This self-report instrument provides an index of the patient's severity of depression. In order to assess the severity of eating disorder symptoms, patients were administered the Eating Attitudes Test (EAT) (16) at all three testing sessions. The EAT is a self-report instrument for which patients indicate the presence/absence of the symptoms of AN. Higher scores on the EAT indicate a greater endorsement of EDO symptoms. Finally, as an index of global physiological status, body-mass index (BMI; kg/m^2) was calculated at all three time points.

Statistical Analyses

An examination of the data revealed violations of normality; therefore nonparametric Wilcoxon signed rank tests were used to compare mean scores on each of the outcome measures at each of the three testing sessions. All tests were two-tailed, with an alpha level set at 0.05.

RESULTS

Table 1 displays the mean BMI, EAT, and RBANS total scale scores at all three testing sessions. Additionally, the BDI and WAIS full-scale IQ (FSIQ) scores are displayed for the admission and follow-up sessions. Although 16 participants were enrolled in the follow-up study, not all of these participants had BMI, EAT, or RBANS data for the admission and/or discharge sessions. Therefore, means for the individuals who had data for all three testing sessions are shown.

Table 2 shows the results from the pairwise inferential tests. BMI scores significantly improved from admission to discharge, from admission to follow-up, and from discharge to

follow-up. Additionally, EAT scores were significantly lower at discharge compared to at admission, and were significantly lower at follow-up compared to admission. EAT scores did not differ significantly between discharge and follow-up. Finally, BDI-II scores significantly decreased from admission to follow-up, and FSIQ scores significantly increased from admission to follow-up.

RBANS scores from the three testing sessions were evaluated in order to determine the stability of neuropsychological performance over time. There was no significant difference between RBANS total scale scores at admission and discharge, but RBANS total scale scores were significantly greater at follow-up compared to at admission. There was no significant difference between RBANS total scale scores at discharge and at follow-up. Next, individual Wilcoxon tests were conducted on the five RBANS domain scores and the 12 individual subtest scores from admission and those from discharge to determine whether the significant improvement effect could be localized (Table 3). There was significant improvement in the attention domain and among the 12 individual subtests, coding (which is part of the attention domain) was the only one to show significant improvement.

Finally, to investigate the relationships between AN symptoms and cognitive function at follow-up, a series of two-tailed Pearson correlations were conducted. Results are shown in Table 4. No significant correlations were found.

CONCLUSIONS

We examined the stability of neuropsychological performance and eating disorder symptoms in 16 women at admission to an inpatient eating disorders program for the treatment of AN, at discharge from the program, and at two years follow-up. Our findings indicate that participants displayed significant weight restoration during treatment, and they displayed even further significant increases in BMI at follow-up. Furthermore, participants displayed significant improvement in eating disorder symptoms as assessed by the EAT inventory over the course of inpatient treatment, and this improvement was maintained at follow-up. Finally, they demonstrated a significant decrease in depressive symptoms as assessed by the BDI-II from admission to follow-up assessment.

Unlike Moser et al. (11), we did not observe an improvement in RBANS total scale scores during the course of treatment. This is likely due to decreased power in our study, as we used a subset of the same subjects used by Moser et al. (11) Comparing RBANS total scale scores at admission and discharge, Moser et al. (11) observed a Cohen's d effect size of 0.56. We observed an effect size of 0.39 comparing the RBANS total scale scores at admission and discharge in the subset of patients involved in our study. Indeed, decreased power - due to our limited sample size and missing data from the admission and discharge evaluations – constitutes a general limitation of the study.

In spite of this limitation, our study demonstrated that RBANS total scale score was significantly greater at follow-up than at admission. This indicates that significant gains in cognitive functioning were achieved and maintained over the long-term. Gains in neuropsychological functioning were most notable in the areas of attention and psychomotor processing speed.

These findings extend previous demonstrations of improved cognition after treatment (7, 11) to indicate that improvement may be evident as long as two years after treatment has been completed. The long-term improvement in the attention domain that we observed is consistent with previous studies showing improved attentional skills following inpatient treatment (4, 7, 10, 11), and our finding of improved performance on a test of psychomotor

processing speed is consistent with the finding of Moser et al. (11) of improvement on the same test over the course of treatment.

We found no evidence of relationships between AN symptoms and cognitive functioning at follow-up. Our ability to detect significant correlations may have been limited by our small sample size. However, these null findings are not entirely surprising given that others have found no relationships between AN symptoms and cognitive functioning in the acute stages of the disorder or immediately post-treatment (4, 11, 17, 18). Thus, AN symptoms may not be causative factors in the cognitive dysfunction seen in the disorder.

It is notable that at follow-up, 69% of participants were still in therapy and 88% were taking psychotropic medications. These factors may have contributed to the significant improvements in BMI and in attention scores.

Additionally, the possibility of a selection bias must be considered in interpreting these results. While we identified 71 patients who were eligible for the follow-up evaluation, only 16 participated. Because we were targeting a fairly young, mobile group of potential participants, we had considerable difficulties locating many of these former patients. It is possible that of those we did reach, those who had experienced improvements in eating disorder symptoms and neuropsychological status were more likely to agree to participate. In order to evaluate the possibility of such a selection bias, we conducted an informal comparison of the subjects in this study to a larger, completely separate group of 98 patients that had also been treated at the University of Iowa Hospitals and Clinics for AN (described by McDowell et al., 2003) (18). These comparisons appear to indicate that the group employed in the present study is similar to the larger group. For instance, the group examined in the current study had a mean age of 27.38 (SD=13.64), and the larger group had a mean age of 27.02 (SD=8.05). Education level was also comparable between the two groups; the current group had a mean of 13.38 years of education (SD=1.86), and the larger group had a mean of 13.62 years of education (SD=1.92). Additionally, the current group had a mean full-scale IQ of 105.13 (SD=8.53), and the larger group had a mean full-scale IQ of 98.23 (SD=12.06). Although the full-scale IQ score of the two groups are somewhat similar, they are not directly comparable because the WAIS-R was used for the larger group while the WAIS-III was used for the group examined in the present study. The current group had a mean BMI of 17.06 (1.96), while the larger group had a mean BMI of 15.86 (SD=2.69). Finally, the current group had a mean BDI score of 23.71 (SD=11.82), and the larger group had a mean BDI score of 26.21(SD=12.10). Thus, comparison of variables collected at admission indicates that the current group was similar to a larger independent sample of AN patients treated at the University of Iowa Hospitals and Clinics. This suggests that our findings cannot be accounted for by a selection bias.

Because patients were assessed up to three times on many of the measures described in this study, the issue of practice effects must also be considered – particularly with regard to the RBANS. However, the RBANS provides two equivalent alternate forms and is thought to hold practice effects to a minimum. During development of this test, subjects demonstrated no improvement in the Total Scale score between baseline and a follow-up administration that occurred only 1-7 days later (13). Our follow-up period of two years makes it unlikely that previous practice can account for the improvement observed on this test.

These results indicate that AN symptoms and cognitive dysfunction may resolve, at least in a subsample of individuals treated for AN, over the course of treatment and as long as two years after the termination of inpatient therapy. Although these results could represent a generalizability problem or a selection bias, our comparisons suggest that the sample of patients that returned for follow-up testing were similar to a larger independent sample of

AN patients treated at the University of Iowa Hospitals and Clinics. Notably, a majority of the participants in the current study were still in therapy and were taking psychotropic medications. Future research should therefore focus on delineating the role that continued psychotherapeutic contact may play in AN recovery.

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Table 1

Mean BMI, EAT and RBANS Total Scale Scores (±standard deviation) at the Thre Testing Sessions

	Admission	Discharge	Follow-up
BMI (N=10)	17.09 (2.20)	19.58 (1.76)	22.60 (2.83)
EAT (N=14)	35.36 (14.51)	11.07 (12.86)	13.71 (9.89)
BDI-II (N=14)	23.71 (SD=11.82)	not administered	9.21 (8.65)
RBANS Total Scale Score (N=8)	91.38 (6.99)	94.50 (10.03)	100.25 (11.01)
FSIQ (N=15)	105.13 (8.53)	not administered	110.13 (10.37)

Table 2

Z and p Values for Wilcoxon Signed Rank Tests of BMI, EAT, and RBANS Total Scale Scores at the Three Testing Sessions

	Admission v . Discharge		Admission v. Follow-up		Discharge v. Follow-up	
	z	p	z	p	z	p
BMI	−2.803	0.005	−3.361	0.001	−1.988	0.047
EAT	−3.171	0.002	−3.108	0.002	−1.006	0.314
BDI-II			−3.181	0.001		
RBANS	−0.981	0.326	−2.549	0.01	−1.734	0.083
FSIQ			−2.369	0.018		

Table 3

Admission and Follow-up RBANS Domain and Subtest Raw Scores

	Admission	Follow-up	z	p
DOMAIN SCORES				
Immediate Memory	91.67 (7.52)	97.67 (9.22)	−1.893	0.058
Visuospatial/Constructional	87.78 (14.45)	99.67 (15.46)	−1.364	0.173
Language	104.56 (10.04)	101.44 (10.19)	−1.294	0.196
Attention	*87.00 (10.62)*	*102.67 (15.48)*	*−2.677*	*0.007*
Delayed Memory	98.11 (10.20)	100.44 (10.97)	−0.892	0.373
SUBTEST SCORES				
List Learning	97.99 (11.26)	101.09 (8.55)	−1.016	0.310
Story Memory	95.57 (8.91)	102.48 (9.92)	−1.873	0.061
Figure Copy	90.19 (5.34)	101.27 (16.59)	−1.420	0.156
Line Orientation	104.75 (11.26)	105.63 (7.54)	−0.256	0.798
Picture Naming	105.89 (7.58)	105.84 (7.56)	−1.000	0.317
Semantic Fluency	108.72 (19.71)	101.87 (16.38)	−1.612	0.107
Digit Span	90.55 (15.85)	101.06 (15.85)	−1.682	0.093
Coding	*89.99 (14.14)*	*104.11 (12.86)*	*−2.521*	*0.012*
List Recall	101.04 (13.32)	105.38 (13.68)	−1.022	0.307
List Recognition	98.93 (9.92)	104.69 (1.14)	−1.633	0.102
Story Recall	102.86 (10.10)	107.51 (5.68)	−1.461	0.144
Figure Recall	87.84 (17.21)	95.46 (24.70)	−1.101	0.271

Table 4

Correlation coefficients and corresponding significance levels between EDO and cognitive measures at follow-up assessment

	Cognitive Measure			
	FSIO		RBANS total scale score	
EDO Measure	*r*	*P*	*r*	*P*
EAT score	−0.256	0.338	−0.087	0.748
BDI score	−0.250	0.351	−0.182	0.499
BMI	−0.292	0.272	−0.430	0.096