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Clinical insight in anorexia nervosa: Associated and predictive factors

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1 **Clinical Insight in Anorexia Nervosa:**
2 **Associated and Predictive Factors.**

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5 **Insight and Anorexia**

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46 **Conflicts of interest:**

47

48 Philip Gorwood has a paid position at the Paris Descartes University and at Sainte-Anne's
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53 The other authors have no conflict of interest.

54

55 **Abstract**

56 Clinical and cognitive factors associated with clinical insight regarding both baseline level
57 and its time-related changes, in outpatients treated for anorexia nervosa. The 193 participants
58 were recruited at 13 French centers specializing in eating disorders (*FFAB network*) and
59 assessed for insight (SAI-ED), body mass index (BMI), eating disorder severity, symptoms of
60 depression and anxiety, emotional state, silhouette, and functionality; two cognitive tests were
61 also administered. The 137 patients were then re-assessed 18 weeks later. Minimum and ideal
62 subjective BMI and premorbid intelligence were associated with poor baseline insight.
63 Contrary to nearly all other clinical factors, the level of insight revealed no improvement after
64 four months of care. Only the higher value of the minimum lifetime BMI was significantly
65 predictive of increased insight. More positive emotions (PANAS), less symptoms of
66 depression and anxiety (HADS scores), and fewer syndromes (HADS above threshold) were
67 the only factors that covaried with the changes in the level of insight. In conclusion, poor
68 insight has little time variability, contrary to nearly all clinical and cognitive factors. As
69 increased insight is mainly accompanied by improvements in the emotional domain, the latter
70 could represent potential targets for patients with lack of awareness about their eating
71 disorder.

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74 **Key-words:** eating disorders, outcome, prognosis, depression, anxiety, cognitions, silhouette

75

76 1. INTRODUCTION

77 Lewis (1934) was the first to present a definition of clinical insight, referring to it as “the
78 amount of realization the patient has of his own condition.” This concept was later described
79 as a multidimensional concept (David, 1990) including awareness of the illness, attribution of
80 symptoms to the disease, and treatment compliance.

81 A large range of psychiatric disorders is associated with poor clinical insight (Goldberg,
82 Green-Paden, Lehman, & Gold, 2001). They include schizophrenia (David et al., 1995), mood
83 disorders (Ghaemi, Boiman, & Goodwin, 2000; Ghaemi & Rosenquist, 2004; van der Werf-
84 Eldering et al., 2011), dementia (Harwood, Sultzer, & Wheatley, 2000; Zanetti et al., 1999),
85 addiction (Arbel, Koren, Klein, & Latzer, 2013; Moeller et al., 2010), and eating disorders
86 (Konstantakopoulos, Tchanturia, Surguladze, & David, 2011).

87 Patients with anorexia nervosa may be particularly impaired by poor insight (Arbel et al.,
88 2013), as this disorder is characterized by distorted cognitions about body weight and shape
89 and ambivalence about and variability in motivation to recover (Vitousek, Watson, & Wilson,
90 1998). Indeed, early descriptions of anorexia nervosa considered an individual's conviction of
91 being fat despite an obvious state of emaciation to possibly be a delusion (Powers, Simpson,
92 & T., 2005). Accordingly, Lasègue (Lasègue, 1873) and Bruch (Bruch, 1973) very early on
93 highlighted that a drive for thinness was a key characteristic of anorexia nervosa and was
94 difficult to acknowledge by patients with this disorder.

95 The quality of insight has been proven to be of clinical relevance in the treatment and
96 prognosis of psychiatric disorders. A lack of insight has been associated with a poorer quality
97 of life (Dias, Brissos, Frey, & Kapczinski, 2008), diminished psychosocial functioning (Yen
98 et al., 2007), capacity status (Owen et al., 2009), less therapeutic compliance (Kao & Liu,
99 2010), reduced cognitive performance (van der Werf-Eldering et al., 2011), and more severe
100 symptoms of an underlying psychiatric disorder (Cairns et al., 2005; Mintz, Dobson, &

101 Romney, 2003). Furthermore, enhancing motivation through specific (such as motivational
102 interviews) and nonspecific interventions is considered to be essential in the treatment of
103 eating disorders (Mac Donald et al., 2013; Denyson-day et al., 2018). The factors underlying
104 a low level of initial insight are not well understood. Moreover, considering the lack of
105 prospective studies, the possible drivers of insight improvement have rarely been analyzed.
106 As indicated in a recent meta-analysis, the effectiveness of specialized treatments for anorexia
107 nervosa has not improved over the past 40 years, and even though such treatments are
108 relatively effective at returning patients to a healthy weight in the short term, they have no
109 more impact on cognitive (psychological) symptoms and weight in the long term than non-
110 specialized treatment (Murray, Quintana, Loeb, Griffiths, & Le Grange, 2018). Therefore,
111 factors associated with improved insight could constitute interesting targets for intervention in
112 patients with a low level of motivation for treatment.

113 The analysis in this paper was facilitated by the development of a valid and easily applicable
114 instrument for the assessment of insight in anorexia nervosa: the Schedule for the Assessment
115 of Insight for EDs (SAI-ED), a short (seven items) self-report questionnaire, which is easy to
116 fill-in and compute (Konstantakopoulos et al., 2011). We decided to use the French network
117 of treatment centers specialized in eating disorder and evaluate the insight of a number of
118 patients diagnosed with anorexia nervosa twice, on average 18 weeks apart. We focused on
119 three aspects, namely the consequences of anorexia nervosa on functionality, the potentially
120 associated traits of depression and anxiety, and cognitions (efficiency and cognitive flexibility
121 only). We generated the hypothesis that insight is closely linked to these three elements,
122 meaning that (1) patients with baseline poor insight are more anxious or depressed and have
123 more cognitive impairment; (2) that these three aspects are predictive of a poorer
124 improvement of insight; and finally (3) that all factors improve with increasing insight.

125

126 **2. METHODS**

127 *2.1 Instruments*

128 The clinical diagnosis of anorexia nervosa in the respondents in this study was verified by
129 psychiatrists with at least five years expertise in eating disorders. They used a list of DSM-5
130 criteria and assessed the patients during a face-to-face interview at each site. Clinical
131 assessments also inquired about present, subjective ideal, and lifetime (since puberty, if
132 present) minimum and maximum BMI, age at onset of anorexia nervosa, and the presence of
133 a familial history of this disorder (checked through the proband only). Minimum and
134 maximum BMI respectively serve as abbreviations of lifetime lowest and lifetime highest
135 BMI in the rest of this text for reasons of simplicity.

136 A set of specific questionnaires and tests was provided to every patient with an established
137 diagnosis after obtaining their consent during the first visit. All tests except one (the National
138 Adult Reading test (NART)) were repeated during the second (follow-up) session.

139 Insight was assessed through the SAI-ED self-report questionnaire (Konstantakopoulos et al.,
140 2011), with the possible answers being positive, negative or unsure: 1 point was attributed for
141 a positive answer (representing evidence of intact insight) and 0 for other responses. Since a
142 threshold for poor versus preserved insight is usually considered to be useful in clinical
143 practice, we divided patients into two groups, one with those with a score below 4
144 (corresponding to poor insight) and the other with the respondents who scored higher than or
145 equal to 4 (high insight) (Konstantakopoulos et al., 2011). Even if the SAI-ED questionnaire
146 has not been fully validated, it has been demonstrated to have a significant level of internal
147 consistency (Cronbach's α 0.77). The French version was adopted after forward and
148 backward translation of the scale. The Cronbach's α was determined to be "acceptable" (0.63)
149 in the present sample. Eating disorder symptomatology was assessed using a French version
150 of the Eating Attitudes Test-26 (EAT-26) (Garner & Garfinkel, 1979; Leichner, Steiger,

151 Puentes-Neuman, Perreault, & Gottheil, 1994). There are three subdivisions of the EAT-26,
152 which distinguishes “bulimia,” “dieting,” and “oral control” (Garner & Garfinkel, 1979).

153 Patient functionality was assessed using the Work and Social Adjustment Scale (WSAS)
154 (Mundt, Marks, Shear, & Greist, 2002). This instrument assesses the level of impairment in
155 the ability to work, manage the home, engage in social and private leisure activities, and
156 maintain close relationships. The maximum possible score is 40, with lower scores
157 representing better functionality.

158 Patients also undertook a body image perception test that consisted of viewing a diagram
159 representing the progression of ten female silhouettes (from 1 meaning “very thin” to 10
160 meaning “very fat”), each corresponding to a specific BMI (Williamson, Cubic, & Gleaves,
161 1993). Patients were then instructed to choose the silhouettes that they perceived to most
162 closely represent their current body image.

163 Respondents’ crystalline intelligence was assessed by the French version of the NART
164 (Mackinnon & Mulligan, 2005), a proven tool used to measure prior intellectual functioning.
165 The test requires participants to successfully pronounce 50 irregular words that violate the
166 grapheme-phoneme correspondence rules. The Brixton test (Burgess & Shallice, 1997), which
167 has been revealed to reflect cognitive flexibility in various types of patients with anorexia
168 nervosa (Tchanturia et al., 2011), was also administered to the patients involved in this study.
169 During this test, the subject is asked to predict the movements of a blue circle, which changes
170 location after each response. A concept (rule) has to be inferred from its movements to make
171 accurate predictions. Occasionally, the pattern of movement changes, and the participant has
172 to abandon the old concept in favor of a new one. Previous research suggests that there exists
173 no practice effect for this test (Burke et al., 2014).

174 Depression and anxiety scores were measured with the Hospital and Anxiety Depressive
175 Scale (HADS), a self-report instrument (Zigmond & Snaith, 1983) with seven questions

176 devoted to depression and a further seven to anxiety. This instrument provides quantitative
177 and qualitative data, as, for both depression and anxiety, a score above 8 has been validated
178 for current depressive or anxiety disorder (Bjelland, Dahl, Haug, & Neckelmann, 2002).
179 Because the presence of a depressive or anxious disorder was evaluated both at the beginning
180 and at the end of the protocol, we computed the number of patients in remission from these
181 conditions during the second visit.

182 The emotional state of the study participants was assessed using the Positive and Negative
183 Affect Schedule (PANAS), a self-report questionnaire that consists of two 10-item scales that
184 reflect positive and negative affects (for example “active” is a positive affect and “guilty” is a
185 negative affect)(Crawford & Henry, 2004). Each item is rated on a 5-point scale, with 1
186 signifying that words characterize the patient “not at all”, and 5 meaning they “very much”
187 do.

188 To simplify the comparison of the main socio-demographic aspects of the participants, we
189 divided subjects into groups based on a number of different factors, such as their educational
190 level (university graduates *versus* below), working activity (full or half-time *versus* absence),
191 and familial history of eating disorder (having at least one relative at the second-degree
192 diagnosed with anorexia nervosa or bulimia nervosa *versus* negative).

193 2.2 Sample

194 Female patients fulfilling the criteria for anorexia nervosa were screened for inclusion in 13
195 eating disorders centers throughout France. The care provided can vary between centers, but it
196 consistently includes a multidisciplinary approach, involving both a psychiatrist or a
197 psychologist and a nutritionist or a dietician. All patients are offered at least one recognized
198 psychological approach to eating disorders (family therapy, cognitive-behavioral therapy,
199 interpersonal therapy...), and psychotropic drugs are prescribed when needed (primarily
200 antidepressants). Initially, 210 out-patients were included.

201 We ultimately excluded one center because all (N=13) patients were lost to follow-up,
202 therefore basing our sample on the other 12 centers from all over France, with three located
203 specifically in the Paris region. Each center recruited a minimum of four and a maximum of
204 37 patients for the current study. Four patients were excluded because there was mandatory
205 data missing, such as their initial BMI (N=3) or their age (N=1).

206 The target schedule for the second visit was four months after the first visit, but there was
207 room left for flexibility. In the end, the shortest follow-up took place 60 days later, while the
208 longest did not occur until 15 months after the initial evaluation (sd=77.36); the average delay
209 was close to our target (121.47 days). To address this variability, the delay between visits was
210 included in the analyses, and, if relevant, it was also included in the multivariate approaches.

211 Of the respondents included in the initial analyses (N=193), 56 patients did not attend the
212 follow-up visit (29,02%). This sample had a center effect ($\chi^2=29.257$, df=12, p=.004), more
213 frequently concerned outpatients ($\chi^2=12.668$, df=2, p.002), and was characterized by a higher
214 initial (16.128, sd=2.966; sd=F=5.116, p=.025), minimum (13.919, sd=2.159; F=8.397,
215 p=.004), and highest (21.970, sd=5.666; F=4.441, p=.036) BMI, and fewer positive (26.05,
216 sd=7.986; F=6.534, p=.011) and negative (26.04, sd=6.641; F=55.982, p<.001) emotions
217 according to the results of PANAS (Table 1).

218 *2.3 Statistics*

219 The normal distribution was initially tested for all the main variables (age, BMI, Brixton
220 score, and EAT, NART, HADS, PANAS, and WSAS scores) and was statistically rejected for
221 the majority (Kolmogorov-Smirnov test, p<.05). Non-parametric approaches (Mann-Whitney
222 for averages, Fisher exact test for percentages, and Spearman for quantitative variables) were
223 then used, except for the analyses of time-related changes, as in this case all the values had a
224 normal distribution (Kolmogorov-Smirnov test, p>.05). The real values are included in the
225 tables (beside rank values) for easier reading. To test the role of all significantly associated

226 variables, logistic regression analyses were used whenever the residual variance had a normal
227 distribution (which was systematically checked before applying).
228 The problem of multiple testing was taken into account by using multivariate analyses at each
229 stage of our hypotheses: our conclusions were based on these results only, rather than on all
230 the significant statistics assessing all the parameters.

231

232 3. RESULTS

233 The initial sample of 193 patients was first assessed in terms of their level of insight.
234 Applying the categorical approach, 88% of patients (N=171) were classified as having a high
235 level insight (SAI-ED total score > 4). Patients with low insight (score < 4) were younger,
236 with an earlier age at the onset of the eating disorder; they had a lower ideal subjective BMI
237 and a lower NART value and rated themselves as larger than patients with better insight
238 (Table 1). The multivariate approach indicated that the ideal subjective BMI ($\chi^2=10.790$,
239 $df=1$, $p=.001$) and the NART score ($\chi^2=5.241$, $df=1$, $p=.022$) were the only features
240 associated with poor insight: these two variables correctly classified 92.7% of patients.

241 When insight was assessed in a continuous way (Table 2), a significant positive
242 correlation was observed between the level of insight (SAI-ED total score) and different
243 continuous variables including age, present, minimum, and ideal subjective BMI, and the
244 NART, silhouette, and WSAS scores. Insight also varied according to the patients' family
245 history and their level of education (Table 2). In the multivariate analysis, the ideal subjective
246 ($t=4.168$, $p<.001$) and minimum lifetime ($t=3.184$, $p=0.002$) BMI and the NART score
247 ($t=2.739$, $p=.007$) were the only parameters still significantly associated with poorer insight.
248 With an r^2 of 0.334, around a third of the total variance is explained by these three factors.

249 For the prospective approach of the protocol, the analyses were restricted to the 137
250 patients who were assessed at the second visit in average 18 weeks later. A substantial change

251 in the clinical picture of the patients was observed at this time (Table 3): patients had
252 increased BMI and cognitive flexibility; the severity of their eating disorder was reduced;
253 they presented less anxiety and depression at the dimensional and at the syndromic level; they
254 were characterized by more positive emotions; they assessed themselves as larger; and they
255 had an increased level of functioning (Table 3). Interestingly, in a logistic regression analysis
256 taking into account collinearity, the improvement of the Brixton score (Wald $\chi^2=9.354$,
257 $p=0.002$) and the choice of a larger silhouette (Wald $\chi^2=5.405$, $p=.020$) were the only
258 variables distinguishing the two waves of assessment. The level of insight revealed no
259 statistical improvement, with only 27 patients increasing their insight between meetings.

260 We then assessed the baseline factors that were predictive of increased insight (gaining
261 at least one point in the SAI-ED total score during the follow-up visit). Only the value of the
262 minimum BMI (15.98 vs. 13.98) was significantly higher in patients who presented an
263 improvement of their level of insight (Table 4). This tendency was still observed when a
264 logistic regression analysis was performed for the multivariate conclusion (Wald ($\chi^2=4.485$,
265 $p=.034$), with a minor capacity to predict such improvement ($r^2=3.6\%$).

266 The next step of our analysis involved determining which factors' changes were most
267 correlated (covarying) with the modifications observed in the level of insight over time (Table
268 5). Increased insight was correlated with increased PANAS positive emotions and decreased
269 HADS-anxiety and HADS-depression scores: at a qualitative level, this involved an
270 improvement of the positive PANAS score and caused the HADS scores to move below the
271 threshold for depressive and anxiety disorders. Within the linear regression analysis based on
272 these different factors, only values below the threshold for anxiety disorders were
273 significantly associated with increased insight ($p=.046$), and the r^2 of the model was relatively
274 low (9.7%).

275 As there is a wide variance in the ages represented in our sample (which makes sense
276 considering that the 13 centers have variable recruitment methods), we reanalyzed the
277 datasets restricting the analyses to adults only (i.e. aged 18 years or older). Some differences
278 were observed (see appendixes for details), and the following similarities became clear: (1)
279 the ideal BMI and NART values continue to explain a large percentage (93.5%) of poor
280 insight (Table 1', appendix); (2) the ideal subjective and minimum lifetime BMI are still
281 correlated to the level of insight, with these two parameters (along with the NART score) now
282 only explaining 18.1% of the variance- (Table 2', appendix); (3) the Brixton and the
283 silhouette ratings are still largely improved with time, even though they are not retained when
284 collinearity is taken into account (Table 3', appendix); (4) the minimum lifetime BMI remains
285 the most significant variable ($r^2=6.4\%$) associated with later increased insight (Table 4',
286 appendix); and (5) the factors covarying with the levels of insight between the two visits are
287 more or less the same (Table 5', appendix).

288

289 **4. DISCUSSION**

290 The main results of this analysis revealed that poor insight in outpatients diagnosed with
291 anorexia nervosa, assessed qualitatively or quantitatively, was strongly associated with ideal
292 BMI and pre-morbid IQ (NART score) in this sample. After four months of a specialized
293 treatment regime, nearly all clinical and cognitive factors improved, mainly due to increased
294 cognitive flexibility and less body size image distortion. However, intriguingly, the level of
295 insight was rarely improved. Furthermore, we observed only one baseline factor limiting the
296 chances for later increased insight, minimum lifetime BMI, which presented a very limited
297 predictive capacity (<5%). Increased insight between the two visits mainly co-varied with
298 emotional and mood aspects, such as a more positive emotional state and decreased anxiety
299 and mood symptoms and syndromes.

300 Contrary to our initial non-specific hypothesis, cognitive efficiency might play a role in traits
301 rather than states and does not appear to be a limiting factor for improved insight (the NART
302 score was associated with lower baseline insight but did not predict its time-related changes).
303 The clinical factors involved in the level of insight mainly concerned ideal subjective BMI
304 (associated) and lifetime minimum BMI (prognostic). The results reveal that associated mood
305 and emotional aspects also play a major role, probably as accompanying factors. An improved
306 depressive syndrome, a reduced level of depression, or increased positive emotions, were
307 indeed all associated with improved insight in this study.

308 At the clinical level, three conclusions could be drawn from this study in which insight was
309 assessed in a prospective manner. Firstly, despite the clinically successful treatment of all
310 clinical and cognitive markers, insight was not improved in the vast majority of patients after
311 an average of four months of specialized care. This discrepancy between clinical and insight
312 improvements has already been demonstrated in studies concerning other psychiatric
313 disorders, such as bipolar disorder (in which treatment outcome was not associated with the
314 level of baseline insight) (Ghaemi et al., 2000) and schizophrenia (in which insight did not
315 necessarily improve while other symptoms did) (Boczkowski, Zeichner, & DeSanto, 1985;
316 Gunderson et al., 1984; Penn et al., 2009). The concept of insight and the way it is assessed
317 could also explain why the level of insight did not change much among treated patients.

318 Insight represents how patients recognize their disorder and potentially also the level of its
319 severity. The overall improvement in eating or weight symptoms could rightly lead patients to
320 rate a decreased need for care. The increase of insight might, therefore, be more difficult to
321 detect following the improvement of these facets in the sample. However, the use of an
322 instrument (SAI-ED) assessing a core aspect of the disorder (ask for care) with dichotomous
323 ratings, may represent a psychometric limit. Another potential explanation is related to the
324 self-report instead of the clinician-based approach, which was used to assess insight in the

325 present study. Indeed, self-report and clinician-based subscales of an instrument assessing
326 insight in schizophrenia (VAGUS) were moderately correlated (Jeong et al., 2017), therefore
327 potentially providing divergent results (Rozalski et al., 2019). On the other hand, self-reported
328 data may give valuable information which is not accessible through clinician-based
329 assessments, such as patient's unique beliefs and values (Cleary et al., 2014; Karow et al.,
330 2008; Uher et al., 2012), and may be advantageous in uncovering the multidimensional nature
331 of insight (Ouzir et al., 2012). Furthermore, a strong correlation was observed between
332 clinician-rated and self-report ratings when the analyses are restricted to the *global* score of
333 insight (Jeong et al., 2017). As all analyses performed here were based on the total score of
334 SAI-ED, the self-report type of rating used in the protocol might have a limited impact on our
335 results.

336 Secondly, there are very few known factors that preclude the possibility of improving insight,
337 and the only one in our sample (minimum BMI) had a very low capacity of prediction. This is
338 an important observation for clinicians, as it could mean that there is no objective marker to
339 determine which patients have the lowest chance of improved insight. Improved mood and
340 anxiety aspects were strongly associated with increased insight, and indeed, negative affects
341 and mood symptoms have long been considered important target when providing effective
342 treatments (Haynos et al., 2017; Solmi et al., 2018). In another study performed on patients
343 with bipolar disorder, depressive symptoms were predictive of poorer insight (van der Werf-
344 Eldering et al., 2011). Therefore, targeting mood and anxiety could be important to improve
345 the insight of patients who are not sufficiently aware of their disorder and its severity to
346 request care.

347 Thirdly, premorbid IQ was highly associated with the level of baseline insight in our sample,
348 contrary to the results of a previous study on insight in anorexia nervosa (Konstantakopoulos
349 et al., 2011). This is possibly because of the differences between these samples (only anorexia

350 nervosa out-patients are considered in the present sample while a mix of anorexia nervosa and
351 bulimia nervosa in- and out-patients are analyzed in the aforementioned study). However, our
352 findings are comparable to previous studies concerning schizophrenia (Aleman, Agrawal,
353 Morgan, & David, 2006; Gerretsen et al., 2013). Notably, in a sample of patients with
354 schizophrenia aged 60 years or more, the level of insight was better explained by premorbid
355 intellectual function (24% of the total variance) than illness severity (16% of the variance)
356 (Gerretsen et al., 2013). Concerning cognitive flexibility, we found that the changes in the
357 Brixton test scores played only a very limited role in predicting an increase in insight. The
358 Wisconsin card sorting test (WCST) has previously been associated with clinician-rated
359 unawareness of illness but not self-rated insight (Trevisi et al., 2012). The Brixton score
360 might, therefore, be insufficiently sensitive. However, among different tests used to detect the
361 level of impairment of patients with anorexia nervosa, the Brixton test has been rated as one
362 of the strongest (Tchanturia et al., 2004).

363 In accordance with the fact that our study sample was recruited from real-life treatment
364 settings, this work has some important limitations. Firstly, the attrition rate was relatively high
365 (around 29%), and our sample was largely heterogeneous, especially regarding age, and
366 therefore not necessarily representative. Of the participants in our study, 29 were minors, and
367 the SAI-ED scale has not been validated in this age group, limiting the generalizability of our
368 results. Underage study participants were also overrepresented in the low baseline insight
369 group, confirming our general finding that insight increases with age. Notably, after we
370 excluded this group from the total sample, the results did not differ significantly. Moreover,
371 the patients that were lost to the follow-up had significantly less positive and negative
372 emotions based on their PANAS results. This point is somewhat concerning, as emotional
373 avoidance has been demonstrated to be associated with poorer treatment outcomes (Seidel et
374 al., 2018). However, these patients had no other differences in clinical criteria that would

375 indicate differences in disease severity. Moreover, most of the attrition rates of studies on
376 anorexia nervosa ranged between 20% and 40% (Dejong, Broadbent, & Schmidt, 2012),
377 averaging around 30% (Abdelbaky, Hay, & Touyz, 2013). Even though this attrition rate is in
378 a “normal” range, it is important to acknowledge that it limits the capacity to generalize our
379 results.

380 A number of other factors that have been previously revealed to be correlated with insight and
381 that could have been interesting to assess are missing in the present analysis. Notably, this
382 study does not use other assessments of cognitive flexibility (such as the TMT or the
383 Wisconsin test), other cognitive functions, such as memory (Nair, Palmer, Aleman, & David,
384 2014), and executive function (Nair et al., 2014) and does not include any aspect of social
385 cognitions. Psychiatric and addictive comorbidity (Yen et al., 2009); prescribed psychotropic
386 drugs (Catapano et al., 2010); or associated personality disorders (Catapano et al., 2010).

387 Social cognitions might be particularly lacking in the present analyses, as being correlated to
388 insight in different psychiatric disorders (Béland et al., 2017; Vaskinn et al., 2013), and
389 relatively independent from the neuro-cognitive tests used in this protocol. Actually, a two-
390 factor model representing ‘social cognition’ and ‘neurocognition’ as separate constructs
391 fitted the data of 100 patients with schizophrenia significantly better than a one-factor
392 model (Sergi et al., 2007).

393 The use of psychotherapy that aims to increase insight was also not discussed, although this
394 element could also be considered significant. The list of items assessed in this study was
395 already relatively long and increasing it could have potentially impacted the recruitment
396 process and the already high attrition rate. Moreover, the study sample was relatively large
397 but unselected, reflecting real-life clinical settings. Studies more focused on rigorously
398 selected samples could be a valuable approach to specific domains of insight in eating
399 disorders. A possible study target could be patients with delusional ideas and a lack of

400 awareness of their illness. Interestingly, around 20% of patients with anorexia nervosa were
401 considered as having delusional eating beliefs (Steinglass et al., 2007). Taking into account
402 the complex overlap between anorexia nervosa, obsessive-compulsive disorder (Starcevic &
403 Brakoulias, 2014), and disorders on the autism spectrum (Karjalainen, Rastam, Paulson-
404 Karlsson, & Wentz, 2018) would require a specific study.

405 This study was also somewhat limited by the fact that all the univariate statistics were non-
406 parametric due to the absence of normal distribution. This might have impacted the statistical
407 possibility of detecting less important but nonetheless significant factors. However, a number
408 of factors emerged, in this relatively heterogenous sample, that explain a fairly large
409 proportion of the total variance, and making sense at a clinical level. This supports the use of
410 a type of statistical method designed for non-normally distributed parameters.

411 Finally, refeeding is associated with improvements in various cognitive and behavioral
412 symptoms of anorexia nervosa. However, in the current study, we did not detect a significant
413 correlation between insight and BMI, in accordance with a previous cross-sectional study
414 (Kontantakopoulos et al., 2010). Nevertheless, the relatively short follow-up period in our
415 study precludes the capacity to detect the benefits of long-term weight gain. It is conceivable
416 that the level of weight restoration during this period was not sufficient to impact the level of
417 insight. Future studies with longer follow-up periods are needed to explore the association
418 between refeeding and insight levels more precisely.

419 In conclusion, the level of insight did not change much during the treatment of the
420 respondents in this survey. However, the improvement of the different facets of depression
421 and anxiety was accompanied by an improvement of insight. Non-specific techniques are
422 frequently used (such as a motivational interview) for patients with poor insight, but it might
423 be interesting to focus directly on depression and anxiety symptoms, as they represent the
424 most covarying factors according to the present cohort.

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Table 1: Social and clinical characteristics of 193 patients with anorexia nervosa with different level of insight

	Good insight (N=171)			Poor insight (N=22)			Statistics	
	Average			Average			Fisher exact test	p-value
	Value	Rank	%	Value	Rank	%	U	
Age	25,86	102,44		18,82	50,64		861,0	<.001
Education (High)			40,48%			18,18%	4,108	0,060
Working (presently)			22,29%			7,69%	1,533	0,304
Familial history of eating disorder (positive)			30,41%			13,64%	3,072	0,215
Subtype (restrictive)			65,81%			50,00%	1,921	0,216
Age at onset (eating disorder)	17,41	100,80		14,27	63,30		1139,5	0,003
Age at onset (binging)	19,45	42,84		16,70	27,95		224,5	0,06
Age at onset (purging)	20,05	47,03		14,36	19,41		147,5	0,001
BMI (baseline)	15,58	96,25		15,56	102,82		1753,0	0,604
Lifetime minimal BMI	13,46	90,54		13,55	94,68		1536,5	0,333
Lifetime maximal BMI	21,69	92,59		20,34	78,20		1354,0	0,247
Subjective ideal BMI	17,58	96,37		15,69	49,74		755,0	<.001
NART	26,18	102,40		20,50	50,93		867,5	<.001
BRIXTON	32,44	96,33		34,18	102,23		1766,0	0,641
EAT Total	33,79	95,41		37,05	109,34		1609,5	0,271
EAT Dieting	17,80	94,95		21,27	112,91		1531,0	0,156
EAT Bulimia	7,85	97,31		7,73	94,57		1827,5	0,828
EAT Oral	8,13	97,42		8,05	93,70		1808,5	0,768
HADS Anxiety score	13,10	97,40		12,45	93,89		1812,5	0,781
HADS anxiety-syndrome (present)			18,71%			27,27%	0,392	0,245
HADS Depression score	8,96	98		8,23	89,2		1709,5	0,485
HADS depression-syndrome (present)			45,03%			40,91%	0,821	0,448
PANAS Positive	28,23	97,68		27,64	91,68		1764,0	0,635
PANAS Negative	32,63	98,01		31,50	89,14		1708,0	0,483
Self rated silhouette	4,30	93,96		5,64	120,61		1361,5	0,034
WSAS	22,84	99,71		18,45	75,93		1417,5	0,06

The quality of insight was based on the SAI-ED score below 3 included (poor insight) versus 4 and over (good insight)

BMI=Body mass index, NART=National Adult Reading Test, EAT=Eating Attitudes Test, HADS=Hospital and Anxiety Depressive Scale, PANAS=Positive and Negative Affect Schedule, Silhouette, WSAS=Work and Social Adjustment Scale.

Table 2: Factors correlated to, or associated with, the level of insight in 193 patients with anorexia nervosa

Patients' baseline characteristics	SAI-ED total score		
	U	Rho (Spearman)	p
Age		0,303	<0,001
Education (High)	3405,5		0,018
Working (presently)	2142,5		0,288
Familial history of eating disorder (positive)	3004,5		0,029
Subtype (restrictive)	3367,0		0,607
Age at onset (eating disorder)		0,114	0,114
Age at onset (binging)		0,195	0,167
Age at onset (purging)		0,274	0,045
BMI		-0,213	0,003
Lifetime minimal BMI		-0,278	<0,001
Lifetime maximal BMI		-0,002	0,975
Subjective ideal BMI		0,173	0,020
NART		0,383	<0,001
BRIXTON		0,007	0,925
EAT Total		0,039	0,586
EAT Dieting		-0,083	0,251
EAT Bulimia		0,212	0,003
EAT Oral		0,193	0,007
HADS Anxiety score		0,106	0,144
HADS anxiety-syndrome (present)	2854,5		0,763
HADS Depression score		0,014	0,850
HADS depression-syndrome (present)	4496,0		0,779
PANAS (Positive)		0,024	0,744
PANAS (Negative)		0,039	0,588
Self rated silhouette		-0,217	0,002
WSAS		0,171	0,017

BMI=Body mass index, NART=National Adult Reading Test, EAT=Eating Attitudes Test, HADS=Hospital and Anxiety Depressive Scale, PANAS=Positive and Negative Affect Schedule, Silhouette, WSAS=Work and Social Adjustment Scale.

Table 3: Clinical characteristics of 114 patients with anorexia nervosa seen three months apart

Clinical characteristics	Before follow-up				After follow-up				Statistics		
	Average	sd	Rank	%	Average	sd	Rank	%	U (MW)	Fisher exact test	p-value
Insight (SAI-ED)	5,5203	1,32659	165,549		5,17073	1,5025	150,16		10895		0,13377
BMI	15,304	1,80071	148,187		16,3247	2,30557	187,822		9879		0,0002
Lifetime minimal BMI	13,329	1,7232	149,102		14,4475	5,70117	159,868		10516,5		0,29543
Lifetime maximal BMI	21,192	3,40094	159,97		22,2679	7,87168	144,132		10141,5		0,12376
Subjective ideal BMI	17,47	1,96226	145,382		17,8523	1,83025	160,779		9806,5		0,13374
BRIXTON	33,374	10,8586	143,762		37,6585	10,3645	184,873		9025		<0,001
EAT Total	34,553	16,5728	176,959		26,0488	17,4553	134,024		8886		<0,001
EAT Dieting	18,382	10,4768	174,378		14,0407	10,3301	137,976		9384		0,00057
EAT Bulimia	7,7398	4,39418	174,715		5,98374	4,88555	137,46		9319		0,0004
EAT Oral	8,4309	4,77542	175,948		6,02439	4,68248	135,571		9081		0,00013
HADS Anxiety score	13,211	4,1375	170,197		11,6016	4,68121	142,984		9998		0,00977
HADS anxiety-syndrome (present)				78,90%				65,90%		7,673	0,004
HADS Depression score	9,0407	3,76001	172,448		7,39024	4,08242	139,508		9563,5		0,00175
HADS depression-syndrome (present)				47,20%				30,10%		5,75	0,011
PANAS Positive	29,228	6,73845	147,06		30,6911	7,04334	178,708		9661,5		0,00269
PANAS Negative	35,927	7,8669	158,14		32,4878	9,45946	161,6		11800		0,74292
Self rated silhouette	4,1951	2,57561	150,578		5,07317	2,57405	173,276		10340,5		0,03044
WSAS	23,577	8,20037	169,308		19,2114	10,4366	142,956		9976,5		0,01243

585 BMI=Body mass index, NART=National Adult Reading Test, EAT=Eating Attitudes Test, HADS=Hospital and Anxiety Depressive Scale,
586 PANAS=Positive and Negative Affect Schedule, Silhouette, WSAS=Work and Social Adjustment Scale.

Table 4: Characteristics of 123 patients with anorexia nervosa who improved (versus did not) their level of insight after (in average) 4 months of care in eating disorders specialized care centers

Baseline characteristics	Stable or decreased insight (N=96)				Improved insight (N=27)				Statistics		
	Mean	sd	Average rank	%	Mean	sd	Average rank	%	U (Mann-Whitney)	Fisher exact test	p
AGE	24,92	8,80	62,71		26,19	15,78	61,79		1324,0		0,905
Education (High)				45,7%				25,0%		3,838	0,079
Working (presently)				22,6%				14,3%		0,704	0,553
Familial history of eating disorder (positive)				69,5%				78,6%		0,879	0,476
Subtype (restrictive)				65,1%				61,5%		0,111	0,817
Age at onset (eating disorder)	17,24	4,65	63,87		16,74	5,53	59,98		1273,5		0,615
Age at onset (binging)	19,45	5,06	27,09		19,62	8,37	26,75		269,5		0,944
Age at onset (purging)	19,82	5,33	28,63		18,92	8,14	26,14		261,0		0,615
BMI	15,23	1,87	60,80		15,56	1,55	70,63		1144,5		0,206
Lifetime minimal BMI	13,14	1,76	54,07		14,02	1,42	72,14		771,5		0,017
Lifetime maximal BMI	21,28	3,51	58,40		20,86	3,00	56,56		1089,0		0,807
Subjective ideal BMI	17,53	1,71	59,36		17,24	2,74	50,88		947,0		0,257
NART	26,20	6,35	66,24		23,70	5,78	51,79		1044,0		0,062
BRIXTON	33,66	10,96	64,12		32,37	10,65	59,13		1249,5		0,520

Table 4 (continued): Characteristics of 123 patients with anorexia nervosa who improved (versus did not) their level of insight after (in average) 4 months of care in eating disorders specialized care centers

Baseline characteristics	Stable or decreased insight (N=96)			Improved insight (N=27)			Statistics	
EAT Total	33,80	16,17	61,24	37,22	18,00	69,09	1187,5	0,312
EAT Dieting	17,77	10,27	60,74	20,56	11,12	70,82	1139,0	0,194
EAT Bulimia	7,58	4,35	61,64	8,30	4,58	67,70	1226,5	0,434
EAT Oral	8,45	4,84	62,78	8,37	4,61	63,75	1337,0	0,901
HADS anxiety score	12,89	4,21	60,57	14,37	3,69	71,43	1122,0	0,161
HADS anxiety-syndrome (present)			76,3%			89,3%	2,228	0,188
HADS depression score	9,03	3,67	62,57	9,07	4,12	64,48	1316,5	0,805
HADS depression-syndrome (present)			47,4%			46,4%	0,009	0,999
PANAS (Positive)	29,02	6,92	61,78	29,96	6,13	67,23	1239,5	0,482
PANAS (Negative)	35,27	8,10	60,25	38,26	6,61	72,52	1091,5	0,114
Self rated silhouette	4,20	2,58	62,68	4,19	2,62	64,13	1326,5	0,851
WSAS	23,80	7,82	63,59	22,78	9,57	60,96	1301,0	0,735
Between visits delay	126,4	84,9	64,13	111,7	62,5	54,44	1092,0	0,212

587 BMI=Body mass index, NART=National Adult Reading Test, EAT=Eating Attitudes Test, HADS=Hospital and
588 Anxiety Depressive Scale, PANAS=Positive and Negative Affect Schedule, Silhouette, WSAS=Work and Social
589 Adjustment Scale.

Table 5: Factors covarying with the level of insight between two visits of 123 patients with anorexia nervosa in specialized treatment centers

Variables	Statistics	
	U	p
Age	rho	
	(MW)	
Age	-,129	,157
BMI (difference)	-,094	,302
Subjective ideal BMI (difference)	,131	,192
Brixton (difference)	,011	,907
Brixton score (improved)	1518,5	,314
EAT Total (difference)	,084	,357
EAT Dieting (difference)	,053	,558
EAT Bulimia (difference)	-,119	,190
EAT Oral (difference)	,075	,412
HADS anxiety (difference)	,212	,019
Anxiety (in remission)	789	,015
HADS depression (difference)	,190	,036
Depression (in remission)	1139,5	,041
PANAS negative (difference)	,116	,200
PANAS negative (improved)	1416	,212
PANAS positive (difference)	-,177	,050
PANAS positive (improved)	1403	,025
Self rated silhouette (difference)	,029	,747
Self rated silhouette (improved)	1690,5	,301
WSAS (difference)	,164	,700
WSAS (improved)	1349	,065
Between visits delay	-,031	,731

590 BMI=Body mass index, NART=National Adult Reading
591 Test, EAT=Eating Attitudes Test, HADS=Hospital and
592 Anxiety Depressive Scale, PANAS=Positive and Negative
593 Affect Schedule, Silhouette, WSAS=Work and Social
594 Adjustment Scale.

Table 1' (appendix): Social and clinical characteristics of 163 adult patients with anorexia nervosa with different level of insight

	Good insight (N=152)			Poor insight (N=11)			Statistics	
	Average			Average			Fisher exact test	p-value
	Value	Rank	%	Value	Rank	%	U	
Age	26,576	83,5		23	61,2		607	0,129
Education (High)			45,27%			36,36%	0,334	0,402
Working (presently)			23,29%			10,00%	1,121	0,298
Familial history of eating disorder (positive)			32,21%			9,09%	3,153	0,097
Subtype (restrictive)			62,77%			27,27%	5,276	0,024
Age at onset (eating disorder)	17,727	82,5		15,636	68,0		682	0,321
Age at onset (binging)	19,647	38,8		18	30,0		182	0,306
Age at onset (purging)	20,108	43,7		15,375	21,4		135,5	0,012
BMI (baseline)	15,641	80,5		16,248	103,0		605	0,126
Lifetime minimal BMI	13,391	75,6		13,938	91,1		512,5	0,306
Lifetime maximal BMI	21,73	76,8		20,581	71,1		594,5	0,702
Subjective ideal BMI	17,501	80,0		16,233	56,0		505	0,104
NART	26,993	84,2		22,636	44,4		422,5	0,006
BRIXTON	32,457	82,6		30,273	73,3		740,5	0,527
EAT Total	34,629	80,3		43,545	105,8		574,5	0,084
EAT Dieting	18,166	80,1		24,455	107,7		553	0,061
EAT Bulimia	8,1656	80,7		10,273	99,5		643,5	0,201
EAT Oral	8,298	81,7		8,8182	85,9		793,5	0,778
HADS Anxiety score	13,199	80,9		14,818	97,5		666	0,259
HADS anxiety-syndrome (present)			82,12%			90,91%	0,641	0,401
HADS Depression score	9,1523	82,3		8,6364	78,0		792	0,77
HADS depression-syndrome (present)			47,02%			45,45%	0,01	0,586
PANAS Positive	28,132	83,1		25,636	66,4		664,5	0,256
PANAS Negative	32,642	81,6		34,182	87,7		773	0,677

Self rated silhouette	4,3311	79,9	6,2727	110,7	520	0,035
WSAS	23,338	83,0	20,273	68,6	688	0,327

The quality of insight was based on the SAI-ED score below 3 included (poor insight) versus 4 and over (good insight).

BMI=Body mass index, NART=National Adult Reading Test, EAT=Eating Attitudes Test, HADS=Hospital and Anxiety Depressive Scale, PANAS=Positive and Negative Affect Schedule, Silhouette, WSAS=Work and Social Adjustment Scale.

596

Table 2' (appendix): Factors correlated to, or associated with, the level of insight in 163 patients with anorexia nervosa

Patients' baseline characteristics	SAI-ED total score		
	U	Rho (Spearman)	p
Age		0,156	0,047
Education (High)	2823		0,232
Working (presently)	1941		0,437
Familial history of eating disorder (positive)	2193,5		0,036
Subtype (restrictive)	2436		0,380
Age at onset (eating disorder)		-0,009	0,914
Age at onset (binging)		0,096	0,412
Age at onset (purging)		0,218	0,049
BMI		-0,270	0,000
Lifetime minimal BMI		-0,335	0,000
Lifetime maximal BMI		-0,064	0,432
Subjective ideal BMI		0,103	0,200
NART		0,333	0,000
BRIXTON		0,079	0,317
EAT Total		-0,019	0,808
EAT Dieting		-0,152	0,052
EAT Bulimia		0,157	0,045
EAT Oral		0,158	0,044
HADS Anxiety score		0,038	0,628
HADS anxiety-syndrome (present)	2972,5		0,244
HADS Depression score		-0,056	0,481
HADS depression-syndrome (present)	4496		0,779
PANAS (Positive)		0,074	0,351

PANAS (Negative)	-0,047	0,552
Self rated silhouette	-0,238	0,002
WSAS	0,117	0,136

597 BMI=Body mass index, NART=National Adult Reading
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601 Adjustment Scale.

Table 3' (appendix): Clinical characteristics of 106 adult patients with anorexia nervosa seen three months apart

Clinical characteristics	Before follow-up				After follow-up				Statistics		
	Average				Average				U (MW)	Fisher exact test	p- value
	Average	sd	Rank	%	Average	sd	Rank	%			
Insight (SAI-ED)	5,625	1,2818	142,06		5,292	1,413	124,13 7		7487,5	0,057	
BMI	15,679	2,324	123,01		16,538	2,285	159,81 3		6685	0,000	
Lifetime minimal BMI	13,42	1,997	123,39		14,687	5,876	137,11 9		7127,5	0,146	
Lifetime maximal BMI	21,694	4,649	133,65		22,269	8,074	123,54 7		7425	0,285	
Subjective ideal BMI	17,419	1,873	124,06		17,786	1,782	137,81 4		7108	0,148	
BRIXTON	32,214	11,74	122,00		37,140	10,954	156,05 1		6521,5	0,000	
EAT Total	35,343	16,308	150,17		27,401	17,306	113,15 116,79		6329	0,000	
EAT Dieting	18,674	10,168	147,77		14,700	10,377	9 116,18		6719,5	0,001	
EAT Bulimia	8,319	4,5956	148,18		6,4672	4,972	2 115,13		6653,5	0,001	
EAT Oral	8,3496	4,864	148,86		6,233	4,594	6 120,73		6541,5	0,001	
HADS Anxiety score	13,325	3,888	144,27		11,934	4,637	1		7126,5	0,015	
HADS anxiety-syndrome (present)				82,82 %				31,13 %	7,005	0,006	
HADS Depression score	9,13	4,085	146,96		7,584	4,084	116,60		6689	0,002	

			3			4			
			47,24			31,13			
			%			%			
HADS depression-syndrome (present)								6,996	0,006
		7,5683				152,08			
PANAS Positive	27,938	7	123,89		30,632	7,111	5	6828	0,004
		8,5833	132,21						
PANAS Negative	32,809	3	8		33,292	9,205	8	8185,5	0,467
		2,7852	83,398						
Self rated silhouette	4,484	3	8		5,037	2,589	9	228	0,000
		8,9926	144,45						
WSAS	23,147	1	4		19,723	10,262	8	6935	0,009

602 BMI=Body mass index, NART=National Adult Reading Test, EAT=Eating Attitudes Test, HADS=Hospital and Anxiety Depressive Scale,
603 PANAS=Positive and Negative Affect Schedule, Silhouette, WSAS=Work and Social Adjustment Scale.

604 Table 4' (appendix): Characteristics of 106 patients with anorexia nervosa who improved (versus did not) their level of insight after (in average)
 605 4 months of care in eating disorders specialized care centers
 606

607	Baseline characteristics	Stable or decreased insight (N=83)				Improved insight (N=23)				Statistics		
608		Mean	sd	Average rank	%	Mean	sd	Average rank	%	U (Mann-Whitney)	Fisher test	p
609												
610	AGE	26,493	8,332			29,173	16,372			922,5		0,806
611	Education (High)				29,63%				14,29%		3,575	0,050
612	Working (presently)				22,78%				14,29%		0,774	0,301
613	Familial history of eating disorder (positive)				15,63%				25,00%		1,186	0,212
614	Subtype (restrictive)				18,97%				26,32%		0,716	0,273
615	Age at onset (eating disorder)	17,674	4,682			17,956	6,335			927,0		0,832
616	Age at onset (binging)	19,878	4,815			20,928	9,425			244,5		0,759
617	Age at onset (purging)	20,062	5,159			20,923	9,393			246,5		0,780
618	BMI	15,316	1,937			15,741	1,573			815		0,285
619	Lifetime minimal BMI	13,122	1,825			14,217	1,595			515		0,023
620	Lifetime maximal BMI	21,438	3,520			21,381	3,413			770		0,999
621	Subjective ideal BMI									769		0,669
622	NART	27,301	5,807			25,173	4,867			724		0,076
623	BRIXTON	33,180	11,468			32,304	11,210			927,5		0,836
624	EAT Total	35,626	14,812			39,695	17,874			824,5		0,319
625	EAT Dieting	18,626	9,629			21,869	11,410			790,5		0,208
626	EAT Bulimia	8,132	4,140			9,130	4,475			823,5		0,313
627	EAT Oral	8,867	4,940			8,695	4,138			948,5		0,963
628	HADS anxiety score	13,156	4,097			15,173	2,886			702,5		0,053
629	HADS anxiety-syndrome (present)				5,26%				25,29%		4,662	0,044
630	HADS depression score	9,277	3,686			9,608	3,893			899,5	0,672	
631	HADS depression-syndrome (present)				20,75%				22,64%		0,056	0,500
632	PANAS (Positive)	29,192	7,162			29,565	6,185			911,5		0,741
633	PANAS (Negative)	35,867	7,605			39,478	5,035			685		0,039
634	Self-rated silhouette	4,265	2,650			4,565	2,936			916		0,766
635	WSAS	24,313	7,920			24,260	8,291			945,5		0,945
636	Between visits delay	130,231	87,5149			117,227	68,218			764,5		0,273

Table 5' (appendix): Factors covarying with the levels of insight between two visits of 123 patients with anorexia nervosa in specialized treatment centers

Variables	Statistics	
	rho	U (MW) p
Age	0,059	0,551
BMI (difference)	0,037	0,711
Subjective ideal BMI (difference)	0,136	0,208
Brixton (difference)	0,026	0,792
Brixton score (improved)		1165 0,446
EAT Total (difference)	0,127	0,195
EAT Dieting (difference)	0,109	0,267
EAT Bulimia (difference)	0,108	0,269
EAT Oral (difference)	0,087	0,373
HADS anxiety (difference)	0,220	0,024
Anxiety (got in remission)		525,5 0,011
HADS depression (difference)	0,197	0,043
Depression (got in remission)		773 0,012
PANAS negative (difference)	0,123	0,209
PANAS negative (improved)		1053,5 0,190
PANAS positive (difference)	0,179	0,066
PANAS positive (improved)		1039,5 0,032
Self-rated silhouette (difference)	0,025	0,800
Self-rated silhouette (improved)		1248,5 0,311
WSAS (difference)	0,159	0,105
WSAS (improved)		1008 0,103
Between visits delay	0,008	0,932

637 BMI=Body mass index, NART=National Adult Reading
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640 Affect Schedule, Silhouette, WSAS=Work and Social
641 Adjustment Scale