

Treating PTSD With Imagery Rescripting During An Underweight State In Eating Disorder Patients. A Multiple Baseline Case Series Study

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Abstract

Background;

Eating disorder patients with a posttraumatic stress disorder have worse treatment results regarding their eating disorder than patients without a posttraumatic stress disorder. Many underweight eating disorder patients with co-morbid posttraumatic stress disorder symptoms are not treated for their posttraumatic stress disorder symptoms during underweight. We pose that posttraumatic stress disorder treatment in underweight eating disorder is possible, and tested whether posttraumatic stress disorder symptoms decrease with Imagery Rescripting, and secondary whether the treatment of trauma has an effect on the process of weight gain and on eating disorder pathology in general.

Method;

Ten patients in clinical treatment (BMI 14-16.5) participated. A multiple baseline design was used, with baseline varying from six to 10 weeks, a six-week treatment phase, a three-week follow-up period and a three month follow-up measurement. Data were analyzed with mixed regression.

Results;

Evidence was found for strong effects of treating posttraumatic stress disorder symptoms with imagery rescripting without interfering with the eating disorder treatment. Positive effects were also found on a range of emotional and cognitive secondary measures.

Conclusion;

Imagery rescripting of traumatic memories at times of underweight was possible, safe and had positive clinical effects.

Trial registration

*Netherlands trial register (NTR) Trial NL5906 (NTR6094). Date of registration 09/23/2016.
<https://www.trialregister.nl/trial/5906>*

Plain English Summary

The present study was the first study to investigate treatment of posttraumatic stress complaints, such as re-experiences and flash backs of the trauma, with underweight patients.

It is important that we did this research because these patients:

* often do not receive treatment for the trauma complaints at the time they are still underweight,

* have worse treatment results regarding their eating disorder than patients without posttraumatic stress complaints.

Patients and patient organizations have since years expressed the wish to treat posttraumatic stress complaints during the weight gaining phase of treatment. Results of this study are important for patients, because they show that the treatment of trauma complaints at times of underweight is possible.

Ten patients received the trauma treatment. Trauma and eating disorder complaints were measured multiple times before, during and after the treatment. We tested whether trauma complaints reduced during and after the treatment.

This research was done in response to the request of patients about the possibility of treating posttraumatic stress complaints during underweight. They were also involved in the development of the interview and have all been interviewed about their experiences. The findings will be published and presented at eating disorder conferences in which patients are also present.

Background

The rate of Post-Traumatic Stress Disorder (PTSD) in clinically admitted patients with Anorexia Nervosa (AN) is estimated to be between 10% (Gleaves et al., 1998) and 47% (Tagay et al., 2014). AN patients with comorbid PTSD generally have more severe obsessive-compulsive complaints, depressed and anxious mood, lower self-esteem and more interpersonal problems (Brewerton, 2007; Carter et al., 2006; Mitchell et al., 2012). From clinical practice we learn that AN patients with PTSD are often more difficult to treat than AN patients without PTSD. Several studies have found higher relapse rates, poorer treatment responses, or more frequent premature termination of treatment in patients with AN and PTSD (Carter et al., 2006; Reyes-Rodriguez et al., 2011; Rodríguez et al., 2005). Based on this, various experts plead for studies that investigate whether the standard treatment of AN patients with co-morbid PTSD symptoms should be expanded with trauma-treatment (Brewerton, 2007; Reyes-Rodriguez et al., 2011).

Treating trauma for underweight Eating Disorder (uED) patients is a controversial issue. As far as we know, there is no literature available on the treatment of trauma at the time of underweight. The clinical tradition is to not focus on trauma processing during uED treatment, based on the assumption that being in an underweight state and/or being malnourished suppresses cognitive functioning (Abbate-Daga et al., 2011; Danner et al., 2012; Martinez, et al., 2014), which is needed for effective trauma-focused treatment. However Rylander et al. (2020) found no significant impairments in cognition in uED. With lack of evidence for deteriorated cognitive functioning, reconsidering the possibility of focusing on trauma processing during uED is important. Otherwise the risk that traumas remain undertreated and trauma complaints make the eating disorder treatment more difficult remains. Also the assumption that trauma processing is not possible then remains untested.

Another argument that is raised in line with the clinical tradition to not offer trauma-processing during uED treatment is that trauma-treatment requires the experience of sufficient emotions. The assumption is that, during underweight, not enough emotions are experienced for effective trauma-focused treatment.

An experimental study showed that people with AN attenuate emotional expression and avoid negative affect (Davies et al., 2011). Cavan & Connan (2010) described that clinicians report that emotional experiences are dampened as a result of starvation. On the other hand, studies found that underweight eating disorder patients report the same or elevated levels of negative affect or emotions compared to healthy controls, and that negative affect is not related to Body Mass Index (BMI) (Davies et al., 2011; Van Elburg et al., 2021; Vroling et al., 2021).

Trauma-treatment also requires the ability to regulate emotions. People with AN have more difficulty regulating emotions than healthy controls (Brockmeyer et al., 2012a; Harrison et al., 2009). Qualitative research described that AN patients experience their eating disorder as helping them to manage difficult experiences (Gregertsen et al., 2017; Marzola et al., 2015). Also, patients report that not-eating and being underweight helps them to handle negative emotions (Kyriacou et al., 2009; Nordbo et al., 2006). However, studies found inconsistent associations between BMI and the degree of emotion regulation problems (Brockmeyer et al., 2012b; Haynos et al., 2014; Racine & Wildes, 2013). Some studies suggest that a lower BMI is related to better emotion regulation skills (Brockmeyer et al., 2012b; Racine & Wildes, 2013), whereas other studies found no evidence for a relation between emotion regulation skills and BMI (Haynos et al., 2014).

Since the emotion regulation problems persist, even with healthy weight, this is not an argument for posturing trauma processing to a healthy BMI. Therefore, there is good reason to start research on trauma-focused treatment with uED.

The regular treatment for patients with uED and PTSD starts with an eating behavior normalization phase. For those patients that are underweight, this normalization phase lasts until the underweight is almost restored to healthy weight. During this normalization phase, American guidelines advise to not offer psychotherapy (Yager et al., 2012). In the Netherlands, common practice is to offer psychotherapeutic management and/or cognitive therapy during weight restoration, and to start (insight oriented) psychotherapy only after this phase has (almost) been completed. Hence, trauma-related problems (if addressed at all) are only addressed in the later phase of treatment. Since 2017, the Dutch standard of care for eating disorders recommends starting trauma processing, if the complaints prevent the eating disorder treatment too much (despite patients being still underweight), although they recognize that there is not enough evidence for this recommendation (GGZ Zorgstandaard eetstoornissen, 2017). When deciding in which order to treat an eating disorder (parallel, as a part of, at the same time) it is suggested to take into account “the severity and complexity of the eating disorder and the comorbidity, the person’s level of functioning and the preference of the patient and if possible their family members or carers” (The NICE guideline, 1.8.12, 2017). In addition, the guideline indicates that there is little evidence on which treatment works best for patients with an eating disorder and comorbidity, and that randomised clinical trials are necessary.

Summarising, there is currently too little evidence to answer the question whether trauma-focused treatment is possible during underweight. In line with the suggestions by Brewerton (2007) and Rodriguez

et al. (2011), Dutch Feeding and Eating Disorder (FED) patient organizations have since years expressed the wish to treat the underlying trauma in an earlier phase of the treatment (IxtaNoa personal communication, May, 2012). We therefore investigate whether traumatized patients can indeed be treated for their trauma during their weight restoration phase.

Current treatment guidelines for PTSD describe two treatments for treating PTSD, which are considered equally effective: individual trauma-focused cognitive behavioral treatment with imaginal exposure (IE) and eye movement desensitization and reprocessing (EMDR) (Multidisciplinaire Richtlijn Angststoornissen, 3^e revision, 2013(1.0)). Recently, a third treatment has emerged as a promising evidence-based treatment: Imagery Rescripting (IMRS). An initial randomized controlled trial comparing the combination of IE and IMRS (IE + IMRS) with the established IE to treat PTSD demonstrated that IE + IMRS was equally effective in reducing PTSD-related symptoms, and had a superior effect in diminishing other trauma-related emotions such as anger, shame, and guilt (Arntz et al., 2007). Moreover, treatment dropout was significantly lower in the IE + IMRS condition. A review of clinical trials and basic studies of Arntz (2012) concluded that, despite some limitations, the results of IMRS as a therapeutic technique are promising. There are also indications that IMRS (without IE) is considered less aversive to patients than IE, judged by the low dropout rates in a recent pilot study (Raabe et al., 2015). Similarly, an international Randomized Clinical Trial (RCT) comparing IMRS and EMDR demonstrated large effects of both active treatments in patients with PTSD due to childhood trauma, with very low dropout (Boterhoven et al., 2020). Another RCT demonstrated that a combination of Skill Training in Affective Regulation (STAIR) and IMRS did not perform better than IMRS alone and IMRS proved to be very effective in the treatment of PTSD due to childhood abuse, and emotion regulation improved more by IMRS than by STAIR (Raabe et al., 2015; Raabe et al., 2021 *Submitted*). A meta-analysis of IMRS as a clinical intervention for aversive memories showed that the method is a promising intervention for psychological complaints related to aversive memories. The meta-analysis describes large effects in a small number of sessions (Morina et al., 2017). In comparison with EMDR and IE, IMRS can be more easily applied to a wider range of traumas including emotional abuse and neglect, and can effectively address complex emotions such as guilt and shame (Arntz, 2012). For these reasons we chose IMRS to treat traumas of FED patients with underweight in our study.

The first aim of the present study was to explore whether IMRS, added to a clinical eating disorder treatment, is effective in reducing trauma-related complaints in underweight eating disorder patients. The secondary aim was to explore whether the treatment of trauma has an effect on the process of weight gain and on eating disorder pathology in general. We investigate this treatment with a group of 10 patients, by using a randomized multiple baseline design with five baseline lengths (6 to 10 weeks) so that we have a higher power of verification of the results because the design controls for time and assessment effects (Carr, 2005). The variation in baseline length gives the opportunity to distinguish between time effects and effects of the IMRS treatment.

Method

Participants

Participants were originally 12 patients with underweight and PTSD, who underwent inpatient treatment for their eating disorder, between February 2017 and July 2019. Mean age was 25.73 (SD 11.09, range 16–58). As two patients dropped out of the study early, in the end 10 participants were included. One participant discontinued clinical treatment during the baseline period of the study, because of the difficulty with participating in a group; she was diagnosed with an autism spectrum disorder. In a dropout interview, she indicated that the upcoming trauma-treatment was a reason for her to try and remain in clinical treatment than a reason to stop clinical treatment. The other participant discontinued after three IMRS treatment sessions. In a dropout interview, she indicated that her trauma complaints diminished immediately through the IMRS sessions. However, the sessions consumed so much energy that she felt she had too little energy left to make the most of her clinical eating disorder treatment. She preferred a sequential treatment rather than a parallel treatment. Because this study was a first concept of proof, we reported on the 10 participants that completed the IMRS treatment. All participants were female and of Dutch nationality. Inclusion criteria were: (1) a BMI between 14 and 16.5; (2) current DSM 5 diagnosis for AN or Other Specified Feeding and Eating Disorder (OSFED); (3) a PTSD diagnosis as defined by DSM-5 and determined with the Structured Clinical Interview DSM (SCID-5) PTSD section (First et al., 2016), and the Clinically Administered PTSD Scale (CAPS-5) interview (Weathers et al., 2018); (4) age between 16 and 65 years; (5) an indication for inpatient treatment; (6) willingness to participate in the study (signed informed consent). Exclusion criteria were: (1) estimated IQ < 80; (2) acute suicide risk; (3) substance dependence; (4) life threatening physical condition; (5) start of new medication within 3 months prior to the start of the study; (6) ongoing trauma; (7) a medical history of psychosis, bipolar disorder, or borderline personality disorder.

Of the 72 patients that were clinically admitted in the defined period of time, 12 met all inclusion criteria. All participants that met the inclusion criteria agreed to participate in the study and provided written consent.

Table 1 presents the demographic and clinical data of the completers group (N = 10).

Table 1
Demographic and clinical data of the completers group (N = 10).

Variable		
Age (Mean, SD)	<i>Range 16–58 (n = 10)+</i>	<i>26.4 (12)</i>
Gender (Number, %)	<i>Female</i>	<i>10 (100%)</i>
Completed educational level (Number, %)	<i>Pre-vocational secondary education</i>	<i>3 (30%)</i>
	<i>Secondary vocational education</i>	<i>3 (30%)</i>
	<i>Senior general secondary education</i>	<i>1 (10%)</i>
	<i>Pre-university education</i>	<i>2 (20%)</i>
	<i>University education</i>	<i>1 (10%)</i>
Feeding and eating disorder (Number, %)	<i>Anorexia Nervosa</i>	<i>9 (90%)</i>
	<i>Other specified feeding and eating disorder</i>	<i>1 (10%)</i>
Body Mass Index, start of the study (Mean, SD)	<i>Range 14.9–17.8</i>	<i>15.6 (1.2)</i>
Body Mass Index, start IMRS phase (Mean, SD)	<i>Range 14.6–18.4</i>	<i>16.7 (1)</i>
Number of participants per trauma category (LEC-5 categories++)	<i>Physical assault (for example, being attacked, hit, slapped, kicked, beaten up)</i>	<i>4</i>
	<i>Sexual assault (rape, attempted rape, made to perform any type of sexual act through force or threat of harm)</i>	<i>5</i>
	<i>Other unwanted or uncomfortable sexual experience</i>	<i>2</i>
	<i>Combat or exposure to a war-zone (in the military or as a civilian)</i>	<i>1</i>
	<i>Any other very stressful event or experience</i>	<i>1</i>
Total CAPS-5+++ score (Mean, SD)	<i>Range Caps total 33–58</i>	<i>44.8 (9.1)</i>

+ One outlier of age 58. Without outlier Range 16-30, Mean 22.9, SD 4.9

++ Weathers, Blake, Schnurr, Kaloupek, Marx, & Keane, (2013).

+++Clinical-Administered PTSD scale for DSM-5.

Procedure

All patients who register with the expertise center for FED, were seen by a psychologist, a medical doctor, and the family present was seen by a family therapist. Next, the SCID-I for DSM-IV-TR was administered to determine the diagnosis of PTSD (Glasofer & Riegel, 2015). Hereafter all the information was discussed in a multidisciplinary meeting where the treatment advice was compiled. During this multidisciplinary meeting, a checklist was used with the inclusion criteria for the IMRS study. Patients who met the inclusion criteria received a brief oral explanation and an information letter (including an informed consent form) about the IMRS study in the admission interview. In the information letter the IMRS method was explained, and because the treatment could temporarily cause emotional distress in patients (as do all therapies which focus on working through trauma), patients were fully informed on these effects. After several days, the patient was approached (by the first author) by telephone, asking whether they would like to participate in the study. After consent was obtained they were invited for CAPS 5, version last month (Boeschoten et al., 2015). The CAPS-5 was used because the Dutch version of the SCID-5 was not yet available at that time. With the CAPS-5 the DSM 5 diagnosis was reconfirmed. After the CAPS 5 the visual analogue scales (VAS) were personalized.

Design

This study was designed as an intervention study during an inpatient treatment program for FED with weekly assessments throughout baseline, therapy, and three weeks post-treatment, as well as a follow-up assessment after three months (Fig. 2). We used a randomized multiple baseline design with five baseline length conditions (6 to 10 weeks). The variation in baseline length gives the opportunity to distinguish between time effects and effects of the IMRS treatment. A randomization schedule for baseline lengths (2 participants per length: 6, 7, 8, 9 and 10 weeks) was determined a priori, and participants were allocated to these randomly predetermined baseline lengths based on inclusion order.

The participants were not informed about the duration of the baseline and were notified three days before the start of the IMRS. Due to a miscommunication 1 participant was given the wrong baseline length. This means there was one participant with 9 weeks baseline and three participants with 6 weeks baseline. One participant did not report any traumatic complaints during the screening, yet reported more and more PTSD complaints during the first weeks of clinical treatment^[1]. This patient was therefore included in the study during her clinical treatment.

Power analysis

Although sophisticated statistical techniques to analyze data from case series over subjects have been developed, there is no simple power analysis method developed yet. We planned 10 participants. To give an impression of the power, this sample size yields 80% power to detect a large effect (Cohen's $d > 1$) with a paired t-test at a two-tailed significance level of 0.05. Such an effect size is reasonable to expect given the pooled pre-post effect size of $g = 1.48$; 95% CI = [1.14; 1.82] for IMRS for PTSD (Morina et al., 2017).

Treatments and therapists

The inpatient treatment program for FED was five days a week with overnight stay. Patients went home during weekends. The program used cognitive behavioral change methods and focused on increasing weight and on factors that sustain the eating disorder for the particular patient. Three main meals and three in-between meals per day were supervised. Beside the meals, the program consisted of the following therapy components: 1) One hour 'cognitive behavioral therapy' (emphasis on maintaining factors of the eating disorder in the present and future, 2) two hours 'eating behavior' (aimed at normalizing the eating pattern), 3) two hours 'body and movement-oriented therapy' (focused on the overvaluation of the body, movement behavior and emotion regulation (De Lange et al., 2019), 4) one hour psycho education, 5) one hour 'progress and goal meeting', 6) 75 minutes 'psychotherapy', and 7) two hours 'activity guidance' (focused on expanding other areas of life; work, study, friendships, hobbies, sports; with the option to spend one hour on creative work). A parent and partner group was offered five times during clinical admission (psychoeducation about eating disorders, opportunity for support, recognition, understanding and advice).

The investigational treatment was IMRS. IMRS is a psychological treatment for processing traumatic experiences (Arntz, 2015; Arntz & Weertman 1999; Raabe et al., 2015; Smucker & Niederee, 1995). IMRS was given in addition to the regular inpatient treatment program for FED. The IMRS treatment consisted of 12 IMRS sessions of 90 minutes each, which were offered in 6 consecutive weeks. IMRS aims to change the meaning of traumatic experiences by experiencing imagined interventions that correct the dysfunctional emotional and interpersonal meanings attached to the trauma. In IMRS, the patient imagines the start of the traumatic event (to activate the trauma memory). When there is enough emotional activation (usually at the hotspot), the rescripting starts. The therapist, and later the patient (from their current perspective), then rescripts the traumatic experience to provide a more desirable outcome, while the patient is imagining this new script as lively as possible. This leads to change of maladaptive beliefs, more control over images, and improved possibilities to reassure oneself (Long & Quewillon, 2009). This way, the patient does not have to relive the full trauma in all its details. It is important, in this respect, that the rescripted outcome contains new and unexpected information for the patient, so that a lasting change of memory is created (Finnie & Nader, 2012).

The first IMRS session was a preparatory session, in which the therapeutic alliance was formed, the rationale and treatment were explained, and a list of experienced traumas was established. The therapist and patient discussed the order in which they would address the traumas. Also, current living circumstances were checked (to check whether there was enough distance from the perpetrator and enough safety to conduct trauma processing). The session ended with a pilot IMRS (using a mildly negative childhood memory) to familiarize the patient with the IMRS technique, and with a session evaluation. Patients were instructed to read the IMRS explanation hand-outs and reread the list of trauma-themes and change items and/or order if applicable before the following IMRS session.

Within each following session, the following sequential steps were followed:

1. Check for intrusions, nightmares, and emotions following the previous session. Discuss how this session affected the patient;
2. Agree upon which trauma theme to start with;
3. Have patient close eyes and retrieve traumatic memory;
4. Therapist (session 1–6) or Adult patient (session 7–12) steps into the image;
5. Therapist or adult patient intervenes and patients imagines this intervention;
6. Check whether the imagined situation is effectively under control and the child's needs are met;
7. If the way of intervening was not successful: rewind and start again;
8. Stop when patient, from the point of view of the child, says 'it is okay';
9. Evaluate the rescripting (rescript another memory if time allows);
10. Evaluate the session;
11. Assign homework: review trauma list (for order and need or wishes to address traumas).

For a more detailed treatment description see Raabe et al. (2015). The IMRS sessions were given by postdoctoral trained registered psychologists (two health psychologists, two psychotherapists and one clinical psychologist). Therapists were trained during a one day workshop by Arnoud Arntz.

The therapists attended weekly group supervision (60 minutes). The supervision was led by the first author with the option of consulting the fourth author by telephone or email.

Treatment integrity

To assure that IMRS was carried out as designed, the treatment integrity was assessed. Treatment sessions were audio-recorded and the adherence was rated by two trained and independent master-level doctoral psychology students, with the use of the Imagery Rescripting Therapist Adherence and Competence Scale (Raabe, 2015). The raters were trained by the first author. Besides that, 4 IMRS sessions were rated by both raters to assess interrater reliability (Perepletchikova et al., 2007). The mean of the treatment adherence of all elements of IMRS was 0.80 (SD 0.071) (0 = the therapist didn't demonstrated the particular intervention, 1 = the therapist demonstrated the particular intervention). This means that 80% of the prescribed elements was detected. Interrater reliability was good (intraclass correlation coefficient [ICC] = .66, $p < .001$ [adherence]).

Instruments

The main primary outcome measure was the PTSD Scale-Self Report for DSM-5 (PSS-SR), which was used to assess the level of PTSD-related symptoms according to DSM-IV (Foa et al., 1993). The scale assesses the frequency of the trauma related symptoms during the last week (range 0–51), with a 4 point scale (3 = very often, always, 2 = often, 1 = sometimes, 0 = never). The completed scores are summed, a higher score is reflecting more PTSD symptoms. Sin, Abidin and Lee (2012) showed that the optimal cut-off point for the PSS-SR is 14 and the scale has high internal consistency and validity. Cronbach's alpha in the present study was .87.

The second group of primary outcomes were core emotional problems and beliefs assessed with Visual Analogue Scales (VAS). The respondents indicated on a 100 mm line with two anchors, to what extent they agreed with an item (don't agree at all – agree completely). The following 'negative emotions' items were presented 1) to what extent did you experience rage in the past three days, 2) to what extent did you experience guilt in the past three days, 3) to what extent did you experience shame in the past three days, 4) to what extent did you experience disgust in the past three days. In addition, three to four personalized 'dysfunctional self-beliefs' and 'dysfunctional body-beliefs' VAS scales with negative thoughts about the self and the body were added, which asked: to what extent did you suffer from your personalized negative thoughts about the self/body in the past three days? (not at all – extremely). An example of such an idiosyncratic VAS is 'I'm fat'. The VAS scales were collected twice per week during baseline period, after each IMRS session, twice per week during the follow-up and once during the follow-up measure. We derived three composite scores from the VASs; a negative emotion score (the average of the emotion VASs), a dysfunctional self-belief score (the average of the idiosyncratic beliefs about the self) and a dysfunctional body-belief score (the average of the idiosyncratic beliefs about the body).

A second relevant question is whether PTSD-related cognitions, eating disorder problems, and emotion regulation difficulties also decline. Therefore the secondary outcome measures consisted of the Post-Traumatic Cognitions Inventory (PTCI), the Body Mass Index (BMI), the Eating Disorder Evaluation-Questionnaire (EDE-Q) and the Difficulties in Emotion Regulation Scale (DERS). The secondary study parameters were administered at fixed timepoints (weekly during baseline period, at the start, mid and end of the IMRS, weekly during follow-up and once during follow-up measure).

The Post-Traumatic Cognitions Inventory (PTCI) was used to measure trauma-related cognitions. An example of a question is 'I am a weak person' or 'The world is a dangerous place'. It assesses the frequency of the trauma-related cognitions during the last week (range 0–51), with a 4 point scale (0 = never, 1 = sometimes, 2 = often, 3 = very often, always). The scores are added together, the higher the score the more trauma-related cognitions. Van Emmerik et al. (2006) and Foa et al. (1999) found a high internal consistency and high two-week test-retest reliability of the PTCI. Cronbach's alpha of the total score in the present study was .91.

BMI is a relative weight measure and is calculated as follows: body weight in kg / body height in m². During inpatient treatment, height is measured once during initial screening, and weight is measured at least two times a week. We asked patients for permission to use the height and weekly weight information from their medical files.

The Eating Disorder Evaluation-Questionnaire (EDE-Q 6.0) is a 28-item self-report questionnaire which is used to measure core attitudinal features of eating disorders for the past 28 days, and the frequency of core eating disorder behavior from the previous 7 days (Fairburn & Beglin, 2008). The EDE-Q includes features of eating disorders and specific behavioral symptoms. An example of a feature is 'eating concern' and of a specific behavioral symptom 'self-induced vomiting'. The EDE-Q demonstrated reliability

of scores, but additional research is needed to generalize these findings (Berg et al., 2012). Cronbach's alpha of the total score in the present study was .89.

The Difficulties in Emotion Regulation Scale (DERS) is 36 item self-report questionnaire which is used to measure difficulties with emotion regulation (Gratz & Roemer, 2004; Neumann et al., 2010). An example of a question is 'I know what my feelings are' or 'When I'm upset, I feel ashamed about it'. The DERS has good test-retest reliability (Gratz & Roemer, 2004) and high internal consistency within clinical patients (Fox et al., 2007). Cronbach's alpha in the present study was .92.

Statistical analysis

Mixed regression was used for the primary (PSS-SR, VAS) and secondary (PTCI, BMI, EDE-Q, DERS) quantitative outcome parameters, to assess differences between treatment, post-treatment and follow-up measures compared to baseline in average scores and linear change. Fixed variables were a dummy to indicate treatment, a dummy indicating the post-treatment and a dummy indicating the follow-up measure (so that baseline is the reference), and time by phase interactions represented by a centered linear time effect within each phase (Vlaeyen et al., 2001). Random variables were a random intercept to capture between subject outcome variation, plus Autoregressive Moving Average Model (ARMA1.1) for the within-subject covariance structure of the repeated part. ARMA1.1 had the best fit for all the questionnaires, except for the VAS scales, in which case we used Autoregressive model (AR1). Given their skewed distributions, the transformed (101 - raw score in mm) outcome measures 'VAS body' and 'VAS belief' were analyzed by Generalized Linear Mixed Models with a gamma distribution and log-link, which is suitable for (very) skewed distributions. We assessed the full model with all predictors.

Cohen's d was calculated as effect size of the change of (post-)treatment resp. follow-up compared to baseline based on estimated means from the mixed regression as numerator and baseline SD as denominator (Arntz et al., 2013; Vlaeyen et al., 2001).

[1] As Zimmerman & Mattia (1999) indicate, some patient feel uncomfortable to share their trauma complaints at the start of treatment. They advise to keep on evaluating on trauma complaints during treatment.

Results

PSS-SR

In Fig. 3, the individual scores of the participants on the PSS-SR are shown. If we look at this figure we see a slight increase in PTSD complaints, compared to the mean of the baseline score per participant, during baseline in 6 of 10 participants. During the IMRS the picture changes, with 4 participants showing a decrease in PTSD complaints, while 3 participants show an increase in PTSD complaints and 3

participants show stable complaints. During post-treatment/FU, 7 participants showed reductions compared to mean baseline scores. None showed long-term deterioration.

Table 2 presents the final results of the mixed regression analysis. No significant effect was found during and immediately after the IMRS treatment on PTSD complaints, except a significant slope of reducing scores during post-treatment. At follow-up measurement the change in PTSD complaints (change in PSS-SR scores at follow-up measure compared to baseline) was significant, with a very large effect size (Sawilowsky & Shlomo, 2009). Note that the beta's (and t-tests, and effect sizes) of all phases, except follow-up, represent the main effect at (within-condition centered) time = 0, which is halfway the pertinent phase.

Table 2
Results mixed regression analyses

	Parameter	Beta	Std. error	df	t	P	Effect size Cohen's d
PSS-SR+	Intercept	33.87	2.45	12.19	13.83	< 0.001	
	Treatment	-1.06	1.51	24.21	-0.70	0.491	0.64
	Post-treatment	-2.72	2.18	14.43	-1.25	0.231	0.93
	3-months Follow-up	-8.70	2.52	15.92	-3.45	0.003	1.53
	Time within baseline	0.58	0.30	41.34	1.94	0.060	
	Time within treatment	-0.57	0.38	48.96	-1.50	0.140	
	Time within Post-treatment	-1.79	0.87	144.41	-2.06	0.041	
VAS++ Negative emotions	Intercept	71.73	6.45	9.98	11.12	< 0.001	
	Treatment	1.91	2.89	34.72	0.66	0.512	1.03
	Post-treatment	-4.04	4.20	33.75	-0.96	0.343	1.08
	3-months Follow-up	-10.42	4.94	57.69	-2.11	0.039	1.39
	Time within baseline	2.97	0.75	44.07	3.98	< 0.001	
	Time within treatment	-2.17	1.03	58.12	-2.10	0.040	
	Time within Post-treatment	-1.35	2.22	286.01	-0.61	0.544	
VAS++ self-belief ¹	Intercept	2.14	0.34		6.22	< 0.001	
	Treatment	0.24	0.14		1.67	0.099	1.15
	Post-treatment	0.52	0.22		2.37	0.20	0.99
	3-months Follow-up	0.93	0.25		2.86	0.005	2.35
	Time within baseline	-0.19	0.04	89	-5.04	< 0.001	
	Time within treatment	0.13	0.05	104	2.50	0.014	

	Parameter	Beta	Std. error	df	t	P	Effect size Cohen's d
	Time within Post-treatment	-0.02	0.20	293	-0.09	0.932	
VAS++	Intercept	1.37	0.37		3.74	0.004	
body-belief ¹	Treatment	0.08	0.12		0.65	0.518	1.16
	Post-treatment	0.46	0.18		2.51	0.014	1.41
	3-months Follow-up	1.45	0.26		5.67	< 0.001	3.79
	Time within baseline	-0.13	0.03	70	-4.22	< 0.001	
	Time within treatment	0.09	0.04	86	2.06	0.043	
	Time within Post-treatment	-0.01	0.15	293	-0.04	0.972	
PTCI+	Intercept	179.42	5.82	13.37	30.81	< 0.001	
	Treatment	6.57	4.35	42.08	1.51	0.138	1.80
	Post-treatment	-8.13	6.15	15.98	-1.32	0.205	2.98
	3-months Follow-up	-15.35	7.08	18.88	-2.17	0.043	4.00
	Time within baseline	3.77	0.93	40.68	4.04	< 0.001	
	Time within treatment	-4.13	1.84	85.34	-2.24	0.028	
	Time within Post-treatment	-0.35	2.49	107.96	-0.14	0.887	
BMI+	Intercept	16.08	0.49	9.84	32.82	< 0.001	
	Treatment	0.95	0.23	125.25	4.20	< 0.001	-1.75
	Post-treatment	1.83	0.38	108.79	4.78	< 0.001	-2.52
	3-months Follow-up	2.34	0.42	104.87	5.52	< 0.001	-3.80

	Parameter	Beta	Std. error	df	t	P	Effect size Cohen's d
	Time within baseline	0.14	0.05	127.90	3.03	< 0.001	
	Time within treatment	0.24	0.08	122.70	3.05	0.003	
	Time within Post-treatment	-0.03	0.09	118.76	-0.32	0.752	
EDE-Q+	Intercept	4.51	0.40	10.74	11.41	< 0.001	
	Treatment	-0.07	0.20	11.78	-0.34	0.739	0.08
	Post-treatment	-0.14	0.28	4.83	-0.52	0.627	0.29
	3-months Follow-up	-0.75	0.31	6.35	-2.42	0.050	1.45
	Time within baseline	-0.03	0.05	17.81	-0.71	0.486	
	Time within treatment	-0.03	0.09	72.52	-0.32	0.752	
	Time within Post-treatment	-0.12	0.12	118.82	-0.97	0.333	
DERS+	Intercept	117.41	5.32	10.94	22.08	< 0.001	
	Treatment	0.27	2.56	33.71	0.11	0.917	0.77
	Post-treatment	-1.86	3.60	9.33	-0.52	0.617	0.97
	3-months Follow-up	-13.19	4.27	10.90	-3.09	0.010	2.41
	Time within baseline	0.96	0.53	27.62	1.81	0.081	
	Time within treatment	-1.13	1.12	87.76	-1.01	0.316	
	Time within Post-treatment	-0.82	1.57	111.70	-0.52	0.602	

¹Analyzed by mixed gamma regression with a loglink, after inverting raw scores by 101-raw score (in mm.). This implies that beta's are in transformed scale, and that positive time effects denote improvement.

+,++ Time-within-Condition: 0 for measurements outside the condition, centered time (with a week as unit) for measurements within condition (* e.g., -3, -2, -2, -1, 0, 1, 2, 3 for a 6 week condition; ** e.g., -3, -2.5, -2, -1.5, -1, -0.5, 0, 0.5, 1, 1.5, 2, 2.5, 3 for 2 weekly measures in a 6 week condition).

VAS negative emotions

In Fig. 4 the individual scores of the participants on VAS 1 to 4 (the negative emotions) are shown. If we look at this figure we see a slight increase in scores on the negative emotions during baseline, compared to the mean of the baseline score per participant, in 6 of 10 participants. The scores of three participants remained about the same, and in one participant the scores fluctuated slightly. During the treatment of 5 participants the negative emotions scores were higher than during baseline, for 2 participants the negative emotions scores remained about the same and for 3 participants the negative emotions scores decreased. During the post-treatment five participants remained approximately the same (higher scores compared to the mean of the baseline score per participant), one participant remained the same compared to the baseline score and four participants had a lower score compared to the baseline mean score per participant.

Mixed regression showed that during baseline (time-within-baseline phase) there was a significant increase of the negative emotions scores. During treatment (time-within-treatment) results showed a significant decrease of the negative emotions scores. No significant main effects of treatment and post-treatment on negative emotions were found (but note that these effects are estimated halfway the pertinent phase). A significant effect was found on negative emotions at 3-months follow-up compared to baseline. This represents a decrease in negative emotions with a very large effect size (Table 2) (Sawilowsky & Shlomo, 2009).

VAS self-beliefs and body-beliefs

Beside the total mean score VAS negative emotions, Fig. 5 shows the total mean scores of the participants on VAS self-beliefs (the negative idiosyncratic beliefs about the self) and VAS body-beliefs (the idiosyncratic belief about the body emotions). If we look at this figure we see an increase of the scores during baseline and a decrease of scores over the rest of the time.

Mixed regression analysis showed a significant increase of the dysfunctional self-belief scores during baseline, and a significant decrease of the dysfunctional self-belief scores during treatment. No significant main effects were found of treatment and post-treatment compared to baseline (but note that these effects are estimated halfway each phase). A significant decrease of dysfunctional self-belief scores compared to baseline was found at follow-up, with a very large effect size (see Table 2) (Sawilowsky & Shlomo, 2009).

Mixed regression analysis also showed a significant increase of dysfunctional body-beliefs scores during baseline (time-within-baseline). During treatment results showed a significant decrease of dysfunctional body-beliefs (time-within-treatment). Compared to baseline post-treatment and follow-up showed significant improvements in body-beliefs with a huge effect size (Table 2) (Sawilowsky & Shlomo, 2009).

PTCI

Mixed regression analysis showed no significant effect of IMRS on PTCL scores during treatment and post-treatment, compared to baseline scores. A significant effect was found compared to baseline at 3-months follow-up, effect size was very high (see Table 2). During baseline the PTCL scores increased significantly. During treatment the PTCL scores decreased significantly.

BMI

Mixed regression analysis showed significant effects of all phases on the BMI, compared to baseline, with very large effect sizes (see Table 2). The time-within-baseline and time-within-treatment scores also showed significantly increased levels of the Body Mass Index, while there was no significant change during the post-treatment phase.

EDE-Q

Mixed regression analysis showed no significant main effects of treatment and post-treatment on the EDE-Q. A significant effect was found compared to baseline at follow-up with high effect size (see Table 2). None of the time-within phase effects was significant. None of the participants showed an increase in ED symptomatology.

DERS

Mixed regression analysis showed no significant effects on the DERS scores, except for follow-up, with high effect size (see Table 2). This result showed a long-term decrease of DERS scores compared to baseline.

Serious Adverse Events.

One participant was diagnosed with a conversion disorder and indicated that she had psychotic symptoms during inclusion at the start of the study. These psychotic symptoms were directly related to the trauma to be treated, therefore the participant was not excluded from the study. During the IMRS these psychotic symptoms increased, so it was decided to start with an anti-psychotic. The conversion complaints worsened during the IMRS, but not to the extent that the IMRS had to be stopped. Loss of contact with one's own body during the IMRS sessions also emerged in two other participants. But these participants wanted to continue with the trauma-treatment. Thus, while some symptoms (temporarily) increased, no serious adverse events took place (i.e., events that necessitated hospitalization and/or were life threatening).

Feedback from participants

Two weeks after the IMRS all participants and therapists were asked about their experiences with IMRS by means of an interview. It was noticeable in the feedback from the therapists that they found IMRS a pleasant method to work with during the underweight phase.

Participating patients reported experiencing sufficient emotions and concentration to engage in IMRS. More detailed and in-depth information from these interviews will be described in a separate article.

Discussion

As far as we know, this is the first study that investigated if treating PTSD with IMRS in eating disorder patients is possible during underweight. We used a randomized multiple baseline case series design with 10 participants. Mixed regression analyses revealed that there was a significant effect on the follow-up measure compared to baseline on all outcomes. On the primary outcome measures we found a significant reduction of severity of the PTSD symptoms, on average emerging at post-treatment, as shown by the clear progress on the PSS-SR. Furthermore, a significant decrease emerged in negative emotions (anger, shame, guilt, disgust), personal negative beliefs about the self and the body as shown by the VAS scores at the follow-up measure. The secondary outcome measures showed a reduction of trauma-related thoughts and beliefs and a reduction of difficulties with emotion regulation. In addition, we found that the eating disorder symptoms also decreased as shown by the EDEQ while the levels of the Body Mass Index increased.

If we look at the pattern in the baseline period, we notice that the scores of the trauma related cognitions (measured by the PTCL) and the core emotional problems and core beliefs (measured by the VAS) worsened significantly. PTSD-symptoms (PSS-SR) and emotion regulation (DERS) also worsened during baseline, albeit not significantly. The EDEQ did not change significantly during baseline. If we look further at the pattern, we notice that the PSS-SR, the EDEQ and the DERS only improved during post-treatment/ at follow-up measurement, while the VAS scores and the PTCL already showed improvement during the IMRS. In sum, participants showed a pattern of deterioration on most outcomes during baseline, when the weight-gain program started, while slowly improving after IMRS started, with the earliest change achieved in core emotions and cognitions, after which in the long-term large changes were achieved.

Interpretation and Implications

These findings are clinically important. They show that in this challenging patient group PTSD symptoms can be reduced by IMRS but that it takes time. The finding that IMRS was effective is in line with a lot of treatment studies about the application of IMRS to different disorders (Arntz, 2012; Morina et al., 2017). However, usually IMRS has immediate effects, and the present finding that initial responses are weak might be specific for the patient population – although it would be realized that the worsening of problems during baseline stopped with the start of IMRS. Beside this, the present results indicate that there was enough emotional experience and cognitive functioning to do trauma-treatment in these uED-patients.

The pattern during the baseline period fits clinical experience that if BMI increases and/or eating disorder (ED)-patients start clinical treatment their trauma-related problems worsen and make recovery from the eating disorder more difficult. It is likely that the decrease in underweight and the reduced possibilities of

using eating disordered behaviors as distractor can explain why patients experience more negative emotions and are more aware of ED as well as non-ED cognitions.

The pattern that the PSS-SR, the EDE-Q and the DERS only improved during the follow-up measurement, while the mean VASs scores and the PTCL already showed improvement during the IMRS, says something about possible mechanisms of change. First we see change in the core emotions, core beliefs, and trauma-related cognitions, then we see change in the pathology of the eating disorder and the PTSD. The change in difficulty with emotion regulation comes afterwards. This is in agreement with the supposed mechanism of IMRS: change of meaning (i.e., affective and cognitive meanings) of trauma representation (Arntz, 2012). Our finding that also emotion regulation improves is in line with Raabe et al. (2021) who showed that IMRS also had an effect on emotion regulation. This gives rise to the hypothesis that changing meaning of traumatic experiences, in underweight patients, helps them later on to have less trouble regulating emotions.

Limitations of the present study

First, this study was a proof of concept study, in which we only analyzed completers. As a result, the data of two people were not included in the analysis, which can give a distorted picture of overall effectiveness.

Second, it is important to mention that no distinction was made in the inclusion criteria regarding single vs multiple/long lasting trauma. This might influence the effects because multiple/long lasting trauma is associated with many other psychological problems (Elklit et al., 2014). In the current study, one participant had two single trauma's and all the other participants had multiple/long lasting childhood trauma's.

Third, we did not make a difference in the number of sessions by the use of the Imagery Rescripting Eye Movement Desensitization and Reprocessing (IREM) 12 session protocol (Arntz, 2015). For some participants this was more than enough, while others indicated that 12 sessions was a good start but it would have been nice if a few more could have been added. This was especially pointed out by several patients with very long lasting multiple trauma.

Fourth, we specifically chose to use IMRS for the treatment of PTSD. We choose IMRS because it had a superior effect in diminishing complex trauma-related emotions compared to imaginal exposure in one study (Arntz et al., 2007). IMRS was considered better tolerable for patients than IE, resulting in a lower dropout rate (Raabe et al., 2015). Boterhoven de Haan et al. (2020) shows a low dropout rate for both EMDR and IMRS. The current study contributes to evidence for the effectiveness of the IMRS as an effective trauma-treatment. However, what trauma-treatment is especially effective and tolerable in this population of patients with uED and PTSD is an issue for further research.

Strengths of the present study

The first strength is the fact that the cases were highly complicated with severe eating disorders for which clinical treatment was required: Patients suffered serious underweight at the start of the study (mean BMI 15.6), and at start of the IMRS treatment the mean BMI was 16.8. The PTSD severity was high with an average baseline score of 45.6 on the CAPS (Boeschoten et al., 2015). There was one index trauma that involved death or threatened death, 4 involved actual or threatened serious injury and 5 involved actual or threatened sexual violence. Most of the trauma experience were in the category of sexual abuse (e.g., rape, incest), in the category non-sexual child abuse (physical abuse, emotional / psychological abuse), or in the category emotional neglect. Five participants used medication. The findings indicate that IMRS works for this very complicated group of patients, which makes it plausible that it will also work for less complex cases.

The second strength of this study is the randomization over multiple baseline lengths, which increases the certainty with which causal conclusions can be drawn: it is highly unlikely that the mere passage of time, or the repeated assessments, did cause the improvements, given the worsening of many complaints during baseline. A sample size of N = 10 seems very small compared to a RCT with much more participants. However, a randomized multiple baseline case series study can be a very powerful way to assess the effectiveness of a treatment and has high clinical validity because of its high resemblance to clinical practice (Onghena, 2005).

Recommendations

The present study was the first study to investigate treatment of PTSD with underweight patients. Because of the different opinions about the impossibility of treatment of trauma due to underweight, we performed a small proof of concept study, with a randomized multiple baseline case series design. This study clearly shows evidence for strong effects of IMRS in decreasing PTSD symptoms, when treating underweight patients, without observable negative effect on the eating disorder treatment. These results give rise to setting up an RCT to further substantiate the possibility and effectiveness of trauma processing early in treatment for this group of underweight eating disorder patients with comorbid PTSD. Another issue for further study is the investigation of the reasons for the initially slow rate of change. For instance, it could be investigated whether this is attributable to the underweight, or to specific characteristics of these patients that are independent of their weight.

An important issue for future RCTs is to test what the optimal phase in ED-treatment to do trauma processing is, and perhaps even more important, what the optimal phase is for whom. Although we found positive effects of trauma processing in the early phase of ED treatment in the current study, it is possible that trauma processing earlier or later in ED-treatment has even better effects.

Besides this, it is advisable to investigate whether the pattern of increased PTSD-symptoms and other problems during baseline recurs and to investigate the cause.

Conclusion

Summarizing, this study clearly shows that treating PTSD symptoms with IMRS at times of underweight is effective. IMRS during underweight showed to have a positive impact on the reduction of the PTSD symptoms and on the emotional experiences of anger, shame, guilt and disgust. Also negative cognitions about the world, about the self and body-views decreased, and difficulties with emotion regulation reduced. Importantly, we found that eating disorder pathology decreased at follow-up and BMI increased, which indicates that the IMRS treatment did not disturb the eating disorder treatment. There was no negative effect of trauma-treatment on the eating disorder pathology during the treatment. The large effects give hope for possibilities for a group of patients where trauma-treatment is not an standard option until now.

Abbreviations

AN Anorexia Nervosa

AR Autoregressive model

ARMA Autoregressive Moving Average Model

BMI Body Mass Index

CAPS Clinically Administered PTSD Scale

DERS Difficulties in Emotion Regulation Scale

DSM Diagnostic and Statistical Manual

EMDR Eye Movement Desensitization and Reprocessing

ED Eating Disorder

EDE-Q Eating Disorder Evaluation-Questionnaire

FED Feeding and Eating Disorder

FU Follow Up

ICC Intraclass Correlation Coefficient

IE Imaginal Exposure

IMRS Imagery Rescripting

IREM Imagery Rescripting Eye Movement Desensitization and Reprocessing

OSFED Other Specified Feeding and Eating Disorder

PTCI Post-Traumatic Cognitions Inventory

PSS-SR PTSD Scale-Self Report for DSM-5

PTSD Post Traumatic Stress Disorder

RCT Randomized Clinical Trial

SCID Structured Clinical Interview DSM

SD Standard Deviation

STAIR Skill Training in Affective Regulation

VAS Visual Analogue Scales

uED underweight Eating Disorders

Declarations

Ethics approval and consent to participate

Ethical approval was obtained from the Ethics Review Board from the University of Amsterdam (reference number 2016-CP-7111).

Consent for publication

Consent for publication is available from all participants

Availability of data and materials

Reasonable requests for data will be considered by the authors under the condition that the European Data Protective is guaranteed for these sensitive patient data, and an appropriate analytic plan is included.

Competing interests

A. Arntz occasionally provides training in Imagery Rescripting. The financial remuneration goes to the University of Amsterdam to support research. The authors have no conflict of interest to declare.

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Authors' contributions

MC was the initiator, organizer, and executor of the entire investigation. MC analyzed and interpreted the patient data and wrote the manuscript.

MV was an important contributor in setting up the research/ design of the research and writing the manuscript.

SHW analyzed and interpreted the patient data and has co-written to the section on statistical analysis.

AA had a substantial contribution of the design of the research, analyzed and interpreted the patient data and was a major contributor in writing the manuscript. AA. Substantively revised the manuscript.

All authors read and approved all substantially modified versions of the manuscript, the final manuscript and approved the submitted version. All authors have agreed both to be personally accountable for their own contributions and ensured that questions related to the accuracy or integrity of any part of the work, even ones in which they were not personally involved, are appropriately investigated, resolved, and the resolution documented in the literature.

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Authors' information (optional)

Not applicable

Footnotes

[1] As Zimmerman & Mattia (1999) indicate, some patient feel uncomfortable to share their trauma complaints at the start of treatment. They advise to keep on evaluating on trauma complaints during treatment.

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Figures

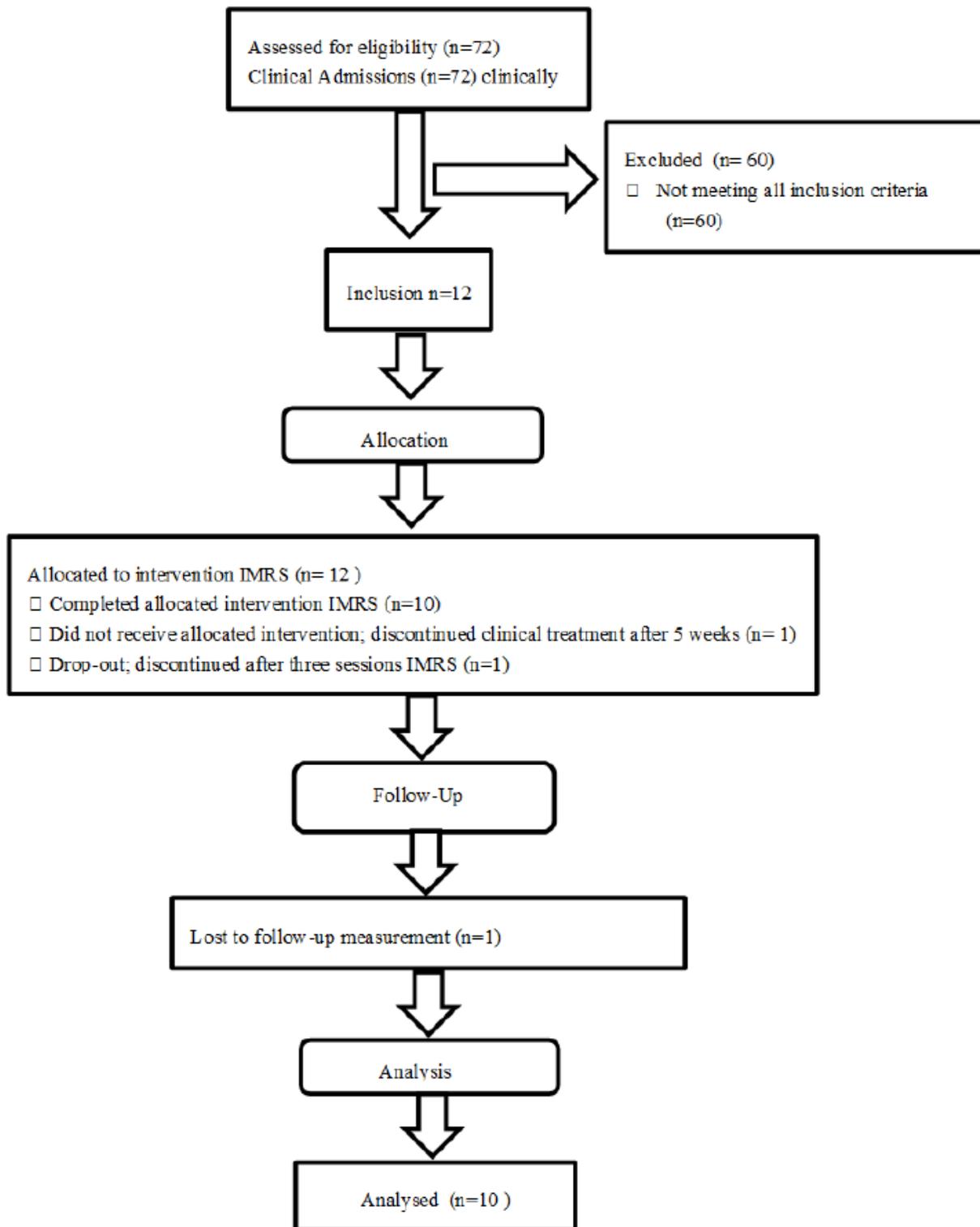


Figure 1

Consort flow diagram.

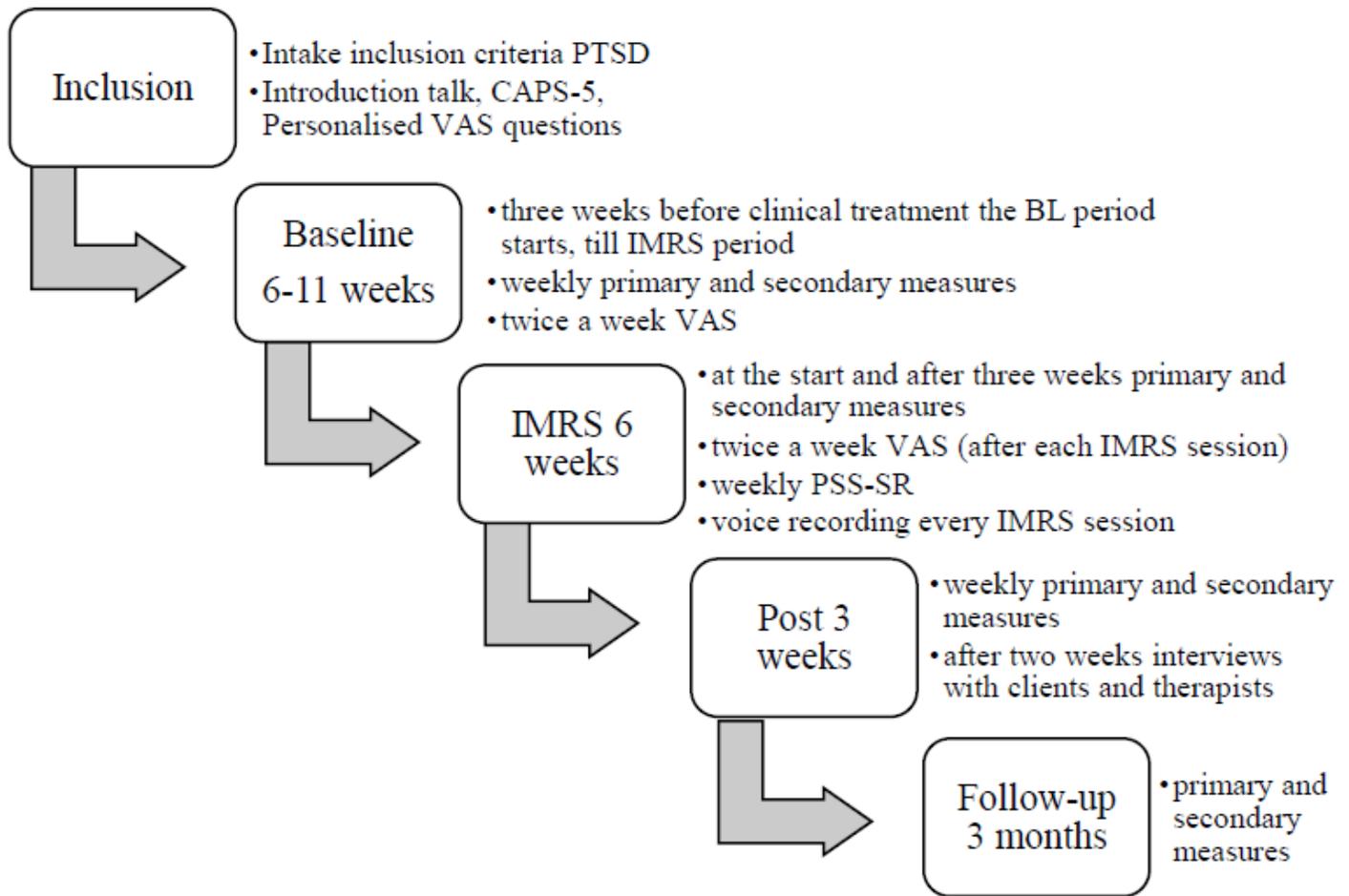


Figure 2

Overview of the design with the different baseline periods and measuring moments.

Individual PSS-SR scores over time

Condition

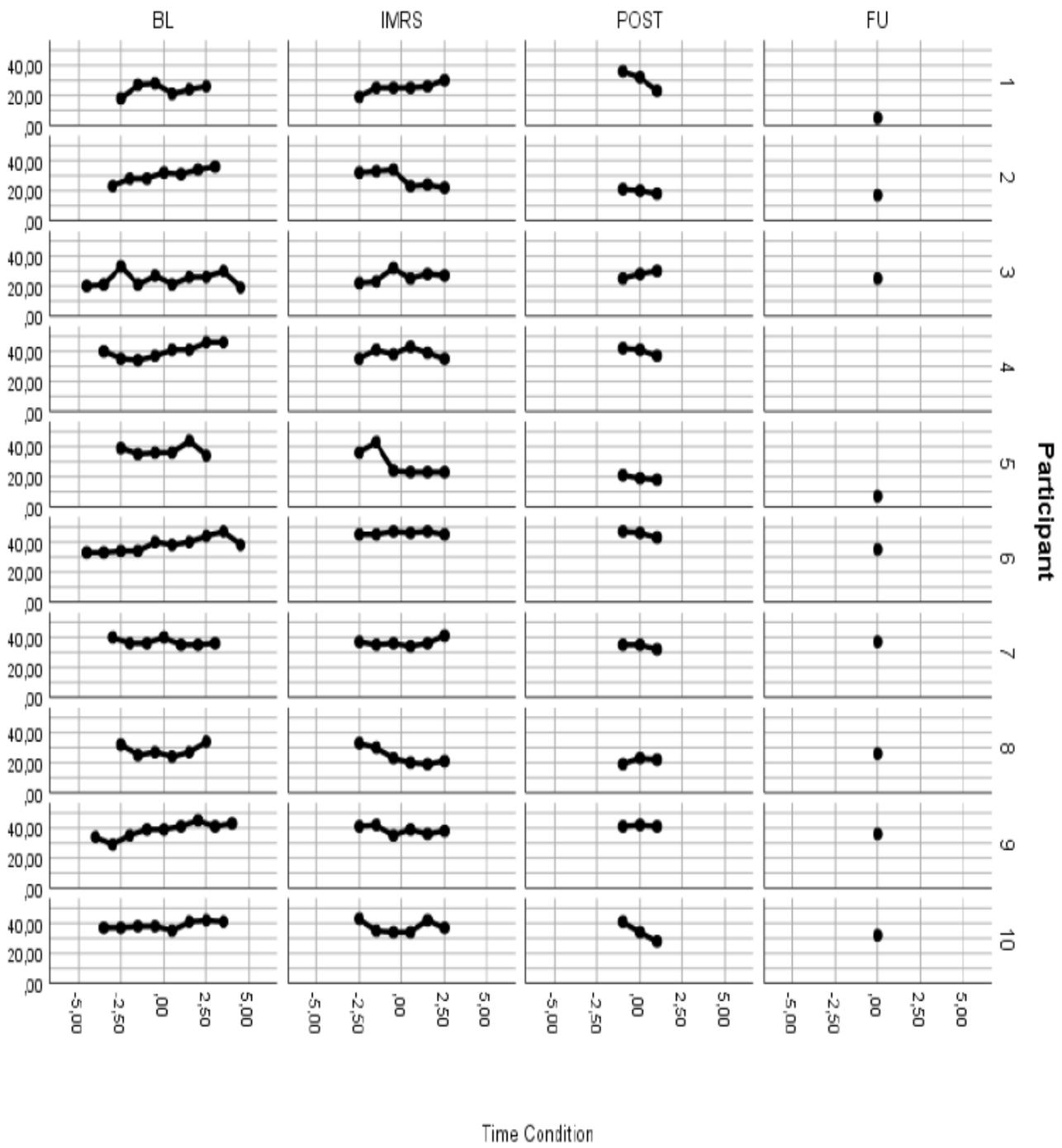


Figure 3

Individual PSS-SR scores over time.

Individuals VAS negative emotion scores

Condition

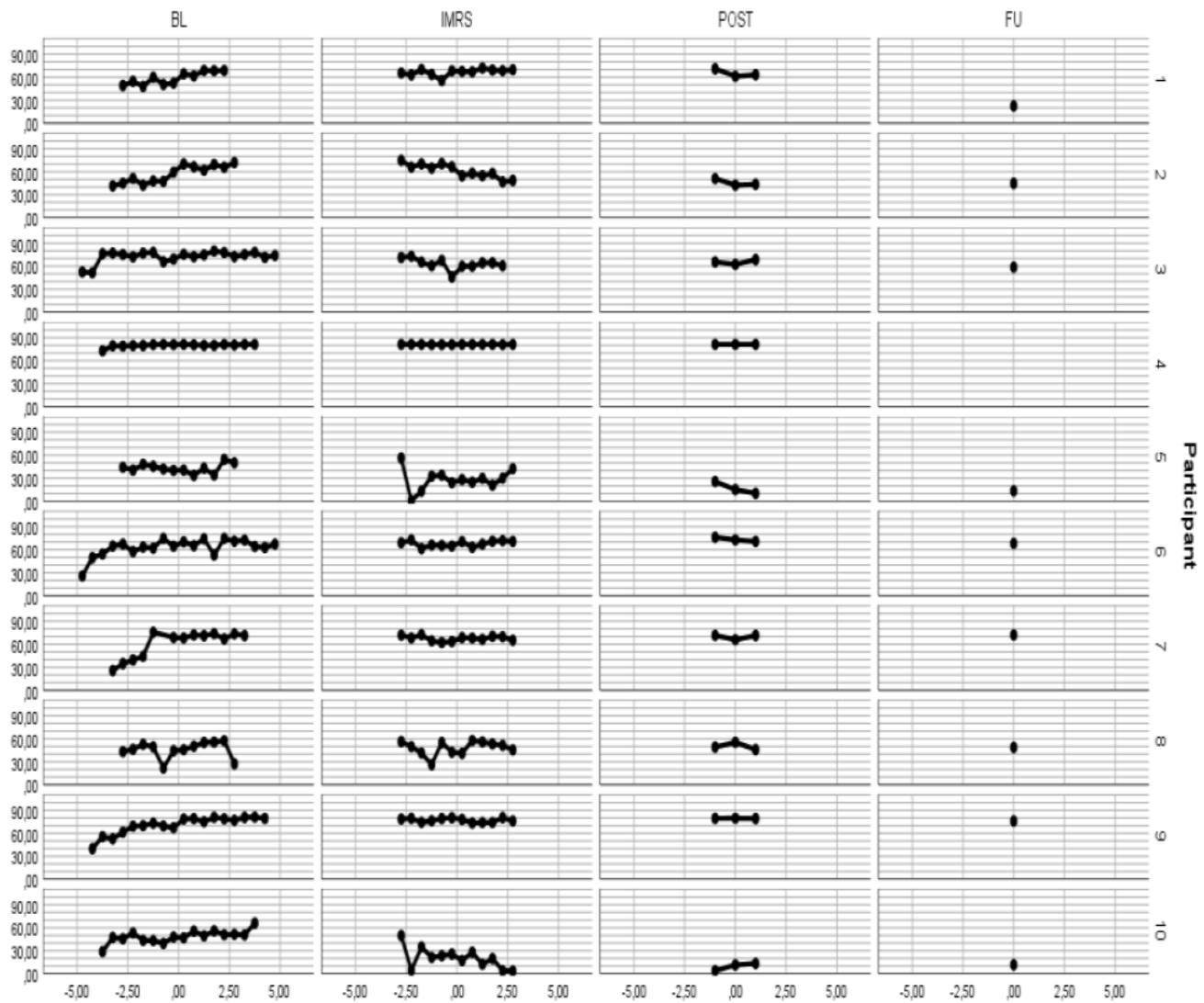


Figure 4

Individual VAS negative emotions scores over time.

Estimated VAS scores

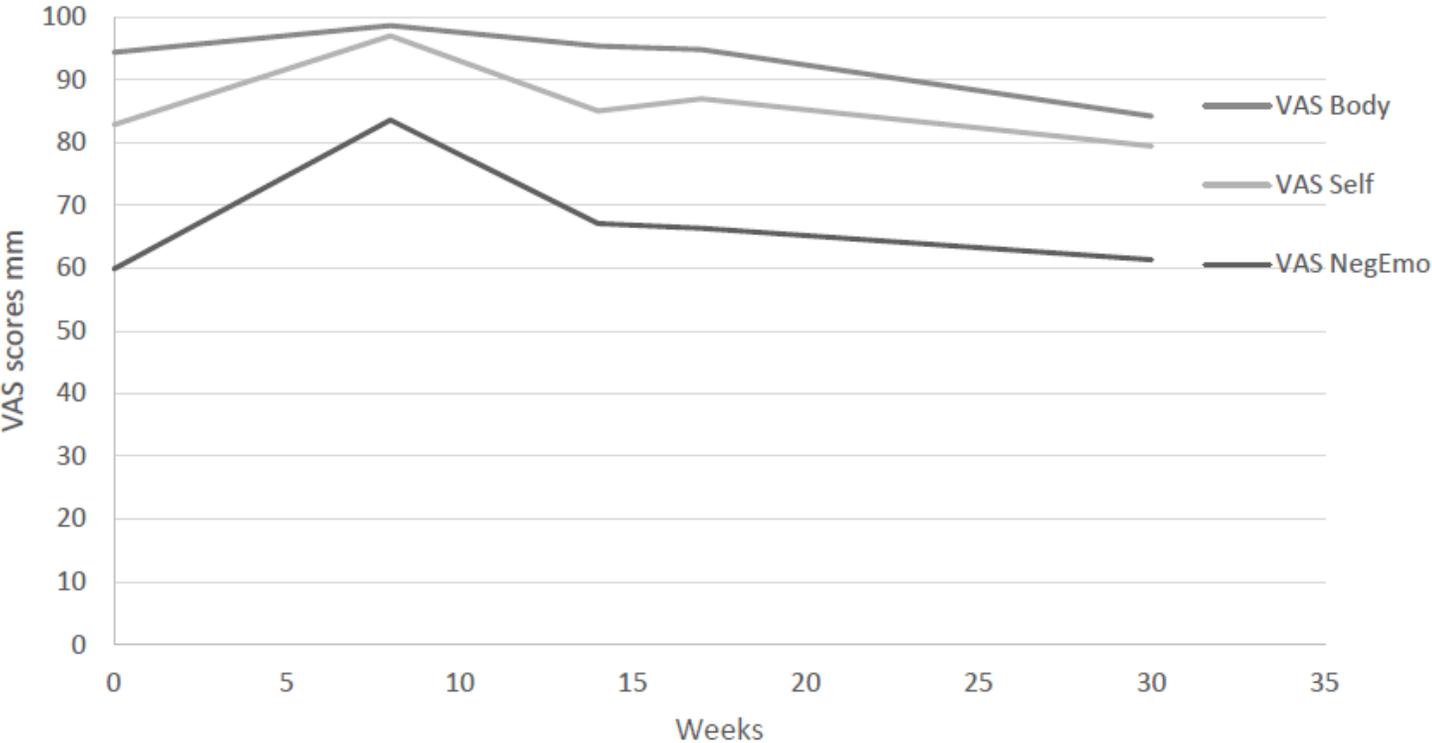


Figure 5

Means VAS negative emotions, self- beliefs, body-beliefs per condition. Baseline mean is set at 8 weeks. VAS Negative Emotion is analyzed with LMM. VAS Body and VAS Self were analyzed with GLMM, gamma distribution and transformed into the original scale.