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# Long term effectiveness of dialectical behavior therapy versus enhanced usual care for adolescents with self-harming and suicidal behavior

Lars Mehlum,[1] Ruth-Kari Ramleth,[1] Anita J. Tørmoen,[1] Egil Haga,[1] Lien M. Diep,[1] Barbara H. Stanley,[1,2] Alec L. Miller,[3] Bo Larsson,[4] Anne M. Sund,[4,5] and Berit Grøholt[1]
[1]National Centre for Suicide Research and Prevention, Institute of Clinical Medicine, University of Oslo, Oslo, Norway; [2]Department of Psychiatry, Columbia University, New York, NY; [3]Albert Einstein College of Medicine, Yeshiva University, New York, NY, USA; [4]Regional Centre for Child and Youth Mental Health and Child Welfare, Norwegian University of Science and Technology, Trondheim; [5]Department of Child and Adolescent Psychiatry, St. Olav's Hospital, Trondheim, Norway

Background: Knowledge is lacking on the long-term outcomes of treatment for adolescents with repetitive suicidal and self-harming behavior. Furthermore, the pathways through which treatment effects may operate are poorly understood. Our aims were to investigate enduring treatment effects of dialectical behavior therapy adapted for adolescents (DBT-A) compared to enhanced usual care (EUC) through a prospective 3-year follow-up and to analyze possible mediators of treatment effects. Methods: Interview and self-report data covering the follow-up interval were collected from 92% of the adolescents who participated in the original randomized trial. Trial registration number: NCT01593202 (www.ClinicalTrials.gov). Results: At the 3-year follow-up DBT-A remained superior to EUC in reducing the frequency of self-harm, whereas for suicidal ideation, hopelessness and depressive and borderline symptoms and global level of functioning there were no inter-group differences, with no sign of symptom relapse in either of the participant groups. A substantial proportion (70.8%) of the effect of DBT-A on self-harm frequency over the long-term was mediated through a reduction in participants' experience of hopelessness during the trial treatment phase. Receiving more than 3 months follow-up treatment after completion of the trial treatment was associated with further enhanced outcomes in patients who had received DBT-A. Conclusions: There were on average no between-group differences at the 3-year follow-up in clinical outcomes such as suicidal ideation, hopelessness, depressive and borderline symptoms. The significantly and consistently larger long-term reduction in self-harm behavior for adolescents having received DBT-A compared with enhanced usual care, however, suggests that DBT-A may be a favorable treatment alternative for adolescents with repetitive self-harming behavior.
Keywords: Self-harm; attempted suicide; psychotherapy; longitudinal.

## Introduction

Suicide attempts and non-suicidal self-harm are important public health problems increasing strongly in prevalence in middle and late adolescence (Nock et al., 2013). Both suicidal and non-suicidal self-harm in adolescence have been found to be robust risk factors for adult suicide attempts (Chesin et al., 2017; Copeland, Goldston, & Costello, 2017), and the majority of adolescents who die by suicide have a history of self-harming behavior the year before their death (Hawton, Houston, & Shepperd, 1999). Repetitive self-harm is, furthermore, associated with severe mental health and behavioral problems requiring emergency room visits and repeated hospitalizations (Finkelstein et al., 2015). Emergency interventions are, however, costly, and there is no evidence that they lead to reductions in suicidal and self-harming behaviors. There is, thus, a strong need to develop and make available affordable, specific and effective treatments for self-harming adolescents and their families. Over recent years the first few randomized control trials of interventions specifically designed for self-harming and suicidal adolescents have shown that this patient group may indeed be successfully treated. These interventions include adaptations for adolescents of mentalization-based therapy (MBT-A) (Rossouw & Fonagy, 2012) and dialectical behavior therapy (DBT-A) (Mehlum et al., 2014), replicated by McCauley et al. (2018), and two interventions based on cognitive behavioral approaches; the integrated cognitive-behavioral therapy (I-CBT) (Esposito-Smythers, Spirito, Kahler, Hunt, & Monti, 2011) and the Safe Alternatives for Teens and Youths (SAFETY) (Asarnow, Hughes, Babeva, & Sugar, 2017). In addition, a very brief, structured family intervention (RAP-P) was found to significantly reduce suicidality (conceptualized as including suicidal ideation, self-harm and suicide attempts) in adolescents both posttreatment and at 6 months follow-up (Pineda & Dadds, 2013). Despite these promising results, there is a need to replicate findings, and several additional questions are still unresolved. The long-term course and outcome after psychotherapy in adolescents is generally sparingly studied and with respect to treatment for self-harm behaviors in adolescents the

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long-term outcome is virtually unknown. Furthermore, while it is imperative to investigate novel interventions for their capacity to improve the health of children and adolescents, it is also important to clarify what mechanisms are involved in therapeutic change.

### *Mechanisms of change in self-harm specific treatments*

Very few studies to date have focused on potential mechanisms of change in the treatment of self-harm behaviors in adolescents. In their study of MBT-A Rossouw and Fonagy (2012) found that the effect on self-harm was mediated by a decrease in attachment avoidance and an increase in self-reported ability to mentalize. In the RAP-P study parent reported improvements in family-functioning fully mediated changes in adolescents' suicidality. Increased DBT skills use were found to mediate the decrease in suicide attempts in a study of adult women with borderline personality disorder receiving standard DBT (Neacsiu, Rizvi, & Linehan, 2010), a finding that received further support from a recent treatment component analysis highlighting the importance of skills training (Linehan et al., 2015). However, no studies of mechanisms of therapeutic change via DBT-A on self-harm behaviors in adolescents have so far been published. When searching for possible mechanisms of change in psychotherapy, it is regarded as important to adopt an empirical, generic and therapy-school independent approach (Kramer, 2018) when formulating hypothetical models. Hopelessness is one of the most robust and well-documented proximal risk factors for both completed suicide and non-fatal self-harming behaviors, and it has been found to be strongly associated with self-harm repetition in a range of clinical studies with teenagers (Asarnow et al., 2011; Witt et al., 2018). Hopelessness has been defined in cognitive skills terms as the 'lack of ability to produce pathways to achieve desired goals and to motivate oneself to use those pathways' (Rand & Cheavens, 2009). Hopelessness could also be viewed as a lack of ability to envision oneself successfully coping with problems and difficulties. DBT-A uses a range of therapeutic strategies to help patients gain stronger coping capacities. Specifically, DBT-A places a strong emphasis on helping patients to identify problem behaviors and factors triggering or maintaining these behaviors. Therapists teach their patients coping skills and coach them in how to use them in their daily life to reduce problem behaviors. DBT therapists also intentionally instill hope in their patients that they will indeed benefit from their new capacities and get a life worth living. We hypothesized that DBT-A would, thus, have a substantial potential for eliciting a stronger reduction in patients' hopelessness during the active treatment period, and that a long-term reduction in frequency of self-harm episodes would be mediated through such a reduction in hopelessness.

We have previously shown that a comparatively brief course of Dialectical Behavior Therapy adapted for adolescents (DBT-A) (Miller, Rathus, & Linehan, 2007) is superior to enhanced usual care (EUC) in reducing self-harming behavior, suicidal ideation and depressive symptoms (Mehlum et al., 2014, 2016), and that this treatment is cost-effective (Haga, Aas, Groholt, Tormoen, & Mehlum, 2018). In the present study, based on data from more than 90% of the originally included sample of adolescents, our aim was to investigate the long-term treatment effectiveness of DBT-A compared to EUC at follow-up 3 years post-randomization with respect to frequency of self-harm episodes, severity of suicidal ideation and depressive symptoms, frequency of subsequent emergency room visits, hospitalizations and use of additional treatments due to risk of self-harm behavior. Finally, we aimed to test the hypothesis that a reduction in hopelessness during the active treatment phase would serve as a mediator of long-term reductions in self-harm behavior, and, furthermore, explore whether other salient variables would have similar influence on the outcomes.

## Methods

### *Participants and procedures*

This was a 3-year follow up of the original sample of 77 adolescents who had participated in a randomized trial of DBT-A versus Enhanced Usual Care (EUC). The original study design, sample, procedures and outcomes have been described previously (Mehlum et al., 2014). Briefly summarized, participants were recruited from child and adolescent psychiatric outpatient clinics and had to have a history of repetitive and recent self-harm and at least two criteria of DSM-IV Borderline Personality Disorder in addition to fulfilling the self-destructive criterion. Patients who had bipolar disorder (except bipolar II) or a psychotic disorder, intellectual disability or Asperger syndrome were excluded. Self-harm was defined as self-poisoning or self-injury irrespective of intent (Hawton, Rodham, Evans, & Weatherall, 2002) including self-harm with suicidal intent, non-suicidal self-harm and self-harm episodes with unclear intent. Details of the original power analysis for this study and the assumptions made regarding effect size have been provided elsewhere (Mehlum et al., 2014), but, briefly, it suggested that, with repetition of self-harm over a 19-week observation period as the primary outcome and an $\alpha$ error level of .05, a sample of 80 participants would be required to provide 80% power with a 2-tailed test. Eighty participants were indeed recruited, but three of these turned out to have a diagnosis of psychotic disorder soon after treatment start and did therefore not fulfill inclusion criteria, resulting in a final sample of 77 participants. Participants were randomly assigned to receive 19 weeks of either DBT-A or EUC at one of the participating child and adolescent psychiatric outpatient clinics, and also received ancillary non-manualized pharmacotherapy as needed. Therapists provided only DBT-A or EUC. DBT-A followed the adaptation by Miller et al. (2007) by therapists having been trained in DBT-A for the purpose of the trial. EUC was standard care enhanced for the purpose of the trial by requiring that EUC therapists agree to provide on average no less than 1 weekly treatment session per patient throughout the trial. EUC was non-manualized and was either

psychodynamically oriented therapy or cognitive behavior therapy combined with psychopharmacological treatment as needed. EUC was delivered for 19 weeks, but patients in this trial arm could have their treatment extended beyond this brief trial treatment time window depending on the EUC therapists' assessment of their patients' needs. This was, however, not an option for DBT-A participants, who were not permitted to receive additional DBT-A, but who could be referred to additional non-DBT treatment depending on their therapists' assessment. All study therapists in both conditions received training in suicide risk assessment and management before patient treatment commenced and the study complied with NIMH recommendations (Pearson, Stanley, King, & Fisher, 2001) for intervention research with persons at high risk for suicidality. The study was approved by the Regional Committee for Medical Research Ethics, South-East Norway, and all patients and parents provided written informed consent at baseline and then again at the follow-up. Clinical Trial Identifier NCT01593202 (www.ClinicalTrials.gov).

Study participants were assessed at baseline (the time of randomization) and then again on multiple additional time points, for details see consort diagram in Figure 1. The post-treatment assessment, first follow-up and second follow-up assessments took place a mean of 0.6 years (*SD* = 0.1), 1.6 years (*SD* = 0.1) and 3.1 years (*SD* = 0.4) respectively after randomization.

Since data from the active treatment period and the first follow-up (Mehlum et al., 2014, 2016) have been published previously, only key data from assessments prior to the second follow-up at 3 years will be presented here. Assessments were both by interview and self-report. Interview assessments at the 3-year follow-up were made by independent interviewers (three child and adolescent psychiatrists and one psychiatrist), blind to treatment allocation. Integrity of blinding was achieved through using an unblinded study coordinator to make all the practical arrangements for follow-up interviews and collection of treatment data. As we have reported earlier, this procedure led to successful blinding results (Mehlum et al., 2016). Previously reported procedures for inter-rater reliability checking (IRR) of diagnoses and outcome variables demonstrated satisfactory interrater reliability coefficients (Mehlum et al., 2016).

## *Assessments*

At the 3-year follow-up we used the same measures of function and outcome as in the original study. The primary outcome; frequency of self-harm episodes over the third follow-up year,

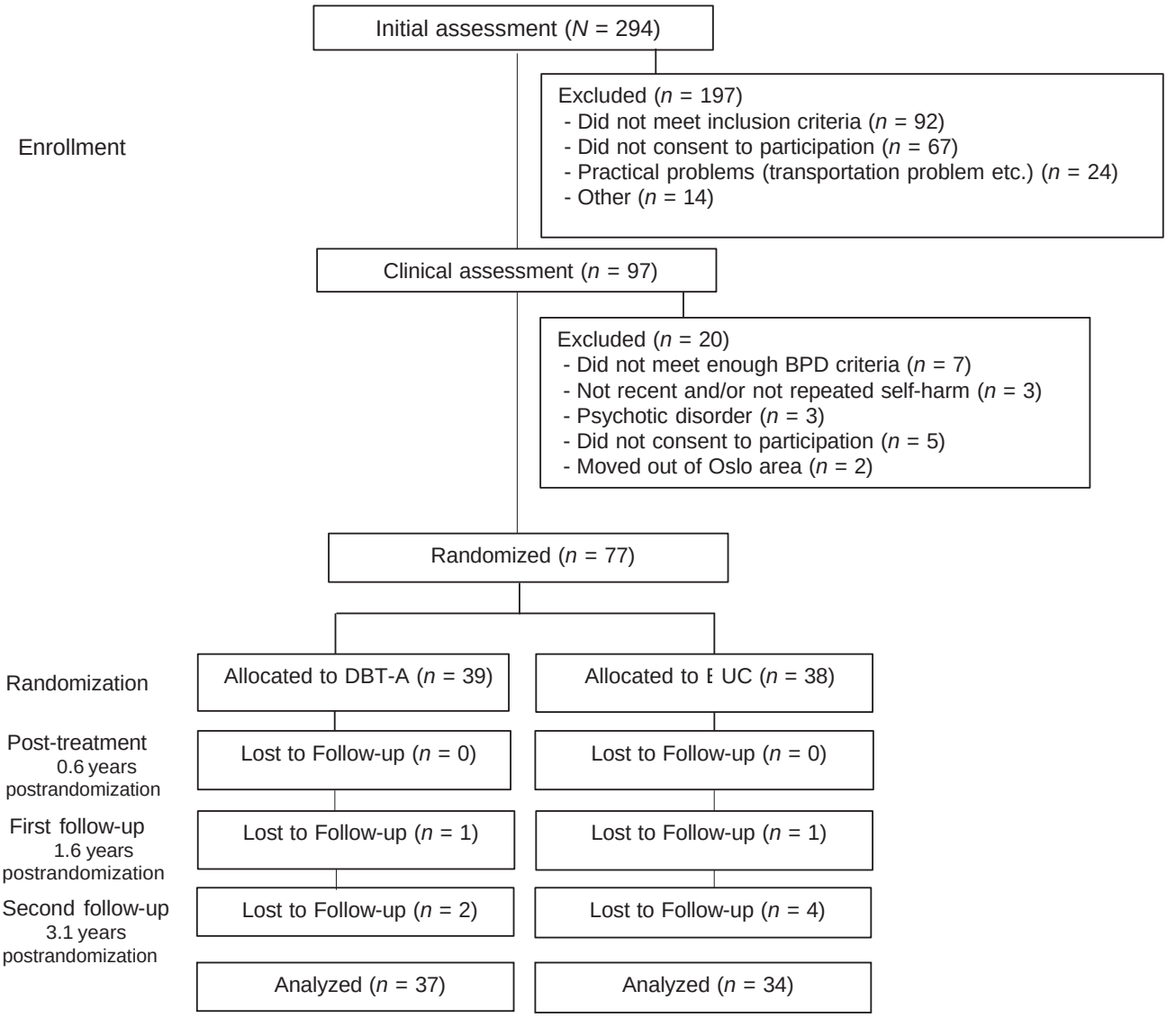


Figure 1 Flowchart (CONSORT) of subjects in long-term follow-up of RCT comparing dialectical behavior therapy adapted for adolescents (DBT-A) and enhanced usual care (EUC) for suicidal and self-harming behavior

was measured through the Lifetime Parasuicide Count (LPC) interview (Linehan & Comtois, 1996). Suicidal ideation was measured by the 15-item self-report Suicidal Ideation Questionnaire (SIQ-JR) (Reynolds & Mazza, 1999). The self-reported level of depressive symptoms was measured by the 13-item version of the Mood and Feelings Questionnaire (SMFQ) (Angold, Costello, & Messer, 1995) whereas interviewer-rated depression was measure by the 10-item MADRS (Montgomery & Asberg, 1979). Hopelessness was measured by the 20-item self-report Beck Hopelessness Scale (BHS) (Beck, Schuyler, & Herman, 1974), borderline symptoms were assessed through the 23-item self-report Borderline Symptom List (BSL) (Bohus et al., 2007) and global level of functioning measured by the children's global assessment scale (CGAS) (Shaffer et al., 1983). A self-report questionnaire was used to collect data from each participant on the use of psychiatric services, psychotropic medication, psychiatric hospitalization and emergency-department visits during the third follow-up year. As at previous data collection time points, participants received a small monetary compensation for their participation.

### *Statistical analysis*

Means and standard deviations or median and interquartile ranges were computed for normally and non-normally distributed variables. Differences between central tendencies in the groups were tested by independent-samples t-tests or Mann-Whitney U-tests and differences between the group proportions were tested by Pearson's chi-squared or Fishers exact tests. *p*-values on Table 2 for statistically nonsignificant results were not corrected for multiple comparisons. Estimation of the average effect of treatment in DBT-A and EUC group from post-treatment 0.6 years post-randomization to 3-years follow-up and testing for difference in the average effects between the groups were performed by using a random intercept and slope model to fit three data points per patient. In the model, patient identifier and time variable were specified as random intercept and slope variables. An exchangeable variance-covariance matrix was used for the random variables and assumed compound symmetry correlation structure for the data points per patient. Before fitting the random intercept and slope model, the time variable was centered. Zero-inflated negative binomial regression analyses were conducted to examine possible influences of randomization stratifying variables on the difference in number of self-harm episodes between the DBT-A and EUC groups over the long-term follow-up. Structural equation modeling (SEM) with maximum likelihood as parameter estimation method was used to analyze potential mediators of the association between treatment and number of self-harm episodes over the observation period. We used SEM with Full Information Maximum Likelihood (FIML) method to handle missing data

bootstrapping. Bias-corrected estimates with 95% confidence intervals based on 10,000 re-samples were given for the paths (Figure 4). Negative binomial regression was used to test interaction between trial treatment condition and amount of follow-up treatment received in the effect on the frequency of self-harm episodes over the long-term follow-up as the dependent variable. The advanced and descriptive analyses were performed with STATA/SE version 15 and IBM SPSS 25, respectively.

## Results

As in the original study, participation rate at the 3-year follow-up was very high. At this evaluation all of the original participants could be traced and there were no suicides. Altogether 71 out of the 77 adolescents agreed to assessments (37 in the DBT-A group and 34 in the EUC group) resulting in a 92% participation rate for the long-term follow-up phase. One participant completed self-report measures only and was hence included in only some of the analyses.

Detailed sample characteristics have been published elsewhere (Mehlum et al., 2014). At the 3-year follow-up participants had a mean age of 18.79 years (*SD* = 1.61) with no significant between group differences and, as in the original sample, 90% (*n* = 63) were females.

### *Suicidal and self-harming behaviors and suicidal ideation*

Figure 2 shows the mean frequency of self-harm episodes among participants in the two treatment conditions during the second follow-up period with the corresponding mean frequencies for the first follow-up period for comparison. Participants in the EUC condition reported a mean of 18.94 self-harm episodes (*SD* = 42.74) during the second follow-up period whereas participants in the DBT-A-group reported 6.32 (*SD* = 12.35). Given the strongly non-normal distribution of episodes of self-harming behavior in this study sample, median numbers, range and interquartile range (IQR) estimates were calculated. Whereas participants in the EUC group had a median number of self-harm episodes over the second follow-up period of 5.00 (range 0.00–226.00) with an IQR of 18.00, the corresponding figures for participants of the DBT-A group were a median of 1.00 self-harm episodes (range 0.00–65.00) with an IQR of 7.00 ($p < .001$ for comparison of ranges across groups). The original sample was randomized using gender, presence of depressive disorder at the time of randomization, and having had at least one suicide attempt within the last 4 months before randomization as stratification variables. Without adjustment for any of these variables receiving DBT-

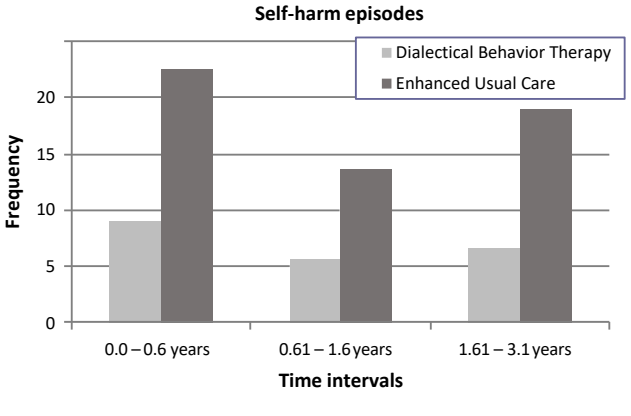


Figure 2 Frequency of self-harm episodes in adolescents receiving dialectical behavior therapy (DBT-A; *n* = 37) or enhanced usual care (EUC; *n* = 33) from randomization to a 3-year follow-up

A was associated with a 68% reduction in the mean number of self-harm episodes compared with the EUC group (95% CI = 0.13, 0.80, $p$ = .015). Adjusting for gender (IRR = 0.36, 95% CI = 0.15, 0.86, $p$ = .022) or suicide attempt last 4 months (IRR = 0.35, 95% CI = 0.13, 0.92, $p$ = .033) did not change this estimate significantly, whereas adjusting for all three stratification variables altered the estimate to a 54% reduction in the mean number of self-harm episodes (IRR = 0.46, 95% CI = 0.18, 1.19, $p$ = .108). The vast majority of self-harm episodes reported by participants over the follow-up intervals were non-suicidal self-injury. Two participants (5.3%) in the DBT-A group reported an average of one suicide attempt over the first follow-up interval and two participants (5.4%) reported an average of 1.5 suicide attempts over the second. The corresponding figures for the EUC group were zero suicide attempting participants in the first period and 6 (17.6%) suicide attempting participants in the second reporting an average of 1.7 attempts.

As we have reported previously both treatment groups had a pretreatment severity of suicidal ideation (SIQ-Jr) well above the clinical cut-off (usually regarded as 31) (Reynolds & Mazza, 1999), and at posttreatment participants having received DBT-A had achieved a significantly greater reduction in their level of suicidal ideation than participants having received EUC (Mehlum et al., 2014). At the first follow-up 1.6 year post-randomization participants in the EUC group had experienced a statistically significant drop in their suicidal ideation level whereas DBT-A participants on average were unchanged. At the second follow-up (Figure 3) no significant changes had occurred; both groups remained on average at the same lower level of suicidal ideation with no sign of relapse.

### *Other outcomes*

The same general pattern as for suicidal ideation was found for outcomes in participants' levels of

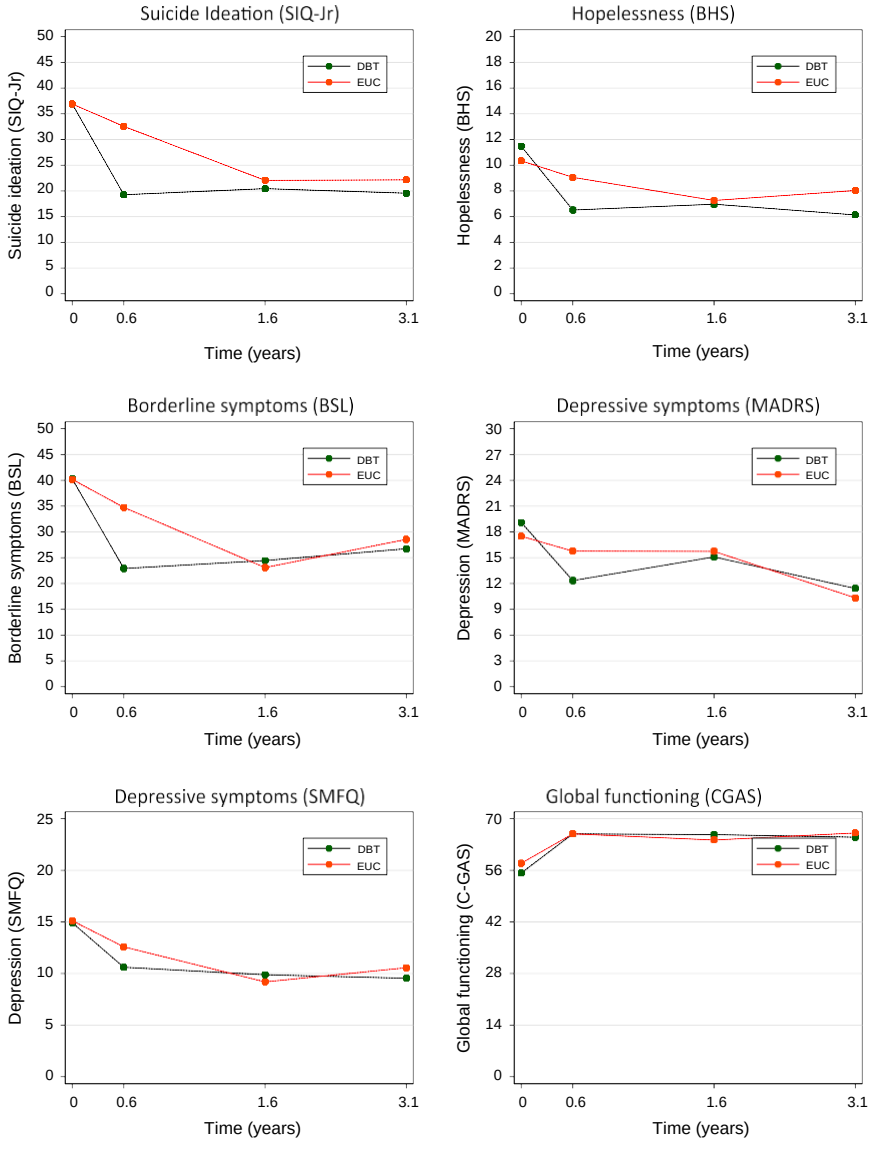


Figure 3 Long-term outcomes for dialectical behavior therapy (DBT-A; $n$ = 37) and enhanced usual care (EUC; $n$ = 34) for adolescents with repeated self-harm

depressive symptoms, hopelessness, borderline symptoms and the general level of functioning (CGAS) at the second follow-up 3 years post-randomization (Figure 3 and Table 1). Both groups remained on average at the same levels as at the first follow-up and there were no significant differences between treatment groups.

### *Participants' use of treatments during the second follow-up period*

In general, participants had made a very limited use of emergency services and psychiatric admissions over the the second follow-up period, as shown in Table 2. Six participants, 3 in each treatment condition, had been psychiatrically hospitalized and there were no inter-group differences in the number of emergency department visits. Slightly more than 50% of participants in both groups had been in psychiatric treatment at least a part of this second follow-up period (Table 2), with a statistically non-significant trend that participants in the DBT-A group had on average received fewer treatment sessions (7.33 vs. 13.35) and had been in psychiatric treatment a smaller proportion of the observation period (n.s.). Psychotropic medication had been used by 29.7% and 21.2% of participants in the DBT-A and EUC groups respectively over the second follow-up period (n.s.).

### *Mediators of the differential outcome in self-harming behavior*

Among the measured outcomes only frequency of self-harm episodes remained significantly different between the two treatment groups over the post-treatment long-term follow-up, and we aimed to identify factors through which this differential outcome could be mediated. Since our primary interest was to study potential mediators directly linked to the treatment, we chose to examine changes in salient symptom scores taking place during the trial treatment period. First, we tested the hypothesis that changes in the level of hopelessness during the trial treatment period would mediate the association between having received DBT-A and the lower frequency of self-harm episodes over the second follow-up period. As shown in Figure 4, having received DBT-A was associated with a significant reduction in the level of hopelessness (measured through the

Table 1 Long-term outcomes for 71 adolescents with borderline personality disorder traits and repeated self-harm having received dialectical behavior therapy (DBT-A; $n$ = 37) or enhanced usual care (EUC; $n$ = 34), by treatment group

| | Dialectical behavior therapy ($n$ = 37)[a] | | | | Enhanced usual care ($n$ = 34)[a] | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Variable | Mean | *SD* | *p*-value slope[b] | Effect size[c] | Mean | *SD* | *p*-value slope[b] | Effect size[c] | D slope[d] | *p*-value D slope[d] | *p*-value D mean[e] |
| Suicidal ideation (SIQ-Jr) | | | | | | | | | | | |
| 0.6 years | 19.42 | 12.15 | | | 31.96 | 23.49 | | | | | |
| 1.6 years | 20.45 | 19.15 | | | 22.05 | 21.86 | | | | | |
| 3.1 years | 19.64 | 18.54 | .941 | 0.05 | 23.15 | 18.12 | .021 | 1.98 | 0.099 | 0.111 | .430 |
| Hopelessness (BHS) | | | | | | | | | | | |
| 0.6 years | 6.74 | 5.50 | | | 9.07 | 6.35 | | | | | |
| 1.6 years | 7.01 | 5.31 | | | 7.44 | 6.27 | | | | | |
| 3.1 years | 6.16 | 5.24 | .743 | 0.43 | 8.10 | 5.76 | .443 | 0.67 | 0.006 | 0.762 | .154 |
| Depression (SMFQ) | | | | | | | | | | | |
| 0.6 years | 10.45 | 5.40 | | | 12.50 | 6.62 | | | | | |
| 1.6 years | 9.78 | 5.42 | | | 9.19 | 6.57 | | | | | |
| 3.1 years | 9.54 | 5.32 | .453 | 0.64 | 10.56 | 6.28 | .110 | 1.33 | 0.011 | 0.556 | .471 |
| Depression (MADRS) | | | | | | | | | | | |
| 0.6 years | 11.90 | 7.24 | | | 15.15 | 8.50 | | | | | |
| 1.6 years | 15.21 | 7.82 | | | 14.58 | 9.03 | | | | | |
| 3.1 years | 11.69 | 7.22 | .621 | 0.12 | 10.33 | 7.03 | .004 | 2.57 | 0.044 | 0.089 | .429 |
| Borderline symptoms (BSL) | | | | | | | | | | | |
| 0.6 years | 23.16 | 16.81 | | | 33.53 | 21.90 | | | | | |
| 1.6 years | 24.45 | 19.17 | | | 25.77 | 21.56 | | | | | |
| 3.1 years | 26.48 | 21.80 | .497 | 0.73 | 28.81 | 20.62 | .167 | 1.04 | 0.099 | 0.143 | .650 |
| Global functioning (CGAS) | | | | | | | | | | | |
| 0.6 years | 65.88 | 9.52 | | | 65.89 | 13.03 | | | | | |
| 1.6 years | 65.68 | 11.81 | | | 64.22 | 14.13 | | | | | |
| 3.1 years | 64.97 | 11.75 | .709 | 0.35 | 66.12 | 11.19 | .931 | 0.10 | -0.012 | 0.747 | .678 |

[a]Due to missing observations $n$ is slightly lower in some cells.
[b]*p*-values for estimates of change in outcomes over follow-up intervals in each of the trial arms.
[c]Effect size calculated as pooled standard deviations using the formula: √(SD12/n1) + (SD22/n2) at 0.6 years. All effect sizes are given as positive values.
[d]Estimates of and *p*-values for difference in slope (per week) from 0.6 years to 3.1 years.
[e]*p*-values for between trial arms differences in mean values at 3.1 years follow-up.

Table 2 Treatment use last year before long-term follow-up for 71 adolescents with borderline personality disorder traits and repeated self-harm having received dialectical behavior therapy (DBT-A; $n$ = 37) or enhanced usual care (EUC; $n$ = 34), by treatment group

| | Dialectical behavior therapy ($n$ = 37) | | | | | Enhanced usual care ($n$ = 34) | | | | | $p$-value |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Variable | Mean | *SD* | Median | IQR | %[a] | Mean | *SD* | Median | IQR | %[a] | |
| Number of treatment sessions with psychiatrist or psychologist | 7.33 | 12.08 | 0.00 | 10.00 | 44.4 | 13.35 | 20.51 | 0.00 | 22.50 | 42.3 | .644[b] |
| Number of emergency department visits | | | | | | | | | | | |
| Full sample | 0.48 | 1.42 | 0.00 | 0.00 | 18.2 | 0.38 | 1.04 | 0.00 | 0.00 | 17.2 | .954[c] |
| Patients with emergency department visits only | 2.67 | 2.42 | 1.50 | 3.75 | – | 2.17 | 1.60 | 1.50 | 2.50 | – | .937[c] |
| Number of psychiatric admissions | 0.24 | 0.82 | 0.00 | 0.00 | 8.8 | 0.35 | 1.32 | 0.00 | 0.00 | 8.8 | 1.000[d] |
| Number of days in psychiatric hospital | 9.26 | 30.43 | 0.00 | 0.00 | – | 18.53 | 80.31 | 0.00 | 0.00 | – | 1.000[d] |
| Number of months in psychiatric treatment[e] | | | | | | | | | | | |
| No treatment | | | | | 44.10 | | | | | 48.40 | .076[c] |
| 0–3 months | | | | | 20.60 | | | | | 6.50 | |
| 4–6 months | | | | | 14.70 | | | | | 3.20 | |
| 7–9 months | | | | | 0.00 | | | | | 0.00 | |
| 12 months | | | | | 20.60 | | | | | 41.90 | |

[a]Proportion of participants having received any of the relevant treatments.
[b]Mann-Whitney U test.
[c]Pearson's chi-squared test.
[d]Fisher's Exact test.
[e]Proportional distribution.

BHS) from baseline to trial treatment completion 0.6 years post-randomization. A reduction in hopelessness over the trial treatment period was, furthermore, associated with a significantly reduced frequency of self-harm episodes during the second follow-up period. When changes in BHS-score (DBHS) were entered into the path model (Figure 4), the direct effect (c') of DBT-A on the frequency of self-harm episodes was no longer significant, indicating a significant mediation effect of DBHS in accordance with the Baron and Kenny criteria (Baron & Kenny, 1986). The estimated mediation effect was -0.17 per week in trial treatment, suggesting that 70.8% of the total effect of DBT-A on self-harm frequency passed through DBHS as a mediator. A similar mediation analysis using frequency of self-harm episodes during the first follow-up period posttreatment as a dependent variable produced a weaker and only borderline significant mediation effect (data not shown). In addition to testing our hypothesis that a reduction in hopelessness during the trial treatment period would mediate the effect of DBT-A in reducing self-harm frequency over the second follow-up period we explored whether changes in depressive symptoms (SMFQ) or borderline symptoms (BSL) during the trial treatment period could have similar mediating effects on the primary outcome measure over the second follow-up period, but no such effects were found.

We also explored the duration of follow-up treatment received and the number of treatment sessions over the first follow-up period posttreatment for their potential roles as mediators of the association between treatment condition and the frequency of self-harm episodes in the second follow-up period. No such effects were found. However, there was a significant interaction between trial treatment condition and amount of follow-up treatment received over the first follow-up interval after the active trial treatment period in the effect on the frequency of

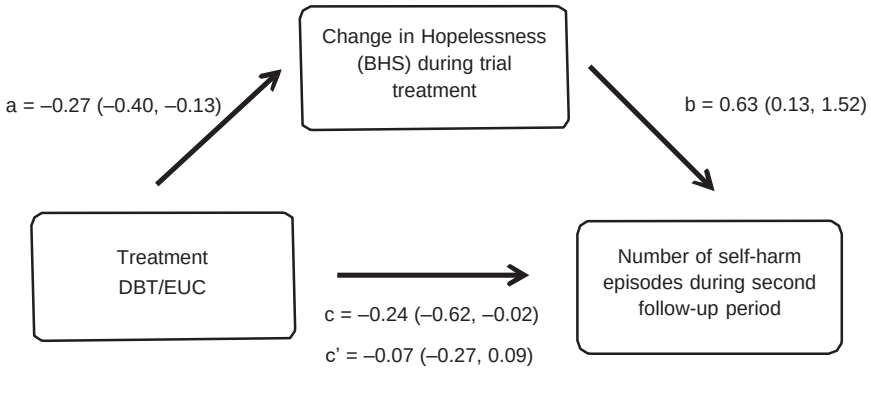


Figure 4 Path diagram of mediation model of the effect of DBT-A on long-term frequency of self-harm episodes through reduction in hopelessness during treatment period in adolescents having received DBT-A or EUC. Structural Equation Modeling was used to estimate the bias-corrected bootstrapped mediated effect per week with 95% bootstrapped confidence intervals

self-harm episodes over the second follow-up interval as the dependent variable. The risk ratio for the interaction term was 0.18 ($p$ = .001) using receipt of <3 months of follow-up treatment as reference. Twenty-six participants received more than 3 months of follow-up treatment during the first follow-up period (12 in the DBT-A group and 14 in the EUC group), whereas the remaining participants received 3 months or less of follow-up treatment. Among study participants who had received more than 3 months follow-up treatment during the first follow-up period, members of the DBT-A group reported 84% fewer self-harm episodes ($p$ < .001) over the second follow-up period compared to members of the EUC-group.

## Discussion

The main findings in this 3-year post-randomization follow-up of self-harming adolescents with borderline traits having received either DBT-A or EUC were that, on average, participants in both groups had retained treatment gains with no sign of relapse and no significant between-group differences for most outcomes. The major exception to this pattern was the frequency of self-harm episodes where a substantially lower posttreatment level reported by participants in the DBT-A group was on average retained at 3-year post-randomization follow-up. We found evidence in support of our hypothesis that a substantial proportion of the effect of DBT-A on self-harm over the long-term would be mediated by a reduction in participants' experience of hopelessness during the trial treatment. We also found that receiving more than 3 months follow-up treatment the first year after completion of the trial treatment was associated with further enhanced outcomes in patients who had received DBT-A.

### *Long-term outcome*

The long-term course and prognosis in clinical samples of adolescents engaging in self-harming behaviors have so far been very sparingly studied. General population studies have, however, shown that adolescents who self-harm face a high risk of subsequent suicide (Finkelstein et al., 2015) but also a wide range of psychosocial problems (Borschmann et al., 2017) in their later adult life. Our findings suggest that usual care may indeed improve the long-term prognosis on a broad range of outcomes in multi-problem adolescents with borderline traits and repetitive self-harm behavior, but that treatment methods containing self-harm specific therapeutic strategies, such as in DBT-A, is probably required to achieve sufficient reductions in self-harm behaviors. The time difference in treatment response between the two treatments, with a more rapid recovery in DBT-A, is also of considerable clinical significance (Kratochvil et al., 2006). While our study is the first to demonstrate long-term beneficial effects of a self-harm specific treatment in adolescents, our findings are consistent with previously published post-treatment follow-up studies of DBT in adults (Linehan et al., 2002, 2006; McMain, Guimond, Streiner, Cardish, & Links, 2012). It should be noted that the average participant in both treatment conditions in our study remained in the 'some problems' range (a score between 61 and 70) on the CGAS, and that some participants even in the DBT-A condition retained their self-harm behavior. There is a possibility that 19 weeks of treatment is too short for some self-harming adolescents, and that extending the treatment period could be beneficial. There is some support for this in our finding that, for participants in the DBT-A group, to receive additional treatment after completion of the experimental brief treatment was associated with further enhanced outcomes. There is also the possibility that certain elements of DBT-A, such as skills training, should be even more strongly emphasized to achieve even stronger reductions in self-harm behaviors. However, more research on mechanisms of change and studies of what are the most active treatment components are needed to inform such possible modifications of the contents and duration of the treatment.

### *Hopelessness*

Our study did not include any data that could explain exactly how or why a reduction in the levels of hopelessness during the trial treatment period would mediate the long-term reduction in self-harm behaviors following DBT-A. However, repetitive suicidal and non-suicidal self-harm behaviors are often linked to difficulties of regulating emotions, and both these types of behavior may be viewed as escape strategies, in the meaning 'escape from intolerable emotional pain'. The strong, although short-lived, relief from emotional pain achieved through self-harm, may for many adolescents with problems of regulating emotions become indispensable. Furthermore, they have often low expectations from and trust in treatment, and their clinicians often find it hard to convince them of the strong need to stop self-harming and start using other coping strategies. A pronounced experience of hopelessness may serve as an important obstacle for adolescents to their willingness or ability to give up self-harming and try alternative ways of regulating emotions. DBT-A includes several interventions to address and to treat hopelessness, for example the use of cognitive strategies such as psychoeducation helping adolescents link problem-behaviors to their goals, and the use of commitment strategies and helping patients clarifying the pros and cons of choices they make about their treatment and future life. Furthermore, DBT-A emphasizes the fostering of dialectical thinking, helping patients change their often extremely polarized perceptions of self and

others. A strong emphasis is also put on building a life worth living and increasing reasons to live. These are some of the treatment strategies which may be associated with DBT-A patients' differentially stronger reduction in hopelessness during the treatment and the following stronger reduction in self-harm behaviors. Therapeutic interventions aiming to reduce self-harm in adolescents should not underestimate the need to work on hopelessness and other cognitive or emotional factors that may stand in the way of needed change.

### *Limitations and strengths*

This study had several limitations. First, although the study was adequately powered, the sample size was relatively small and findings should be interpreted with caution. The vast majority of self-harm episodes reported by participants in our study was non-suicidal self-injury, thus, our data did not allow for analyses of suicidal and non-suicidal behaviors as separate outcomes. The control condition, EUC, was not a manualized treatment and EUC-therapists were not monitored for fidelity as was the case with DBT-A therapists. As in most trials of self-harm, the patient sample was mostly female, and the sample was too small to study gender differences in treatment outcomes. Our analyses did not account for possible therapist effects. However, since altogether 38 therapists delivered the treatments in this trial, the likelihood that the characteristics or performance of single therapists could have significantly affected results is regarded as small. Some of our mediation analyses were exploratory and not hypothesis driven and will need confirmation. Finally, our analysis of follow-up treatment dosage as a post-randomization effect modifier should be interpreted with caution since such variables might be affected by differences in participants' selection of follow-up treatment and the interventions offered.

Among study strengths are the prospective and long-term follow-up design, the use of rigorous procedures for data collection, the high integrity of ratings and blinding and independence of raters and the very high participation rate even at 3-years follow-up. Our use of liberal inclusion criteria and that the study was conducted in a community mental health care setting covering all socioeconomic classes with patients recruited from a defined catchment area further strengthens the external validity of the findings.

## Conclusions

With these limitations in mind, our results show that DBT-A was associated with a consistently larger long-term reduction in self-harm behavior in adolescents compared with enhanced usual care. Additional treatment following the brief experimental treatment phase enhanced, furthermore, recovery rates with respect to self-harm behavior in adolescents who had received DBT-A. A reduction in the level of hopelessness during the active treatment phase was a significant mediator of the long-term reduction in self-harm behavior after DBT-A. These findings suggest that DBT-A may be a favorable treatment alternative for adolescents with repetitive self-harming behavior.

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## Correspondence

Lars Mehlum, National Centre for Suicide Research and Prevention, Institute of Clinical Medicine, University of Oslo, Sognsvannsveien 21, Building 12, N-0372 Oslo, Norway; Email: lars.mehlum@medisin.uio.no

## Key points

- DBT-A is an effective treatment for self-harming adolescents with traits of borderline personality disorder leading to a persistently stronger long-term reduction in the frequency of self-harm behavior than enhanced usual care.
- Receiving more than 3 months follow-up treatment after the experimental treatment was associated with further enhanced outcomes in patients who had received DBT-A.
- A substantial proportion of the long-term effect of DBT-A on self-harm frequency passed through a reduction in the level of hopelessness during the active treatment.
- These findings show that DBT-A leads to long term sustainable recovery rates for severely impaired adolescents with repetitive self-harming behaviors.
- Clinicians providing DBT-A and similar relatively brief treatments for adolescents should consider offering add-on treatments to increase long-term recovery rates.

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