

## Meta-Analysis of Dialectical Behavior Therapy (DBT) for Treating Substance Use

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### Abstract

Dialectical Behavior Therapy (DBT) is an evidence-based treatment approach used to treat a variety of psychological issues. In this meta-analysis study, we examined six between-groups studies based on DBT for the reduction of substance use symptoms. We aggregated the findings of these studies at the post-treatment assessment as well as follow-up assessment. DBT groups were superior to alternative treatment and waitlist groups in the remission of substance use symptoms or increase in substance use abstinence. When we compared DBT to comparison groups at the follow-up assessment scores, we observed no significant differences. However, when we removed one study conducted outside of the United States (U.S.) run the analysis with U.S. samples only ( $j = 5$ ), we obtained significant differences between DBT and comparison groups (treatment and waitlist groups). Our findings suggest that DBT is an effective approach in the treatment of substance-related issues, as evidenced by post-treatment assessment and follow-up assessment. We provided implications for clinicians, counselors, researchers, as well as institutions and organizations.

### Key Words

Dialectical behavior therapy • DBT • Meta-analysis • Substance use disorders • SUD

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Borderline personality disorder (BPD) and substance use disorders (SUDs) are two psychological problems often diagnosed in the same person, and these comorbidity rates are high (Linehan, Schmidt, Dimeff, Craft, Kanter, & Comtois, 1999; Owens, Nason, & Yeater, 2018; Trull, Sher, Minks-Brown, Durbin, & Burr, 2000). Personality disorders are long-term patterns of internal experiences and pattern of behavior that are significantly different from what is expected. BPD is a type of personality disorder that involves a pattern of instability in personal relationships, a lack of impulse control, poor self-image, and intense emotions. Clinical features of BPD include recurrent suicidal behaviors, inability to regulate emotions, and inappropriate expression of anger and aggression (American Psychiatric Association, 2013). SUDs are a cluster of behavioral, cognitive, and physiological symptoms that indicate an individual's continued use despite substance use related problems. In addition, an important characteristic of individuals with a SUD is the change in brain function which may last longer than the detoxification period and these effects may contribute to repeated relapse (American Psychiatric Association, 2013). One factor common to BPD and SUD is the difficulty to cope with negative emotions and an increased intolerance of such distress (Hall et al., 2018). Therefore, there is a need to investigate interventions tailored to treat co-occurring BPD and SUD (Hall et al., 2018) and Dialectical Behavior Therapy (DBT) is one evidence-based intervention that can meet this pressing need.

### **Overview of DBT**

Dialectical Behavior Therapy (DBT) is an evidence-based, transdiagnostic modular treatment originally developed to treat individuals with suicidal behavior and symptoms of BPD. Treatment includes a combination of individual therapy, skills training, phone coaching, and the therapist engages in consultation with other DBT therapists (Karaman, 2019; Linehan, 2015). The modules are divided into acceptance skills (mindfulness and distress tolerance) and change skills (emotion regulation and interpersonal effectiveness), and the modules are taught in a way that reflects the dialectic of accepting while acknowledging the need for change (Linehan, 2015; Linehan & Wilks, 2015). DBT has four modules which include mindfulness, interpersonal effectiveness, emotion regulation, and distress tolerance. Within the acceptance and change skills there are specific goals for each module. Mindfulness skills are core to DBT and usually the first skills taught as these skills provide foundation for the other modules. Mindfulness, as used in DBT, is drawn from Zen practices and used to help others cultivate nonjudgmental attention to the present moment. The distress tolerance skills progress naturally from mindfulness skills and include learning how to accept oneself and current situation in a nonjudgmental way. Regulating painful emotions are essential skills which are hard to teach, however, in the emotion regulation module, individuals learn how to name and identify emotions in the context of self-validation. Finally, within the interpersonal effectiveness module individuals learn strategies for how to say no, how to manage interpersonal conflicts, and how to ask for what one needs in a skillful way (Linehan, 2015).

The dialectics – synthesis or integration of opposites (acceptance and change), are part of the underlying philosophy of DBT, with particular emphases on three assumptions that reality is: interrelated, oppositional or heterogeneous, and endlessly changing (Swales & Heard, 2009). Within DBT, the two major characteristics are a problem-solving behavioral focus that is combined with acceptance-based strategies while emphasizing a dialectical

approach (Linehan et al., 2002). Linehan (1993) stated that emotion dysregulation, in those diagnosed with DBT, was a result of a biologically based emotional vulnerability combined with insufficient regulation ability. In the biosocial theory of BPD, Linehan explains the process where individuals with emotion dysregulation are exposed to invalidating environments and can quickly become very emotional in response to triggers, however they are slow to regulate (Linehan, 2020; Swales & Heard, 2009).

Given Linehan's (1993) conceptualization of BPD as a disorder of emotion regulation and Trull and colleagues' (2000) suggestion that substance misuse is a maladaptive strategy used for emotion regulation, these negative impacts can affect one's cognitive and behavioral functioning in a way that jeopardizes the quality of their interpersonal connections. Given the comorbidity rates of BPD and SUD, individuals with these co-occurring disorders may use substances as a way to cope with social rejection, relational tensions, and intense emotional states more than individuals with a SUD diagnosis alone (Hall et al., 2018; Kruegelbach et al., 1993).

### **DBT as a Treatment for BPD and SUDs**

Given the alarming rate of comorbidity between BPD and SUDs, and the documented effectiveness of DBT, it is recommended that DBT be incorporated into SUD treatment protocols (Bornovalova & Daughters, 2007). DBT is the first integrated treatment developed to treat concurrent BPD and SUD and the treatment manual has progressed through research and clinical practice (McMain et al., 2007). Linehan and colleagues (1999) adapted the standard DBT protocol for use with SUD clients and noted a significant reduction in SUD among participants assigned to the DBT group as compared with those assigned to a treatment as usual group. Specific interventions added to DBT for concurrent BPD and SUD include three main categories to address issues in attachment to treatment, dealing with urges and cravings, and self-management strategies for consequences of substance use (McMain et al., 2007). The structure of DBT makes it an appropriate treatment for addressing the needs of individuals with a SUD and a diagnosis of BPD, and DBT may also be useful for retaining SUD clients in treatment (Bornovalova & Daughters, 2007). Taken together, there is evidence to support continued research to address the research gap on DBT for individuals with comorbid BPD and SUD (Hall et al., 2018; Owens et al., 2018).

### **Rationale and Purpose of the Study**

Despite the promising results reported by researchers, few studies examined the efficacy of DBT with SUD. These studies were conducted with smaller groups; thus, more vigorous studies are required to determine whether DBT is effective with SUD. To date, we were able to identify one meta-analysis study (Giannelli, Gold, Beileninik, Ghetti, & Gelo, 2019) comparing DBT to 12-step substance abuse programs for the treatment of SUD. This study included 3 primary studies, one of which did not compare DBT to the comparison group (Courbasson, Nishikawa, & Dixon, 2011) as the remaining participants in the comparison group was insufficient to run an analysis. Therefore, inclusion of the aforementioned article was an unfit for Giannelli et al.'s (2019) meta-analysis study.

Therefore, we believed that a more comprehensive meta-analysis on the aggregated effectiveness of DBT with SUD was warranted. To this end, the purpose of the current study is to examine all experimental or quasi-

experimental studies comparing DBT to an alternative treatment or a control/waitlist group for the reduction of symptoms of SUD. Specifically, we sought answers to the following research questions in this study:

1. To what degree is DBT effective in reducing the symptoms of SUDs or increasing substance abstinence when compared to alternative treatments or no treatment (i.e., control group or waitlist) at post-treatment measurement?
2. To what degree is DBT effective in reducing the symptoms of SUDs or increasing substance abstinence when compared to alternative treatments or no treatment (i.e., control group or waitlist) at follow-up measurement?

### **Method**

We undertook a meta-analysis to identify between-group studies in the published and unpublished literature comparing efficacy of DBT to alternative treatments or control group in increasing substance abstinence across treatment settings (e.g., community, university) and various client groups. We did not use a time window to narrow down the studies as limited studies were available based on the topic under investigation. We conducted a comprehensive literature review, identified the studies meeting the inclusion criteria, then coded them into a Microsoft Excel sheet, transferred the necessary data into Comprehensive Meta-Analysis, version 3, to execute data analysis.

#### **Inclusion and Exclusion Criteria**

Since modern meta-analytic endeavors frequently eliminate investigations with no comparison group (Higgins & Green, 2011), we filtered through articles for inclusion in this meta-analysis study using the following criteria: (a) studies using DBT and a comparison group (treatment vs alternative treatment or waitlist or control group) in reduction of substance use or increase of substance abstinence; (b) studies that were published in English, with no country-of-origin or time frame restrictions; (d) articles published in peer-reviewed journals, conference papers, dissertations, or theses; (e) articles conducted between-group analysis, such as studies used randomized controlled trial (i.e., true experimental studies) or quasi-experimental design; (f) studies reported sufficient data to compute mean differences or other data allowing computation of mean gain effect-size. Studies not meeting the criteria above or reporting only within-group results were excluded.

#### **Search Strategies**

Our search strategy was fourfold. We searched (a) electronic databases, (b) pre-identified journals, (c) literature review of studies already published related to DBT and substance abuse, and (d) Google Scholar. Our database specific search included Academic Search Complete, Google Scholar, Marqcat plus, ProQuest Dissertation and Theses, and PsycINFO. We searched the following specific journals due to their historical reputation for publishing outcome research related to substance use or DBT: Behavior Therapy; Journal of Counseling and Development; Counseling Outcome Research and Evaluation; Journal of Consulting and Clinical Psychology; Cognitive and Behavior Practice; Journal of Cognitive Psychotherapy; The Counseling Psychologist; Psychological Trauma: Theory, Research, Practice, and Policy; Journal of Aggression, Maltreatment, and Trauma; Journal of Substance Abuse Treatment; Alcoholism Treatment Quarterly; Journal of Substance Use; Journal of Addictions and Offender

Counseling; Substance Use; Substance Use and Misuse; Addiction. For both database and journal-specific searches, the keywords Dialectical Behavior Therapy or Dialectical Behavioral Therapy or DBT were entered in the first available search box and substance or drug or alcohol or medication in the second search box. Article searches were carried out by the principle investigator (PI) and a research assistant.

### **Data Coding Procedures**

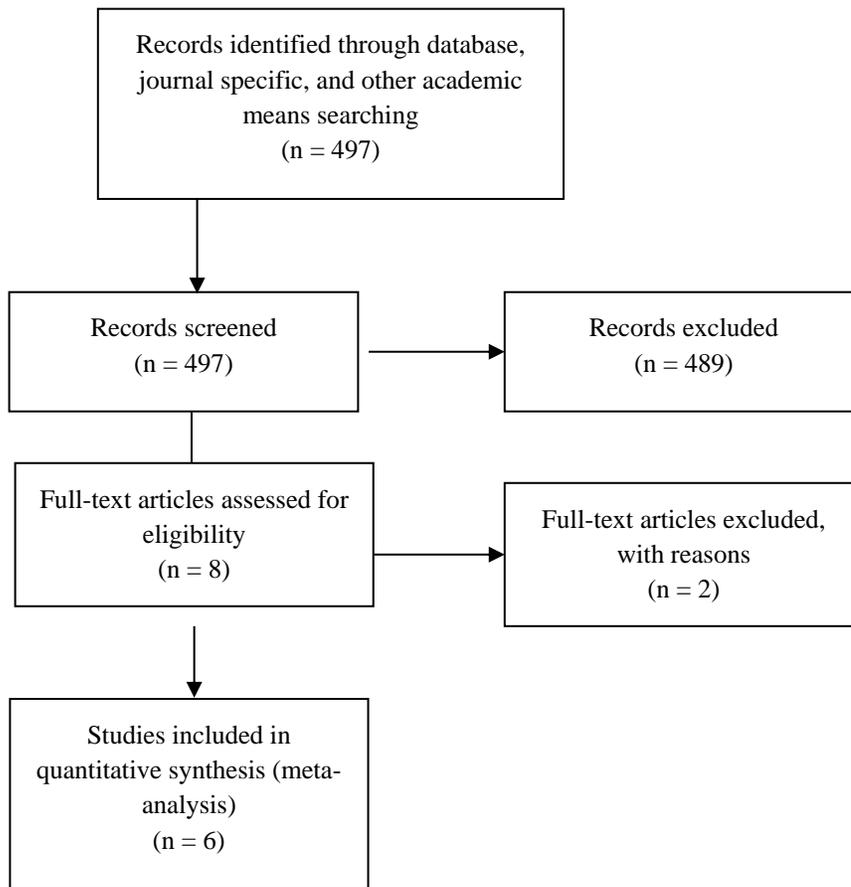
We used a Microsoft Excel spreadsheet to transfer useful data from articles. To achieve this, we followed [Cooper, Hedges, and Valentine's \(2009\)](#) recommendations. Initial coding was completed by the PI. Next the PI double checked the studies and compare with the coded data in the Microsoft Excel sheet. The PI observed two errors and corrected the discrepancies.

### **Statistical Methods**

To analyze data, we used Comprehensive Meta-Analysis, Version 3.3.070. Due to small sample size and variation of sample sizes among studies, we computed the Hedge's  $g$  as the standardized mean difference index. When available, we used the mean, standard deviation, sample size for treatment and comparison group. When mean and standard deviation results were not provided, we used t-test or F-test (when a covariate was taken into consideration) results with sample size, or p value with sample sizes provided. In computing treatment effects, we assumed a common variance and selected random-effects model as this method is more suitable when researcher believe that studies are different and groups are independent of each other ([Lipsey & Wilson, 2001](#)).

### **Results**

Utilizing the search criteria outlined in the methods section, the PI identified 497 candidate articles, of which 489 were eliminated upon application of the inclusion and exclusion criteria, details of which can be seen in Figure 1. After further examination, one study was removed since the remaining sample size for the treatment as usual group was insufficient and the analysis was carried out “only on the DBT group from baseline to post-treatment (12 months), along with 3 and 6 month follow-up” ([Courbasson et al., 2012, p. 441](#)). Additionally, though one study met the inclusion criteria, it was published in a conference report format ([Abdelkarim, Molokhia, Randy, & Ivanoff, 2017](#)). This quasi-experimental study compared effectiveness of DBT against treatment as usual (TAU) with an Egyptian population and reported that participants in the DBT group showed significantly lower drug use compared to the TAU group. However, no statistical data was available on the conference report. Since no author email address was provided, the PI searched the affiliated university to find the principal author's email address, however, could not locate the author on the university websites since the author appeared to be an adjunct professor. The PI sent a message to the principle author through a social networking site for researchers and scientists, yet no reply has been received. Thus, this particular study could not be included in this meta-analysis. The process of article selection was conducted by a research assistant and the author, with an agreement rate of 100%.

Figure 1. *Depiction of Searched, Yielded, and Retained Studies*

### Study Characteristics

The final sample composed of six studies ( $j = 6$ ;  $k = 11$ ) examining Dialectical Behavioral Therapy (DBT) with substance abuse or drug or alcohol dependency and included a total of 278 participants, where  $j$  represents the number of studies included and  $k$  represents the number of comparisons. All of the studies used a randomized clinical trial to assign participants to either a waitlist ( $j = 1$ ;  $k = 2$ ) or an alternative treatment ( $j = 5$ ;  $k = 9$ ). Alternative treatments contained community treatment by experts (Harned et al., 2008), treatment as usual (Linehan et al., 1999; van den Bosch et al., 2002), comprehensive validation therapy plus 12-step (CVT+12S; Linehan et al., 2002), health promotion (Nyamathi et al., 2017). The average number of sessions provided was 38 weeks ranging from 8 to 52 weeks. Four studies reported post test scores/results comparing DBT to alternative or waitlist ( $j = 4$ ;  $k = 4$ ) while five studies ( $j = 5$ ;  $k = 7$ ) reported follow-up comparison results. Study characteristics of these six studies are provided in Table 1.

### Participant Characteristics

Five studies were carried out in community inpatient settings ( $n = 219$ ) while one study implemented an online intervention ( $n = 59$ ; Wilks et al., 2018). Participants recruited in the primary studies were predominantly women ( $n = 237$ , 85.25%) with a BPD diagnosis and recently suicidal ( $n = 17$ , Harned et al., 2008), BPD and drug use disorder ( $n = 24$ , Linehan et al., 2002;  $n = 18$ , Linehan et al., 1999), recently incarcerated homeless women ( $n = 116$ , Nyamathi et al., 2017), BPD and substance abuse ( $n = 44$ , van den Bosch et al., 2002), and suicidal as well as heavy episodic drinking problem ( $n = 59$ , Wilks, Lung, Ang, Metsumiya, Yin, & Linehan, 2018). The average age of all participants was 35.03 ranging from 29.30 to 38.85 years. Since researchers usually reported the ethnic composition of the participants at the baseline, it was difficult to find the ethnic composition of the participants who completed the study. The average baseline ethnic composition was 51.80% Caucasian, 24.10% African American, 19.06% Latino, .72% Asian, .72% mixed, and 3.60% others, see Table 1.

### Risk of Bias within Studies

Though all the studies constituting this meta-analysis used a randomized clinical trial, they had limited sample size in the post treatment phase, ranging between 17 and 116. This affects statistical power and may negatively impact generalizability of findings. Additionally, due to the nature of DBT, individuals assigned to DBT treatment received not only group session but also individual session, as needed. This may be an advantage for the DBT group that the alternative treatments did not have. Another potential bias is that five out of six

**Table 1**

*Descriptive Statistics for Characteristics of Studies Contributing Mean Effect Sizes*

Characteristic	<i>M</i>	<i>SD</i>	Range	# of Studies	<i>N</i>	% Total Sample
Method Characteristics						
Publication year	2007.67	8.16	1999-2018			
Conducted in the U.S. (1 = yes)	.83	.41	0-1	5		
Average sample size	46.33	37.90	17-116			
Treatment setting						
Community-based				5		
Online				1		
Comparison Type						
Alternative Treatment				5	219	78.78
Waitlist				1	59	21.22
Participant sample characteristics						
Age (years)	35.03	3.76	29.30-38.85			
Women					237	85.25
Men					41	14.75
Ethnic composition						
*White/Caucasian					100	35.97
*African American					67	24.10
*Latina/o American					53	19.06

Dutch		44	15.83
*Other		10	3.60
*Asian American		2	.72
*Mixed		2	.72
Other sample description			
Recently incarcerated homeless women	1	116	41.73
BPD	3	86	30.93
Suicidal and heavy drinking episodes	1	59	21.22
BPD and recently suicidal	1	17	6.12

*Note:*  $N = 278$ ; Six articles were included in the analysis.

primary studies included were conducted in the U.S. while one study was carried out in the Netherlands. Consequently, findings may not be generalizable to other nations.

### **Outcome Characteristics**

All studies included in this meta-analysis examined substance use or abstinence as measured by urine analysis, self-assessment, or clinician assessment. When possible, we utilized the data from urine analysis, as this is the most objective method among all three. Due to limited number of studies available on the topic investigation and insufficient data reported in the primary studies, no secondary outcome was examined.

### **Effectiveness of DBT vs Comparison Group on Substance Use**

Since only one primary study used waitlist as the comparison group, the PI did not carry out a mediator analysis comparing control group and alternative treatment. Additionally, alternative treatments varied across the studies, thus no specific analysis was conducted to ascertain the differences across treatment groups.

### ***DBT vs Comparison Group at Post-Treatment***

The analysis was based on four studies ( $N = 118$ ;  $j = 4$ ;  $k = 4$ ) that evaluated the effect of DBT treatment on substance (e.g., alcohol, drug, substance) abstinence. Each study used a randomized clinical trial and compared DBT treatment to an alternative treatment ( $j = 3$ ) or a waitlist ( $j = 1$ ). The analysis revealed that DBT groups were statistically significantly better than comparison groups in increasing substance abstinence including drugs, alcohol, and medications, standard differences in mean value of .66 (95% CI [.27, 1.04]),  $p = .001$ . Lipsey and Wilson (2001) proposed that a Cohen's  $d$  value of below .30 is small effect size, a value of .50 is medium effect size, and effect sizes larger than .67 are large effect size. The effect size in this study was considered medium to large effect size. In other words, participants receiving DBT tended to report higher abstinence from substances about .65 standard deviation unit than did those in the waitlist or alternative treatment. These studies were done based on samples from a universe of studies outlined in the methods section. For the present study, the confidence interval for differences in means is 1.04 to .27, from higher end to the lower end. This confidence interval suggests that the mean raw difference in the universe of studies comparing DBT treatment to other comparison groups in increasing substance abstinence could fall anywhere in this range. Since this range is not inclusive of a difference of zero ( $\mu_1 \neq \mu_2$ ), it can be inferred that the true mean difference is probably not zero. Additionally, the  $Z$ -value associated with the null

hypothesis ( $\mu_1 = \mu_2$  or  $\mu_1 - \mu_2 = 0$ ) is 3.31,  $p = .001$ . Subsequently, the null hypothesis suggesting that there is no difference between DBT treatment and other comparison treatments in increasing substance abstinence is rejected.

### ***Heterogeneity of Post-Treatment Results***

The observed effect size in post-treatment results slightly varies across studies, yet a certain amount of variation can be attributed to sampling error. To test whether the observed effect size variation can be attributed to sampling error,  $Q$ -statistic was examined, of which null hypothesis suggest that all primary studies included in the meta-analysis share a common effect size. When the null hypothesis is correct, the  $Q$ -statistic value would be equal to the degrees of freedom ( $df = j-1$ ). The  $Q$ -statistic value obtained in the current study was  $Q(3) = .87$ . Therefore, there is no evidence that the true effect size varies across studies. Furthermore, the  $I^2$  statistic, which quantifies the extent to which the proportion of the observed variance reflects differences in true effect sizes rather than sampling error. The  $I^2$  value obtained in this study was .000.

### ***Publication Bias in the Post-Treatment Studies***

In general, studies demonstrating a significant difference are more likely to get published. Consequently, primary studies that are published are more likely to be included in meta-analysis studies (Borenstein Hedges, Higgins, & Rothstein, 2009). This creates a publication bias in meta-analysis. To mitigate the possibility of publication bias, we conducted the article search through google scholar and grey literature (i.e., theses and dissertations) in addition to database and journal search indicated in the methods section. Then we inspected the CMA for funnel plots. The standard errors were distributed asymmetrically. Given that only four studies were included and that the interpretation of funnel plot is subjective, we run Rosenthal's *Fail-safe N*, which assesses the degree to which the observed overall effect is robust. According to this test, eight studies with no effect would bring the  $p$  value to a non-significant point, which is double the studies included in this analysis. Finally, we examined the Trim and Fill approach of Duval and Tweedie using the random effects model. This analysis suggested imputed two values to the left of mean effect size, where studies lacked. This analysis decreased the effect size from .66 to .54 and 95% CI to .21 and .87 range. The  $Q$  value was still below the degrees of freedom ( $df$ ) value. Considering that the  $Q$  value was still below the  $df$  value and that the effect size was still in favor of DBT treatment and at the medium level, the researcher deemed publication bias not to be a significant concern for this analysis.

### ***DBT vs Comparison Group at Follow-up Assessment***

The follow-up assessment analysis was based upon five studies ( $N = 245$ ;  $j = 5$ ;  $k = 7$ ) that evaluated the effect of DBT treatment on substance (e.g., alcohol, drug, substance) abstinence at follow-up assessment. Each study used a randomized clinical trial and compared DBT treatment to an alternative treatment ( $j = 6$ ) or a waitlist ( $j = 1$ ). The analysis revealed no significant differences between DBT groups and comparison groups in increasing substance abstinence including drugs, alcohol, and medications, standard differences in mean value of .34 (95% CI [-.02, .71]),  $p = .06$ . Lipsey and Wilson (2001) proposed that a Cohen's  $d$  value of below .30 is small effect size, a value of .50 is medium effect size, and effect sizes larger than .67 are large effect size. We obtained a small effect size in this study.

In other words, participants receiving DBT tended to report higher abstinence from substances about .34 standard deviation unit than did those in the waitlist or alternative treatment, which was not significant.

### ***Heterogeneity of Follow-up Assessment Results***

The observed effect size in post-treatment results considerably varies across studies. To test whether the observed effect size variation can be attributed to sampling error,  $Q$ -statistic was examined, of which null hypothesis suggest that all primary studies included in the meta-analysis share a common effect size. When the null hypothesis is correct, the  $Q$ -statistic value would be equal to the or larger than the degrees of freedom ( $df = j-1$ ). The  $Q$ -statistic value obtained in the current study was  $Q(6) = 13.96$ . Therefore, it can be inferred that the true effect size may vary from study to study. Furthermore, the  $I^2$  statistic, which quantifies the extent to which the proportion of the observed variance reflects differences in true effect sizes rather than sampling error. The  $I^2$  value obtained in this study was 57.03 and  $T^2$  was .13. These results can be interpreted that there may be an evidence that effect size varies across populations/subgroups. Therefore, we examined the primary study effect sizes and noticed that one study (van den Bosch et al., 2002), which was conducted in the Netherlands, reported considerably different results. Since this was the only study conducted outside of the U.S., the data was not suitable for a moderator analysis. Therefore, we removed this study and re-run the analysis. It may be noteworthy to indicate that this study only reported follow-up measures and was not included in the post assessment analysis.

### ***DBT vs Comparison Group at Follow-up Assessment with U.S. Samples Only***

The follow-up assessment analysis was based on four studies ( $N = 201$ ;  $j = 4$ ;  $k = 5$ ) that evaluated the effect of DBT treatment on substance (e.g., alcohol, drug, substance) abstinence at follow-up assessment with U.S. samples only. All studies used a randomized clinical trial and compared DBT treatment to an alternative treatment ( $j = 3$ ) but one waitlist group ( $j = 1$ ). The analysis yielded significant differences between DBT groups and comparison groups in increasing substance abstinence including drugs, alcohol, and medications with U.S. samples only, standard differences in mean value of .54 (95% CI [.27, .80]),  $p < .001$ . Lipsey and Wilson (2001) proposed that a Cohen's  $d$  value of below .30 is small effect size, a value of .50 is medium effect size, and effect sizes larger than .67 are large effect size. Thus, the effect size in this study represented a medium effect size. Additionally, the  $Z$ -value associated with the null hypothesis ( $\mu_1 = \mu_2$  or  $\mu_1 - \mu_2 = 0$ ) is 3.90,  $p < .001$ . Subsequently, the null hypothesis suggesting that there is no difference between DBT treatment and other comparison treatments at follow-up in increasing substance abstinence is rejected, U.S. samples only.

### ***Heterogeneity of Follow-up Results with U.S. Samples Only***

The observed effect size in post-treatment results somewhat varies across studies, yet a certain amount of variation can be attributed to sampling error. We examined  $Q$ -statistic to determine whether the observed effect size variation can be attributed to sampling error. The  $Q$ -statistic value obtained in the current study was  $Q(4) = 4.17$ . although the  $Q$ -statistic value was larger than the  $df$ , the  $p$  value associated with this statistic was non-significant. Therefore, we deemed that true effect size across studies were somewhat similar. Furthermore, the  $I^2$  statistic, which quantifies the extent to which the proportion of the observed variance reflects differences in true effect sizes rather

than sampling error. The  $I^2$  value obtained in this study was 4.15 and  $T^2 = .004$ . Higgins et al. (2003) proposed rule-of-thumbs in interpreting the  $I^2$  value. Based on their criteria, 25% would indicate low amount of variance, 50% moderate amount of variance, and 75% high amount of variance with lower scores are better. Since the obtained value in this study was only 4.15, we believe that heterogeneity was not an issue.

#### ***Publication Bias of Follow-up Studies with U.S. Samples Only***

We inspected the funnel plots in CMA. The standard errors showed an asymmetric distribution. Given that only four studies were included and that the interpretation of funnel plot is subjective, Rosenthal's *Fail-safe N* was run, which assesses the degree to which the observed overall effect is robust. This test suggested that 18 studies with no effect would bring the  $p$  value to a non-significant point, which is 4.5 times more than the studies included in this analysis. Finally, Duval and Tweedie's Trim and Fill approach was used. This analysis added two values to the left of mean effect size, where studies lacked. This analysis decreased the effect size from .54 to .44 and 95% CI to .12 and .76 range. Considering that the confidence interval did not include zero and that the effect size was still in favor of DBT treatment and at the medium level, the researcher deemed publication bias not to be a significant concern for this analysis.

### **Discussion**

Substance abuse frequently co-exists with BPD and the effectiveness of DBT with BPD is well-established. In this meta-analysis study, we investigated studies comparing DBT to alternative treatment or waitlist in reducing substance use or increasing substance abstinence. To this end, after eliminating studies that did not meet our inclusion criteria outlined in the method section, we examined six studies comparing DBT treatment to an alternative treatment ( $j = 5$ ) or a waitlist ( $j = 1$ ). Our findings are promising with the utility of DBT with clients with SUD.

A comparison of DBT treatment group with other comparison groups (i.e., alternative treatment and waitlist) revealed that DBT was more effective at the post-treatment assessment. We obtained a medium to large effect size (.66), indicating that participants assigned to DBT groups showed significantly higher remission in the symptoms of SUD in comparison to other alternative treatments or no treatment groups.

When we compared groups at follow-up assessment, we obtained no difference between DBT and other comparison groups (i.e., alternative treatment and waitlist). Upon reviewing the primary studies, we noticed that one study, which was the only study conducted outside of the US, appeared to have rather different results than those of other studies. We were unable to carry out a moderator analysis since only one non-US based study existed. We removed the study undertaken outside of the US and re-run the analysis with the studies conducted in the US only. This analysis revealed significant difference between DBT group and other comparison groups (i.e., alternative treatment or waitlist) at follow-up measure, with medium effect size. In other words, participants assigned to the DBT group reported moderately higher reduction of SUD symptoms than those in other comparison groups. Our findings support the primary studies (e.g., Linehan, 1999) asserting the efficacy of DBT in reducing SUD.

### **Implications for Practice**

Taken together, our findings demonstrate the effectiveness of DBT both at the post-treatment assessment and follow-up assessment in addressing SUD with American samples. Clinicians and counselors practicing in the U.S. should consider using DBT when working with clients diagnosed with SUD. Our results also uncovered that the effectiveness of DBT went beyond post-treatment and the therapeutic gain was also maintained at the follow-up assessment. We believe that this is especially important as relapse is a common issue among individuals with SUD. Considering our evidence of the effectiveness of DBT, national institutions and organizations in the U.S., such as the National Institute on Drug Abuse (NIDA), can encourage researchers and clinicians to employ this treatment approach in addressing SUD through grants and funding.

### **Limitations and Recommendations for Future Research**

Though this study elicited promising results for the utility of DBT with SUD, several limitations should be taken into consideration. First, since the number of studies comparing DBT to a comparison group in reducing SUD were limited, we conducted this meta-analysis with a limited number of studies. Though other studies using within-study methods existed, we specifically examined true or quasi-experimental studies. We encourage researchers to further examine the efficacy of DBT in SUD remission to support the evidence-based utility of DBT. Second, the quantity of the primary studies also limited the number of participants and heterogeneity of the samples. There was a total of 278 participants, majority of which was American women. Therefore, our results fall short in generalizing the findings to other populations, such as men and non-American. We recommend that researchers all around the world investigate the utility of DBT in SUD remission with heterogeneous groups and disseminate their results in the international literature. Third, in this meta-analysis we did not separate potential comorbidities, specifically SUD with BPD. This may pose a problem as we did not take this situation into account in the data analysis. Consequently, as the body of literature on this topic expands, researchers can further examine potential influence of comorbidities.

### **Conclusion**

Despite its limitations, this study revealed that DBT is an effective treatment approach in reduction of SUD symptoms at post-treatment assessment and follow-up assessment. Subsequently, clinicians and counselors working with individuals having substance use problems can incorporate DBT in their work with clients. Considering the limited number of studies included in this meta-analysis, we regard our results as preliminary and encourage researchers all around the world to contribute to the body of literature on this topic.

### **Disclosure Statement**

We declare no potential conflict of interest related to research, authorship, or article publication.

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