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# The Impact of a Depression Self-Management Intervention on Seizure Activity

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## Abstract

**Purpose:** Seizures have a variety of significant physical, cognitive, and social effects upon the individual. Depression has been linked to an increase in seizure activity and Project UPLIFT was shown to reduce depressive symptoms. Project UPLIFT, based upon Mindfulness-Based Cognitive Therapy (MBCT), provides distance delivery of depression management skills to groups of people with epilepsy. Because Project UPLIFT reduces depression and depression is linked to seizure activity, the current analysis was designed to determine the impact of Project UPLIFT upon seizure frequency and severity.

**Method:** Participants (n = 107) were adults ages 21-70 with epilepsy and mild-to-moderate depressive symptoms from the states of Georgia, Michigan, Texas, and Washington. The eight-session Project UPLIFT intervention was group-delivered weekly via the Web or telephone. Participants were randomly assigned to condition (i.e., Project UPLIFT or a treatment-as-usual [TAU] waitlist) and assessed at baseline, and after intervening in the Project UPLIFT group (~10 weeks). Assessments included valid self-report measures of seizure frequency and severity and depression.

**Results:** Mediation analysis found that there was a significant negative direct relationship between condition and number of seizures at posttest; the mean number of seizures decreased by 3.2 in the Project UPLIFT group, but increased by 2.3 in the TAU group. The indirect path from condition to number of seizures through change in depression was not significant. Conversely, there was no significant negative direct relationship between condition and seizure severity at posttest, although the seizure severity decreased by 2.2 points in the UPLIFT group and increased by 2.7 points in the TAU group. The indirect path from condition to seizure severity through depression was significant, however, demonstrating that change in depression mediated the effect of Project UPLIFT on seizure severity.

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**Conclusions:** This study found that participating in Project UPLIFT directly reduced the number of seizures experienced by participants with epilepsy. This was not mediated by the change in depression. Participation in Project UPLIFT also reduced their perceived seizure severity indirectly, through reducing their depressive symptoms. This suggests Project UPLIFT may have the potential to impact the health, health care costs, and well-being of people with epilepsy.

### Keywords

epilepsy; seizures; depression; cognitive behavioral therapy; mindfulness

## Introduction

Seizures, a period of abnormal firing of a population of neurons, have varied symptoms including loss of awareness, confusion, body shaking, and visual or other sensory symptoms [1, 2] Seizures have a variety of significant physical, cognitive, and social effects upon the individual. Seizure frequency is associated with injuries, most commonly due to falls [3]. A review of studies found a small, but measurable decline in intellectual performance associated with seizures [4], and cognitive issues related to attention, memory, language, and information processing are of frequent concern [5–7]. Although another review reported that both children and adults were able to demonstrate plasticity and cognitive recovery after intervention to improve seizures [8], data from the Institute of Medicine indicate that cognitive, behavioral, and social problems may persist after epilepsy resolves [9]. Furthermore, increased seizures and poor seizure control increase the stigma associated with epilepsy [10] as the epilepsy, which may not have previously been apparent to others, becomes apparent when recreational and vocational activities are limited after a seizure occurs [9, 11]. The stigma, for many people with epilepsy, is among the most burdensome aspects of this disorder [12].

Depression, worldwide the second leading cause of years of life lost to disability [13], is common among people with epilepsy [14, 15]. A recent meta-analysis estimated the pooled prevalence of depressive disorders among people with epilepsy to be 23% [16]. Depression has predicted reduced quality of life in people with epilepsy more strongly than seizure frequency [17]. Individuals with epilepsy and depression also report increased levels of perceived seizure frequency and severity [18]. Such an increase in perceived frequency and severity could result from emotional reactivity, negative thinking, and/or stressors associated with depression. Research has shown that these factors influence both the way stressful events like having a seizure are interpreted and evaluated, as well as the actual occurrence of these events [19, 20], establishing a link between depression and seizures.

Furthermore, studies have suggested that having a history of depression increases the likelihood of developing epilepsy. The first such study, conducted in Sweden, matched newly diagnosed cases of epilepsy ages 17 to 74 to population-based controls by age and sex [21]. The odds of depression prior to onset were 17.2 times greater in cases than in controls. Another study of older adults found that cases with new-onset idiopathic/cryptogenic seizures had 3.7 times the odds of major depression prior to the onset of their first

unprovoked seizure when compared to matched controls receiving medical evaluation during the same year as the case's first unprovoked seizure [22]. In a population-based case-control study of Icelandic residents ages 10 years and older [23],cases were individuals with newly diagnosed, unprovoked seizures, each matched by age and gender to two controls. Cases had 1.7 times the odds of major depression preceding the onset of the unprovoked seizures. These studies establish depression as a risk factor for seizures. Subsequently, Hesdorffer et al. demonstrated that the relationship between depression and epilepsy is bidirectional: epilepsy can lead to depression, and depression can lead to epilepsy [24].

Recognizing the high rate of depression in people with epilepsy, combined with the transportation limitations of people with seizures, the Centers for Disease Control and Prevention (CDC) released a call for a home-based depression treatment program for people with epilepsy. With funding from the CDC, Project UPLIFT was developed to provide group delivery by telephone or Web of depression management skills to people with epilepsy [25]. The program was evaluated in two randomized, controlled studies. In the first study, conducted in one southeastern state, the Project UPLIFT intervention was found to increase depression-management knowledge and skills and reduce depressive symptoms among people with epilepsy who screened positive for depression [26]. Subsequently in the second study, funded by the National Institute for Minority Health and Health Disparities (NIMHD), the Project UPLIFT intervention demonstrated the same results among people with epilepsy from four geographically diverse states who had symptoms of depression, but did not screen positive for major depressive disorder [27]. In this study, Project UPLIFT also significantly reduced the incidence of Major Depressive Disorder compared to the treatment-as-usual waitlist.

The prior studies, reviewed above, establish a link between depression and an increase in perceived or actual seizure activity. Research has also demonstrated the effectiveness of participation in the Project UPLIFT intervention in reducing depressive symptoms. A question that remains is whether Project UPLIFT, in addition to its impact upon depression, has an impact upon seizures. The current analysis uses data from the NIMHD study to investigate two questions:

1. Did participation in the Project UPLIFT intervention decrease seizure frequency and severity?
2. If participation in the Project UPLIFT intervention decreased seizure frequency or severity, was this decrease mediated by a decrease in depressive symptoms?

## Method

### Design

This randomized, controlled trial used a cross-over design (see Figure 1). All groups were assessed at Baseline, Interim (after the intervention groups completed the program; at about 9-10 weeks), and Follow-up (after the treatment-as-usual [TAU] groups completed the program; at about 18-20 weeks). This analysis is based upon data from the first two assessments, at baseline and interim, before the cross-over occurred. Further details about the methodology are described elsewhere [27].

## Intervention

Project UPLIFT is a psychoeducational program designed to teach mental health skills in 8-sessions delivered to groups by telephone or Web [25–27]. The content of the program is based upon Mindfulness-Based Cognitive Therapy (MBCT) [28] and is manualized, including a script for use by the telephone facilitators when leading activities and discussions. Because the delivery is not face-to-face, use of the script is feasible. The same script is used on the Web pages of the Internet version. The Project UPLIFT activities and discussions were designed to increase knowledge and skills related to mental health self-management. These include education about depression; monitoring, challenging, and changing of thoughts; coping and relaxing; attention and mindfulness; focusing on pleasure; the importance of reinforcement; and preventing relapse. Each session is planned to last one hour by telephone and includes a check-in period, educational material laid out in slides that covers the topic of that week's session, group discussion, a skill-building exercise, and recommended material for practice between sessions.

## Participants

Participants were recruited between 2010 and 2013 from the clinical populations to which the four participating university sites (located in Georgia, Michigan, Texas, and Washington) had access. Criteria for inclusion in the study were: 1) diagnosis of epilepsy; 2) at least three months post initial diagnosis of epilepsy and either on medication or physician-approved to participate; 3) symptoms of depression, but absence of moderate-to-severe depression on the Center for Epidemiologic Studies-Depression (CES-D) scale [29] (i.e., 8 < CES-D score < 27) or Major Depressive Disorder according to the Patient Health Questionnaire-9 (PHQ-9) [30]; 4) no active suicidal ideation; 5) 21 years of age and older; 6) English speaking; 7) access to a telephone; and 8) mentally stable, as determined by a score of > 23 on the telephone version of the Mini-Mental Status Examination (T-MMSE) [31].

A total of 367 adults were recruited from the four sites. Among those recruited, 183 did not meet inclusion criteria; 88 (24%) screened as too depressed, and 10 (3%) others expressed suicidal ideation. Random assignment and baseline assessment were performed on 128 people who met criteria and consented, but 10 of the 128 (7.8%) now met criteria for Major Depressive Disorder on the baseline assessment; these participants were excluded from the study. Subsequently, another participant scored as an extreme outlier for number of seizures and was also removed. Among the final 117 participants, 62 were in the intervention condition, and 55 were in the TAU group. Five (8.9%) intervention participants dropped out before attending any sessions and 5 others (8.9%) dropped out after attending at least one session, leaving 107 participants for the analyses. A CONSORT diagram is presented in Figure 2.

## Measures

Measures of seizure severity, depressive symptoms, sleep, knowledge and skills, self-efficacy, self-compassion, satisfaction with life, and quality of life comprised the assessments at baseline and interim. The current study employed only the measures of seizure severity and depressive symptoms.

*Seizure Frequency and Severity* were assessed with the Liverpool Seizure Severity Scale (LSSS) [32]. The LSSS is a validated 12-item scale assessing the frequency and severity of seizures experienced using a 4-week reference period. This instrument quantifies seizure frequency by self-report, asking, “How many seizures have you experienced during the past 4 weeks?” Seizure severity assessed patients’ perceptions of the most severe seizure they had during the past 4 weeks.

*Depressive Symptoms* were assessed using the mBDI [33], a modified form of the BDI [34]. The 21-item BDI has demonstrated validity for assessing depression among people with epilepsy [35]. The mBDI assesses depression severity during the past 2 weeks. It is comprised of the original 21 items of the BDI, but it also includes a positive response category for each item. As a result, the responses are scaled from 0 (positive response) to 4 (severe). With the additional response category, the mBDI better detects differences in depression when depression scores are low [33].

## Procedure

**Assignment.—**After being screened with the CES-D [29] and the T-MMSE [31] and giving consent, participants were stratified by whether or not they were on antidepressants and randomly assigned to the Project UPLIFT condition or the TAU waitlist condition. In the original study of Project UPLIFT, we found that Web and telephone delivery were equivalent in efficacy [26]. In the current study, therefore, within each condition, people who required a particular mode of delivery (Web or telephone) were placed in that group and the remainder (the majority of participants) were assigned to equalize the groups.

**Assessment.—**Baseline, interim, and follow-up assessments included the measures previously described. Assessment of participants from all sites was conducted by telephone by Master of Public Health students in Georgia. Participants were contacted in advance to schedule the timing of the assessment. They were paid $25 for each assessment completed, and $15 for each session attended.

**Delivery.—**Telephone sessions were held weekly at a scheduled time. Before each telephone session, participants received reminder phone calls. The telephone groups used the telephone technology services of the university in Georgia. Participants were provided with a conference bridge for each call; this allowed them to call in using their own telephone. Those whose call incurred long-distance charges, were provided a calling card number to cover the cost.

The Web-based intervention used Blackboard Course Management System software, a secure online learning system that houses content and includes communication tools. Blackboard tools can be accessed using standard dial-up or higher Internet access. As with a protected website, Blackboard content is accessible by computer at any time to study participants who have the required password(s). It can be used in any location, at any hour. Within the Blackboard system, one develops “courses,” which include asynchronous discussion boards, areas for posting content, and other resources. The Web intervention was created as a Blackboard course. Only the course in which (s)he was enrolled was accessible to the user once (s)he logged into the system. Users’ communications and personal

information within the course could be viewed only by the users and system administrators. A username, which did not include an actual name, and a password created by each participant were the only personal information that was entered into Blackboard. Participants were allowed to choose whether or not they wished to share their names with other members of the group. Web sessions were posted on Mondays, and the previous session was moved to an accessible archive when a new session was posted. If a Web participant had not logged into the session by Wednesday, (s)he received a reminder call or email.

Safety management of the participants is described in detail elsewhere [27].

**Analysis.—**Data input and management were performed using SPSS version 24.0. Descriptive analyses were run and data were prescreened for missing data and outliers. Mean values were used to replace missing data for any participant who was missing fewer than 10 percent of the items on a scale. One extreme outlier was removed from the data and variables were centered. All statistical tests were 2-sided and a p-value $\leq 0.05$ was considered statistically significant.

Chi squares and t-tests were used to determine whether the randomization produced equal intervention and TAU groups at baseline with respect to the variables measured. According to Vickers [36], ANCOVA should be selected as the method for the analysis of randomized trials with baseline measures, except when the data have extreme skew. Thus, we assessed the skewness of the outcome measures to ensure the skew was not extreme before changes in seizure measures over time in the intervention and TAU groups were assessed using repeated-measures analyses of covariance (ANCOVAs). The analyses controlled for any variables that differed between groups at baseline. We also planned to explore the association between the number of Project UPLIFT sessions attended and change in the seizure variables using Pearson's correlation coefficient.

Mediation was assessed using MPlus version 7.2 [37]. Data were pre-screened for missing data, outliers, and skewness. Bootstrapping (5000 replications) was added to the analysis command to account for asymmetry, particularly for the number of seizures. Model fit was determined by examining the $X^2$ statistic, Standardized Root Mean Square Residual (SRMR), Root Mean Squared Error of Approximation (RMSEA), and the Comparative Fit Index (CFI) [38].

## Results

### Descriptive Results

Twenty-two groups of up to 7 people received the Project UPLIFT program. A total of 118 participants were randomized and met study criteria. Participants ranged in age from 21 to 70, with a mean of 41.2 years and a median of 40.0 years; almost one-third (32.4%) were on antidepressant medication. Beck Depression scores ranged from 0 to 30 with a mean of 7.1 and a median of 6.0. A total of 108 (91.5%) participants completed the intervention, and one was removed due to the number of seizures at baseline being an extreme outlier (>10 standard deviations from the mean). Among the remaining 107 participants, 52 were assigned to the UPLIFT group (23 telephone, 29 Web) and 55 were assigned to the TAU

group (26 telephone, 29 Web). Descriptive data for the 107 participants by condition are summarized in Table 1. Two-thirds of the 107 participants were female (66.4%). Most (n = 63, 58.9%) were in the 31-59 year age range. Most participants reported being Caucasian (n = 66, 60.7%), with 10 (9.3%) African Americans, 2 (1.9%) people of Hispanic origin, and 6 (5.6%) people of other races; 24 (22.4%) participants did not provide their race/ethnicity. The greatest proportions of participants were married (46.7%), and not working or on disability (37.4%), had graduated college or more (n = 52, 48.6%), and were living with family (n = 70, 65.4%). There were no significant differences in characteristics between the intervention and TAU waitlist conditions at baseline. The difference in *number of days in the past 30 on which health was not good* closely approached significance (p = 0.058), however, so it was controlled in the analyses. Neither the number of seizures in the past 30 days ($t_{54.833}$ = 1.430; p = 0.159) nor seizure severity ($t_{105}$ = 0.381, p = 0.704) differed between groups at baseline.

More than half of the participants (51.9%) had experienced seizures in the past 4 weeks. The average number of seizures in the last 4 weeks ranged from 0 to 100. The mean number of seizures (sd) was 4.2 (14.0) and the median was 1.0. The seizure severity score ranged from 0 to 85, with a mean (sd) of 20.3 (24.7) and a median of 1.25.

Table 2 presents the distribution properties of the seizure measures. The distributions for number of seizures were non-normal at both baseline and posttest. In this study, while the baseline and posttest distributions of number of seizures were somewhat skewed, the change in number of seizures was not. Thus, ANCOVA was used to analyze the changes in the seizure measures from baseline to posttest, as planned.

## Analyses of Covariance (ANCOVAs)

Results of the repeated-measures ANCOVAs are presented in Table 3. While the average number of seizures increased by 2.3 in the TAU group, it was reduced by 3.2 in the UPLIFT group. The change in number of seizures differed significantly for the two groups ($F_{1,104}$= 5.178; p = 0.025). Similarly, the seizure severity score increased by 2.7 in the TAU group but decreased by 2.2 in the UPLIFT group. This difference did not achieve statistical significance ($F_{1,104}$=2.505, p = 0.117).

The number of Project UPLIFT sessions attended was negatively skewed, with a mean of 6.56 and a median of 7.00 out of a possible 8 sessions to attend. Due to this skewness, we categorized the attendance variable; we elected to categorize into tertiles because assessing dose-response requires a minimum of three categories. The first tertile was comprised of those attending 5 or fewer sessions, the second tertile was those attending 6 or 7 sessions, and the third tertile was those attending all 8 sessions. After categorizing the variable, we used ANOVA rather than Pearson's correlation to assess the association of tertile of attendance with changes in the seizure outcomes (Table 4). As attendance increased, change in number of seizures decreased. No similar dose relationship was found for seizure severity.

## Mediation Analyses

The ANOVA analysis tests a total path from condition to the outcome. According to Kenny and Judd [39] there is higher power for testing an indirect path through a mediating variable,

relative to the total path. For this reason, the mediation analysis was conducted if the ANCOVA achieved a p-vlaue less than 0.20. The mediation analyses tested whether the proposed mediating variable (Depression at posttest), mediated between treatment group (UPLIFT versus TAU waitlist) and each seizure measure at posttest, when controlling for Depression at baseline, that seizure measure at baseline, and the control variable (number of days in the past 30 on which health was not good). Suggested Hu and Bentler Criteria [38] are Standardized Root Square Mean Residual (SRMR) ≤ 0.08, Comparative Fit Index (CFI) ≥ 0.95, and Root Mean Square Error of Approximation (RMSEA) ≤ 0.06.

Figure 3 illustrates the relationships of Treatment Group, Depression, and Number of Seizures, when baseline depression and number of seizures are controlled, as well as number of days when health was not good. The model fit was adequate, $\chi^2 = 7.59$, df(3), p = .06. The SRMR (0.045) and CFI (0.966) met the suggested fit criteria. The RMSEA (0.120) did not, but Kenney, Kaniskan, and Mccoach [40] found that this measure too often incorrectly indicates a model is a poor fit when degrees of freedom are low (i.e., N is less than 200) and recommend against its use in this circumstance. The total effect for the model was significant (Estimate = - 0.260, 95% CI = −0.740, −0.009). The confidence interval for direct effect of condition to number of seizures demonstrated significance (Estimate = −0.224; 95% CI = −0.625, −0.007). The indirect (mediation) effect from treatment through depression at posttest to number of seizures at posttest was not significant (Estimate = −0.036; 95% CI = −0.217, 0.005).

Figure 4 illustrates the relationships of Treatment Group, Depression, and Seizure Severity when baseline depression and seizure severity are controlled, along with number of days when health was not good. The model fit was adequate, $\chi^2 = 7.01$, df(3), p = .07. The SRMR (0.044) and CFI (0.974) met the suggested fit criteria. Once again, the RMSEA (0.112) did not. The total effect was not significant (Estimate = −.255, 95% CI = −0.555, 0.052). The confidence interval for direct effect of condition to number of seizures was not significant (Estimate = −0.162; 95% CI = −0.460, 0.150). The indirect (mediation) effect from treatment through depression-at-posttest to seizure severity-at-posttest was significant (Estimate = −0.092, CI = −0.239, −0.015).

## Discussion

### Summary of Findings

As noted in the Introduction, seizures are costly in terms of both financial resources and their physical, cognitive, and social effects [3, 4, 8, 12, 15, 41]. In this study of the effect of Project UPLIFT on seizures, we found that participation in the program significantly reduced the number of seizures, but not seizure severity. On average, the number of seizures in the past 30 days decreased by more than 3 in the intervention group, while increasing by more than 2 in the TAU waitlist group. As participants attended more sessions, the decrease in number of seizures was greater, but no similar dose-effect was found for seizure severity. Through path analysis, we further found that the impact of Project UPLIFT participation on number of seizures was not mediated by the decrease in depressive symptoms resulting from the program. In contrast, Project UPLIFT did have an indirect impact on perceived seizure severity that operated through depressive symptoms.

The finding that participation in Project UPLIFT reduced the reported number of seizures, but that the effect did not operate through the reduction in depressive symptoms suggests the reduction is not due to cognitive or other factors associated with improved mood state [19, 20], or to the reduced level of depression, a potential precipitant of seizures. Based in MBCT, Project UPLIFT has the potential to impact factors other than depression such as anxiety [42], stress [43], insomnia [44], or general self-management skills, which may have, in turn, affected seizure frequency. In other analyses, we did not see a change in reported sleep quality as a result of participating in Project UPLIFT, but we did not have measures of anxiety, stress, or general self-management to explore.

The finding that there was a significant mediation effect of depressive symptoms on the relationship between Project UPLIFT participation and perceived seizure severity, but negative findings for the ANCOVA, and the total effect in the model is not surprising. Kenny and Judd [39] have described the higher power associated with testing an indirect path relative to the total path, which is also tested by the ANCOVA. The significant mediation effect of the path from Project UPLIFT to perceived seizure severity by depressive symptoms is consistent with prior findings. Project UPLIFT significantly reduces depressive symptoms in people with epilepsy [26, 27], and people with epilepsy and depression report higher levels of perceived seizure severity than those without depression [17].

## Implications for Health and Cost Saving

We found that participation in Project UPLIFT, a distance-delivered self-management program, reduced seizures among participants by an average of 3, while seizures in the TAU waitlist condition increased by an average of 2. Thus, program participation reduced the seizures per person by somewhere between 3 and 5 in the 30-day period assessed. This represents about 18 to 30 seizures per month in a group of six Project UPLIFT program participants.

Reducing seizures is critical for a variety of physical and mental health reasons. Research shows a mild cognitive decline, particularly related to memory, in adults with a longstanding history of seizures [4]. In addition, patients with epilepsy experience deficits in attention and concentration [45], and fatigue is more severe among epilepsy patients than controls, especially among those with epilepsy whose seizures are uncontrolled [46]. Not surprisingly, then, seizures and their cognitive effects can result in an increased risk of injury from falls, motor vehicle crashes, burns or submersion (drowning), as well [47]. Moreover, seizure frequency is associated with depression [48], anxiety [49], and quality of life [50].

In addition to these health benefits, the reduction in seizures resulting from participation in Project UPLIFT has important implications for saving health care costs. In 2014, the total cost burden of epilepsy (medical cost and lost or reduced earnings and productivity) was estimated at $36.8 billion for 2.8 million Americans with epilepsy [51]. More recent figures estimate there were 3.4 million people with active epilepsy in 2015 [52], leading to an increase in costs.

Using claims data from 2007-2009 for 8,571 adult patients with controlled epilepsy, the average cost of a visit to the emergency department (ED) was $316 [53]. In 2008, the

average cost per admission to a U.S. hospital for a person with epilepsy/convulsion was $18,739 [54]. These costs are significantly higher today simply on the basis of the 2-3% annual medical cost inflation [55]. In contrast, the cost of conducting an 8-session UPLIFT program ranges from $1150-$2525, depending on the salary and credentials of the facilitator. Thus, if the 18-30 seizures that were averted during the 30-day period assessed resulted in the elimination of 5 ED visits, 1 hospitalization, or some combination of the two, the program would pay for itself in one month. This is likely, since depression [56] and anxiety [57] are associated with increased use of the ED for seizures, and participation in mindfulness-based cognitive therapy programs like Project UPLIFT has been shown to reduce depression, anxiety, and other psychiatric disorders [26, 27, 58, 59].

### Study Limitations and Strengths

One main limitation of this study is the insufficient power to detect the main effect of Project UPLIFT upon perceived seizure severity. There was, however, sufficient power to detect the indirect pathway from participation in Project UPLIFT through depressive symptoms to decreased seizure severity. Another limitation was the representation of racial and ethnic minorities among the participants. To address this issue, studies are currently underway to assess the effectiveness of Project UPLIFT among Blacks [60] and Hispanics [61]. These studies can also explore the impact of Project UPLIFT upon stress; the study among Blacks includes a measure of post-traumatic stress disorder, and the study among Hispanics includes a measure of the perception of stress.

The strengths of this study include the randomized, controlled design; the use of validated seizure and depression measures; the assessment of dose-response; and the path analysis test of mediation. These features of the study contribute to the strength of the findings of an impact of Project UPLIFT upon seizure frequency and severity.

### Conclusion

Participation in Project UPLIFT, an evidence-based, distance-delivered intervention based upon mindfulness-based cognitive therapy, directly reduced the number of seizures experienced by participants with epilepsy. It also reduced perceived seizure severity indirectly, by reducing depressive symptoms. Providing this low-cost, self-management intervention to people with epilepsy has the potential to impact the health and well-being of people with epilepsy, as well as their significant seizure-related health care costs.

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## Highlights

- Depression and seizures are linked
- Participation in Project UPLIFT, a depression self-management intervention, directly reduced seizure frequency
- Participation in Project UPLIFT indirectly reduced and perceived seizure severity through reduction in depression
- Participation in the Project UPLIFT self-management intervention may improve seizure control and reduce seizure-related costs

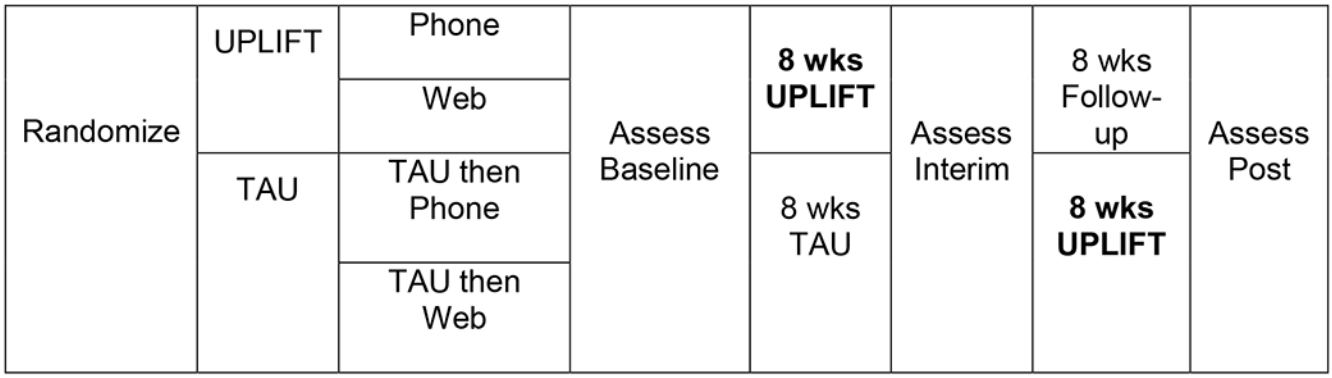


**Figure 1.**
Crossover Design

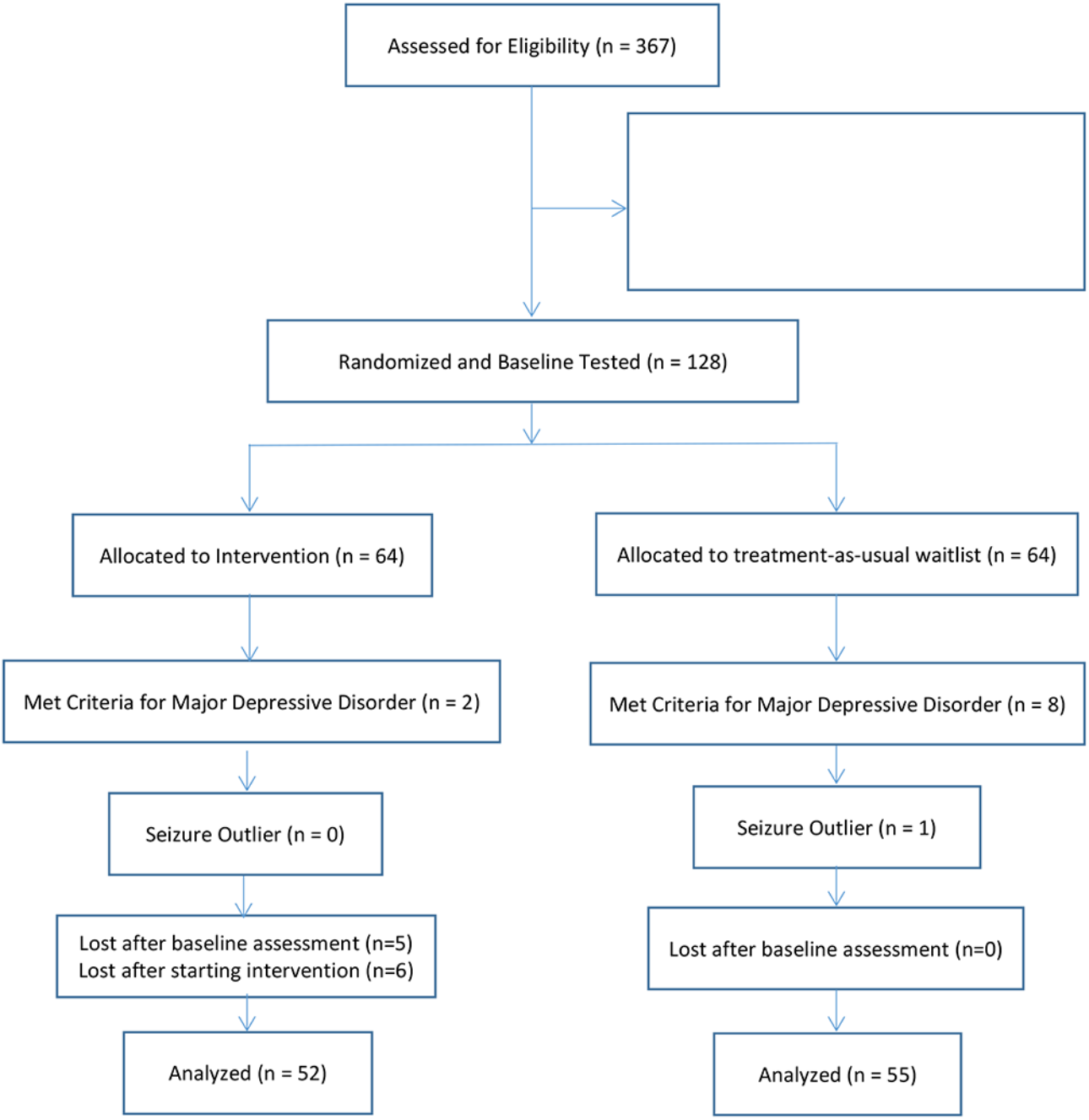


**Figure 2.**
CONSORT Flow Diagram

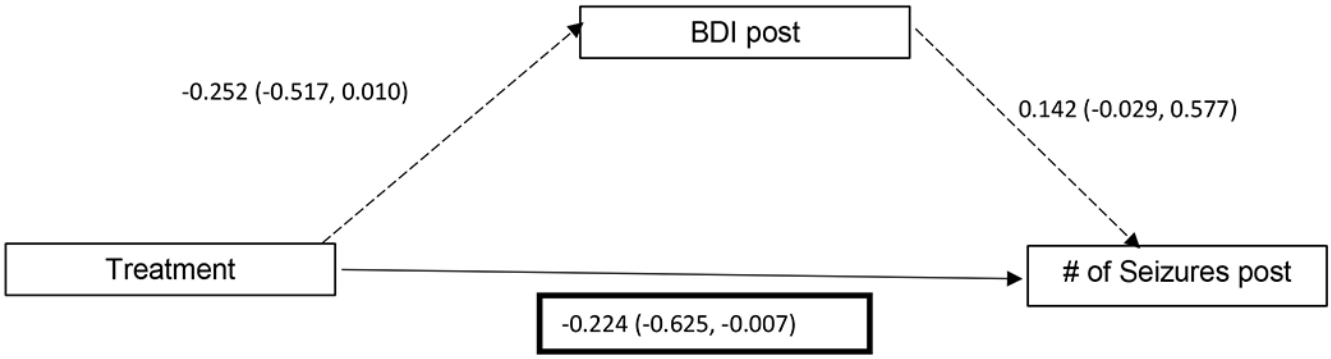


**Figure 3.**

Longitudinal Path Analysis for Number of Seizures at Posttest, controlling for baseline depression, baseline number of seizures, and days health was not good (n = 107)

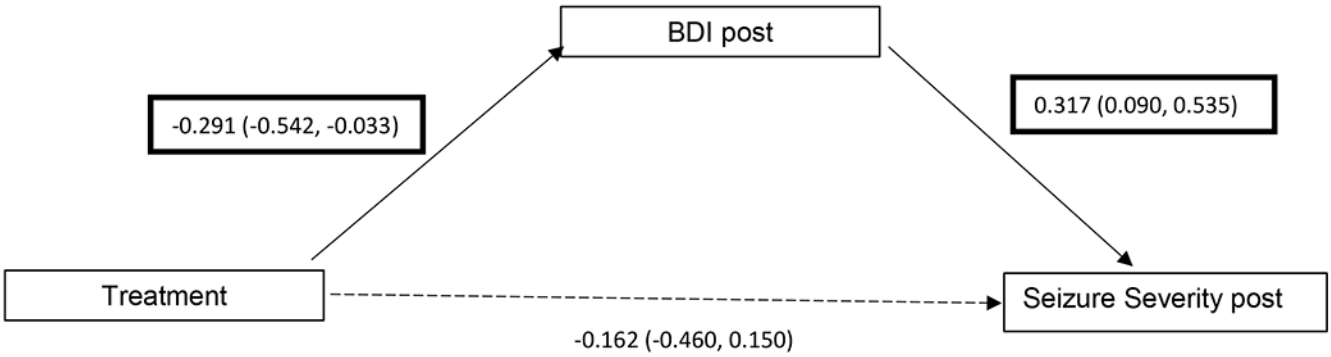


**Figure 4.**

Longitudinal Path analysis for Seizure Severity, controlling for baseline depression, baseline seizure severity, and days health was not good (n = 107)

**Table 1.**

Demographic Characteristics of Participants

| Variable | Category | Intervention Group (n=52) | TAU Waitlist Group (n=55) | TOTAL (N=107) |
|---|---|---|---|---|
| | | n (%*) | n (%*) | |
| Gender | Female | 35 (67.3) | 36 (65.5) | 71 (66.4) |
| | Male | 17 (32.7) | 19 (34.5) | 36 (33.6) |
| Age Group | <=30 | 17 (32.7) | 18 (32.7) | 35 (32.7) |
| | 31-59 | 31 (59.6) | 32 (58.2) | 63 (58.9) |
| | 60+ | 4 (7.7) | 5 (9.1) | 9 (8.4) |
| Race/Ethnicity | African American | 5 (9.6) | 5 (8.9) | 10 (9.3) |
| | Hispanic | 1 (1.9) | 1 (1.8) | 2 (1.9) |
| | Caucasian | 31 (59.6) | 34 (61.8) | 66 (60.7) |
| | Other | 2 (3.8) | 4 (7.3) | 6 (5.6) |
| | No Response | 13 (25.0) | 11 (20.0) | 24 (22.4) |
| Marital Status | Married | 27 (51.9) | 23 (41.8) | 50 (46.7) |
| | Single, never married | 15 (28.8) | 24 (43.6) | 39 (36.4) |
| | Single, living with partner | 3 (5.8) | 3 (5.5) | 6 (5.6) |
| | Divorced | 6 (11.5) | 5 9.1) | 11( 10.3) |
| | Widowed | 1 (1.9) | 0 (0.0) | 1 (0.9) |
| Employment | Working full-time | 17 (32.7) | 16 (29.1) | 33 (30.8) |
| | Working part-time | 8 (15.4) | 6 (10.9) | 14 (13.1) |
| | Volunteer | 1 (1.9) | 1 (1.8) | 2 (1.9) |
| | Student | 5 (9.6) | 5 (9.1) | 10 (9.3) |
| | Retired | 2 (3.8) | 5 (9.1) | 7 (6.5) |
| | Do not work or on disability | 18 (34.6) | 22 (40.0) | 40 (37.4) |
| | Other | 1 (1.9) | 0 (0.0) | 1 (0.9) |
| Education | High School or Less | 7 (13.5) | 12 (21.8) | 19 (17.8) |
| | Some College | 11 (21.2) | 19 (34.5) | 30 (28.0) |
| | Graduated College or More | 30 (57.7) | 22 (40.0) | 52 (48.6) |
| | Other Program | 4 (7.7) | 2 (3.6) | 6 (5.6) |
| Living Situation | Alone | 9 (17.3) | 14 (25.5) | 23 (21.5) |
| | Family | 37 (71.2) | 33 (60.0) | 70 (65.4) |
| | Friend, Roommate, Partner | 5 (9.6) | 8 (14.5) | 13 (12.1) |
| | Homeless | 1 (1.9) | 0 (0.0) | 1 (0.9) |

*Column percent

**Table 2.**

Distribution Properties of Seizure Variables

| Variable | Assessment | Mean | Skewness | Kurtosis |
|---|---|---|---|---|
| Number of Seizures | Baseline | 4.24 | 6.25 | 41.17 |
| | Posttest | 3.82 | 6.77 | 54.74 |
| | Change | −0.42 | 0.377 | 33.75 |
| | | | | |
| Seizure Severity | Baseline | 20.16 | 0.74 | −0.95 |
| | Posttest | 19.46 | 0.81 | −0.68 |
| | Change | −0.70 | −0.48 | 3.06 |

**Table 3.**

ANCOVA Results—Change in Seizure Variables by Condition

| Variable | Condition | Baseline | Posttest | Change | F-interaction | df | p-value |
|---|---|---|---|---|---|---|---|
| Number Seizures | UPLIFT | 6.6 | 3.4 | −3.2 | 5.178 | 1,104 | 0.025 |
| | TAU | 2.0 | 4.3 | +2.3 | | | |
| | | | | | | | |
| Seizure Severity | UPLIFT | 20.8 | 16.6 | −2.2 | 2.505 | 1,104 | 0.117 |
| | TAU | 19.5 | 22.2 | +2.7 | | | |

**Table 4.**

Change in Seizure Variables by Tertile of Attendance (n=52)

| UPLIFT Sessions Attended | n | Mean Change in Number of Seizures | Mean Change in Seizure Severity |
|---|---|---|---|
| 1-5 | 12 | 0.00 | −1.25 |
| 6-7 | 17 | −.94 | −1.18 |
| All 8 | 23 | −5.83 | −6.96 |