NIH Public Access
Author Manuscript
Ann Behav Med. Author manuscript; available in PMC 2010 September 1.

Published in final edited form as:
Ann Behav Med. 2008 August ; 36(1): 21–32. doi:10.1007/s12160-008-9046-7.

Relaxation Training and Written Emotional Disclosure for Tension or Migraine Headaches: A Randomized, Controlled Trial

Pamela J. D'Souza, **Mark A. Lumley**, **Christina A. Kraft**, and **John A. Dooley**
Wayne State University, Detroit, MI

Abstract

Background and Purpose—Behavioral medicine interventions that directly reduce arousal and negative emotions, such as relaxation training (RT), are conceptually different from interventions that temporarily increase negative emotions, such as written emotional disclosure (WED), but no studies have directly compared their efficacy. We compared the effects of RT and WED on people with tension or migraine headaches.

Methods—College students with either tension (n = 51) or migraine (n = 90) headaches were randomized to 1 of 3 groups: RT, WED, or a neutral writing control condition; 4 sessions were held over 2 weeks. Mood was measured before and after each session, and outcomes (headache frequency, severity, disability, and general physical symptoms) were assessed at baseline and at 1-month and 3-month follow-ups.

Results—As expected, RT led to an immediate increase in calmness, whereas WED led to an immediate increase in negative mood, for both headache samples. Intent-to-treat analyses showed that for the tension headache sample, RT led to improved headache frequency and disability compared to both WED and the control group, but WED had no effect. For migraine headaches, RT improved pain severity relative to the control group, but WED again had no effect.

Conclusions—A brief RT protocol was effective for tension headaches, but WED had no effect on health status for either tension or migraine headaches. Modifications to WED, such as targeting people with unresolved stress, providing guidance to enhance the potency of the writing, or including additional at-home writing and exposure exercises, may improve its efficacy for people with headaches and other health problems.

Keywords

migraine headache; tension headache; stress; relaxation; emotional disclosure; expressive writing

There are two conceptually different psychological approaches to reducing stress and improving health. One approach views negative emotions and physiological arousal as problematic, and advocates directly reducing arousal and increasing calmness to improve health. Many techniques that are empirically-supported and central to contemporary stress and pain management programs have this goal, including relaxation training (RT) and it variants (e.g., autogenic training, controlled breathing, and distraction), as well as cognitive reappraisal, increasing pleasant activities, and problem-solving (1,2).

A second approach to stress reduction views the inhibition or avoidance of negative emotions as fundamentally problematic, and that such avoidance contributes to unresolved stress

Address correspondence and reprint requests to Mark A. Lumley, Ph.D., Department of Psychology, Wayne State University, 5057 Woodward Avenue, 7th Floor, Detroit, Michigan, 48202. Phone: 313-577-2838, FAX: 313-577-7636, mlumley@wayne.edu.

NIH-PA Author Manuscript
NIH-PA Author Manuscript
NIH-PA Author Manuscript

NIH-PA Author Manuscript

NIH-PA Author Manuscript

NIH-PA Author Manuscript

reactions and health problems. In this view, it is potentially adaptive to access, experience, and express negative emotions because doing so allows habituation to occur, provides valuable information about one's action tendencies, permits one to assimilate cognitions and emotions, and eventuates in the resolution of the stressor (3). Techniques based in emotional processing, such as in vivo or imaginal exposure therapy for anxiety disorders including post-traumatic stress disorder, also have a documented track record of success (4,5).

Whereas interventions such as RT have long been used for physical health problems, emotional exposure-based approaches have only recently made inroads into behavioral medicine. In particular, studies of expressive writing or written emotional disclosure (WED) have led this movement. Pennebaker and Beall (6) introduced the WED research paradigm, in which participants are randomized to write for 20 minutes daily for several days about either a stressful experience or a non-emotional control topic, and groups are compared on health changes from baseline to follow-up to determine disclosure's effects. During the first decade of WED research (1986 – 1996), studies were conducted on healthy people (typically students), and WED was shown to lead to a range of health and performance improvements (7), with a moderate effect size of $d = .47$ compared with control writing (8). The most recent decade has witnessed a surge of WED research conducted on a wide range of populations and using many variations of the original protocol. A recent meta-analysis of 146 published and unpublished studies found a much smaller effect size of $r = .075$ (9).

Many of the recent studies have examined WED in people with primary complaints of health problems rather than stress or adjustment difficulties. In particular, there have been several studies of WED for people with chronic pain, but the results have been inconsistent. Two studies of WED for people with fibromyalgia demonstrated overall positive effects, although the benefits were limited to certain outcome measures or assessment time points (10,11). Six studies of written or verbal emotional disclosure in people with rheumatoid arthritis have had mixed results, including one showing benefits (12), two that showed positive effects that were limited to one or two of many measures, but not pain (13,14), one that showed only control group deterioration (15), and two that showed no benefits (16,17). A study of women with chronic pelvic pain also had very limited main effects of writing about the stress of pelvic pain (18), and a study of patients with cancer pain showed no benefits of WED (19).

Tension and Migraine Headaches

Tension headaches are very common; about one-third of people have several tension headaches per month (episodic tension headaches), but only 3% having chronic tension headaches, defined as at least half of the days (20). Tension headaches last at least 30 minutes, are bilateral, of mild to moderate severity, with a tightening but non-pulsating quality. Migraine headaches also are common; about 25% of the general population has experienced a migraine, and about 6% of men and 17% of women have had at least one migraine in the past year (21). Migraines last from 4 to 72 hours and include two of the following: unilateral location, pulsating quality, moderate or severe intensity, or pain that is exacerbated by routine activity; and at least one of the following: photophobia and phonophobia, nausea, or vomiting.

A range of environmental, physiological, and behavioral factors influence headache types, but stress also contributes to the frequency, severity and disability of both tension and migraine headaches. Negative life events are associated with the frequency of tension headaches in undergraduates (22), and life stressors often precede tension headaches (23). Stressful events were found to precede migraines up to 4 days before the headache (24). Various childhood adversities (divorce, family conflict, physical abuse, etc.) are more common in migraine patients than healthy controls (25,26), although one study did not find this, but reported that people with migraines have more PTSD symptoms than do controls in response to stressors (27).

NIH-PA Author Manuscript

NIH-PA Author Manuscript

NIH-PA Author Manuscript

Given the role of stress in both tension and migraine headaches, interventions to decrease stress should be beneficial. There is substantial empirical support for those techniques that reduce arousal and negative emotion for tension headaches. For example, RT leads to substantial improvement (28), and abbreviated RT for tension headache also has a moderate effect size (29). Techniques that reduce negative emotion and arousal in migraine headaches also have support, although brief RT protocols by themselves appear to be less effective for migraine than for tension headaches (30).

In contrast to research on stress management for headaches using techniques that directly reduce negative emotion and arousal—such as RT—there is almost no research testing the effects of helping patients access, express, and process negative emotions stemming from stressful experiences. Indeed, no published studies of WED have been conducted on tension or migraine headaches. Furthermore, no studies have directly compared the efficacy of these two approaches, RT and WED, for any health or adjustment problem. The goals of this study, therefore, were to conduct the first test of WED versus control writing in both tension and migraine headache sufferers, and to conduct the first direct comparison of WED and an abbreviated RT condition designed to match the WED protocol with respect to frequency, duration, and its self-directed nature.

Our first hypothesis was that both RT and WED would be more effective in improving headache status than a control condition, for both headache types. There was little to guide hypotheses about the comparative efficacy of the two interventions, but given the strength of the evidence for brief RT for tension headaches, and the inconsistent evidence for WED for pain problems, we thought that RT might prove to be more effective than WED, at least for tension headaches. Nonetheless, we thought that the link between life stress and migraines would make migraine headaches an ideal target for WED. We also assessed participants' immediate mood responses to these interventions to verify that each intervention generated the intended mood—increased positive and decreased negative mood for RT, and the opposite for WED.

Methods

Participants

Participants were undergraduate psychology students who had either migraine headaches or tension headaches without migraine. Recruitment occurred from February 2001 to March 2002. A brief survey screened students in classes for self-reported headache type and frequency, and people reporting headaches at least twice per week that were of moderate or severe intensity, or who reported having migraine headaches at least once per month were considered for inclusion and invited to the laboratory. After providing written consent, participants were given a structured headache diagnostic interview by a trained interviewer to determine whether they met International Headache Society criteria for either tension or migraine headaches. We excluded people who did not meet such criteria, as well as those whose headaches were suspected as being due to neurologic disease (e.g., a tumor), alcohol abuse, or a primary medical disorder, or who were currently in psychotherapy or counseling.

As shown in Figure 1, about 2000 students were screened, and 297 had headaches potentially meeting inclusion criteria. Of these students, 50 could not be reached by email or telephone, 82 were not interested, and 24 met exclusion criteria. Of the remaining 141 participants, 51 had tension headaches at least twice per week (without migraine), and 90 had migraine headaches at least monthly, and these participants were randomized. Table 1 presents demographic data for both samples.

NIH-PA Author Manuscript

NIH-PA Author Manuscript

NIH-PA Author Manuscript

Procedures

Participants from both headache samples were studied concurrently using the same procedures. During their first laboratory visit, participants completed baseline health measures and then were randomized (using a random numbers table) in blocks of six into one of the three experimental groups; this was done separately for the tension and migraine samples. Participants were seated in a private room and given a sealed packet containing their specific group instructions. A similar rationale was presented to all groups: the intervention was described as a potential way to manage stress with possible health benefits. Then, the first of four intervention sessions occurred, and participants returned to the laboratory three more times during the next two weeks for the remaining sessions, resulting in four, 20-minute sessions over two consecutive weeks. Immediately before and after each session, participants rated their mood. Participants were scheduled to return to the laboratory to complete health status measures at 1-month and 3-month follow-ups. Participants were given course credit or payment for participating. Researchers were uninformed about participants' group assignment at their follow-up visits.

Intervention Groups

Written emotional disclosure (WED)—Participants were given the standard instructions (6,12) to write about "a trauma or upheaval or stressful experience that you may be experiencing right now, or that you experienced at some other time in your life," particularly "the most stressful that you have experienced and is the most significant to you," and "ideally one that you have not talked about in detail with others." Participants were encouraged to write about the facts as well as their deepest feelings, and to try to write about the same events for all four writing days. Finally, they were encouraged to "tell a story" and consider writing about how the event has affected their relationships, health, or headaches. Writings were left with the research team at the end of each session.

Relaxation training (RT)—This condition was structured like the four WED sessions and modeled after the training described by Nash and Holroyd (31); thus, it was done without therapist contact. During each of the four sessions, participants sat in a comfortable chair in a private room and listened to different sections of a relaxation audiotape. In session 1, participants were taught active relaxation training for 14 muscle groups, and applied relaxation (cued and release only) procedures were introduced. During session 2, deep breathing and autogenic procedures were taught. In session 3, the exercise continued with autogenic relaxation using vivid imagery and emphasized the integration of breathing techniques with cued, release-only, and differential relaxation skills. Finally, in session 4, training integrated all the skills from the previous three days, particularly cued and release only techniques with an emphasis on autogenic relaxation. Consistent with skills training protocols, participants were encouraged to practice the exercises later and were given the audiotape for at-home use.

Time management control—Participants engaged in time management writing to control for expectations, number of sessions, effort, and attention from lab personnel received by both active groups (RT and WED). Participants wrote about their activities for the past week (session 1) and past 24 hours (session 2), and their planned activities for the next 24 hours (session 3) and next week (session 4). Instructions asked participants to write only about their actions, but to refrain from writing about their feelings or opinions.

Measures

Immediate mood—We assessed the effect of each intervention on immediate mood as a manipulation check to verify that the conditions operated as expected. Immediately before and after each intervention session, participants rated how they felt "right now" on specific moods

NIH-PA Author Manuscript

NIH-PA Author Manuscript

NIH-PA Author Manuscript

using an abbreviated version of the Positive and Negative Affect Schedule-Expanded Version (PANAS-X; 32), which we used earlier (33). Participants rated items from 1 (*not at all*) to 7 (*a great deal*) for four negative moods (anger, guilt, sadness, fear) and for calmness. The four negative moods were highly correlated (e.g., alpha for session 1 was .75 for tension and .73 for migraine samples), so we averaged the four ratings into one negative mood score and analyzed it separately from calmness.

At baseline and the two follow-up points, we assessed three primary outcome measures (headache frequency, severity, and disability) and one secondary outcome (physical symptoms).

Headache frequency—At each follow-up assessment, participants retrospectively reported the number of days in the last month that they had a headache. We also asked all participants to complete prospectively a brief diary each evening during the follow-up (but not baseline) period, recording the presence and severity of headaches each day. During the first month post-intervention, most participants (45 tension and 75 migraine participants; completion rates were equal for the three groups) turned in diaries, but adherence to diary recording dropped substantially during the next two months (although there were equal completion rates across the three groups). The correlation between retrospectively reported HA frequency and the frequency of HA recorded on the diary for the first follow-up month was $r = .92$, $p < .001$ for the tension sample and $r = .67$, $p < .001$ for the migraine sample. Thus, we considered the retrospective report of headaches to have reasonable validity.

Headache severity—Participants rated how painful the headaches were, on average, during the past month on a scale of 0 to 10 (0 = no pain at all, and 10 = pain as bad as it can be). Data from the first month follow-up daily diary, in which headaches were rated on the same 0 to 10 scale, revealed correlations between retrospective HA severity and mean ratings from the diary of $r = .74$, $p < .001$ for the tension sample and $r = .52$, $p < .001$ for the migraine sample. Thus, the retrospective rating of headache severity had reasonable validity.

Headache disability—Behavioral disability from headaches was assessed with the Migraine Disability Assessment Scale (MIDAS; 34). This 5-item inventory assesses the number of days in the past month when the respondent's functioning was reduced or impaired due to headaches, including days of work (including housework), school, or other activities missed as well as the number of days where productivity was reduced by half. The measure has been validated against daily logs of activity (35). Alpha coefficients at baseline were .63 (tension HA) and .71 (migraine HA). A total of the five items was calculated and analyzed.

Physical symptoms—Participants reported general physical symptoms on the 12-item Somatization subscale of the Symptom Checklist-90-R (36). Symptoms were rated from 0 (not at all) to 4 (extremely) regarding the past month, and ratings were totaled. Alphas at baseline were .79 (tension HA) and .73 (migraine HA).

Data Analytic Approach

The tension and migraine samples were analyzed separately. First, the three experimental groups were compared on demographics and baseline levels of the outcome measures to evaluate whether randomization created equivalent groups. Second, manipulation check analyses tested whether the interventions created the expected immediate mood effects. We calculated change scores (post-session minus pre-session ratings) in both negative mood and calmness for each session and created a mean change score by averaging all sessions. We also tested for group x session effects using repeated measures ANOVAs over the four sessions. The linguistic content of WED and control writings was compared with *t*-tests.

NIH-PA Author Manuscript

NIH-PA Author Manuscript

NIH-PA Author Manuscript

Regarding outcomes, as shown in Figure 1, of the 51 participants with tension HA, 50 provided at least one follow-up assessment (one RT participant dropped), and 40 completed both follow-ups. Of the 90 participants with migraines, 82 did at least one follow-up (two RT, two WED, and four controls dropped), and 58 completed both follow-ups. Only the 1-month outcomes were available for eight tension HA and 17 migraine HA participants, and only the 3-month outcomes were available for two tension and seven migraine participants. (The most common barrier to completing both follow-ups was that the 3-month assessment often occurred after the semester ended, and some students were no longer available or motivated to finish.)

Primary analyses compared the three groups on outcomes. Following an approach used earlier (37), we conducted primary analyses on each participant's most distal follow-up assessment point; thus, we used the 3-month outcomes when available (42 tension and 65 migraine participants), otherwise, we used the 1-month outcomes. (Secondary analyses were conducted on 1-month outcomes only.) We conducted intent-to-treat analyses on all randomized participants, so for the nine participants lacking all follow-up data, their baseline values were carried forward. We used analyses of covariance, comparing outcomes after controlling the baseline level of the outcome measure. We first compared RT and WED groups to the control group, and then directly compared RT and WED groups to each other. When group differences were noted, we conducted within-group analyses using paired *t*-tests to determine how each group changed from baseline. Because time to follow-up varied (due to using the 1-month outcomes if 3-month outcomes were not available), we repeated the outcome analyses also controlling for time until follow-up. All analyses were conducted with 2-tailed tests. We present the effect size difference between groups as partial eta squared ($p\eta^2$), which estimates the proportion of variance in the outcome due to group while holding covariates constant. Values of $p\eta^2$ of .01, .06, and .14 are considered to be small, medium, and large, respectively.

Results

Tension Headache Sample

Baseline Comparisons Among Experimental Groups—Table 1 presents the demographic data for the tension HA sample. The groups did not differ on age, gender, or ethnicity (coded as European American or other) (all $p > .16$). There were no group differences on baseline levels of the four outcome variables (all $p > .18$; see baseline rows of Table 2). Thus randomization was successful in creating equivalent groups.

Adherence to the Interventions and Manipulation Checks—With the exception of one control participant who missed the fourth session, all 51 tension HA participants completed all four sessions of the assigned intervention. Changes in immediate mood were examined for the tension HA sample. For negative mood, there were no session or group by session effects, but there were group effects. The increase in negative mood (averaged across sessions) was greater for WED ($M = 0.17$, $SD = 0.55$) than both the control group ($M = -0.26$, $SD = 0.28$), $t(32) = 2.87$, $p = .007$, $p\eta^2 = .21$, and RT group ($M = -0.57$, $SD = 0.47$), $t(32) = 4.22$, $p < .001$, $p\eta^2 = .36$. The RT group decreased more in negative mood than the controls, $t(32) = 2.32$, $p = .027$, $p\eta^2 = .14$. For changes in calmness, there were no session or group by session effects, but the increase in calmness (averaged over sessions) was greater for the RT group ($M = 1.78$, $SD = 1.19$) than both controls ($M = 0.07$, $SD = 0.99$), $t(32) = 4.48$, $p < .001$, $p\eta^2 = .39$, and the WED group ($M = -0.35$, $SD = 1.04$), $t(32) = 5.54$, $p < .001$, $p\eta^2 = .49$, but the WED group did not differ from controls, $p = .34$. Thus, the immediate mood effects were largely as expected.

With respect to the content of the WED and control writings, the transcribed writings were submitted to the software program, Linguistic Inquiry and Word Count-Second Edition (38). The mean percentage (over 4 sessions) of total words referring to negative emotions was about five times greater in the WED ($M = 2.31$, $SD = 0.84$) than control writings ($M = 0.44$, $SD =$

NIH-PA Author Manuscript

NIH-PA Author Manuscript

NIH-PA Author Manuscript

0.34), $t(32) = 8.54$, p <.001, supporting the expected differences between the two writing conditions. Finally, we reviewed the 68 writings of the 17 WED group participants and categorized them as follows: academic or work-related struggles (34%), problems in intimate relationships (23%), deaths of loved ones (20%), family conflicts (14%), general low self-esteem (6%), accidents (2%), and health problems (1%).

Health Status Outcome Analyses—Table 2 presents baseline and follow-up outcome data for the three groups in the tension HA sample, and follow-up scores adjusted for baseline. Compared to controls, RT led to greater reductions in headache frequency, $F(1, 31) = 4.60$, $p = .04$, $p\eta^2 = .13$, which was due to improvement from baseline to follow-up for the RT group ($p = .001$), but no change in the controls ($p = .51$). The RT group also had less headache disability than the control group, $F(1, 31) = 5.92$, $p = .02$, $p\eta^2 = .16$, which was due to improvements in the RT group ($p = .003$), but not control group ($p = .16$). The RT and control groups did not differ in headache severity, $F(1, 31) = 0.82$, $p = .37$. For the secondary outcome, RT led to marginally less physical symptoms than the control group, $F(1, 31) = 3.89$, $p = .058$, $p\eta^2 = .11$, which was due to both a small reduction in symptoms for the RT group ($p = .20$), and some increase for controls ($p = .053$). Controlling for time until follow-up did not change the significant difference between RT and controls on disability ($p = .02$), and the effect on physical symptoms became fully significant ($p = .05$), whereas the effect on headache frequency become marginally significant ($p = .057$).

The WED group did not differ from the control group on any of the outcome measures: headache frequency, $F(1, 31) = 0.10$, $p = .75$; headache severity, $F(1, 31) = 0.28$ $p = .60$; headache disability, $F(1, 31) = 0.73$, $p = .40$; or physical symptoms, $F(1, 31) = 2.49$, $p = .13$.

Finally, compared to WED, RT led to significantly greater improvement in headache frequency, $F(1, 31) = 16.34$, $p < .001$, $p\eta^2 = .35$, and headache disability, $F(1, 31) = 8.62$, $p = .006$, $p\eta^2 = .22$, although not headache severity, $F(1, 31) = 1.94$, $p = .17$. The substantial group difference in headache frequency was due to both significant improvement in the RT group ($p = .001$) and to marginal worsening of the WED group ($p = .065$). The group difference in headache disability was due solely to improvement in the RT group ($p = .003$), with no change in the WED group ($p = .95$). Controlling for time to follow-up did not alter the two significant effects (headache frequency, $p = .003$; headache disability, $p = .038$). RT did not differ from WED on physical symptoms, $F(1, 31) = 0.38$, $p = .54$.

Analyses of 1-month outcomes—The unexpected lack of WED effects at 3 months prompted us to explore the possibility that there were transient benefits of WED, given that positive effects of WED at 1-month follow-ups have been reported (39). Thus, we examined outcomes at the 1-month follow-up, replacing missing values for two tension headache participants with their baseline values. Again, WED was no different than the control or RT groups on any measure. Relaxation training reduced 1-month headache frequency more than both the control group, $F(1, 31) = 7.16$, $p = .012$, $p\eta^2 = .19$, and WED group, $F(1, 31) = 6.73$, $p = .014$, $p\eta^2 = .18$; and RT was marginally better than WED in reducing 1-month disability, $F(1, 31) = 3.15$, $p = .086$, $p\eta^2 = .09$.

Migraine Headache Sample

Baseline Comparisons Among Experimental Groups—Table 1 shows demographics for the migraine sample. There were no differences among the three groups on age, gender, or ethnicity (all $p > .26$). As shown in the baseline rows of Table 3, there also were no differences (all $p > .15$) among groups on baseline levels of the outcome measures, except RT was marginally higher than WED on physical symptoms ($p = .06$).

NIH-PA Author Manuscript

NIH-PA Author Manuscript

NIH-PA Author Manuscript

Adherence to the Interventions and Manipulation Checks—Of the 90 participants with migraines, 85 conducted all four sessions of the intervention, but four (one RT, two WED, and two control) completed just one session, and one WED participant completed two sessions. Analyses examined changes in immediate mood. For negative mood changes, there were no session or group by session effects, but there were group effects. The average negative mood increase was greater for WED ($M = 0.51$, $SD = 0.88$) compared with both the controls ($M = -0.16$, $SD = 0.39$), $t(59) = 4.00$, $p < .001$, $p\eta^2 = .21$, and the RT group ($M = -0.64$, $SD = 0.49$), $t(56) = 6.23$, $p < .001$, $p\eta^2 = .41$. The RT group led to less negative mood than the control group, $t(57) = 4.24$, $p < .001$, $p\eta^2 = .24$. For changes in calmness, there were no session or group by session effects, but there were group effects. The RT group ($M = 1.74$, $SD = 1.08$) increased in calmness more than the control group ($M = 0.09$, $SD = 0.96$), $t(57) = 6.15$, $p < .001$, $p\eta^2 = .40$, and more than the WED group ($M = -0.71$, $SD = 1.31$), $t(56) = 7.47$, $p < .001$, $p\eta^2 = .50$, and WED led to less calmness than the control group, $t(59) = 2.85$, $p = .006$, $p\eta^2 = .12$. Thus, all of the immediate mood effects were as hypothesized.

Linguistic analysis of the writings indicated that the percentage of negative emotion words in the WED writings (M = 2.91, SD = 0.80) was 4.5 times higher than in the control writings (M = 0.64, SD = 0.55), t(60) = 12.98, p < .001, confirming expected differences. Of the 112 WED writings, problems in intimate relationships were by far the most common event (44%), followed by academic or work problems (21%), family conflict (14%), one's own health problems (5%), abuse (5%), accidents (5%), death of loved ones (3%), low self-esteem (2%), and having an abortion (1%).

Health Status Outcome Analyses—Table 3 shows the data for the outcome measures for the migraine sample. Analyses of covariance, controlling for baseline levels, again compared groups. Even though there were larger samples for the migraine than the tension HA sample, there was only one group effect: RT led to lower pain severity than the control group, $F(1, 56) = 4.50$, $p = .04$, $p\eta^2 = .07$. This effect was due to a substantial decrease in severity for the relaxation group from baseline to follow-up ($p < .001$), even though the control group also decreased in headache severity ($p = .006$). Controlling for time to follow-up did not change this effect ($p = .04$). Compared with the control group, there was no effect of RT on headache frequency, $F(1, 56) = 0.83$, $p = .37$; headache disability, $F(1, 56) = 0.50$, $p = .49$; or physical symptoms, $F(1, 56) = 1.13$, $p = .29$.

The WED group did not differ from controls on any measure: headache frequency, $F(1, 59) = 1.00$, $p = .32$; severity, $F(1, 59) = 0.56$, $p = .46$; disability, $F(1, 59) = 0.19$, $p = .67$; or physical symptoms, $F(1, 59) = 0.63$, $p = .43$. Finally, RT did not differ from WED on any measure: headache frequency, $F(1, 56) = 0.04$, $p = .85$; headache severity, $F(1, 56) = 1.43$, $p = .24$; headache disability, $F(1, 56) = 0.10$, $p = .76$; or physical symptoms, $F(1, 56) = 0.03$, $p = .86$.

Analyses of 1-month outcomes—We again explored the possibility of short-lived effects, present at the 1-month follow-up. Thus, we replaced missing 1-month follow-up values for 15 migraine headache participants with their baseline values. Yet, there were no significant effects at 1-month for either RT or WED, compared with the control group or with each other, on any outcome measure.

Discussion

This is the first study to directly compare two conceptually different approaches to stress reduction—a technique that directly reduces arousal and negative mood (relaxation training), and one that elicits arousal and negative emotions (written emotional disclosure). This also is the first study to test the effects of WED on people with tension or migraine headaches. There were two primary findings. First, RT was superior to a control condition and—more

NIH-PA Author Manuscript

NIH-PA Author Manuscript

NIH-PA Author Manuscript

importantly—to WED among those with tension headaches. Second, there was a complete lack of efficacy of WED for those with either headache type. The first finding informs the type of stress reduction approach to use for tension headaches, and the second finding adds to a growing literature questioning the benefits of WED, particularly for people with health-related problems.

These two stress reduction approaches created the expected immediate effects. For both headache samples, RT increased calmness and decreased negative mood during each session. In contrast, WED had the opposite effects—increasing negative mood and decreasing calmness, which is consistent with other studies (8). These immediate mood effects not only confirm that the interventions were implemented as intended, but that they engage or activate different processes. These differing mood effects also have implications for prescribing these two interventions, as discussed below.

Effects of Relaxation Training

Regarding outcomes at the 3-month follow-up, among those with tension headaches, RT led to reduced headache frequency, reduced headache disability, and marginally less physical symptoms, compared with a control condition. Four brief (20-minute) audiotape-based relaxation sessions were sufficient to induce improvement beyond that of a active control group. These findings support prior research showing the benefits of RT for tension headaches (40), and also support findings that self-help approaches to headaches can be quite helpful (41). This study adds further to the literature by directly comparing RT to WED—a technique that has had some positive effects in other studies, particularly among college students. Importantly, RT resulted in better outcomes (headache frequency and disability) than did WED, indicating that RT is the preferred treatment of these two approaches for tension headaches.

With respect to migraine headaches, however, RT had limited effectiveness. It surpassed the control group on only one outcome (pain severity), but not on other outcomes, suggesting the single finding may not be reliable, and RT was not superior to WED on any outcomes. The fact that a brief, audiotape-based, therapist-absent RT protocol was not very effective for migraine headaches should not be surprising. Treatment of migraine is thought to be more challenging than treatment of tension headaches (40), and empirically-supported behavioral interventions for migraine headaches typically are more comprehensive, including more sessions of RT, often conducted by a therapist, and sometimes thermal biofeedback and/or cognitive restructuring (30).

Lack of Effects of Written Emotional Disclosure

In contrast to the positive effects of RT, at least with tension headaches, WED was wholly ineffective for both tension and migraine headaches. Indeed, on three of the four outcomes for both headache types, the WED group scored (non-significantly) in the direction of having a poorer outcome than controls, suggesting that even larger samples would not have revealed benefits of WED. The lack of effect of WED is particularly noteworthy because we used methods designed to increase the effectiveness of WED. We used four rather than the commonly used three writing sessions, writing occurred under supervised conditions of the laboratory, the study was presented with a rationale that writing might improve health (rather than simply being "a study of writing"), and adherence to the sessions was very good, with only three WED participants not completing all writing sessions. Also, the lack of effect was not due to poor outcome measures, which demonstrated significant group effects for the RT group.

But why was WED not effective in this study? A critical review of the WED literature reveals several possible contributors. First, in contrast to the initial excitement about the potential

NIH-PA Author Manuscript

NIH-PA Author Manuscript

NIH-PA Author Manuscript

health benefits of WED (7), an increasing number of studies have found limited or null effects. Early studies of WED were conducted on unselected healthy participants, typically college students, and showed a moderate effect size (8), and recent studies of students, especially when selected for the experience of unresolved stress, also show benefits of WED (37,39,42,43). Yet, studies of WED in clinical populations are much less supportive. For example, a meta-analysis that examined nine WED studies on clinical populations found a much smaller effect size of $d = .19$ (44). Another recent meta-analysis (45) found no significant effect of WED on reducing health care use among medical or "psychological" populations, although a positive effect was found for healthy people. In addition to the mixed, often null effects of WED in chronic pain populations that were noted in the introduction, no main effects of WED have been reported for psoriasis (46), asthma (47), people with HIV+ or AIDS (48), and breast cancer (49). There are occasional reports of WED main effect benefits in medical samples (50–52), yet given that null findings are difficult to publish, the presence of a growing number of studies not showing benefits of WED for people with health problems suggests that emotional disclosure likely has very modest benefits overall for such people.

It is likely that benefits of WED depend on characteristics of the sample studied and methods used, as noted by a series of articles recently published on the boundary conditions of WED (53). We published one of those articles on individual differences as predictors of outcomes on the 90 participants with migraine headaches from the current sample (54). These analyses showed that greater emotional approach coping (55) predicted improvement (reduced headache frequency and disability) following WED relative to both RT and the control condition, and lower headache management self-efficacy (56) predicted improvement (reduced pain severity and negative affect) following both WED and RT, relative to controls. These results suggest that having emotional skills may be a specific predictor—and having low self-efficacy may be a general predictor—of positive responses to WED. In other samples, we have shown that being alexithymic (lacking emotional understanding, expression, and introspective abilities) predicts poorer responses to WED (57).

The success of WED also may depend on people having experienced—and being willing to disclose—emotionally difficult, private, and unresolved life stressors. Yet, a close reading of the disclosures in this study suggests this may not have occurred. Although adherence to the structure of the intervention (four writing sessions) was high, and many more negative emotion words were written in the WED than the control writings, the severity of the stressors seems relatively low, suggesting that there may have been little need for emotional processing. The largest category of stressful events (23% for tension HA and 44% for migraine HA samples) dealt with relationship problems, and these were typically current conflicts with boyfriends or girlfriends and considerations of breaking up or reuniting. The second largest category of disclosure writings (34% in the tension HA sample and 21% of the migraine sample) dealt with ongoing academic or work problems, often about the daily hassles of juggling homework, outside jobs, and commuting, fears about exams, and indecision about majors. Notably, there appeared to be few stressors that were highly private (rather than publicly known), stemming from betrayal, associated with shame or guilt, or that led to inhibited emotion. Rather, most of the stressful topics were rather ordinary, and even those such as the death of a loved one often appeared to have been already processed and resolved. Unfortunately, we cannot tell whether these participants had more challenging and unresolved stressors but chose to not write about them, or they simply have not had much unresolved adversity, in which case, WED would not be expected to lead to much health change. Given that earlier we found more powerful disclosure stories among students recruited for unresolved stress, and WED was effective among those students (37), we suspect that this sample of students recruited due to headaches simply had relatively low stressor or trauma levels, or they were less able or willing to disclose them. Such participants may need assistance identifying possible stressors that they can write about.

NIH-PA Author Manuscript

NIH-PA Author Manuscript

NIH-PA Author Manuscript

Limitations, Recommendations, and Conclusions

The current study has several limitations. The control group we used (neutral writing) is one typically used for studies of WED, but not for studies of RT. Although our control group controlled for factors such as in-lab sessions, researcher contact, experimental demand, and the passage of time—factors relevant to both WED and RT— it likely did not serve as an optimal control for RT, which included audiotape-guided exercises and recommendations for home practice. It would have been ideal to have an additional control group that more closely matched the in-lab and outside activities of the RT group. Also, the RT group was given the audiotapes to take home and practice, whereas the WED and control groups were not encouraged to engage in at-home activities; thus, one might argue that the RT group got a higher "dose" of the intervention. We decided to implement WED and RT in the standard research fashion, and studies of RT call for at-home practice, whereas studies of WED do not. Thus, although the two interventions likely had different amounts of at-home activity, which may have contributed to an advantage of RT, this approach may be an unavoidable complication when comparing different interventions that require different client responses. Our results suggest that RT is superior to WED—at least for tension headaches—when each is implemented in the standard research fashion. Yet, future research may be wise to consider prescribing additional at-home writing and other emotional exercises (e.g., imaginal or in vivo exposure to emotionally avoided stimuli), to test whether the efficacy of WED can be enhanced and to increase its comparability to other skills training approaches.

It would have been ideal to have all participants keep daily diaries of measures, both at baseline and during the entire follow-up period. Although we did obtain one month of follow-up diaries on most participants—enough to provide validation data for their self-reported headache variables—the use of student volunteers limited the amount of time each was willing to commit as well as the duration of the study. Better reporting methods, such as daily mail-back diaries, automated telephone contacts, electronic devices, or internet-based reporting would be ideal to verify outcomes in real-time. The assessment of medication use would also have been useful to determine if it differed between groups, either at baseline or as an outcome.

In addition, the use of a clinical sample of headache sufferers is indicated, rather than the sample of college students, even though we screened several thousand students to obtain our sample, and the mean number of days with HA was quite high. Yet, clinic patients with headaches would be more likely to have frequent and stable headaches over time as well as higher levels of pain and disability, which might permit greater room for improvement, and such patients are also more likely than non-patients with pain problems—such as those in our sample—to have unresolved stressors (58), which might respond better to WED. Patient samples also might be more motivated to participate, keep daily records, and be involved for a longer duration. Selecting patients who also acknowledge having unresolved stressors that they view as health-relevant would be especially advantageous for a study of WED, and it may be unproductive to test it in people with health problems independent of their acknowledgement of stress. Indeed, WED appears to have relatively robust effects in populations that acknowledge unresolved stress (37,39), yet, recruiting people only because they have a health problem may render WED less effective, because such samples include people with little unresolved stress as well as those who have little motivation or ability to disclose and process such stress in writing.

We think, however, that RT and related exercises (e.g., breathing retraining, cognitive reappraisal, and perhaps mindfulness meditation) probably have broader applicability for health problems than does WED. Relaxation and related techniques usually create an immediate calming state and less negative affect, whereas disclosure induces arousal and negative affect, making it less attractive than RT. Also, it is likely that RT and other arousal-reduction interventions require less psychological insight or motivation than WED; that is, they can be helpful whether or not people report stressors and are able and motivated to disclose

NIH-PA Author Manuscript

NIH-PA Author Manuscript

NIH-PA Author Manuscript

emotional experiences. In contrast, disclosure techniques have more limited or specific applicability. Those who might benefit from emotional disclosure must not only have some unresolved stressor to disclose, but also the motivation to do so repeatedly, to tolerate the transient negative mood that is induced, and the skills to put their experience into emotional words and engage in cognitive reprocessing (57). These requirements probably lead to much smaller effects when the intervention is applied to a broad sample of people. We hope that future research will address when and for whom relaxation techniques are most beneficial, when disclosure techniques are better, and when these two approaches might be usefully combined.

Acknowledgments

This research was based on the dissertation of the first author under the direction of the second author. Preparation of this manuscript was supported, in part, by a Clinical Science Award from the Arthritis Foundation, and by NIH grants AR049059 and AG009203. We thank Melanie Ramos, Tameka Roberson, and Barbara Stanislawski, and for their assistance in data collection.

References

1. Compas BE, Haaga DA, Keefe FJ, Leitenberg H, Williams DA. Sampling of empirically supported psychological treatments from health psychology: smoking, chronic pain, cancer, and bulimia nervosa. J Consult Clin Psychol 1998;66:89–112. [PubMed: 9489263]
2. Dixon KE, Keefe FJ, Scipio CD, Perri LM, Abernethy AP. Psychological interventions for arthritis pain management in adults: a meta-analysis. Health Psychol 2007;26:241–150. [PubMed: 17500610]
3. Foa EB, Kozak MJ. Emotional processing of fear: exposure to corrective information. Psychol Bull 1986;99:20–35. [PubMed: 2871574]
4. Barlow DH, Lehman CL. Advances in the psychosocial treatment of anxiety disorders. Implications for national health care. Arch Gen Psychiatry 1996;53:727–735. [PubMed: 8694686]
5. Nemeroff CB, Bremner JD, Foa EB, et al. Posttraumatic stress disorder: a state-of-the- science review. J Psychiatr Res 2006;40:1–21. [PubMed: 16242154]
6. Pennebaker JW, Beall SK. Confronting a traumatic event: Toward an understanding of inhibition and disease. J Abnorm Psychol 1986;95:274–281. [PubMed: 3745650]
7. Pennebaker, JW. Opening Up: The Healing Power of Expressing Emotions. New York: Guilford Press; 1997. rev. ed
8. Smyth JM. Written emotional expression: Effect sizes, outcome types, and moderating variables. J Consult Clin Psychol 1998;66:174–184. [PubMed: 9489272]
9. Frattaroli J. Experimental disclosure and its moderators: a meta-analysis. Psychol Bull 2006;132:823–865. [PubMed: 17073523]
10. Broderick JE, Junghaenel DU, Schwartz JE. Written emotional expression produces health benefits in fibromyalgia patients. Psychosom Med 2005;67:326–334. [PubMed: 15784801]
11. Gillis ME, Lumley MA, Mosley-Williams, Leisen JC, Roehrs T. The health effects of at-home written emotional disclosure in fibromyalgia: a randomized trial. Ann Behav Med 2006;32:135–146. [PubMed: 16972811]
12. Smyth JM, Stone AA, Hurewitz A, Kaell A. Effects of writing about stressful experiences on symptom reduction in patients with asthma or rheumatoid arthritis: A randomized trial. JAMA 1999;281:1304–1309. [PubMed: 10208146]
13. Danoff-Burg S, Agee JD, Romanoff NR, Kremer JM, Strosberg JM. Benefit finding and expressive writing in adults with lupus or rheumatoid arthritis. Psychol Health 2006;21:651–665.
14. Kelley JE, Lumley MA, Leisen JCC. Health effects of emotional disclosure in rheumatoid arthritis patients. Health Psychol 1997;16:331–340. [PubMed: 9237085]
15. Wetherell MA, Byrne-Davis L, Dieppe P, et al. Effects of emotional disclosure on psychological and physiological outcomes in patients with rheumatoid arthritis: an exploratory home-based study. J Health Psychol 2005;10:277–285. [PubMed: 15723896]

NIH-PA Author Manuscript

NIH-PA Author Manuscript

NIH-PA Author Manuscript

16. Broderick JE, Stone AA, Smyth JM, Kaell AT. The feasibility and effectiveness of an expressive writing intervention for rheumatoid arthritis via home-based videotaped instructions. Ann Behav Med 2004;27:50–59. [PubMed: 14979863]
17. Keefe FJ, Anderson T, Lumley M, et al. A randomized, controlled trial of emotional disclosure in rheumatoid arthritis: Can clinician assistance enhance the effects? Pain. 2007 in press.
18. Norman SA, Lumley MA, Dooley JA, Diamond MP. For whom does it work? Moderators of the effects of written emotional disclosure in a randomized trial among women with chronic pelvic pain. Psychosom Med 2004;66:174–183. [PubMed: 15039501]
19. Cepeda M, Chapman C, Miranda N, et al. Emotional disclosure through patient narrative may improve pain and well-being: Results of a randomized controlled trial in patients with cancer pain. J Pain Symptom Manage. 2008 in press.
20. Rasmussen BK, Jensen R, Schroll M, Olesen J. Epidemiology of headache in a general population--a prevalence study. J Clin Epidemiol 1991;44:1147–1157. [PubMed: 1941010]
21. Lipton RB, Bigal ME, Diamond M, et al. Migraine prevalence, disease burden, and the need for preventive therapy. Neurology 2007;68:343–349. [PubMed: 17261680]
22. Reynolds DJ, Hovanitz CA. Life event stress and headache frequency revisited. Headache 2004;40:111–118. [PubMed: 10759910]
23. De Benedittis G, Lorenzetti A, Pieri A. The role of stressful life events in the onset of chronic primary headache. Pain 1990;40:65–75. [PubMed: 2339018]
24. Levor RM, Cohen MJ, Naliboff BD, McArthur D, Heuser G. Psychosocial precursors and correlates of migraine headache. J Consult Clin Psychol 1986;54:347–353. [PubMed: 3722563]
25. Sumanen M, Rantala A, Sillanmäki LH, Mattila KJ. Childhood adversities experienced by working-age migraine patients. J Psychosom Res 2007;62:139–143. [PubMed: 17270571]
26. Goodwin RD, Hoven CW, Murison R, Hotopf M. Association between childhood physical abuse and gastrointestinal disorders and migraine in adulthood. Am J Public Health 2003;93:1065–1067. [PubMed: 12835180]
27. de Leeuw R, Schmidt JE, Carlson CR. Traumatic stressors and post-traumatic stress disorder symptoms in headache patients. Headache 2005;45:1365–1374. [PubMed: 16324169]
28. Lipchik GL, Holroyd KA. Behavior therapy for headaches. The Clin Psychol 1999;52:3–6.
29. Carlson CR, Hoyle RH. Efficacy of abbreviated progressive muscle relaxation training: a quantitative review of behavioral medicine research. J Consult Clin Psychol 1993;61:1059–1067. [PubMed: 8113484]
30. Rains JC, Penzien DB, McCrory DC, Gray RN. Behavioral headache treatment: history, review of the empirical literature, and methodological critique. Headache 2005;45 (Suppl 2):S92–S109. [PubMed: 15921506]
31. Nash JM, Holroyd KA. Home-based behavioral treatment for recurrent headache: a cost effective alternative? Amer Pain Soc Bull 1992;2:1–6.
32. Watson, D.; Clark, LA. Manual for the Positive and Negative Affect Schedule-Expanded Form. Iowa City, IA: The University of Iowa; 1994. The PANAS-X.
33. Labouvie-Vief G, Lumley MA, Jain E, Heinze H. Age and gender differences in cardiac reactivity and subjective emotion responses to emotional autobiographical memories. Emotion 2003;3:115–126. [PubMed: 12899414]
34. Stewart WF, Lipton RB, Dowson AJ, Sawyer J. Development and testing of the Migraine Disability Assessment (MIDAS) Questionnaire to assess headache-related disability. Neurology 2001;56 (Suppl 1):S20–S28. [PubMed: 11294956]
35. Stewart WF, Lipton RB, Kolodner KB, et al. Validity of the Migraine Disability Assessment (MIDAS) score in comparison to a diary-based measure in a population sample of migraine sufferers. Pain 2000;88:41–52. [PubMed: 11098098]
36. Derogatis, LR. SCL-90R Administration, Scoring, and Procedures Manual-II. Towson, MD: Clinical Psychometrics Research; 1983.
37. Radcliffe AM, Lumley MA, Kendall J, Stevenson J, Beltran J. Written emotional disclosure: Testing whether social disclosure matters. J Soc Clin Psychol 2007;26:362–384.

NIH-PA Author Manuscript

NIH-PA Author Manuscript

NIH-PA Author Manuscript

38. Pennebaker, JW.; Francis, ME.; Booth, RJ. Linguistic Inquiry and Word Count (LIWC): LIWC2001. Mahwah, NJ: Erlbaum Publishers; 2001.
39. Sloan DM, Marx BP, Epstein EM. Further examination of the exposure model underlying the efficacy of written emotional disclosure. J Consult Clin Psychol 2005;73:549–554. [PubMed: 15982152]
40. Holroyd KA. Assessment and psychological management of recurrent headache disorders. J Consult Clin Psychol 2002;70:656–677. [PubMed: 12090375]
41. Larsson B, Daleflod B, Håkansson L, Melin L. Therapist-assisted versus self-help relaxation treatment of chronic headaches in adolescents: a school-based intervention. J Child Psychol Psychiatry 1987;28:127–136. [PubMed: 3104371]
42. Slatcher RB, Pennebaker JW. How do I love thee? Let me count the words: The social effects of expressive writing. Psychol Sci 2006;7:660–664. [PubMed: 16913946]
43. Lepore SJ, Greenberg MA. Mending broken hearts: Effects of expressive writing on mood, cognitive processing, social adjustment and health following a relationship breakup. Psychol Health 2002;7:547–560.
44. Frisina PG, Borod JC, Lepore SJ. A meta-analysis of the effects of written emotional disclosure on the health outcomes of clinical populations. J Nerv Ment Dis 2004;192:629–634. [PubMed: 15348980]
45. Harris AH. Does expressive writing reduce health care utilization? A meta-analysis of randomized trials. J Consult Clin Psychol 2006;74:243–252. [PubMed: 16649869]
46. Vedhara K, Morris RM, Booth R, et al. Changes in mood predict disease activity and quality of life in patients with psoriasis following emotional disclosure. J Psychosom Res 2007;62:611–619. [PubMed: 17540218]
47. Harris AHS, Thoresen CE, Humphreys K, Faul J. Does writing affect asthma? A randomized trial. Psychosom Med 2005;7:130–136. [PubMed: 15673635]
48. Rivkin ID, Gustafson J, Weingarten I, Chin D. The effects of expressive writing on adjustment to HIV. AIDS Behav 2006;10:13–26. [PubMed: 16421649]
49. Zakowski SG, Ramati A, Morton C, Johnson P, Flanigan R. Written emotional disclosure buffers the effects of social constraints on distress among cancer patients. Health Psychol 2004;23:555–563. [PubMed: 15546223]
50. Petrie KJ, Fontanilla I, Thomas MG, Booth RJ, Pennebaker JW. Effect of written emotional expression on immune function in patients with human immunodeficiency virus infection: a randomized trial. Psychosom Med 2004;66:272–275. [PubMed: 15039514]
51. Harvey AG, Farrell C. The efficacy of a Pennebaker-like writing intervention for poor sleepers. Behav Sleep Med 2003;1:115–124. [PubMed: 15600133]
52. Stanton AL, Danoff-Burg S, Sworowski LA, et al. Randomized, controlled trial of written emotional expression and benefit finding in breast cancer patients. J Clin Oncol 2002;20:4160–4168. [PubMed: 12377959]
53. Smyth JM, Pennebaker JW. Exploring the boundary conditions of expressive writing: In search of the right recipe. Br J Health Psychol 2008;13:1–7. [PubMed: 18034917]
54. Kraft CA, Lumley MA, D'Souza PJ, Dooley JA. Emotional approach coping and self-efficacy moderate the effects of written emotional disclosure and relaxation training for people with migraine headaches. Br J Health Psychol 2008;13:67–71. [PubMed: 18230235]
55. Stanton AL, Kirk SB, Cameron CL, Danoff-Burg S. Coping through emotional approach: Scale construction and validation. J Pers Soc Psychol 2000;78:1150–1169. [PubMed: 10870915]
56. French DJ, Holroyd KA, Pinell C, Malinoski PT, O'Donnell F, Hill K. Perceived self- efficacy and headache-related disability. Headache 2000;40:647–656. [PubMed: 10971661]
57. Lumley, MA.; Tojek, TM.; Macklem, DJ. The effects of written emotional disclosure among repressive and alexithymic people. In: Lepore, SJ.; Smyth, JM., editors. The Writing Cure: How Expressive Writing Promotes Health and Emotional Well-being. Washington, DC: American Psychological Association; 2002. p. 75-95.
58. Aaron LA, Bradley LA, Alarcón GS, et al. Perceived physical and emotional trauma as precipitating events in fibromyalgia. Associations with health care seeking and disability status but not pain severity. Arthritis Rheum 1997;40:453–460. [PubMed: 9082933]

NIH-PA Author Manuscript
NIH-PA Author Manuscript
NIH-PA Author Manuscript

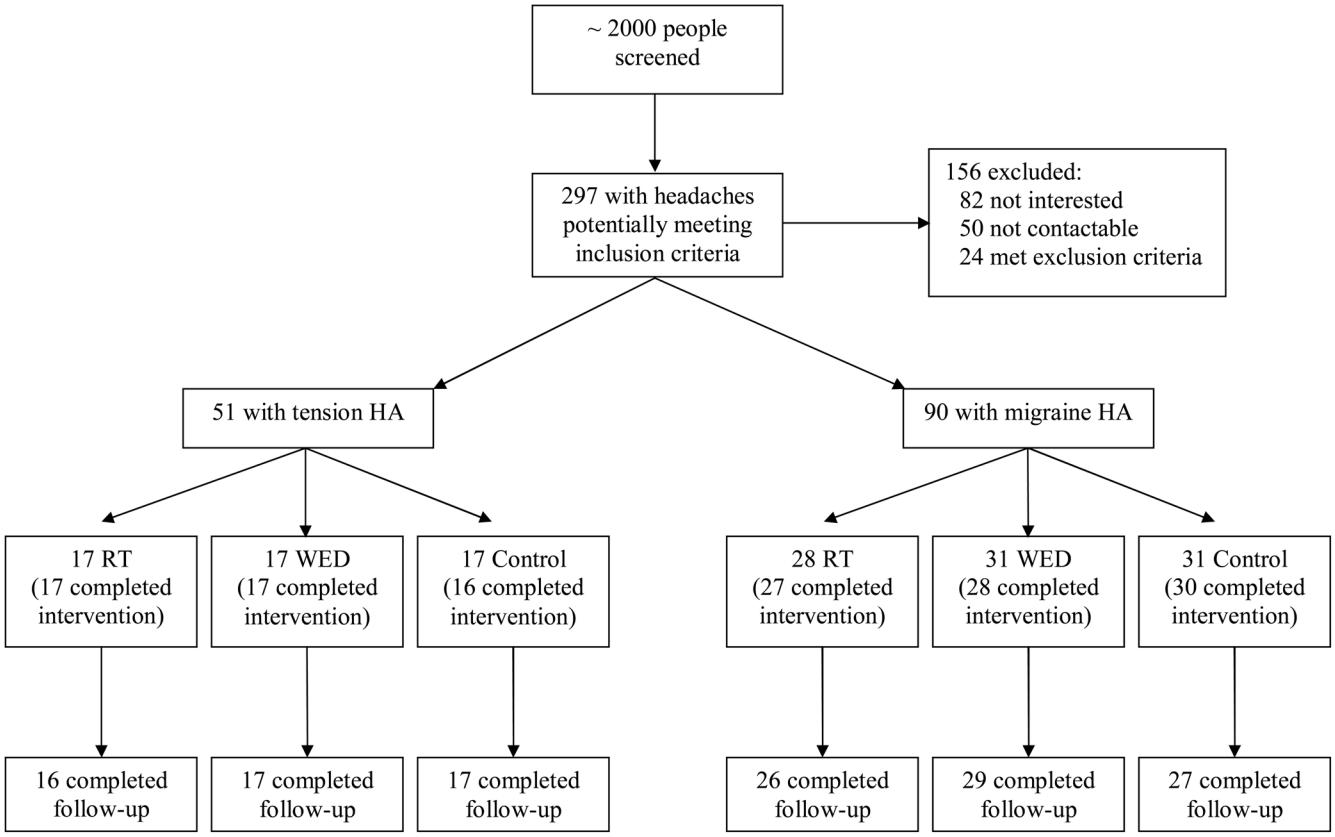

Figure 1.
Flow chart of participants through the study. HA = headache; RT = Relaxation training; WED = Written emotional disclosure

NIH-PA Author Manuscript

NIH-PA Author Manuscript

NIH-PA Author Manuscript

Table 1

Demographic Data for the Tension Headache and Migraine Headache Samples

Variables	Tension Headache (*n* = 51)	Migraine Headache (*n* = 90)
Age M (SD)	20.27 (2.30)	21.44 (5.47)
Gender n (%)		
Women	42 (82.4%)	80 (88.9%)
Men	9 (17.6%)	10 (11.1%)
Ethnicity n (%)		
European American	29 (56.9%)	53 (58.9%)
African American	10 (19.6%)	17 (18.9%)
Asian	0 (0%)	6 (6.7%)
Hispanic	0 (0%)	4 (4.4%)
Arabic	10 (19.6%)	5 (5.6%)
Native American	1 (2%)	1 (1.1%)
Multiracial	1 (2%)	4 (4.4%)

NIH-PA Author Manuscript

NIH-PA Author Manuscript

NIH-PA Author Manuscript

Table 2

Baseline, Follow-up, and Baseline-Adjusted Follow-up Data for the Outcome Measures for the Three Intervention Groups for Participants with Tension Headaches (n = 51)

Variable	Relaxation (*n* = 17)	Disclosure (*n* = 17)	Control (*n* = 17)
Headache frequency			
Baseline	11.82 (5.42)	9.94 (7.22)	9.65 (6.64)
Follow-up	6.82 (5.46)	12.24 (7.90)	11.24 (9.01)
Adjusted follow-up	6.00 (1.61)	12.56 (1.60)	11.74 (1.60)
Headache severity			
Baseline	5.53 (1.28)	5.47 (1.81)	5.43 (1.79)
Follow-up	4.12 (2.26)	5.00 (1.62)	4.71 (1.80)
Adjusted follow-up	4.10 (0.44)	5.00 (0.44)	4.73 (0.44)
Headache disability			
Baseline	12.94 (13.37)	8.24 (8.84)	9.24 (6.53)
Follow-up	4.41 (5.55)	8.35 (8.89)	7.29 (7.82)
Adjusted follow-up	3.05 (1.44)	9.23 (1.43)	7.73 (1.42)
Physical symptoms			
Baseline	11.53 (5.89)	9.53 (6.35)	9.06 (5.20)
Follow-up	10.18 (3.97)	8.71 (5.03)	11.06 (4.76)
Adjusted follow-up	9.62 (1.01)	8.90 (1.00)	11.42 (1.00)

Baseline and follow-up data are mean (standard deviation), and adjusted follow-up data are mean (standard error of the mean) of the follow-up value, adjusted for the baseline value.

NIH-PA Author Manuscript

NIH-PA Author Manuscript

NIH-PA Author Manuscript

Table 3

Baseline, Follow-up, and Baseline-adjusted Follow-up Data for Outcome Measures for the Three Intervention Groups for Participants with Migraine Headaches (n = 90)

Variable	Relaxation (*n* = 28)	Disclosure (*n* = 31)	Control (*n* = 31)
Headache frequency			
Baseline	9.86 (6.21)	9.65 (6.46)	11.77(7.58)
Follow-up	9.36 (6.13)	9.00 (5.81)	8.97 (6.14)
Adjusted follow-up	9.63 (0.98)	9.37 (0.93)	8.35 (0.94)
Headache severity			
Baseline	6.57 (1.57)	6.39 (1.52)	6.35(1.14)
Follow-up	4.68 (2.13)	5.23 (2.28)	5.55 (1.69)
Adjusted follow-up	4.60 (0.36)	5.25 (0.34)	5.60 (0.34)
Headache disability			
Baseline	12.11 (8.88)	13.35 (11.83)	15.35 (12.25)
Follow-up	9.89 (12.91)	9.87 (8.79)	10.13 (11.49)
Adjusted follow-up	10.81 (1.71)	10.05 (1.62)	9.13 (1.63)
Physical symptoms			
Baseline	15.50 (8.32)	12.39 (4.94)	13.48 (5.16)
Follow-up	13.32 (7.82)	11.26 (7.61)	10.61 (5.37)
Adjusted follow-up	12.15 (1.08)	12.15 (1.02)	10.78 (1.02)

Baseline and follow-up data are mean (standard deviation), and adjusted follow-up data are mean (standard error of the mean) of the follow-up value, adjusted for the baseline value.