The effectiveness of prescribed recreation activity in decreasing biochemical stress and improving mood in alcoholic patients

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Abstract
The purpose of this controlled study was to determine whether prescribed recreation activity (RA) could decrease stress and improve mood. The study involved 20 male and female participants who were in alcohol rehabilitation. Ten participants served as matched controls. Treatment consisted of three groups of RAs classified according to physical intensity or the amount of oxygen required to perform them. Prescribed RAs (RxA) lasted 20 minutes and included three intensity levels. Biochemical analyses were coupled with psychological changes to test the study hypothesis. Results of the study indicated that participation in the RxA reduced depression in the experimental group when compared with the control. Overall mood as well as its subcomponents, anger, tension, depression, fatigue, and vigor scores improved after both the low intensity (RxA1) and moderate intensity (RxA2) interventions. RxA1 and RxA2 interventions also produced statistically significant reductions in cortisol, a biochemical marker of stress. It is, therefore, concluded that prescribed RAs can produce biochemical and psychological changes consistent with decreased stress and improved mood. The ability to evoke positive physiological and psychological changes by more natural and less addicting behaviors provides rationale for this type of intervention as a potential complementary and alternative medicine. The findings of this study underscore the importance of recreational therapy in the treatment of alcoholism and other stress-related medical disorders.

Key words: stress, mood, alcoholism, recreational therapy, cortisol, prescribed recreation activity, complementary, alternative and behavioral medicine, depression

Background and significance
According to the National Institute on Alcohol Abuse and Alcoholism, alcohol abuse or alcoholism is drinking more than three drinks a day and seven drinks a week for women and more than four drinks a day or 14 drinks a week for men. In 2002, it was estimated that 18 million US adults or more than 7 percent met this diagnostic criteria. Certain groups such as the physically impaired report twice this rate. National Institute on Alcohol Abuse and Alcoholism has also reported that alcohol abuse and alcoholism increases the risk of death from injuries, violence, suicide, poisoning, cirrhosis, certain cancers, and possibly hemorrhagic stroke. Moreover, alcohol-related traffic crashes result in more than 17,000 deaths and 275,000 nonfatal injuries at a cost of $51 billion. Pain and suffering for abusers and their families are hallmarks of a disease that cost 185 billion in 2003 alone. Alcoholism is caused by both biological and psychological factors. These factors appear to influence imbibers at all stages of drinking, including initiation, continuation, and progression. A major factor associated with alcoholism is stress, which has been shown to exacerbate alcohol’s use. In turn, alcohol use exacerbates emotional stress and often results in depression and sometimes death. Nonetheless, there is expectancy that alcohol use will improve mood and reduce stress. These expectancies are prevalent in 12 years olds and continue through adolescence.
Interestingly, the stress reduction expectancy is stronger than the actual contradictory result of consuming alcohol and is one of the primary causes of relapse.\textsuperscript{10}

One current theory posits that individuals become physiologically accustomed to relying on alcohol as a means to cope with physical and psychological stressors.\textsuperscript{11,12} Researchers have recently demonstrated alcohol's addicting effects on both the peripheral and central nervous systems. Studies assessing hormonal change also support this hypothesis by demonstrating that many physiological coping systems are activated when alcohol is ingested.\textsuperscript{13,14}

Alcohol does decrease stress in some people in some situations.\textsuperscript{15} There is a cost, however, as a physiological rebound effect is seen with dramatic increases in stress system activity in chronic active alcoholism and in alcohol withdrawal.\textsuperscript{7} The stress reduction effect of alcohol is mediated by common neurochemical systems, such as the serotonin, dopamine, and opiate peptide systems, as well as the hypothalamic-pituitary-adrenal (HPA) axis. Researchers contend that additional studies in this area will become particularly important and will eventually lead to individualized treatment approaches that emphasize stress management strategies.\textsuperscript{16}

**Recreation activity**

Recreation activity (RA) provides a wide array of health benefits\textsuperscript{17,18} and, as a result, have been used by humans since the beginning of recorded history for fitness, sport, meditation, and fun.\textsuperscript{19} Among the numerous benefits are social interaction,\textsuperscript{20} physical activity,\textsuperscript{21} mental distraction,\textsuperscript{22} and laughter.\textsuperscript{23} Good things happen to people when they are having fun. Psychological constructs attempting to explain the benefits of recreation include a hyperfocused positive mental state and a feeling of relaxation and in balance. One psychologist\textsuperscript{24} called this hyper focused state *flow*. His theory stating RAs such as rock climbing or playing chess produce a psychological experience that is contrary to stress and negative mood has provided a psychological rationale for the inherent therapeutic benefits. Recently, basic biochemical scientists also interested in emotional change are providing evidence that this psychological experience also had a biochemical basis.

For example, alterations in hormonal profiles, some the opposite of those produced by stress and depression, have been reported following physical exercise, a component of many RAs.\textsuperscript{25} In fact, exercise is considered a standard method to change human growth hormone hGH,\textsuperscript{26,27} B-Endorphin,\textsuperscript{28} and adrenocorticotropic hormone,\textsuperscript{29,30} Candace Pert, who helped identify the receptor sites for the biochemical beta-endorphin, summarizes the potential of RAs.\textsuperscript{31}

> “Having fun is the cheapest, easiest and most effective way I know to instantly reduce stress and rejuvenate the body, mind and spirit ... Engaging in play is the antidote to stress because it gets our emotions flowing, and our emotions are what connect us, give us a sense of unity, a feeling we are part of something greater than our small and separate egos.”
> *Molecules of Emotion* p 295

Once it was established that biochemical changes occur during participation in RAs, it became necessary for recreational therapists (RTs) to understand these changes in relation to human growth and development and to establish prescriptive parameters for health maintenance and improvement. Ultimately, with research and clinical testing, these RAs or therapeutic interventions could become standardized recreational therapy (RT) treatments.

Individuals generally have a more positive perception toward RA because of its ability to produce positive side effects such as enjoyment or laughter. Thus, RA participation is a primary incentive for initiating and maintaining physical activity involvement.\textsuperscript{32} There is an emerging evidence that this “positive perception” toward an activity enhances positive biochemical change. For example, it has been demonstrated that the highest levels of B-Endorphin are present when exertion ratings\textsuperscript{33} or stress levels\textsuperscript{34} are perceived less by study populations. Hence, choice of RA or “treatment” is an important consideration.
Since clients do not necessarily know which RAs positively affect their health outcomes and sometimes intentionally choose activities that negatively affect them (e.g., anorexics wanting to incessantly exercise), it becomes incumbent on the RT to provide the client with choice but within the appropriate prescriptive parameters. RA only becomes treatment when it prescribed (based on evidence) to meet health-related goals. Therefore, an understanding of the prescriptive parameters of RAs by RTs is essential.

The Recreation Therapy Medicine (RTM)\textsuperscript{35} model was developed to provide a method for RTs to prescribe RAs as a medical intervention (R\textsubscript{X}A). The RTM model presents a scientific method to research and prescribe RAs based on the physical, social, emotional, cognitive, and spiritual changes evoked by the RAs. The RTM model served along with the theories of flow and activity produced biochemical change as the theoretical underpinnings of this study.

Recreational therapy
Recreational therapy is defined by the American Therapeutic Recreation Association as “the provision of Treatment Services and the provision of Recreation Services to persons with illnesses or disabling conditions. The primary purposes of treatment often referred to as recreation therapy, are to restore, remediate or rehabilitate to improve functioning and independence as well as reduce or eliminate the effects of illness or disability.” RTs are trained using the biological, psychological, cognitive, social, and spiritual model of health. RTs realize that baseline information has to be collected, analyzed, and incorporated into a comprehensive treatment plan in a relatively short period of time. RTs focus on a person’s strengths and recreational interests, which then becomes the vehicle for delivering services. For instance, an RT may take a person’s interest in basketball and devise a means to shoot baskets (even from the hospital bed). The goal may be to increasing upper extremity range of motion, muscle strength, and endurance. If the person was experiencing untoward stress or anxiety, the RT may select a card game, board game, or craft activity as a means of helping the client distract themselves and direct him or her toward a more normal cardiorespiratory rhythm.

RTs are charged with enhancing the natural benefits of RA by prescribing the appropriate frequency, duration, and intensity to get the desired therapeutic result. Since participation in RAs can have both positive and negative effects, it is imperative that physiological and psychological changes are evaluated in the context of specific prescriptions. Whether a prescribed RA can contribute to healing by altering physiological processes is not known but warrants serious exploration. A deeper understanding of the therapeutic effects of RAs by comparing underlying physiological and psychological changes is needed.

Study purpose
Prescribed RAs (R\textsubscript{X}As) may have the potential to assist in the treatment of many stress-related illnesses such as alcoholism and/or their related symptoms. Unfortunately, there have been no studies that have explored biochemical and mood state changes after RAs; therefore, treatment specificity has been limited. The purpose of this study, therefore, was to determine whether R\textsubscript{X}As directed by an RT could reduce stress and improve mood.

Procedures
Participants
The study involved 20 participants who either voluntary sought acute alcohol treatment or were mandated by the court. Participants were recruited from two locations. One was an in-patient unit housed in local hospital, and the second was a free-standing alcohol treatment facility. Both facilities stressed minimal medication usage and considered them a roadblock to treatment. The primary method of intervention in both facilities was counseling and education. The facility maintains a diverse population from a variety of cultural and socioeconomic backgrounds.

The experimental group consisted of eight males and two females. The control group consisted of eight males and two females. All participants were off all
prescribed drugs except for vitamins for at least 24 hours prior to the study. Comorbid conditions such as anxiety or panic disorder and depression were common in this alcohol treatment population but not assessed for this study.

To limit the potential extraneous effects on study variables, participants in experimental group were matched with participants in the control group on age, weight, number of previous admits, primary diagnosis of alcoholism, no cocaine use 30 days prior to the study. The age of the participants was between 18, the minimum age required for treatment, and 45 years, the maximum age recommended for an exercise study without vo<sub>2</sub> maximum testing. Participants that were of average height (females 5 ft to 5 ft 9 in and males 5 ft 5 in to 6 ft 2 in) were included. Participants who had a diagnosis of either anorexia or obesity were excluded. Those participants with more than three previous hospitalizations for alcoholism were also excluded because of the potential physiological and psychological problems caused by chronic abuse of alcohol.

Potential participants were identified by the hospital's charge nurse. The researcher then met with potential participants and discussed the study's ramifications and their rights as participants in research. All who voluntarily agreed to participate signed an Institutional Review Board approved informed consent form. Every other subject who agreed to participate was assigned to the control group. All procedures, treatments, data collection, and analyses other than the collection of blood samples (collected by registered nurses at the facility) and radioimmunoassay tests were conducted by the researcher. Both experimental and control participants were assessed for prealterations and postalterations in mood state and depression.

Changes in cortisol between the control and experimental group were measured before and after alcohol treatment. In the experimental group, blood was drawn before and after the three R<sup>x</sup>AAs that occurred during the course of hospitalization. All R<sup>x</sup>AAs were scheduled prior to 10 am. There were at least 24 hours between each R<sup>x</sup>A.

Prescribed RAs

There were three categories of RAs used as treatments. Each activity was classified by the physical intensity or amount of METs (250 mL O<sub>2</sub> per minute) needed to perform them. The RAs that made up each category were selected because they represented those typically used by RTs in alcohol treatment facilities; they were available for this study, and they met the intensity requirements. Low-intensity (0 to 2 METs) R<sub>x</sub>A1 consisted of board games or card games for with a duration of 20 minutes after the game started. Participants were instructed to choose the board game or card game. Moderate-intensity (2 to 5 METs) R<sub>x</sub>A2 consisted of billiards, ping pong, or air hockey for 20 minutes. High-intensity (5+ METs) R<sub>x</sub>A3 consisted of riding a stationary bike, circuit training (free weights, stationary bike, small trampoline, stair stepper, and cross country ski machine), or an outside power walk for a duration of 20 minutes at 65 percent or greater of the individual’s maximum heart rate. Participants were instructed to begin exercising and after approximately two to four minutes of warm up the individuals pulses were calculated. If the subject was at or above 0.65 percent of maximum heart rate, the subject was told to continue at this pace for 20 minutes. Low-intensity treatments and moderate-intensity treatments were also recorded for 20 minutes beginning after the subject appeared to be in the “flow” of an activity. That is, after the initial shuffling of cards or after a warm up on the ping pong table. All 10 experimental participants completed one intervention from each category during their treatment stay.

The prescriptive parameters for the RAs used in this study were as follows: frequency: once R<sub>x</sub>A from each category of R<sub>x</sub>AAs completed during a two-week inpatient treatment; duration: each R<sub>x</sub>A performed for at least 20 minutes; and intensity 1x R<sub>x</sub>A1 + R<sub>x</sub>A2 + R<sub>x</sub>A3.

Measurement of stress

The concept of homeostasis is based on the principle that all cells, tissues, and organs of an organism strive to maintain a constant “steady state” condition in their internal environment. However, recent studies employing continuous recording of various physiological
variables such as heart rate, blood pressure, and nerve activity convincingly showed that all biological processes vary in a complex and a nonlinear way at any time, even during a “steady state” condition. These facts lead to the understanding that healthy physiological function is a result of the continuous dynamic interactions between multiple complex regulatory mechanisms on various levels ranging from subcellular to organs and systems.

The autonomic nervous system (ANS) is a vastly complex system that is responsible for the regulation of approximately 80 percent of the body’s subsystems such as circulation, immune, and endocrine responses. The sympathetic branch is the mediator of the fight or flight response. An increase in sympathetic stimulation causes alterations in heart rate, blood pressure, respiratory rate, blood flow, thermoregulation, and basal metabolic rate. The parasympathetic branch is mediated by respiration and is associated with the relaxation or balance of ANS.

A consistently high level of sympathetic stimulation is an indicator of decreased cardiac reserve and can reflect a specific condition or disease. Among these conditions are health problems like insulin resistance, diabetes, obesity, hypertension, sleep apnea, and congestive heart failure as well as other cardiac conditions that can be better assessed through the evaluation of the ANS regulatory function. One established method of measuring ANS nervous system changes is by evaluating specific parameters evoked by stress such as hormones.

Cortisol is a hormone that reflects sympathetic involvement and can be used to measure the plasticity of the hypothalamic pituitary axis since high morning and lower afternoon and evening values have been consistently reported. Cortisol stimulates fat accumulation and is elevated by perceived and physiological stress. It is considered an indicator of endocrine, metabolic, and circulatory health with chronic high levels associated with central obesity in adults and a variety of chronic diseases such as diabetes. Because of this accuracy and other advantages, cortisol has become a standard measure of acute stress. Normal diurnal cortisol ranges for men and women are 1.0 to 8.0 ng/mL (AM) and 0.1 to 1.0 ng/mL (PM). Sample collection adhered to the standard method for biochemical assay collection.

### Measurement of mood

Depression between the experimental and control group was measured using the Beck Depression Inventory (BDI). The BDI is a 21-item self-report rating inventory measuring characteristic attitudes and symptoms of depression. Internal consistency has been reported from 0.73 to 0.92, with a mean of 0.86. The BDI demonstrates high internal consistency, with alpha coefficients of 0.86 and 0.81 for psychiatric and nonpsychiatric populations, respectively.

Changes in various components of mood were also assessed using the Profile of Moods States (POMS). The POMS is a factor analytically derived inventory that measures six subscales: tension, depression, anger, vigor, fatigue, and confusion; it is used with “Last Week” and “Right Now” administrations. Internal consistency for the POMS has been reported at 0.90 or above. Test re-test reliability is reported between 0.68 and 0.74 for all factors. Construct and predictive validity have been established in four

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*p < 0.10; d = 1.18.


Table 2. Comparison of pretreatment and posttreatment mood state scores*

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<td>Experimental group</td>
<td>53.6</td>
<td>33.8</td>
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*5 = 0.46.

Results

The data from this study support the hypothesis that mood depression would decrease as a result of the RxA interventions, with the BDI scores approaching statistical significance decrease in spite of the low number of participants and an overall average hospital stay of 13 days (Table 1). When analyzed further with Cohen’s Delta (d) or statistics recommended for treatment studies with small sample sizes, the results indicated a large treatment effect had taken place in the experimental group.

Cohen’s d is a measure of effect size or the standard mean difference and is a standard measure to calculate treatment effect. Cohen’s d describes differences in means relative to an assumed common variance. According to Cohen, effect size changes can be classified as small (0.20); medium (0.50); and large (0.80). In this study, a treatment’s effect size of d = 1.16 indicated a very large decrease in depression scores in the experimental group when compared with the control group.

Changes in Profile of Mood States scores between the control and experimental group were not statistically significant. However, effect size analysis revealed that a medium (d = 0.46) mood shift had occurred when compared with the control group. Multivariate tests of significance using the repeated measures approach indicated that there was not a significant time effect (pillia’s = 0.45) but, when combined, the overall effect of the three treatments on mood approached statistical significance (F = 3.27, p = 0.09). Data were not collected from the control group after a comparison RA because of the intrusiveness (draw blood an additional six times) of the method. The results of overall mood changes are presented in Table 2.

When the POMS subcomponents were compared pre- and post-RxA, the experimental group reported significant reductions in anger, tension, depression, and fatigue scores (Table 3). Increases in vigor neared statistical significance as well. Confusion was the only variable that was not changed by the interventions.

The results of mood changes before and after each category of RxA are presented in Table 4. Participants completing RxA1s and RxA2s reported significant improvement in mood.

High-intensity RAs (RxA3s) also appeared to improve mood but not at the level seen in low and moderate intensity RAs. Using Cohen’s d to further examine the relationship with high-intensity activities, a moderate (d = .60) effect size change in mood was noted.

Twenty-minute RxA1 significantly decreased physical stress as indicated in reductions of cortisol (Table 5). RxA2s also resulted in decreases in physical stress.

Interestingly, cortisol levels also were lower after RxA3s showed a large effect size change but did not reaching statistical significance.

Discussion

The analyzed data from this study support the hypothesis that prescribed RAs can decrease stress and improve mood. These findings are consistent with earlier psychological research on the benefits of RA. Moreover, individual treatments decreased physical
Table 3. Overall mood state variable changes

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<td>Anger</td>
<td>10.2</td>
<td>10.3</td>
<td>9</td>
<td>3.14*</td>
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<td>Vigor</td>
<td>4.2</td>
<td>6.6</td>
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<td>2.03</td>
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<td>Confusion</td>
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<td>9</td>
<td>1.46</td>
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<tr>
<td>Tension</td>
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<td>9</td>
<td>8.48†</td>
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<td>Fatigue</td>
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<td>9</td>
<td>4.41‡</td>
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<td>Depression</td>
<td>17.2</td>
<td>14.3</td>
<td>9</td>
<td>3.81‡</td>
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*p < 0.05; †p < 0.001; ‡p < 0.01.

stress or a “relaxation” of the ANS as measured by decreases in cortisol.

The main limitation of this study was the sample size. Power analysis indicated less than 75 percent likelihood that a significant change would be found. Given this was a pilot study and there were inherent dangers associated with blood draws, it was decided to limit the participants to 10 in each group. Nonetheless, a number of variables were statistically significant. Changes in cortisol pre-post study were not analyzed as it was surmised that fluctuations in individual hormone profiles would be influenced by multiple variables (counseling, nutrition, abstinence); therefore, comparisons, even if significant, would not be representative of changes evoked by RA treatments. Another limitation involved participant choice of a RA. It is rare that two different RAs possess exactly the same variables; thus, it is very difficult to accurately compare them. To address this confounding issue, the physical intensity needed to perform the activity was the chosen method of classification for this study. Since the prescription was not classified considering other factors like cognition and emotion, caution should be taken before generalizing these results.

When the PCMS was broken down into its six sub-components (Figure 3), the experimental group reported significant decreases in tension, fatigue, depression, and after all RAs. Tension and fatigue are variables that have been linked to worry and mental exhaustion and are important symptoms to ameliorate as they can become obstacles to alcohol treatment and prevention. Large increases in vigor are consistent with the increased mental alertness. Acute alcohol treatment often involves anger and depression management as core components. Being able to measurably affect these variables with RAs represents a significant step in treatment specificity. Given these findings, RAs should begin to include prescribed RAs into their anger and depression management programs.

Given the need for interventions that help improve or stabilize mood, further exploration into the efficacy of RAs are warranted. Specifically, more research is needed in the alcohol-dependent populations to more precisely determine the prescriptive parameters of RAs and whether they can augment or replace some current interventions such as medications and talk therapy.

Participation in R1A1 and R2A2 intensity activities decreased cortisol, indicating these types of RAs treatments were effective in reducing this stress hormone. This is important finding because as a person encounters a stressful circumstance, cortisol turns up energy producing mechanisms while inhibiting less


Table 4. Pretreatment and posttreatment mood state change scores

<table>
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<th>Intensity</th>
<th>md</th>
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<td>Low (0-2 METs)</td>
<td>-16.5</td>
<td>16.4</td>
<td>9</td>
<td>3.18*</td>
</tr>
<tr>
<td>Moderate (2-5 METs)</td>
<td>-13.5</td>
<td>10.7</td>
<td>9</td>
<td>3.99†</td>
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<tr>
<td>High (5+ METs)</td>
<td>-6.4</td>
<td>10.6</td>
<td>9</td>
<td>1.92‡</td>
</tr>
</tbody>
</table>

*p < 0.05; †p < 0.01; ‡p = 1.3.

essential functions. Cortisol has a significant effect on numerous processes including metabolism, fluid regulation, emotional and cognitive functioning, and the immune system. Researchers applying the Tier Social Stress Test found cortisol levels increased two to three fold in about 70 to 80 percent of participants within one to 20 minutes after task demonstrating a link between a psychosocial task and allostatic response. It has been shown that if this short-term allostatic response is not curtailed through the HPA feedback loop or when the demand exceeds the person’s capacity to respond a number of changes occur which can sometimes lead to disease. Given RxAs can have an opposite effect suggests they have potential to prevent and treat stress-related medical disorders.

Patients experienced a large decrease in cortisol in the high-intensity treatment, which appears contradictory on the surface (increases in physical exercise typically increases cortisol). This could be simply be, however, the timing of sample collection, occurred approximately 10 to 15 minutes after the RxA3 allowing for cooling down and a reversal of cortisol flow or relaxation of the ANS. Since cortisol can now be measure in saliva immediately before and after a stimulus, future studies could control for this.

Since each RA may have different components, biological, emotional, cognitive, social and spiritual, it should be studied individually to determine prescriptive parameters. This is an arduous task to be sure but it is becoming more and more evident that RAs have many health benefits. There is an increasing urgency to focus on this important and growing area of healthcare because of its potential to be therapeutic and cost effective. Hence, research that defines the prescriptive parameters of these potentially healing activities is very valuable. This study provides a classification system based on METs intensity and a method and to delve further into the therapeutic aspects of RAs.

Alcoholism, stress, and emotion are inexorably intertwined. There is little doubt that the successful management of stress and emotion is necessary for alcohol abstinence. It seems reasonable to, therefore, develop and prescribe interventions that have demonstrated efficacy in reducing stress and improving mood. The fact that participation in RxA produces specific psychological and physiological change lends credibility to the notion that RAs possess a potential healing effect and could be used in this manner. It appears logical and prudent to develop RT protocols for managing the ANS thereby effecting stress-related medical disorders. Additional research is needed to elucidate the underlying physiological mechanisms and further increase prescription specificity.

Conclusions

RTs wanting to derive similar results can use the prescription provided in this article as a guideline, but more research is needed before this can be considered a standard approach. In addition, RTs are encouraged to refer to the RTM model, which provides a method to evaluate treatment effectiveness and to adjust their prescriptions accordingly.

Preliminary evidence suggests that a number of other similar therapeutic activities help facilitate ANS and HPA balance. For example, mindfulness-based stress reduction significantly improved quality of life, symptoms of stress, and sleep in early-stage
breast and prostate cancer. When researchers measured cytokine changes, they found that T cell production of IL-4 increased and IFN-γ decreased. In addition, NK cell production of IL-10 also decreased prompting them to conclude that there was a shift from one immune profile associated with depressive symptoms to a more normal immune profile. Using the same intervention, another study reported an overall reduction in mood disturbance (65 percent) and a (31 percent) decrease in stress symptoms.

Other novel interventions like music have been shown to positively affect the immune system. Significant increases in secretory immunoglobulin-A (S-IgA) were found after listening to recorded, classical music and using music as a vehicle for relaxation, researchers found IL-6 levels were significantly lowered afterward, whereas IL-1β, IL-10 remained unchanged. One group of researchers reported that complementary and alternative medicine therapies such as music and meditation are important in producing ANS & HPA balance and the immune response recommending immediate research in this important area.

Perhaps, the most important finding of this study was that participants experienced a consistent integrated positive HPA axis (cortisol) response to RAs similar to the therapeutic interventions described earlier. To prescribe RAs to prevent or treat stress-related medical disorders is a form of behavioral medicine much like other complementary and alternative medicine interventions.

These findings, therefore, have extremely important implications for RTs and their obligations to the client’s health-related outcomes. For one thing, RTs need to acknowledge that distinct biochemical changes occur when a client is placed in RAs. They should, therefore, strive for treatment specificity including the identification of potential adverse effects. Continuing to put clients in RAs without considering positive and negative biochemical changes is unethical and in some cases dangerous. RTs should reevaluate their treatments and create new RAs based on current research in medical science. Second, RTs have an obligation to explain these important biochemical changes in simple terms so that their clients understand the importance of their prescriptions. Hence, RT educators should teach students about specific biochemical changes associated with emotion, cognition, physical, and social activity as well as methods to structure RA prescriptions. Third, the professional associations that represent RT should update their definitions created before science demonstrated consistent physiological change related to specific RAs. Finally, RTs should be very excited to know that evidence uncovered in this study and others supports what our previous theories have purported; participation in RAs produces measurable positive health outcomes.

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