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EXERCISE TRAINING AS ADJUNCT THERAPY FOR SUBSTANCE USE DISORDER

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EXERCISE TRAINING AS ADJUNCT THERAPY
FOR SUBSTANCE USE DISORDER

By

Emily Lynn Roessel

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University of the Pacific
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2020

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FOR SUBSTANCE USE DISORDER

By

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DEDICATION

My sincere thanks to Drs. Mark VanNess and Courtney Jensen. These professors hold up the Health, Exercise, and Sport Sciences department. With limited resources they make our learning experience worth it all. Mark VanNess and Courtney Jensen dedicate their time and energy to their students, helping them through miles stones that put them on a path about which they are passionate.

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My gratitude goes out to Vechi Mutum for taking the time to introduce me to and get in contact with Tree House Recovery.

Special thanks to Justin McMillen and Ryan Bain from Tree House Recovery in giving me this opportunity. Without their involvement, I would not have been able to complete this thesis.

I want to also take this opportunity to acknowledge the creators of the modalities used in Tree House Recovery.

Justin McMillen is one of the developers of Action Based Induction Therapy (ABIT) along with Robert Funk and Neil Trusso. Robert Funk has a Bachelor of Architecture focusing on sustainable architectural design and environments that foster strong connected and healthy communities. He developed and currently oversees the admissions department, protocols and philosophies and is the chief marketing officer at Tree House Recovery (THR). Neil Trusso is the Director of the Physical Empowerment Department at THR. He has a background as a US Navy SEAL team member, has an advanced educational background in education, and is a coach for youth sports in the local community. He is an expert on team and social dynamics. His focus at Tree House is rebuilding drug-damaged brains, specifically the prefrontal cortex region, with fitness, meditation and team-based therapies. As the Physical Empowerment Director, Neil oversees Action Based Induction Therapy (ABIT), Exercitium Semita Medela (ESM), and Embodied Presence (EP) yoga therapy in Costa Mesa, California to ensure that every physical empowerment staff member is providing the best care possible.

Kathy Du Vernet, M.S., C-IAYT, E-RYT 500 is the developer of the Embodied Presence program and has been with THR since its inception. She is a Yoga Alliance registered advanced/experienced yoga teacher (E-RYT 500), continuing education provider through the Yoga Alliance Continuing Education Provider (YACEP), and a certified yoga therapist through the International Association of Yoga Therapists (C-IAYT). Kathy holds a bachelor's degree in theatre and dance and a master's degree in counseling psychology, and has over three decades of experience in the helping professions and movement arts. She holds certifications in Kripalu Yoga, Phoenix Rising Yoga Therapy, and The Yoga of 12 Step Recovery (Y12SR). In 2016, she completed 40 hours of trauma sensitive yoga teacher training with the Trauma Center of the Justice Resource Institute. In addition to her work at THR, Kathy teaches therapeutic yoga at the Veterans Administration Hospital in Long Beach, California and at the Dialectical Behavior Therapy Center's Intensive Outpatient Program in Newport Beach, California. She serves as a mentor and is on the Yoga Therapy School faculty for Be the Change Yoga and Wellness in Irvine, California.

Ryan Bain is the creator and developer of ESM, the Latin abbreviation for *Exercitium Semita Medela*, which roughly translates to "Exercise as a Pathway to Healing." ESM is THR group fitness therapy program. Bain is a mental health professional specializing in addiction treatment with an educational background in sociology and counseling psychology. His education is coupled with experience as an accomplished athlete, personal trainer, and sports coach which provides him a deep understanding into the therapeutic value of physical exertion and teamwork. He utilizes an integrative approach to counseling in order to adapt to client needs on their paths toward biological, psychological and social optimization. Along with working directly with clients in the helping profession, Bain is also on the Management Board of

Directors for Sparking Life Inc., a nonprofit organization dedicated to fueling a national movement to communicate the overwhelming evidence that physical exercise enhances brain development, improves mental health, reduces addictive behavior and helps maintain mental acuity as we age.

Geoffrey Blaylock, the creator and developer of Integrative Reformation Therapy, brings the insight of 15 years of experience in counseling and lecturing on Substance Use Disorder (SUD). Geoff understands what it takes to get sober and stay sober. He has developed a great understanding of and appreciation for the importance of educating those suffering with addictions in relation to the biological, psychological and social dynamics of their disease. Being a certified alcohol and drug abuse counselor and having years of firsthand experience, Geoff helps recovering addicts discover the strength and ability to steer clear of the trappings of relapse. Focused on optimal results and a passion to advocate for clients' success, Geoff is the guy you want in your corner when your life is on the line, because he doesn't rest until lasting solutions are found for each client.

George Coleman is the creator and developer of "Naked Writing," a unique, effective and integrative clinical modality offering an expressive outlet for all participants at THR. As a survivor of three combat tours as a U.S. Military intelligence specialist in Asia, and an unblemished history of sobriety for over 30 years, Coleman is a staff member with whom men can connect. George personally guides and directs clients through every stage of the program and has mentored and advised hundreds of young men seeking to understand and embrace their individual journeys.

EXERCISE TRAINING AS ADJUNCT THERAPY FOR SUBSTANCE USE DISORDER

Abstract

By Emily Lynn Roessel

University of the Pacific
2020

Exercise training for clients at out-patient drug rehabilitation centers likely helps with coping skills. However, a better examination of the mechanisms producing changes may help identify effective interventions. **PURPOSE:** To test the effect of a vigorous exercise prescription on drug abstinence in voluntary rehabilitation patients. **METHODS:** 25 surveyed participants in a male drug treatment program underwent a 12-week minimum training program. The program included moderate-rigorous exercise and psychotherapy. Three days per week all subjects participated in EP for 90 minutes. Subjects also participated in ABIT 3 days per week where each session lasted 2 hours. Subjects also participated in ESM which ran for 90 minutes 5 days per week. Within each week, program participants also completed between 2-3 hours of psychotherapy (individual and/or group) per day, varying depending on level of care and phase of the treatment process. Exercise performance and adherence, sobriety and relapse rates, and emotional coping skills were collected. **RESULTS:** Subjects experienced frequent relapse (5±8 occurrences) prior to admission; however, 84% were currently sober on completion of the program, 8% relapsed during treatment, and 36% relapsed after treatment. The longest duration of sobriety a subject achieved was 273±111 days. Post-treatment survey results indicate 84% of subjects still exercised regularly, 68% continued to practice yoga or meditation, and 60%

followed a diet that required disciplined awareness. Bench press max improved significantly throughout the program (39%; $p < 0.001$), as did squat (55% improvement; $p < 0.001$) and deadlift (69.8%; $p < 0.001$). On completion of the survey 91% of patients who exercised regularly were sober; 50% of patients who did not engage in regular exercise were sober on completion of the program ($P = 0.043$). Owing to a small sample of patients who relapsed during treatment ($N = 2$), the difference in exercisers who relapsed during treatment (5%) and non-exercisers who relapsed (25%) was not significant ($P = 0.171$). Twenty-nine percent of exercisers relapsed after treatment; 75% of non-exercisers relapsed after treatment ($P = 0.076$). The odds of managing adverse emotional states when they arose increased 20-fold among subjects who reported regular participation in exercise (Nagelkerke $R^2 = 0.333$; $P = 0.036$). Similarly, each additional day per week that a patient practiced yoga predicted a 20-day increase in duration of sobriety ($R^2 = 0.227$; $P = 0.016$). **CONCLUSION:** Exercise training exerts a statistically significant positive effect for sobriety and coping skills within a population that previously struggled with perpetual relapse.

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LIST OF ABBREVIATIONS

ABIT	action based induction therapy
β	beta
BDNF	brain-derived neurotrophic factor
CM	contingency management
DF	degrees of freedom
DSM– IV TR	Diagnostic and Statistical Manual of Mental Disorder, fourth edition, text revision
EP	embodied presence
ESM	exercitium semita medela
f	frequency
IRT	integrative reformation therapy
MRI	magnetic resonance imaging
r	correlation coefficient
sig.	significance
SUD	Substance Use Disorder
THR	Tree House Recovery

CHAPTER 1: INTRODUCTION

There is a growing body of evidence that assigns a panacea-like role to exercise. Exercising for just 30 minutes a day is reportedly capable of curing, or at least ameliorating, prevalent diseases in today's society (Thompson, 2019, pp. 72-73). Cardiovascular disease, type II diabetes, hypertension, and hyperlipidemia are now widespread diseases that are managed with prescription drugs. Resolving the issues with an exercise prescription can replace the need for medication and the impermanent effects it delivers (Metzl, 2015).

Substance Use Disorder (SUD) is a prevalent set of conditions that is centered around continued substance use despite the negative consequences (Hartney, 2020). Its negative consequences affect nearly 20% of the U.S. population (Weinstock, 2017). Worldwide, 15% of individuals will experience SUD in their lifetimes which contributes to approximately 250,000 global deaths per year from illicit drugs and 2.25 million deaths from alcohol use. Individuals who suffer from SUD are generally less likely to meet physical activity guidelines (Linke, 2014). More than 85% of individuals in a standard substance use program relapse within the first year of treatment and two-thirds relapse within 2 weeks to a month from the start of the program (American Addiction Centers [AAC], 2019).

Exercise has been suggested as adjunct therapy for SUD due to the wide range of positive benefits of physical and mental health it provides. Growing research suggests exercise advocates for intrinsically rewarding, engaging, healthy, and safe alternative behaviors that have a broad range of positive health and mood enhancing benefits, which have the capacity to reduce acute effects of withdrawal (Linke, 2014, p. 2).

The American College of Sports Medicine defines exercise as physical activity done to improve or maintain physical fitness. Physical fitness can be categorized as occupational, recreational or transportation.

Even though exercise has been suggested as a treatment for SUD, there are some concerns with the adherence to and development of an integrated intervention of motivational interviewing and contingency management (CM). Exercise training and CM are still widely controversial even though there has been evidence of consistent improvement in SUD treatment (Petry, 2017, p. 1). Weinstock (2017) reviews SUD as maladaptive patterns that are associated with psychiatric comorbidity, unhealthy lifestyle choices, and high rates of relapse. He recognizes that there are long- and short-term benefits to exercise but there is concern of relapse risk factors, low adherence and high attrition rate that reduce the benefits of regular exercise.

Though major weaknesses still exist, there has been significant research on exercise as an adjunct therapy to SUD and its positive effects to treatment engagement and sobriety adherence. Multiple mechanisms, including physiological, neurobiological, psychological, and behavioral have been identified and are under further investigation (Linke, 2014, p. 2). In this study, a subjective questionnaire was given which skewed data based on individuals' biased opinions.

History

Justin McMillen created the Tree House Recovery Model for Treating Substance Use Disorder. The model has a specific admissions process and consists of five interdependent modalities (therapeutic interventions). Three are physical in nature and two are focused on psychology.

Justin McMillen has been obsessed with the human condition since childhood. He has had personal experience with addiction and mental illness. Through his own healing and desire

to understand himself, he began to look at humanity through a lens of 50,000 years. This led him to the obvious realization that human beings have jumped off the evolutionary plane in the last 100 years or so. We are genetically much the same as our ancestors of the past however the environment and social conditions in which we live now are wildly different (National Institution of Health, 2007). This realization led Justin McMillen to ask a simple question that led him to the creation of The Tree House Recovery Model for Treating Substance Use Disorder.

Justin asked himself, “How has the change in our environment affected us in a way that no longer honors our genetic makeup?” He came up with two conclusions. One, since humans have gained the ability to harness electricity, we have stopped moving and lost a connection with our physical bodies. This has led to less kinetic energy expenditure, and an overall disconnection with a felt sense of the body and an understanding of the body as a tool to do work. Two, since human beings have gained the ability to harness electricity, we have grown more isolated and less dependent on each other which appears to be growing worse every day.

He then asked himself, “What if?”. What would happen if he created a program that got patients in a physical condition that was similar to that of our ancestors 100 years ago (pre-industrial revolution) and got patients to connect with others in ways that were similar to a tight-knit interdependent tribe. With this in mind and the help of some brilliant minds, Justin created Tree House Recovery (THR).

There are three components to the admissions process at THR. Logistics of payment is the first step to see if insurance and/or private pay will cover the cost of treatment. Second, there is the clinical portion to ensure that all the self-reported information the client provides is correct. This will provide knowledge that will establish if this program is the right fit for the individual.

The third component is peer approval. This component consists of a 45-minute interview with clients who are currently in the program. The purpose of the peer approval is to evaluate if the incoming client will be a benefit to the team already enrolled in the program.

Justin created this component to help create a bond that strengthens and enhances the team of individuals for the remainder of the treatment process. This keeps each individual accountable throughout the program. The client will get accepted into the program if there is a unanimous vote from the team.

There are three body-based modalities that comprise the Physical Empowerment Department at THR.

The first modality is Embodied Presence (EP). EP consists of yoga and mindfulness practice focused on recalibrating the central nervous system. The second modality is Action Based Induction Therapy (ABIT). This therapy uses a platform that comes from U.S. Navy Seal team training exercises. It focuses on rebuilding prefrontal cortex functionality in order to develop a more socially healthy human being. Lastly, Exercitium Semita Medela (ESM) is a hybrid of cardiovascular conditioning, interval and resistance training in conjunction with supportive psychotherapeutic approaches, promoting a robust mind-body connection for individuals newly entered into sobriety.

Two psychotherapeutic modalities comprise the Clinical Department at THR. The first psychology modality is Naked Writing. This therapy uses a series of specific writing assignments that are designed to help heal trauma and repair the working memory. The second psychology modality is Integrative Reformation Therapy (IRT), which is a combination of a college-level addiction education class combined with individual therapy and psychosocial group

counseling. The same therapist facilitates All IRT components. This allows the therapist to better understand and connect to each client.

Definitions

Oxford Medical Dictionary defines the following terms, which are included to give the reader a better understanding of this study.

- Adipose tissue: fibrous connective tissue packed with masses of fat cells.
- Connective tissue: a tissue of mesodermal origin that consists of various cells (such as fibroblasts and macrophages) and interlacing protein fibers (as of collagen) embedded in a chiefly carbohydrate ground substance, that supports, and binds together other tissues, and that includes loose and dense forms (such as adipose tissue, tendons, ligaments, and aponeuroses) and specialized forms (such as cartilage and bone).
- Chemokines: any class of cytokines with functions that include attracting white blood cells to sites of infection. Chemokines are vital to immune functions.
- Endorphins: any group of endogenous peptides found especially in the brain that bind chiefly to opiate receptors and produce some pharmacological effects (such as pain relief) like those of opiates.
- Glial cells: surround neurons and provide support and insulation between them.
- Gliogenesis: the developmental process in which glial cells are generated.
- Hypothalamic pituitary adrenal axis: a complex set of direct influences and feedback interactions among three components the hypothalamus, pituitary, and adrenal glands.
 - Hypothalamus: a small region of the brain that is located at the base of the brain. The hypothalamus plays a crucial role in many important functions, including releasing hormones and regulating body temperature.
 - Pituitary gland: a small pea sized gland located in the brain that plays a major role in regulating vital body functions. This gland is referred to as the body's "master gland" because it controls the activity of most other hormone-secreting glands.
 - Adrenal gland: endocrine glands that produce a variety of hormones, including epinephrine (adrenaline) and the steroids aldosterone and cortisol. They are found above the kidneys.

- **Inflammation:** a local response to cellular injury that is marked by capillary dilation, leukocytic infiltration, redness, heat, and pain and that serves as a mechanism initiating the elimination of noxious agents and of damaged tissue.
- **Mitochondria:** round or long cellular organelles of most eukaryotes that are found outside the nucleus, produce energy for the cells through cellular respiration, and are rich in fats, proteins, and enzymes.
- **Neurogenesis:** the process by which nervous system cells and neurons are produced by neural stem cells.
- **Neurotransmitters:** a substance (such as norepinephrine or acetylcholine) that transmits nerve impulses across a synapse.
- **Parasympathetic nervous system:** part of the autonomic nervous system. This nervous system is sometimes referred to as the rest and digest system, conserving energy as it slows heart rate and increases intestinal and gland activity.
- **Proliferation:** rapid reproduction of a cell or an organism.
- **Rapamycin:** a drug used to keep the body from rejecting organ and bone marrow transplants. Rapamycin blocks certain white blood cells that can reject foreign tissues and organs. It also blocks a protein that is involved in cell division. It is a type of antibiotic, a type of immunosuppressant, and a type of serine/threonine kinase inhibitor.
- **Spinogenesis:** the development of connectivity via dendritic spines in neurons.
- **Vagal tone:** refers to the activity of the vagus nerve, the tenth cranial nerve and fundamental component of the parasympathetic nervous system. It is not under conscious control and is largely responsible for the regulation of several body compartments at rest.
- **5-HT_{2C}:** a receptor that is a subtype of 5-HT receptor that binds the endogenous neurotransmitter serotonin (5-hydroxytryptamine, 5-HT). It is a G protein-coupled receptor (GPCR) that is coupled to G_q/G₁₁ and mediates excitatory neurotransmission.

Basic Assumptions

There were two basic assumptions made in this study.

It was assumed that each subject participating in this study completed the questionnaire with integrity and honesty.

It was assumed that each participant gave their full effort and adhered to the protocols for training and therapy.

Limitations

Limitations are defined as influences that the researcher cannot control and place restrictions on the methodology and conclusions.

The following limitations occurred in this study:

There is the acknowledgment of varying motivational levels from each individual as well as different variations in activity before entering the program.

There were only 25 participants in this study accounting for a small sample size.

A subjective questionnaire was given to patients

Delimitations

Delimitations are choices made by the researcher which should be mentioned. They describe the boundaries the researcher sets for the study.

The following delimitations were established for this study:

The age range for participants was 18 to 22 years of age.

Only male participants were involved in this study.

Research Form Hypothesis

The following experimental hypothesis was made for this study: There is more likelihood of sobriety for individuals who adhere to a sobriety program for substance dependence in addition to following a strict diet and exercise regime.

Justification

This study attempted to show the relationship between an exercise regime in adjunct to psychological approaches by answering the following questions: Will the participants involved have increased days in sobriety? Will the participants' mental health improve?

Every participant took the questionnaire referenced in the Appendix B. Twenty-five males who recently took the survey were chosen at random for the purpose of this study. With this questionnaire, bivariate correlations, chi square and linear regressions were ran through SPSS to analyze the effectiveness of the program.

CHAPTER 2: REVIEW OF LITERATURE

This section is divided into four categories: Description of modalities used in Tree House Recovery (THR), the positive relationship exercise has on sobriety and mental health, exercise as an adjunct therapy to Substance Use Disorder (SUD) and the physiology of exercise in the brain.

Description of Modalities

Active addiction not only disconnects people from their families and from life, but also disconnects people from themselves.

Embodied Presence Yoga

Embodied Presence (EP) is a mindfulness-based, therapeutic yoga practice designed to help men in early recovery from substance use recapture their relationships with their bodies, minds, hearts, and spirits in a gentle and compassionate way. It combines trauma-informed yoga, focused breathwork, and mindfulness meditation to help clients in recovery reconnect with themselves. EP yoga looks much like a traditional yoga class, but what is different is the lens people use to treat addiction. It is a method that is rooted in love, yoga philosophy, and recovery themes, as well as in positive and somatic psychology, trauma theory, and neuroscience.

Tree House Recovery believes, and some scientific research supports the idea, that practicing meditative yoga in a thoughtful and systematic way not only makes men feel better physically but also changes their brain and nervous system functions in a positive way. Among other things, EP yoga helps clients build a strong mind and body connection, the capacity to be present in the here and now, an ability to see themselves and the world with clarity and compassion, and a facility for emotional and mental calm. Some studies have shown that mindful yoga can reduce stress, anxiety, and depression, as well as improve vagal tone and heart

rate variability, which have been linked to increased resilience under stress as well as to positive emotional and cognitive self-regulation.

According to the United States Association for Body Psychotherapy (2014), becoming more aware of bodily sensations, emotions, images and behaviors can be useful for those with eating disorders, addiction and/or trauma. The connection between mind and body gives a participant the ability to practice breaking out of rigid patterns of living and become more conscious of their breathe, movement, speech, and the location and experience of feelings in their bodies (p. 112).

David Emerson and Elizabeth Hopper of the Justice Resource Institute and authors of the book *Overcoming Trauma Through Yoga: Reclaiming Your Body* discuss that trauma affects the body's physiology since these memories are stored somatically. Due to this they believe that trauma treatment must incorporate the body (pp. 1-23).

Body-oriented therapies such as yoga focus on making connections at a somatic level. Therapists can then assist clients to move from that entry point to addressing emotions and cognitions. Yoga uses a series of postures and breathing techniques to build a sense of connection to the self. Practitioners develop a capacity to remain present, to notice and tolerate inner experience, and to develop a new relationship with their bodies. This can then have a ripple effect on emotional and mental health, on relationships, and on a person's experience of living in the world. The study of yoga, mindfulness meditation and other body-oriented therapies as treatment for addiction specifically is still in its early stages. In their 2013 paper "A Narrative Review of Yoga and Mindfulness as Complementary Therapies for Addiction," Khanna and Greeson support the idea of yoga and mindfulness as a complimentary therapy for

treating and preventing addictive behaviors for individuals who experience smoking, alcohol dependence, and illicit substance use.

There are two early morning and one late afternoon EP group sessions provided to clients weekly. All sessions are designed, sequenced, and delivered in order to create a safe and inviting space for introspection, growth, and healing.

Action Based Induction Therapy

Action Based Induction Therapy (ABIT) is a combination of neurobiological restructuring by way of carefully orchestrated physical activity as well as psychosocial group therapy, which is used to develop optimal prefrontal cortex function. These two therapies work interdependently to treat various types of maladaptive behaviors. These therapies unite the team of individuals participating and provides them with deep interpersonal connections. One of the therapist's primary goals in ABIT therapy is to help nurture bonds that are so powerful that they act as a lifelong support system for each individual participant.

One example of group activity that occurs in ABIT therapy is group exercise that helps participants deal with stress. The group gets in a life raft and paddles out into the water off the shore. As a group, they must work together to paddle back to shore. This activity helps create the social support needed in recovery and helps participants learn coping skills for stressful situations. These coping skills are then used for natural stressors that occur in life in hopes to prevent relapse.

Exercitium Semita Medela

Exercitium Semita Medela (ESM) is the Latin abbreviation for "Exercise as a Pathway to Healing." Ryan Bain created ESM as a form of addiction treatment at THR in Costa Mesa, California. ESM is a hybrid of cardiovascular conditioning, resistance training and supportive

psychotherapy, which promotes sustainable neurobiological and psychological growth in individuals newly entered into sobriety. ESM is a 12-week progressive periodization scheme utilizing specific exercise methods and techniques as forms of eustress on the neurobiological system inducing periodic homeostatic disturbances and causing the brain and body to heal, adapt, and grow over time. Some of the methods include the following.

Aerobic exercise. This is any type of exercise, typically those performed at moderate levels of intensity for extended periods of time while maintaining an increased heart rate, anywhere from 60-80% of an individual's maximum heart rate (MHR). In a study published by the National Institute of Health on the work of James A. Blumenthal, Ph.D., Patrick J. Smith, Ph.D., and Benson M. Hoffman, Ph.D., appropriate dosages of high intensity expenditure aerobic work proved to be an effective treatment for depression.

Resistance training. This is any type of physical exercise that specializes in gradually increases the body's ability to resist force typically through the consistent use of free weights, machines, or an individual's bodyweight. Some of the benefits include building a stronger heart, reducing blood pressure, improving blood flow, promoting muscle growth, helping to control blood sugar and improving cholesterol levels.

High volume training. This is a training technique that involves performing a high number of sets, repetitions, or both, for an extended period of time. This method results in an anabolic boost increasing muscle gain, strength and endurance.

Tempo training. This is a method where an individual deliberately changes the pace of the exercise by controlling the weight being pushed or pulled during the eccentric or concentric phase of the movement to create more time under tension. This helps to strengthen mind-body

awareness, develop connective tissue strength, improve body control and encourage stabilization. This also supports more muscle growth than most normal tempo movements.

Multi-joint complex movements. These are exercises that engage two or more different joints to fully stimulate entire muscle groups and multiple muscles simultaneously. The body has to work along a kinetic chain and large portions of the body assist other portions of the body. These exercises require a more significant energy output, cause greater systemic stress than isolation movements, create greater increases in metabolic rates, and are also known to stimulate natural testosterone and growth hormone production. The brain has to think harder and the body has to work together to complete these types of movements. Essentially, the brain and body work harder and experience more benefits in less time.

Supra-maximal interval training. This is a training technique that alternates between absolute maximal energy output levels and complete rest recovery intervals. Incorporating this technique into a routine allows participants to experience improvements in maximal oxygen uptake and develop a higher lactate threshold and tolerance, more efficient lactate clearance, better glycogen utilization, better body compositions and improvements in relative power output. This helps boost metabolism, burn calories and fat hours after exercise, make more effective use of time while exercising, build endurance and increase heart health.

Positive Relationship Between Exercise, Sobriety, and Mental Health

Current literature explores exercise and the effects it has on sobriety. In the United States teenagers who reported lower physical activity had higher alcohol consumption (Pate et al., 1996, pp. 1577-1581). A study on Spanish adolescents suggested that there is an inverse relationship between physical activity and tobacco dependency (Rodriguez Garcia et al., 2014, pp. 12-18). Those with frequent physical activity in a school-aged population showed lower

rates of marijuana use (Kulig et al., 2003, pp. 905-912). Physical activity prevents smoking in adolescents and young adults (Charilaou et al., 2009, pp. 969-976). Prevention of substance use in later adulthood may be linked to suppression of substance use in adolescents and physical exercise in younger ages. A nation-wide survey in United States middle schools found that students with active participation in popular sports are less likely to become heavy smokers in adulthood (Escobedo et al., 1993, pp. 1391-1395). Higher rate of illicit drug abuse in early adulthood is associated with a sedentary lifestyle in adolescents (Korhonen et al., 2009, pp. 261-268).

Mikkelsen (2008) saw the abundance of literature on the positive effects of exercise on mood states such as anxiety, stress, and depression through physiological and biochemical mechanisms. The physiological and biochemical mechanisms include endorphins, mitochondria, mammalian target of rapamycin, neurotransmitters, and the hypothalamic pituitary adrenal axis. In this article, it was also found that exercise reduces inflammation via several different processes, including inflammation, chemokines, toll-like receptors, adipose tissue, and the vagal tone, which can contribute to better health outcomes in people suffering from mood disorders.

Elisabeth Zschucke (2012) discusses the beneficial role of exercise intervention in psychiatric disorders, especially in SUD. With exercise intervention there is evidence of the reduction of craving, mood regulation in conjunction with anxious and depressive symptoms and stress reactivity (pp. 1-19).

One of the most prominent factors of relapse in the recovery of SUD is acute craving. There is evidence in tobacco use patients that exercise intervention can negate the craving of use along with the negative moods associated with withdrawal. The negative moods associated with withdrawal include stress, anxiety, and depression which create a higher risk for relapse. Studies

show that different types of exercise, aerobic or anerobic, improve mood regulation in patients suffering from SUD. With the improvement of mood, there is the reduction of anxious and depressive symptoms. Depression is one of the most prevalent disorders found in SUD patients and is a negative predictor for treatment outcome.

Subjective stress is also a factor that is involved in relapse. Rimmelé (2007) states that exercise can work against everyday stress, and that there is a reduction in the reaction to psychosocial stressors in those who are trained (pp. 627–635). This suggests that with a higher activity level in an individual, the less impact and easier it is to cope with everyday stress. This seems important since everyday stress can contribute to early relapse.

Another key factor to sobriety and the prevention of relapse is a strong social network. Brooks (2003) says that group exercise may help to improve communication skills, conflict management, and frustration tolerance in those recovering from SUD. Having a strong social network helps with coping skills that will help with stressful or difficult situations. Exercise is another coping strategy for emotional regulation (pp. 153-164).

Exercise as Adjunct Therapy

Weinstock (2008) created a study that investigated the relationship between completing exercise-related activities and SUD treatment to discover the outcome in an outpatient sample receiving contingency management treatments. He found that those who completed an exercise-related activity had significantly longer durations of abstinence compared to those who did not. Suggestions for continuing this research include incorporating exercise into SUD treatment via CM. He then states that “exercise programs can be structured such that the behavior is monitored and reinforced” (p. 1).

A pilot study by Brown (2010) examined the feasibility of aerobic exercise as an adjunct to SUD treatment among drug dependent patients. Participants included 16 (31% female, 38.3 years old) drug dependent patients who participated in a 12-week, moderate intensity aerobic exercise intervention. Participants attended a mean of 8.6 sessions, demonstrating a significant increase in percent days abstinent for both alcohol and drugs at the end of treatment. Those who attended at least 75% of the exercise sessions had significantly better substance use outcomes than those who did not.

Physiology of Exercise in the Brain

Zhang and Yuan (2019) conducted research on exercise and SUD created the following abstract:

Exercise intervention has long been used as one adjunctive treatment for drug abuse. Both animal studies and human trials suggest that exercise training effectively prevents addiction formation, suppresses drug seeking behaviors, and ceases addictions. Moreover, exercise improves both mental and cognitive deficits that commonly occur during drug withdrawal. Those observations are supported by neurobiological studies in which exercise training modulates several neural networks including the dopaminergic reward system, regulating neurogenesis and spinogenesis that affect cognitive behaviors and mental health. In sum, exercise training is a safe and effective way to relieve substance abuse, although both intervention guideline and biomarkers warrants further investigation. (p. 269)

The authors acknowledged the possibility of exercise training modulating the midbrain dopaminergic reward system, which would antagonize the disruption by addicted drugs. Exercise may also help to promote neurogenesis and gliogenesis for relieving addiction behaviors (p. 274).

Exercise is a stimulant for neurogenesis and aides in the recovery of hippocampal neurogenesis. It is a factor that reduces drug vulnerability and recovery and enhances the secretion of neurotrophic factors (p. 275).

In addition to neurogenesis, gliogenesis contributes to addictive behaviors and can be affected by exercise training. Impaired gliogenesis from methamphetamine intake was corrected in voluntary exercise training (Mandyam et al., 2007).

Exercise also can relieve some of the related symptoms of addiction and drug withdrawal effects, including mental and cognitive deficits (Figure 1). With exercise training promoting neurogenesis and activating neuronal activities in the hippocampus, it can be used as an effective way to prevent and reduce drug addiction. Zhang (2019) came to the conclusion that exercise can be used as a reward system, exerting the effects on neural plasticity. In SUD, the reward system is modified by drug addiction. Exercise may modify the reward system and modulate drug-seeking behaviors and cognitive functions (p. 276).

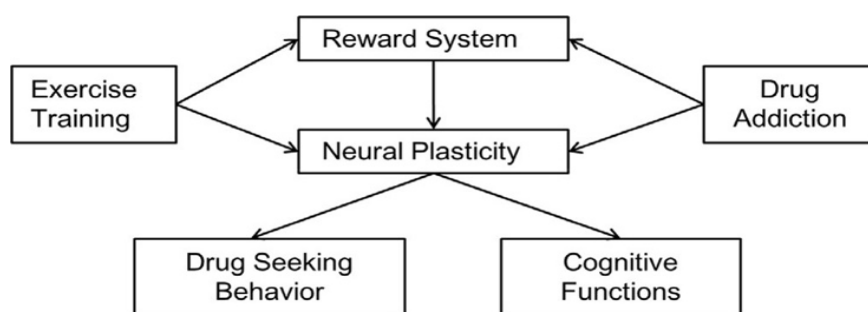


Figure 1. Model for exercise intervention of drug addiction. Adapted from “Exercise and Substance Abuse”, by Li Zhang, 2019, *International Review of Neurobiology*, volume 147, page 276. 2019, Elsevier Inc.

Major questions and challenges still exist to delay a large-scale adoption of exercise training. First, the article suggests the need for further research to decide the correct exercise intensities and durations in suppressing addiction behaviors. Then, researchers should identify effective and objective biomarkers for exercise intervention. Last, research should establish guidelines for exercise paradigms for different conditions. Li Zhang (2019) comes to the

conclusion that to address those issues, there is a need for further analyses of neurobiological mechanisms in exercise intervention.

Zschucke (2012) examines the neurochemical alterations of exercise interventions. She found that there is a malfunction of the dopaminergic, glutamatergic, and opiodergic neurotransmission in alcohol-dependent individuals (pp. 1-19). This defect has been linked to craving and relapse in SUD patients (as cited in Heinz, 2009, pp. 108- 118). Research has supported this theory both in animal and human studies. Some animal studies suggest that there are corrections in transmitter systems associated with exercise therapy. Modifications to transmitter release, uptake, turnover, receptor density, and sensitivity were all transformed with chronic exercise. In humans, there have been reports of downregulation of postsynaptic serotonin 5-HT_{2C} in panic patients and reductions in prefrontal and limbic/paralimbic opioid receptor availability. Brain-derived neurotrophic factor (BDNF) secretion after endurance training suggests that it may be linked to neuroprotection and plasticity.

Brene's (2007) article discusses that patients who suffer from SUD only experience a positive relaxed state of mind with substance consumption. Exercise changes neurotransmission which can induce an internal reward stimulus that can give patients the same effect as drug consumption by producing a similar positive state of mind (pp. 136-140).

Rensburg's (2011) research in "The Effects of Exercise on Cigarette Cravings and Brain Activation in Response to Smoking Related Images" touches on the topic of substance-related cues/stimuli that acquire incentive motivational properties. She acknowledges that there is an increased activation in regions of the brain when viewing smoking related stimuli versus exposure to neutral stimuli. Regions of the brain include the mesocorticolimbic dopamine system, which includes the nucleus accumbens, amygdala, hippocampus, prefrontal cortex,

orbitofrontal cortex, and anterior cingulate, and areas of the visuospatial attention system (parietal cortex and fusiform gyrus) (p. 2). With this information, she conducted research on 20 smokers who smoked at least 10 cigarettes a day and have been regular smokers for 2 years or more. She conducted MRI scans to see the effects that exercise had on the brain.

Rensburg conducted a crossover design study with 20 participants who abstained from smoking for 15 hours. Self-reported cravings were taken at baseline, mid exercise, and post exercise. The purpose of this study was to take MRI scans to assess the effect of exercise on regional brain activation. Smoking-related and neutral images were used to activate brain regions associated with cravings. Since cravings was a factor of early relapse, Rensburg wanted to see the effects exercise has on brain activation vs. non-active treatment. Half of the participants then went through a 10-minute moderate intensity stationary cycling and the other half was seated (at rest) for the same duration. After the 10-minute duration, participants underwent an MRI scan while viewing smoking and neutral images. She found that those who exercised had significantly lower scores for desire to smoke compared to those who sat for the 10-minute duration.

Exposure to smoking cues activated the insula, a limbic structure that is thought to mediate the autonomic responses to drugs of abuse in participants who rested for the 10-minute duration. In those who exercised, there was less activation in the superior parietal lobe, a region that has been implicated in visual attention, when viewing the images compared to those who were at rest (p. 6). This research found activation in the cuneus and the inferior occipital gyrus extending to the middle occipital gyrus in response to smoking images compared to no activation found in response to the neutral images. In the resting group, there was activation in the inferior

and middle occipital gyri, which has been associated with the primary visual cortex in response to the smoking images (Figure 2).

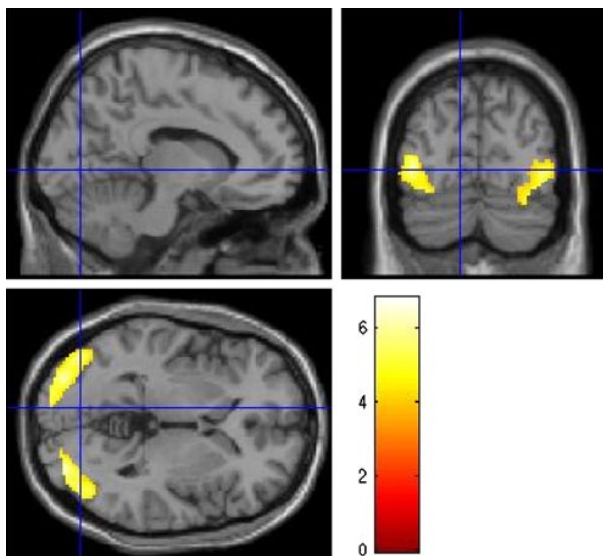


Figure 2. Image of the brain showing enhanced activation to smoking in control treatment. Adapted from K. Rensburg, A. Taylor, A. Benattayallah, and T. Hodgson 2012, “The effects of exercise on cigarette cravings and brain activation in response to smoking-related images”, *Psychopharmacology*, volume 221, page 665. 2011 by Springer

They came to the conclusion that this was because the individuals allowed themselves to experience cigarette cravings with evidence of heightened activation in areas of the brain associated with primary and secondary visual processing. It was also shown that activity in the cuneus was positively correlated with nicotine dependence. This study may point to a neurocognitive process in the brain that follows exercise leading to mediation of cigarette craving effects.

Following the session of exercise, the individuals showed no activations to smoking images (Figure 3). This suggests that a session of exercise may cause a shift in regional brain responses in a similar way that smoking or being satiated does.

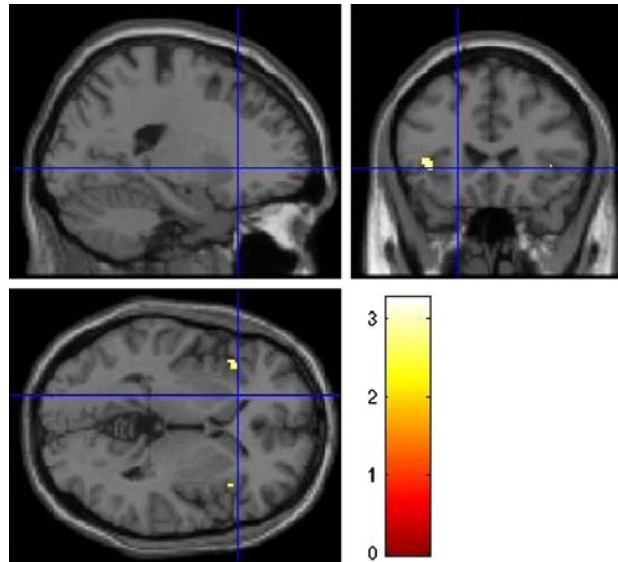


Figure 3. Image of the brain showing enhanced activation to smoking after exercise. Adapted from K. Rensburg, A. Taylor, A. Benattayallah, and T. Hodgson 2012, “The effects of exercise on cigarette cravings and brain activation in response to smoking-related images”, *Psychopharmacology*, volume 221, page 664. 2011 by Springer

Rensburg thus came to the conclusion that a single exercise session can reduce subjective desire to smoke with the abstinence of nicotine (p. 5).

CHAPTER 3: RESEARCH METHODOLOGY

Tree House Recovery (THR) methods are discussed in this chapter, including the three physical modalities used in the program.

Twenty-five male participants went through a 12 week periodized exercise program. A hybrid recovery prescription was used to promote a sustainable neurobiological and psychological growth for individuals' advancement in addiction recovery, involving cardiovascular conditioning, resistance training, and supportive psychotherapy. These 25 participants were given a questionnaire to determine the outcomes of their treatment.

Five days a week, participants started off their days with a modality, either embodied presence (EP) with mindfulness practices and trauma-informed yoga therapy with traditional yoga practices, or action-based induction therapy (ABIT) lasting 2 hours. They then have a 30 to 45-minute break before exercitium semita medela (ESM) fitness therapy, which started at 8:30am and lasted 90 minutes (only 60 minutes of exercise not including warmup). Once a week they have an active recovery day, 2 hours of low-moderate intensity exercise.

Every EP session began with some gentle movement to prepare for meditation, an introduction to the session theme, and an approximately 10-minute breath centered meditation. The centering meditation guided clients to internally check in by noticing their breath, sensations felt in their physical bodies, their thoughts, their emotions, and how they experience their spirit in the moment.

Participants were then invited to report out loud on how they currently felt and what they noticed during the internal check in. The centering meditation was followed by warm-up poses. After warm-up poses, the 90-minute morning sessions included a series of standing, balancing

and flowing poses to enhance mental and physical flexibility; physical, mental and emotional strength; and internal focus, and to learn to breathe deeply so as to engage the parasympathetic nervous system, which helps calm the body and the mind. These sessions ended with cool down poses in preparation for deep rest, which included a short progressive or guided relaxation, and then a closing meditation and check out on how the participants were feeling and how they intended to use what they learned in EP during that day. The 2-hours late afternoon session included all of the above elements but also incorporated a series of deeply relaxing, restorative and long held, supported poses as well as a time for meditation, followed by a longer discussion of the session theme and self-reflection. Regardless of the poses introduced in a session, the purpose of the practice was to guide participants to connect deeply to their breath and their bodies in order to know themselves more fully, to become more comfortable with what they find, to more easily let go of habits that no longer serve them, and to embrace opportunities for personal growth and change, enhanced well-being, sustained recovery, and a healthy, thriving life.

Logistics

At the THR Orange County, California location, there was three different teams of clients participating in the session at once. At the THR Portland, Oregon location, there was only one team of participants participating in ESM sessions. Due to ESM's commitment to offer all clients the same programming and overall level of care, each individual session was broken up into three stations where each group completed multiple sets and reps of various exercises within each station. After 20 minutes at a station, participants then rotated to the next station and performed the next set of exercises until the 20- minute time frame expired. This process continued until every team completes all three stations. The same session structure continued for

an entire week. The following week participants began all sessions at their respective second station. The rotation process continued into the following week where each team began the session at their respective third station. Weights were adjusted with each passing week, considering the pre-exhaustion phases endured in each session. After 3 weeks the routine progressed into a new phase of the periodization scheme, and each team began back at their original station for the entire week. This process was repeated in a 12-week cycle. This method offered all participants on all teams the ability to enjoy the therapeutic benefits of the exact same workout program.

Time and Frequency

ESM sessions was run 5 days per week and were 90-minutes long on Mondays, Tuesdays, Thursdays and Fridays. ESM sessions was 120 minutes long on Wednesdays. All sessions started at 8:30am.

Check In

Sessions began with a “check-in” which took roughly 10-minutes depending on the size of the group and the topics covered. This was where clients expressed their mental, physical, and emotional state of being and typically assessed their states on a scale from 1-10. This was followed by a brief psychoeducational lesson. Therapist discuss concepts during “check ins”. The information was then carried over and expanded upon throughout the session when deemed appropriate based on participant needs.

Warm Up

The “check in” was immediately followed by a warm-up routine. The warm-up varied depending on the day and the specific exercises or activities in which the clients participated in.

The warm-up typically took 10 minutes to complete. Immediately after the warm-up concluded, the exercises began.

Exercise Regime

Immediately after warm-up, participants would be directed to their respective stations and the 60-minute exercise session officially began.

Check Out

Sessions always ended with “check outs” which was roughly 10-minutes in duration, depending on the size of the group and the topics covered. This was where participants revisited their mental, physical, and emotional states of well being prior to the session and discussed any changes they may have experienced. This was followed by feedback from their peer group as well as the ESM therapist. After each participant talked about their experience, the weekly concept was then revisited.

Appropriate parametric statistics were employed.

Bivariate correlations were conducted to determine relationships between two variables.

Chi square tests were done to establish how likely an observed distribution is due to chance and if it fits with the distribution that is expected.

Descriptive statistics were completed to show a simple summary about the sample and measures used in this study.

Linear regressions were applied to predict the value of the dependent variables based on the values of the independent variables.

Logistic regressions were used to describe data and explain relationships between the dependent variable and independent variable.

CHAPTER 4: RESULTS

Tree House Recovery (THR) was the source of data collection. A questionnaire was given to 25 male subjects, located in Appendix B.

Bivariate correlations were run to see whether there was a statistically significant linear relationship between variables in the data. The main result of a bivariate correlation is called the correlation coefficient represented by the letter "r". It ranges from -1.0 to +1.0. The closer "r" is to +1 or -1, the more closely the two variables are related. If "r" is close to 0, it means there is no relationship between the variables. This study found only positive correlations. A positive r value expresses a positive relationship between the two variables.

A small p-value (typically ≤ 0.05) indicates strong evidence against the null hypothesis. Researchers would then reject the null hypothesis. A large p-value (> 0.05) indicates weak evidence against the null hypothesis. Researchers would then fail to reject the null hypothesis.

Bivariate correlations found in this study are as followed:

Currently sober: exercised regularly ($r=0.405$; $p=0.045$).

Longest duration of sobriety at THR: following diet that requires discipline ($r=0.358$; $p=0.079$), average days per week practicing yoga or meditation ($r=0.476$; $p=0.016$).

Relapse after treatment: exercise regularly ($r= -0.355$; $p=0.082$), following diet that requires discipline ($r= -0.408$; $p=0.043$).

Times treated prior to THR: baseline squat strength ($r= -0.439$; $p=0.060$).

If the subject has a history of methadone or suboxone: exercise regularly ($r=0.419$; $p=0.037$), days per week practicing yoga or meditation ($r= -0.402$; $p=0.047$).

Make your bed every day: exercise regularly ($r=0.600$; $p=0.002$), average days per week practicing yoga or meditation ($r=0.364$; $p=0.074$).

Whether participants successfully addressed adverse conditions when they arose: Exercise regularly ($r=0.510$; $p=0.009$), deadlift change ($r=0.488$; $p=0.034$).

After leaving, whether still connected with other THR graduates: Exercise regularly ($r=0.676$; $p<0.001$).

After leaving, how many THR graduates are they in touch with: Exercise regularly ($r=0.707$; $p<0.001$).

Highest level of education: Days per week practicing yoga or meditation ($r=0.510$; $p=0.009$).

Self- chosen mentor/coach/advisor in life: Exercise regularly ($r=0.405$; $p=0.045$), days per week practicing yoga ($r=0.456$; $p=0.022$).

Average nightly hours of sleep: Exercise regularly ($r=0.656$; $p<0.001$), follows diet that requires discipline ($r=0.433$; $p=0.031$).

How often one “connects with nature”: Exercise regularly ($r=0.528$; $p=0.007$), days of yoga ($r=0.369$; $p=0.070$).

Maintaining energy levels throughout the study: Exercise regularly ($r=0.846$; $p<0.001$), diet that requires discipline ($r=0.452$; $p=0.023$).

Subjects experienced frequent relapse (5 ± 8 episodes) prior to the current admission.

Across the sample, 84% were sober on completion of the survey, 8% relapsed during treatment, and 36% relapsed after treatment. During the program, 84% exercised regularly, 68% practiced yoga, and 60% followed a disciplined diet (Table 1).

Table 1
Descriptive Statistics of the Population with Regards to the Variable

Variable	N	No	Yes
Currently Sober	25	16.0%	84.0%
Relapsed During Treatment	25	92.0%	8.0%
Relapsed After Treatment	25	64.0%	36.0%
Exercised Regularly	25	16.0%	84.0%
Practices Yoga	25	32.0%	68.0%
Follows Disciplined Diet	25	40.0%	60.0%

Bench press max improved over the program (39%; $p < 0.001$), as did squat max (55%; $p < 0.001$) and deadlift max (69.8%; $p < 0.001$). Among patients who exercised regularly, 91% were sober on completion compared to 50% of patients who did not engage in regular exercise ($p = 0.043$) (Table 2). Owing to a small sample of patients who relapsed during treatment ($N = 2$), the difference in exercisers who relapsed during treatment (5%) and non-exercisers who relapsed (25%) was not significant ($p = 0.171$). Following treatment, 29% of exercisers and 75% of non-exercisers relapsed ($p = 0.076$) (Table 2).

Table 2
Chi Square Analyses of Demographics Consisting of Two Variables

Variable	N	No Improvement	Improvement	Sig.
Bench Press Max	25	61.0%	39.0%	P<0.001
Squat Max	25	45.0%	55.0%	P<0.001
Deadlift Max	25	30.2%	69.8%	P<0.001
Variable	N	Did Not Exercise Regularly	Exercised Regularly	Sig.
Sober	25	50%	90.5%	P=0.043
Relapsed After Treatment	25	75%	28.6%	P=0.076

The odds of successfully managing adverse emotional states when they arose increased 20-fold in subjects who exercised regularly ($p=0.036$) (Table 4). Each additional session of yoga per week predicted a 20-day increase in the longest duration of sobriety ($p=0.016$) (Table 3).

Table 3
Linear Regression of Length of Sobriety During Treatment Based on Yoga and or Meditation Attendance

R² = 0.227	Variable	Unst. β	95% CI		t	Sig.
			Lower	Upper		
Error: 99.291	Mean Number of Days of Yoga or Meditation	20.392	4.142	36.643	2.596	P=0.016
F = 6.739	Dependent Variable: Longest Duration of Sobriety During Treatment					
P = 0.016	DF (regression): 1 DF (residual): 23 DF (Total): 24					

CHAPTER 5: DISCUSSION

Based on the results of this study, exercise appears to exert a positive effect on drug and alcohol sobriety and coping skills in a population that struggles with frequent relapse. The isolated effect of different modalities of exercise has not been clearly defined. Yoga and heavy resistance training coupled with rehabilitation therapy both appear to enhance drug abstinence.

Results suggest the following:

Hydration is inconsequential.

There is an importance of sleep in max speed ($p=0.039$) and peak power watts per kg ($p=0.068$). Max speed of low sleep group was 20.8rpm while max speed of high sleep group was 24.9rpm. Peak power watts per kg of high sleep group was 1.8 and peak power watts per kg of low sleep group was 1.5.

Abstaining from food is inconsequential.

Abstaining from exercise in the last 24 hours shows importance in max speed ($p=0.036$) and peak power watts per kg ($p=0.055$). Max speed in groups that abstained from exercise was 24.3rpm compared to max speed of those in the exercising group being 19.2rpm. Peak power (watts/kg) in abstaining group was 1.8. compared to exercising group of 1.4.

Abstaining from caffeine is inconsequential.

Previous training is inconsequential.

These findings can help create future studies in exercise training programs as adjunct therapy.

Further examination of the mechanisms producing these changes may help identify more effective interventions. Although further research is needed to establish prescriptive volumes and type of exercise, the effect is beneficial even without consideration of the physical health outcomes. Some of the beneficial health outcomes include control of weight, reducing risk of heart disease, management of blood sugar and improved mental health.

Further research factoring in some of the limitations and delimitations will show the effectiveness of an exercise program on sobriety.

The literature review and results of the study developed several items of interest for discussion. Major challenges still exist for the adoption of exercise as an adjunct therapy for Substance Use Disorder (SUD). Although a large amount of research has been done on the subject, there are still many unanswered questions with no established guidelines for exercise programs for patients with different conditions or addictions. There is also the need for further research on the correct exercise intensities and durations for suppressing addiction behaviors.

Psychology can be difficult to study due to the complexity of the human brain is. Even with today's medical achievements, there are no effective and objective bio-markers that can be identified for exercise intervention. To address these issues, there is the need to analyze the neurobiological mechanisms of exercise intervention.

Abrantes (2019) discusses some potential mechanisms that could help further research on exercise as an adjunct therapy for SUD. She hypothesizes some biopsychosocial mechanisms based on research on neurobiological pathways. She suggests that exercise activates the dopaminergic brain reward system, which is similar to most drugs used in abuse. With this in mind, exercise can potentially normalize the disrupted dopaminergic signaling in those suffering from SUD (pp. 103-108).

Another hypothesis discussed in the article is that through the production of endogenous opiates, exercise may serve as a competing reinforcer and help decrease drug urges and cravings. Researchers can then hypothesize that in the case of alcohol use, there can be a decrease in alcohol cues post exercise.

Another potential mechanism involves the effects of exercise on improved cognitive functioning. Chronic drug use leads to neurocognitive consequences. This includes executive functioning deficits and learning and memory difficulties, which can impact treatment retention, and success and be a factor of early relapse. Many studies suggest that regular exercise improves cognitive functioning both acutely and long term. With improved cognitive functioning in SUD patients, exercise may help in preventing relapse.

There are a few other potential mechanisms to consider that pose risks for relapse. Exercise can be an effective non-pharmacological resource for sleep difficulties, which is a significant factor for early relapse. The social support of group activities with individuals who have similar experiences could help abstinence. Petry (2005) suggests that SUD treatment is rarely implemented in community-based settings and shows to be efficacious (pp. 1-8). Lastly, self-efficacy and sense of accomplishment from exercising can help with maintaining sobriety.

As explained in Sari's (2019) journal, there are some factors contributing the dropout rate of participants in SUD. These include the following: (a) structural barriers, including type of exercise and timing of the intervention; (b) social barriers, including accountability and unsupportive relations; and (c) emotional barriers, including fear, guilt, shame, and negative effects of the intervention.

With these three barriers in mind it is recommended that future programs utilize a group structure in which members have similar performance levels and peer support that will enhance group cohesion and increase adherence. It is also important for intervention designs to be more easily integrated into participants' lives and contain more varied and interesting activities keeping participants actively interested in the program.

Lastly, researchers must consider the population they are working with. This population already has addictive behaviors so consider the factor of exercise addiction. Exercise addiction is not easily defined and can be hard to recognize. It is difficult to distinguish the gym enthusiast from someone addicted to exercise.

Hausenblas and Downs (2004) identify exercise addiction based on criteria that is a modification of the DSM-IV TR criteria for substance dependence (p. 183-201).

The definition is as follows:

Tolerance: increasing the amount of exercise in order to feel the desired effect or sense of accomplishment.

Withdrawal: In the absence of exercise, the person experiences negative effects, such as anxiety, irritability, restlessness, and sleep problems.

Lack of control: unsuccessful at attempts to reduce exercise level or cease exercising for a certain period of time.

Intention effects: unable to stick to one's intended routine as evidence by exceeding the amount of time devoted to exercise or constantly going beyond the intended amount.

Time: A great deal of time is spent preparing for, engaging in, and recovering from exercise.

Reduction in other activities: As a direct result of exercise, social, occupational, and/or recreational activities occur less often or are stopped.

Continuance: continuing to exercise despite knowing that this activity is creating physical, psychological, and/or interpersonal problems.

The definition for behavioral addiction is closely aligned with the DSM-5 criteria for substance dependence. With the criteria being widely similar, there is a risk that needs to be addressed with using exercise as an adjunct therapy for SUD. Within this population, the exercise program cannot be too intense or competitive because this increases the possibility that the program has a negative effect.

Further research factoring in some of the limitations and considerations discussed will show the effectiveness of an exercise program and sobriety.

REFERENCES

- Abrantes, A. M., & Blevins, C. E. (2019). Exercise in the context of substance use treatment: Key issues and future directions. *Current Opinion in Psychology, 30*, 103–108. <https://doi.org/10.1016/j.copsyc.2019.04.001>
- American Addiction Centers Editorial Staff. (n.d.) Drug relapse: Drug addiction relapse statistics & prevention. <https://drugabuse.com/drug-relapse/>
- Blumenthal, J., Smith, P., & Hoffman, B. (2012). Opinion and evidence: Is exercise a viable treatment for depression?. *ACSM's Health & Fitness Journal, 16*(4), 14-21. <https://doi.org/10.1249/01.FIT.0000416000.09526.eb>
- Brené, S., Bjørnebekk, A., Aberg, E., Mathe, A., Olson, L., & Werme, m. (2007). Running is rewarding and anti-depressive, *Physiology and Behavior, 92*(1-2), 136–140.
- Broocks, A., Meyer, T. & Opitz, M. (2003). 5-HT1A responsivity in patients with panic disorder before and after treatment with aerobic exercise, clomipramine or placebo. *European Neuro-Psychopharmacology, 13*(3), 153–164.
- Brown, R. Abrantes, A., Read, J., Marcus, B., Jakicic, J. Strong, D., Oakley, J., Ramsey, S., Kahler, C., Stuart, G., Dubreuil, E., & Gordan, A. (2010). A pilot study aerobic exercise as an adjunctive treatment for drug dependence. *Mental Health and Physical Activity, 3*(1), 27-34. <https://doi.org/10.1016/j.mhpa.2010.03.001>
- Charilaou, M., Karekla, M., Constantinou, M., & Price, S. (2009). Relationship between physical activity and type of smoking behavior among adolescents and young adults in Cyprus. *Nicotine & Tobacco Research, 11*(8), 969–976. <https://doi.org/10.1093/ntr/ntp096>.

- Chow, C., Epp, J. R., Lieblich, S. E., Barha, C. K., & Galea, L. A. (2013). Sex differences in neurogenesis and activation of new neurons in response to spatial learning and memory. *Psychoneuroendocrinology*, *38*(8), 1236–1250. <https://doi.org/10.1016/j.psyneuen.2012.11.007>.
- Collingwood, T. R., Sunderlin, J., Reynolds, R., & Kohl, H. W. (2000). Physical training as a substance abuse prevention intervention for youth. *Journal of Drug Education*, *30*(4), 435–451. <https://doi.org/10.2190/rvue-9xw7-tyrq-ejr8>.
- Downs, D. S., Hausenblas, H. A., & Nigg, C. R. (2004). Factorial validity and psychometric examination of the exercise dependences. *Measurable Physical Education Exercise Science*. *8*, 183–201
- Emmerson, D., & Hopper, E. (2011). *Overcoming trauma through yoga: Reclaiming your body*. North Atlantic Books. <https://www.readhowyouwant.com>.
- Escobedo, L. G., Marcus, S. E., Holtzman, D., & Giovino, G. A. (1993). Sports participation, age at smoking initiation, and the risk of smoking among U.S. high school students. *269*(11), 1391–1395.
- Freimuth, M., Moniz, S., & Kim, S. (2011). Clarifying exercise addiction: Differential diagnosis, co-occurring disorders, and phases of addiction. *International Journal of Environmental Research and Public Health*. *8*, 4069-4081. <https://doi.org/10.3390/ijerph8104069>
- Greene, E., & Goodrich-Dunn, B. (2014). *The psychology of the body*. Philadelphia: Wolters Kluwer Health/Lippincott Williams & Wilkins.
- Tree House Recovery Staff. (n.d.). *Tree house recovery: Drug and alcohol addiction rehab*. <https://treehouserecovery.com/>

Hartney, E. (n.d.). The symptoms used to diagnose substance use disorders.

<https://www.verywellmind.com/dsm-5-criteria-for-substance-use-disorders-21926>

Heinz, A., Beck, A., Gruesser, S., Grace, A., & Wrase, J. (2009). Identifying the neural circuitry of alcohol craving and relapse vulnerability. *Addiction Biology, 14*(1), 108–118.

Khanna, S., & Greeson, J. M. (2013). A narrative review of yoga and mindfulness as complementary therapies for addiction. *Complementary Therapies in Medicine, 21*(3), 244–252. <https://doi.org/10.1016/j.ctim.2013.01.008>

Korhonen, T., Kujala, U. M., Rose, R. J., & Kaprio, J. (2009). Physical activity in adolescence as a predictor of alcohol and illicit drug use in early adulthood: A longitudinal population-based twin study. *Twin Research and Human Genetics, 12*(3), 261–268. <https://doi.org/10.1375/twin.12.3.261>.

Kulig, K., Brener, N. D., & McManus, T. (2003). Sexual activity and substance use among adolescents by category of physical activity plus team sports participation. *Archives of Pediatrics & Adolescent Medicine, 157*(9), 905–912. <https://doi.org/10.1001/archpedi.157.9.905>.

Linke, S. E., & Ussher, M. (2014). Exercise-based treatments for substance use disorders: Evidence, theory, and practicality. *The American Journal of Drug and Alcohol Abuse, 41*(1), 7–15. <https://doi.org/10.3109/00952990.2014.976708>

Ma, X., Hamadeh, M. J., Christie, B. R., Foster, J. A., & Tarnopolsky, M. A. (2012). Impact of treadmill running and sex on hippocampal neurogenesis in the mouse model of amyotrophic lateral sclerosis. *7*(4). <https://doi.org/10.1371/journal.pone.0036048>.

- Mandyam, C. D., & Koob, G. F. (2012). The addicted brain craves new neurons: Putative role for adult-born progenitors in promoting recovery. *Trends in Neurosciences*, 35(4), 250–260. <https://doi.org/10.1016/j.tins.2011.12.005>.
- Mandyam, C. D., Wee, S., Eisch, A. J., Richardson, H. N., & Koob, G. F. (2007). Methamphetamine self-administration and voluntary exercise have opposing effects on medial prefrontal cortex gliogenesis. *The Journal of Neuroscience*, 27(42), 11442–11450. <https://doi.org/10.1523/jneurosci.2505-07>.
- Metzl, J. D., & Heffernan, A. (2015). *The exercise cure: A doctors all-natural, no-pill prescription for better health and longer life*. New York: Rodale.
- National Institutes of Health. (2007). Understanding human genetic variation. <https://www.ncbi.nlm.nih.gov/books/NBK20363/>
- Oxford University. (n.d.). Oxford Concise Medical Dictionary. Retrieved 2015, from <https://www.oxfordreference.com/view/10.1093/acref/9780199557141.001.0001/acref-9780199557141>
- Pate, R. R., Heath, G. W., Dowda, M., & Trost, S. G. (1996). Associations between physical activity and other health behaviors in a representative sample of U.S. adolescents. *American Journal of Public Health*, 86(11), 1577–1581. <https://doi.org/10.2105/ajph.86.11.1577>.
- Petry, N. M., Alessi, S. M., Olmstead, T. A., Rash, C. J., & Zajac, K. (2017). Contingency management treatment for substance use disorders: How far has it come, and where does it need to go? *Psychology of Addictive Behaviors*, 31(8), 897–906. <https://doi.org/10.1037/adb0000287>

- Petry, N. M., Peirce, J. M., Stitzer, M. L., Blaine, J., Roll, J. M., Cohen, A., & Li, R. (2005). Effect of prize-based incentives on outcomes in stimulant abusers in outpatient psychosocial treatment programs. *Archives of General Psychiatry*, *62*(10), 1148. <https://doi.org/10.1001/archpsyc.62.10.1148>
- Rensburg, K. J. V., Taylor, A., Benattayallah, A., & Hodgson, T. (2012). The effects of exercise on cigarette cravings and brain activation in response to smoking-related images. *Psychopharmacology*, *221*(4), 659–666. <https://doi.org/10.1007/s00213-011-2610-z>
- Rodriguez Garcia, P. L., Lopez Villalba, F. J., Lopez Minarro, P. A., & Garcia Canto, E. (2014). Physical exercise, energy expenditure and tobacco consumption in adolescents from Murcia (Spain). *Archivos Argentinos de Pediatría*, *112*(1), 12–18. <https://doi.org/10.1590/s0325-00752014000100004>. 10.5546/aap.2014.12.
- Sari, S., Muller, A. E., & Roessler, K. K. (2017). Exercising alcohol patients don't lack motivation but struggle with structures, emotions and social context - a qualitative dropout study. National Center for Biotechnology Information. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5363022/>
- Thompson, W. R. (2019). *ACSMs clinical exercise physiology*. Philadelphia: Wolters Kluwer.
- U. Rimmele, B. C. Zellweger, & B. Marti. (2007). Trained men show lower cortisol, heart rate and psychological responses to psychosocial stress compared with untrained men, *Psychoneuroendocrinology*, *32*(6), 627–635.
- Weinstock, J., Barry, D., & Petry, N. M. (2008). Exercise-related activities are associated with positive outcome in contingency management treatment for substance use disorders.

National Center for Biotechnology Information.

<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2488402/>.

Weinstock, J., Farney, M. R., Elrod, N. M., Henderson, C. E., & Weiss, E. P. (2017). Exercise as an adjunctive treatment for substance use disorders: rationale and intervention description. National Center for Biotechnology Information.

<https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5289308/>

Zhang, L., & Yuan, T. (2019). Exercise and substance abuse. *International Review of Neurobiology*, 147, 269-280.

Zschucke, E., Heinz, A., & Ströhle, A. (2012). Exercise and physical activity in the therapy of substance use disorders. *The Scientific World Journal*, 2012, 1–19. <https://doi.org/10.1100/2012/901741>

APPENDIX A: TABLES

currently_sober * exercise_regularly Crosstabulation

		exercise_regularly		Total	
		0	1		
currently_sober	0	Count	2	2	4
		% within exercise_regularly	50.0%	9.5%	16.0%
	1	Count	2	19	21
		% within exercise_regularly	50.0%	90.5%	84.0%
Total		Count	4	21	25
		% within exercise_regularly	100.0%	100.0%	100.0%

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	4.096 ^a	1	.043		
Continuity Correction ^b	1.638	1	.201		
Likelihood Ratio	3.230	1	.072		
Fisher's Exact Test				.106	.106
Linear-by-Linear Association	3.932	1	.047		
N of Valid Cases	25				

a. 3 cells (75.0%) have expected count less than 5. The minimum expected count is .64.

b. Computed only for a 2x2 table

relapse_during_treatment * exercise_regularly Crosstabulation

		exercise_regularly		Total	
		0	1		
relapse_during_treatment	0	Count	3	20	23
		% within exercise_regularly	75.0%	95.2%	92.0%
	1	Count	1	1	2
		% within exercise_regularly	25.0%	4.8%	8.0%
Total	Count	4	21	25	
	% within exercise_regularly	100.0%	100.0%	100.0%	

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	1.870 ^a	1	.171		
Continuity Correction ^b	.131	1	.717		
Likelihood Ratio	1.399	1	.237		
Fisher's Exact Test				.300	.300
Linear-by-Linear Association	1.795	1	.180		
N of Valid Cases	25				

a. 3 cells (75.0%) have expected count less than 5. The minimum expected count is .32.

b. Computed only for a 2x2 table

relapse_after_treatment * exercise_regularly Crosstabulation

		exercise_regularly		Total	
		0	1		
relapse_after_treatment	0	Count	1	15	16
		% within exercise_regularly	25.0%	71.4%	64.0%
	1	Count	3	6	9
		% within exercise_regularly	75.0%	28.6%	36.0%
Total	Count	4	21	25	
	% within exercise_regularly	100.0%	100.0%	100.0%	

Chi-Square Tests

	Value	df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	3.144 ^a	1	.076		
Continuity Correction ^b	1.451	1	.228		
Likelihood Ratio	3.045	1	.081		
Fisher's Exact Test				.116	.116
Linear-by-Linear Association	3.018	1	.082		
N of Valid Cases	25				

a. 2 cells (50.0%) have expected count less than 5. The minimum expected count is 1.44.

b. Computed only for a 2x2 table

Logistic Regression

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	13.586 ^a	.173	.333

a. Estimation terminated at iteration number 6 because parameter estimates changed by less than .001.

Classification Table^a

Observed		Predicted		Percentage Correct
		successfully_address_adverse_emotional_states_when_occur	0	
Step 1	successfully_address_adverse_emotional_states_when_occur = 0	0	3	.0
	successfully_address_adverse_emotional_states_when_occur = 1	0	22	100.0
Overall Percentage				88.0

a. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I. for EXP(B)	
								Lower	Upper
Step 1 ^a	exercise_regularly	2.996	1.432	4.378	1	.036	20.000	1.209	330.952
	Constant	.000	1.000	.000	1	1.000	1.000		

a. Variable(s) entered on step 1: exercise_regularly.

Linear Regression

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.476 ^a	.227	.193	99.291

a. Predictors: (Constant), average_days_per_week_practice_yoga_or_meditation

ANOVA^a

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	66435.792	1	66435.792	6.739	.016 ^b
	Residual	226749.648	23	9858.680		
	Total	293185.440	24			

a. Dependent Variable: longest_duratio_of_sobriety_at_treehouse

b. Predictors: (Constant), average_days_per_week_practice_yoga_or_meditation

Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B	
		B	Std. Error	Beta			Lower Bound	Upper Bound
1	(Constant)	221.484	28.713		7.714	.000	162.087	280.882
	average_days_per_week_practice_yoga_or_meditation	20.392	7.856	.476	2.596	.016	4.142	36.643

a. Dependent Variable: longest_duratio_of_sobriety_at_treehouse

APPENDIX B: QUESTIONNAIRE

Questionnaire given to participants of the program:

1. City of residence?
2. State of residence?
3. Is this interview being conducted in person or via technology?
4. Are you currently sober?
5. What is your sobriety date?
6. How many days have you been using for?
7. What substance do you use?
8. What is the longest duration of sobriety from the day you entered Tree House?
9. Did you relapse during treatment?
10. How many days were you using for?
11. What would you say was the cause of your relapse?
12. Were you on psychiatric /psychotropic medications when you came into treatment?
13. Are you currently on any type of psychotropic medications?
14. How many times were you in treatment prior to Tree House?
15. Did you go to treatment anywhere after Tree House?
16. Are you on any opiate blockers such as Suboxone, Vivitrol or Methadone?
17. Have you ever been on Suboxone or Methadone maintenance?
18. When you came into Tree House were you employed?
19. Are you currently employed?
20. Do you make your bed every day?

21. When you came to Tree House did you have any unresolved court issues?
22. Do you exercise regularly?
23. How many hours per week?
24. Do you currently live in a sober living environment?
25. Do you use writing at least twice (2x) per month as a tool to maintain your well-being?
26. Do you believe that you successfully address adverse emotional states whenever they occur?
27. Are you still connected with other Tree House Recovery graduates in person, over the phone, or through digital chat?
28. How many graduates are you still connected with them?
29. Do you work or volunteer in the treatment/ recovery, or human services field?
30. What is the highest level of education you have earned?
31. Are you currently in school?
32. What kind of school?
33. Do you follow a diet that requires discipline and awareness of the foods that you eat?
34. Do you have a self-chosen mentor, coach, or advisor in your life?
35. Are you a mentor for anyone in your life?
36. Do you utilize reflection to evaluate current life circumstances on a daily basis?
37. Do you use insight from past situations and current circumstances to make positive decisions about your future?
38. When working on a collaborative project, do you find yourself taking initiative and do people look to you for insight and direction?
39. On average how many hours of sleep do you get each night?

40. In the last month how many hours each week have you spent connecting with nature?
41. Are you able to maintain steady energy levels throughout the day?
42. Do you use breathing practices as a tool for emotional self-regulation?
43. On average how many days a week do you practice yoga or meditation?
44. Would you recommend Tree House to a friend or loved one?