Effect of Supervised Exercise on State Anxiety and Stress

A dissertation submitted to

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Abstract

Mental health conditions continue to rise, and the treatments currently used, have many negative side effects. Consequently, exercise has emerged as a potential treatment method aimed at improving negative mental health outcomes including anxiety and stress. I therefore sought to determine the effects of such exercise on state anxiety and stress levels over an acute period.

Eighteen personal training clients (Male=12, Female=6) from a private fitness facility agreed to participate. Participants completed between 1 and 3 personal training sessions a week for 6 weeks, inclusive of aerobic and resistance exercises. Quantitative surveys after 1 and 6 weeks of exercise and a qualitative survey was completed after 6 weeks of exercise to determine state anxiety and stress. Effect Sizes (Glass's Delta 2) and 95% confidence intervals were calculated, along with p value.

Anxiety (1.67 [0.84, 2.49], p=0.01) and stress (1.49 [0.69, 2.26], p=0.02) scores between baseline and week 6 significantly improved (0.32 [-0.30, 0.93], p=0.01). Participants found supervised exercise improved stress and anxiety by holding them accountable and making time for their fitness and health.

Supervised exercise incorporating both aerobic and resistance exercise improved state anxiety and stress over 6 weeks.

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Attestation of Authorship

I Shayne Taupo hereby declare that this submission is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person (except where explicitly defined in the acknowledgements), nor used artificial intelligence tools or generative artificial intelligence tools (unless it is clearly stated, and referenced, along with the purpose of use), nor material which to a substantial extent has been submitted for the award of any other degree or diploma of a university or other institution of higher learning.

Signature: STaupo **Date**: 14/06/2024

Co-authored Works

• Shayne, data collection, analyses, write-up, approval final manuscript

• Dr. Robert Borotkanics, analyses, write-up, approval final manuscript

• Professor Nigel Harris, analyses, write-up, approval final manuscript

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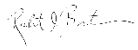
Chapter 3 manuscript has been accepted for publication by the journal Gazzetta Medica Italiana.

Shayne Taupo

Robert Borotkanics 

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Ethics Approval

22/318: Effect of Supervised Exercise on Stress and Anxiety

All experimental procedures of this dissertation were approved by the Auckland University of Technology Ethics Committee on 14/02/2023.

CHAPTER 1: INTRODUCTION

The dissertation includes a manuscript that has been accepted for publication to the journal Gazzetta Medica Italiana. However, to set the scene for the topic I have conducted a literature review. This review will be exploring mental health literature. More specifically state anxiety and stress. Anxiety and stress conditions continue to rise worldwide, and current treatment options aimed at reducing state anxiety and stress includes medication and cognitive behaviour therapy (CBT). However, these treatments also include negative side effects and stigma. Consequently, the review will examine what is known about exercise as a treatment option, aimed at reducing state anxiety and stress. The review will cover meta-analyses and systematic studies, epidemiological studies, and randomized control studies that include exercise and anxiety and stress. Themes within the review will include the intensity of exercise, supervision, short-term effects, and type of exercise. Followed by a conclusion summarizing the current literature findings and gaps in the research.

CHAPTER 2: LITERATURE REVIEW

Effect of Supervised Exercise on State Anxiety and Stress

Introduction

It has been established that the prevalence of mental health issues and increased mental stress and anxiety have risen in the last few years (Diaz-Silveira et al., 2020). Diaz-Silveira et al. (2020) highlights several factors that have contributed to the rise including increased work demand, lifestyle conditions, and worldwide events including the Covid-19 pandemic. The authors describe psychological stress as a prominent factor in society's modern lifestyle where individuals are faced with job insecurity, multitasking to complete multiple roles, sensory overload, time pressure, 24/7 availability, and competitiveness. Stress can negatively affect an individual both short and long term. Short term stress can lead to elevated levels of blood pressure and heart rate, headaches, emotional irritability, and muscle tension, whereas long term stress can cause cognitive complications, increased exhaustion and fatigue, and anxiety disorders and depression (Diaz-Silveira et al., 2020). Winroth et al. (2019) defined anxiety as a response to either an internal or external stimulus that leads to feelings of nervousness, apprehensiveness, and pessimism. The authors elaborate that, anxiety can be categorized into either state anxiety or trait anxiety. State anxiety is the response to a specific circumstance that is momentarily, and an expected emotional state of mind. State anxiety is the heightened temporary autonomic nervous system response to stress that fosters anxiety symptoms. On the other hand, trait anxiety is a chronic personality attribute that can produce fear and worry across many situations (Winroth et al., 2019). Individuals who experience frequent state anxiety symptoms are more likely to document low levels of physical activity, mental distress, high risk of substance abuse, pain, and poor sleep (Gordon et al., 2017). Individuals with high levels of state anxiety are more at risk of developing noncommunicable conditions including cardiovascular disease, diabetes, and cancer (Bartley et al., 2013; Stonerock et al., 2015).

In the United States (US) 15% of the population records suffering from frequent state anxiety on two or more weeks of the previous month (Gordon et al., 2017). Anxiety symptoms was identified as the primary determinant of negative mental health affecting more than 40 million of the US adult population (Hill et al.,

2019). Therefore, finding effective treatment methods to reduce recurring elevated state anxiety is critical to improve mental health conditions.

Current treatment for state anxiety symptoms includes medication and alternative therapy methods including cognitive behaviour therapy (CBT). Broman-Fulks et al. (2015) established these methods of treatment as effective, resulting in reduced state anxiety levels. However, those receiving treatment suffered from negative side effects including financial burden, and stigma (Broman-Fulks et al., 2015). More specifically, Winroth et al. (2019) identified serotonin-norepinephrine reuptake inhibitors (SNRI) and selective serotonin reuptake inhibitors (SSRI) as antidepressant medications commonly used to treat state anxiety. The authors explain that antidepressant medications target the neurotransmitters and hormones and suppress the physiological response to state anxiety. However, SNRI and SSRI use can cause serious side effects including dizziness, fatigue, deregulated sexual behaviour and nausea (Winroth et al., 2019). Lastly, Broman-Fulks et al. (2015) described that due to stigma around mental health, many do not seek the treatment they need. As a result, less than 15% of individuals suffering from mental health issues including state anxiety receive sufficient treatment (Broman-Fulks et al., 2015).

Accordingly, it is essential that an alternative treatment method be found that can treat anxiety without the side effects and stigma that are experienced when using antidepressant medication. This review will explore current research that has been carried out determining the effects of exercise on state anxiety and stress. This review will look at epidemiological studies first, followed by meta-analysis and systematic reviews then randomized control trials (RCT) that have been carried out to determine the effects of exercise on state anxiety and stress.

Exercise & State Anxiety & Stress (Epidemiological)

Exercise can provide a safe and accessible method that can be utilized to help those suffering from state anxiety and stress. Exercise has been commonly referred to as an outlet to escape the daily grind, reduce state anxiety and increase one's own self-care both physically and mentally (Fishman et al., 2019).

Epidemiological research highlights both improved physiological and psychological state anxiety and stress related changes experienced through regular exercise (Brown et al., 2019; Goodwin, 2003; Strickland & Smith, 2014). Strickland and Smith (2014) and Brown et al. (2019) further elaborate the benefit of exercise on improved mental health, including positive mood, increased cognition, reduced stress, and better quality of life. Additionally, Goodwin (2003) demonstrated an inverse relationship where participants who exercised 2 to 3 times per week were 25% to 35% less likely to develop an anxiety disorder than those who were mainly sedentary.

Exercise & State Anxiety & Stress (Meta-Analysis and Systematic Reviews)

Meta-analysis and systematic review findings on the effects of exercise on state anxiety and stress have produced similar results (Aylett et al., 2018; Bartley et al., 2013; Ensari et al., 2015; Gordon et al., 2017; Stonerock et al., 2015). Exercise training significantly improved state anxiety and stress when compared to waitlist and control groups. However, when exercise was compared to alternative treatment methods including CBT and meditation, no difference was found between groups (Aylett et al., 2018; Bartley et al., 2013; Ensari et al., 2015; Gordon et al., 2017; Yu et al., 2022).

Mikkelsen et al. (2017) review identified specific physiological changes include increased mitochondriogenesis, increased endorphins and mammalian target of rapamycin (mTor) signaling, thus reducing the hypothalamic pituitary adrenal (HPA) axis response to state anxiety and stress. Secondly, specific psychological changes include positive emotions experienced through self-efficacy and mastery as well as mental distractions from state anxiety and stress (Mikkelsen et al., 2017). In their meta-analysis Ensari et al. (2015) noted small significant ($p = > 0.05$) improvements in state anxiety scores after exercise compared to control. The authors concluded that daily state anxiety can be reduced through the implementation of exercise (Ensari et al., 2015). Moreover, Stonerock et al. (2015) systematic review observed reduced state anxiety immediately following exercise in individuals suffering from anxiety symptoms. In contrast, Bartley et al. (2013) meta-analysis revealed aerobic exercise had no significant ($p = 0.85$) effect on anxiety disorder participants with an effect size of -0.20 to 0.24. The meta-analysis showed no benefits to other comparative

methods including resistance exercise, however reduced state anxiety scores were present when compared to control groups (Bartley et al., 2013). Similarly, Aylett et al. (2018) systematic review and meta-analysis demonstrated exercise significantly ($p = 0.01$) reduced state anxiety compared to waitlist participants with elevated and diagnosed anxiety disorders. The exercise groups compared to wait list groups presented -0.70 to -0.12 effect size showing reduced anxiety following exercise, yet no difference was seen when aerobic exercise was compared to alternative treatment methods including medication or CBT (Aylett et al., 2018). These analyses excluded resistance exercise. Gordon et al. (2017) reviewed resistance training studies and presented very similar findings to other meta-analyses and reviews that included aerobic training. A significant ($p = < 0.001$) reduction in anxiety symptoms was present in resistance exercise groups compared to control groups with an effect size of 0.17 to 0.44 (Gordon et al., 2017). Ensari et al. (2015) was the only meta-analysis that recorded both aerobic, and resistance exercise studies compared to control groups. It was also the only analysis that investigated acute effects immediately after completing exercise training, yielding similar results to research implemented over longer training periods up to 36 weeks. The meta-analysis demonstrated significant ($p = < 0.05$) reductions in state anxiety for participants who underwent acute exercise compared to a control group with an effect size of 0.05 to 0.27 (Ensari et al., 2015). Lastly, Yu et al. (2022) extensive systematic review involving over 100 randomized controlled trials (RCTs) presented multimodal exercise or the combination of both aerobic and resistance exercise as the most efficient for improving mood in anxiety and depression diagnosed patient.

Meta-analyses and systematic reviews have presented favorable results when exercise has been compared to waitlist and mixed results when compared to alternative treatment methods. However, specific mechanistic responses that need to be considered for the changes in affect seen after completing exercise includes the intensity, supervised, length of program and type of exercise effects on state anxiety and stress.

Intensity

Research have demonstrated a wide array of different intensities from 40% to 100% utilizing heart rate percentage and one repetition maximum percentage have been used within the exercise protocols involving

aerobic and resistance training respectively (Faro et al., 2019; Fishman et al., 2019; Strickland & Smith, 2014; Yin et al., 2021). Strickland and Smith (2014) systematic review highlighted low intensities of resistance training between 50% to 70% one repetition maximum (1RM) presented higher reductions in state anxiety than intensities above 70% (Chovanec & Gropel, 2020). This contrasts with Yin et al. (2021) meta-analysis and systematic review who reported moderate to vigorous forms of exercise intensity produced the most beneficial results of reduced state anxiety. Though, individuals who were limited in exercise capacity through severe obesity, high sedentary lifestyles and pain induced chronic conditions, experienced negative emotional state following high intensity exercise. The analysis and review also observed higher participant dropout rates due to exercise being too strenuous (Yin et al., 2021).

Fishman et al. (2019) RCT resulted in significantly ($P=<0.05$) reduced state anxiety utilizing resistance training and moderate loads around 70% of 1RM compared to high and low loads of 100% and 40% 1RM respectively. Additionally, Faro et al. (2019) RCT explained low to moderate intensities of exercise showed a higher positive affect than high intensity exercises, due to increased blood lactate, respiration and ventilation experienced when performing higher intensities that causes unpleasantness and dominant focus over cognitive processes (Faro et al., 2019).

Supervised

Supervised exercise has been known to improve state of mind by reducing stress and diminishing state anxiety through increased personal social interaction (Fokkenrood et al., 2013; Makris et al., 2012) Meta-analyses and systematic reviews have recognized supervised exercise has produced improved quality of life and psychological well-being (Bartley et al., 2013; Meneses-Echavez et al., 2015).

Courneya et al. (2012) carried out an RCT on supervised and unsupervised participants performing aerobic exercise over 12 weeks. The study identified social support and guidance was the leading factor linked to improved self-efficacy experienced by participants during supervised exercise. The supervised group significantly improved stress levels than the non-supervised group (Courneya et al., 2012). However, few

studies exist that implement supervised exercise, specifically in those involving aerobic exercise. Aerobic exercise research typically involves cardio machines and the use of self-reporting methodologies to determine intensity and time. This may lead to inaccurate results that can influence effects. Nonetheless, studies that have implemented supervised exercise have developed mixed results. Chovanec and Gropel (2020) RCT found that the supervised training group had less stress in everyday life after 8 weeks of aerobic, and resistance training compared to the control group. The study utilized both aerobic, and resistance training separately and produced similar results that equated to significantly ($p = < 0.05$) reduced state anxiety and stress in both training groups. The researchers identified reduced feelings of loneliness, by widening social networks through increased interaction and an increased stress tolerance when faced with external stress through increased progressive physical requirements throughout the training study (Chovanec & Gropel, 2020). Gordon et al. (2022) RCT highlighted supervised moderate intensity resistance training have produced mixed results on the effects of state anxiety when compared to each other or waitlist groups (Gordon et al., 2022)

Short-Term

It is important to determine the short-term effects of exercise on state anxiety and stress. Short-term has been described in literature between a single session and two months in length (Strickland & Smith, 2014). The short-term effects of exercise on state anxiety and stress have shown favorable results for participants with higher baseline state anxiety scores, and research that has implemented increased frequency of sessions than those performing fewer (Aylett et al., 2018). Short-term will now be referred to as acute for the remainder of the literature review. Though, there lies subjectivity to the exact length of time an acute period covers, studies covering acute effects have a duration between immediately following exercise to nine weeks (Ensari et al., 2015; Gordon et al., 2022; Lucibello et al., 2019)

Strickland and Smith (2014) systematic review demonstrated mixed results for single session resistance exercise on stress and state anxiety. Studies demonstrated reduced state anxiety scores between pre and post exercise, though most were non-significant reductions. The review highlighted those participants suffering from higher baseline state anxiety and stress presented increased improvement as opposed to

individuals with lower baseline scores who presented smaller improvements (Strickland & Smith, 2014). Aylett et al. (2018) meta-analysis and systematic review demonstrated both non-significant ($p = > 0.05$) and significant ($p = <0.05$) reductions in state anxiety and stress scores between one and two weeks for participants completing aerobic exercise in comparison to waitlist participants. Most studies that demonstrated significant reductions underwent three times per week of aerobic exercise. Whereas studies that performed less frequency of aerobic exercise produced non-significant reduced state anxiety and stress (Aylett et al., 2018).

Type of Exercise

Debates continue over the most effective type of exercise to reduce state anxiety and stress (Faro et al., 2019). Previous research has looked at a variety of exercise training methods and their influence on state anxiety in adults (Broman-Fulks et al., 2015; Fishman et al., 2019; Lucibello et al., 2019). The most common methods include aerobic training (Broman-Fulks et al., 2015; Fishman et al., 2019; Hill et al., 2019; LeBouthillier & Asmundson, 2017; Lucibello et al., 2019) and resistance training (Broman-Fulks et al., 2015; Faro et al., 2019; Fishman et al., 2019). Research implementing aerobic exercise has utilized cardio-based equipment including treadmills, stationary bikes, and elliptical trainers (Broman-Fulks et al., 2015; Fishman et al., 2019; Hill et al., 2019; LeBouthillier & Asmundson, 2017; Lucibello et al., 2019). Resistance training studies have implemented a wide variety of machines, free weights, and bands (Broman-Fulks et al., 2015; Faro et al., 2019; Fishman et al., 2019).

Aerobic & RCT

Several RCTs have been carried out to determine the effects of acute aerobic exercise on state anxiety and stress. Evidence shows that aerobic exercise promotes anxiolytic effects on those who suffer from frequent state anxiety as well as individuals who have an anxiety related disorder (Gordon et al., 2017).

Broman-Fulks et al. (2015) and Fishman et al. (2019) RCTs have demonstrated aerobic exercise to be effective at significantly ($p = < 0.05$) reducing state anxiety including single sessions compared to waitlist participants. Correspondingly, Lucibello et al. (2019) RCT presented small to moderate reductions in anxiety

symptoms for non-clinically anxious individuals who completed an exercise program involving six 20-minute aerobic exercise sessions. The authors also found individuals with higher levels of state anxiety demonstrated greater reductions in state anxiety following aerobic exercise training (Lucibello et al., 2019). These findings are aligned with LeBouthillier and Asmundson (2017) RCT that established aerobic exercise significantly ($p = < 0.05$) reduced state anxiety sensitivity compared to waitlist. The researchers also highlighted those with higher levels of state anxiety, less fitness experience and increased sedentary lifestyle had enhanced reductions in anxiety symptoms and psychological distress after completing exercise (LeBouthillier & Asmundson, 2017).

Resistance & RCT

RCTs have demonstrated mixed results of resistance training acute effects on state anxiety. Some studies have demonstrated improved state anxiety, yet others have presented improved self-body image but negative state anxiety results (Gordon et al., 2022). Broman-Fulks et al. (2015) observed no changes in state anxiety after completing a single resistance training workout. On the other hand, Fishman et al. (2019) showed that a single bout of resistance exercise training significantly ($p = < 0.05$) reduced state anxiety and increased calmness from 15 to 60 minutes after completion. However, one major difference that may have influenced the different results between the two studies was the resistance training approaches. Both studies performed 10 repetitions per exercise with 90 seconds to two minutes rest between exercises. Broman-Fulks et al. (2015) implemented a total of three exercises for a single warm up set and two working sets for a total time of 20 minutes, whereas Fishman et al. (2019) study prescribed the American College of Sports Medicine resistance training guidelines that include eight exercises for three sets for a total time of 50 minutes. Consequently, the longer session may have provided more time for effects to take place post exercise.

Faro et al. (2019) RCT found significantly ($p = < 0.01$) reduced state anxiety in college aged females when resistance training was completed over 4 weeks. Participants completed both traditional and functional types of supervised resistance training for two sessions and measured acute state anxiety responses both immediately following and 15 minutes post exercise. Both types of supervised resistance training showed

significantly ($p = 0.03$) reduced state anxiety between pre and post, and pre to 15 minutes post exercise with an effect size of -0.58 and -0.37 for functional resistance training and traditional resistance training respectively (Faro et al., 2019).

Gordon et al. (2020) carried out an RCT that implemented twice weekly supervised resistance training intervention for eight weeks with young adults at high risk for state anxiety and stress. State anxiety and stress were measured before the first session, after four weeks and again at eight weeks. The researchers found resistance training significantly ($p = < 0.05$) reduced state anxiety and stress symptoms compared to the control group between baseline and week 8, with an effect size of 0.06 to 1.63 (Gordon et al., 2020). Being able to conduct the research on non-clinically diagnosed participants makes the results more inclusive for measuring state anxiety and stress on high-risk individuals who do not suffer from an anxiety disorder. However, including only young adults makes it more difficult to generalize findings to other adults not within the same age bracket.

Resistance & Aerobic

Very limited studies exist comparing aerobic exercise to resistance exercise and the acute effects on state anxiety and stress. LeBouthillier and Asmundson (2017) carried out an RCT on diagnosed anxiety disordered participants. The supervised exercise intervention consisted of three times weekly 45-minute training sessions of either aerobic or resistance and a control comparison group for a total of four weeks. The study resulted in a significant ($p = < 0.001$) reduction in state anxiety between aerobic exercise and waitlist. The resistance exercise group demonstrated non-significant ($p = > 0.05$) reduced state anxiety in comparison to waitlist. The aerobic exercise group presented no significant difference in state anxiety and stress scores when compared to the resistance exercise group (LeBouthillier & Asmundson, 2017).

Oftedal et al. (2019) speculates that being able to combine resistance and aerobic training may produce enhanced health benefits over and above participating in single modalities, yet little research exists that explores this position. The benefits of single modalities alone have been widely researched, yet the lack of

research combining the modalities of aerobic and resistance training together is alarming. With an increasing number of supervised fully equipped fitness centers that promote longevity and healthy wellbeing, it is vital that more research be carried out on the effects they have on state anxiety and stress.

Conclusion

Overall, evidence has demonstrated mixed results on the effects of exercise on state anxiety and stress. However, several confounding factors that can influence results are used inconsistently in the research that has been undertaken including intensity, whether the exercise was supervised or unsupervised and the length of the exercise program. An intensity of 70% for aerobic exercise and 70% of 1RM for resistance training showed the most effective results for training intensity and adherence from studies. Secondly, supervised exercise has shown more favorable results on state anxiety and stress outcomes than self-reported exercise. The number of weeks of exercise program was also less influential and what impacted results more was the frequency of sessions completed within the specific period and the length of the session. Furthermore, acute effects on state anxiety and stress presented improved results from single sessions up to 6 weeks when exercise frequency was three or more times per week. Lastly both aerobic, and resistance exercise have presented improved results on state anxiety and stress when compared to waitlist and control groups. Whereas, the studies that have compared aerobic, and resistance exercise to state anxiety medication and alternative treatment methods presented no further beneficial results.

Nonetheless, zero evidence exists combining aerobic and resistance training into an exercise program together and the effects on mental health. Accordingly, being able to implement more research studies including both aerobic and resistance exercise training collectively into an exercise program is important. With the rise in multimodal training, encompassing both aerobic and resistance exercise into a single session, it is vital that more research be implemented, to determine the effects on mental health including state anxiety and stress.

In conclusion, zero research exists involving supervised exercise that encompasses aerobic and resistance together and the acute effects on state anxiety and stress. Consequently, the aim of this research is to fill the gap in research and determine the acute effects of supervised exercise that includes both aerobic and resistance exercise within the same single session, on state anxiety and stress.

Table 1
Randomized Control Trial Study Results

Study RCT	Participant Characteristics Exercise at Baseline (Intervention/Control) (>3x 30 minutes per week)	Exercise Intervention Protocol	Control Group Protocol	Mental Health Outcomes	Intervention Results Mean Scores	Control Results Mean Scores EDS > (Number of Participants)	Between Group Difference Significant *P* value < 0.05	Within Group Mean Score Difference (Intervention & Control)
Broman-Fulks (2015) USA	77 (60% Female 40% Male)	Single Session Supervised Aerobic: 2min warm-up 20min treadmill (65%-75% max HR) Supervised RE: 20min session 3 exercises 2 sets x 10 repetitions 2min rest between sets	Sit in chair quietly for 20 minutes	ASI-3 Mean Score STAI-S Mean Score 5min post protocol	AE (Baseline: Post) ASI-3 10.92:6.96 STAI-S 30.28:31.32 RE (Baseline: Post) ASI-3 9.77:5.11 STAI-S 30.65:32.54	Control (Baseline: Post) ASI-3 10.23:8.77 STAI-S 28.54:28.35		ASI-3 AE: <0.001 RE: <0.001 Control 0.009 STAI-S Aerobic, Resistance, Control: >.10
Lebouthillier (2017) Canada	48 Anxiety-Related Disorders	3x Week for 4 Weeks Exercise Instructor	Waitlist	ASI-3 Mean Score DASS21 Mean Score	AE (Baseline: Post) ASI-3 35.96: DASS21 28.83:15.99 RE (Baseline: Post) ASI-3 35.61 DASS21 29.06:17.06	WL (Baseline: Post) ASI-3 39.13:42.75 DASS21 26.60:33.23	ASI-3 Wait – AE .338 Wait – RE .002 DASS21 Wait – AE <0.001 Wait – RE 0.004	
Chovanec (2020) Slovakia	65 Female Students Mean age – 21.02 years	3x Week for 8 Weeks Supervised Group Format 60min Session: 7min warm-up 45min AE or RE 7min stretch AE: Low to High Impact Aerobic Dance Week 1 to Week 4 (130-148BPM) High Impact Week 5 to Week 8 (148-160BPM) RE: Full Body 8x Exercises 5x8-12 repetitions 2min rest Week 1-2 = 40% 1RM Week 3-4 = 50% 1RM Week 5-6 = 60% 1RM Week 7-8 = 70% 1RM	Waitlist	PSS Mean Score	AE (Baseline: Post) PSS 2.69:2.35 RE (Baseline: Post) PSS 2.76:2.28	WL (Baseline: Post) PSS 2.82:2.87		PSS AE: <0.05 RE: <0.001 Waitlist: >0.05

Table 1 cont.
Randomized Control Trial Study Results

Gordon (2020) Ireland	**28 Students (64% Female) Mean Age – 26 years**	**2x Week for 8 Weeks Supervised RE** **25min Sessions** **8x Exercises** **8-12 repetitions** **Increase resistance progressively**	**Waitlist**	**STAI-Y2 Mean Score**	**RE (Baseline: Week 1: Week 4: Week 8)** **STAI-Y2** **39.9:36.3:36.2:31.8**	**WL (Baseline: Week 1: Week 4: Week 8)** **STAI-Y2** **36.7:37.6:36.2:36.0**		**RE** **Week 1: >0.05** **Week 4: >0.05** **Week 8: <0.05** **WL** **Week 1: >0.05** **Week 4: >0.05** **Week 8: >0.05**
Hill (2018) USA	30 Students (50% Female) Mean Age – 21.2 years	3x Visits 1x session of either AE,RE or Control Unsupervised AE: Stationary cycling 35min session Self-selected pace & resistance RE: Supervised 6x Exercises 3 sets x 10 repetitions 90sec Rest	Control – Seated for 35min	STAI Mean Score				STAI AE: 0.06 RE: 0.28 WL: 0.29
Lucibello (2019)	42 Students (85% Female) Mean Age – 19.5 years	3x Week for 9 Weeks Supervised AE Stationary cycling Moderate pace 3min warm up 27.5min 70-75% max HR 2.5min cool down	Control – Continue lifestyle	BAI Mean Score STAI-6 Mean Score	AE (Baseline: Post) STAI-6 12.6	Control (Baseline: Post) STAI-6 12.1		

Abbreviations:
API – Acute Panic Inventory
BAI – Beck Anxiety Inventory
PSS – Perceived Stress Scale
ASI – Anxiety Sensitivity Index
STAI-S – State Trait Anxiety Inventory
DTS – Distress Tolerance Scale
HR – Heart Rate
WL – Waitlist
AE – Aerobic Exercise
HR – Heart Rate
STAI – State & Trait Anxiety Inventory
RE – Resistance Exercise
BPM – Beats Per Minute
WHO-5 – World Health Organization Well-Being Index
CES-D – Center for Epidemiological Studies Depression Scale

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CHAPTER 3: MANUSCFRIPT

After reviewing the current literature, we found that there lies zero research exploring the effects of supervised exercise involving both aerobic and resistance exercises combined within a single session and the effects on anxiety and stress. Therefore, the current chapter will cover the manuscript of the acute effect of supervised exercise on state anxiety and stress.

I am a personal trainer based in Florida, United States. It was not feasible to conduct a randomized control trial within the environment I carried out the study. Including a larger number of participants is difficult as many are seasonal and travel often for work, sometimes weeks at a time. Secondly, involving a control group is unpractical in the environment when participants would be told to abstain from exercising, when they are contacting the facility because they want to exercise. The loss in revenue due to inactive clients for the organization and personal trainers involved would have been burdensome.

Acute Effect of Supervised Exercise on State Anxiety and Stress

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Acute Effect of Supervised Exercise on State Anxiety and Stress

ABSTRACT

BACKGROUND: Supervised exercise has the potential to treat and improve mental health, but very limited research has investigated combined aerobic and resistance exercise under the supervision of a trainer. We therefore sought to determine the effects of such exercise on state anxiety and stress levels over an acute period.

METHODS: Eighteen personal training clients (Male=12, Female=6) from a private fitness facility agreed to participate. Participants completed between 1 and 3 personal training sessions a week for 6 weeks, inclusive of aerobic and resistance exercises. Quantitative surveys after 1 and 6 weeks of exercise and a qualitative survey was completed after 6 weeks of exercise to determine state anxiety and stress. Effect Sizes (Glass's Delta 2) and 95% confidence intervals were calculated, along with p value.

RESULTS: Anxiety (1.67 [0.84, 2.49], p=0.01) and stress (1.49 [0.69, 2.26], p=0.02) scores between baseline and week 6 significantly improved (0.32 [-0.30, 0.93], p=0.01). Participants found supervised exercise improved stress and anxiety by holding them accountable and making time for their fitness and health.

CONCLUSION: Supervised exercise incorporating both aerobic and resistance exercise improved state anxiety and stress over 6 weeks.

Key Words: training, mental health; workout

Introduction

It has been established that the prevalence of mental health issues and increased mental anxiety and stress have risen in the last few years from increased work demand, lifestyle conditions, and worldwide events including the Covid-19 pandemic. (Diaz-Silveira et al., 2020) Anxiety and stress can negatively affect an individual short and long term and lead to cognitive complications, increased exhaustion and fatigue, and anxiety disorders and depression. (Diaz-Silveira et al., 2020) In the United States 15% of the population records suffering from frequent anxiety and stress on two or more weeks of the previous month. (Gordon et al., 2017) Anxiety and stress symptoms were identified as the primary determinant of negative mental health affecting more than 40 million of the US adult population. (Hill et al., 2019) Therefore, finding effective treatment methods to reduce recurring elevated anxiety and stress is critical to improve mental health conditions.

Current treatment includes medication and cognitive behaviour therapy (CBT) however individuals suffer from negative side effects including dizziness and fatigue. (Winroth et al., 2019) Individuals also experience stigma, when seeking help and as a result, less than 15% of those suffering from consistent bouts of anxiety and stress receive sufficient treatment. (Broman-Fulks et al., 2015; Winroth et al., 2019) Exercise may provide an alternative treatment method without the side effects and stigma for improved mental health benefits as opposed to medication and CBT. (Fishman et al., 2019) Evidence demonstrates improved anxiety and stress from interventions incorporating aerobic and resistance exercise independently over an acute period. (Aylett et al., 2018; Bartley et al., 2013; Brown et al., 2019; Ensari et al., 2015; Goodwin, 2003; Gordon et al., 2017; Stonerock et al., 2015; Strickland & Smith, 2014) No research has determined the effects on anxiety and stress of implementing a supervised exercise incorporating both aerobic and resistance exercise within a single session. Therefore, with the rise in functional exercise and multimodal fitness facilities combining both aerobic and resistance exercise, there lies a gap in the research to investigate the effects. (Yu et al., 2022) Consequently, the aim of this study was to determine the effects of supervised training incorporating the combination of aerobic and resistance exercise on state anxiety and stress over an acute period.

Material and Methods

Participants

A mixed methods within-subjects study design was used, set in a single private fitness facility. Participants were excluded if they were currently taking anti-depressant medication or had done so in the past or were diagnosed with a mental health disorder or non-communicable disease, or currently pregnant. All participants provided informed consent, and ethics approval was provided by the institutional Ethics Committee prior to recruitment.

Procedure

The participants underwent 55-minute supervised personal training sessions for a total 6 week duration. The number of sessions per week ranged between 1 and 3. The fully supervised sessions involved a combination of both resistance and aerobic exercises. Sessions were led individually by 4 different personal trainers at the fitness facility. Resistance exercises included free weights, bands, machines, and bodyweight exercises and aerobic exercises included both machines and bodyweight exercises. Exercise sessions began with a 5-minute warm up followed by 40 minutes of resistance and aerobic exercises, concluded by 10 minutes of stretching. During the resistance portion of the workout, participants were asked to perform between five and fifteen repetitions and two to four sets per exercise. Rest between sets ranged between 30 and 60 seconds. Repetitions, sets and rest times were prescribed according to the exercise level of the participants to ensure exercises were challenging and the session would be completed on time. Intensity was monitored where participants were told to stop before technique deteriorated or were unable to complete a repetition. Aerobic exercise involved using cardio equipment machines or performing bodyweight exercises continuously between 3 and 5 minutes with no rest. Intensity was monitored where participants were able to perform between 70 to 85 percent of self-perceived maximum effort, continuously without rest for the specified amount of time given by the personal trainer.

Anxiety and stress symptoms were assessed using the Depression, Anxiety and Stress Survey (DASS21), and Kessler Distress Psychological Survey (K10). The DASS21 is a 21-item survey that measures

depression, anxiety, and stress feelings within the previous week. The items within the survey use a 4-point Likert-type scale that ranges from did not apply to me at all to applied to me very much or most of the time. The DASS21 showed good internal consistency and excellent convergent validity. (Henry & Crawford, 2005) The K10 is a 10-item survey that aims to measure anxiety and stress feelings within the past 30 days. The items are measured using a 5-point Likert-type scale ranging from none of the time to all the time. The values of Cronbach's alpha and test-retest reliability present good internal consistency (Cronbach's $\alpha = 0.93$) of the K10 for non-clinical populations. (Kessler et al., 2002) Both surveys are self-report assessments completed by the participants online. The DASS21 survey was completed at baseline, week 1 and week 6. The K10 survey was completed by participants at baseline and week 6.

Additionally, a qualitative questionnaire survey was completed by the participants after week 6. The self-report questionnaire contained 12 questions that asked for details using open ended questions about how the participant felt exercise affected their mental health including anxiety and stress over the previous 6 weeks. The recall questions asked how the participant felt their anxiety and stress levels were at baseline, the effects of exercise on anxiety and stress after week 1 of exercise and the effects of exercise on anxiety and stress after week 6 of exercising. Themes were identified from the responses given for each question completed by the participants and grouped accordingly.

Statistical Analyses

Descriptive statistics are presented as mean and standard deviation ($M \pm SD$) or median (interquartile range) along with maximum and minimum values for continues variables. Categorical variables are descriptively summarized using frequency (percentage). Before-after treatment analyses of the primary and secondary outcomes were carried out using the Friedman's test. This was indicated due to limited loss to follow up.

Effect sizes Glass's Delta 2 were assessed by partial eta squared η^2 which were defined as trivial, small, moderate, and large for values η^2 <0.1, 0.2 to 0.5, 0.5 to 0.8 and >0.8 respectively along with 95% confidence intervals, and p values.

Results

Seven participants that enrolled and completed the baseline participant characteristic form, baseline DASS21 and baseline K10 surveys did not complete the full 6 weeks of training. Reasons stated for incompletion included sickness from Covid, and unable to attend due to time constraints and other commitments. Eighteen participants completed the entire 6 weeks of training and all surveys throughout the 6 weeks. Characteristics are detailed in **Table 1**.

Participant responses to the post exercise survey carried out at week 6 indicated high levels of anxiety and stress at baseline, due to work obligations and family commitments as the holiday season was approaching:

"Experienced high anxiety levels with the season ending and going into winter break." "Highly stressed. work deadlines before the end of the year at work and family stresses for gifts and finances."

Table 1
Baseline Participant Characteristics

Gender	*n* (%)
Male	16 (64%)
Female	9 (36%)
Age (years)	
18-34	5 (20%)
35-54	8 (32%)
55-74	12 (48%)
Ethnicity	
Other	2 (8%)
White	14 (56%)
White + Hispanic	3 (12%)
White + Other	6 (24%)
Education	
Bachelor's Degree	6 (24%)
Master's Degree	15 (60%)
Doctorate or Professional Degree	4 (16%)
Marital Status	
Single	7 (28%)
Married	18 (72%)
Employment	
Employed Full Time	8 (32%)
Homemaker	3 (12%)
Self-Employed	14 (56%)
Training Age (years)	
1-3	10 (40%)
4-9	10 (40%)
10+	5 (20%)

Depression scores (DASS-21) between baseline and week 1 improved significantly with large effect. Anxiety scores between baseline and week 1 improved with a moderate effect, but not significantly. Stress scores between baseline and week 1 also improved with a moderate effect, but not significantly. Results are detailed in **Table 2**. After one week of exercise, participants responded whether they felt anxiety and stress reduced. Some participants expressed they felt exercise helped reduce anxiety and stress after 1 week: *"Having an outlet for stress helped coping levels."* Over half of the responses selected 'maybe', as they felt 1 week of exercise was not long enough to notice any type of change: *"Difficult to measure with only 1 week of exercise."* Few participants selected yes, reporting that incorporating a structured fitness routine helped reduce anxiety and stress: *"A structured fitness regimen and the accountability of having a trainer, helped me step*

away from the office to focus on my health including both body and mind." The remaining participants reported no change in anxiety and stress over the 1 week: *"Zero changes in my stress levels even after exercising."*

We observed a significant improvement from baseline to week 6 in both the DASS21 and K10 scores. Depression (DASS21) scores significantly improved to large effect between baseline and week 6. Anxiety scores between baseline and week 6 significantly improved with a large effect. Stress improved significantly with large effect between baseline and week 6. K10 scores between baseline and week 6 improved significantly to a small effect.

After week 6 of training, participants responded whether they felt anxiety and stress reduced. Nearly two thirds of the participants felt as though their anxiety and stress had reduced after week 6, attributed to a combination of the exercise and the beginning of the new year: *"Exercise definitely eased my tension during a busy time of year for my family and I." "Anxiety levels lowered once festive season with family ended and we continued routine."* However, those that selected 'no improvement' highlighted covid and sickness as a major factor towards feelings of non-improvement in anxiety and stress levels: *"Hard to tell with covid lasting over the month." "Being sick throughout the research set back the improvements I may have experienced otherwise."* Other participants noted that exercise had no effect given they were already exercising consistently before the beginning of the study. *"Exercising is already part of my routine, so nothing changed."* Individual data points can be seen in **Figures 1a, 1b, 1c, and 1d.**

Table 2
Survey Results

Measure	***M* ± *SD***	**η^2_p Effect Size [95% CI]**	***P Value***
DASS21-D			
Baseline	21.4 ± 8.0		
Week 1	15.6 ± 5.7	1.03 [0.37, 1.67]	0.02
Week 6	10.9 ± 5.7	1.84 [0.96, 2.69]	<0.01
DASS21-A			
Baseline	19.4 ± 8.1		
Week 1	15.1 ± 6.4	0.67 [0.56, 1.27]	0.07
Week 6	10.4 ± 5.4	1.67 [0.84, 2.49]	0.01
DASS21-S			
Baseline	19 ± 8.7		
Week 1	15.3 ± 6.6	0.57 [-0.04, 1.16]	0.28
Week 6	10.8 ± 5.5	1.49 [0.69, 2.26]	0.02
K10			
Baseline	24.5 ± 6.6		
Week 6	22.5 ± 6.3	0.32 [-0.30, 0.93]	0.01

Discussion

The aim of the study was to determine the effects of personal trainer supervised exercise involving both resistance and aerobic training on state anxiety and stress over an acute period. We found 1 week of supervised exercise resulted in non-significant reductions on anxiety and stress, and participants indicated that reductions in anxiety and stress were difficult to notice after 1 week of exercise. Participants responded that 1 week was not enough time to see reductions in anxiety and stress levels. The few participants that did experience improvements explained having a personal trainer held them accountable and they were able to get into a routine that allowed them to leave the office and focus on their health. No previous studies exist that have implemented less than a week of both aerobic and resistance exercise performed together and their effects on state anxiety and stress. However, our results are consistent with previous studies looking at the effects of a single session of aerobic and resistance exercise performed independently on state anxiety and stress (Broman-Fulks et al., 2015; Hill et al., 2019) resulting in non-significant reductions in anxiety or stress state.

We observed significant medium to large reductions in anxiety and stress after week 6 of supervised exercise. Participants expressed that exercise helped ease tension and improved anxiety and stress levels. Some participants that saw no improvement stated sickness and covid as the overwhelming factor effecting their results. These findings support previous research on the acute effects of aerobic and resistance exercise on anxiety and stress (Chovanec & Gropel, 2020; Faro et al., 2019; Gordon et al., 2020; LeBouthillier & Asmundson, 2017; Lucibello et al., 2019) albeit from aerobic and resistance exercise performed in separate sessions. However, all studies performed similar interventions where participants performed 45- min to 1-hr sessions two to three times per week up to 8 weeks duration. (Chovanec & Gropel, 2020; Faro et al., 2019; Gordon et al., 2020; LeBouthillier & Asmundson, 2017; Lucibello et al., 2019) These studies identified supervision, self-mastery and self-efficacy experienced through weekly exercise progressive overload and positive rapport with the fitness trainer as potential factors influencing the significant reduction of state anxiety and stress after completing the exercise training period. (Gordon et al., 2020; LeBouthillier & Asmundson, 2017)

Figure 1a

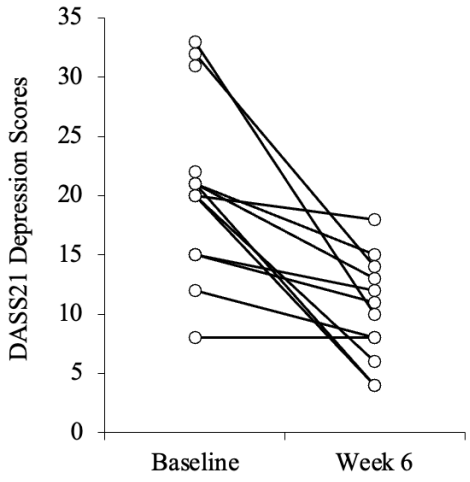


Figure 1b

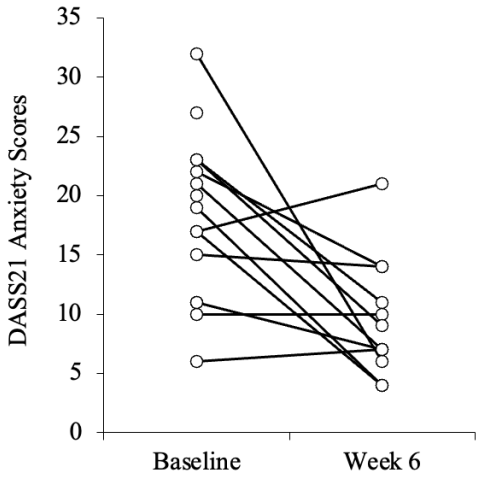


Figure 1c

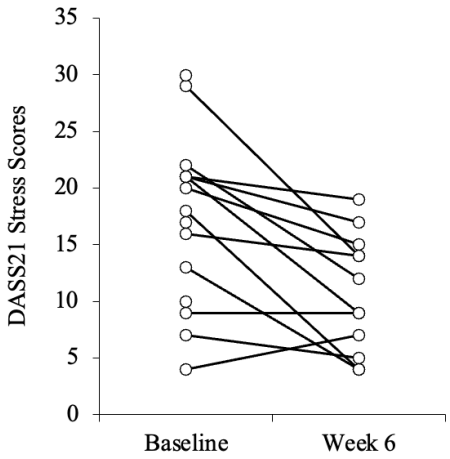
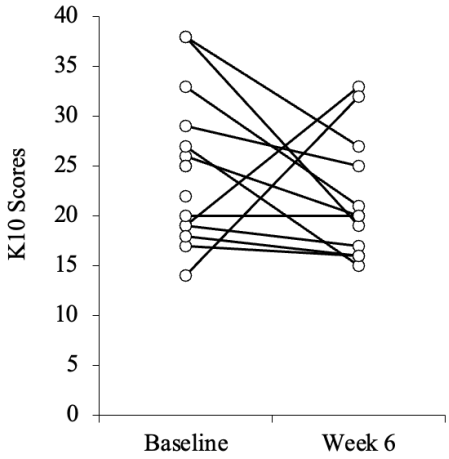


Figure 1d



Several limitations should be considered when interpreting our findings. The supervised exercise sessions were not monitored therefore, a wide array of exercises were implemented during the 6 weeks by various trainers. Therefore, exercises differed, and being able to specifically quantify the exact ratio of resistance to aerobic exercise was not possible. Also, the timing of the current study may have influenced results. Many participants identified the holiday season affecting their anxiety and stress levels during the 6 weeks of exercise training that was carried out between November to February. Participants expressed high levels of anxiety and stress at baseline due to the upcoming festive season and improved levels after the festive season had ended. Identifying how the timing of the year influenced results as opposed to the exercise is difficult. Finally, the lack of a control group and low number of participants must be considered as factors confounding our ability to draw definitive conclusions.

Conclusion

Future studies should include a non-exercise group to control for factors such as the seasonality. Nonetheless, both our quantitative and qualitative findings provide an insight into the positive effects supervised combined aerobic and resistance exercise can have on state anxiety and stress over 6 weeks, but not after 1 week.

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Authors Contribution: All authors read and approved the final version of the manuscript

ST: data collection, analyses, write-up, approval final manuscript

RB: analyses, write-up, approval final manuscript

NH: analyses, write-up, approval final manuscript

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Appendices

Appendix A

Ethics Approval

Auckland University of Technology Ethics Committee (AUTEC)

14 February 2023

Nigel Harris

Faculty of Health and Environmental Sciences

Dear Nigel

Re Ethics Application: **22/318 Effect of Supervised Exercise on Stress and Anxiety**

Thank you responding to AUTEC's conditions.

Your ethics application has been approved for three years until 14 February 2026.

Standard Conditions of Approval

1. The research is to be undertaken in accordance with the Auckland University of Technology Code of Conduct for Research and as approved by AUTEC.
2. All public facing documents must have the AUTEC approval number and be of a high standard of spelling and grammar. Dates on the Information Sheet(s) and Consent Form(s) must be consistent.
3. Any amendments to the project must be approved by AUTEC prior to being implemented.
4. A progress report is due annually on the anniversary of the approval date.
5. A final report is due at the expiration of the approval period, or, upon completion of project.
6. Any serious or adverse events must be reported to AUTEC, this includes unforeseen issues that might affect continued ethical acceptability of the project.
7. AUTEC grants ethical approval only. You are responsible for obtaining management permission for access from any institution or organisation at which your research is being conducted and you need to meet all ethical, legal, public health, and locality obligations or requirements for the jurisdictions in which the research is being undertaken.

The application number and title need to be referenced on all correspondence related to this project.

All forms are available online http://www.aut.ac.nz/research/researchethics

For any enquiries, please contact ethics@aut.ac.nz

(This is a computer-generated letter for which no signature is required)

The AUTEC Secretariat

Auckland University of Technology Ethics Committee

Cc: shaynetaupo@hotmail.com

Appendix B

Post Intervention Survey Questionnaire

Post Intervention Survey Questionnaire

1. How stressed were you before the start of the research?
2. How much anxiety did you have before the start of the research?
3. Do you believe your stress reduced from pre research until the conclusion of week 1

3b. If yes/no, why?

4. Do you believe your anxiety reduced from pre research until the conclusion of week 1?

4b. If yes/no, why?

5. Do you believe your stress reduced from pre research until post research?

5b. If yes/no, why?

6. Do you believe your anxiety reduced from pre research until post research?

6b. If yes/no, why?

7. What effect did exercise for 1 week have on your mental health?
8. What effect did exercise for 6 weeks have on your mental health?

Appendix C

Participant Information Sheet

Participant Information Sheet

Date Information Sheet Produced:
20/02/2023

Project Title
Effect of Supervised Exercise on State Anxiety & Stress

An Invitation
My name is Shayne Taupo, and I am a student at Auckland University of Technology in New Zealand. I am conducting a dissertation for my master's qualification and will be the primary researcher in this study. My study is to determine the effects of supervised exercise training on mental health including state anxiety and stress.

The research will involve completing surveys on the effects of training sessions on your wellbeing. You are invited to partake in this study through completing and returning these surveys via the link in the email sent. Choosing to either participate or not participate in the research study will neither advantage nor disadvantage you. You would still be continue with full 1-on-1 private personal training services at 1 Fitness West Palm Beach.

What is the purpose of this research?
The prevalence of mental health issues including anxiety and stress have risen in the last few years affecting more than 40 million of the United States adult population. Factors that have contributed to the rise in stress and anxiety include increased work demand, lifestyle conditions and worldwide events including the Covid-19 pandemic. Finding effective treatment methods to reduce elevated anxiety from chronic stress is critical. Past research has demonstrated exercise training to be effective at reducing anxiety, yet no research exists primarily focused on 1-on-1 supervised exercise on state anxiety & stress.

Therefore, the research is focused on the psychological well-being of non-clinically diagnosed individuals who have chosen to participate in 1-on-1 supervised exercise. The purpose of the research is to increase knowledge on the effects of exercise on psychological health, specifically anxiety and stress. This masters dissertation aims to determine whether supervised exercise can improve anxiety and stress. The findings of this research may be used for academic publications and presentations.

How was I identified and why am I being invited to participate in this research?
You are being invited to take part in this research because you have signed up to 1 Fitness West Palm Beach training facility to undergo one on one personal training services. However, you will be excluded from the study if you present any of the following conditions.

1. Currently diagnosed with a mental disorder
2. Currently taking antidepressant medication
3. Currently diagnosed non communicable disease
4. Currently pregnant or planning to be pregnant

You will be excluded because the surveys we are using in the research are designed to determine changes in stress and anxiety for individuals who do not have these current conditions.

How do I agree to participate in this research?
Your participation in this research is voluntary (it is your choice) and whether you choose to participate will neither advantage nor disadvantage you. If you volunteer to take part in this study, you will be one of 25 males and females to do so. You can withdraw from the study at any time. If you choose to withdraw from the study, then you will be offered the choice between having any data that is identifiable as belonging to you removed or allowing it to continue to be used. However, once the findings have been produced, removal of your data may not be possible.
If you have read this form, had the opportunity to ask questions about the research and received satisfactory answers, and want to participate, then sign the consent form, complete the surveys, and return via email.

What will happen in this research?
Upon agreeing to volunteer you will be sent a link to fill in a baseline characteristic form and complete the *Kessler Psychological Distress Scale – 10 and **Depression, Anxiety, Stress Scale – 21 surveys online. Then upon availability you will visit 1 Fitness West Palm Beach to undergo the supervised exercise sessions you have requested. After the completion of week 1 you will complete the Depression, Anxiety, Stress Scale – 21 online to measure acute responses. After the completion of week 6 you will complete the Depression, Anxiety, Stress Scale – 21 and Kessler Psychological Distress Scale – 10 surveys online. You will then be sent a link to an online open-ended survey post survey to measure and reflect on current and or/if any changes occurred to your psychological state during the research.

*** Kessler Psychological Distress Scale – 10:** The Kessler Psychological Distress Scale. It is a 10-item questionnaire with five answers to select ranging from "none of the time" to "all of the time." The survey is used to measure how distressed you've been in the last 4 weeks, by signs of depression and anxiety.

****Depression, Anxiety, Stress Scale – 21:** The Depression Anxiety Stress Scales is a 21-item questionnaire divided into three self-report scales designed to measure the emotional states of depression, anxiety, and stress. All questions have five answers to select from, with scores between 0 and 4. The scores range from 0 "did not apply" to 4 "applied to me very much." The survey measures psychological state over the previous week.

What are the discomforts and risks?
As a result of completing The Kessler Psychological Distress Scale and/or The Depression Anxiety Stress surveys you reflect, realize and acknowledge your own stress levels are high, then the following support is publicly available: Substance Abuse and Mental Health Services Administration (SAMHSA): free, confidential 24/7, 365-day-a-year treatment referral and information service (in English and Spanish) for individuals and families facing mental and/or substance use disorders

SAMHSA's National Helpline, 1-800-662-HELP (4357)

What are the benefits?
Potential benefits from this study may include improved mental health status and reduced stress and anxiety. The results from this study will add to the body of knowledge on the psychological response to exercise, that may inform society on sustainable ways to improve mental health. Successful completion of the research will assist the primary researcher in obtaining their masters qualification in sports, exercise, and health at the Auckland University of Technology.

How will my privacy be protected?
For all data collected at 1 Fitness West Palm Beach, The Health Insurance Portability and Accountability Act (HIPAA) regulations and procedures will be followed.

All surveys that will be conducted in the research will be completed using a unique identification number given by the researcher. At no stage throughout the research will any personal identifiable information be used on any documents or data collection. At no time will the results from the surveys be disclosed with the other trainers at the facility. Your information will be combined with information taken from other people partaking in the study. When we write up the study to share it with other researchers, we will write about the combined information. You will not be identified in any published or presented materials. To ensure your information is kept confidential, identification numbers, but not names will be used on all documents. All data entry and analysis will be conducted with statistical programs using these identification numbers. All files including consent forms and data will be stored electronically with the primary supervisor and will be deleted after 10 years.

What are the costs of participating in this research?
Standard 1 on 1 personal training rates will continue to apply for all participants involved in the study. Participants will also be required to complete 6 online questionnaires throughout the research that will take between 10 and 15 minutes each. Totalling around 60 to 90 minutes.

What opportunity do I have to consider this invitation?
You will be given up to one month to confirm your participation in the research.

Will I receive feedback on the results of this research?
Individual results will be provided for each participant at the conclusion of the research. Also, an overall summary from the findings of the research will be provided for all participants within which there will be no identification of any individual.

What do I do if I have concerns about this research?
Any concerns regarding the nature of this project should be notified in the first instance to the Primary Supervisor, *Nigel Harris* nigel.harris@aut.ac.nz
Concerns regarding the conduct of the research should be notified to the Executive Secretary of AUTEC, *ethics@aut.ac.nz* , (+649) 921 9999 ext 6038.

Whom do I contact for further information about this research?
Please keep this Information Sheet and a copy of the Consent Form for your future reference. You are also able to contact the research team as follows:

Researcher Contact Details:
Shayne Taupo
Email: shaynetaupo@hotmail.com
Project Supervisor Contact Details:
Nigel Harris
Email: nigel.harris@aut.ac.nz

Approved by the Auckland University of Technology Ethics Committee on *type the date final ethics approval was granted*, AUTEC

Reference 22/3

Appendix D

Gym Owner Information Sheet

Gym Owner Information Sheet

Date Information Sheet Produced:
15/01/2023

Project Title
Effect of Supervised Exercise on Stress and Anxiety

An Invitation
My name is Shayne Taupo, and I am a student at Auckland University of Technology in New Zealand. I am conducting a dissertation for my master's qualification and will be the primary researcher in this study. My study is to determine the effects of supervised exercise training on mental health including stress and anxiety.

The research will involve completing surveys on the effects of training sessions on your wellbeing. Participants are invited to partake in this study through completing and returning these surveys via the link in the email sent. Choosing to either participate or not participate in the research study will neither advantage nor disadvantage the participants. The participants will still continue with full 1-on-1 private personal training services at 1 Fitness West Palm Beach.

What is the purpose of this research?
The prevalence of mental health issues including stress and anxiety have risen in the last few years affecting more than 40 million of the United States adult population. Factors that have contributed to the rise in stress and anxiety include increased work demand, lifestyle conditions and worldwide events including the Covid-19 pandemic. Finding effective treatment methods to reduce elevated anxiety from chronic stress is critical. Past research has demonstrated exercise training to be effective at reducing anxiety, yet no research exists primarily focused on one-on-one supervised exercise on stress and anxiety.

Therefore, the research is focused on the psychological well-being of non-clinically diagnosed individuals who have chosen to participate in one-on-one supervised exercise. The purpose of the research is to increase knowledge on the effects of exercise on psychological health, specifically stress and anxiety. This masters dissertation aims to determine whether supervised exercise can improve stress and anxiety.
The findings of this research may be used for academic publications and presentations.

How were participants identified and why are they being invited to participate in this research?
Participants are being invited to take part in this research because they have signed up to 1 Fitness West Palm Beach training facility to undergo one on one personal training services. However, they will be excluded from the study if they present any of the following conditions.

1. Currently diagnosed with a mental disorder
2. Currently taking antidepressant medication
3. Currently diagnosed non communicable disease
4. Currently pregnant or planning to be pregnant

Participants will be excluded because the surveys we are using in the research are designed to determine changes in stress and anxiety for individuals who do not have these current conditions.

How do participants agree to participate in this research?
Participation in this research is voluntary (it is their choice) and whether they choose to participate will neither advantage nor disadvantage them. If they volunteer to take part in this study, they will be one of 25 males and females to do so. They can withdraw from the study at any time. If they choose to withdraw from the study, then they will be offered the choice between having any data that is identifiable as belonging to them removed or allowing it to continue to be used. However, once the findings have been produced, removal of data may not be possible.
If participants have read the participant information sheet, had the opportunity to ask questions about the research and received satisfactory answers, and want to participate, then they will sign the consent form, complete the surveys, and return via email.

What will happen in this research?
Upon agreeing to volunteer participants will be sent a link to fill in a baseline characteristic form and complete the *Kessler Psychological Distress Scale – 10 and **Depression, Anxiety, Stress Scale – 21 surveys online. Then within the next week and upon availability they will visit 1 Fitness West Palm Beach to do the supervised exercise sessions they have requested. After the completion of week 1 they will complete the Depression, Anxiety, Stress Scale – 21 online to measure acute responses. After the completion of week 6 they will complete the Depression, Anxiety, Stress Scale – 21 and Kessler Psychological Distress Scale – 10 surveys online. Participants will then be sent a link to an online open-ended survey post survey to measure and reflect on current and or/if any changes occurred to their psychological state during the research.

*** Kessler Psychological Distress Scale – 10:** The Kessler Psychological Distress Scale. It is a 10-item questionnaire with five answers to select ranging from "none of the time" to "all of the time." The survey is used to measure how distressed you've been in the last 4 weeks, by signs of depression and anxiety.

****Depression, Anxiety, Stress Scale – 21:** The Depression Anxiety Stress Scales is a 21-item questionnaire divided into three self-report scales designed to measure the emotional states of depression, anxiety, and stress. All questions have five answers to select from, with scores between 0 and 4. The scores range from 0 "never" to 4 "almost always." The survey measures psychological state over the previous week.

What are the discomforts and risks?
As a result of completing The Kessler Psychological Distress Scale and/or The Depression Anxiety Stress surveys the participants reflect, realize and acknowledge their own stress levels are high, then the following support is publicly available: Substance Abuse and Mental Health Services Administration (SAMHSA): free, confidential 24/7, 365-day-a-year treatment referral and information service (in English and Spanish) for individuals and families facing mental and/or substance use disorders

SAMHSA's National Helpline, 1-800-662-HELP (4357)

What are the benefits?
Potential benefits from this study may include improved mental health status and reduced stress and anxiety. The results from this study will add to the body of knowledge on the psychological response to exercise, that may inform society on sustainable ways to improve mental health. Successful completion of the research will assist the primary researcher in obtaining their masters qualification in sports, exercise, and health at the Auckland University of Technology.

How will participant privacy be protected?
For all data collected at 1 Fitness West Palm Beach, The Health Insurance Portability and Accountability Act (HIPAA) regulations and procedures will be followed.

All surveys that will be conducted in the research will be completed using a unique identification number given by the researcher. At no stage throughout the research will any personal identifiable information be used on any documents or data collection. At no time will the results from the surveys be disclosed with the other trainers at the facility. Individual participant information will be combined with information taken from other people partaking in the study. When we write up the study to share it with other researchers, we will write about the combined information. Participants will not be identified in any published or presented materials. To ensure their information is kept confidential, identification numbers, but not names will be used on all documents. All data entry and analysis will be conducted with statistical programs using these identification numbers. All files including consent forms and data will be stored electronically with the primary supervisor and will be deleted after one year.

What are the costs of participating in this research?
Standard 1 on 1 personal training rates will continue to apply for all participants involved in the study. Participants will also be required to complete 6 online questionnaires throughout the research that will take between 10 and 15 minutes each. Totaling around 60 to 90 minutes.

What opportunity do the participants have to consider this invitation?
Participants will be given up to one month to confirm their participation in the research.

Will participants receive feedback on the results of this research?
Individual results will be provided for each participant at the conclusion of the research. Also, an overall summary from the findings of the research will be provided for all participants within which there will be no identification of any individual.

What do I do if I have concerns about this research?
Any concerns regarding the nature of this project should be notified in the first instance to the Primary Supervisor, *Nigel Harris* nigel.harris@aut.ac.nz
Concerns regarding the conduct of the research should be notified to the Executive Secretary of AUTEC, *ethics@aut.ac.nz* , (+649) 921 9999 ext 6038.

Whom do I contact for further information about this research?
Please keep this Information Sheet and a copy of the Consent Form for your future reference. You are also able to contact the research team as follows:

Researcher Contact Details:
Shayne Taupo
Email: shaynetaupo@hotmail.com
Project Supervisor Contact Details:
Nigel Harris
Email: nigel.harris@aut.ac.nz

Approved by the Auckland University of Technology Ethics Committee on *type the date final ethics approval was granted*, AUTEC Reference number *type the reference number*.

Appendix E

Participant Consent Form

Consent Form

Project title: ***Effect of Supervised Exercise on Stress and Anxiety***
Project Supervisor: ***Nigel Harris***
Researcher: ***Shayne Taupo***

- ○ I have read and understood the information provided about this research project in the Information Sheet dated 20/02/2023.
- ○ I have had an opportunity to ask questions and to have them answered.
- ○ I understand that taking part in this study is voluntary (my choice) and that I may withdraw from the study at any time without being disadvantaged in any way.
- ○ I understand that if I withdraw from the study then I will be offered the choice between having any data that is identifiable as belonging to me removed or allowing it to continue to be used. However, once the findings have been produced, removal of my data may not be possible.
- ○ I agree to take part in this research.
- ○ I wish to receive my individual results from the study (please tick one): Yes○ No○
- ○ I wish to receive a summary of the research findings (please tick one): Yes○ No○

Participant's signature: .....

Participant's name: .....
Date:

Approved by the Auckland University of Technology Ethics Committee on 13 February 2023 AUTEC Reference number 22/318
Note: The Participant should retain a copy of this form

Appendix F

DASS21 Survey

DASS21

Name: Date:

Please read each statement and circle a number 0, 1, 2 or 3 which indicates how much the statement applied to you **over the past week**. There are no right or wrong answers. Do not spend too much time on any statement.

The rating scale is as follows:

0 Did not apply to me at all
1 Applied to me to some degree, or some of the time
2 Applied to me to a considerable degree or a good part of time
3 Applied to me very much or most of the time

1 (s)	I found it hard to wind down	0	1	2	3
2 (a)	I was aware of dryness of my mouth	0	1	2	3
3 (d)	I couldn't seem to experience any positive feeling at all	0	1	2	3
4 (a)	I experienced breathing difficulty (e.g. excessively rapid breathing, breathlessness in the absence of physical exertion)	0	1	2	3
5 (d)	I found it difficult to work up the initiative to do things	0	1	2	3
6 (s)	I tended to over-react to situations	0	1	2	3
7 (a)	I experienced trembling (e.g. in the hands)	0	1	2	3
8 (s)	I felt that I was using a lot of nervous energy	0	1	2	3
9 (a)	I was worried about situations in which I might panic and make a fool of myself	0	1	2	3
10 (d)	I felt that I had nothing to look forward to	0	1	2	3
11 (s)	I found myself getting agitated	0	1	2	3
12 (s)	I found it difficult to relax	0	1	2	3
13 (d)	I felt down-hearted and blue	0	1	2	3
14 (s)	I was intolerant of anything that kept me from getting on with what I was doing	0	1	2	3
15 (a)	I felt I was close to panic	0	1	2	3
16 (d)	I was unable to become enthusiastic about anything	0	1	2	3
17 (d)	I felt I wasn't worth much as a person	0	1	2	3
18 (s)	I felt that I was rather touchy	0	1	2	3
19 (a)	I was aware of the action of my heart in the absence of physical exertion (e.g. sense of heart rate increase, heart missing a beat)	0	1	2	3
20 (a)	I felt scared without any good reason	0	1	2	3
21 (d)	I felt that life was meaningless	0	1	2	3

Appendix G

K10 Survey

K10 Test

These questions concern how you have been feeling over the past 30 days. Tick a box below each question that best represents how you have been .

1. During the last 30 days, about how often did you feel tired out for no good reason?				
1. None of the time	2. A little of the time	3. Some of the time	4. Most of the time	5. All of the time

2. During the last 30 days, about how often did you feel nervous?				
1. None of the time	2. A little of the time	3. Some of the time	4. Most of the time	5. All of the time

3. During the last 30 days, about how often did you feel so nervous that nothing could calm you down?				
1. None of the time	2. A little of the time	3. Some of the time	4. Most of the time	5. All of the time

4. During the last 30 days, about how often did you feel hopeless?				
1. None of the time	2. A little of the time	3. Some of the time	4. Most of the time	5. All of the time

5. During the last 30 days, about how often did you feel restless or fidgety?				
1. None of the time	2. A little of the time	3. Some of the time	4. Most of the time	5. All of the time

6. During the last 30 days, about how often did you feel so restless you could not sit still?				
1. None of the time	2. A little of the time	3. Some of the time	4. Most of the time	5. All of the time

7. During the last 30 days, about how often did you feel depressed?				
1. None of the time	2. A little of the time	3. Some of the time	4. Most of the time	5. All of the time

8. During the last 30 days, about how often did you feel that everything was an effort?				
1. None of the time	2. A little of the time	3. Some of the time	4. Most of the time	5. All of the time

9. During the last 30 days, about how often did you feel so sad that nothing could cheer you up?				
1. None of the time	2. A little of the time	3. Some of the time	4. Most of the time	5. All of the time

10. During the last 30 days, about how often did you feel worthless?				
1. None of the time	2. A little of the time	3. Some of the time	4. Most of the time	5. All of the time