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Effect of a 2-Week Relaxing Music Intervention on Anxiety, Stress, and Gut Symptoms in Aerobic Exercisers

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by

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ABSTRACT

EFFECT OF A 2-WEEK RELAXING MUSIC INTERVENTION ON ANXIETY, STRESS, AND GUT SYMPTOMS IN AEROBIC EXERCISERS

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The purpose of this study was to determine the impact of a two-week relaxing music intervention on stress, anxiety, and gastrointestinal (GI) symptoms in exercisers with at least mild anxiety and exercise-related GI symptoms. Block randomization was used to allocate 15 women and two men into control (n = 8) or intervention (n = 9) groups following a one-week baseline. During the baseline period, participants recorded details of their aerobic exercise sessions and discomfort with GI symptoms (nausea, regurgitation/reflux, stomach fullness, bloating, abdominal cramps, gas, the urge to defecate). Following randomization, both groups tracked these same details for two additional weeks. Intervention participants were tasked with listening to 30 minutes of relaxing music per day from five pre-selected playlists and record their adherence, engagement, and perceived relaxation. Pre- and post-intervention assessments included perceived stress scale (PSS-14), general anxiety disorder questionnaire (GAD-7), and visceral sensitivity index (VSI) scores. PSS-14, GAD-7, and VSI scores were normally distributed, so a mixed ANOVA analysis was used to compare time, group, and time x group effects, and effect sizes were reported as partial eta squared (ηp^2). Significance was set at $p < 0.05$. Participants in the music group reported that they found the intervention to be relaxing and engaging on a 1-10-scale (*Engagement* = 7.3±0.9; *Perceived Relaxation* = 7.2±1.5). No statistically significant group, time, or interaction effects were found for GI symptoms at rest,

exercise-related GI symptoms, and PSS-14, GAD-7, or VSI scores. Considering resting GI symptoms, the effect size for a time x group interaction was large ($\eta p^2 = 0.198$). Resting GI scores went from 25.6±10.9 to 20.4±10.5 in the music group, compared to from 15.0±14.3 to 15.1±12.1 in the control group. Other notable effect sizes include time effects for resting GI symptoms ($\eta p^2 = 0.183$), exercise-related upper GI symptoms ($\eta p^2 = 0.151$), and PSS-14 scores ($\eta p^2 = 0.146$), all of which indicate potential pre-to-post reductions. Given the relatively high ratings of relaxation and engagement reported with the intervention and the observed effect sizes, further research is warranted on relaxing music as a means to reduce GI symptoms, anxiety, and stress in exercisers.

TABLE OF CONTENTS

Page

LIST OF TABLES

CHAPTER I

INTRODUCTION

Problem Description

Although some previous research has observed the phenomena of experiencing gastrointestinal (GI) symptoms while exercising amongst athletic populations, many of these studies have disagreed on the prevalence of symptoms, specific symptoms of interest, and the primary cause of these symptoms. It is unclear the exact portion of the exercising population that experiences GI symptoms, with reviews reporting wide ranges of 30-70% among literature due to differences in symptoms tracked and the type of athletes observed (De Oliveira et al., 2014). Suggested causes of GI symptoms during exercise are wide-ranging, with examples including mechanical jarring, changes in splanchnic blood flow during vigorous activity, overconsumption of carbohydrates (CHO), and dehydration (Joyner & Casey, 2015; Ho, 2009; O'Brien & Rowlands, 2011). It is evident that the issue of experiencing GI symptoms while exercising is multifactorial, but one potential factor that has not been widely researched is the relationship of stress or anxiety and GI symptoms in populations that regularly train and exercise.

Stress and anxiety have previously been linked to exacerbated GI symptoms in populations diagnosed with chronic GI disorders. This previous research includes the finding that there appears to be a positive relationship between GI symptoms and increased levels of stress or anxiety in people with irritable bowel syndrome (IBS) (Jerndal et al., 2010). Additionally, previous research has linked stress to GI symptoms in college students (Norton et al., 1999). That being said, few articles to date have explored the link of GI symptoms and stress/anxiety in exercising populations. Previous studies that have observed this link were observational in nature, meaning that cause-and-effect relationships cannot be established with a high degree of

certainty (Wilson, 2018; Wilson, 2019; Wilson et al., 2020). Thus, additional work—particularly experimental research—is needed on stress/anxiety, GI symptoms, and regular participation in exercise.

One potential intervention that could help to reduce anxiety and GI symptoms in regular exercisers is relaxing music. Indeed, several studies have shown that listening to relaxing music over several weeks can reduce anxiety, though these studies were done in populations such as elderly subjects or pregnant women (Chang et al., 2007; Costa et al., 2018; Elliot et al., 2014; Linnemann et al., 2015). On a mechanistic level, relaxing music may activate the parasympathetic nervous system and/or decrease sympathetic drive (Mojtabavi et al., 2020), which, in theory, could normalize GI function in people who tend to suffer from chronic elevations in stress or anxiety.

This will be the first study, to our knowledge, to attempt to use a relaxing music intervention to alleviate GI symptoms that are potentially caused or exacerbated by stress or anxiety in a population of habitual exercisers. Previous research suggests the potential for using relaxing music interventions to reduce stress and, in turn, decrease GI symptoms if anxiety/stress is a risk factor for experiencing symptoms in aerobic exercising populations.

Statement of Purpose

The purpose of this study is to determine the impacts of a two-week relaxing music listening intervention on symptoms of anxiety, stress, and GI distress in individuals who perform a minimum of 120 minutes of structured aerobic exercise weekly.

Significance of Study

The significance of this study is to provide a potential method of alleviating GI symptoms proposed to be linked to feelings of stress or anxiety in individuals who perform aerobic exercise.

Research Hypothesis

Individuals using a two-week relaxing music intervention consisting of 30 minutes of daily music listening are hypothesized to experience decreases in stress, anxiety, and exercise-related GI symptoms as compared to individuals in a control group.

Variables

Independent Variables

The independent variable in this study was the addition of a 30-minute relaxing music intervention to an individual's daily routine over a two-week period.

Dependent Variables

The dependent variables in this study include levels of anxiety, stress, visceral sensitivity, and GI symptoms experienced by participants.

Limitations

This study will be performed virtually, and participants will not be observed while completing their daily music listening regimen. Participants will be completing daily symptom tracking and activity journals on the honor system without the researchers being able to confirm the reported experiences.

Delimitations

This study will only include individuals 18 years or older reporting at least mild anxiety and who experience GI symptoms at least occasionally during aerobic exercise. Additionally,

any individuals prescribed psychotropic medications will not be included if they have not been on a stable medication dose and regimen for a minimum of three months prior to enrollment in the study.

Operational Definitions

- Structured aerobic exercise: performing planned aerobic exercise such as cycling, running, HIIT, elliptical, rowing, swimming, etc.
- GI symptoms: gut discomfort including GI cramps, urge to defecate, diarrhea, bloating, fullness, nausea, vomiting, belching, gas/flatulence, and reflux/heartburn.

CHAPTER II

LITERATURE REVIEW

Exercise and the Gastrointestinal Tract

It has been widely studied that participation in exercise can cause GI symptoms such as nausea, belching, abdominal cramps, urge to defecate, flatulence, diarrhea, vomiting, heartburn, and reflux (Steege et al., 2012; De Oliveira et al., 2014). These gut symptoms have been commonly reported in endurance athletes, with runners being noted as one of the groups that are most frequently affected (Ho, 2009; De Oliveira et al., 2014). Peters et al. (1999) directly compared reported symptoms among runners, cyclists, and triathletes while also considering the potential causes of said symptoms. The results of this research suggested that runners and triathletes reported a greater amount of lower GI symptoms (stomach cramps, urge to defecate, diarrhea, bloating) during running while cyclists and triathletes exhibited a higher prevalence of upper GI symptoms (nausea, belching, heartburn) when cycling (Peters et al., 1999). These findings point to the role that mode of exercise may have in causing symptoms when observing multiple endurance activities. Overall, it is accepted that aspects of exercise and, in particular, aerobic training, produce gut symptoms, but the exact modality or interaction of factors causing symptoms has not been agreed upon in previous literature.

While the question of what causes GI symptoms is a multifactorial issue for athletes, previous research has primarily focused on physiological and nutritional factors. From a physiological perspective, exercise causes a redistribution of blood flow away from the splanchnic bed toward the more metabolically active skeletal muscle. These changes in blood flow are most pronounced with vigorous exercise (Joyner & Casey, 2015), which may help explain the higher incidence of certain gut symptoms during intense training and competition.

The main underlying mechanism involved in this blood flow redistribution is the activation of the sympathetic nervous system (Joyner & Casey, 2015). Ho (2009) did acknowledge that, among several factors including exercise intensity and hydration status, psychological stress also plays a role in activating the sympathetic nervous system, which directly impacts gut function. Although this article notes the potential for stress to interact with gut function, it does not further explore the concept and primarily discusses vigorous exercise, dehydration, mechanical jostling, nutritional factors, and supplementation as factors for GI distress during athletic performance (Ho, 2009).

Of the studied GI-symptom modifiers, nutritional factors have perhaps received the most attention in the literature to date. Indeed, the intake of certain foods and nutrients has been associated with a greater incidence and/or severity of GI symptoms in several observational studies of endurance athletes (Pfeiffer et al., 2012; Rehrer et al., 1992; Wilson et al., 2015; Wilson, 2016). In a 2016 study, for example, Wilson found a positive correlation between the number of kilocalories and carbohydrates consumed and upper GI symptoms in the cycling portion of a triathlon when consumed on the day of the event (Wilson, 2016). This finding suggests that meal timing, size, and macronutrient composition may impact gut symptoms in endurance athletes. Conversely, a 2018 study of recreational marathon runners did not find a correlation between nutritional intake and GI symptoms during a marathon, and the authors attributed this finding to the relatively short duration of the event (Pugh et al., 2018). Interestingly, both Wilson (2016) and Pugh et al. (2018) found that a history of GI symptoms before an athletic event was related to experiencing symptoms during the triathlon and marathon, respectively.

Research has also demonstrated the impact of carbohydrate (CHO) intake for performance enhancement on gut function and symptoms in endurance athletes. One study, for example, noted that the ratio of glucose-to-fructose that is ingested during exercise impacts GI discomfort when endurance athletes consume more than 50-60 grams of CHO per hour (O'Brien & Rowlands, 2011). A later study by Wilson and Ingraham (2015) supported this finding when subjecting endurance runners to glucose-only and glucose-fructose supplements, and it has also been found that consumption of a mixed-saccharide supplement improves performance over ingestion of single-saccharide supplements (Triplett et al., 2010). It is evident that the type and quantity of CHO consumed when performing aerobic exercise can significantly impact gut discomfort.

Fluid intake has also previously been shown to have significant impacts on GI discomfort and symptoms. In a study comparing fluid intake based on thirst and programmed fluid intake, it was found that drinking in excess of thirst was not beneficial to endurance athletes (Dion et al., 2013). An additional study subjected participants to various amounts of a carbohydrate-electrolyte beverage and found that gut discomfort was increased when individuals were expected to meet a prescribed intake of fluid (Rollo et al., 2012). Aside from studying the impacts of large amounts of CHO and fluid on gut comfort, previous research has also explored the ability to train one's gut to withstand higher amount of CHO and fluid. One such study found that two weeks of gut training with carbohydrate gel discs and carbohydrate food sources improved both GI symptoms and performance in runners when compared with individuals taking a placebo (Costa et al., 2016). Improved tolerance to fluid intake has also been previously observed. Lambert et al. (2008) found that stomach comfort was improved after repeated sessions of consuming fluid at a given rate, though rates of gastric emptying were unaffected by

fluid training. These studies suggest that consuming large amounts of CHO or fluid can increase gut discomfort, but gut training has the potential to moderately improve these symptoms.

It is important to consider additional causes of GI symptoms which are not limited to those already mentioned. Gut bacteria have also been considered as possible contributors to runners experiencing symptoms, but Schommer, Bärtsch, and Sauer (2011) found that overgrowth of bacteria in the small intestine was not a factor when observing distance runners complaining of gut symptoms. In the previously mentioned study by Peters et al. (1999), the prevalence of lower gut symptoms was suggested to be caused primarily by mechanical bouncing during running while upper gut symptoms were associated with the tilted forward position of cyclists when biking. This study also reported a higher occurrence of GI symptoms in cyclists compared to runners and triathletes, which the authors attributed to the longer duration of cycling events and younger athletes causing an age-effect within their sample (Peters et al., 1999). Lastly, several studies have found that younger age, female sex, and less training experience are predictive of experiencing more frequent or worse GI symptoms during exercise (Keeffe et al., 1984; Riddoch & Trinick, 1988; Wilson, 2018). For women, a higher incidence of certain GI symptoms has also been observed in the general population (Haug et al., 2002) and may, in part, be due to sex differences in GI motility and transit time (Rao et al., 2009).

Previous research has noted the relationship between participating in exercise and experiencing potentially adverse gut symptoms, but it is also necessary to consider the positive impact of exercise on the GI tract. Several reviews have weighed the potential risks and benefits of participating in exercise for the GI tract (Bi & Triadafilopoulos, 2003; De Oliveira & Burini, 2009; Peters et al., 2001; Simren, 2002). In their review of the literature, Bi and Triadafilopoulos (2003) found that regular engagement in light-to-moderate exercise can decrease the risk of

diseases such as inflammatory bowel disease or liver disease as well as colon cancer, but acute vigorous exercise may cause the previously mentioned GI symptoms, though these issues are most prominent during and immediately after exercise. Peters et al. (2001) and Simren (2002) also came to similar conclusions. Thus, it is possible to conclude that, despite its potential long-term health benefits, vigorous exercise like running may negatively impact the gut (at least transiently) and is characterized by the presence of GI distress in some people.

Stress, Anxiety, and Gut Symptoms

Stress and anxiety have also been linked to GI symptoms in both non-athlete and athlete populations. Several studies, for instance, have exhibited the impacts of stress, anxiety, or depression on gut function or the risk of GI diseases such IBS (Chang, 2011; Jerndal et al., 2010; Norton et al., 1999). Based on the finding that 70% of young adults in America and Sweden exhibit symptoms of function GI disorders, Norton et al. (1999) sought to determine if anxiety and depression were correlated with the symptoms experienced for this population. The authors did find that symptoms of anxiety and depression were correlated with GI symptoms in college students (Norton et al., 1999). Much like the occurrence of GI symptoms in runners, it has been stated that the symptoms associated with IBS have multifactorial causes (Jerndal et al., 2010). Jerndal et al. (2010) found that stress related to or caused by the presence of GI symptoms was the best indicator of the presence and extent of GI symptoms. This finding poses interesting implications, as it considers the potential for stress related to GI dysfunction as a driving factor for symptoms as opposed to general anxiety or stress. Lastly, Chang (2011) noted that previous studies have found that stress is both a possible driving force for developing IBS and an agitator of the condition, manifested by increases in the severity of GI symptoms experienced by individuals with and without dysfunction. In sum, it is evident that the occurrence of stress,

anxiety, or depression often coincides with an individual suffering from GI symptoms or, in more severe cases, disorder or disease.

Gil et al. (1998) also explored colonic motility during exercise, diet, and stress as potentially impacting GI symptoms in runners, noting that previous research connects stress to gut symptoms but not to those in runners. There are still few research studies to date considering the relationship between stress and gut symptoms in individuals performing aerobic exercise. One pre-existing study which observed the relationship between gut symptoms and anxiety/stress in runners found that they were slightly correlated (Wilson, 2018). Subsequent studies have also confirmed these modest associations between anxiety and GI disturbances in endurance athletes (Wilson, 2020; Wilson et al., 2020). These results do not confirm a causal relationship between stress or anxiety and GI symptoms in regular exercisers, but they do suggest a need for further research and the consideration of life stressors as a driving force behind gut symptoms in this population.

In response to the link between anxiety and GI symptoms, some researchers have sought to alleviate symptoms through mindfulness programming (Kearney et al., 2011). Implementing a mindfulness-based stress reduction (MBSR) program, Kearney et al. (2011) found that participants exhibited a decrease in anxiety related to their GI symptoms and had improved quality of life. This suggests that psychological interventions may have potential to improve GI symptoms and bolsters the idea that there is a deep connection between one's psychological state and the function of their GI tract. Indeed, a 2014 meta-analysis of mindfulness interventions in people with functional gut disorders found significant improvements in symptoms and quality of life (Aucoin et al., 2014).

Wilson et al. (2020) observed the relationship between anxiety, stress, and GI symptoms during endurance races and determined that stress and anxiety were related to GI symptoms. Furthermore, they found that "state" anxiety, or temporary anxiety brought forth at a particular time, was most highly related to the occurrence of GI symptoms in the recreational endurance athletes included in their study (Wilson et al., 2020). This finding suggests that event anxiety could be a driving factor for GI symptoms during athletic competition. Overall, there is an abundance of evidence showing that stress, anxiety, and/or depression are directly related to GI symptoms or, in some cases, dysfunction and disease, but there is lack of research interpreting the effects of this relationship in athletic populations. More importantly, there is currently no experimental research in highly physically active populations that has attempted to reduce GI symptoms through interventions that target stress and anxiety.

Music Therapy

Given that elevations in stress and anxiety are linked to a higher incidence of GI disturbances, there has been a growing interest in evaluating interventions that aim to reduce anxiety and stress as a means to improve GI function. One such strategy, music therapy or listening to "relaxing" music, has been used in a variety of scenarios to reduce stress or anxiety. Specifically, it has been studied as an intervention for psychological health benefits in pregnant women, older adults in care facilities, in sports, and in daily life (Chang et al., 2008; Costa et al., 2018; Elliot et al., 2014; Linnemann et al., 2015). The methods and outcome measures were not consistent across these studies intending to improve psychological health, making it necessary to analyze their results to determine the best methods to apply to future populations.

First, two studies observed the impacts of implementing relaxing music interventions on stress and anxiety among other factors. Chang et al. (2008) provided four pre-selected music

options lasting 30 minutes each and had women in their experimental group choose one of the four selections to listen to daily for a two-week period. Observing self-reported stress, anxiety, depression, the researchers found that the intervention reduced all three factors in pregnant women (Chang et al., 2008). Liu et al. (2015) also provided prerecorded music options and allowed their participants to select which to listen to for 30 minutes at bedtime daily for two weeks. In this study, the researchers found that stress and anxiety were reduced in pregnant women and sleep quality was improved following their two-week intervention (Liu et al., 2015). The results from these two studies suggest that individuals experiencing moderate-to-high psychological stress or anxiety, in this case pregnant women, can benefit from two weeks of listening to relaxing music for a minimum of 30 minutes daily.

Additional research has focused on the implementation of self-selected music in potentially improving depression, anxiety, and pain in older adults living in a care facility (Costa et al., 2018). After a three-week, 30-minute per day music-listening intervention, the researchers concluded that the participants had a greater reduction in depression and anxiety than pain (Costa et al., 2018). Further research also implemented music listening for stress reduction in daily life (Linnemann et al., 2015; Raglio et al., 2019). In contrast to the previously mentioned studies, Linnemann et al. (2015) did not require participants to listen to music for a set period of time daily and found that participants chose to listen to less music when exposed to more stressful situations. To further understand the importance of music selection, Raglio et al. (2019) prescribed 30 minutes of daily self-selected music listening for three weeks to one study group and two weeks of an algorithmically generated playlist for a second group with the hypothesized outcome of reducing work-related stress. The results of this study supported that daily music listening for relaxation decreases stress and that both music selections produced similar results

(Raglio et al., 2019). Lastly, music has also previously been used to mitigate anxiety derived from participation in a competitive situation (Elliot et al., 2014). While the researchers reported that the use of relaxing music in their intervention produced an anxiolytic effect, the competitive scenario was contrived and may have impacted the extent of competitive anxiety participants felt (Elliot et al., 2014). This suggests a need for further research regarding the use of music to decrease the impacts of competitive anxiety, preferably involving a real competition. Existing literature strongly shows that relaxing music interventions impact stress and anxiety and point to potential routes for future studies.

Although the literature on the use of chronic music-listening interventions as a tool to manage anxiety is rather limited, a relatively large body of research exists on the acute effects of relaxing music on physiological stress markers. It has previously been confirmed that relaxing music has a significant impact on heart-rate variability and, thus, the cardio autonomic system (Mojtabavi et al., 2020). Additional research has found that music listening impacts both physiological and psychological factors. Music listening has been found to impact heart rate, blood pressure, and hormone levels, with the heart rate exhibiting the most significant impact (De Witte et al., 2020). Heart rate, blood pressure, and hormone levels are physiological markers of stress and the impact of music listening on these factors suggests a strong potential for improving the psychological factors of stress and anxiety as well.

In examining previous literature regarding the use of music therapy, it is important to consider the characteristics of the music selected for use in an intervention. Previous research suggests the use of music with a tempo of 60-80 beats per minute (BPM) to mimic the resting heart rate of most humans (Liu et al., 2015; Chang et al., 2008). Additionally, Elliot et al. (2011) researched which characteristics of music are revered as most anxiolytic. To avoid bias and

ensure replicability of research design, the research supported the use of researcher-selected music exhibiting a tempo of 80-100 bpm, simple melodies and rhythms, a 4/4 time signature, and could be described as “tranquil” among other features (Elliot et al., 2011). Portions of these suggestions have been adopted in various studies, which have found therapeutic music interventions to be anxiolytic or stress reducing, suggesting that they are a valid basis for selecting relaxing music. In support of these findings, Ooishi et al. (2017) described an increase in salivary oxytocin and decrease in cortisol, related with relaxation, when participants were asked to listen to slow-tempo piano music.

The effect of relaxing music on different ages and genders has also been considered. Lee-Harris et al. (2018) found that, when studying two age groups with various pieces of music, that older and younger adults did differ in their response to music. They also found that meditative binaural music (MBM) was not more effective at inducing relaxation than other genres typically used such as classical music. The results of Lee-Harris et al.’s study suggests that different ages may have different preferences for relaxing music and that music from multiple genres with similar characteristics can be equally effective for relaxation as opposed to one specific genre providing the greatest results (2018). Lastly, Knight& Rickard (2001) exhibited that both healthy men and women experience anxiolytic effects when listing to relaxing music but those with the greatest perceived stress experienced the largest reduction. It is likely that the amount of stress an individual is experiencing determines the extent of music therapy’s benefits as opposed to demographic characteristics. Previous literature has laid a concrete foundation for the selection of music in relaxing music interventions.

Amidst previous research on music therapy, one factor of this intervention method remains consistent throughout. Music therapy for relaxation is attractive for a wide variety of

scenarios because it is convenient to implement and does not pose major risks for side effects (Raglio et al., 2019). For this reason, music therapy has been used clinically and casually as a means of stress or anxiety reduction. Thus, it follows that this is an appropriate intervention as a potential treatment for additional populations who may suffer from anxiety, depression, or stress impacting their quality of life.

Summary

Previous research has constructed a framework that GI symptoms impact a large portion of the athletic population and are most prevalent in endurance athletes such as distance runners. While literature agrees on the negative impact of GI distress on athletes, there is not a consensus regarding the exact cause or causes of GI symptoms in this population. Studies have researched the impacts of diet (e.g., Wilson, 2016), mechanical bouncing (Peters et al., 2001; Rehrer, 1991), and gut bacterial growth (Schommer et al., 2011) among a multitude of potential factors. In reality, it's likely that, for many people who exercise habitually, exercise-associated GI distress is caused by a combination of factors.

One factor lacking in the current literature is psychological health and its impacts on athletes' gut function and symptomology. Three previous observational studies have considered the relationship of stress and anxiety with GI symptoms in endurance athletes and elucidated associations between these variables (Wilson, 2018; Wilson et al., 2020; Wilson, 2020). In addition, several other studies have reported that some endurance athletes believe that anxiety plays a role in their GI disturbances during exercise (Worobetz & Gerard, 1985; Sullivan, 1987; Sullivan & Wong, 1992). As such, there is reason to believe stress and anxiety may impact GI symptoms in endurance athletes and further research is needed to demonstrate this relationship and propose potential solutions for affected individuals.

Although few studies have linked psychological distress and GI symptoms in athletes, numerous studies have observed the role stress and anxiety play in causing or exacerbating gut symptoms in other populations. Norton et al. (1999) linked the prevalence of GI symptoms in college students to stress and anxiety, and Chang et al. (2011) explained how stress can cause IBS and increase its severity in afflicted individuals. In response to this link between psychological distress and GI function, studies have sought relief for those affected through mindfulness programming (Kearney et al., 2011; Aucoin et al., 2014). Kearney et al. (2011) did find an improvement in GI related anxiety stemming from their intervention, suggesting that an intervention targeting psychological health could improve GI symptoms.

Lastly, a wide range of literature suggests the implementation of therapeutic or relaxing music interventions for the improvement of stress, anxiety, or depression. Several studies have shown the ability of relaxing music to decrease stress and anxiety in populations such as pregnant women (Chang et al., 2008; Liu et al., 2015), older adults (Costa et al., 2018), college students (Raglio et al., 2019), and healthy men and women (Knight & Rickard, 2001). Previous research has also established a foundation for the type of music and intervention which will yield improvements in stress and anxiety (Elliot et al., 2011). This wide application and availability of relaxing music interventions suggests their use could benefit additional populations suffering from stress and anxiety.

To date, there is no pre-existing research implementing the use of a relaxing music intervention to reduce the stress, anxiety, and GI symptoms in people who engage in aerobic exercise regularly. Based on previous literature, it follows that a relaxing music intervention has the potential to reduce stress or anxiety, thereby diminishing the GI symptoms that many aerobic exercisers reportedly experience.

CHAPTER III
METHODS

General Experimental Design

This study was a two-group randomized parallel trial and was not blinded due to the nature of the study. Due to the presence of the COVID-19 pandemic, this study was conducted virtually to ensure the safety of all subjects and researchers. Study instructions and materials were delivered virtually through email, video call, and Qualtrics.

Participants

The sample of this study was comprised of individuals who regularly participated in structured aerobic exercise, had at least mild anxiety, and at least occasionally suffered from GI symptoms during exercise. Individuals were recruited via advertisements in online groups, distribution of flyers in gyms/stores specializing in recreation apparel/equipment, posts on social media, and information shared via endurance race organizers. Regular aerobic exercise was defined as participation in structured aerobic exercise (jogging, running, biking, elliptical, rowing, swimming, etc.) at a moderate intensity or greater for a minimum of 120 minutes per week. Inclusion criteria included:

- being 18 years of age or older
- meeting the 120-minute/week minimum requirement for structured aerobic exercise
- having a General Anxiety Disorder (GAD)-7 score of 5 or more at baseline
- having at least occasionally experienced GI symptoms during exercise over the past month

Exclusion criteria included individuals altering any treatments or medications for known conditions during the study period. Individuals taking psychotropic medications needed to be on a stable medication regimen for a minimum of three months prior to the study for inclusion. Individuals listening to music for the purpose of relaxation more than 60 minutes per week were also excluded. All participants were screened with a questionnaire regarding these inclusion and exclusion criteria before being permitted to enroll in the study. This protocol for this study was approved by the university Institutional Review Board (local board reference number: 20-209), and each participant signed an informed consent form before any data were collected.

Experimental Procedures

Following recruitment, participants were block randomized into a control and experimental group. Block sizes of 2 and 4 were used, and sex-specific randomization lists were produced using the following website: https://www.sealedenvelope.com/simple-randomiser/v1/lists. A person not involved in the data collection was asked to generate the lists and then fill sequentially labelled envelopes with the results which were opened at the time of randomization for each participant.

The study period was approximately three weeks in length, with a one-week baseline tracking period followed by a two-week intervention period. Participants were asked to track their exercise and gut symptoms in a daily journal. Randomization occurred after the one-week baseline assessments.

Experimental Group

The first week of the study period served as an observation period of the participant's baseline characteristics before introduction of the intervention. Beginning on the second week of the

study, participants assigned to the experimental group were asked to select and listen to at least thirty minutes of relaxing music daily from five pre-created playlists provided by the researchers via Youtube. The five 30-minute relaxing music playlists were based on previously described qualities that make music relaxing. These playlists differed in genre to allow the participants to select the music which appealed to them as most relaxing. Previous research has shown that self-selection can be just as important as a song's relaxing characteristics (Lee-Harris et al., 2018). Participants were asked to listen to one playlist each day for the entirety of weeks two and three of the study while continuing to complete their daily journals. Daily journals for the experimental group consisted of both an activity and GI symptom journal and a music intervention adherence and engagement journal. Participants were asked to report their engagement and their level of relaxation during each music listening session on a scale of 1-10.

Control Group

For the three-week study duration, control participants were asked not to alter their normal daily routine. They were instructed to continue to complete their daily journals regarding physical activity and gut symptoms.

Study Variables

General Anxiety Disorder-7 (GAD-7)

The GAD-7 questionnaire contains seven questions regarding the frequency of anxiety symptoms experienced over the two weeks prior to completing the document. These questions are each ranked on a 0 – 4 scale with 0 representing "Not at All" and 4 representing "Nearly Every Day". Scores on the GAD-7 are summed to provide the level of anxiety the person experienced over the previous two weeks. This questionnaire has been previously validated

(Johnson et al., 2019; Kertz et al., 2013; Spitzer et al., 2006). Participants were asked to complete the GAD-7 before and after the study period.

Perceived Stress Scale-14 (PSS-14)

The PSS-14 consists of 14 questions regarding a person's stressful feelings and thoughts over the month prior to completing the questionnaire. Participants were asked to complete the PSS-14 before and after the study period. For the post-study assessment, the instructions on the questionnaire were modified so that participants responded how they felt over the previous two weeks. The scale has been previously validated (Cohen et al., 1983; Lee, 2012).

Visceral Sensitivity Index (VSI)

The VSI is a 15-item questionnaire regarding GI symptom-specific anxiety. Participants were asked to complete this questionnaire before and after the study period. This index has been previously validated and found to be reliable (Labus et al., 2004).

GI Symptoms

Following each session of structured aerobic exercise, participants were asked to rate the overall level of discomfort they experienced for several symptoms (nausea, regurgitation/reflux, stomach fullness, bloating, abdominal cramps, gas, and urge to defecate) on a scale of 0 to 10. A "0" rating on this scale represented no discomfort while "10" represented unbearable discomfort. This rating system has previously been shown to be valid and reliable (Wilson, 2017).

GI symptom ratings from each exercise session were summed to create total, upper, and lower GI symptom scores. Average total, upper, and lower GI symptom scores were calculated by summing scores from each exercise session and dividing them by the number of exercise

sessions over the tracking period. Scores from week 1 (pre-intervention) were compared to scores from week 3.

Statistical Analyses

Normality of the data was evaluated using the Shapiro-Wilks test along with visually inspecting histogram plots. Visual inspection of the distributions and tests for normality showed that the outcome data (PSS-14, GAD-7, VSI, GI scores) were normally distributed. Descriptive data for continuous data are presented as mean ± standard deviation (SD).

Since the outcome data were normally distributed, they were analyzed using Mixed ANOVA analysis that tested for group (music vs. control), time (pre vs. post), and group x time interaction effects. For participants who did not have complete data but who were randomized to one of the two groups, the last-observation-carried-forward method was used so that an intention-to-treat analysis could be carried out. In addition, a per-protocol analysis was carried out to evaluate whether the results were relatively consistent when only participants who completed the study measures were included.

Version 27 of SPSS software (IBM Corporation, Armonk, NY, USA) was used to conduct the analyses, and a p-value of < 0.05 was used as the threshold for statistical significance.

CHAPTER IV

RESULTS

Subjects

Twenty-four individuals were screened for eligibility to participate in this study, and 18 individuals were ultimately consented. Figure 1 shows the distribution of these individuals between the control and intervention group.

Figure 1

CONSORT Flowchart of Participants.

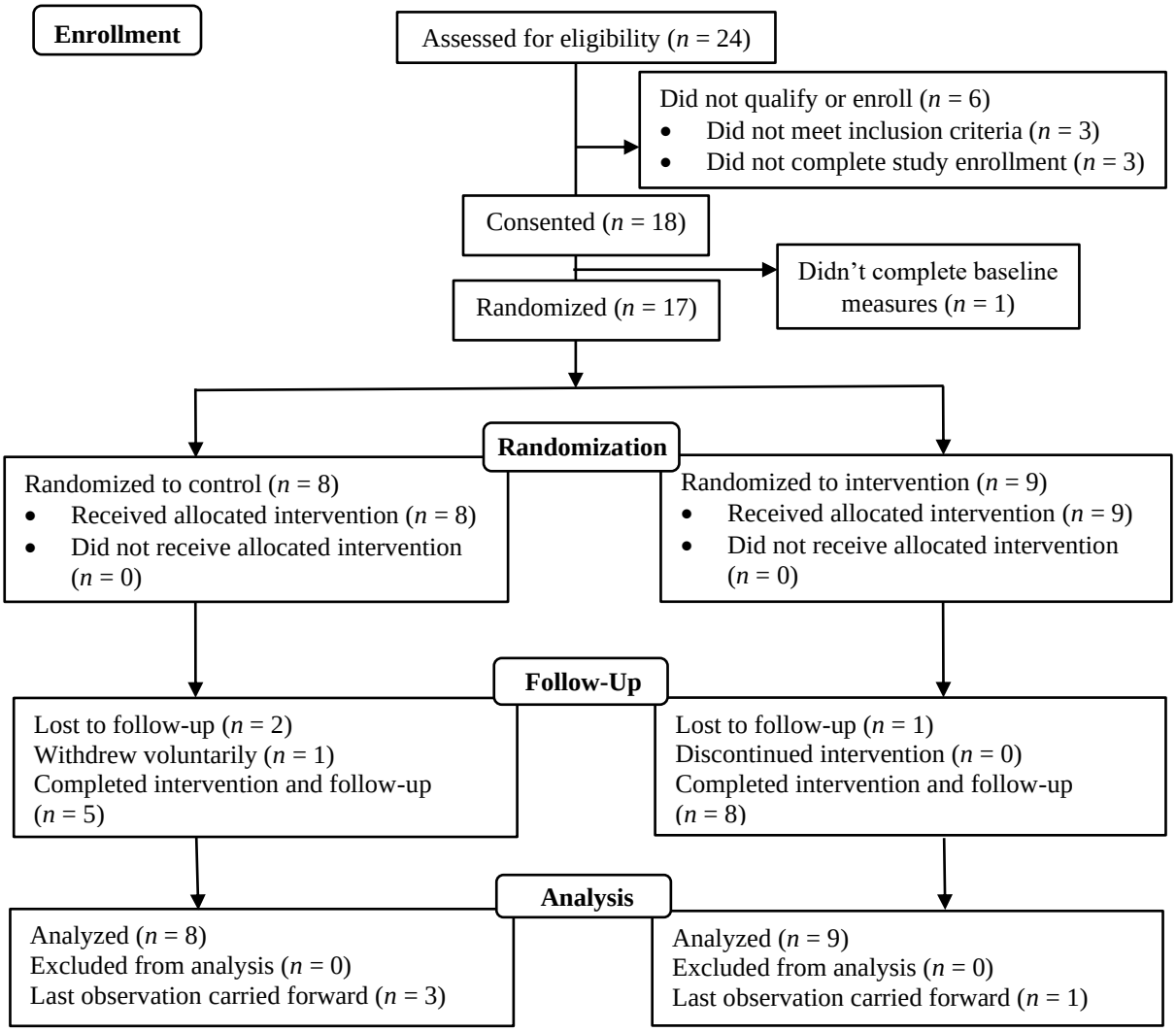

Table 1 exhibits the characteristics of participants in both the music and control groups, including their age, height, mass, body mass index (BMI), employment status, presence of gastrointestinal condition, and treatment of any gastrointestinal conditions with medication. In addition, it also provides the number of aerobic sessions, rating of perceived exertion (RPE), and exercise duration at baseline. Although not subjected to statistical hypothesis testing, the groups appeared to be relatively well matched at baseline.

Table 1

Subject characteristics

	Music (***n*** **= 9)**	**Control** (***n*** **= 8)**
Age (years)	39.4±4.00	35.6±2.4
Height (cm)	168.5±3.3	171.2±3.3
Mass (kg)	79.0±8.1	77.4±13.6
BMI (kg/m^2)	27.7±2.4	26.0±3.9
Pre-Intervention Aerobic Sessions (#)	6.8±1.0	7.6±1.2
Pre-Intervention Aerobic Session RPE (6-20)	14.0±0.8	13.7±0.7
Pre-Intervention Aerobic Session Duration (min)	55.2±5.1	62.7±11.0
% Female	88.9	87.5
% Male	11.1	12.5
% Employed	88.9	100.0
% with Reported GI Condition	33.3	25.0
% that Used Medications for GI-Symptom Management with Exercise	0.0	12.5

BMI, body mass index; RPE, rating of perceived exertion.

Music Intervention

Individuals allocated into the intervention group were asked to record their adherence to daily music listening over two weeks as well as their perceived engagement in the task and the extent to which they found the task relaxing. Table 2 presents these results among participants who sent back a completed music journal (n = 8). Adherence to the intervention and ratings of engagement and relaxation suggest that relaxing music listening was a reasonable and tolerable activity.

Table 2

Music intervention adherence and reported experience

Measure	Average
Number of music sessions (0-16)	14.25±1.58
Engagement (1-10)	7.28±0.91
Perceived relaxation (1-10)	7.15±1.53

GI Symptoms, PSS-14, GAD-7, and VSI

Table 3 presents pre- and post-intervention averages for resting gastrointestinal symptoms, as well as total, upper, and lower GI symptoms during aerobic exercise, PSS-14 scores, GAD-7 scores, and VSI scores for both the music and control groups. It also provides p-values and Partial Eta Squared values for time, group, and time x group for the mentioned study variables. There were no statistically significant values for the variables measured within this study.

Partial Eta Squared (ηp^2) was included in our statistical analysis to provide additional insight on the changes observed in this study. This measure refers to effect size. When a result is not statistically significant based on p-value, effect size provides the magnitude of the difference

between two measures (Sullivan and Feinn, 2012). Resting GI symptoms, PSS-14 scores, GAD-7 scores, and total GI during aerobic exercise did not show significant differences from beginning to end of this study, nor were they found to significantly differ between groups, but they did trend towards a significant decrease for the music intervention group. Partial eta squared (ηp^2) values of 0.01, 0.06, and 0.14 are often defined as small, medium, and large, respectively (Cohen, 1992). Considering resting GI symptoms, the effect size for a time x group interaction was large ($\eta p^2 = 0.198$), suggesting a large difference how GI symptoms changed over time between the two groups. Specifically, resting GI scores went from 25.6±10.9 to 20.4±10.5 in the music group, which compares to a change from 15.0±14.3 to 15.1±12.1 in the control group. Other notable effect sizes found in Table 3 include the time effects for resting GI symptoms ($\eta p^2 = 0.183$), upper GI symptoms during aerobic exercise ($\eta p^2 = 0.151$), and PSS-14 scores ($\eta p^2 = 0.146$), all of which indicate potential reductions in each measure over time. In addition, the group effect for PSS-14 data was $\eta p^2 = 0.204$. These findings suggest that a larger sample size may have led to a statistically significant finding for the measures mentioned.

In Table 4, results for a per-protocol analysis are shown for comparison to the intention-to-treat analysis. In general, the patterns in the means (SDs), p-values, and effect sizes are relatively similar.

Table 3

Mixed ANOVA Results for the Intention-to-Treat Analysis

Measure	Music (n=9)	Control (n=8)	Time Effect p value (ηp^2)	Group Effect p value (ηp^2)	Time*Group p value (ηp^2)
Resting GI (0-70)			0.087 (0.183)	0.18 (0.116)	0.073 (0.198)
Pre	25.6±10.9	15.0±14.3			
Post	20.4±10.5	15.1±12.1			
Aerobic Total GI			0.549 (0.024)	0.240 (0.091)	0.540 (0.026)
Pre	15.7±6.8	12.8±8.6			
Post	15.7±7.0	10.7±7.9			
Aerobic Upper GI			0.124 (0.151)	0.365 (0.055)	0.664 (0.013)
Pre	8.9±4.8	6.8±3.3			
Post	7.8±5.0	6.2±3.7			
Aerobic Lower GI			0.907 (0.001)	0.362 (0.056)	0.336 (0.062)
Pre	6.8±5.0	6.0±6.4			
Post	7.9±5.4	4.5±4.7			
PSS-14 (0-56)			0.130 (0.146)	0.069 (0.204)	0.466 (0.036)
Pre	27.6±6.5	32.0±5.9			
Post	24.1±6.1	30.8±7.6			
GAD-7 (0-21)			0.522 (0.028)	0.261 (0.083)	0.522 (0.028)
Pre	9.2±3.2	10.4±2.9			
Post	8.2±3.4	10.4±3.7			
VSI (15-90)⁑			0.275 (0.079)	0.268 (0.081)	0.436 (0.041)
Pre	38.0±10.6	34.0±19.1			
Post	36.7±15.2	26.3±15.8			

GAD-7, general anxiety disorder-7; GI, gastrointestinal; PSS-14, perceived stress scale-14; VSI, visceral sensitivity index.

Table 4

Mixed ANOVA Results for a Per-Protocol Analysis

Measure	Music (n=6)	Control (n=5)	Time Effect p value (ηp^2)	Group Effect p value (ηp^2)	Time*Group p value (ηp^2)
Resting GI (0-70)			0.08 (0.302)	0.099 (0.273)	0.068 (0.324)
Pre	29.3±8.2	15.6±12.0			
Post	21.7±10.1	15.8±6.1			
Aerobic Total GI†			0.481 (0.046)	0.267 (0.111)	0.475 (0.047)
Pre	16.0±7.2	13.2±9.3			
Post	16.1±7.5	9.9±7.9			
Aerobic Upper GI†			0.142 (0.185)	0.334 (0.085)	0.874 (0.002)
Pre	8.9±5.1	6.3±2.3			
Post	7.6±5.3	5.3±3.0			
Aerobic Lower GI†			0.774 (0.008)	0.480 (0.046)	0.328 (0.087)
Pre	7.1±5.3	6.9±7.5			
Post	8.4±5.5	4.6±5.1			
PSS-14 (0-56)			0.141 (0.224)	0.071 (0.317)	0.494 (0.053)
Pre	26.3±6.6	29.4±3.9			
Post	21.2±3.1	27.4±6.5			
GAD-7 (0-21)			0.550 (0.041)	0.340 (0.101)	0.550 (0.041)
Pre	9.5±3.5	10.8±3.7			
Post	8.0±3.7	10.8±4.7			
VSI (15-90)‡			0.276 (0.130)	0.605 (0.031)	0.424 (0.072)
Pre	36.5±8.7	37.2±23.4			
Post	34.5±15.9	24.8±19.4			

GAD-7, general anxiety disorder-7; GI, gastrointestinal; PSS-14, perceived stress scale-14; VSI, visceral sensitivity index. †Sample sizes for the journal data were as follows: music, n = 8; control, n = 5.

CHAPTER V

DISCUSSION

The purpose of this study was to determine the impact of a two-week relaxing music intervention on stress, anxiety, and gut symptoms in aerobic exercisers. Previous research has not explored the potential of music listening to decrease stress and anxiety in aerobic exercisers and, in turn, decrease these individuals' gastrointestinal symptoms. This study hypothesized that a two-week relaxing music intervention would produce a decrease in stress, anxiety, and GI symptoms in aerobic exercisers. The following sections address the dependent variables measured in this research and whether the study's hypothesis was supported.

Gastrointestinal Symptoms

One primary focus of this research was the relationship between aerobic exercise, stress, anxiety, and gastrointestinal symptoms. Previous research has described the connection between the occurrence of GI symptoms including nausea, belching, abdominal cramps, urge to defecate, gas, and reflux, among others, during exercise (Steege et al., 2012; De Oliveira et al., 2014). Additionally, stress and anxiety have also been linked to the experience of gut symptoms in several populations (Chang, 2011; Jerndal et al., 2010; Norton et al., 1999). This research directly considered the relationship between stress, anxiety, and gut symptoms in regular aerobic exercisers.

Regarding GI symptoms at rest over the course of this study, no significant difference was found between or within the control and intervention groups. It should be noted that results from the time x group analysis trended towards significance and the magnitude of the difference between groups was considered large ($p = 0.073$, $\eta p^2 = 0.198$). Considering total GI symptoms

during exercise and the upper and lower components of these symptoms, no significant differences were observed. It is important to note that this study's small sample size (n = 17) and the use of last observation carried forward for participants lost to follow up may not have been sufficient for detecting significant changes for GI measures.

Stress, Anxiety, and Visceral Sensitivity

In order to elicit a decrease in GI symptoms, this research targeted decreasing potential psychological causes of GI discomfort including stress and anxiety. The relationship between psychological stressors and the experience of GI symptoms or diseases has been widely researched (Chang, 2011; Jerndal et al., 2010). Kearney et al. (2011) did successfully implement a mindfulness-based stress reduction program that produced a decrease in subject anxiety related to GI symptoms. While the results of this study cannot be directly compared to our research, it is important to note that Kearney et al. (2011) observed a larger sample size and measured data at both the two- and six-month marks and did not observe significant reductions until six months of exposure to their intervention. This suggests that both sample size and study length may have impacted the findings within our study.

Significant differences were not found for PSS-14, GAD-7, or VSI scores during this study. Nonsignificant differences for PSS-14 scores for group measures did, however, trend towards significant (p = 0.069, ηp^2 = 0.204). This suggests that subjects between groups did differ in PSS-14 scores throughout the study, from baseline to conclusion. As mentioned, the small sample size for this study may have impacted the significance of these findings.

Music Intervention

Lastly, this study is the first to our knowledge to implement a relaxing music listening intervention for decreasing stress, anxiety, and gastrointestinal symptoms. Previous research supports the use of music listening interventions top improve psychological health in a variety of populations (Chang et al., 2008; Costa et al., 2018; Elliot et al., 2014; Linnemann et al., 2015). Two previous studies focused on two-week music listening interventions in pregnant women and both reported significant decreases in stress and anxiety (Chang et al., 2008; Liu et al., 2015). These studies both implemented 30-minutes of daily relaxing music listening from pre-selected playlists and, as such, provide the best comparison for our study.

As mentioned, at the conclusion of two weeks of relaxing music listening this study did not produce a significant change in psychological or gastrointestinal measures. This does not reflect the same findings as seen in previous research. That being said, participants' self-reported adherence, engagement, and relaxation scores provide insight to the ease of incorporating a music listening intervention (*Engagement* = 7.3±0.9; *Perceived Relaxation* = 7.2±1.5). Given the low risks associated with this intervention and decrease in stress and anxiety seen in previous literature, it remains a potential activity for reducing psychological stress in many populations. In addition, the moderate-to-high levels of engagement and relaxation that were reported by the participants provide evidence that this is a feasible intervention that deserves continued study with larger sample sizes of aerobic exercisers.

There are several notable limitations to this project. Sample size, technological fatigue, and the impacts of the COVID-19 pandemic were all potential limitations of this study. First, it is possible that the small sample size (n = 17) for this study was not conducive to exhibiting significant differences between groups that may only have been obvious in a larger sample. For example, measures which were found to have a large effect size suggest that a significant

difference may have been seen between groups with a larger amount of data. Secondly, the COVID-19 pandemic likely had the largest impact on the ability to recruit and sustain participants for this research. Due to the pandemic, this research was conducted entirely virtually which may have limited accessibility to participants and altered the means through which this study was advertised. In addition, it is important to note the impacts of the COVID-19 pandemic on mental health which potentially impacted the dependent variables measured in this research. While the COVID-19 pandemic is ongoing and the impacts of this pandemic cannot be fully tabulated, multiple studies have observed the negative psychological impact of this pandemic on individuals across many populations (Gavin et al., 2020; Talevi et al., 2020). Lastly, technological fatigue was also a major concern during the COVID-19 pandemic. Many individuals were placed on stay-at-home order and working from home virtually (i.e., teleworking) if they were able to do so. A 2016 study from Lee et al. described technology overload and social networking service (SNS) fatigue, stating the ability of technology use to lead to overload and the need for users to limit or manage their exposure to technology and SNS. It is sufficient to assume, based on these findings, that extended exposure to technology due to teleworking and following quarantine procedures may have caused an increase in fatigue during the COVID-19 pandemic. Although it is not possible to quantify the impact of these limitations, it is important to note their potential impact on this study.

CHAPTER VI

CONCLUSION

The focus of this study was determining the efficacy of a relaxing music intervention for aerobic exercisers experiencing stress, anxiety, and gastrointestinal symptoms. Prior studies have observed the relationships between exercise and GI symptoms, stress/anxiety and GI symptoms, and the use of relaxing music to decrease stress and anxiety, but none have examined the connection between relaxing music interventions and stress, anxiety, and GI symptoms in aerobic exercisers.

The results of this study do not show a significant relationship between relaxing music listening and GI symptoms, anxiety, and stress in aerobic exercisers. Although this study did not produce significant findings, the observed effect sizes suggest that significant results may have been present for measured dependent variables in a larger sample. With these results in mind, future studies may find more conclusive results with a larger sample size. Finally, observations of adherence, engagement, and relaxation within the music intervention group paired with previous research support the use of relaxing music as a low risk and enjoyable intervention; however, the impacts of these interventions on measures of stress, anxiety, and GI symptoms are inconclusive.

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APPENDIX A

RECRUITMENT FLYER

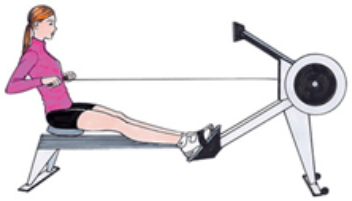
Aerobic Exercisers Needed for a Study

ODU
IDEA FUSION
Human Performance Lab

This study is evaluating the effects of daily relaxing music listening on psychological factors and gastrointestinal (GI) symptoms in aerobic exercisers.

Participation involves:

- Completing daily 30-minute music listening for 2 weeks
- Tracking information about your aerobic exercise for one week before and two weeks during the intervention
- Completing an electronic survey before and after the two-week intervention



To be eligible, you must:

- Be 18 years or older
- Do aerobic exercise for at least 120 min/week
- At least sometimes have gut symptoms during exercise
- Have at least mild anxiety
- Have access to the internet
- If you're taking medication for a mental disorder, you must be on a stable dose for the past 3 months
- Not currently listening to relaxing music for >60 minutes/week

Contact Halie Maass: hmaas001@odu.edu

Hmaas001@odu.edu
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APPENDIX B

PRE-SCREENING SURVEY

Date and Time: _____

Pre-Screening Survey

We are conducting a study on relaxing music interventions and their effects on gastrointestinal symptoms, and measures of stress/anxiety in aerobic exercisers. The purpose of this brief conversation is to determine whether you are eligible for the study. The questions I will ask are about your age, access to the internet, how much you exercise, your history of gut symptoms during exercise, how you've felt mentally in recent weeks, whether you use any psychotropic medications, and how often you currently listen to relaxing music.

Your responses will be recorded on a form, but neither your name nor any other identifying `information will be collected on the form.

These forms will allow us, the researchers, to simply report in scientific papers/presentations the number of people who were considered eligible vs. ineligible for the study, as well as the general reasons for ineligibility. However, no data from these forms will be used for analytical purposes, and no identifying information will be reported in scientific papers/presentations. These screening forms will be destroyed after the study finishes enrolling participants.

Are you OK to proceed with the screening questions?

1. Are you 18 years of age or older? YES _____ NO_____

2. Do you perform structured aerobic exercise (i.e. jogging, rowing, swimming, cycling, elliptical, etc.) for at least 120 minutes at moderate intensity or higher during a typical week?

YES _____ NO _____

3. Do you have access to the internet? YES _____ NO _____

4. Are you currently taking any psychotropic medications (e.g. Xanax, Prozac, Zoloft)?

YES _____ NO _____

5. If YES to previous question: Have you been on a stable dose for the last 3 months?

YES _____ NO _____

6. Do you currently listen to relaxing music for more than 60 minutes per week?

YES _____ NO _____

Date and Time: _____

7. How often have you experienced gastrointestinal symptoms (nausea, reflux, fullness, bloating, abdominal cramps, gas, urge to defecate, etc.) during aerobic exercise in the last month?

- Never _____
- Rarely _____
- Sometimes _____
- Often _____
- Always _____

8. Anxiety Screening: GAD-7

Over the last 2 weeks, how often have you been bothered by the following problems?	Not at all	Several days	More than half the days	Nearly every day
1. Feeling nervous, anxious or on edge	0	1	2	3
2. Not being able to stop or control worrying	0	1	2	3
3. Worrying too much about different things	0	1	2	3
4. Trouble relaxing	0	1	2	3
5. Being so restless that it is hard to sit still	0	1	2	3
6. Becoming easily annoyed or irritable	0	1	2	3
7. Feeling afraid as if something awful might happen	**0**	1	2	3
Column Totals				

Total Score:

GAD-7 Classification:

This is calculated by assigning scores of 0, 1, 2, and 3 to the response categories, respectively, of "not at all," "several days," "more than half the days," and "nearly every day." GAD-7 total score for the seven items ranges from 0 to 21.

0–4: minimal anxiety
5–9: mild anxiety
10–14: moderate anxiety
15–21: severe anxiety

Eligible for Study Inclusion: YES _____ NO _____

APPENDIX C

INFORMED CONSENT DOCUMENT

INFORMED CONSENT DOCUMENT

OLD DOMINION UNIVERSITY

Project Title: Effect of a 2-week relaxing music intervention on anxiety, stress, and gut symptoms in aerobic exercisers.

Introduction

The purposes of this form are to provide you with information that may affect your decision about whether to say YES or NO to participating in this research, and to document the consent of those who say YES. This form describes the purpose of the study, what would be asked of you if you choose to participate, and the procedures, benefits, and potential risks of participating.

Researchers

Halie Maass, BS. MS Student in the Department of Human Movement Sciences at Old Dominion University.
Patrick Wilson, PhD, RD. Associate Professor in the Department of Human Movement Sciences at Old Dominion University.

Description of the Research Study

You have been asked to participate in a study that seeks to determine the effects of 30-minute daily relaxing music listening on several psychological factors (stress, anxiety, visceral sensitivity, etc.) and gastrointestinal (GI) symptoms during structured aerobic exercise. If you decide to participate, you will be asked to complete the following procedures:

- You will be emailed an 'Activity Journal', which you will use to track information about your structured aerobic exercise for one week, including perceived exertion and the severity of several GI symptoms. You will also be emailed a hyperlink to an electronic survey that will inquire about demographics, anthropometrics, aerobic training history, typical GI symptoms, GI system diagnoses, medication use, and your levels of stress, anxiety, and sensitivity to abdominal/gut sensations.
- After one week of tracking your aerobic exercise sessions, you will be randomly designated into one of two groups. Members of one group will be asked to listen to 30 minutes of relaxing music each day, delivered via Youtube playlists. They will also track adherence to the intervention in a journal. Members of the other group will not complete any unique intervention and will be asked to keep up their normal routine. You have an equal chance (1 in 2) of being designated into each group, and specific instructions will be provided once your group is determined.
- Immediately after being assigned to your group, you will also be resent a blank 'Activity Journal' and will be asked to track the same type of information as before for two more weeks.

- Two weeks after being assigned to your group, you will be emailed the final electronic survey to complete. This survey will ask about your levels of stress, anxiety, and sensitivity to abdominal/gut pain or sensations.

If you say YES, your participation will occur over the course of about three weeks. You will spend a few minutes each day completing each of the two 'Activity Journals'. Each of the two electronic surveys will take about 10-15 minutes to complete. Participants assigned to the music group will also spend 30 minutes a day listening to relaxing music for two weeks. Therefore, participants in the control group will devote aproximately 90 minutes to the study, while those in the relaxing music group will devote approximately 500 minutes to the study. Up to 80 individuals will participate in this study.

Exclusionary Criteria

If you are receiving this consent document, you have already been screened for anxiety levels with the GAD-7 and asked about your GI symptoms during structured aerobic exercise in the past month. To be able to participate in this research study, you should:

- Be 18 years of age or older.
- Be currently performing structured aerobic exercise at a moderate intensity or greater for a minimum of 120 minutes a week.
- Have access to the internet.
- Have scored ≥5 on the GAD-7 during initial screening.
- Have experienced GI symptoms "sometimes", "often", or "always" during aerobic exercise in the past month.
- Either not be taking psychotropic medications or be on a stable dose for the last 3 months.
- Not already be listening to relaxing music for >60 minutes per week.

Risks and Benefits

RISKS: There are minimal risks of participating in this study. Due to the nature of questions regarding emotional or mental health and GI symptoms, participants may experience temporary mild discomfort. At the end of the Qualtrics survey, we will provide links to mental health resources. Participants will be encouraged to use these resources if they experience discomfort or distress when completing the surveys.

There is also a small risk that participants' identifiable information may be seen by other individuals than the investigators. However, precautions will be taken to ensure participants' identifiable data remain confidential. An

alphanumeric ID code will be used on data collection forms to protect information. All data will be stored according to the participant's alphanumeric ID code in locked cabinets and/or on password-protected computers and secure network servers. A master list linking the participants' names and alphanumeric ID codes will be stored in a locked cabinet within the HPL and/or on a secure computer. Participant names and ID codes will only be referenced together in this master list. This list will be destroyed once the data analysis is complete.
BENEFITS: There are no direct benefits to participating in this study. Participants in the intervention group, however, could experience a decrease in stress, anxiety, or gut symptoms. If this intervention proves beneficial it could lead to the implementation of music therapy for exercisers who regularly experience anxiety and gut symptoms. Further, this study will improve societal knowledge of how psychological factors contribute to the development of GI symptoms in regular exercisers.

Costs and Payments

The investigators want your decision about participating in this study to be completely voluntary. You will not receive any payment for participating in the study.

New Information

If the investigators discover any new information during the study that would reasonably affect your decision about participating, then they will provide it to you.

Confidentiality

The investigators will take several steps to keep any private or identifiable information confidential. Instead of using identifying information like your name in data files, the investigators will use ID codes. A master list linking your name to your ID code will be maintained during the study, but it will be stored separately from the data files. This master list will be destroyed once the data is analyzed. Data files and signed copies of this consent form will be stored in locked filing cabinets in the investigators' offices, on password-protected computers, and/or on secure cloud storage services. The results from this study may be used in reports, publications, or presentations, but the investigators will not identify you as a participant. Of course, your records may be subpoenaed by court order or inspected by government bodies with oversight authority.

Withdrawal Privilege

It is okay for you to say NO to participating in this study. Even if you say YES now, you can say NO later and withdraw from the study at any time. Your decision will not affect your relationship with Old Dominion University or cause any loss of benefits you might otherwise be entitled to. The investigators reserve the right to

withdraw your participation from the study at any time if they observe potential problems associated with your continued participation.

Compensation for Illness and Injury

If you say YES, then your consent in this document does not waive any of your legal rights. However, in the event of illness or injury during your participation in this study, neither Old Dominion University nor the investigators can provide money, insurance coverage, free medical care, or any other compensation for the illness or injury. In the event that you suffer harm as a result of participation, you may contact Patrick Wilson, PhD at 757-683-4783, or Dr. Tancy Vandecar-Burdin, the current IRB chair at 757-683-3802 at Old Dominion University, or the Old Dominion University Office of Research at 757-683-3460 who will gladly review the matter with you.

Voluntary Consent

By typing your name on this document, you are saying several things. You are saying that you have read this form or have had it read to you, that you acknowledge that you understand this form, the research study, and its risk and benefits. The investigators should have answered any questions you may have had about the study and will continue to do so for any questions you may have later on.

Patrick Wilson, PhD, RD

Associate Professor

Human Movement Sciences

Old Dominion University

Phone: 757-683-4783

Email: pbwilson@odu.edu

Halie Maass, BS

Human Movement Sciences

Old Dominion University

Phone: 757-683-3099

E-mail: hmaas001@odu.edu

If at any time you feel pressured to participate, or if you have any questions about your rights or this form, then you should call Dr. Tancy Vandecar-Burdin (tvandeca@odu.edu), the current IRB chair, at 757-683-3802, or the Old Dominion University Office of Research, at 757-683-3460.

Do wish to participate in this research?

- ○ Yes
- ○ no

Type your name below if you agree to participate.

APPENDIX D

BASELINE SURVEY

Music Study Baseline Survey

Start of Block: Default Question Block

Start of Block: Default Question Block

This survey is being used to evaluate demographics, work information, anthropometrics, exercise training/history, presence of gut conditions, typical gut symptoms, and psychological factors (e.g. stress, anxiety, attention given or sensitivity to internal body sensations). Your responses will be kept confidential.

This survey has been approved by the Old Dominion University Institutional Review Board.

What's your age?

▼ 18 ... 99

What is your sex?

- Male
- Female

What is your race/ethnicity?

- Mexican American
- Other Hispanic
- Non-Hispanic White
- Non-Hispanic Black
- Non-Hispanic Asian
- Other

What is your height?

_____

What is your weight to the nearest pound?

_____

Page Break

Are you working or currently employed?

- Yes
- No

How stressful would you rate your job on the following scale?

- 0
- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9
- 10

Page Break

Page Break

Do you have any disorders or medical conditions that cause you frequent gastrointestinal symptoms such as excessive gas, diarrhea, constipation, heartburn, abdominal pain, etc?

- Yes
- No

What is the name of the medical condition that causes you frequent gastrointestinal symptoms?

_____

Page Break

Page Break

Over the past month, how many minutes each week have you typically spent doing planned aerobic exercises like jogging, running, rowing, biking, ellipticalling, HIIT training, etc.?

_____

Do you regularly take any medications for the specific purpose of reducing or preventing gastrointestinal symptoms **associated with aerobic exercise**?

- Yes
- No

End of Block: Block 6

Start of Block: Block 10

How often have you used relaxation techniques over the last month?

- Never
- About once per week
- Several times per week
- Nearly every day

End of Block: Block 10

Start of Block: Block 3

For the following gastrointestinal symptoms, please rate the overall level of discomfort you typically experienced at rest (i.e., not during exercise) over the past week. A rating of 0 means 'no discomfort', 5 means 'moderate discomfort' and 10 means 'unbearable discomfort'.

Nausea: A feeling of sickness in the stomach marked by an urge to vomit.
Regurgitation / Reflux: Sensation of food or fluid returning from the stomach to the esophagus or mouth.
Stomach Fullness: A sensation of fullness or abdominal pressure in the upper abdomen.
Bloating: A feeling of distension from a buildup of gas in the gut.
Abdominal Cramps: Pain or cramping sensation, often experienced in the mid- or lower-portion of the abdomen.
Gas / Flatulence: Gas or flatus expelled through the anus.
Urge to Defecate: Sensation of needing to pass a bowel movement.

	0 (No discomfort)	1	2	3	4	5 (moderate discomfort)	6	7	8	9	10 (unbearable discomfort)
Nausea	○					○					○
Regurgitation/Reflux	○					○					○
Stomach Fullness	○					○					○
Bloating	○					○					○
Abdominal Cramps	○					○					○
Gas/Flatulence	○					○					○
Urge to defecate	○					○					○

End of Block: Block 3

Start of Block: Block 4

The questions in this scale ask you about your feelings and thoughts **during the last month**. In each case, you will be asked to indicate **how often** you felt or thought a certain way. Although some of the questions are similar, there are differences between them and you should treat each one as a separate question. The best approach is to answer each question fairly quickly. That is, don't try to count up the number of times you felt a particular way, but rather indicate the option that seems like a reasonable estimate.

	Never	Almost never	Sometimes	Fairly often	Very often
How often have you been upset because of something that happened unexpectedly?	○	○	○	○	○
How often have you felt that you were unable to control the important things in your life?	○	○	○	○	○
How often have you felt nervous or stressed?	○	○	○	○	○
How often have you found that you could not cope with all the things that you had to do?	○	○	○	○	○
How often have you been angered because of things that happened that were outside of your control?	○	○	○	○	○
How often have you found yourself thinking about things that you have to accomplish?	○	○	○	○	○
How often have you felt difficulties were piling up so high that you could not overcome them?	○	○	○	○	○

The questions in this scale ask you about your feelings and thoughts **during the last month**. In each case, you will be asked to indicate **how often** you felt or thought a certain way. Although some of the questions are similar, there are differences between them and you should treat each one as a separate question. The best approach is to answer each question fairly quickly. That is, don't try to count up the number of times you felt a particular way, but rather indicate the option that seems like a reasonable estimate.

	Never	Almost never	Sometimes	Fairly often	Very often
How often have you dealt successfully with irritating life hassles?	○	○	○	○	○
How often have you felt that you were effectively coping with important changes that were occurring in your life?	○	○	○	○	○
How often have you felt confident about your ability to handle your personal problems?	○	○	○	○	○
How often have you felt that things were going your way?	○	○	○	○	○
How often have you been able to control irritations in your life?	○	○	○	○	○
How often have you felt that you were on top of things?	○	○	○	○	○
How often have you been able to control the way you spend your time?	○	○	○	○	○

Over the last 2 weeks, how often have you been bothered by the following problems?

	Not at all	Several days	More than half the days	Nearly every day
Feeling nervous, anxious, or on edge	○	○	○	○
Not being able to stop or control worrying	○	○	○	○
Worrying too much about different things	○	○	○	○
Trouble relaxing	○	○	○	○
Being so restless that it is hard to sit still	○	○	○	○
Becoming easily annoyed or irritable	○	○	○	○
Feeling afraid, as if something awful might happen	○	○	○	○

Below are statements that describe how some people respond to symptoms or discomfort in their belly or lower abdomen. These may include pain, diarrhea, constipation, bloating or sense of urgency. Please answer 'how strongly you agree or disagree' with each of these statements, AS THEY RELATE TO YOU. Answer all of the statements as honestly and thoughtfully as you can.

	Strongly agree	Moderately agree	Mildly agree	Mildly disagree	Moderately disagree	Strongly disagree
I worry that whenever I eat during the day, bloating and distension in my belly will get worse.	○	○	○	○	○	○
I get anxious when I go to a new restaurant.	○	○	○	○	○	○
I often worry about problems in my belly.	○	○	○	○	○	○
I have a difficult time enjoying myself because I cannot get my mind off of discomforts in my belly.	○	○	○	○	○	○
I often fear that I won't be able to have a normal bowel movement.	○	○	○	○	○	○
Because of fear of developing abdominal discomfort, I seldom try new foods.	○	○	○	○	○	○
No matter what I eat, I	○	○	○	○	○	○

will probably feel uncomfortable.						
As soon as I feel abdominal discomfort, I begin to worry and feel anxious.	○	○	○	○	○	○
When I enter a place I have been before, one of the first things I do is look for a bathroom.	○	○	○	○	○	○
I am constantly aware of the feelings I have in my belly.	○	○	○	○	○	○
I often feel discomfort in my belly could be a sign of a serious illness.	○	○	○	○	○	○
As soon as I awake, I worry that I will have discomfort in my belly during the day.	○	○	○	○	○	○
When I feel discomfort in my belly, it frightens me.	○	○	○	○	○	○
In stressful situations, my belly bothers me a lot.	○	○	○	○	○	○
I constantly think about what is happening inside my belly.	○	○	○	○	○	○

Thank you for completing this survey and participating in our research study. Some of these questions were personal and can cause some people mild psychological distress. If you are struggling with anxiety or other mental health issues, you are encouraged to follow the links below to resources provided by the National Institute of Mental Health and the American Psychiatric Association.

https://www.nimh.nih.gov/health/education-awareness/shareable-resources-on-anxiety-disorders.shtml

https://www.psychiatry.org/patients-families/anxiety-disorders

APPENDIX E

POST SURVEY

Music Study Post-Survey

This survey is being used to evaluate demographics, work information, anthropometrics, exercise training/history, presence of gut conditions, typical gut symptoms, and psychological factors (e.g. stress, anxiety, attention given or sensitivity to internal body sensations). Your responses will be kept confidential.

This survey has been approved by the Old Dominion University Institutional Review Board.

End of Block: Default Question Block

For the following gastrointestinal symptoms, please rate the overall level of discomfort you typically experienced at rest (i.e., not during exercise) over the past week. A rating of 0 means 'no discomfort', 5 means 'moderate discomfort' and 10 means 'unbearable discomfort'.

Nausea: A feeling of sickness in the stomach marked by an urge to vomit.
Regurgitation / Reflux: Sensation of food or fluid returning from the stomach to the esophagus or mouth.
Stomach Fullness: A sensation of fullness or abdominal pressure in the upper abdomen.
Bloating: A feeling of distension from a buildup of gas in the gut.
Abdominal Cramps: Pain or cramping sensation, often experienced in the mid- or lower-portion of the abdomen.

Gas / Flatulence: Gas or flatus expelled through the anus.
Urge to Defecate: Sensation of needing to pass a bowel movement.

	0 (No discomfort)	1	2	3	4	5 (moderate discomfort)	6	7	8	9	10 (unbearable discomfort)
Nausea	○					○					○
Regurgitation/Reflux	○					○					○
Stomach Fullness	○					○					○
Bloating	○					○					○
Abdominal Cramps	○					○					○
Gas/Flatulence	○					○					○
Urge to defecate	○					○					○

End of Block: Block 3

Start of Block: Block 4

The questions in this scale ask you about your feelings and thoughts **during the last two weeks**. In each case, you will be asked to indicate **how often** you felt or thought a certain way. Although some of the questions are similar, there are differences between them and you should treat each one as a separate question. The best approach is to answer each question fairly

quickly. That is, don't try to count up the number of times you felt a particular way, but rather indicate the option that seems like a reasonable estimate.

	Never	Almost never	Sometimes	Fairly often	Very often
How often have you been upset because of something that happened unexpectedly?	○	○	○	○	○
How often have you felt that you were unable to control the important things in your life?	○	○	○	○	○
How often have you felt nervous or stressed?	○	○	○	○	○
How often have you found that you could not cope with all the things that you had to do?	○	○	○	○	○
How often have you been angered because of things that happened that were outside of your control?	○	○	○	○	○
How often have you found yourself thinking about things that you have to accomplish?	○	○	○	○	○
How often have you felt difficulties were piling up so high that you could not overcome them?	○	○	○	○	○

The questions in this scale ask you about your feelings and thoughts **during the last two weeks**. In each case, you will be asked to indicate **how often** you felt or thought a certain way. Although some of the questions are similar, there are differences between them and you should treat each one as a separate question. The best approach is to answer each question fairly quickly. That is, don't try to count up the number of times you felt a particular way, but rather indicate the option that seems like a reasonable estimate.

	Never	Almost never	Sometimes	Fairly often	Very often
How often have you dealt successfully with irritating life hassles?	○	○	○	○	○
How often have you felt that you were effectively coping with important changes that were occurring in your life?	○	○	○	○	○
How often have you felt confident about your ability to handle your personal problems?	○	○	○	○	○
How often have you felt that things were going your way?	○	○	○	○	○
How often have you been able to control irritations in your life?	○	○	○	○	○
How often have you felt that you were on top of things?	○	○	○	○	○
How often have you been able to control the way you spend your time?	○	○	○	○	○

End of Block: Block 4

Start of Block: Block 5

Over the last 2 weeks, how often have you been bothered by the following problems?

	Not at all	Several days	More than half the days	Nearly every day
Feeling nervous, anxious, or on edge	○	○	○	○
Not being able to stop or control worrying	○	○	○	○
Worrying too much about different things	○	○	○	○
Trouble relaxing	○	○	○	○
Being so restless that it is hard to sit still	○	○	○	○
Becoming easily annoyed or irritable	○	○	○	○
Feeling afraid, as if something awful might happen	○	○	○	○

Below are statements that describe how some people respond to symptoms or discomfort in their belly or lower abdomen. These may include pain, diarrhea, constipation, bloating or sense of urgency. Please answer 'how strongly you agree or disagree' with each of these statements, AS THEY RELATE TO YOU. Answer all of the statements as honestly and thoughtfully as you can.

	Strongly agree	Moderately agree	Mildly agree	Mildly disagree	Moderately disagree	Strongly disagree
I worry that whenever I eat during the day, bloating and distension in my belly will get worse.	○	○	○	○	○	○
I get anxious when I go to a new restaurant.	○	○	○	○	○	○
I often worry about problems in my belly.	○	○	○	○	○	○
I have a difficult time enjoying myself because I cannot get my mind off of discomforts in my belly.	○	○	○	○	○	○
I often fear that I won't be able to have a normal bowel movement.	○	○	○	○	○	○
Because of fear of developing abdominal discomfort, I seldom try new foods.	○	○	○	○	○	○
No matter what I eat, I will probably feel uncomfortable.	○	○	○	○	○	○
As soon as I feel abdominal discomfort, I begin to worry and feel anxious.	○	○	○	○	○	○
When I enter a place I have been before, one of the first things I do is look for a bathroom.	○	○	○	○	○	○
I am constantly aware of the feelings I have in my belly.	○	○	○	○	○	○
I often feel discomfort in my belly could be a sign of a serious illness.	○	○	○	○	○	○
As soon as I awake, I worry that I will have discomfort in my belly during the day.	○	○	○	○	○	○
When I feel discomfort in my belly, it frightens me.	○	○	○	○	○	○
In stressful situations, my belly bothers me a lot.	○	○	○	○	○	○
I constantly think about what is happening inside my belly.	○	○	○	○	○	○

Thank you for completing this survey and participating in our research study. Some of these questions were personal and can cause some people mild psychological distress. If you are struggling with anxiety or other mental health issues, you are encouraged to follow the links below to resources provided by the National Institute of Mental Health and the American Psychiatric Association.

https://www.nimh.nih.gov/health/education-awareness/shareable-resources-on-anxiety-disorders.shtml

https://www.psychiatry.org/patients-families/anxiety-disorders

APPENDIX F

ACTIVITY JOURNAL

Activity Journal

- **Aerobic exercise** is considered any type of exercise that results in a sustained increase in your heart rate and breathing. Examples include jogging, running, swimming, rowing, ellipticaling, stair-stepping, cycling, and HIIT training.
- Complete this record immediately after each **aerobic exercise** session. Keep in mind, your records are more likely to be inaccurate if you wait until the end of the day.
- After each aerobic exercise session, rate your overall level of perceived exertion (RPE) using the scale below:

Rating	Perceived Exertion
6	No exertion
7	Extremely light
8	
9	Very light
10	
11	Light
12	
13	Somewhat hard
14	
15	Hard
16	
17	Very hard
18	
19	Extremely hard
20	Maximal exertion

Table 1. The Borg Rating of Perceived Exertion Scale

- After each aerobic exercise session, rate the overall level of discomfort you experienced for the following symptoms:
  - Nausea: A feeling of sickness in the stomach marked by an urge to vomit.
  - Regurgitation / Reflux: Sensation of food or fluid returning from the stomach to the esophagus or mouth.
  - Stomach Fullness: A sensation of fullness or abdominal pressure in the upper abdomen.
  - Bloating: A feeling of distension from a buildup of gas in the gut.
  - Abdominal Cramps: Pain or cramping sensation, often experienced in the mid- or lower-portion of the abdomen.
  - Gas: Gas or flatus expelled through the anus.
  - Urge to Defecate: Sensation of needing to pass a bowel movement.
- Each symptom should be rated on a 0 to 10 scale, where 0 means 'no discomfort', 5 means 'moderate discomfort' and 10 means 'unbearable discomfort'.

Date & Time (Start-Stop)	Minutes	Training Type	Overall RPE (6-20)	Nausea (0-10)	Regurgitation / Reflux (0-10)	Stomach Fullness (0-10)	Bloating (0-10)	Abdominal Cramps (0-10)	Gas (0-10)	Urge to Defecate (0-10)
January 10th (8:00-8:25 am)	25	HIIT	17	4	3	0	0	2	3	2

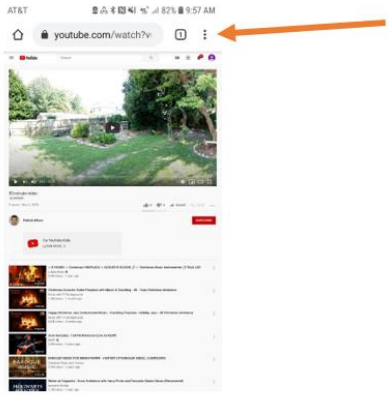
APPENDIX G

YOUTUBE PHONE INSTRUCTIONS

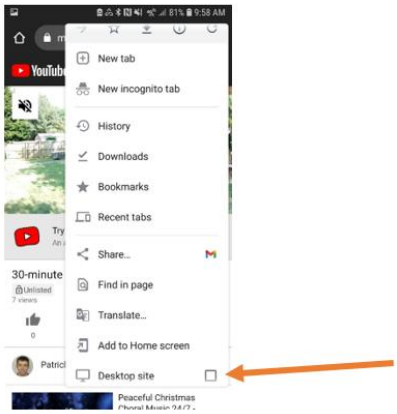
The YouTube App on iOS and Android phones doesn't allow you to play videos with the screen locked. However, there is a workaround for this issue. The following steps can be used to allow a video to play in the background using the Google Chrome web browser.

Android

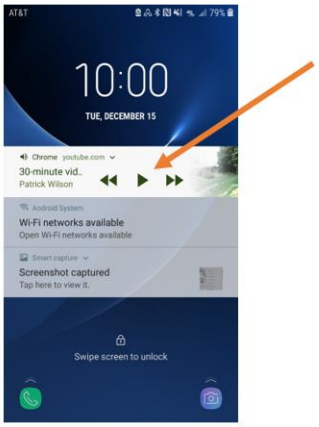
1. Open your Google Chrome mobile browser and tap on the three dots at the top right of the screen.



2. Check **Desktop Site** from the list of items.

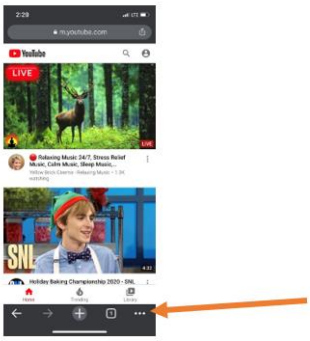


3. Begin playing the YouTube video in the Chrome browser. Once you lock your screen, the video may temporarily stop. However, there should be a play button that is visible when you hit your phone's home button.

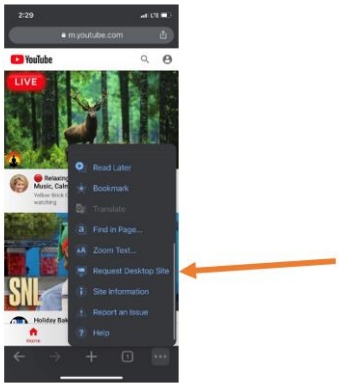


iOS

1. Open your Google Chrome mobile browser and tap on the three dots at the bottom right of the screen.

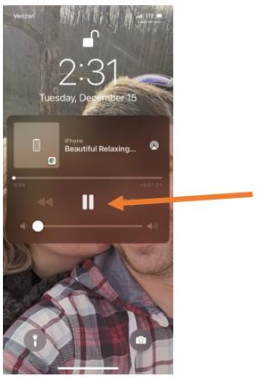


2. Select **Request Desktop Site** from the list.



3. The page should look something like below.

4. Begin playing the YouTube video in the Chrome browser. Once you lock your screen, the video may temporarily pause. However, there should be a play button that is visible when you open your phone's lock screen.



APPENDIX H

MUSIC LISTENING JOURNAL

Music Listening Intervention Journal

- The YouTube playlists that you may choose from for each 30-minute listening sessions can be found at these links: **INSERT APPROPRIATE LINKS HERE.**
- You should listen to the music at a time and place in which you feel capable of relaxing (e.g., before bed, at dinner, after work, etc.). Please try to avoid multi-tasking or distracting activities while you listen to the music.
- Please complete the record immediately after each music listening session. If you wait until the end of the day, your records are more likely to be inaccurate.
- Record the date and time of each music listening session in the table below.
- After each session, rate 1) how engaged in the music listening session you were on a scale ranging from 1 ('Not at all') to 10 ('Fully engaged') and 2) how relaxing you found the experience, ranging from 1 ('Not relaxing at all') to 10 ('Very relaxing').

Date/Time (Start-Stop)	How Engaged in the Music Listening Were You? (1-10)	How Relaxing Did You Find the Experience? (1-10)
January 1st 10:00-10:30 a.m.	8	7

VITA

Halie Maass

1811 W Lakeview Dr. Apt A2, Johnson City, TN 37601 · (804)381-8034 · hmaas001@odu.edu

Skills

Fitness professional at East Tennessee State University with over five years of experience working in collegiate recreation. Has a strong background in research developed through her work as a chemist and time spent developing her master's thesis.

Core Competencies

- Expedient critical thinking and problem-solving skills
- Excellent verbal and written communication

Academic Experience

Old Dominion University **August 2015 - Present**

Master of Science in Exercise Science — Anticipated August 2021

Bachelor of Science in Chemistry — May 2019

Bachelor of Science in Chemical Oceanography — May 2019

Rappahannock Community College **September 2012 – June 2015**

Arts and Science Associate's Degree — June 2015

Professional Experience

ETSU Coordinator of Fitness and Wellness **July 2021 – Present**

- Oversee Fitness and Wellness operations for ETSU Campus Recreation

ODU GA of Group Exercise and Instructional Planning **August 2019 – May 2021**

- Hired, trained, supervised, and evaluated 28 group fitness instructors and 9 personal trainers
- Conducted "Train to be an Instructor Prep Course" to teach ACE's Group Fitness Instructor Curriculum to a group of individuals with varying backgrounds and goals
- Managed group exercise, personal training, small group training, and wellness programming

ODU Courage Miller Partners Challenge Course Facilitator **January 2017 – May 2021**

- Facilitated team and individual growth by leading participants through four of the five stages of team building: Forming, Storming, Norming, and Performing (Tuckman)

ODU Group Exercise Instructor **January 2017- August 2019**

- Taught safe and effective group exercise classes in formats to a diverse population

ODU Outdoor Adventure Program Trip Leader **January 2016 - August 2019**

- Led a variety of outdoor adventure trips required both critical thinking and organization skills

Conferences and Honors

2018 – Presented at the Annual Biomedical Research Conference for Minority Students in Indianapolis, Indiana and was one of the first two Old Dominion University students to receive an award for an oral presentation in Chemistry