MUSIC THERAPY FOR PROACTIVE WELLNESS

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Lay Abstract

Within this thesis, I examine the effectiveness of music therapy as a proactive intervention for stress and anxiety amongst undergraduate university students. While verbal-based therapies remain the standard of care for mental health, stigma often acts as a barrier preventing individuals from seeking support. Offering alternative therapy options like music therapy may reduce this barrier and encourage more individuals to engage with mental health services. The findings of this thesis advocate for incorporating the option of group music therapy on university campuses, enabling students to proactively manage stress and anxiety. The findings of the research within this thesis have the potential to extend beyond university campuses to various community and health care settings. Stress can exacerbate symptoms across a range of conditions, including dementia, pain perception, palliative care and Parkinson's disease. Therefore, including music therapy as an option for the proactive management of stress and anxiety could have broader applications beyond the university environment.

Abstract

Support for proactive mental health interventions is imperative to reduce the number of individuals experiencing a mental health crisis. However, proactive mental health interventions are not prioritized within the current healthcare paradigm. It is well established that engaging in proactive measures such as exercise, maintaining good sleep hygiene and adhering to a balanced diet can prevent physical health ailments. Accordingly, proactive management of physical health has become a societal norm. Unfortunately, proactive management of mental health is not societal norm, despite the physical health consequences of poor mental health. Verbal based therapies remain the standard of care within mental health services, and they are primarily available to individuals diagnosed with a mental illness or experiencing a crisis. Due to the stigma associated with verbal-based therapies and seeking mental health support, many individuals are reluctant to proactively seek assistance. In contrast, music is a universally embraced activity, transcending age, ethnicity, socio-economic status and health conditions. The positive associations linked with music may make music therapy a more approachable option for support. In this thesis, I investigated undergraduate university students' interest in participating in music therapy, as well the effectiveness of both online and in-person group music therapy as proactive interventions for stress and anxiety. Data were collected from standardized psychometric tools and the physiological markers of heart rate variability and cortisol. The research presented in Chapter 2 of this thesis

provides evidence of student interest in music therapy as an option to support mental health. The research presented in Chapter 3 demonstrates the effectiveness of group music therapy as an online intervention for managing stress and anxiety, while Chapter 4 supports the effectiveness of in-person group music therapy for managing stress and anxiety. Together, this research supports the inclusion of music therapy as a cost-effective proactive intervention for stress and anxiety management on university campuses.

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me to continually question, examine and explore the many facets of research and statistical analyses.

I am fortunate to have a strong friend and family support system, which includes parents who live down the street who keep me fed with all kinds of home baked sweets and home cooked savouries, as well as assisting with the logistics of driving kids, and helping with basically anything needed. My family and friends are amazing cheerleaders, showing genuine interest and encouragement in the work I have been doing.

When I started teaching the Introduction to Music Therapy course at McMaster University (2010), I had a vision of incorporating experiential music therapy groups into the course. Prior to starting the PhD, I supervised and mentored McMaster undergraduate students through my company, The Music Therapy Academy. Ritika Arora was one of these students. Ritika collaborated with the Music Therapy Academy to bring drop-in music therapy groups to campus as a pilot study for her thesis. The preliminary work with Ritika Arora, and the McMaster Open Circle, provided the inspiration to move forward with bringing music therapy to campus and helped me to recognize that furthering this work through a PhD would provide the best opportunity to make music therapy accessible to students on campus. Thank you to Ritika Arora for completing her inquiry project and thesis with the Music Therapy Academy and for collaborating in the initiation of bringing music therapy to campus.

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LIST OF ABBREVIATIONS AND SYMBOLS

α, alpha

ANOVA, analysis of variance

App, application

ASD, autism spectrum disorder

B, Beta value

BF_{10}, Bayes factor in favor of H1 over the null hypothesis (H0)

COVID-19, coronavirus disease 2019

d, Cohen's d

f, frequency distribution

F, variation or equality of population from an F-test

h, hour

M, mean

min., minutes

ms., milliseconds

N, total number of participants

n, number of participants

η^2, eta squared

ng, nanograms

p, p value, probability

PTSD, post-traumatic stress disorder

r, correlation coefficient

SE, standard error

t, test statistic from a t-test

ω, omega, total set of possible outcomes.

W, Kendall's W statistic or the Coefficient of Concordance.

W, The Mann-Whitney statistic (W-Value), the sum of the ranks of the first sample.

χ^2 Chi-squared, from Kruskal Wallis test

z, z-score, or z-statistic, standard deviations above or below the mean population.

~, approximately

>, greater than

%, percent

Declaration of Academic Achievement

I, Rachael Finnerty, declare that this thesis titled, "Music Therapy for Proactive Wellness" and the work presented in it are my own.

This thesis consists of five chapters in total and is presented in the format of a sandwich thesis. The thesis consists of an introduction, three empirical chapters, and a discussion. Two empirical chapters are published in peer-reviewed scientific journals (Chapters 2 and 3) and one chapter has been submitted for publication (Chapter 4).

I am the primary author of all five chapters. I conceptualized and designed each experiment in consultation with Dr. Laurel J. Trainor who co-authored all three empirical chapters. For each study, I was the primary individual responsible for collecting data, supervising data collection by undergraduate students, analyzing the data, and preparing the manuscripts. The primary author of this thesis holds the copyright for the two published research articles and the submitted manuscript listed below:

Finnerty, R., Marshall, S. A., Imbault, C., & Trainor, L. J. (2021). Extra-Curricular Activities and Well-Being: Results From a Survey of Undergraduate University Students During COVID-19 Lockdown Restrictions. *Frontiers in Psychology*, *12*. https://doi.org/10.3389/fpsyg.2021.647402

Rachael Finnerty, Sara Marshall, and Laurel Trainor conceived the research ideas and designed the survey. Rachael Finnerty, Sara Marshall, and Connie Imbault analyzed the data. All authors contributed to writing the paper.

Finnerty, R., McWeeny, S., & Trainor, L.J (2023), Online Group Music Therapy: Proactive Management of Undergraduate Students' Stress and Anxiety. *Frontiers in Psychiatry* doi: 10.3389/fpsyt.2023.1183311

Rachael Finnerty and Laurel Trainor designed the study. Rachael Finnerty supervised the implementation of the protocol and data collection. Rachael Finnerty and Sean McWeeny analyzed the data with input from Laurel Trainor. All authors contributed to writing the manuscript, read, and approved the submitted version.

Finnerty, R., & Trainor, L.J (2024), Finnerty, R., Trainor, L.J. (2024). Group music therapy for the proactive management of stress and anxiety. *PLOS Mental Health* (manuscript submitted July 10, 2024)

Rachael Finnerty and Laurel Trainor designed the study. Rachael Finnerty supervised the implementation of the protocol and data collection. Rachael Finnerty analysed the data with input from Laurel Trainor. Both authors contributed to writing the manuscript.

Chapter 1
Introduction

Mental health, as defined by the World Health Organization, is considered an integral aspect of overall health (*Health and Well-Being*, 2024). Recognition of the interconnectedness between mental and physical well-being traces back to ancient Greek philosophy, notably Hippocrates' principle of a 'healthy mind in a healthy body' (Kleisiaris et al., 2014). However, modern Western society often treats mental and physical ailments separately and emphasizes physical health. For example, it is socially acceptable to maintain physical health through exercise and nutrition, while seeking support for mental health concerns remains stigmatized and less readily available.

The social acceptance of prioritizing physical health over mental health may contribute to the rising ~~prevalence~~ incidence of mental health challenges that are particularly evident among university students (Ogrodniczuk et al., 2021). Individuals aged 15-24 experience disproportionately high rates of anxiety and depression compared to other age groups (CAMH, 2022). Alarmingly, suicide ranks as the second leading cause of death among Canadians aged 15-29 and is the fourth leading cause of death globally (WHO, 2021; Navanaleen T., 2012). Among university students, stress and anxiety are prevalent experiences that can significantly impact mental and physical well-being when left unmanaged (Epel et al., 2018; Miller et al., 2009). Therefore, addressing these challenges and promoting proactive initiatives on campuses is imperative.

In this thesis, I present three studies that I conducted to investigate the effectiveness of group music therapy to proactively help undergraduate university

students to manage their stress and anxiety. I conducted three research studies (Chapters 2-4). In my first study (Chapter 2), which took place during the COVID-19 pandemic, a survey was designed to determine students' interest in participating in group music therapy and if they were engaging in music during this naturally stressful time-period. At the time of this survey, students were experiencing the first lock-down restrictions imposed by the COVID-19 pandemic. Students reported engaging in music listening (tied with watching movies/ TV series), more than any other activity, and engaging in music was ranked third among many activities for contributing to wellness, after outdoor exercise and online socializing. Given the widespread interest in music among young adults, I hypothesized that music therapy would be a promising proactive approach to mental health in general.

My second study (Chapter 3) also took place during the COVID-19 pandemic and was a randomized controlled trial. In this study, students were provided with the opportunity to proactively engage in six-weeks of online group music therapy. The term 'proactive' refers to engaging students in mental health supports before experiencing a crisis, and regardless of a mental illness diagnosis. Proactive wellness on campus aims to maintain and manage the stress and anxiety of *normal* student life. To my knowledge, this was the first-time that online group music therapy had been offered to students for proactive wellness at a Canadian University campus. In this study, both short-term and retrospective data on stress and anxiety were collected using both psychometric and physiological measures. Participants' changes in stress and anxiety measures in the music therapy group were compared to the standard of care (verbal-based therapy), and to a

control group (student life as usual). The intention of the study design was to test the hypothesis that music therapy is *as* efficacious as the standard of care, and therefore should be considered as a standard of care option for students on campus.

In a music therapy session, music therapists draw upon both active and receptive music therapy interventions. Active music therapy interventions include singing, improvising, song writing and lyric analysis. Receptive music therapy interventions include music listening activities. I was curious if there would be a difference in stress and anxiety outcomes between receptive and active music therapy interventions. Therefore, in my second study, students were randomly assigned to either a receptive music therapy group, active music therapy group, verbal therapy group or a control group (student life as usual). The potential co-variates of participants' demographic data, personality traits, music sophistication and changes in quality of life on the outcomes of stress and anxiety were also explored.

My third study (Chapter 4), which took place after the COVID-19 pandemic, was also a randomized controlled trial in which I investigated effects of proactive music therapy in an in-person setting. In this study, I replicated most aspects of the second study (Chapter 3); differences included (1) six-weeks of *in-person* group music therapy as opposed to *online* group music therapy, (2) both active and receptive music therapy interventions were offered within each music therapy session (i.e., were not studied separately, as music therapy typically combines both) and, (3) a standard of care group (verbal therapy) was not offered, as my study in Chapter 2 suggested music therapy was as effective as verbal therapy, and this has also been observed in in-person contexts

(Erkkilä et al., 2011; Gold et al., 2013; Aalbers et al., 2017). To my knowledge, this was the first-time that in-person group music therapy had been offered to students for proactive wellness at a Canadian University.

Collectively, the results of the three studies presented in Chapters 2-4 suggest that (1) university students are interested in proactively engaging in group music therapy, (2) the effectiveness of group music therapy (both online and in-person) reduces stress and anxiety, (3) music therapy should be considered as a standard of care for mental health, and (4) music sophistication and personality traits have little effect on stress and anxiety outcomes related to group music therapy.

1.1 Stress and Anxiety

Stress is a subjective experience that can assist with survival by aiding responses to various challenges (Sapolsky, 2000). However, if unmanaged, chronic stress can also contribute to adverse health conditions. It is well established that stress is a risk factor for the onset and progression of a range of health problems, such as cardiovascular diseases, cancers, anxiety disorders, depression, and burnout (Eckerling et al., 2021; Van Praag, 2005; Steptoe & Kivimäki, 2012, Zhou et al., 2020).

Stress was first described as a biological experience by Selye in 1936, who observed a relationship between stress and the release of corticosteroids (Selye H., 1936). The effects of stress are mediated by the corticosteroid cortisol; commonly referred to as the stress hormone. It is released through the activation of the hypothalamic pituitary adrenal (HPA) axis, to maintain bodily homeostasis.

University students are particularly prone to stress, which can exacerbate mental health problems resulting in poor relationships with other students and faculty members, lower levels of engagement in campus clubs and activities, lower grade averages, and lower rates of graduation (Byrd and McKinney, 2012; Keyes et al., 2012).

In addition to the experience of stress, university students are also prone to feeling anxious. Anxiety is a healthy emotion that can stem from thinking about upcoming stressful events. Like stress, anxiety is a subjective experience. It is characterized by feelings of tension, worry and physical changes like increased blood pressure, and is considered a future-oriented response (*Anxiety*, May 2, 2024). Learning skills to manage anxiety is imperative as anxiety disorders have become the most common type of mental disorder, currently affecting an estimated 301 million people globally (GBD 2019 Mental Disorders Collaborators, 2022). University life is filled with many exciting and positive aspects, but it can also feel overwhelming as students learn to navigate living on campus or commuting, managing finances, time management, relationships, etc.

Stress and anxiety are subjective internal states with many contributing factors, making it difficult to objectively quantify. Measurement of long-term stress has primarily included questionnaires which are often useful but limited due to the subjective nature of questionnaires and recall bias. In my two randomized controlled studies (Chapters 3 and 4), I measured long-term stress through both questionnaires and hair cortisol.

1.2 Hair Cortisol

Cortisol has become an important biological measure of stress, which can now be used to assess average long-term stress through hair samples. The first report of cortisol

measurement in hair was by Raul et al., (2004). Hair cortisol as a measure of long term stress has been validated (Manenscheijn et al., 2011; Short et al., 2016; Thomson et al., 2010) and observed to have high test-re-test reliability (Short et al., 2016; Stalder et al., 2012). Hair cortisol has been used as an objective biomarker in studies investigating the experience of stress during a medical internship (Mayer et al., 2018), the effect of a natural disaster (Luo et al., 2012), and the trauma of war (Dajani et al., 2018). Extracting cortisol from hair provides several benefits in comparison to saliva, urine, and blood. Namely, hair cortisol allows for retrospective quantification of cortisol release, and is not affected by circadian fluctuations. Additionally, hair samples can be conveniently obtained and can be stored at room temperature.

In hair, it appears that free cortisol diffuses from the follicular capillaries into the medulla of the hair shaft during growth (Russel et al., 2012). A study including radiolabelling with rhesus monkeys suggests that cortisol is deposited into growing hair proportionally to the quantity of cortisol in circulation at any given point in time (Kapoor et al., 2018). Hair growth occurs at approximately 1cm per month, with some variance across individuals, including variance related to ethnicity (Sauve et al., 2007; Loussouarn, G. 2001). This growth rate has allowed for the assessment of average cortisol levels over time, with 1cm of growth representing approximately 1 month of cortisol release (Greff et al., 2019). There are a few variables that may affect the hair cortisol measurements such as natural sunlight and artificial UV radiation (Wester et al., 2016), frequency of sweating on the scalp, hair washing, and medications (Wester et., 2017). There are conflicting reports about the effect of chemical treatment of hair dyes on hair cortisol (Hoffman et

al., 2014, Kristensen et al., 2017).). In my RCT studies (Chapters 3 and 4), I used a within-subject design to mitigate such effects of between-subject variance in hair cortisol.

1.3 Music and Health

The utilization of music for promoting health and well-being has a rich history. Egyptian priest-physicians referred to music as *physics for the soul* (Feder and Feder 1981) and Ancient Greek physicians documented the use of instruments like flutes, lyres, and zithers as remedies for ailments such as viper and scorpion bites, gout, and epilepsy, and recognized the therapeutic benefits of vibration for digestion, mental health, and inducing sleep (Meymandi, 2024). Ancient Greeks believed that music had the ability to heal the soul, and consequently the body, underscoring a holistic approach to healing through music (Kleisiaris et al., 2014). Boethius (480-524 AD) further emphasized music's role in alleviating melancholy, a sentiment echoed over a century later by physicians throughout the 17th century (Byers, Hryniw, 2016). Music was also recognized as preventative medicine. For example, the *Fasiculo di Medicina* (1493) advocated for the use of music to guard against negative feelings, and to build resistance against disease (Feder and Feder, 1981).

With the advent of modern medicine, systematic inquiries into music's medical applications began. Diogel's studies in the 19th century documented the physiological effects of live music played at patients' bedsides, revealing impacts on heart rate, pulse rate, and blood pressure (Meymandi, 2024). These pioneering findings, dating back to 1880, marked the inception of scientific exploration into music's therapeutic potential. The term *music therapy* emerged in the 18th century, gaining traction with the publication

of an anonymous paper in Columbian Magazine in 1789, and Edwin Augustus Atlee's doctoral dissertation in 1804. Both of these written works advocated for music as a therapeutic intervention requiring specialized practitioners (AMTA, 2024). Subsequent studies further investigated music's role in healthcare, laying the groundwork for the establishment of music therapy as a distinct profession.

Modern day research continues to support the claim that music can influence physiological processes that bring about enhanced mental well-being. For example, research supports that music enhances feelings of happiness (Jäncke,2008; Juslin & Västfjäll, 2008), reduces feelings of stress (Thoma et al., 2013) and reduces the experience of anxiety (Blood & Zatorre, 2001; Voss et al., 2004; Pittman & Kridli, 2011). Additionally, studies have shown that music modulates activity in the amygdala and the meso-limbic reward brain system, areas known to be involved in emotional and motivational processes (Blood & Zatorre, 2001; Koelsch, 2015; Koelsch et al.,2016; Levitin, 2009).

The impact of music on emotional responses makes it a potentially powerful tool within a therapeutic context with a trained practitioner, such as within the practise of music therapy.

1.4 Music Therapy

Despite music's historical presence in healthcare dating back to antiquity, the formal profession of music therapy did not emerge within the framework of Western healthcare professions until the mid-1900s. Initially, the American Army utilized music to uplift the spirits of returning soldiers post-World War II. This initiative led to the

establishment of a formal music program aimed at improving health outcomes of veterans in 1943. The program's objective was to reintegrate wounded servicemen into duty or civilian life in optimal physical and mental health (Rorke, 1996). A three-and-a-half year study initiated by the Army in 1944 and evaluated by psychiatrists, revealed that 74% of patients experienced significantly positive health outcomes through participation in music programs (Byers, Hryniw, 2016).

Following these developments, and further research, national associations responsible for regulating the profession of music therapy began to emerge worldwide. These professional bodies currently mandate the training and education standards for music therapy practitioners. The United States formed the first music therapy professional association in 1950, followed by the United Kingdom in 1958, and Canada in 1974. Additionally, several European countries established professional associations, culminating in the establishment of the European Music Therapy Confederation in 1989, and the World Federation of Music Therapy in 1985.

In Canada, music therapy is defined as *a discipline in which Certified Music Therapists use music purposefully within therapeutic relationships to support development, health, and well-being. Music therapists employ music ethically and safely to address human needs across cognitive, communicative, emotional, musical, physical, social, and spiritual domains* (Canadian Association of Music Therapists, September 2020).

Becoming a music therapist in Canada entails completing a Bachelor's or Master's degree in music therapy, a 1000-hour supervised clinical internship, and passing

the Certified Board of Music Therapists exam. Upon fulfilling these requirements,

individuals apply to the Canadian Association of Music Therapists to receive the

credential 'MTA' (Music Therapist Accredited). Music therapy training equips

practitioners with the skills necessary to address healthcare goals spanning various ages

and diagnoses. For instance, music therapists facilitate physical objectives including gait

and range of motion, cognitive objectives related to speech and communication following

an acquired brain injury or a stroke, pain management in cancer care, end of life care, and

provide cognitive engagement for those diagnosed with Dementia. In the context of this

thesis, music therapists play a role in achieving mental health objectives, such as stress

and anxiety reduction. Music therapy interventions are increasingly being recognized for

stress management and for enhancing the well-being of clients across a variety of clinical

populations (Agres et al., 2021; Bainbridge et al., 2020; Landis-Shack et al., 2017; De

Witte et al., 2020).

1.4.1 Music Therapy Interventions

Music therapists utilize a variety of music forms to address diverse healthcare

objectives, often tailoring interventions to the preferences of the client. Table 1 provides a

succinct overview of prominent music therapy interventions (CAMT, 2024).

Music Therapy Intervention	Purpose
Singing	Assists in the development of articulation, rhythm, and breath control.
Playing instruments	Improves gross/fine motor coordination and range of motion.

Music Therapy Intervention	Purpose
Rhythmic based activities	Rhythm and beat play a crucial role in 'priming' the motor areas of the brain, regulating autonomic processes like breathing and heart rate, and improving gait.
Improvising	A non-judgmental activity that requires no prior musical training. When words fail or emotions are difficult to express, music can bridge the gap. Improvisation offers a safe space for meaningful interpersonal connection.
Songwriting	Facilitates the sharing of feelings, ideas, and experiences. It may also offer an opportunity to create a legacy or shared experience before death.
Lyric Analysis	Promotes self-reflection, validation, and expression.
Listening	Aids in cognitive skill development such as attention and memory. It also evokes emotions and memories.

Table 1. *Prominent Music Therapy Interventions*

In Chapter 3 of this thesis, I investigated whether active and receptive music therapy interventions yield different outcomes in stress and anxiety. Due to COVID-19 restrictions, the study implemented online group music therapy sessions, limiting active interventions to singing, song writing, and lyric analysis. Receptive interventions involved listening to participant-selected music. In Chapter 4, in-person group music therapy sessions were conducted that incorporated all interventions listed in Table 1.

1.4.2 Community Music Therapy

There are various approaches to verbal-based therapies, such as psychotherapy, cognitive-behavioral therapy, and dialectical behavior therapy. Similarly, there are diverse approaches within music therapy. The research featured in Chapters 3 and 4 of this thesis adopted a Community Music Therapy approach.

Community Music Therapy is an approach that considers the broader cultural, institutional, and social context of the clients. In the context of this thesis, I focused on the application of music therapy for mental health within university campus life, and the wider cultural framework of Western societies' approach to mental health. Community Music Therapy emphasizes health promotion and recognizes that music creates an environment conducive to well-being, that is tailored to the needs of individuals within a shared situation. Some examples of research conducted within a community music therapy framework include work with refugees (Enge & Stige, 2021), elementary school children (McFerran et al., 2014), adults with disabilities (Curtis & Mercado, 2004), and adolescence in a mental health treatment centre (Mitchell, 2019). Typically, this approach does not involve intake forms or assessments, fostering a sense of community rather than clinical intervention. Music, in this context, is likened to an immunogen, aligning with the proactive stance of this thesis (Ruud E., 2013).

1.5 Summary: Thesis Outline and Contributions

My three research articles comprising this thesis examine the effectiveness of group music therapy as a proactive measure for stress and anxiety management in university students. Collectively, my research provides support for the implementation of group music therapy for proactive wellness on university campuses. My studies employed a combination of qualitative and quantitative data analysis, including psychometric and physiological measurements. The primary aim of my research was to contribute to the limited body of research about proactive mental health interventions, particularly within the realm of music therapy. The focus on undergraduate university students stems from

the pressing mental health challenges faced by this population. By targeting this age

group, I aimed to determine whether a shift in campus culture that embraces proactive

mental health management is warranted. I hypothesized that this shift could reduce stigma

about mental health supports, equip students with effective stress and anxiety

management skills, and ultimately reduce the mental health crisis on campuses.

My three research articles are presented in Chapters 2, 3 and 4:

Chapter 2. Finnerty, R., Marshall, S. A., Imbault, C., & Trainor, L. J. (2021). Extra-Curricular Activities and Well-Being: Results From a Survey of Undergraduate University Students During COVID-19 Lockdown Restrictions. *Frontiers in Psychology*, *12*. https://doi.org/10.3389/fpsyg.2021.647402

Chapter 3. Finnerty, R., McWeeny, S., & Trainor, L.J (2023), Online Group Music Therapy: Proactive Management of Undergraduate Students' Stress and Anxiety. *Frontiers in Psychiatry* doi: 10.3389/fpsyt.2023.1183311

Chapter 4. Finnerty, R., & Trainor, L.J. (2024). Group music therapy for the proactive management of stress and anxiety, *PLOS Mental Health* (manuscript submitted July 10, 2024)

My first research article (Chapter 2) presents findings from a survey distributed to

undergraduate students at McMaster University. This research was driven by the need to

gauge student interest in music therapy as participation in the intervention is an essential

factor for its success. This survey was administered during the initial COVID-19

lockdown in Hamilton, Ontario, Canada, and also sought to uncover what activities

students engaged in during this time. It revealed that listening to music was the most

popular activity among students at this time (along with watching movies), and it was

perceived as beneficial for their overall well-being. Additionally, students expressed a

preference for seeking out music therapy over traditional talk therapy. This prompted the

research that led to the second article, entitled *Online group music therapy: Proactive Management of Undergraduate Students' Stress and Anxiety*.

My second research article (Chapter 3) presents findings from a randomized controlled trial aimed to evaluate the effectiveness of online group music therapy for the management of stress and anxiety. Participants were randomly assigned to an active or receptive music therapy group, a verbal-based group, or a control group (student life as usual). Reductions in stress and anxiety measures were observed in the music therapy groups and the verbal-based group (standard of care). Average cortisol levels increased during the term in the control group but remained stable in the music therapy group. Bayesian analyses provided evidence that the stress and anxiety outcomes of music therapy did not differ from the outcomes of the standard of care, and that the outcomes between active and receptive music therapy interventions did not differ. The limitations of a small sample size and the challenges associated with online delivery prompted my third research study, which featured in-person group music therapy sessions and a larger sample size.

My third research article (Chapter 4) presents findings from a randomized controlled trial aimed at evaluating the effectiveness of in-person group music therapy for the management of stress and anxiety. Both receptive and active music therapy interventions were implemented within each session, representing a typical music therapy session. Greater decreases in all stress and anxiety measures were observed across the six-week study period in the music therapy group compared to the control group. As well, stress and anxiety decreased pre-post each group music therapy session. Lastly,

participants were asked to complete a feedback questionnaire which provided invaluable data to complement the psychometric and physiological measures.

My three research articles collectively suggest that students are indeed motivated to participate in music therapy, and that music therapy is an effective intervention to proactively manage stress and anxiety among undergraduate students.

Overall, my research in this thesis highlights the importance of proactive wellness interventions on university campuses, specifically the use of music therapy to manage stress and anxiety. Recognizing that the negative impacts of stress and anxiety are not confined to university campuses, my research calls attention to proactively managing stress in other settings as well, such as the workplace, high schools, hospitals, and long-term care facilities.

1.6 References

Aalbers, S., Fusar-Poli, L., Freeman, R. E., Spreen, M., Ket, J. C., Vink, A. C., Maratos, A., Crawford, M., Chen, X., & Gold, C. (2017). Music therapy for depression. *Cochrane Library*, *2017*(11). https://doi.org/10.1002/14651858.cd004517.pub3

Agres, K. R., Schaefer, R. S., Volk, A., van Hooren, S., Holzapfel, A., Dalla Bella, S., Müller, M., de Witte, M., Herremans, D., Ramirez Melendez, R., Neerincx, M., Ruiz, S., Meredith, D., Dimitriadis, T., & Magee, W. L. (2021). Music, computing, and health: A roadmap for the current and future roles of Music Technology for Health Care and well-being. *Music & Science*, *4*, 205920432199770. https://doi.org/10.1177/2059204321997709

AMTA- American Music Therapy Association. History of Music Therapy | American Music Therapy Association (AMTA). (May 4, 2024). https://www.musictherapy.org/about/history/

Bainbridge, C. M., Bertolo, M., Youngers, J., Atwood, S., Yurdum, L., Simson, J., Lopez, K., Xing, F., Martin, A., & Mehr, S. A. (2020). Infants relax in response to unfamiliar foreign lullabies. *Nature Human Behaviour*, *5*(2), 256–264. https://doi.org/10.1038/s41562-020-00963-z

Blood, A. J., & Zatorre, R. J. (2001). Intensely pleasurable responses to music correlate with activity in brain regions implicated in reward and emotion. *Proceedings of the national academy of sciences*, *98*(20), 11818-11823.

Byers, Hryniw, K. L. (2016). *A history of the music therapy profession*. Barcelona Publishers.

Byrd, D. R., & McKinney, K. (2012). Individual, interpersonal, and institutional level factors associated with the mental health of college students. *Journal of American College Health*, *60*(3), 185–193. https://doi.org/10.1080/07448481.2011.584334

CAMT, *About music therapy*. About Music Therapy : CAMT. (May 3, 2024). https://www.musictherapy.ca/about-camt-music-therapy/about-music-therapy/

Curtis, S. L., & Mercado, C. S. (2004). Community music therapy for citizens with developmental disabilities. *Voices: A World Forum for Music Therapy*, *4*(3). https://doi.org/10.15845/voices.v4i3.185

Dajani, R., Hadfield, K., Van Uum, S., Greff, M., & Panter-Brick, C. (2018). Hair cortisol concentrations in war-affected adolescents: A prospective intervention trial. *Psychoneuroendocrinology*, *89*, 138–146. https://doi.org/10.1016/j.psyneuen.2017.12.012

de Witte, M., Da Silva Pinho, A., Stams, G. J., Moonen, X., Bos, A. E. R., & Van Hooren, S. (2020). Music therapy for stress reduction: a systematic review and meta-analysis. *Health Psychology Review*, *16*(1), 134–159. https://doi.org/10.1080/17437199.2020.1846580

Eckerling, A., Ricon-Becker, I., Sorski, L. *et al.* Stress and cancer: mechanisms, significance and future directions. *Nat Rev Cancer* **21**, 767–785 (2021). https://doi.org/10.1038/s41568-021-00395-5

Enge, K. E. A., & Stige, B. (2021). Musical pathways to the peer community: A collective case study of refugee children's use of music therapy. *Nordic Journal of Music Therapy*, *31*(1), 7–24. https://doi.org/10.1080/08098131.2021.1891130

Epel, E. S., Crosswell, A. D., Mayer, S. E., Prather, A. A., Slavich, G. M., Puterman, E., & Mendes, W. B. (2018). More than a feeling: A unified view of stress measurement for population science. *Frontiers in Neuroendocrinology*, *49*, 146–169. https://doi.org/10.1016/j.yfrne.2018.03.001

Erkkilä, J., Punkanen, M., Fachner, J., Ala-Ruona, E., Pöntiö, I., Tervaniemi, M., Vanhala, M., & Gold, C. (2011). Individual music therapy for depression:

randomised controlled trial. *British Journal of Psychiatry*, *199*(2), 132–139. https://doi.org/10.1192/bjp.bp.110.085431

Feder, E., & Feder, B. (1981). The expressive art therapies. Englewood Cliffs, NJ: Prentice-Hall, Inc.

Global, regional, and national burden of 12 mental disorders in 204 countries and territories, 1990–2019: a systematic analysis for the Global Burden of Disease Study 2019. (2022). *The Lancet. Psychiatry*, *9*(2), 137–150. https://doi.org/10.1016/s2215-0366(21)00395-3

Gold C, Mössler K, Grocke D, Heldal TO, Tjemsland L, Aarre T, Aarø LE, Rittmannsberger H, Stige B, Assmus J, Rolvsjord R. Individual Music Therapy for Mental Health Care Clients with Low Therapy Motivation: Multicentre Randomised Controlled Trial. Psychother Psychosom. 2013;82(5):319-331. https://doi.org/10.1159/000348452.

Greff, M., Levine, J. M., Abuzgaia, A. M., Elzagallaai, A. A., Rieder, M., & Van Uum, S. H. M. (2019). Hair cortisol analysis: An update on methodological considerations and clinical applications. *Clinical Biochemistry*, *63*, 1–9. https://doi.org/10.1016/j.clinbiochem.2018.09.010

Health and Well-Being. (2024, June 20). https://www.who.int/data/gho/data/major-themes/health-and-well-being

Hoffman, M. C., Karban, L. V., Benitez, P., Goodteacher, A., & Laudenslager, M. L. (2014). Chemical processing and shampooing impact cortisol measured in human hair. *Clinical & Investigative Medicine*, *37*(4), 252. https://doi.org/10.25011/cim.v37i4.21731

Jäncke, L. Music, memory and emotion. *J Biol* **7**, 21 (2008). https://doi.org/10.1186/jbiol82

Juslin, P., & Västfjäll, D. (2008). Emotional responses to music: The need to consider underlying mechanisms. *Behavioral and Brain Sciences*, *31*(5), 559–575. https://doi.org/10.1017/s0140525x08005293

Kapoor, A., Schultz-Darken, N., & Ziegler, T. E. (2018). Radiolabel validation of cortisol in the hair of rhesus monkeys. *Psychoneuroendocrinology*, *97*, 190–195. https://doi.org/10.1016/j.psyneuen.2018.07.022

Keyes, C. L. M., Eisenberg, D., Perry, G. S., Dube, S. R., Kroenke, K., & Dhingra, S. (2012). The relationship of level of positive mental health with current mental

disorders in predicting suicidal behavior and academic impairment in college students. *Journal of American College Health*, *60*(2), 126–133. https://doi.org/10.1080/07448481.2011.608393

Kleisiaris, C. F., Sfakianakis, C., & Papathanasiou, I. V. (2014). *Health care practices in ancient Greece: The Hippocratic ideal*. PubMed Central (PMC). https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4263393/

Koelsch, S. (2015). Music-evoked emotions: Principles, brain correlates, and implications for therapy. *Annals of the New York Academy of Sciences*, *1337*(1), 193–201. https://doi.org/10.1111/nyas.12684

Koelsch, S., Boehlig, A., Hohenadel, M., Nitsche, I., Bauer, K., & Sack, U. (2016). The impact of acute stress on hormones and cytokines and how their recovery is affected by music-evoked positive mood. *Scientific reports*, *6*(1), 23008.

Kristensen, S. K., Larsen, S. C., Olsen, N. J., Fahrenkrug, J., & Heitmann, B. L. (2017). Hair dyeing, hair washing and hair cortisol concentrations among women from the healthy start study. *Psychoneuroendocrinology*, *77*, 182–185. https://doi.org/10.1016/j.psyneuen.2016.12.016

Landis-Shack, N., Heinz, A. J., & Bonn-Miller, M. O. (2017). Music therapy for posttraumatic stress in adults: A theoretical review. *Psychomusicology*, *27*(4), 334–342. https://doi.org/10.1037/pmu0000192

Levitin, D. J. (2009). The neural correlates of temporal structure in music. *Music and Medicine*, *1*(1), 9–13. https://doi.org/10.1177/1943862109338604

Loussouarn, G. (2001). African hair growth parameters. *British Journal of Dermatology*, *145*(2), 294–297. https://doi.org/10.1046/j.1365-2133.2001.04350.x

Luo, H., Hu, X., Liu, X., Ma, X., Guo, W., Qiu, C., Wang, Y., Wang, Q., Zhang, X., Zhang, W., Hannum, G., Zhang, K., Liu, X., & Li, T. (2012). Hair Cortisol Level as a Biomarker for Altered Hypothalamic-Pituitary-Adrenal Activity in Female Adolescents with Posttraumatic Stress Disorder After the 2008 Wenchuan Earthquake. *Biological Psychiatry*, *72*(1), 65–69. https://doi.org/10.1016/j.biopsych.2011.12.020

Manenschijn, L., Koper, J. W., Lamberts, S. W. J., & van Rossum, E. F. C. (2011). Evaluation of a method to measure long term cortisol levels. *Steroids, 76*, 1032–1036. https://doi.org/10.1016/j.steroids.2011.04.005

Mayer, S., Lopez-Duran, N. L., Sen, S., & Abelson, J. L. (2018). Chronic stress, hair cortisol and depression: A prospective and longitudinal study of medical

internship. *Psychoneuroendocrinology*, *92*, 57–65.
https://doi.org/10.1016/j.psyneuen.2018.03.020

McFerran, K. S., & Rickson, D. (2014). Community music therapy in schools: Realigning with the needs of contemporary students, staff and systems. *International Journal of Community Music*, *7*(1), 75–92. https://doi.org/10.1386/ijcm.7.1.75_1

Meymandi, A. (May 3, 2024). *Music, Medicine, Healing, and the Genome project*. PubMed Central (PMC). https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2766288/

Miller, G., Chen, E., & Cole, S. W. (2009). Health psychology: Developing biologically plausible models linking the social world and Physical Health. *Annual Review of Psychology*, *60*(1), 501–524. https://doi.org/10.1146/annurev.psych.60.110707.163551

Mitchell, E.L. (2019). Community Music Therapy and Participatory Performance: Case Study of a Coffee House. Voices: A World Forum for Music Therapy, 19(1). https://doi.org/10.15845/voices.v19i1.2701

Navaneelan T. Suicide Rates: An Overview. Mental Illness and Addiction: Facts and Statistics. Toronto, ON: CAMH (2012).

Ogrodniczuk JS, Kealy D, Laverdière O. Who is coming through the door? A national survey of self-reported problems among post-secondary school students who have attended campus mental health services in Canada. Couns Psychother Res. 2021;21(4):837–45.

Pittman, S. K., & Kridli, S. A. (2011). Music intervention and preoperative anxiety: an integrative review. *International Nursing Review*, *58*(2), 157–163. https://doi.org/10.1111/j.1466-7657.2011.00888.x

Raul, J., Cirimele, V., Ludes, B., & Kintz, P. (2004). Detection of physiological concentrations of cortisol and cortisone in human hair. *Clinical Biochemistry*, *37*(12), 1105–1111. https://doi.org/10.1016/j.clinbiochem.2004.02.010

Rorke, M. A., (1996). Music and the Wounded of World War II, *Journal of Music Therapy*, *33* (3), 189–207, https://doi.org/10.1093/jmt/33.3.189

Russell, E. M., Koren, G., Rieder, M., & Van Uum, S. (2012). Hair cortisol as a biological marker of chronic stress: Current status, future directions and unanswered questions. *Psychoneuroendocrinology*, *37*(5), 589–601. https://doi.org/10.1016/j.psyneuen.2011.09.009

Ruud E. (2013). Can music serve as a "cultural immunogen"? An explorative study. *International journal of qualitative studies on health and well-being*, *8*, 20597. https://doi.org/10.3402/qhw.v8i0.20597

Sapolsky, R. M., Romero, L. M., & Munck, A. U. (2000). How do glucocorticoids influence stress responses? integrating permissive, suppressive, stimulatory, and preparative actions*. *Endocrine Reviews*, *21*(1), 55–89. https://doi.org/10.1210/edrv.21.1.0389

Sauvé, B., Koren, G., Walsh, G., Tokmakejian, S., & Van Uum, S. H. M. (2007). Measurement of cortisol in human Hair as a biomarker of systemic exposure. *Clinical and Investigative Medicine*, *30*(5), 183. https://doi.org/10.25011/cim.v30i5.2894

Selye, H. (1936). A syndrome produced by diverse nocuous agents. Nature, 138, 32.

Short, S. A., Stalder, T., Marceau, K., Entringer, S., Moog, N. K., Shirtcliff, E. A., Wadhwa, P. D., & Buß, C. (2016). Correspondence between hair cortisol concentrations and 30-day integrated daily salivary and weekly urinary cortisol measures. *Psychoneuroendocrinology*, *71*, 12–18. https://doi.org/10.1016/j.psyneuen.2016.05.007

Stalder, T., Steudte, S., Miller, R., Skoluda, N., Dettenborn, L., & Kirschbaum, C. (2012). Intraindividual stability of hair cortisol concentrations. *Psychoneuroendocrinology*, *37*(5), 602–610. https://doi.org/10.1016/j.psyneuen.2011.08.007

Steptoe, A., & Kivimäki, M. (2012). Stress and cardiovascular disease. *Nature Reviews. Cardiology*, *9*(6), 360–370. https://doi.org/10.1038/nrcardio.2012.45

Thoma, M. V., La Marca, R., Brönnimann, R., Finkel, L., Ehlert, U., & Nater, U. M. (2013). The effect of music on the Human Stress Response. *PLoS ONE*, *8*(8). https://doi.org/10.1371/journal.pone.0070156

Thomson, S., Koren, G., Fraser, L. A., Rieder, M., Friedman, T. C., & Van Uum, S. H. M. (2010). Hair analysis provides a historical record of cortisol levels in Cushing's syndrome. *Experimental and Clinical Endocrinology & Diabetes*, *118*(02), 133-138.

Van Praag, H. M. (2005). Can stress cause depression? *The World Journal of Biological Psychiatry*, *6*(sup2), 5–22. https://doi.org/10.1080/15622970510030018

Voss, J., Good, M., Yates, B. C., Baun, M. M., Thompson, A. B., & Hertzog, M. (2004). Sedative music reduces anxiety and pain during chair rest after open-heart surgery. *Pain*, *112*(1), 197–203. https://doi.org/10.1016/j.pain.2004.08.020

Wester, V. L., Van Der Wulp, N. R., Koper, J. W., De Rijke, Y. B., & Van Rossum, E. F. C. (2016). Hair cortisol and cortisone are decreased by natural sunlight. *Psychoneuroendocrinology*, *72*, 94–96. https://doi.org/10.1016/j.psyneuen.2016.06.016

Wester, V. L., Noppe, G., Savas, M., Van Den Akker, E. L. T., De Rijke, Y. B., & Van Rossum, E. F. C. (2017). Hair analysis reveals subtle HPA axis suppression associated with use of local corticosteroids: The Lifelines cohort study. *Psychoneuroendocrinology*, *80*, 1–6. https://doi.org/10.1016/j.psyneuen.2017.02.024

World Health Organization. Suicide. Geneva: World Health Organization (2021).

Zhou AY, Panagioti M, Esmail A, Agius R, Van Tongeren M, Bower P. Factors Associated With Burnout and Stress in Trainee Physicians: A Systematic Review and Meta-analysis. *JAMA Netw Open.* 2020;3(8):e2013761. doi:10.1001/jamanetworkopen.2020.13761

Chapter 2

Extra-Curricular Activities and Well-Being: Results From a Survey of Undergraduate University Students During COVID-19 Lockdown Restrictions

2.1   Preface

Despite growing awareness of the importance of mental health on university campuses, concerns continue about the well-being of undergraduate university students. The first COVID-19 lockdown that students experienced at McMaster University provided an opportunity to investigate which activities students organically engage in to manage stress experiences. Understanding how students are engaging in stress management can help to inform on-campus supports for students, and help to add student voices to the conversation about on campus supports to improve students' help seeking behaviours. On campus supports for students are currently dominated by verbal-based interventions for individuals with a diagnosis or experiencing a crisis. In Chapter 2, I present the results of a survey that we delivered across the McMaster University campus. The survey provided information about student stress and anxiety during this difficult time, as well as information about the activities students were spontaneously engaging in for wellness, and which professional services they would most likely seek out (ie., music therapy, art therapy, verbal-based therapy).

2.2   Abstract

Participation in extra-curricular activities has been found to associate with increased well-being. Here we investigated in a survey ($n = 786$) what activities university students at a Canadian university engaged in during the stressful COVID-19 pandemic lockdown in April, 2020, which coincided with a novel online exam period, and how these activities related to perceived well-being, anxiety (STAI-S), social aspects of activities, and personality. Sixty-five percentage of students scored in the high anxiety category of the STAI-S, an alarming statistic given that only 24% had reached out for professional supports. This is consistent with reports that current supports on university campuses are inadequate. Listening to music (92%) and watching movies/series (92%) were engaged in most frequently, followed by socializing virtually (89%) and engaging in social media (85%). The activities students rated as most helpful to their well-being were somewhat different, with outdoor exercise rated highest, followed by socializing virtually and listening to music. While all activities were rated as beneficial, those with a social component tended to have high ratings, consistent with students attempting to replace lost social interactions. Linear regression models found few associations between STAI-S scores and other measures, likely because of large individual differences and lack of a pre-pandemic baseline needed to assess changes in anxiety. The importance of individual differences was evident in that those higher
in *conscientiousness* or *extraversion* or *emotional stability* were more likely to engage in exercise, while those higher in *openness to experience* were more likely to engage in journaling, playing a musical instrument, or singing, with a trend for higher engagement

in song writing. Individual differences were also evident in that equal numbers of students gave positive and negative comments related to their well-being during the pandemic. The individual differences uncovered here suggest that having a variety of proactive interventions would likely reach more students. Indeed, 52% indicated an interest in online group music therapy, 48% in art therapy and 40% in verbal therapy, despite music and art therapies being virtually non-existent on campuses. In sum, the findings highlight the importance of choice in extra-curricular activities and therapies that support well-being.

2.3   Introduction

Undergraduate university students fall into an age range that is vulnerable for poor mental health, with significantly higher rates of mental health struggles than the general population (Lee and Jung, 2018). The situation of a global pandemic would be expected to further exacerbate anxiety and impact wellness. In March, 2020, university students in Ontario, Canada were asked to stay home and to self-isolate as a precautionary measure in response to the COVID-19 global pandemic. This timing coincided with the last weeks of classes before final exams, with all classes immediately transitioning to online formats. In addition to the academic disruption, students' in-person social activities were also severely constrained. Despite the transition to isolation, students may have continued participating in extra-curricular activities from home. Extra-curricular activities have been shown to be an important part of facilitating problem-solving, enabling expression of emotion, enhancing adaptability, and contributing to the development of interpersonal skills (Fares et al., 2016). They also appear to be related to the development of self-

regulatory mechanisms underpinning psychological and social outcomes, which is of particular importance to this age group as they transition into adult roles (Guilmette et al., 2019).

The goal of the present exploratory research was to investigate participation in, and the impact of, extra-curricular activities on wellness in university students during a time of high stress and social isolation by making use of the convergence of COVID-19 stay-at-home precautionary measures and an exam period that had transitioned to an online format. Specifically, we investigated (1) which extra-curricular activities undergraduate students engaged in on their own volition during this time, (2) which activities students reported as contributing to their wellness, (3) how anxious students were during this time as revealed by scores on a standardized measure of anxiety, (4) relations between anxiety scores and participation in particular activities, (5) whether social aspects of activities impacted anxiety levels, (6) whether students' ratings of how key activities affected their well-being related to their anxiety levels, (7) whether personality traits played a role in the activities chosen and on anxiety, (8) how much interest students had in participating in online group music, art and verbal therapy, and (9) how students described their experiences during COVID-19 precautionary measures in an open-ended format.

A number of extra-curricular activities have been studied in relation to wellness and anxiety, including exercise, use of social media, and creative activities, such as music and art. We were particularly interested in music, as it has a long history of supporting humankind through pandemics (Bassler, 2020). Media content today suggests this is also

the case in the current pandemic; indeed, a new category of music has been identified—
"pandemic pop" (Cross, 2020; Rosen, 2020; Wilson, 2020)—highlighting the importance
of music during this time.

Exercise is widely recognized as contributing to health and wellness. Systematic
reviews and meta-analyses support that engaging in physical activity/exercise increases
wellness (Reed and Buck, 2009; Rodriguez-Ayllon et al., 2019), while recognizing that
the amount of exercise is likely important (there may be a minimum amount of weekly
exercise needed to impact mental well-being). Although Rodriguez-Ayllon et al. (2019)
found that physical activity improved well-being across many different measures, the
association between physical activity and anxiety was less clear. Studies examining the
impact of sedentary behavior find the expected inverse relationship with anxiety, that is,
sedentary behavior has a small, positive association with anxiety (Allen et al., 2019).
There are also likely individual differences in the association between exercise and well-
being, with the positive effect of engaging in exercise potentially mediated by genetic
factors (De Moor et al., 2008).

The impact of social media on wellness and anxiety is controversial. In a sample
of adolescents, Woods and Scott (2016) found that greater overall social media use was
related to higher levels of anxiety and, in a systemic review, Keles et al. (2020) noted a
general association between social media use and mental health struggles in adolescents,
although they concluded that the relationship between the two is complex. With regard to
sedentary screen time, a meta-analysis of observational studies specific to children and
adolescents found that ~1 h a day of screen time associated with decreased symptoms of

depression, whereas 2 h or more per day associated with increased symptoms of depression (Liu et al., 2016). It should be noted, however, that these findings were only significant for those younger than 14 years of age. A systematic review and meta-analysis by Wang et al. (2019), also supports that increased screen time results in increased symptoms of depression, although in this analysis the findings were only significant in females. Passive screen time also has been associated with anxiety severity (Maras et al., 2015). The type of screen-based activity, and particularly whether it involves passive vs. active engagement, likely affects whether the impact is positive, negative, or neutral. However, the picture here is far from clear. Video games, but not television or general computer use, may be related to more severe symptoms of anxiety (Maras et al., 2015), but other studies have suggested that video games could have a positive impact on wellness (Johnson et al., 2013).

Creative activities, including music, can reduce anxiety according to Toyoshima et al. (2011). This study found that when people participated in creative arts activities that they had prior experience with, all the activities, including calligraphy, clay molding, and piano playing, reduced anxiety compared to a control group who sat silently for an equivalent amount of time. This suggests that there are likely individual differences in how beneficial a particular creative activity may be. Perruzza and Kinsella (2010) completed a literature review to examine the perceived outcomes of creative arts occupations with respect to health and well-being and concluded that the creative arts support overall wellness. A systematic review of the use of creative arts activities as interventions to promote mental well-being found that nine articles out of 11 highlighted

"significant improvements in well-being," including ratings of mood, self-esteem, and interactions with others (Leckey, 2011). A review of the literature supports the use of music listening to positively impact preoperative anxiety, and more generally to promote relaxation (Biley, 2000). Some studies report that everyday listening to music and creating music may serve as proactive tools to promote or maintain well-being. Linnemann et al. (2015) found that university students had lower subjective stress levels after listening to music in a naturalistic study where students completed assessments multiple times a day over 5 days. Participating in music has also been linked to increased wellness, lowered burnout rates, and is highly recommended during medical training (Fares et al., 2016).

In the present study, to examine the nine questions outlined above, we created an online survey and administered it about 1 month after the start of the COVID-19 precautionary measures, which also coincided with students' exam period, thus creating a situation of potentially high anxiety. To examine the extent of students' participation in different extra-curricular activities, we asked students which activities from a list of 16 they were engaging in (as well as to indicate other activities not listed). For those activities they were engaging in, we asked how much they felt each activity contributed to their well-being and whether they engaged in the activity alone or with others (either in person or virtually). We also obtained a measure of their current state anxiety using the State portion of the standardized State Trait Anxiety Inventory (STAI-S; Spielberger et al., 1983) and a measure of the Big Five personality traits using the standardized Ten-Item Personality Inventory (TIPI; Gosling et al., 2003). Finally, we probed their interest

in participating in online group music, art and verbal therapies and asked about their experiences during the COVID-19 precautionary measures in an open-ended question.

To address our nine main questions, we used a combination of descriptive statistics; exploratory linear regression models to determine what factors predicted anxiety scores; and content analysis of the open-ended questions about COVID-19 experiences. Unfortunately, it was not possible to obtain a measure of their state anxiety prior to this stressful period so we were unable to examine how much state anxiety changed from before to during the COVID-19 restrictions. We expected music, exercise, social media and creative arts to be popular activities during the time of the survey and for participation in these activities to correlate with perceived wellness benefit and with STAI-S anxiety scores. We also expected student self-reported ratings of how much an activity contributed to their wellness to be related to their anxiety scores.

Recognizing that social engagement can contribute to wellness (Caldwell et al., 1992; Brajša-Žganec et al., 2011; Doerksen et al., 2014), and that a lack of social connection is associated with poorer health, including increased depression and social anxiety (Morina et al., 2020), we asked students whether they participated in their extra-curricular activities alone or with others. We expected the COVID-19 social restrictions to motivate students to engage in activities that promote a feeling of being connected to others. Additionally, we anticipated that engaging in activities with others, whether in person or virtual, would relate to lower anxiety scores.

Individual differences in personality is a key factor in how different people manage state-anxiety and the enjoyment of extra-curricular activities. A metasynthesis

conducted by Strickhouser et al. (2017) suggested that personality predicts overall health and well-being. In addition, several studies indicate that personality predicts which activities people choose to engage in (Wolfradt and Pretz, 2001; Aaron et al., 2011; Gil De Zuniga et al., 2017; Gjermunds et al., 2020). Thus, we investigated how personality, as measured by the TIPI, related to anxiety levels and which extra-curricular activities individuals chose to participate in during the pandemic. As per Bunevicius et al. (2008), we expected the trait of high emotional stability as measured by the TIPI to relate to lower anxiety scores on the STAI-S. We also expected that students who scored higher on the openness trait on the TIPI would engage more in creative activities such as music and art (Kaufman et al., 2016; Gjermunds et al., 2020).

Finally, an important long-term goal of the present study was to inform development of further supports for wellness on university campuses. Currently, in Canada mental health supports are almost entirely limited to verbal therapies and are often only accessible once a crisis has been reached. In thinking about establishing *proactive* supports to help students manage stress and anxiety before they reach critical levels, and while recognizing the importance of individual differences by offering a variety of programs, in the present survey we asked students to indicate their interest in participating in online group music, art, and verbal therapies. Although music and art therapy are used in other situations as interventions for mental and physical conditions, including depression, they are seldom offered on university campuses in Canada. A critical review of art-based therapies in mental health recovery indicates that such interventions can lead to improved self-esteem, self-discovery, empowerment, self-

expression, rebuilding of identity, self-validation, motivation, and sense of purpose (Van Lith et al., 2013). In addition to gauging interest in proactive group music, art, and verbal therapies, our content analysis of students' responses to the open-ended question regarding their experiences during the COVID-19 restrictions may further inform the need for, and types of, interventions that would be impactful.

2.4 Methods and Materials

2.4.1 Participants

A convenience sample of 786 full-time undergraduate students at McMaster University completed the survey (144 male, 634 female, 4 non-binary and 4 preferred not to answer; 50% selected the age category 19–20 years; 17% <19 years; 29% 21–22 years; 3% 23–24 years; 1% >24 years). 26 (3%) were international students; the majority (82%) were enrolled in the Faculty of Science; and the majority were living in a detached home (61%) with their parents (69%) and siblings (56%) during the lockdown. 17% reported a psychological or neurological disorder. The TIPI revealed distributions for each of the 10 indicators that closely matched those previously reported for the same age range (Gosling et al., 2003). Questions related to musical background revealed 55% of the students could play an instrument, 6% played an instrument professionally, 44% had an immediate family member who played an instrument, and 26% could play by ear. 41% of students listened to music 1–10 h/week, 29% listened 10–20 h/week, 15% listened 20–30 h/week, and 12% listened more than 30 h/week. When asked to rate how closely they pay attention when listening to music from 1 (music is always background only) to 5 (always pay attention to music), the average rating was 3.31. The top three styles of music listened

to were Pop (84%), R&B (63%), and Rap (52%). An additional 126 students began but did not complete the survey. Recruitment methods included social media platforms, direct emails (from Faculty of Science; School of the Arts), and announcements on McMaster's online learning platform Avenue to Learn. We did not have a target number of participants but simply analyzed all completed surveys. It is possible that the sample was biased, as students concerned about their mental health may have been more or less likely to participate. Students were informed that they could win one of twenty $50 CAD prizes by participating in the survey. The protocol was approved by the McMaster Research Ethics Board.

2.4.2 Materials

A survey was created (see Supplementary Materials for the full survey) consisting of 35 questions related to demographics, musical background, and participation in extra-curricular activities, followed by a question on interest in participating in group online music, art, and verbal therapy, an open-ended question on their experiences during the COVID-19 restrictions, and ending with two standardized questionnaires on anxiety levels (STAI-S) and personality traits (TIPI). Concerning extra-curricular activities, students first indicated whether they participated in each of the 16 extra-curricular activities listed (with the option to add additional activities not on the list). The list of activities can be seen in Figure 1. For each activity in which they participated, students were asked to give subjective ratings of how much they felt that each activity supported their overall well-being during the COVID-19 precautions (1 = not at all; 7 = extremely). For each activity students reported participating in, they were asked if they participated in

the activity alone, with those in their household, or with others over the internet. Students were also asked if they participated in any activities more presently than prior to the COVID-19 precautionary measures. To gauge interest in proactive online group therapies, students were asked whether they would be interested (yes, no, maybe) in participating in each of group music, art, and verbal therapy. It was mandatory to complete each question in order to move through the survey (but sensitive questions included the response option "prefer not to answer").

-----------------------------Insert figure 1----------------------------

There were two optional questions. Students were asked whether they had sought mental health support and, if so, the type of support. Finally, in an open-ended question, students were asked to describe their experiences during the COVID-19 lockdown.

State-Trait Anxiety Inventory (STAI-S)

The State-Trait Anxiety Inventory (STAI) is a self-report questionnaire created to measure a person's level of anxiety. The original inventory (Form X) was revised in 1979 to replace items that had weak psychometric properties for certain groups, to better discriminate between feelings of anxiety and depression, and to improve its factor structure (Spielberger et al., 1983). The updated inventory (Form Y; Spielberger et al., 1980) was used in the present study. The STAI consists of two forms. The Trait form (STAI-T) measures individual differences in anxiety proneness and a person's general anxiety levels, while the State form (STAI-S) measures the intensity of the participant's anxiety at the moment of testing, in the recent past, or how they anticipate they would feel in a hypothetical situation (Spielberger et al., 1983). We asked students to answer the questions based on their present state. Each form consists of 20 statements. On the STAI-S, participants rate the intensity of their feelings on a Likert scale from (1) not at all to (4)

very much so. Spielberger et al., collected normative adult data for these forms from 4 different groups: working adults ($N = 1,838$), college students ($N = 855$), high school students ($N = 424$), and military recruits (1964). The STAI-S showed good reliability and validity across the different normative groups; Cronbach's alpha = 0.86–0.95, and median item-remainder correlation = 0.55–0.63 (Spielberger et al., 1983). Construct validity was tested in two studies by comparing the mean STAI-S scores of college students in anxiety-inducing conditions (e.g., how they would feel just before an important exam, after being interrupted on the third administration of the Concept Mastery Test (Terman, 1956), or after watching a stressful movie) to mean STAI-S scores in control or relaxed conditions (e.g., normal form procedures, after a relaxation training period). In both studies, the anxiety-inducing conditions resulted in higher scores (Spielberger et al., 1983). The adequate reliability and validity of this instrument across different populations was also confirmed in a paper summarizing reported psychometric properties reported in 75 studies using the STAI (Barnes et al., 2002). In the present study, the STAI-S scores were used to examine students' anxiety levels, and as the dependent variable in exploratory regression analyses.

Ten-Item Personality Inventory

The Ten-Item Personality Inventory (TIPI) is a self-report questionnaire that measures a person's Big Five personality dimensions: extraversion, agreeableness, conscientiousness, emotional stability, and openness to experiences (Gosling et al., 2003). The questionnaire consists of 10 pairs of words (e.g., extraverted, enthusiastic). Participants rate the extent that each pair of traits applies to themselves on a Likert scale from (1) disagree strongly to (7) agree strongly. The TIPI has been shown to have good validity: mean convergent r with the Big-Five Inventory = 0.77, convergent r with the NEO Personality Inventory-Revised = 0.56–0.68, mean test-retest reliability = 0.72

(Gosling et al., 2003). Norms were also established with this sample ($N = 1,813$) (Gosling et al., 2003). In the present study, the TIPI was used to see if personality traits were related to anxiety levels and which extra-curricular activities students engaged in.

2.4.3 Procedure

Students were informed that the survey would take ~20 min to complete. The initial page of the survey contained the letter of information and students gave consent online. The survey was anonymous, and students were provided the option to withdraw from the survey at any time while remaining eligible for the draw (see Participants section). After the submission of the survey (or if they chose not to complete) students were provided with links to mental health resources and the option to enter the draw. The survey was made available from April 21st−30th 2020, coinciding with the exam period at McMaster University.

2.4.4 Data Analysis

First, descriptive statistics of students' responses were collated to answer our first three questions: Question 1: Which extra-curricular activities did undergraduate students engage in on their own volition during this time? Question 2: Which activities did students report as contributing to their wellness? Question 3: How anxious were students as measured by the standardized STAI-S during this time?

Second, exploratory analyses using linear regression models in R version 4.0.2 (R Core Team, 2019) were conducted to examine the following questions: Question 4: How did participating in each key activity relate to anxiety scores? Question 5: Did social aspects—participating in activities alone or with others—impact wellness and anxiety?

Question 6: Did students' ratings of how key activities affected their well-being relate to their state anxiety scores? Question 7: Did students' personality traits relate to their state anxiety scores or the activities they chose to participate in? Each model was fitted using STAI-S scores as the dependent measure. To control for the fact that women report higher stress levels than men (Bayram and Bilgel, 2008; Al-Qaisy, 2011) we included participant gender as a control variable in each model. To ensure proper fit, we removed any students who either did not report their gender (four students) or reported a gender other than male or female (four students) as there was not enough data in these categories to analyze. This resulted in data from 778 students being included in the models. Furthermore, we included the result of the question "Have you ever been diagnosed with a neurological/psychological disorder?" as a control variable. We chose to focus on nine key activities out of the 16 in the survey based on two criteria: they were chosen by a substantial number of students and/or were related to a priori predictions concerning music and well-being. The nine key activities analyzed were (1) playing an instrument or singing, (2) listening to music, (3) writing songs, (4) participating in social media, (5) watching movies and TV series, (6) playing computer games, (7) outdoor exercise, (8) indoor exercise, and (9) journaling. For each question, single models were created for each of the nine key activities. These models are exploratory; we corrected for multiple comparisons using the Bonferroni correction.

Third, answers to the question on interest in participating in online group music, art, and verbal therapy were tabulated to answer Question 8: How much interest did students report in participating in online group music, art and verbal therapy?

Finally, to answer Question 9: How did students describe their experiences during COVID-19 precautionary measures, answers to the open-ended question inviting students to describe their experiences during the precautionary measures of the first wave of the COVID-19 pandemic were independently categorized by two researchers. Initial searches indicated that comments could be categorized at a high level into positive and negative categories. Each researcher further independently identified subthemes within each of the positive and negative categories. On amalgamation of their results, 3 positive subthemes and 3 negative subthemes were identified.

2.5 Results

2.5.1 Descriptive Analyses

Question 1: Which Extra-Curricular Activities Did Undergraduate Students Engage in of Their Own Volition During This Time?

The number of students who reported engaging in each of the 16 extra-curricular activities is shown in Figure 1. It can be seen that the two top activities were listening to music (92% of students) and watching movies/series (92%), followed by socializing with others over social media or phone (89%). Listening to music was the top activity that students engaged in alone (82%), socializing with others virtually using social media or phone was the top activity engaged in with others over the internet (74%), and watching movies was the top activity engaged in with those in the same living space (65%). A full list of how students engaged in each activity is presented in Figure 2.

-----------------------------------Insert Figure 2---------------------------------------

Question 2: Which Activities Did Students Report as Contributing to Their Wellness?

For each extra-curricular activity that students reported engaging in, they rated how helpful that activity was for their well-being on a scale from 1 (not helpful) to 7 (extremely helpful). Mean ratings for each activity are shown in Figure 3. The top-rated activities were outdoor exercise (M = 5.8, SE = 0.07), socializing with others through social media or phone (M = 5.6, SE = 0.06), and listening to music (M = 5.4, SE = 0.06).

-----------------------------------Insert Figure 3--

Question 3: How Anxious Were Students as Measured by the Standardized STAI-S During This Time?

Scores on the STAI-S revealed that, as a group, students showed high anxiety (Figure 4). 507 students (65%) scored in the high anxiety category. By gender, 67% of female students compared to 54% of male students scored in this high anxiety category. Females also had a higher mean STAI-S score than males [females: M = 50.89, SE = 0.50; males: M = 45.58, SE = 0.95; $t_{(227.63)}$ = 4.67, $p < 0.001$]. 187 students (24%) reported they had reached out for supports through the McMaster University Wellness Centre or another professional support system. Together these scores suggest that students were highly stressed during the precautionary measures imposed during the first wave of the pandemic.

-----------------------------------Insert Figure 4--

2.5.2 Exploratory Regression Analyses

Question 4: How Did Participating in Each Key Activity Relate to Anxiety Scores?

With this group of models, we were interested in the effect of participating in each activity on a participant's state anxiety score. We dummy-coded whether the participant

reported participating in the activity or not during the initial wave of the COVID-19 pandemic. As noted in the statistical analyses section in the Methods, participant gender and whether they reported having a psychological disorder were included as control variables. No activity significantly predicted a change in state anxiety after controlling for multiple comparisons (see Table 1 for the main effect of each activity). There was a significant effect of gender and whether they reported having a psychological disorder on their STAI-S score in every model. Watching movies/series during the start of the pandemic was associated with a lower STAI-S score by 3.6 points ($t = -2.22$; uncorrected $p = 0.027$; corrected $p = 0.24$). In this model, men reported a state anxiety score of 4.48 points lower than women ($t = -3.99$; uncorrected $p < 0.001$; corrected $p < 0.001$). Furthermore, students who reported a psychological disorder had an anxiety score that was 6.11 points higher than students without a psychological disorder ($t = -3.99$; uncorrected $p < 0.001$; corrected $p < 0.001$). Thus, future research could look at the effect of watching movies and TV series on anxiety during times of high stress.

-----------------------------------Insert Table 1--

Question 5: Did Social Aspects—Participating in Activities Alone or With Others—Impact Anxiety?

With this group of models, we were interested in whether there was a benefit to participating in the extra-curricular activities with other individuals. We asked students whether they did each activity alone, with others in person, or with others online. We coded individuals as "participating with others" if they responded yes to either "with those in self-isolation with you" or "socially using the internet," even if they reported

participating in the activity alone. A negative estimate indicates that performing an activity with others (compared to doing so alone) is associated with lower STAI-S scores. As noted in the statistical analyses section in the Methods, participant gender and whether they reported having a psychological disorder were included as control variables. These two variables were consistently predictive of STAI-S score. After correcting for multiple comparisons, there were no significant differences in any of the activities (see Table 2 for the main effect of each activity). Playing computer games with others resulted in a STAI-S score of 4.97 points less than those who played alone ($t = -2.67$; uncorrected $p = 0.008$; corrected $p = 0.072$). Engaging in indoor exercise with others was associated with a STAI-S score of 2.84 points lower than doing indoor exercise alone ($t = -2.66$; uncorrected $p = 0.008$; corrected $p = 0.072$). Future research can investigate the effects of playing computer games and exercising indoors with others on state anxiety during a time of crisis.

------------------------------------Insert Table 2 --

Question 6: Did Students' Ratings of How Key Activities Affected Their Well-Being Relate to Their State Anxiety Scores?

With this group of models, we were interested in the relation between state anxiety scores and students' perception of an activity's helpfulness on their well-being. In the questionnaire, students rated how well each activity supported their overall well-being during the COVID-19 precautions on a scale from 1 (not at all) to 7 (extremely). A negative estimate indicates that with increases in how helpful a particular activity was rated for well-being, STAI-S scores decreased. As noted in the statistical analyses section

in the Methods, participant gender and whether they reported having a psychological disorder were included as control variables. For three activities (social media, outdoor and indoor exercise), student reports that the activity was helpful for well-being were associated with lower STAI-S scores (see Table 3 for the main effect of each activity). For every 1-point increase in well-being rating for social media, STAI-S scores were lower by 0.90 points ($t = -3.72$; uncorrected $p < 0.001$; corrected $p < 0.01$). For every 1-point increase in well-being rating for outdoor exercise, STAI-S scores were lower by 1.4 points ($t = -3.39$; uncorrected $p < 0.001$; corrected $p < 0.01$). For every 1-point increase in well-being rating for indoor exercise, STAI-S scores were lower by 1.41 points ($t = -4.44$; uncorrected $p < 0.001$; corrected $p < 0.001$). Thus, finding these activities helpful for well-being was associated with lower anxiety. In addition, for all activities, the direction of the effect was in the appropriate direction, indicating that higher helpfulness ratings on each activity were associated with lower anxiety scores, although most did not reach significance.

----------------------------------Insert Table 3 ---------------------------------------

Question 7: Did Students' Personality Traits Relate to Their State Anxiety Scores or the Activities They Chose to Participate in?

With this group of models, we were interested in the relation between each of the five personality traits (as measured by the TIPI on a scale from 1 to 7) on students' state anxiety scores and on particular extra-curricular activities they chose to engage in. As noted in the statistical analysis section in the Methods, participant gender and whether they reported having a psychological disorder were included as control variables. We

included all five TIPI traits as main effects. Beta-values for each TIPI trait represent the change in STAI-S score with a one-point increase on the 7-point personality trait scale. Individuals who scored high in conscientiousness or emotional stability had lower STAI-S scores (conscientiousness: $B = -0.900$, $t = -2.89$, $p = 0.0039$; emotional stability: $B = -4.85$, $t = -17.19$, $p < 0.001$).

We built additional binomial generalized linear models to look at the effect of TIPI traits on participation in the various extra-curricular activities during the COVID-19 lockdown. We included participants' gender and the presence/absence of a psychological disorder as control variables, and included all five TIPI variables as our main effects of interest. *P*-values were corrected to account for multiple comparisons (running models on the nine activities of interest). Individuals who were higher in openness to experience were more likely to participate in song writing ($B = 0.453$, $z = 2.27$, uncorrected $p = 0.023$; corrected $p = 0.21$), journaling ($B = 0.315$, $z = 3.56$, uncorrected $p = 0.00037$; corrected $p = 0.0033$) and playing an instrument or singing ($B = 0.347$, $z = 4.38$, uncorrected $p < 0.001$; corrected $p < 0.001$). Individuals who were higher in conscientiousness were more likely to participate in indoor exercise ($B = 0.260$, $z = 3.60$, uncorrected $p = 0.00032$; corrected $p = 0.0029$) and social media ($B = 0.179$, $z = 2.05$, uncorrected $p = 0.040$; corrected $p = 0.36$), and were less likely to play video or computer games ($B = 0.224$, $z = B=3.24$, uncorrected $p = 0.0012$; corrected $p = 0.011$). Individuals who were higher in extraversion were more likely to participate in indoor exercise ($B = 0.156$, $z = 2.63$, uncorrected $p = 0.0086$; corrected $p = 0.078$), outdoor exercise ($B = 0.114$, $z = 2.22$, uncorrected $p = 0.0262$; corrected $p = 0.24$), and social media ($B = $

0.159, $z = 2.16$, uncorrected $p = 0.031$; corrected $p = 0.28$). Individuals who were higher in emotional stability were more likely to participate in outdoor exercise ($B = 0.120$, $z = 2.03$, uncorrected $p = 0.042$; corrected $p = 0.38$) and individuals who were higher in agreeableness were less likely to play video or computer games ($B = 0.161$, $z = 2.14$, uncorrected $p = 0.033$; corrected $p = 0.29$). No personality traits predicted watching movies or TV series or listening to music. Together these analyses indicate that there are large individual differences related to personality traits in students' choices of extra-curricular activities, suggesting that to engage the maximum number of students in proactive wellness initiatives, a variety of programs would be beneficial.

Question 8: How Much Interest Did Students Report in Participating in Online Group Music, Art, and Verbal Therapy?

When asked about interest in participating in three types of online group therapy, 52% indicated that either they were interested or were maybe interested in participating in music therapy. The percentage for art therapy was comparable at 48%. The percentage for verbal therapy was lower at 40%. The complete breakdown by gender can be seen in Figure 5. Together these results suggest considerable interest in group music and art therapy among university students.

----------------------------------Insert Figure 5 ---------------------------------------

2.5.3 Content Analysis of Open-Ended Responses

Question 9: How Did Students Describe Their Experiences During COVID-19 Precautionary Measures in an Open-Ended Format?

145 students (18%) responded to the open-ended question "*Please add any additional information that you feel comfortable sharing about how you are coping at this time of change as a result of the COVID-19 pandemic.*" Comments were fairly evenly split between expressing positive (73 comments) and negative (78 comments) experiences (see Table 4). A few students wrote more than one comment, giving rise to a total of 151 comments analyzed. Within the positive category, three subthemes surfaced: (1) positive impact of engaging in self-care ($n = 15$ comments), (2) positive impact of engaging in activities ($n = 40$), and (3) impact of keeping a positive attitude ($n = 18$). Three subthemes also surfaced within the negative category: (1) negative impact on studies ($n = 24$), (2) negative impact on well-being ($n = 45$), and (3) negative impact due to living arrangements ($n = 9$). The full set of responses in each subtheme is available in Supplementary Materials, Section B. Table 4 shows an example response for each subtheme.

2.6 Discussion

It is recognized that participating in extra-curricular activities have cognitive, social and mental health benefits (Fares et al., 2016), and this may be even more important during stressful times when social interactions are limited. In our survey, the most popular extra-curricular activities students reported engaging in during the pandemic lockdown were listening to music (92% of students), watching movies/series (92%), socializing with others virtually (89%), and engaging in social media (85%) (see Figure 1). Interestingly, these activities were engaged in by a greater number of students than indoor exercise (74%) or outdoor exercise (53%), despite exercise being an activity that is

known to lower stress (Reed and Buck, 2009; Rebar et al., 2015). One limitation in interpreting these numbers, however, is that we did not gather data on how often or for what duration of time students engaged in these activities. Nor do we know how the types of activities engaged in may have changed pre to post pandemic, or whether the amount of time spent engaging in each activity changed compared to pre-pandemic levels. Nonetheless, it is interesting that listening to music was one of the two activities engaged in by the most students during this time, suggesting that music was important to them.

Also of interest was that watching movies/series, socializing with others virtually, and engaging in social media were done to a large extent with others, either in person or virtually (see Figure 2), compared to alone. Even for music listening, 36% of students reported engaging in this activity with others in person and 44% reported engaging in this activity with others virtually (see Figure 2). Together these numbers suggest that the activities students were engaging in the most tended to be ones in which they incorporated a social component. In turn, this suggests that extra-curricular activities were serving the important function of increasing students' social interactions with others.

When asked how much students felt that each extra-curricular activity contributed to their well-being, the mean ratings for all of the 16 activities were above 4 on a scale from 1 (not helpful) to 7 (extremely helpful), and the mean across all activities was 5.0. This corroborates previous literature on the positive impact of extra-curricular activities on wellness (Fares et al., 2016). The data from the present study suggests, further, that this is also true during a highly stressful time involving social isolation. Despite the fact that only 53% of students reported engaging in outdoor exercise, it received the highest

rating (5.8 ± 0.07) for contributing to well-being. This is consistent with many studies

showing that engaging in exercise is beneficial for mental health and well-being (Reed

and Buck, 2009; Rebar et al., 2015). Interestingly, exercising indoors (5.4 ± 0.07) was

rated as having lower benefit than exercising outdoors, despite the fact that more students

engaged in indoor exercise. One speculation is that this relates to the fact that students

engaged in outdoor exercise to a greater extent with others than was the case with indoor

exercise, again suggesting that during the pandemic, activities incorporating social

interaction were felt by students to lead to the most benefit. Consistent with this is also

that ratings were high for the perceived well-being benefits of socializing with others

virtually (5.6 ± 0.06) and listening to music (5.4 ± 0.06), both of which were engaged in

to large extent with others, whether virtually or in person (see Figure 2).

To obtain a more objective indication of students' anxiety during the convergence

of the initial pandemic lockdown and a newly virtual exam period, students completed the

STAI-S. Scores were alarmingly high, with 65% scoring in the high anxiety category

(see Figure 4). The expected norms for state anxiety by gender are 36.47 for males and

38.76 for females (Spielberger et al., 1983). The cut off for the high anxiety category is

commonly classified as 45 and above (Kayikcioglu et al., 2017) and the students in the

present study had an average of 49.69 with more females (67%, $M = 50.59$) than males

(54%, $M = 45.58$) falling in the high anxiety category, consistent with previous findings

(Moyser, 2020). However, interpretation of these results needs to be qualified by several

factors. First, it is possible that the sample was biased. For example, students with mental

health concerns might have been more likely to complete the survey; alternatively,

students with mental health concerns may have avoided completing the survey. Second, many more female than male students completed the survey (82%), despite the percentage of female students at McMaster being 63%. It is possible that there is a greater stigma for male students than for female students to think about or admit to challenges related to their well-being (Chatmon, 2020). It is also possible that the lower STAI-S scores in males in the present study reflects that those with concerns about their mental health chose not to participate. Interestingly, the number of students who reported reaching out for support through the McMaster University Wellness Centre or other professional support systems was only 24%, despite 67% scoring in the high anxiety category of the STAI-S. This suggests that many students who may have benefitted from a mental health intervention were not getting professional support during this time.

A series of exploratory analyses revealed that STAI-S scores were not significantly related to participation in any particular key extra-curricular activity after controlling for multiple comparisons. However, in general, both reporting to have a psychological disorder and being female were associated with higher STAI-S scores. This suggests that the STAI-S scores may have reflected individual differences in trait anxiety to a greater extent than whether particular extra-curricular activities lowered anxiety during the stressful pandemic circumstances. We were of course unable to obtain STAI-S scores pre-pandemic, so it was impossible to examine how anxiety scores *changed* from before to during the pandemic in relation to what activities students chose to engage in. As well, the study was exploratory in that we did not have random assignment to participate in particular extracurricular activities. It thus remains for future studies to

examine how various extra-curricular activities may moderate changes in anxiety when students are placed in stressful circumstances.

Similarly, exploratory analyses concerning whether participating in particular key activities alone or with others (whether in person or virtually) found no effects after controlling for multiple comparisons. However, there were trends that playing computer games with others and that engaging in indoor exercise with others were associated with lower STAI-S scores when compared to participating in these activities alone. The same caveat applies here of course, that we do not have pre-pandemic STAI-S scores, so we cannot determine whether participating in particular activities socially during the lockdown was associated with a smaller pre to during *change* in anxiety compared to participating in those activities alone.

Exploratory analyses of whether STAI-S scores related to students' ratings of how participation in key activities affected their well-being revealed a positive relationship for every activity, but only three of these reached significance levels after correction for multiple comparisons: engaging in social media, indoor exercise and outdoor exercise. Again, if we had been able to obtain STAI-S scores before and during the lockdown, and been able to examine changes in anxiety, it is possible that stronger relations might be found between students' ratings of how effective an activity was and how much their anxiety changed pre to during pandemic lockdown.

These exploratory analyses all suggest that individual differences likely play a large role in how students respond to stress, which activities they find helpful for their well-being, and the extent to which social aspects affect their well-being. As a

preliminary foray into examining this question, we investigated how the five personality traits measured by the TIPI related to STAI-S anxiety scores, as well as to the activities participants chose to engage in. We first noted that students who scored high in conscientiousness or emotional stability had lower STAI-S scores. We are unable of course to determine whether this represents lower trait anxiety or a superior ability to cope with stress. However, the findings are consistent with Bunevicius et al. (2008) that emotional stability is related to anxiety and with Strickhouser et al. (2017), that conscientiousness is related to anxiety. Of interest here is that participation in some particular extracurricular activities was associated with particular personality traits. In particular, participating in exercise was significantly higher in individuals scoring high in conscientiousness, extraversion or emotional stability. Engaging in journaling and playing an instrument or singing were significantly higher in individuals who scored high on openness to experience, with a trend for higher engagement in song writing. No personality traits were associated with listening to music or to watching movies or TV. However, the vast majority of students engaged in these activities, so a lack of association with personality traits may reflect ceiling effects. In future studies, measures of how often students engage in these activities, rather than simply whether they engage in them or not, might be more sensitive at picking up how they relate to personality differences. What is clear from the present data is that listening to music and watching movies or TV are very common extracurricular activities regardless of personality. In general, from the present study, we cannot determine whether particular extracurricular activity choices were similar pre to during the pandemic, but the important point is that individual differences

likely lead people to participate in different extracurricular activities, all of which may be beneficial for their mental health.

Further to the question of individual differences, we found a variety of responses when students were simply asked to share their experiences during the COVID-19 precautionary measures. We were surprised to find that about half the responses were positive while half were negative. For example, some students found living at home a positive experience while others found it a negative experience. Some students were happy to have time to engage in particular activities, whether cooking or engaging in self-care, whereas others keenly felt the negative impact of in-person isolation from their friends.

The question of individual differences is critical when thinking about providing mental health supports for students on university campuses. University students are at a vulnerable age for mental health struggles compared to the general population (Lee and Jung, 2018), a situation likely exacerbated by the pandemic lockdown. Currently, university mental health supports in Canada tend to be limited to verbal-based therapies. According to the Canadian Alliance of Student Associations, wait times to see a campus counselor can be up to 2–3 months, potentially contributing further to a mental health crises that might have otherwise been prevented (Max and Waters, 2018). In 2016, 40% of individuals under the age of 24 who visited an emergency department for a mental illness or addiction problem in Ontario had not received mental health care from a family doctor, pediatrician, or psychiatrist within the past 2 years (Health Quality Ontario, 2018). Three considerations arise from this situation. First, there needs to be a way to *scale*

up mental health supports to reach more students. Second, a *proactive* approach is needed, so that students have supports for managing stress and anxiety before crises are reached. And, third, *individual differences* need to be considered, so that optimal supports for individual students are available.

The present survey was conducted in part to gauge students' needs and interest in additional alternative mental health supports on university campuses. In particular, we were interested in music- or art-based group therapies. Currently, such supports are rare on university campus, but such therapies could go some way to addressing the three considerations outlined here. Group therapies are cost effective and scale up easily, they can be delivered to students proactively prior to or without a specific diagnosis, and they could provide an alternative for students who prefer not to engage in individual therapy. In our survey, 52% of students indicated they either were interested or might be interested in group music therapy. A comparable percentage indicated interest in group art therapy (48%), while the percentage interested in verbal group therapy was lower at 40%. Combined with other findings from our survey—that students felt that engaging in musical extracurricular activities was beneficial for their well-being, that they often engaged in music listening with others (whether virtual or in person), that students tended to rate activities as more beneficial when they involved a social component, and that different personality traits were associated with which extracurricular activities students chose to engage in—this suggests that offering proactive group music therapy on university campuses would be of interest to a substantial number of students, and could be a cost effective way to provide a social, proactive mental health support to a significant

subset of students for whom such an approach might be more optimal than verbal therapy. To this end, we are currently conducting a randomized control study using questionnaire and physiological measures to compare the benefits of participating in different types of group music therapies and group verbal therapy.

2.7 Conclusions

A survey of over 700 students at a Canadian university during the pandemic lockdown in April 2020 revealed that students were feeling highly anxious, with 65% scoring in the high anxiety category of the standardized STAI-S measure. Previous studies have shown that participation in extracurricular activities is associated with cognitive, social and well-being benefits. Results of the present survey revealed that students engaged in a variety of extracurricular activities during this time, the most popular being listening to music, watching movies and series, socializing with others virtually, and engaging in social media. All extracurricular activities were rated as being beneficial for well-being, with the highest ratings going to outdoor exercise, socializing virtually with others and listening to music. Social interaction was important in these activities, with students reporting engaging with others (virtually or in person) in the activities reported to be most beneficial. After correction for multiple comparisons, there were few significant associations between STAI-S scores and self-report measures, likely because we did not have a pre-pandemic measure of STAI-S and therefore could not examine changes in STAI-S scores. However, it was clear that individual differences in the choice of, and perceived benefit of, different extracurricular activities were large. Individual differences in activity choice were significantly related to personality characteristics, with individuals

higher in *conscientiousness* or *extraversion* or *emotional stability* more likely to engage in exercise, and those higher in *openness to experience* more likely to engage in journaling and playing a musical instrument or singing with a trend for higher engagement in song writing. That the current practice on university campuses of providing almost exclusively verbal therapy, and few options of proactive (i.e., before crisis) group therapies, is not meeting the needs of many students was evident in that 52% of respondents were either interested or maybe interested in proactive group music therapy and 48% in proactive group art therapy, while 40% were potentially interested in group verbal therapy. The results of this survey suggest that providing a variety of proactive social (group) therapy options for students would likely contribute substantially to students' mental health and well-being.

2.8 Acknowledgments

2.9 References

1. Aaron R. A., Rinehart K. L., Ceballos N. A. (2011). Arts-based interventions to reduce anxiety levels among college students. *Arts Health* 3, 27–38. 10.1080/17533015.2010.481290 [CrossRef] [Google Scholar]

2. Allen M. S., Walter E. E., Swann C. (2019). Sedentary behaviour and risk of anxiety: a systematic review and meta-analysis. *J. Affect. Disord.* 242, 5–13. 10.1016/j.jad.2018.08.081 [PubMed] [CrossRef] [Google Scholar]

3. Al-Qaisy L. M. (2011). The relation of depression and anxiety in academic achievement among group of university students. *Int. J. Psychol. Counsell.* 3, 96–100. 10.5897/IJPC.9000056 [CrossRef] [Google Scholar]

4. Barnes L. L., Harp D., Jung W. S. (2002). Reliability generalization of scores on the Spielberger state-trait anxiety inventory. *Educ. Psychol. Meas.* 62, 603–618. 10.1177/0013164402062004005 [CrossRef] [Google Scholar]

5. Bassler S. (2020). Plague and music in the renaissance, by Remi Chiu. *J. Am. Musicol. Soc.* 73, 397–401. 10.1525/jams.2020.73.2.397 [CrossRef] [Google Scholar]

6. Bayram N., Bilgel N. (2008). The prevalence and socio-demographic correlations of depression, anxiety and stress among a group of university students. *Soc. Psychiatry Psychiatr. Epidemiol.* 43, 667–672. 10.1007/s00127-008-0345-x [PubMed] [CrossRef] [Google Scholar]

7. Biley F. C. (2000). The effects on patient well-being of music listening as a nursing intervention: a review of the literature. *J. Clin. Nurs.* 9, 668–677. 10.1046/j.1365-2702.2000.00392.x [CrossRef] [Google Scholar]

8. Brajša-Žganec A., Merkaš M., Šverko I. (2011). Quality of life and leisure activities: how do leisure activities contribute to subjective well-being? *Soc. Indic. Res.* 102, 81–91. 10.1007/s11205-010-9724-2 [CrossRef] [Google Scholar]

9. Bunevicius A., Katkute A., Bunevicius R. (2008). Symptoms of anxiety and depression in medical students and in humanities students: relationship with big-five personality dimensions and vulnerability to stress. *Int. J. Soc. Psychiatry* 54, 494–501. 10.1177/0020764008090843 [PubMed] [CrossRef] [Google Scholar]

10. Caldwell L. L., Smith E. A., Weissinger E. (1992). The relationship of leisure activities and perceived health of college students. *Loisir et Société/Soc. Leisure* 15, 545–556. 10.1080/07053436.1992.10715431 [CrossRef] [Google Scholar]

11. Chatmon B. N. (2020). Males and mental health stigma. *Am. J. Men's Health* 14:1557988320949322. 10.1177/1557988320949322 [PMC free article] [PubMed] [CrossRef] [Google Scholar]

12. Cross A. (2020, March 29). Alan cross: a look at the art and music created in times of a pandemic. *Global News*. Available online at: https://globalnews.ca/news/6735528/alan-cross-art-pandemiccoronavirus/ (accessed December 18, 2020).

13. De Moor M. H. M., Boomsma D. I., Stubbe J. H., Willemsen G., De Geus E. J. C. (2008). Testing causality in the association between regular exercise and symptoms of anxiety and depression. *Arch. Gen. Psychiatry* 65, 897–905. 10.1001/archpsyc.65.8.897 [PubMed] [CrossRef] [Google Scholar]

14. Doerksen S. E., Elavsky S., Rebar A. L., Conroy D. E. (2014). Weekly fluctuations in college student leisure activities and well-being. *Leisure Sci.* 36, 14–34. 10.1080/01490400.2014.860778 [CrossRef] [Google Scholar]

15. Fares J., Saadeddin Z., Al Tabosh H., Aridi H., El Mouhayyar C., Koleilat M. K., et al.. (2016). Extracurricular activities associated with stress and burnout in preclinical medical students. *J. Epidemiol. Glob. Health* 6, 177–185. 10.1016/j.jegh.2015.10.003 [PMC free article] [PubMed] [CrossRef] [Google Scholar]

16. Gil De Zuniga H., Diehl T., Huber B., Liu J. (2017). Personality traits and social media use in 20 countries: how personality relates to frequency of social media use, social media news use, and social media use for social interaction. *Cyberpsychol. Behav. Soc. Networking* 20, 540–552. 10.1089/cyber.2017.0295 [PubMed] [CrossRef] [Google Scholar]

17. Gjermunds N., Brechan I., Johnsen S. Å. K., Watten R. G. (2020). Personality traits in musicians. *Curr. Issues Personal. Psychol.* 8, 100–107. 10.5114/cipp.2020.97314 [CrossRef] [Google Scholar]

18. Gosling S. D., Rentfrow P. J., Swann W. B. (2003). A very brief measure of the big five personality domains. *J. Res. Pers.* 37, 504–528. 10.1016/S0092-6566(03)00046-1 [CrossRef] [Google Scholar]

19. Guilmette M., Mulvihill K., Villemaire-Krajden R., Barker E. T. (2019). Past and present participation in extracurricular activities is associated with adaptive self-regulation of goals, academic success, and emotional wellbeing among university students. *Learn. Individ. Differ.* 73, 8–15. 10.1016/j.lindif.2019.04.006 [CrossRef] [Google Scholar]

20. Health Quality Ontario (2018). *Measuring Up 2018: A Yearly Report on How Ontario's Health System is Performing*. Toronto, CA: Queen's Printer for Ontario.

Available online at: https://www.hqontario.ca/System-Performance/Yearly-Reports/Measuring-Up-2018 (accessed December 28, 2020). [Google Scholar]

21. Johnson D., Jones C. M., Scholes L., Colder Carras M. (2013). *Videogames and Wellbeing: A Comprehensive Review. Games Research Group, Young and Well Cooperative Research Centre, Melbourne, AUS*. Available online at: https://www.researchgate.net/publication/251478450_Videogames_and_Wellbeing_A_ComprehensiveReview (accessed December 23, 2020)

22. Kaufman S., Quilty L. C., Grazioplene R., Hirsh J. B., Gray J. R., Peterson J. B., et al.. (2016). Openness to experience and intellect differentially predict creative achievement in the arts and sciences. *J. Pers.* 84, 248–258. 10.1111/jopy.12156 [PMC free article] [PubMed] [CrossRef] [Google Scholar]

23. Kayikcioglu O., Bilgin S., Seymenoglu G., Deveci A. (2017). State and trait anxiety scores of patients receiving intravitreal injections. *Biomed. Hub*. 2, 1–5. 10.1159/000478993 [PMC free article] [PubMed] [CrossRef] [Google Scholar]

24. Keles B., McCrae N., Grealish A. (2020). A systematic review: the influence of social media on depression, anxiety and psychological distress in adolescents. *Int. J. Adolesc. Youth* 25, 79–93. 10.1080/02673843.2019.1590851 [CrossRef] [Google Scholar]

25. Leckey J. (2011). The therapeutic effectiveness of creative activities on mental well-being: a systematic review of the literature. *J. Psychiatr. Ment. Health Nurs.* 18, 501–509. 10.1111/j.1365-2850.2011.01693.x [PubMed] [CrossRef] [Google Scholar]

26. Lee R. A., Jung M. E. (2018). Evaluation of an mHealth App (DeStressify) on university students' mental health: pilot trial. *JMIR Mental Health* 5:e2. 10.2196/mental.8324 [PMC free article] [PubMed] [CrossRef] [Google Scholar]

27. Linnemann A., Ditzen B., Strahler J., Doerr J. M., Nater U. M. (2015). Music listening as a means of stress reduction in daily life. *Psychoneuroendocrinology* 60, 82–90. 10.1016/j.psyneuen.2015.06.008 [PubMed] [CrossRef] [Google Scholar]

28. Liu M., Wu L., Yao S. (2016). Dose-response association of screen time-based sedentary behaviour in children and adolescents and depression: a meta-analysis of observational studies. *Br. J. Sports Med.* 50, 1252–1258. 10.1136/bjsports-2015-095084 [PMC free article] [PubMed] [CrossRef] [Google Scholar]

29. Maras D., Flament M. F., Murray M., Buchholz A., Henderson K. A., Obeid N., et al.. (2015). Screen time is associated with depression and anxiety in Canadian youth. *Prevent. Med.* 73, 133–138. 10.1016/j.ypmed.2015.01.029 [PubMed] [CrossRef] [Google Scholar]

30. Max A., Waters R. (2018). *Breaking Down Barriers: Mental Health and Canadian Post-Secondary Students*. Canadian Alliance of Student Associations. Available online at: https://d3n8a8pro7vhmx.cloudfront.net/casaacae/pages/2449/attachments/original/1515601718/Breaking_Down_Barriers_Mental_Health_and_Post-Secondary_Students.pdf?1515601718 [Google Scholar]

31. Morina N., Kip A., Hoppen T. H., Priebe S., Meyer T. (2020). A potential impact of physical distancing on physical and mental health. a rapid narrative umbrella review of meta-analyses on the link between social isolation and health. *medRxiv* 1–11. 10.1101/2020.10.06.20207571 [PMC free article] [PubMed] [CrossRef] [Google Scholar]

32. Moyser M. (2020, July 9). Gender differences in mental health during the COVID-19 pandemic. *Statistics Canada*. Available online at: https://www150.statcan.gc.ca/n1/pub/45-28-0001/2020001/article/00047-eng.htm (accessed April 23, 2021).

33. Perruzza N., Kinsella E. A. (2010). Creative arts occupations in therapeutic practice: a review of the literature. *Br. J. Occup. Therap.* 73, 261–268. 10.4276/030802210X.12759925468943 [CrossRef] [Google Scholar]

34. R Core Team (2019). *Core R: A Language and Environment for Statistical Computing, Version 3.5. 3*. Vienna: R Foundation for Statistical Computing. [Google Scholar]

35. Rebar A. L., Stanton R., Geard D., Short C., Duncan M. J., Vandelanotte C. (2015). A meta-meta-analysis of the effect of physical activity on depression and anxiety in non-clinical adult populations. *Health Psychol. Rev.* 9, 366–378. 10.1080/17437199.2015.1022901 [PubMed] [CrossRef] [Google Scholar]

36. Reed J., Buck S. (2009). The effect of regular aerobic exercise on positive-activated affect: a meta-analysis. *Psychol. Sport Exer.* 10, 581–594. 10.1016/j.psychsport.2009.05.009 [CrossRef] [Google Scholar]

37. Rodriguez-Ayllon M., Cadenas-Sánchez C., Estévez-López F., Muñoz N. E., Mora-Gonzalez J., Migueles J. H., et al.. (2019). Role of physical activity and sedentary behavior in the mental health of preschoolers, children and adolescents: a systematic review and meta-analysis. *Sports Med.* 49, 1383–1410. 10.1007/s40279-019-01099-5 [PubMed] [CrossRef] [Google Scholar]

38. Rosen J. (2020, March 20). Pandemic pop: at home and around the world, dark-humored new songs about coronavirus go viral. Los Angeles Times. Available online at: https://www.latimes.com/entertainment-arts/music/story/2020-03-20/cardi-b-coronavirus-dj-imarkkeyz-pandemic-pop (accessed March 22, 2021). [Google Scholar]

39. Spielberger C. D., Gorsuch R. L., Lushene R., Vagg P. R., Jacobs G. A. (1983). *Stait-Trait Anxiety Inventory for Adults: Sampler Set. Manual, Instrument and Scoring Guide*. Menlo Park, CA: Mind Garden, Inc. [Google Scholar]

40. Spielberger C. D., Vagg P. R., Barker L. R., Donham G. W., Westberry L. G. (1980). The factor structure of the state-trait anxiety inventory, in *Stress and Anxiety.* Vol. 7, eds Sarason I. G., Spielberger C. D. (New York, NY: Hemisphere/Wiley;), 95–109. [Google Scholar]

41. Strickhouser J. E., Zell E., Krizan Z. (2017). Does personality predict health and well-being? A metasynthesis. *Health Psychol.* 36, 797–810. 10.1037/hea0000475 [PubMed] [CrossRef] [Google Scholar]

42. Terman L. M. (1956). *Concept Mastery Test*. New York, NY: Psychological Corporation. [Google Scholar]

43. Toyoshima K., Fukui H., Kuda K. (2011). Piano playing reduces stress more than other creative art activities. *Int. J. Music Educ.* 29, 257–263. 10.1177/0255761411408505 [CrossRef] [Google Scholar]

44. Van Lith T., Schofield M. J., Fenner P. (2013). Identifying the evidence-base for art-based practices and their potential benefit for mental health recovery: a critical review. *Disabil. Rehabil.* 35, 1309–1323. 10.3109/09638288.2012.732188 [PubMed] [CrossRef] [Google Scholar]

45. Wang X., Li Y., Fan H. (2019). The associations between screen time-based sedentary behavior and depression: a systematic review and meta-analysis. *BMC Public Health* 19:1524. 10.1186/s12889-019-7904-9 [PMC free article] [PubMed] [CrossRef] [Google Scholar]

46. Wilson C. (2020, March 24). The race to write the coronavirus anthem is on. Slate. Available online at: https://slate.com/culture/2020/03/best-coronavirus-songs-spotify-playlist-cardi-b-psychs.html (accessed December 18, 2020).

47. Wolfradt U., Pretz J. E. (2001). Individual differences in creativity: personality, story writing, and hobbies. *Eur. J. Pers.* 15, 297–310. 10.1002/per.409 [CrossRef] [Google Scholar]

48. Woods H. C., Scott H. (2016). #Sleepyteens: social media use in adolescence is associated with poor sleep quality, anxiety, depression and low self-esteem. *J. Adolesc.* 51, 41–49. 10.1016/j.adolescence.2016.05.008 [PubMed] [CrossRef] [Google Scholar]

2.10 Figures

Figure 1
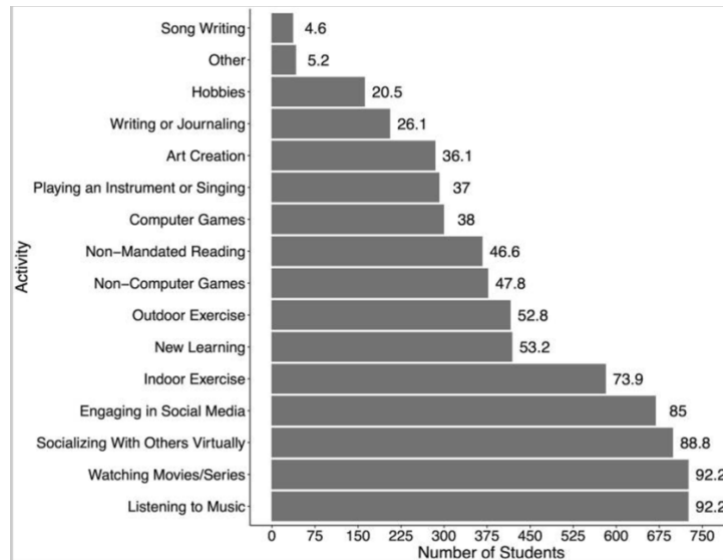
Number of students out of 786 who reported engaging in each extra-curricular activity. Numbers at the end of each bar indicate the % of students.

Figure 2
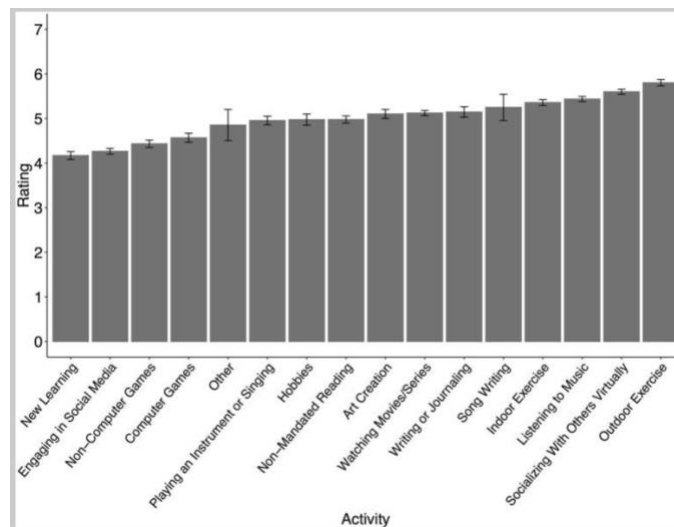
Percent of students out of 786 who reported engaging in each extra-curricular activity alone, with others in person or with others over the internet. Note that students could engage in a particular activity in more than one way.

Figure 3
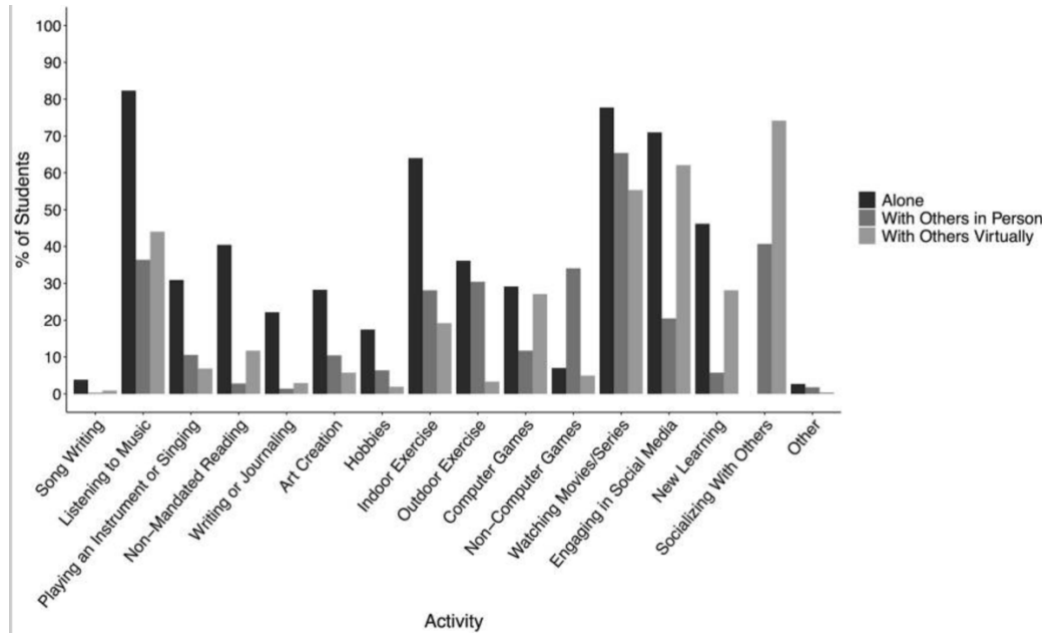
Mean ratings out of 7 for how helpful each extra-curricular activity was rated to be for well-being. Note that for each extra-curricular activity, only those students who reported engaging in the activity were included in the ratings for that activity. Error bars represent standard error.

Figure 4
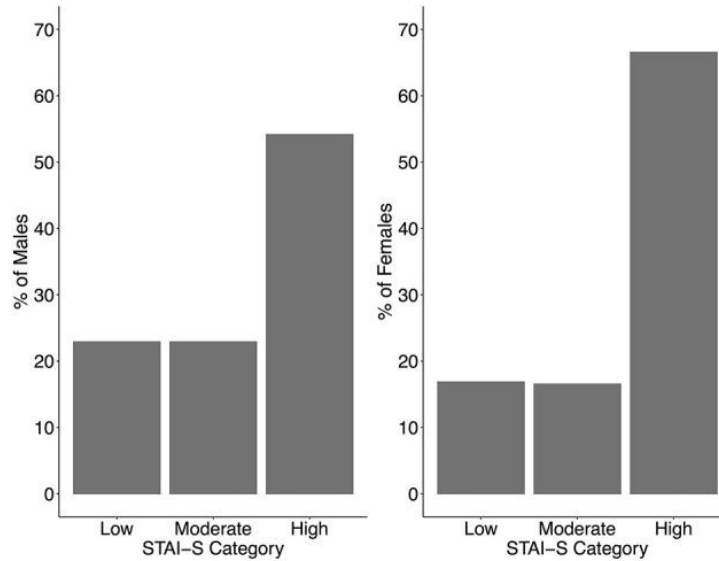
Percentage of males ($n = 144$; left panel) and females ($n = 634$; right panel) scoring in each category of the State Trait Anxiety Inventory—State subscale. Note: the students with gender other than male or female all scored in the High STAI-S category ($n = 4$).

Figure 5
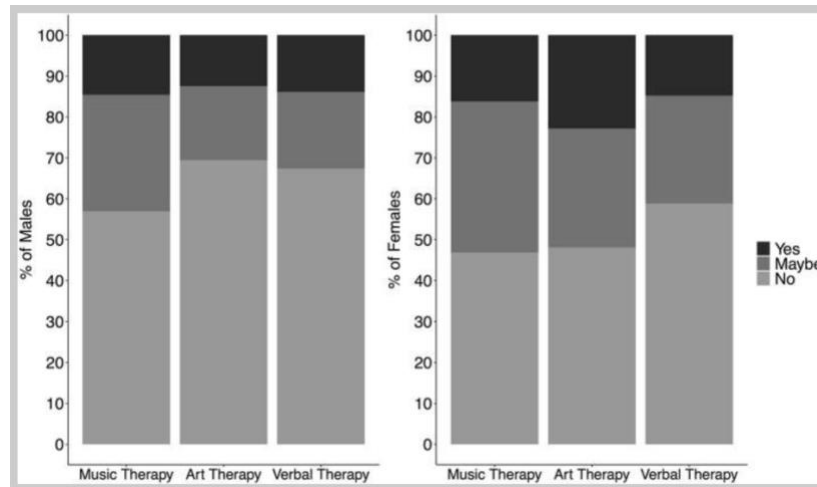
Percentage of males ($n = 144$; left panel) and females ($n = 634$; right panel) indicating if they were interested, maybe interested, or not interested in three types of drop-in online therapy: music, art, and verbal. Note that out of students with gender other than male or female ($n = 4$), 1 said No to Music Therapy, 3 said Yes to Music Therapy, 1 said No to Art Therapy, 3 said Yes to Art Therapy, 3 said No to Verbal Therapy, and 1 said Yes to Verbal Therapy).

2.11 Tables

Table 1

Effect of participating in each key activity on state anxiety scores (corrected *p*-values use Bonferroni correction for the 9 models examined).

Variable	Estimate	Std. error	*T*-value	*P*-value	Corrected *p*-value
Instrument playing and singing	0.45	0.91	0.05	0.96	N/A
Listening to music	−1.93	1.65	−1.17	0.24	N/A
Song writing	1.60	2.22	0.72	0.47	N/A
Social media	0.83	1.24	0.67	0.50	N/A
Movies/Series	−3.60	1.62	−2.22	0.027	0.24
Computer games	−1.75	0.95	−1.84	0.067	0.60
Outdoor exercise	−0.32	0.88	−0.36	0.72	N/A
Indoor exercise	−1.65	1.00	−1.65	0.099	0.891
Journaling	0.25	1.02	0.25	0.80	N/A

Table 2

Effects of participating alone or with others on state anxiety scores (with alone as the reference point; corrected *p*–values use Bonferroni correction for the 9 models examined).

Variable	Estimate	Std. error	*T*-value	*P*-value	Bonferroni corrected *p*-value
Instrument playing and singing	−2.97	1.55	−1.92	0.056	0.50
Listening to music	0.11	1.04	0.11	0.92	N/A
Song writing	−1.41	5.72	−0.25	0.81	N/A
Social media	−1.76	1.21	−1.45	0.15	N/A
Movies and TV series	02.17	1.50	−1.45	0.15	N/A
Computer games	−4.97	1.86	−2.67	0.0080	0.072
Outdoor exercise	0.31	1.35	0.23	0.82	N/A
Indoor EXERCISE	−2.84	1.07	−2.66	0.0080	0.072
Journaling	0.67	2.81	0.24	0.81	N/A

Table 3

The effect of students' ratings of how effective key activities were on their well-being as predictors of STAI–S scores (corrected p-values use Bonferroni correction for the 9 models examined).

Variable	Estimate	Std. error	T-value	P-value	Corrected p-value
Instrument playing and singing	−0.72	0.44	−1.62	0.11	0.99
Listening to music	−0.32	0.30	−1.07	0.28	N/A
Song writing	−0.33	1.38	−0.24	0.81	N/A
Social media	−0.90	0.24	−3.72	0.00021	0.0019
Movies and TV series	−0.26	0.30	−0.86	0.39	N/A
Computer games	−0.57	0.42	−1.37	0.17	N/A
Outdoor exercise	−1.40	0.41	−3.39	0.00078	0.0070
Indoor exercise	−1.41	0.32	−4.44	0.000011	0.0001
Journaling	−0.55	0.56	−0.97	0.33	N/A

Table 4

Example responses to the open-ended question falling into each of the three positive and three negative subthemes.

Subtheme	Example response
Positive impact on self-care	I am just trying to take care of myself. I enjoy listening to music and socializing with my family members, who I live at home with. It is such a tough time and trying to learn something new is what I have been doing—whether if it is a cool little fact or something new about myself as a person
Positive impact of engaging in activities	I started a couple of personal projects such as a video series and a story
Positive impact on attitude	Each day is a bit different, some are better and some are worse but I'm trying to stay optimistic. One really great thing about being home is that I can spend more time with family and on hobbies, but on the other hand, I really miss my friends and boyfriend.
Negative impact on studies	Exams have been insanely anxiety provoking and stressful after having been isolated and learning online.
Negative impact on well-being	I find it very hard to be motivated to do essentially anything. I stay in bed until 1 every day because I know that the day will be boring when I eventually get up.
Negative impact due to living arrangements	Difficult to be at home due to family issues, hard to be away from friends and other loved ones

2.12 Supplementary Materials

A. The complete survey given to students

EXTRA-CURRICULAR ACTIVITIES AND WELLNESS UNDER COVID-19
PRECAUTIONARY MEASURES

Purpose of the Study:
To gain insight into undergraduate students' engagement in extra-curricular activities and
their wellbeing under COVID-19 precautionary measures.
Description of the research: The COVID-19 precautionary measures implemented end of
day Friday March 13th resulted in student classes transitioning to on-line platforms,
cancellations of events and activities, social distancing and, for many, relocation of
accommodations. The data collected in this questionnaire will inform how McMaster
University can better support its students. You will be asked to complete a number of
questions that includes demographic and health questions, questions about your musical
background and your current extra-curricular activities. It should take approximately 30
minutes to complete.

Potential Risks:
There are no known harms associated with these procedures. You may choose to not
answer questions on the questionnaires if they make you feel uncomfortable. There is a
risk that someone else in the vicinity of your workspace or who has access to your
computer could see your responses; to minimize this risk, it is recommended that you
complete the questionnaire in a private place and clear your web browser's history after
submitting your responses.

Potential Benefits:
Completing the questionnaire will not benefit you directly, but the intent is that the study
will contribute to the development of meaningful supports for undergraduate students. If
you are enrolled in an appropriate course, you will be able to obtain course credit as
outlined in your course outline. After completing the study, you will have a choice to
participate in a draw for one of ten $50 prizes. Odds of winning the draw will depend on
how many people take part in the study. We expect about 500 participants in which case
the odds of winning should be about 1 in 50. Only winners will be contacted, and we
expect this to happen before the end of May, 31 2020.

Confidentiality:
Confidentiality will be respected and no information that discloses your identity will be
released or published without your consent, unless required by law (for example, laws
pertaining to the protection of vulnerable individuals including children). Data collected
by LimeSurvey is stored on secure servers at McMaster University. All data will remain
in Dr. Trainor's lab, stored in de-identified form for possible future analysis, until such
time as they are destroyed.

Participation:
Participation in research is voluntary. If you choose to participate, you can withdraw from the study at any time without prejudice, even after signing this form. In the case of withdrawal, all data will be destroyed unless you indicate otherwise.

Ethics Review:

This research has been approved by the McMaster Research Ethics Board (MREB). Participants with concerns or questions may contact the Ethics Secretariat, Research Office for Administration, Development and Support (ROADS), (905) 525-9140 ext. 23142, ethicsoffice@mcmaster.ca

Consent to Participate
I acknowledge that the research procedures have been explained to me and that any questions that I have asked have been answered to my satisfaction. I have been informed of the alternatives to participation in this study, including the right not to participate and the right to withdraw at any time without prejudice. As well, the potential harms and benefits of participating have been explained to me. I know that I may ask now, or in the future, any questions I have about the study or the research procedures. I have been assured that individual results will be kept confidential and that no information will be released or printed that would disclose my personal identity without my permission, unless required by law. Having read the above, I understand that by clicking the "Next" button below, I agree to take part in this study under the terms and conditions outlined in the accompanying letter of information.

There are 35 questions in this survey.

General Information

Please indicate your age.
• 18 or younger
• 19-20
• 21-22
• 23-24
• 25 or older

What is your gender:
• Male
• Female
• Prefer not to answer
• Prefer to self-describe

Please enter your comment here:

Are you a full-time student?
• Yes
• No

Are you an international student?
• Yes
• No

How many hours per week are you currently spending on your coursework?
• 1-5 hours
• 5-10 hours
• 10-15 hours
• More than 15 hours

If you are employed, how many hours per week do you currently work?
• 1-5 hours
• 5-10 hours
• 10-15 hours
• More than 15 hours

Under which faculty are you studying?
• Science
• Humanities
• Social Science
• Business
• Engineering
• Health Sciences

What are your current accommodations?
• Detached house
• Semi-detached house
• Apartment/Condominium
• One room rental in shared accommodation
• Other.
Please describe

Please enter your comment here:

Please indicate with whom you are sharing your accommodations:
• Parent(s)
• Sibling(s)
• Friend(s)
• Partner

• Child(ren)
• I am living alone
• Other

Please enter your comment here:

Have you ever been diagnosed with a neurological/psychological disorder?
• Yes
• No
• Prefer not to answer

Are you a McMaster University student?
• Yes
• If no, which university do you attend?

Please enter your comment here:

Which year of study will you complete in April 2020?
• Year 1
• Year 2
• Year 3
• Year 4
If other, please describe.

Please enter your comment here:

Have you always lived in Canada?
• Yes
• No
If not, where else have you lived?

Please enter your comment here:

Can you play any musical instruments? If yes, please indicate with which instruments you play (including singing) and the level of training achieved on each.

Comment here:
Instrument 1 Level of training
Instrument 2 Level of training
Instrument 3 Level of training

Extra-Curricular Activities

Which of the following activities have you engaged in since the COVID-19 precautionary measures were implemented March 16, 2020? Please select all that apply.
• Song writing
• Listening to music
• Non-mandated reading (includes audiobooks & podcasts)
• Writing or journaling
• Art creation
• Hobbies such as knitting or model building
• Indoor Exercise
• Outdoor Exercise
• Computer gaming
• Non-computer games (board games or cards)
• Watching movies/series
• Engaging in social media
• New learning (online courses, webinars etc.)
• Socializing with others (through social media or phone)
• Other (please specify)

Please enter your comment here:

Which of these activities have you engaged in alone? Please select all that apply.
• Song writing
• Listening to music
• Non-mandated reading (includes audiobooks & podcasts)
• Writing or journaling
• Art creation
• Hobbies such as knitting or model building
• Indoor Exercise
• Outdoor Exercise
• Computer gaming
• Non-computer games (board games or cards)
• Watching movies/series
• Engaging in social media
• New learning (online courses, webinars etc.)
• Socializing with others (through social media or phone)
• Other (please specify)

Please enter your comment here:

Which of these activities have you engaged in with those in self-isolation with you? Please select all that apply.
• Song writing
• Listening to music
• Non-mandated reading (includes audiobooks & podcasts)

• Writing or journaling
• Art creation
• Hobbies such as knitting or model building
• Indoor Exercise
• Outdoor Exercise
• Computer gaming
• Non-computer games (board games or cards)
• Watching movies/series
• Engaging in social media
• New learning (online courses, webinars etc.)
• Socializing with others (through social media or phone)
• Other (please specify)
Please enter your comment here:
Which of these activities have you engaged in socially using the internet? Please select all that apply.
• Song writing
• Listening to music
• Non-mandated reading (includes audiobooks & podcasts)
• Writing or journaling
• Art creation
• Hobbies such as knitting or model building
• Indoor Exercise
• Outdoor Exercise
• Computer gaming
• Non-computer games (board games or cards)
• Watching movies/series
• Engaging in social media
• New learning (online courses, webinars etc.)
• Socializing with others (through social media or phone)
• Other (please specify)

Please enter your comment here:

Which of these activities have you spent more time doing in comparison to before March 16? Please select all that apply.
• Song writing
• Listening to music
• Non-mandated reading (includes audiobooks & podcasts)
• Writing or journaling
• Art creation
• Hobbies such as knitting or model building
• Indoor Exercise
• Outdoor Exercise
• Computer gaming

• Non-computer games (board games or cards)
• Watching movies/series
• Engaging in social media
• New learning (online courses, webinars etc.)
• Socializing with others (through social media or phone)
• Other (please specify)

Please enter your comment here:

Which of the following do you feel have supported your overall well-being during the COVID-19 precautions?

Please rate each activity from 1 (Not at all) to 7 (Extremely)

Song writing
1 2 3 4 5 6 7
Listening to music
1 2 3 4 5 6 7
Non-mandated reading (includes audiobooks & podcasts)
1 2 3 4 5 6 7
Writing or journaling
1 2 3 4 5 6 7
Art creation
1 2 3 4 5 6 7
Hobbies such as knitting or model building
1 2 3 4 5 6 7
Indoor Exercise
1 2 3 4 5 6 7
Outdoor Exercise
1 2 3 4 5 6 7
Computer gaming
1 2 3 4 5 6 7
Non-computer games (board games or cards)
1 2 3 4 5 6 7
Watching movies/series
1 2 3 4 5 6 7
Engaging in social media
1 2 3 4 5 6 7
New learning (online courses, webinars etc.)
1 2 3 4 5 6 7
Socializing with others (through social media or phone)
1 2 3 4 5 6 7
Other (please specify)
Please enter your comment here:

1 2 3 4 5 6 7

Please add any additional information that you feel confortable sharing about how you are coping at this time of change as a result of the COVID-19 pandemic.

Please comment here:

Music Background
Do you have any hearing difficulty?
• No
• Yes (please describe)
Please enter your comment here:

Do you play music professionally? If yes, please describe the situations in which you are paid to play. Please select all that apply.
• I do not play music professionally
• Performing
• Teaching
• Playing in bands or orchestra
• DJ
• Choir
• Other (please specify)

Please enter your comment here:

Can you play by ear? Playing or learning to play a piece of music by ear means you can do so by listening without the aid of printed material.
• Yes
• No

How many hours per week do you spend listening to music?
• None
• 1-10 hours
• 10-20 hours
• 20-30 hours
• 30+ hours

How closely do you pay attention when listening to music? Please rate from 1 (music is always background
only) to 5 (always pay close attention to music)
1 2 3 4 5

What styles of music do you listen to?
• Rock

• R&B
• Pop
• Broadway/Musicals
• Classical
• Traditional/Folk
• Rap
• Other (please specify

Please enter your comment here:

Do any of your immediate family members play a musical instrument?
• Yes
• No
Standardized questionnaire #1: TIPI (Big 5 short version)
Standardized questionnaire #2: STAI – S

Would you be interested in participating in an online music therapy group on a drop-in basis?
• Yes
• No
• Maybe

Would you be interested in participating in an online art therapy group on a drop-in basis?
• Yes
• No
• Maybe

Would you be interested in participating in an online verbal therapy group on a drop-in basis?
• Yes
• No
• Maybe

Which of the following supports (if any) have you accessed since March 13, 2020?
• McMaster Student Wellness Centre (if comfortable, please share which supports you have accessed)
Please enter your comment here:
• McMaster Open Circle (if comfortable, please share which supports you have accessed)

Please enter your comment here:
• Mental Health practitioner such as: psychotherapist, psychiatrist, social worker, counsellor.

Please enter your comment here:

• A telephone support line

Please enter your comment here:
• Other (please specify)

Please enter your comment here:

Thank you for your participation!
We hope that you are keeping well! Please click here for a list of wellness resources.
McMaster Student Supports.
If you are interested in (1) receiving a newsletter summarizing the results of this and other studies (2) information on potential online therapy drop in groups and/or (3) participating in the draw for one of ten $50 prizes, please click the button below.

Note that this will take you to another website so that your email will not be associated with the answers you gave on this questionnaire, which will remain anonymous.

B. The complete list of students' comments to the open-ended question "Please add any additional information that you feel comfortable sharing about how you are coping at this time of change as a result of the COVID-19 pandemic."

Positive Comments (73)

Self-Care (15)
1.Reading my old writings, going over my old drawings and thinking of the good days I can make after the pandemic is over.
2.I find myself organizing things that I've always meant to and never had the time for. Also, I find myself relaxing more and taking the time to sit down and enjoy meals.
3.By trying to maintain consistency in my day to day schedule.
4.I like to space out the time that I'm doing school work and time that I am engaging in other activities. Usually the night before, I'll try to plan at least one special thing to do so that each day seems exciting and unique!
5.I am also coping by paying more attention to my pets, as they provide me a sense of comfort.
6.Sleeping a lot, getting ready everyday such as brushing teeth and washing face, taking care of my health more than usual(taking vitamins)
7.Trying to set goals that are still reasonable to complete during the pandemic , like learn a new hobby, learning how to cook and eat healthier or trying to stay outside for multiple hours in a day.
Setting goals help keep me feeling optimistic and positive for the future
8.A healthy mindset, keeping one's self busy and self-awareness are key to stay positive during this tough time.
9.For me, I do my best to minimize my stress levels, and I think one of the best ways to do that is be wary of how much I use the computer and my phone. A lot of the news that

is currently circulating often makes me more upset and stressed. While I do stay informed about updates on the situation, I try to minimize my usage to socializing with others and asking others how they are doing instead

10. I've enjoyed it to some degree. Lots of time to spend at home and focus on my own skills and sense of self.

11. I am just trying to take care of my self. I enjoy listening to music and socializing with my family members, who I live at home with. It is such a tough time and trying to learn something new is what I have been doing -- whether if it is a cool little fact or something new about myself as a person

12. I make sure to check in weekly with my doctor in regards to my mental health

13. For me it was important to keep a schedule. Get up, make my bed and get changed as I would regularly

14. I think attempting to realize that I am having a hard time coping has helped. by not pushing my feelings aside and actually trying to focus on them to understand that I need to do something today besides studying to feel mentally healthier I have been getting better at coping with the negative emotions that comes with the pandemic.

15. Talking with my family about my feelings and thoughts about the pandemic, avoiding the news and virus information when not necessary (not harbouring fear)

Activities (40)

1.Cooking and learning how to make new foods is also something I've been doing.

2.I started a couple of personal projects such as a video series and a story

3.I think my environment has drastically impacted my time in isolation in a positive manner as I am able to push myself during this hard time in catching up with coursework alongside picking up new things and spending time with my family. In the past, I don't think I have spent as much family time as I am spending now amidst school and other commitments.

4.I am coping by Facetiming with my friends and my boyfriend. Me and my boyfriend watch Netflix together online at the same time by using a Google extension.

5.Been doing a lot of baking, lots of sleeping.

6.Being able to have more time for my faith has really improved my overall mood and wellness

7.Working out has helped a lot. Not only does it break up the day but it's also helped me mentally and physically feel better. Especially since social media usage has increased, body shaming and "ideal" beauty standards are more accessible and frequent than ever. So working out had made me feel like I'm making progress for myself which helps combat the negative feelings I get when scrolling through social media.

8. My parents have been teaching me how to cook quick meals and I have been meditating and learning to deal with anxiety and depression in healthy, proactive ways. I am grateful for this time to work on myself but also very worried. I feel I am taking the proper steps to create a productive second year for myself.

9. I feel great. I think it is a nice break, I have been sleeping better, eating better, and exercising more. I find peace and serenity in not having obligations of always being go go go between work, school, and other obligations. While sometimes feeling a little bored

and lonely, I am staying busy and honestly quite enjoying it

10. By praying and reading my Bible. Connecting with my church. Helping to raise funds for families who have lost their jobs.

11. I've been baking a lot of bread. It makes me feel like I have control over something, also I really missed bread.

12. Meditation, cleaning

13. Spending more time with family (i.e. those who I'm self-isolating with)

14. Sleep in a lot has been really good. More time to organize school work, not in in control of the virus but in control of what I'm doing and being organized, lots of cleaning.

15. Social media engagement with and without people (virtually or in person) has been a weird way of coping that I honestly don't know if it helps me or not. It feels like I used social media to fill my time and distract myself rather than actually cope with what's going on or how I'm feeling. I definitely have also been exercising more and it provides a little bit of structure and planning to my day that I need right now since everything is at home. I think I've discovered what might work for me more when dealing with stressful factors in my life in that I used to think singing or playing a musical instrument casually really helped me cope when things got rough. Now that I have more time at home I've learned that song-writer helps me way more because I'm preaching a message that is completely what I need at that moment.

16. I like making lists of things I should accomplish in a day so I don't end up wasting all my time on social media or surfing the web (too much screen time makes me depressed) My happiest moments during these times are when I can go outside and feel the sunshine (I live in rural area so we have lots of space). I love working in our gardens J

17. Spending more time with family and making my dad watch my favourite movie series with me as a form of bonding time

18. Self-reflection through journaling in the midst of everything truly allows me to focus better on myself, the world and see what's important in life. Truly got to reflect on the meaning of life.

19. The only way I'm keeping sane is because I get to go out and work, otherwise my situation would be worse.

20. Keeping in contact and checking up on friends constantly

21. Since I am an international student, I am always have video call with my mom and grandparents. They already been through the self isolation, therefore they knew how I feel right now, so my mom will call me every morning and evening, I share what I did for a day, what I cook today and so on. For me try to contact with your family and your friends!

22. Cooking new recipes with music

23. Finding resources to not be behind in my plans for work, research, graduate and med applications; since limited professor accommodation has resulted from this mainly studying all day.

24. Finding time to exercise and spending time on social media has helped me focus on happier things during the pandemic.

25. Sleeping 9 hours per day

26. Making new recipes!

27. Watching the news
28. Cooking and baking is really a awesome way to kill time
29. Cooking
30. It's important to stay connected with friends and family and get some fresh air!
31. Caring for animals has helped me
32. Trying to do activities that engage my siblings and parents as well as myself to have more social interaction throughout the day. Also, trying to keep a somewhat regular daily routine has been helpful in making the days feel more normal.
33. Spending time in the outdoors
34. Since it is currently exam season, I am using more time to study as I am still in my student house. Once exams are over I feel like my habits in quarantine will change to include more exercise and hobbies.
35. Cooking more
36. According to my Nintendo Switch I have spent 95+ hours playing animal crossing and I only got it on March 31, if that gives any indication of how bored I've been. I also work full time from home (40 hrs/wk) as I am on an internship.
37. I have provided myself with a long-term goal of running a marathon that I can begin during the pandemic but can be completed even once the pandemic is over. This gives me some type of routine.
38. Honestly, I don't mind staying at home in quarantine. I have lots of things to do in the house including baking, cooking, painting, catching up with my friends through social media, and watching movies. Ever since the quarantine was announced, I have done a lot of things at home that I never had time to do in the past.
39. Reading has been a great relief to me and I am very happy to get to since I love it and don't get to very often (because of school/ work/ other commitments)
40. I am just hanging out a lot. I have done lots of cleaning and organizing and am trying to find things to keep me busy since I am someone that needs to constantly be doing something.

Positive Attitude (18)
1. I think the most helpful thing is to know that we're all in this together.
2. Doing anything to engage your entire focus so that you forget about the pandemic for a while. Realizing how many things we can still do instead of focusing on all of the restrictions.
3. Each day is a bit different, some are better and some are worse but I'm trying to stay optimistic. One really great thing about being home is that I can spend more time with family and on hobbies, but on the other hand, I really miss my friends and boyfriend.
4. I am actually doing really well in isolation. Albeit, I have my parents and a sister in the house with me, but I thrive in alone-time which is what this is. For the first week home I felt a little weird, but since then, I've been feeling really comfortable.
5. Surprisingly, my motivation for completing school work has increased since March. My grades are higher than the first semester, and the grades that I received after quarantine became are higher than other grades I received this term. I have never studied harder than I did for my final exams, and the grades displayed this. I believe

this is due to being closer to my family, the environment in Hamilton was becoming a bit tedious, I wasn't eating, I had trouble sleeping, I was experiencing many anxiety attacks and depressive spells which I was not used to. Being home allowed for some familiarity and some time for healing. After exams were completed I have been taking the time to become physically active and build back the muscle I lost, I have been increasing my appetite, and I have been creating a healthy sleep schedule.

6. Just try to be positive and hopeful that all will be normal again one day.

7. I'm worried about the situation in the world, but I'm enjoying this time myself. I'm an introvert, so having more time to myself helps a lot. I have more time to focus on the things I enjoy.

8. Taking it as a mental health break, working on my health

9. One day at a time

10. Knowing that by self isolating I am not increasing the risk of anyone else getting sick.

11. I'm coping by staying positive and looking at the bigger picture, that the best thing to do is to follow the rules so we can keep everyone safe. And that this too shall end. I spend a lot of time talking to my friends who are able to share the same feelings towards the insanity of our world right now and the adjustment/ difficulty to online learning. It helps to maintain the morale to know you're not alone.

12. I have the privilege of being able to work from home so my situation has not changed drastically. For the aspects that have changed, I don't stress over things that are out of my control. Control your immediate environment and make it somewhere you want to be for the time being.

13. Living day by day and trying to think about future big plans

14. It is always important to remember that not everyone has the same privilege of being at home with family during this pandemic. Even those that have a 'house' to be in do not necessarily have a safe 'home'. Thank you for doing this survey and gauging perceptions!

15. I'm doing pretty good, if it wasn't for school this is probably how I'd spend most of my time anyways.

16. I have been coping by staying in close contact with my friends and doing a lot of work for the MSU club I am leading along with others.

17. Once the emergency benefit money came through, I've been much more peaceful. I'm chronically ill and prefer working from home, yet without the stress of expectations to get to campus, I've been able to fully enjoy working from home and have finished my fourth year peacefully and with straight As.

18. But very thankful for Mcmaster postponing in person graduation ceremonies to a later date - it doesn't make the hard work of 4 years go to waste.

Negative Comments (78)

Negative Impact on Studies (24)
1. Teachers not giving proper help and activities make it very hard
2. It's not amazing. I definitely prefer not to live at home when it comes to my studies. Especially at a time like this where everyone is present within the house, things can get really tense. In addition, it's difficult to stick to a schedule which makes the days seem

pretty long and dreary. Everything sucks lol

3. I don't understand how one could be able to sustainably learn 5 courses online for an entire year. This is a great concern for me personally heading into next year. Things have been very overwhelming lately. My thesis supervisor cancelled my placement due to COVID-19, I'm switching programs, it's my final year in university, and everything seems like it's all crashing down, and I'm feeling so helpless about everything around me.

4. Exams have been insanely anxiety provoking and stressful after having been isolated and learning online.

5. I worry that because of the financial repercussions of this pandemic, University will be a short- lived experience for myself and many others.

6. I appreciate how fair and accommodating some coordinators and departments have been through all of this (s/o to Stephen Russells, Sara Cormier, and Michelle Cadieux), but then it kind of sucks to see other departments placing restrictions on exams that seem unfair (e.g. not

being able to go back to a question and change your answer). I understand that it's hard for them to ensure academic dishonesty doesn't occur, but I wish there was a better way of doing it.

7. School work is difficult to get motivated to do.

8. Lack of routine makes me restless and anxious. I can't figure out what I should be doing. With school still going any time I relax or try and do art or music I feel guilty. I'm hoping this fades

as my exams end. I get upset that I spend all day on my phone (tiktok drew) and try and self regulate but lack the motivation and energy to encourage myself to do more tasks etc

9. It's kind of hard losing the routine that in-person classes gave you. Once you don't have a structure anymore, it's really up to you to keep it together. Which can be hard depending on your family life (if you stay at home/move back home), or the situations you face. I believe everyone faces hardships in one form or another, and it may get amplified during these times.

10. It is very strange to be finishing my undergrad at home. I feel like I'm in limbo a bit, with no certain end and no closure on school. I don't have a job yet.

11. Hard to do anything other than school because school takes longer to do when there are so many people around

12. Initially, was a blow to routine schedule which did not help with all the other upheaval that happened this year. Has settled into a new normal.

13. I'm not because I have so much stuff to study. Honestly, I'm not coping. I am not sure why the school keeps thinking we are. Every single professor did not feel compassion at all, and instead asked for more things to be done. Even during a pandemic, they have chosen to show us that

school and education is more important than our family time and our coping time.

14. The unfortunate aspect about the COVID-19 pandemic is that it caused us to quarantine and self-isolate during a time when most of my courses were teaching material that was to be covered on exams (e.g. my CHEM 1AA3 class was going over the organic chemistry unit, which was covered extensively on the exam). Because things were so dramatically online, it disrupted a lot of learning that was important. Additionally, I

personally felt that moving out of residence and going back home was very stressful and challenging, both on my academics and on my mental well-being. A lot of us, myself included, don't have proper access to internet or a quiet space to study and work. Living on residence was what allowed me to really focus on myself and my work, and I was not happy that the university decided to make us move out especially at a time when exam preparations were underway. Additionally, the financial costs associated with this pandemic have been pretty stressful too.

15. School has been really stressful. The shift to online tests has resulted in a mark drop for me because I've felt that the rests are now harder. Also having more trouble focusing and studying and being productive. Constantly feeling tired, just want to sleep. And rest.

16. Just finding things to occupy myself with around the house and searching random stuff on the internet. Also trying to use this time to plan my future, as I am stressed that no standardized tests for DAT or OAT or MCAT are taking place, which I had planned to study for and write this summer.

17. I found it extremely difficult to keep up with assignments throughout March and the beginning of April. It was also difficult not being able to study in a quiet environment or at the library.

18. Really badly, I couldn't cope because of the sudden changes and so many things have been shifted in my life that I couldn't even keep with school and failed academically. I ended up being more stressed, depressed and hopeless.

19. Some of my professors at McMaster have been absolutely atrocious and extremely unaccommodating with all that is in mind leading to deteriorating mental health and unnecessary struggling. On the other hand, some professors have been showing a copious amount of understanding and empathy while maintaining an adequate and not too lenient system for science courses.

20. I definetly feel that profs needed to work out the marking scheme in a better way. Many Universities offered the option of mark freezing, which would have been extremely helpful

21. My home environment is not exactly suitable for 10h studying a day for exams, so professors needed to have supported students and understand the mark on their exams may not reflect the student. Exams have been insanely anxiety provoking and stressful after having been isolated and learning online.

22. online school sucks, I usually have a lot of motivation to study for exams, but I feel drained constantly and am always distracted

23. a lot of wasted time on social media, all my time goes to studying for exams

24. studying is harder as home is not a library, but oh well

Negative Impact on Well-being (45)

1. Schoolwork is difficult to get motivated to do, also not having an ideal living situation severely impacts how isolation is going

2. I find it very hard to be motivated to do essentially anything. I stay in bed until 1 every day because I know that the day will be boring when i eventually get up.

3. I've been coping alright, but I've lost a lot of motivation. It usually comes in waves.

4. My social media use has dramatically increased since I'm not occupied by attending lectures or visiting the library to study. As a result, my procrastination has also increased dramatically. This honestly causes me a lot of anxiety because I've been running out of time and haven't been able to put my normal effort into my studies (which is still my fault, but when you're trapped inside, it's difficult to ignore the freedom that the internet offers).

5. I've been sleeping a lot more often than I usually would. Honestly feel like the only reason I do that is to make the days pass quicker.

6. The pandemic really affected my motivation level and mood. Even though we have a lot more time to get work done, it is a lot harder to get the motivation to actually sit down and be productive. Moreover, it really impacted my sleep schedule.

7. I believe anti-depressants are probably helping a lot in addition to the self-care and exercise I have been participating in as I am coping. However, the changes to the world/lifestyle and anxieties about the pandemic have seemed to worsen psychological symptoms.

8. Hard to cope, tougher if you have mild depression, studying is harder as home is not a library, but oh well

9. Phone calls with therapist

10. I'm having a really difficult time. Living with my mental illness is so much more difficult in the present circumstances. I know were all in this "together" but it doesn't feel like that when you're separated from the people who support you and all of your coping strategies are either stretched thin or unavailable.

11. Loss of personal connection, last year of undergraduate completely changed.

12. taking lorazepam

13. Everything is so awful right now. I already have depression that makes it extremely difficult to do my work and now I am still expected to function at a high level? I wasn't functioning before the pandemic.

14. The pandemic has caused me to feel extremely trapped and hopeless for the future. I struggle with my mental health and the current situation has caused me to regress to a state that took 6 years of intense psychotherapy and pharmaceutical intervention to manage. Mundane tasks, such as picking up my prescriptions or visiting the doctor, have become increasingly difficult and impossible. The lack of a definitive endpoint for all of this has caused me the most stress. I recognize that this situation has been difficult for everyone and I hope that the government, large corporations, and academic institutions will approach post-COVID-19 life with compassion, patience, and generosity

15. Not coping at all

16. Nothing it sucks and makes my depression awful

17. It is particularly hard not seeing my friends from school every day. It was hard knowing I didn't get to wish them the best…even though we are keeping in touch virtually.

18. I work full time as I am on internship. I am currently working from home and that takes up most of my weekdays. I also play a lot of animal crossing, go on Tiktok (which I only downloaded after quarantine as a desperate measure to combat my

boredom) and FaceTiming loved ones

19. I am doing alright – as an introverted person, life has not changed too much for me. But I hope that this can all end soon, because as much as I do enjoy spending time alone, I really do miss my school friends.

20. Difficult to be at home due to family issues, hard to be away from friends and other loved ones

21. At times, I feel quite lonely from staying at home for so long.

22. Working full time keeps you busy, without that I would be bored at home.

23. I am very bad at communication using a phone and prefer in person interaction and communication, so it has been difficult for me to adjust in that way.

24. One really great thing about being home is that I can spend more time with family and on hobbies, but on the other hand, I really miss my friends and boyfriend.

25. According to my Nintendo Switch I have spent 95+ hours playing animal crossing and I only got it on March 31, if that gives any indication of how bored I've been. I also work full time from home (40 hrs/wk) as I am on an internship.

26. I feel a constant sense of worry about how coronavirus will affect the people around me and my future. I also miss seeing my friends and family in real life and being able to do activities with them.

27. I am bored and have a lot of time to just sit and think. I don't get sad, it's just hard to sleep sometimes.

28. I basically masturbate 2000 times a day which is pretty much toxic. Being lonely literally drives me sad and I realized that life is actually fairly short!!!

29. I live in a house with other people but I have separate entrance and do not know them, so have been feeling very lonely especially when I see other people spending time and doing activities with roommates or housemates. I usually enjoy living alone and it works for me but being self-isolated by myself has been difficult as I have no in person interaction anymore, only online.

30. Social media engagement with and without people (virtually or in person) has been a weird way of coping that I honestly don't know if it helps me or not. It feels like I used social media to fill my time and distract myself rather than actually cope with what's going on or how I'm feeling.

31. I will sometimes just call a friend and leave them on a video call, buy we won't talk much. I have to live in student housing still because my wifi at home is not strong enough to support our whole family using it. It gets very lonely, so video calls are necessary for me to stay well.

32. It's a very difficult time to not live with my partner. Especially when they are a front line worker and I am stuck at home worried.

33. I am super fortunate that my boyfriend and I moved in together in February so we ended up being in isolation together otherwise I don't know if we would be seeing each other. I do miss my family and I truly appreciate talking on the phone with them.

34. The abundance of sleep and the lost sense of time adds to the lack of reality and realization of current events.

35. Just worried about how much longer we have to wait during this pandemic.

36. My social media use has dramatically increased since I'm not occupied by attending

lectures or visiting the library to study. As a result, my procrastination has also increased dramatically. This honestly causes me a lot of anxiety because I've been running out of time and haven't been able to put my normal effort into my studies (which is still my fault, but when you're trapped inside, it's difficult to ignore the freedom that the internet offers).

37. I feel a constant sense of worry about how coronavirus will affect the people around me and my future. I also miss seeing my friends and family in real life and being able to do activities with them.

38. Just stressed out about the fall term will look and if I will be able to work this summer.

39. Exams have been insanely anxiety provoking and stressful after having been isolated and learning online.

40. It's a very difficult time to not live with my partner. Especially when they are a front line worker and I am stuck at home worried.

41. This has severely affected both my mental and physical health. I need exercise (gym) to manage my mood and I have not been able to work out the way I like throughout this pandemic. In my free time I enjoy seeing live music with my friends but I have not been able to do that since the first week of March. I have now finished exams but I am not able to work due to the pandemic. I am currently living at home with my family, but I still have an apartment in Hamilton that I am responsible for. The recent announcement about funding for students will not cover my schooling, rent, utilities, food, etc. The money that I make during the summer has to last me through the entire school year. As the government funding is much less than what I usually make per month in the summer (I have been working at the same job for 4 years and I have been promoted/given a raise) I am extremely concerned about my financial situation in the fall. Additionally, I am concerned that I will not be able to take certain required courses in the fall (experimental learning/community engagement courses) and I will have to defer my graduation to the following academic year.

42. I want to go to the grocery store without fear

43. Lack of routine makes me restless and anxious.

44. It's been stressful and boring but we all have to do our part for this to be over :)

45. It has been extremely difficult not being able to go outside but I am trying my best to cope especially with financial strains.

Negative Due to Living Arrangements (9)
1. Also not having an ideal living situation severely impacts how isolation is going
2. Difficult to be at home due to family issues, hard to be away from friends and other loved ones
3. Due to COVID, my parents got me to move back in with them. I love them, but living with them definitely has a negative impact on my wellness.
4. It is always important to remember that not everyone has the same privilege of being at home with family during this pandemic. Even those that have a 'house' to be in do not necessarily have a safe 'home'. Thank you for doing this survey and gauging perceptions! I am feeling quite restless at home and it is difficult to stay productive

here.

5. I am not coping well, being in forced close proximity with my family and previously my roommates has caused my relationships with them to shift. My mental health has suffered a sharp decline.

6. Being isolated with one person this whole time has caused my mental health to deteriorate so rapidly, I don't know if I can come out of this sane.

7. It has been stressful, always being home, getting in each other's way… generally, my family tries to keep out of each other's way. When we come together, we enjoy each other's company, but we don't push it.

8. I live in a house with other people but I have separate entrance and do not know them, so have been feeling very lonely especially when I see other people spending time and doing activities with roommates or housemates. I usually enjoy living alone and it works for me but being self-isolated by myself has been difficult as I have no in person interaction anymore, only online.

9. I will sometimes just call a friend and leave them on a video call, buy we won't talk much. I have to live in student housing still because my wifi at home is not strong enough to support our whole family using it. It gets very lonely, so video calls are necessary for me to stay well.

Chapter 3

Online group music therapy: proactive management of undergraduate students' stress and anxiety

Finnerty, R., McWeeny, S., & Trainor, L. (2023). Online group music therapy: Proactive management of undergraduate students' stress and anxiety. *Frontiers in Psychiatry*, *14*. https://doi.org/10.3389/fpsyt.2023.1183311

3.1 Preface

In Chapter 3, I present a published randomized controlled trial conducted to investigate the effectiveness of online group music therapy to proactively manage undergraduate students' stress and anxiety. Recognizing that students are proactively engaging in music activities to cope with stress and are interested in participating in music therapy (Chapter 2), music therapy could be a viable option to offer students on campus to proactively manage stress and anxiety. There is a paucity of research about the effectiveness of music therapy with individuals without a diagnosis or who are not experiencing a mental health crisis. The research in Chapter 3 investigates the effectiveness of providing music therapy on campus as a standard of care. This is

important as providing choices for students beyond verbal-based therapies could improve help-seeking behaviours, and ultimately reduce the wait list of students experiencing a crisis. This study was originally designed to be delivered as in-person group music therapy on campus. As a result of the COVID-19 pandemic restrictions, the research study transitioned to online delivery, providing the first study to collect data about on-line group music therapy with undergraduate university students. Online therapies are cost-effective due to the lack of infrastructure required, and more accessible for students.

3.2 Abstract

In alignment with the World Health Organization's (WHO) goal to provide comprehensive and integrated mental health services in community-based settings, this randomized control trial explored the efficacy of online group music therapy as a proactive intervention for reducing stress and anxiety in university students who do not necessarily have a diagnosis.

3.3   Introduction

Despite research demonstrating the role of high stress in adverse health outcomes, including decreased mental and physical health (1–4), and despite anxiety remaining the main concern among students in counseling (5), proactive stress and anxiety reduction are not at the forefront of health care interventions. Research in relation to stress and anxiety predominantly focuses on interventions for individuals in crisis, as opposed to proactive measures to prevent acute and chronic experiences of stress and anxiety. Preventative strategies for undergraduate students are paramount considering that the highest levels of anxiety (33.5%) and depression (27.7%) are observed among younger Canadians (15–39

years of age) in comparison to other age groups (6), with suicide ranking the second

leading cause of death among young Canadians (7), and the fourth leading cause of death

among youth (15–29 years of age) globally (8). A longitudinal study of over 10,000

students from 15 different universities across Canada reported high student stress over the

course of the 2020–2021 academic year which aligned with the COVID-19 pandemic (9).

Student support services switched to online platforms as a result of the COVID-19

restrictions, which has led to a more permanent shift in thinking about methods of health

care provision; the demand for online interventions is expected to continue (10). The

present research explored the efficacy of online group music therapy in comparison to the

standard of care (online verbal group therapy) and to a no-intervention control group. We

predicted that online group music therapy would provide students with a positively

stigmatized alternative for support, as engaging in music was reported as a common

activity for self-support by university students during the COVID-19 pandemic (11).

Recognizing that elevated stress among university students has been associated with

anxiety and depression (12, 13) shifting the focus to stress prevention could lead to a

reduction in anxiety and depression. A meta-analysis reviewing proactive measures of

cognitive, behavioral, and mindfulness-based interventions supports this idea (14). Arts-

based interventions were explored in this meta-analysis, but there were not enough data

on these interventions to be included in the analysis. Without meaningful data, arts-based

therapies (e.g., music therapy) cannot be proposed with confidence, further highlighting

the need for research in this area. An advantage of music therapy is that it is likely to be

less negatively stigmatized because engaging in music is typically considered to be a

healthy activity and is not associated with being mentally ill ([15](#)–[17](#)). This is important as more than 75% of students experiencing significant psychological distress do not seek support as a result of negative stigma ([18](#)).

Music therapy initially developed as a health care profession in the 1950s in the USA in response to soldiers experiencing post-traumatic stress disorder ([19](#)). The Canadian Association of Music Therapy was established in 1974 as the national professional body that sets the standards and qualifications for music therapists in Canada. Music therapists use music purposely within a therapeutic relationship to support health care goals for all age groups and diagnoses including dementia care, neonatal intensive care, autism, mental illness, and perioperative care. Systematic reviews report positive findings as a result of engaging in music therapy, such as improved verbal fluency, reduced anxiety, reduced depression, reduced pain perception, improved psychosocial measures, and improved motivation for treatment, while also recognizing the need for clinical trials with larger sample sizes, appropriate experimental methodology, and objective measurements of treatment effectiveness in order to substantiate these claims ([20](#)–[25](#)).

Despite music therapists working with diverse age groups and diagnoses, only three studies have been published to date on the effects of music therapy with university or college students ([26](#)–[28](#)). Each of these studies reported on the benefits of engaging in music therapy to treat a clinical symptom or developmental difficulty; however, only one of the studies implemented a randomized controlled trial (RCT) design ([27](#)) and none included a physiological measure. To our knowledge, no music therapy studies have been

conducted with a non-clinical population such as university students, who are likely to experience stress and anxiety. The present study was directed at all undergraduate students, as opposed to only those in crisis or with a diagnosis, thereby investigating the effects of proactive rather than reactive support for stress and anxiety.

Proactive or preventive interventions may be helpful in curbing the increasing numbers of students experiencing a crisis. A meta-analysis of clinical control trials and random control trials exploring the effects of music therapy on both physiological and psychological stress-related outcomes observed a medium to large effect of music therapy on stress related outcomes (29), and highlighted a larger effect for group compared to individual music therapy. Prior to the COVID-19 pandemic, research reporting on the online delivery of music therapy was limited to military veterans (30–32) and adolescents (33, 34). Although the COVID-19 pandemic forced music therapists to shift to online platforms (35), research on the efficacy of this delivery mode since the start of the COVID-19 pandemic remains limited to children and adolescents with visual impairments (36), dementia care (37), and student refugees (27).

In the present online music therapy study, a community music therapy approach was used that takes into account the larger cultural, institutional, and social context of the participants (38). Specifically, this approach aims to reframe participants' preconceived notions about engaging in mental health supports within campus culture. Recruitment posters advocated for proactive wellness and engaging in online group therapy; and students participating in the therapy groups were presented with the opportunity to recognize that it is normal to experience stress or anxiety, and that it is *ok* to engage in

support. The community music therapy approach does not require an intake form, an assessment, or a treatment plan.

The present RCT reports on the first application of online music therapy for proactive wellness with undergraduate university students. The study took place during COVID-19 lockdowns when university classes had transitioned to online. It aimed to explore the efficacy of online group music therapy as a proactive intervention for undergraduate students' stress and anxiety in comparison to the standard of care (online verbal group therapy) and no intervention. More specifically, this research asked two main questions.

Question 1: *Does participating in a 45-min online group music therapy session reduce stress and anxiety from pre- to post-session in comparison to the corresponding standard of care (online verbal therapy)?*

We hypothesized that significant reductions in stress and anxiety measures would be observed pre- to post-sessions for all therapy groups and that the reductions would not differ significantly between therapy groups. To test our hypotheses, we asked participants in both music therapy groups and the verbal therapy group to complete the State-Trait-Anxiety Inventory, State version (STAI-S), to rate their stress on a five-point Likert scale (Likert Stress), and to record their heart rate variability (HRV) from an app on their phone before and after each online group therapy session. Collecting measures before and after each therapy session provides information about the immediate effects of the intervention on stress and anxiety. This is important as experiencing low levels of stress, even for a short period of time, can have benefits (39). HRV was collected as a physiological

measure of autonomic nervous system (ANS) function (40). Greater HRV is associated

with increased ability to rapidly cope with uncertain and changing environments (41).

However, a comprehensive review of the effects of psychotherapeutic interventions on

the hypothalamic pituitary adrenal axis (HPA) and ANS regulation in adult samples with

mental disorders reported inconclusive results (42). Here we examined whether HRV was

sensitive to potential effects of online group music therapy.

Question 2: *Does participating in 6 weeks of weekly online group music therapy sessions*

reduce stress in comparison to the corresponding standard of care (online verbal

therapy) and a no-intervention control group?

     We hypothesized that reductions in stress measures would be observed from week

1 to week 6 for all three therapy groups with no difference in outcomes between the

music therapy groups and the standard of care, and that music therapy would result in a

reduction in stress in comparison to the control group. To test our hypotheses, we asked

participants in both music therapy groups, the verbal therapy group, and the control group

to complete the Perceived Stress Scale (PSS), and to mail in a hair sample for cortisol

analysis, in both week 1 and week 6. A previous systematic review of RCTs exploring the

effects of music interventions on cortisol revealed that only one music therapy study has

measured cortisol before and after an intervention, and it was done via saliva (43).

However, the results specific to the music therapy group were not reported due to the

small sample size (44). Because cortisol from hair samples reflects total HPA activity in

the preceding months and is more stable than saliva or blood samples that are affected by

circadian rhythms and day-to-day fluctuations (45), in the present study, hair samples

were collected in weeks 1 and 6 to provide retrospective information about participant HPA activity. Collecting cortisol and the PSS measure in weeks 1 and 6 provided information about the longer-term effects of engaging in 6 weeks of weekly online group therapy interventions.

In addition to the main outcome measures, we examined several variables that might potentially moderate the results. In addition to demographic data, these variables included personality traits, musical sophistication, and changes in quality of life over the 6-week period of the study. It is important to examine personality traits, as a meta-analysis showed that personality traits can moderate therapy outcomes (46). Regarding musical sophistication, while there is ample evidence that music can positively affect mental health (47), it is unclear if music sophistication moderates the degree of benefit, or a person's response to music therapy in comparison to verbal therapy. Changes in quality of life cannot be controlled in a naturalistic setting, but it is important to try to account for any adverse or positive experiences of a physical, psychological, social, or environmental nature that might impact the effects of the therapy. This was particularly important for the present study as many students experienced turmoil as pandemic restrictions were continually changing.

As the objectives of the therapy groups were to proactively manage stress and anxiety, we predicted that a significant reduction in stress and anxiety would be observed across outcome measures in all of the online therapy groups pre- and post- each online therapy session (measured by STAI-S, Likert stress, and HRV), as well as an overall reduction in stress between week 1 and week 6 (measured by PSS and cortisol). We also

expected that online group music therapy would be as effective as the standard of care (online verbal therapy) and that all therapies would be more effective than the no-intervention control.

3.4   Materials and Methods

3.4.1 Overall study design

A randomized control trial, pretest–posttest study design with four groups was approved by the Hamilton Integrated Research Ethics Board (project #11376). The groups were: (1) online active music therapy group, (2) online receptive music therapy group, (3) online verbal based therapy group (standard of care), and (4) no-intervention control. The study included five blocks and all blocks were completed between September 2020 and February 2022. Each block included all four groups. Within each block, each of the three therapy groups participated in a 45-min therapy session every week for 6 weeks (with the exception of Block 1, which ran for 5 weeks due to a conflict with the exam schedule). Measures of stress and anxiety were taken pre and post each therapy session for each individual in each of the three therapy groups. Measures of stress and cortisol hair samples were taken pre and post the 6 weeks of the study protocol for each individual in all four groups in all five blocks (see details below).

3.4.2 Participants

Participants were full-time undergraduate students, aged 18–24 ($M = 20$ years old), at a Canadian university who agreed to adhere to the therapy group guidelines (Supplementary material 1). The study was originally designed with five different groups: (1) online active music therapy group, (2) online receptive music therapy group, (3)

online verbal therapy group, (4) wait-listed group, and (5) no-intervention control group. Due to challenges recruiting participants during the COVID-19 pandemic, the waitlist group was removed from the study. Groups were to be run with weekly sessions for 6 weeks, with 10 participants per group. Thus, a block of the four concurrent group types was designed to consist of 40 participants. Four blocks were run in an attempt to achieve the desired sample size.

Power analyses were conducted using G*Power version 3.1 (48). To test whether stress and anxiety reduced from pre- to post-session, 80% power for detecting a medium effect ($d = 0.5$), at a significance criterion of $\alpha = 0.05$, was reached at $N = 41$ for a one-tailed paired t-test. To test whether state anxiety and stress reductions differed across the therapy and control groups, 80% power for detecting a medium effect ($f = 0.25$), at a significance criterion of $\alpha = 0.05$, was reached at $N = 159$ for a one-way ANOVA.

To achieve the desired sample of $n = 160$ (40 per block), four blocks were required. To capture student experiences across the school year, the study blocks were run in each of the four semesters. A total of 150 students provided consent to participate in the study, but only 110 students responded to the follow-up emails with questionnaires. The 110 students were randomly assigned to a therapy group or the control group. Students were evenly assigned to the different groups, but as a result of attrition, 84 students (15 males) completed the study: Receptive Music Therapy ($n = 28$), Active Music Therapy ($n = 18$), Verbal Therapy ($n = 18$), Control ($n = 20$). On average, students in the Music Therapy groups attended 77.5% of the online therapy sessions and students in the Verbal Therapy groups attended 71.0% of the online therapy sessions.

Demographically, students from all university Faculties were represented, but most students were in the Faculty of Science (56%). A total of 72/84 students self-described their ethnicity, broadly reporting: 32 Asian, 14 White, 6 African, 6 European, 6 cross-continent, 6 North American, 1 Caribbean, and 1 Jewish (more specific self-descriptions are presented in Supplementary material 2). Ethnicity was not used in the analysis and is presented to characterize the sample.

3.4.3 Procedure

A recruitment poster and recruitment email were circulated via social media platforms and email prior to each 6-week block. Students who responded to the recruitment messages were provided with the consent form as a Google form via email to review. Students choosing to sign and submit the consent form received a link to complete a demographic survey, the Goldsmith Music Sophistication Index (GOLD-MSI), the Ten Item Personality Inventory (TIPI), PSS, and WHO-QOL-BREF (see below for details of these measures). The PSS and WHO-QOL were completed again in week 6 of the study. Prior to the 6-week block commencing, participants received two hair sample collection kits, and were asked to provide a hair sample in week 1 and week 6 of the study. Participants were provided with an ID number to use for data collection to de-identify participants. The kits included instructions and an envelope to mail their hair sample to the lab. Finally, a 6-week recurring zoom link was sent to all participants in the three online therapy groups.

All three online therapy groups were facilitated by a registered psychotherapist, meaning the facilitators were members in good standing with the College of Registered

Psychotherapists of Ontario. The therapists facilitating the online music therapy groups were also registered music therapists in good standing with the Canadian Association for Music Therapists. To minimize facilitator effects, different therapists facilitated different blocks throughout the research study, with a total of four music therapists and three verbal therapists participating. In addition, there were three undergraduate student co-researchers per block, who were either completing a research project course for credit or volunteering. Prior to data collection, online practice sessions with student co-researchers and therapists were conducted to review the data collection process.

Each online therapy group session was conducted on Zoom and began and finished with the student co-researcher being present on zoom to help participants as needed to fill out their Google form, which included completing the STAI-S, the Likert stress scale, and measuring their HRV (via the Welltory App on their phone) and recording it. The de-identified data from each participant was automatically input into a spreadsheet for later analysis. During this data collection, participants connected privately if needed with the student co-researcher using the private chat function in Zoom. Each week, after initial data collection, the therapist facilitated a 45 min online group session. The student co-researcher remained in a break-out zoom room during the therapy session and was not present for any of the therapy sessions. At the end of the therapy session, the student co-researcher was again available to help participants fill out their forms.

The instructions for the collection of the hair sample in week 1 and week 6 included the following steps: (1) cutting a small sample of hair and placing it on the paper provided in the kit, (2) folding the paper, and placing the paper with the hair in the pre-

addressed, stamped envelope provided, and (3) posting the hair sample to the Drug Safety

Laboratory at Western University, Ontario (Supplementary material 3).

Interventions implemented in the online active music therapy group included song

writing, singing, lyric analysis, and verbal processing. Interventions implemented in the

online receptive music therapy group included participant-directed music listening and

verbal processing. Interventions implemented in the online verbal therapy group included

verbal processing. Both the online music therapy and verbal therapy groups were

informed by the model offered at the McMaster Student Wellness Centre, *Stress*

Less (Supplementary material 4).

3.4.4 Measures

Three stress and anxiety measures were collected pre and post each online therapy

session for each of the three therapy groups in each block: (1) STAI-S, (2) Likert stress,

and (3) HRV. Two stress measures were collected in week 1 and week 6 from the three

therapy groups and the control group: (1) PSS and (2) Cortisol. Three standardized

questionnaires were given to capture participant variables that could moderate stress and

anxiety outcomes: (1) Ten Item Personality Inventory (TIPI), (2) GOLD-MSI, and (3)

World Health Organization Quality of Life (WHO-QOL) (49). The first two were

collected prior to the onset of the therapy groups. The WHO-QOL was collected in week

1 and week 6 of the study. Participant variables collected from the demographic

questionnaire included: self-described gender, self-described ethnicity, year of birth,

University Faculty, previous or present use of psychotropic medication, and previous

engagement in therapy. The following contains details about each of the measures.

3.4.5 Pre- and post-therapy session measures: all three therapy groups (no control group)

State-Trait Anxiety Inventory, State version

The STAI-S includes twenty questions assessing the intensity of participant anxiety at the moment of testing ([50](#)). The STAI-S was administered in the present study to measure how students' anxiety changes as a result of external factors in the moment. When completing the STAI-S, participants rate the intensity of their feelings on a Likert scale from (1) *not at all* to (4) *very much so*. The STAI-S has shown good reliability and validity across different normative groups; Cronbach's alpha = 0.86–0.95 ([50](#)). Construct validity was established in two studies by comparing the mean STAI-S scores of college students in anxiety-inducing conditions ([50](#)).

Likert stress (1–5)

The Likert scale is an example of a psychometric scale that is flexible and need-based, and whose validity is driven by the applicability of the topic in the context of participant understanding ([51](#)). In the present case, participants rated their stress from 1 to 5 (1 = None, 2 = Mild, 3 = Moderate, 4 = High, 5 = Extreme).

Heart rate variability

Heart rate variability is a non-invasive measure of the ANS as a reliable assessment of stress ([40](#)). Greater variability in heart rate can result in a greater ability to rapidly cope with uncertain and changing environments ([41](#)). In this study, HRV was collected using the Welltory smart phone application using the camera of the smart phone. Participants place their finger over the phone camera and flash for 2 min. A

previous study compared HRV measurements using the Welltory App and the Polar chest strap (which are ECG accurate-site) and determined the technical error of estimate (TEE) was acceptable for all conditions (average TEE CV% [90% CI] = 6.35 [5.13; 8.5]) and both the PPG- and heart-rate-sensor-derived measures had almost perfect correlations with ECG *(r* = 1.00 [0.99; 1.00]) ([52](#)).

3.4.6 Pre-post 6-week intervention measures: all groups

Perceived Stress Scale (PSS-10)

The PSS is a 10-item self-report questionnaire designed to evaluate the extent to which an individual perceives life to be "unpredictable, uncontrollable, and overloading" ([53](#)). The scale is designed to assess feelings about life events and situations over the previous month using a five-point scale ranging from (0) *Never* to (4) *Very Often*. PSS scores have demonstrated adequate reliability ($\alpha = 0.78$) and moderate concurrent criterion validity with the amount of stress experienced during an average week ($r = 0.39$, $p < 0.001$) and the frequency of stressful life events within the past year ($r = 0.32$, $p < 0.001$) ([54](#)). Additional studies reporting the PSS-10 to have good internal consistency and reliability include Barbosa-Leiker et al. ([55](#)), Golden-Kreutz et al. ([56](#)), and Reis et al. ([57](#)).

Cortisol

Cortisol is a glucocorticoid secreted from the adrenal glands that is often used as a biomarker for stress ([58](#)). Hair cortisol is not an acute marker of hypothalamic pituitary adrenal axis (HPA-axis) activity. Rather, it acts as a proxy for total HPA activity in the preceding months ([45](#)). Cortisol from hair samples thus provides information about

participant HPA activity retrospectively. Several studies have shown that hair cortisol levels can serve as a reliable approximation of average blood cortisol levels, pointing to the validity of this method relative to established standards ([45], [59]).

3.4.7 Standardized questionnaires for participant variables: all groups

Ten Item Personality Inventory

The TIPI is a self-report questionnaire consisting of ten pairs of words to measure a person's Big Five personality dimensions: Extraversion, Agreeableness, Conscientiousness, Emotional Stability, and Openness to experiences ([60]). Participants are asked to rate the extent that each pair of words applies to themselves on a Likert scale from (1) *disagree strongly* to (7) *agree strongly*. The TIPI has been shown to have good validity: mean convergent validity with the Big-Five Inventory was $r = 0.77$ ([60]).

The Goldsmith Music Sophistication Index

The GOLD-MSI is a psychometric tool for the measurement of musical attitudes, behaviors, and skills. It is comprised of a self-report questionnaire measuring musical sophistication, defined as musical skills, expertise, achievements, and related behaviors ([61]). There are five subscales within the GOLD-MSI: (1) Active Engagement, (2) Perceptual Abilities, (3) Musical Training, (4) Singing Abilities, and (5) Emotions. A study by Müllensiefen et al. ([61]), reported that the GOLD-MSI possesses good reliability on each subscale (all α and ω > 0.79).

World Health Organization Quality of Life

The WHO-QOL-BREF is a questionnaire containing 26 questions to assess four domains: (1) Physical Health, (2) Psychological Health, (3) Social Relationships, and (4)

Environmental Quality of Life. The WHO-QOL-BREF provides a valid and reliable

alternative to the assessment of domain profiles using the WHO-QOL-100

(WHO/HIS/HSI Rev.2012.03) (49).

3.5 Analysis plan

Analyses were conducted using both JASP 0.14.1 and RStudio 2022.07.02.

Question 1: Does participating in a 45-min online group music therapy session reduce

stress (Likert stress) and anxiety (STAI-S) from pre- to post-session in comparison to the

corresponding standard of care (online verbal therapy)?

One-tailed paired *t*-tests (corrected for multiple comparisons) were conducted

between the average pre-session scores to the average post-session scores for each of the

three therapy groups to determine if stress (Likert stress) and anxiety (STAI-S) reduced

from pre- to post-session for each of the therapy groups.

Separate one-way ANOVAs were conducted to determine if the average change

(pre-session scores were subtracted from post-session scores) in stress (Likert stress) and

anxiety (STAI-S) scores differed amongst the three therapy groups (Active Music

Therapy, Receptive Music Therapy, and Verbal Therapy). Following this, Bayesian

ANOVAs were conducted to determine the degree of evidence for the null hypothesis

(i.e., no difference among the three therapy groups in stress and anxiety reduction).

Question 2: Does participating in 6 weeks of weekly online group music therapy session

reduce stress in comparison to the corresponding standard of care (online verbal therapy)

and to the no-intervention control group?

Separate one-tailed paired *t*-tests (corrected for multiple comparisons) were conducted to determine whether there was a reduction in PSS and in cortisol scores between week 1 and week 6 scores for each of the therapy groups and the control group. Separate one-way ANOVAs were planned to determine if the difference in PSS and cortisol scores across the 6 weeks (week 1 scores were subtracted from week 6 scores for each group) differed among the two music therapy groups and the control group. Following this, Bayesian ANOVAs were conducted to determine the degree of evidence for the *a priori* null hypothesis that there was no difference among the two music therapy groups in comparison to the standard of care (verbal therapy group) in stress reduction based on PSS and cortisol scores.

3.6 Results

3.6.1. Outcome variables: stress and anxiety

Question 1: Does participating in a 45-min online group music therapy session reduce stress (Likert stress) and anxiety (STAI-S) from pre- to post-session in comparison to the corresponding standard of care (online verbal therapy)?

A total of 64 students participated in the therapy groups and provided STAI-S and Likert stress scores pre and post each group therapy session. The pre- vs. post-session scores for STAI-S and Likert stress met assumptions for equal variance [$F(2,61) = 0.85$, $p = 0.43$; $F(2,61) = 1.47$, $p = 0.24$, respectively].

One-tailed paired *t*-tests comparing the average pre- and the average post-session STAI-S and Likert stress scores for each online group therapy session revealed a significant average reduction in both STAI-S and Likert stress scores separately for each

of the three therapy groups (all p's < 0.0008 after Bonferroni Correction for multiple comparisons). Detailed results are presented in Table 1.

---Insert Table 1---

ANOVAs using the average change scores (pre-session scores subtracted from post-session scores) for each therapy group found no significant differences among therapy groups for either change in STAI-S scores [$F(2,61) = 0.55$, $p = 0.58$, $\eta^2 = 0.02$] or Likert stress scores [$F(2,61) = 0.09$, $p = 0.91$, $\eta^2 = 0.003$]. To provide stronger evidence for the null hypothesis (no difference between the music therapy groups and the verbal therapy standard of care), a Bayesian ANOVA revealed moderate evidence that the therapy groups did not differ from the standard of care on either changes in STAI-S ($BF_{10} = 0.195$) or Likert stress ($BF_{10} = 0.198$) scores.

Due to the HRV scores being highly variable, only descriptive statistics are reported (see Supplementary material 4). According to the app used, HRV should range from 65 to 105 ms (62). Our participants reported measurements from 3.3 to 298 ms. This variability was likely due to several factors, including a lack of control of participants' activities at home immediately preceding the measurements, perhaps not using the app correctly, and potential issues in participants' reporting of the HRV values from the Welltory phone application.

Question 2: Does participating in 6 weeks of weekly online group music therapy sessions reduce stress in comparison to the corresponding standard of care (online verbal therapy) and to a no-intervention control group?

A total of 68 students completed the PSS in both week 1 and week 6, and a total of 39 students provided hair samples in both week 1 and week 6. The cortisol data were heavily skewed; therefore, we log-transformed the cortisol data (63, 64). One-tailed paired t-tests comparing week 1 scores to week 6 scores for PSS revealed only a significant average reduction in PSS scores in the Receptive Music Therapy group ($p = 0.02$), but the finding did not survive Benjamini–Hochberg correction for multiple comparisons ($p = 0.08$). One-tailed paired t-tests comparing week 1 cortisol to week 6 cortisol for each group revealed only a significant increase in cortisol in the control group ($p = 0.04$ after Benjamini–Hochberg corrections for multiple comparisons). Detailed results are presented in Table 2.

--Insert Table 2 ---

To test our hypothesis that reductions in PSS scores would differ among the music therapy groups (active music therapy group, receptive music therapy) and the control group, we conducted a one-way ANOVA comparing difference scores (week 1 scores were subtracted from week 6 scores). We found a non-significant effect of group [$F(2,50) = 0.661, p = 0.521, \eta^2 = 0.026$], indicating that we found no evidence that the music therapy groups differed significantly from the control group for changes in PSS scores from week 1 to week 6.

To determine whether the two music therapy groups (active music therapy group, receptive music therapy) were equivalent on PSS change scores to the standard of care (verbal therapy), a Bayesian ANOVA revealed moderate evidence that the two music therapy and the verbal groups did not differ ($BF_{10} = 0.126$).

With respect to our hypothesis that reductions in cortisol scores would differ among the music therapy groups (active music therapy group, receptive music therapy) and the control group, difference scores (week 1 scores were subtracted from week 6 scores) failed to meet the Shapiro-Wilk criteria for normality ($W_{Pre} = 0.89$, $p < 0.01$; $W_{Post} = 0.91$, $p < 0.01$; $W_{Cortisoldifference} = 0.83$, $p < 0.01$). Therefore, the non-parametric Kruskal–Wallis test was used to compare the cortisol difference scores from among the two music therapy groups and the control group. This revealed a significant effect of group (receptive music therapy, active music therapy, and control group) on change in cortisol [Kruskal–Wallis $\chi^2(2) = 7.73$, $p = 0.02$, $\eta^2 = 0.25$]. A pairwise *post-hoc* Dunn test with Bonferroni adjustments revealed significant differences between the receptive music therapy group and the control group ($p = 0.01$).

To determine whether the two music therapy groups (active music therapy group, receptive music therapy) and the standard of care (verbal therapy group) were equivalent on cortisol difference scores, a Bayesian ANOVA revealed anecdotal evidence that therapy group had no effect on the changes in cortisol ($BF_{10} = 0.655$).

3.6.2 Correlates of stress and anxiety outcomes

Pearson correlations across all possible participants (i.e., collapsing across the three therapy groups for the pre-post session scores, and all four groups for the pre-post intervention period scores) were conducted between each participant variable and the four stress and anxiety difference scores (Table 3). After corrections for multiple comparisons, the only significant correlation was between changes in PSS and the personality trait of conscientiousness ($r = 0.39$, $p = 0.02$). The direction of the relationships was such that

higher conscientiousness was related to an average increase in PSS scores across the 6-week intervention period.

3.7 Discussion

In alignment with the World Health Organization's (WHO) goal to provide comprehensive and integrated mental health services in community-based settings, this research explored the efficacy of online group music therapy as a proactive intervention for reducing university students' stress and anxiety. The term proactive refers to engaging students in therapy as a means to manage the stressors and anxiety of student life. Stress can be a healthy emotion when an individual has the tools to manage it, whereas persistent exposure to stressors and continual activation of the stress response can be detrimental to health and wellbeing (65). To our knowledge, this RCT reports on the first application of online group music therapy for proactive wellness with undergraduate university students.

Regarding our first question, *whether participating in a 45-min online group music therapy session reduces stress and anxiety in comparison to the corresponding standard of care (online verbal therapy)*, we found that both STAI-S and Likert stress self-report scores decreased significantly from pre to post therapy session, for each therapy group (active music therapy, receptive music therapy, and verbal therapy). Furthermore, there were no significant differences among the groups and a Bayesian analysis found moderate evidence for no difference among the groups. Thus, by these self-report measures, group music therapy was effective and no different from the standard of care (online verbal therapy). As far as a direct measure of ANS function, this

was more challenging to collect remotely. Unfortunately, the HRV scores reported by participants using a phone app at home appeared to be unreliable, so it is difficult to make any conclusions regarding this measure. However, the evidence from the STAI-S and Likert stress tools clearly points to short-term benefits of online group music therapy that are similar to the verbal therapy standard of care.

Regarding our second question, *whether participating in 6 weeks of weekly online group music therapy sessions reduces stress in comparison to the corresponding standard of care (online verbal therapy) and a no-intervention control group*, there were no significant differences among the four groups (active music therapy, passive music therapy, verbal therapy, and control) on the self-report PSS stress scale, and a Bayesian analysis found moderate evidence that the groups did not differ. Furthermore, changes in PSS from week 1 to week 6 were not significantly different from chance for any group when corrected for multiple tests. The research comparing self-reported stress scores to a biomarker is mixed; several studies have reported non-significant changes in self-reported measures of stress, despite reporting significant changes in cortisol (44, 66), although several also report significant correlations between self-reported stress and cortisol (67, 68). Regarding cortisol, despite only about half of participants sending in both hair samples, there was a significant difference among the music therapy groups and the control group on the change in cortisol across the intervention. *Post-hoc* tests revealed that the receptive music therapy and control groups differed significantly on cortisol changes. Specifically, this was driven by a significant increase in cortisol in the control group and a marginal decrease in cortisol in the receptive music therapy group, as

revealed via paired *t*-tests. Without intervention, it is plausible that stress levels would increase over the university term, as they did in the control group. In this light, it is interesting that the intervention groups did not show this trend. Future studies should attempt to replicate these findings with a larger sample size.

Individual differences have been reported as an important factor in the experience of stress (2). We therefore examined several variables that might moderate stress and anxiety outcomes. None of the demographic variables collected, including gender, and area of study at university, correlated significantly with any of the measures of change in stress or anxiety after correcting for multiple comparisons. Although there is literature relating personality traits to stress responses, the role of personality in response to engaging in therapy has been less studied. A meta-analysis on the associations between the Big Five personality traits and stress reported neuroticism was positively related to stress, while extraversion, agreeableness, conscientiousness, and openness were negatively related to stress (69). In the present research study, only conscientiousness was significantly correlated with changes in PSS after correction for multiple comparisons. We found that conscientiousness scores were significantly correlated with an increase in PSS scores from week 1 to week 6, suggesting that people with this personality trait may be less responsive to therapy. However, the present study differed from previous studies that explored correlations between PSS scores and personality as it explored *changes* in PSS scores over the study period, as opposed to PSS scores in the final week of the study, which appears to be a more common study design. Given that these analyses were

exploratory, further research is needed to understand the complex relations between various individual differences and responsiveness to music therapy.

Participants also completed the QOL questionnaire as stress and anxiety levels can be affected by particular events in an individual's life that affect their quality of life. We found no significant associations between any of the QOL subscales and any of the measures of stress and anxiety after correcting for multiple comparisons. However, as the study was conducted during the COVID-19 pandemic restrictions, it is possible that all or most students were experiencing negative quality of life changes, making it difficult to see effects of individual differences. Given that previous studies have linked lower quality of life scores to higher stress (70–72), it would be useful for future research to examine how quality of life measures might relate to music therapy outcomes with a larger sample size and outside of a pandemic period.

Engaging in music therapy does not require participants to have a background in music, or to be able to play an instrument or to sing. However, whether musical sophistication affects music therapy outcomes remains understudied. We did not observe any significant correlations between music sophistication scores and any of the stress or anxiety measures, nor did we find any significant differences between the active and receptive music interventions. While these null findings need to be replicated with a larger sample, they suggest that musical sophistication may not be necessary for positive music therapy outcomes and that participants with varied musical backgrounds may benefit even from music therapy that involves active music making.

Despite several challenges and limitations (see section "4.1. Limitations"), the present study was innovative in showing that music therapy can be effectively delivered to university students online and in a group setting. The COVID-19 pandemic has likely forever changed aspects of health care delivery. Beyond the scope of university students, access to proactive online group mental health therapies provides a relatively inexpensive option that can drastically increase accessibility for many populations, including those from poorer economic backgrounds, those who have mobility challenges (such as seniors in care), and those living in remote areas (32).

Although on-campus treatment options are being expanded in Canada, few universities have attempted a whole campus approach to create a health-promoting culture, as is described in the Okanagan Charter (73), and we are not aware of any campuses that are offering music therapy. One important aspect of a health-promoting cultures is a *proactive approach* that provides services aimed at improving mental health before crisis situations are reached. This is of course beneficial for students, but at the same time it could lead to reductions in treatment costs. A second important aspect of a health-promoting culture is to *include a variety of options*. Creative arts therapies are not recognized as a standard of care for mental health goals, yet the findings of the present research suggest that music therapy could be a viable option to offer to students on a university campus. Considering that 75% of students who experience significant psychological distress do not seek support as a result of negative stigma (18), offering music therapy could help to lower this number as a non-negatively stigmatized option for support. This idea is further supported by a survey completed by 786 university students

who indicated the most interest in engaging in music therapy for mental health support, followed by art therapy, and lastly verbal therapy ([11]). In sum, the present results support that the option of online group music therapy on campus for students without a clinical diagnosis can effectively reach some students who would not otherwise engage in proactive therapy for stress and anxiety.

3.8 Limitations

Conducting this online study presented some challenges. First, because the university campus was closed as a result of COVID-19 restrictions, students had to be recruited remotely, and we experienced a considerable attrition rate from the time students completed the consent form and pre-questionnaires, to the time the time the therapy sessions began. Thus, our sample size was smaller than desired, affecting statistical power, particularly for between-group analyses. Collecting the important physiological data was also a challenge remotely. Although participants were instructed on how to collect HRV data using an app on their phone, we were not able to control how well they did this, the accuracy of their reporting, or what activity they were engaged in immediately prior to the therapy session. In the end, the HRV data was highly variable and not analyzable. Future online studies will need to find a more reliable method to collect this data. Finally, although the cortisol analyses yielded significant results, only about half of the participants sent in both samples, so these analyses were underpowered.

The present randomized control trial conducted during COVID-19 restrictions highlights the benefits of offering online group music therapy to university students as a proactive intervention for stress and anxiety in the absence of a clinical diagnosis.

Significant reductions in anxiety, as measured by the STAI-S, and stress, as measured on a Likert scale, were observed from pre- to post-45 min of both active and receptive online group music therapy. Further, there was moderate evidence that these reductions in stress and anxiety did not differ from the standard of care (online verbal therapy), suggesting that group music therapy provides a viable option for stress and anxiety reduction. Significant reductions in stress from week 1 to week 6 were not observed by the PSS report measure. However, cortisol levels measured from hair samples taken at the beginning and at the end of the therapy period significantly increased in the control group from week 1 to week 6 as the university term progressed but remained stable in the therapy groups from week 1 to week 6. This study is unique in targeting university students without a clinical diagnosis and exploring the efficacy of online music therapy relative to the standard of care. Further, it is the first music therapy study to measure cortisol from hair samples collected remotely, pushing the boundaries of remote physiological measurement in therapy assessment. The results suggest a choice in therapy type could benefit many students and that music therapy can provide an alternative for students reluctant to engage in, or unable to access, verbal therapy options. This study provides an example of how a health-promoting culture on university campuses can be achieved, consistent with the mental health goals of the Okanagan Charter.

3.10 Acknowledgements

3.11 References

1. Boyce WT. Epigenomics and the unheralded convergence of the biological and social sciences. In: Kaplan R, Spittel M, David D. editors. Population Health: Behavioral and Social Science Insights. (Rockville, MD: National Institutes of Health;) (2015). p. 219–32.

2. Epel ES, Crosswell AD, Mayer SE, Prather AA, Slavich GM, Puterman E, et al. More than a feeling: a unified view of stress measurement for population science. Front Neuroendocrinol. (2018) 49:146–69. 10.1016/j.yfrne.2018.03.001 - DOI - PMC - PubMed

3. McEwen B. The brain on stress: how behavior and the social environment "get under the skin". In: Kaplan R, Spittel M, David D. editors. Population Health: Behavioral and Social Science Insights. (Rockville, MD: National Institutes of Health;) (2015). p. 233–50.

4. Miller G, Edith C, Steve WC. Health psychology: Developing biologically plausible models linking the social world and physical health. Annu Rev Psychol. (2009) 60:501–524. 10.1146/annurev.psych.60.110707.163551 - DOI - PubMed

5. Mistler BJ, Reetz DR, Krylowicz B, Barr V. The AUCCCD Annual Survey and Report Overview. The Association for the University and College Counseling Center Directors. (2012). Available online at: https://files.cmcglobal.com/Monograph_2012_AUCCCD_Public.pdf (accessed February 23, 2023).

6. Centre for Addiction and Mental Health. Anxiety, Feelings of Depression and Loneliness Among Canadians Spikes to Highest Levels Since Spring 2020. CAMH. (2022). Available online at: https://www.camh.ca/en/camh-news-and-stories/anxiety-depression-loneline... (accessed February 24, 2023).

7. Navaneelan T. Suicide Rates: An Overview. Mental Illness and Addiction: Facts and Statistics. Totonto, ON: CAMH; (2012).

8. World Health Organization. Suicide. Geneva: World Health Organization; (2021).

9. Linden B, Stuart H, Ecclestone A. Trends in post-secondary student stress: a pan-Canadian study. Can J Psychiatry. (2022). 10.1177/07067437221111365 [Epub ahead of print]. - DOI - PubMed

10. Babaei N, Zamanzadeh V, Valizadeh L, Lotfi M, Samad-Soltani T, Kousha A, et al. A scoping review of virtual care in the health system: infrastructures, barriers, and facilitators. Home Health Care Serv Q. (2023). 10.1080/01621424.2023.2166888 [Epub ahead of print]. - DOI - PubMed

11. Finnerty R, Marshall SA, Imbault C, Trainor LJ. Extra-curricular activities and well-being: results from a survey of undergraduate university students during COVID-19 lockdown restrictions. Front Psychol. (2021) 12:647402. 10.3389/fpsyg.2021.647402 - DOI - PMC - PubMed

12. Andrews B, Wilding JM. The relation of depression and anxiety to life-stress and achievement in students. Br J Psychol. (2004) 95:509–21. 10.1348/0007126042369802 - DOI - PubMed

13. Sawatzky RG, Ratner PA, Richardson CG, Washburn C, Sudmant W, Mirwaldt P. Stress and depression in students. Nurs Res. (2012) 61:13–21. 10.1097/NNR.0b013e31823b1440 - DOI - PubMed

14. Regehr C, Glancy D, Pitts A. Interventions to reduce stress in university students: a review and meta-analysis. J Affect Disord. (2013) 148:1–11. 10.1016/j.jad.2012.11.026 - DOI - PubMed

15. Tuastad L, Johansen B, Østerholt AL, Nielsen I, McIvor DSH. Being a person who plays in a band rather than being a person with a mental illness playing in a band: A qualitative study of stigma in the context of music therapy in mental health aftercare. Nord J Music Ther. (2022) 32:121–39. 10.1080/08098131.2022.2075437 - DOI

16. Solli HP, Rolvsjord R. The opposite of treatment: a qualitative study of how patients diagnosed with psychosis experience music therapy. Nord J Music Ther. (2015) 24:67–92. 10.1080/08098131.2014.890639 - DOI - PMC - PubMed

17. Tuastad L, Johansen B, Østerholt AL, Nielsen I, McIvor DSH. Being a person who plays in a band rather than being a person with a mental illness playing in a band: a qualitative study of stigma in the context of music therapy in mental health aftercare. Nord J Music Ther. (2022) 32:121–39. 10.1080/08098131.2022.2075437 - DOI

18. Rosenthal B, Wilson WC. Mental health services: use and disparity among diverse college students. J Am Coll Health. (2008) 57:61–8. 10.3200/JACH.57.1.61-68 - DOI - PubMed

19. Beyers KL. A History of the Music Therapy Profession: Diverse Concepts and Practices. Dallas, TX: Barcelona Publishers; (2016).

20. Caponnetto P, LaMattina G, Quattropani MC. Music therapy and psychological-clinical impact in surgery: A systematic review. Health Psychol Res. (2022) 10. 10.52965/001c.38615 - DOI - PMC - PubMed

21. Carter T, Panisch LS. A systematic review of music therapy for psychosocial outcomes of substance use clients. Int J Ment Health Addict. (2021) 19:1551–68. 10.1007/s11469-020-00246-8 - DOI

22. Lam HL, Li WTV, Laher I, Wong RY. Effects of music therapy on patients with dementia-A systematic review. Geriatrics. (2020) 5:62. 10.3390/geriatrics5040062 - DOI - PMC - PubMed

23. Liwang F, Nadobudskaya D, Lestari I, Hendrarto T. Preterm infant physiological responses to music therapy: a systematic review. Paediatr Indones. (2018) 58:242–51. 10.14238/pi58.5.2018.242-51 - DOI

24. Marquez-Garcia AV, Magnuson J, Morris J, Iarocci G, Doesburg S, Moreno S. Music therapy in autism spectrum disorder: a systematic review. Rev J Autism Dev Disord. (2021) 9:91–107. 10.1007/s40489-021-00246-x - DOI

25. Nyashanu M, Ikhile D, Pfende F. Exploring the efficacy of music in palliative care: a scoping review. Palliat Support Care. (2020) 19:355–60. 10.1017/s1478951520001042 - DOI - PubMed

26. Aalbers S, Vink A, de Witte M, Pattiselanno K, Spreen M, van Hooren S. Feasibility of emotion-regulating improvisational music therapy for young adult students with depressive symptoms: A process evaluation. Nord J Music Ther. (2021) 31:133–52. 10.1080/08098131.2021.1934088 - DOI

27. Nnanyelugo CE, Iyendo TO, Emmanuel NO, Okwuowulu C, John EI, Apuke OD, et al. Effect of internet-mediated music therapy intervention on reduction in generalized anxiety disorder symptoms among displaced Nigerians of the Russia–Ukraine war. Psychol Music. (2022):1–12. 10.1177/03057356221129649 - DOI

28. Schwantes M, Rivera E. "A team working together to make a big, nice, sound": an action research pilot study in an inclusive college setting. Arts Psychother. (2017) 55:1–10. 10.1016/j.aip.2017.01.011 - DOI

29. de Witte M, Knapen A, Stams G, Moonen X, van Hooren S. Development of a music therapy micro-intervention for stress reduction. Arts Psychother. (2022) 77:101872. 10.1016/j.aip.2021.101872 - DOI

30. Levy CE, Spooner H, Lee JB, Sonke J, Myers K, Snow E. Telehealth-based creative arts therapy: transforming mental health and rehabilitation care for rural veterans. Arts Psychother. (2018) 57:20–6. 10.1016/j.aip.2017.08.010 - DOI

31. Lightstone AJ, Bailey SK, Voros P. Collaborative music therapy via remote video technology to reduce a veteran's symptoms of severe, chronic PTSD. Arts Health. (2015) 7:123–36. 10.1080/17533015.2015.1019895 - DOI

32. Spooner H, Lee JB, Langston DJ, Sonke J, Myers KJ, Levy CE. Using distance technology to deliver the creative arts therapies to veterans: case studies in art, dance/movement and music therapy. Arts Psychother. (2019) 62:12–8. 10.1016/j.aip.2018.11.012 - DOI

33. Baker F, Krout R. Songwriting via skype: an online music therapy intervention to enhance social skills in an adolescent diagnosed with Asperger's syndrome. Br J Music Ther. (2009) 23:3–14. 10.1177/135945750902300202 - DOI

34. Baker F, Krout RE. Therapeutic songwriting with clients in an e-health environment. In: Magee W. editor. Music Technology in Therapeutic and Health Settings. (London: Jessica Kingsley;) (2014). p. 299–310.

35. Kantorova L, Kantor J, Hořejší B, Gilboa A, Svobodova Z, Lipský M, Marečková J, Klugar M. Adaptation of music therapists' practice to the outset of the COVID-19 pandemic–Going virtual: A scoping review. Int J Environ Res Public Health. (2021) 18:5138. 10.3390/ijerph18105138 - DOI - PMC - PubMed

36. Ahessy B. 'Boom boom in the zoom zoom room': online music therapy with children and adolescents with visual impairment. Br J Vis Impair. (2023) 41:143–61. 10.1177/02646196211029342 - DOI

37. Gvili RL. An intergenerational zoom music therapy group during COVID-19. Innov Aging. (2021) 5(Suppl. 1):566. 10.1093/geroni/igab046.2175 - DOI

38. Ansdell G. Community music therapy and the winds of change-A discussion paper. In: Kenny C, Stige B. editors. Contemporary Voices in Music Therapy: Communication, Culture and Community. (Oslo: Unipub Forlag;) (2002). p. 109–43.

39. Jones BJ, Kaur S, Miller M, Spencer RMC. Mindfulness-based stress reduction benefits psychological well-being, sleep quality, and athletic performance in female collegiate rowers. Front Psychol. (2020) 11:572980. 10.3389/fpsyg.2020.572980 - DOI - PMC - PubMed

40. Kim H-G, Cheon E-J, Bai D-S, Lee YH, Koo B-H. Stress and heart rate variability: a meta-analysis and review of the literature. Psychiatry Investig. (2018) 15:235–45. 10.30773/pi.2017.08.17 - DOI - PMC - PubMed

41. Shaffer F, Ginsberg JP. An overview of heart rate variability metrics and norms. Front Public Health. (2017) 5:258. 10.3389/fpubh.2017.00258 - DOI - PMC - PubMed

42. Laufer S, Engel S, Knaevelsrud C, Schumacher S. Cortisol and alpha-amylase assessment in psychotherapeutic intervention studies: A systematic review. Neurosci Biobehav Rev. (2018) 95:235–62. 10.1016/j.neubiorev.2018.09.023 - DOI - PubMed

43. Wong MM, Tahir T, Wong MM, Baron A, Finnerty R. Biomarkers of stress in music interventions: a systematic review. J Music Ther. (2021) 58:241–77. 10.1093/jmt/thab003 - DOI - PubMed

44. Gebhart V, Buchberger W, Klotz I, Neururer S, Rungg C, Tucek G, et al. Distraction-focused interventions on examination stress in nursing students: effects on psychological stress and biomarker levels. A randomized controlled trial. Int J Nurs Pract. (2020) 26:e12788. 10.1111/ijn.12788 - DOI - PubMed

45. Wright KD, Hickman R, Laudenslager ML. Hair cortisol analysis: a promising biomarker of HPA activation in older adults. Gerontologist. (2015) 55(Suppl. 1):S140–5. 10.1093/geront/gnu174 - DOI - PMC - PubMed

46. Bucher MA, Suzuki T, Samuel DB. A meta-analytic review of personality traits and their associations with mental health treatment outcomes. Clin Psychol Rev. (2019) 70:51–63. 10.1016/j.cpr.2019.04.002 - DOI - PubMed

47. McCrary JM, Altenmüller E, Kretschmer C, Scholz DS. Association of music interventions with health-related quality of life. JAMA Netw Open. (2022) 5:e223236. 10.1001/jamanetworkopen.2022.3236 - DOI - PMC - PubMed

48. Faul F, Erdfelder E, Lang AG, Buchner A. G*power 3: a flexible statistical power analysis program for the social, behavioral, and biomedical sciences. Behav Res Methods. (2007) 39:175–91. 10.3758/bf03193146 - DOI - PubMed

49. World Health Organization. WHO-BREF Manual, The WHOQOL Group. (2012). Available online at: https://www.who.int/tools/whoqol (accessed February 23, 2023).

50. Spielberger CD. State-Trait Anxiety Inventory for Adults. PsycTESTS Dataset. Washington, DC: American Psychological Association (1983). 10.1037/t06496-000 - DOI

51. Joshi A, Kale S, Chandel S, Pal DK. Likert scale: explored and explained. Br J Appl Sci Technol. (2015) 7:396–403. 10.9734/bjast/2015/14975 - DOI

52. Plews DJ, Scott B, Altini M, Wood M, Kilding AE, Laursen PB. Comparison of heart-rate-variability recording with smartphone photoplethysmography, polar H7 chest strap, and electrocardiography. Int J Sports Physiol Perform. (2017) 12:1324–8. 10.1123/ijspp.2016-0668 - DOI - PubMed

53. Cohen S, Kamarck T, Mermelstein R. Perceived Stress Scale [Database Record]. Washington, DC: APA PsycTests; (1983). 10.1037/t02889-000 - DOI

54. Cohen S. Perceived stress in a probability sample of the united states. In: Spacapam S, Oskamp S. editors. The Social Psychology of Health. (Newbury Park, CA: Sage;) (1988). p. 31–67.

55. Barbosa-Leiker C, Kostick M, Lei M, McPherson S, Roper V, Hoekstra T, et al. Measurement invariance of the perceived stress scale and latent mean differences across gender and time. Stress Health. (2013) 29:253–60. 10.1002/smi.2463 - DOI - PubMed

56. Golden-Kreutz DM, Browne MW, Frierson GM, Andersen BL. Assessing stress in cancer patients: a second-order factor analysis model for the perceived stress scale. Assessment. (2004) 11:216–23. 10.1177/1073191104267398 - DOI - PMC - PubMed

57. Reis RS, Hino AA, Rodriguez-Añez CR. Perceived stress scale: Reliability and validity study in Brazil. J Health Psychol. (2010) 15:107–14. 10.1177/1359105309346343 - DOI - PubMed

58. Dhama K, Latheef SK, Dadar M, Samad HA, Munjal A, Khandia R, et al. Biomarkers in stress related diseases/disorders: diagnostic, prognostic, and therapeutic values. Front Mol Biosci. (2019) 6:91. 10.3389/fmolb.2019.00091 - DOI - PMC - PubMed

59. Cirimele V, Kintz P, Dumestre V, Goullé JP, Ludes B. Identification of ten corticosteroids in human hair by liquid chromatography–ionspray mass spectrometry. Forensic Sci Int. (2000) 107:381–8. 10.1016/s0379-0738(99)00180-2 - DOI - PubMed

60. Gosling SD, Rentfrow PJ, Swann WB., Jr. A very brief measure of the big five personality domains. J Res Pers. (2003) 37:504–28. 10.1016/S0092-6566(03)00046-1 - DOI

61. Müllensiefen D, Gingras B, Musil J, Stewart L. The musicality of non-musicians: an index for assessing musical sophistication in the general population. PLoS One. (2014) 9:e89642. 10.1371/journal.pone.0089642 - DOI - PMC - PubMed

62. Welltory. HRV Chart by Age and Gender and What's a Good HRV Score. Welltory. (2023). Available online at: https://welltory.com/hrv-chart-by-age/ (accessed March 6, 2023).

63. Dettenborn L, Tietze A, Kirschbaum C, Stalder T. The assessment of cortisol in human hair: associations with sociodemographic variables and potential confounders. Stress. (2012) 15:578–88. 10.3109/10253890.2012.654479 - DOI - PubMed

64. Manenschijn L, Koper JW, Lamberts SWJ, van Rossum EFC. Evaluation of a method to measure long term cortisol levels. Steroids. (2011) 76:1032–6. 10.1016/j.steroids.2011.04.005 - DOI - PubMed

65. Can YS, Iles-Smith H, Chalabianloo N, Ekiz D, Fernández-Álvarez J, Repetto C, et al. How to relax in stressful situations: a smart stress reduction system. Healthcare. (2020) 8:100. 10.3390/healthcare8020100 - DOI - PMC - PubMed

66. Bittman BB, Berk LS, Felten DL, Westengard J, Simonton OC, Pappas J, et al. Composite effects of group drumming music therapy on modulation of neuroendocrine-immune parameters in normal subjects. Altern Ther Health Med. (2001) 7:38–47. - PubMed

67. Lai H-L, Li Y-M. The effect of music on biochemical markers and self-perceived stress among first-line nurses: a randomized controlled crossover trial. J Adv Nurs. (2011) 67:2414–24. 10.1111/j.1365-2648.2011.05670.x - DOI - PubMed

68. Laohawattanakun J, Chearskul S, Dumrongphol H, Jutapakdeegul N, Yensukjai J, Khumphan N, et al. Influence of music training on academic examination-induced stress in Thai adolescents. Neurosci Lett. (2011) 487:310–2. 10.1016/j.neulet.2010.10.045 - DOI - PubMed

69. Luo J, Zhang B, Cao M, Roberts BW. The stressful personality: a meta-analytical review of the relation between personality and stress. Pers Soc Psychol Rev. (2022). 10.1177/10888683221104002 [Epub ahead of print]. - DOI - PubMed

70. Meira TM, Paiva SM, Antelo OM, Guimarães LK, Bastos SQ, Tanaka OM. Perceived stress and quality of life among graduate dental faculty. J Dent Educ. (2020) 84:1099–107. 10.1002/jdd.12241 - DOI - PubMed

71. Meira TM, Ronsani MM, Ignácio SA, Miyoshi CS, Pithon MM, Tanaka OM. Predictors of perceived stress and quality of life amongst dental master and doctoral students. Eur J Dent Educ. (2022) 27:19–28. 10.1111/eje.12771 - DOI - PubMed

72. Yang X, Ge C, Hu B, Chi T, Wang L. Relationship between quality of life and occupational stress among teachers. Public Health. (2009) 123:750–5. 10.1016/j.puhe.2009.09.018 - DOI - PubMed

73. Jaworska N, De Somma E, Fonseka B, Heck E, MacQueen GM. Mental health services for students at postsecondary institutions: a national survey. Can J Psychiatry. (2016) 61:766–75. 10.1177/0706743716640752 - DOI - PMC - PubMed

3.12 Tables

Table 1.

Group*	N (males)	STAI-S						Likert stress					
		Pre (SD)	Post (SD)	Change (SD)	t	df	d	Pre (SD)	Post (SD)	Change (SD)	t	df	d
AMT	18 (2)	43.20 (8.94)	32.92 (6.90)	−10.28 (5.28)	7.4	17	1.77	3.03 (0.81)	2.26 (0.64)	−0.77 (0.63)	5.18	17	1.22
RMT	28 (5)	44.59 (9.09)	34.89 (6.72)	−9.70 (5.5)	9.3	27	1.77	3.09 (0.93)	2.23 (0.81)	−0.86 (0.69)	6.55	27	1.24
VT	18 (3)	45.29 (10.85)	37.08 (8.07)	−8.21 (7.48)	4.6	17	1.10	3.29 (0.68)	2.63 (0.68)	−0.65 (0.64)	4.43	17	1.04
All	64 (10)	44.40 (9.46)	34.95 (7.23)	−9.45 (6.15)	12.3	63	0.54	3.15 (1.43)	2.37 (0.94)	−0.78 (0.66)	8.58	63	1.07

All p's < 0.001; Bonferroni alpha = 0.0083 (0.05/6 comparisons). *AMT, Active music therapy; RMT, receptive music therapy; VT, verbal therapy.

Table 2

Group*	N (males)	PSS					Cortisol						Shapiro– Wilk
		Change (SD)	p	t	df	Effect	N (males)	Change (SD)	p	t (W)	df	Effect	
AMT	16 (1)	−1.94 (6.63)	0.13	1.2	15	0.29	8 (1)	−0.05 (0.25)	0.31	0.54	7	0.19	0.53
RMT	19 (3)	−2.90 (5.48)	0.02	2.3	18	0.53	11 (2)	−0.11 (0.23)	0.06	1.67	10	0.5	0.40
VT	15 (3)	−1.80 (5.81)	0.13	1.2	14	0.31	9 (1)	−0.00 (0.71)	0.33	(27)	8	0.2	0.016**
C	18 (4)	−0.78 (4.67)	0.76	0.71	17	0.17	11 (3)	0.31 (0.49)	0.01	(8)	10	−0.76	0.005**

For the Student's t-test, effect size (Cohen's d). For the Wilcoxon test, effect size (matched rank biserial correlation). *AMT, Active music therapy; RMT, receptive music therapy; VT, verbal therapy. **Wilcoxon signed-rank used for Shapiro–Wilk p < 0.005.

Table 3 (cannot format image to insert)

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3.13 Supplementary Material

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Supplementary Material

Online Group Music Therapy:
Proactive Management of Undergraduate Students' Stress and Anxiety
Finnerty, R, McWeeny, S, and Trainor, L

1. On-Line Group Therapy Guidelines

Adopted with permission from McMaster University Open Circle

- **Give and receive welcome.** People learn best in hospitable spaces. In this space we support each other's learning by giving and receiving hospitality.
- **Respect**: Listen to each other with openness and curiosity, being respectful of different ideas and opinions while open to learn from everyone.
- **No fixing, saving, advising or correcting each other.** This is one of the hardest guidelines for those of us who like to "help." But it is vital to welcoming the soul.
- **Set aside reaction and judgment and turn towards wonder and compassionate inquiry**. Ask yourself, "I wonder why they feel/think this way?" or "I wonder what my reaction teaches me about myself?" Set aside judgment to listen to others—and to yourself—more deeply.
- **Speak your truth in ways that respect each person's truth.** Our views of reality may differ but speaking one's truth in this space does not mean interpreting, correcting or debating what others say. Speak from your center to the center of the group, using "I" statements, trusting people to do their own sifting and growth.
- **Creating inclusive space for diversity.** We work together to hold a safe space for all forms of diversity, including ethnicity, religion, gender identity and expression, sexual orientation, ability, and socio-economic status.
- **Freedom to share or to pass.** Be here with your listening as well as your speaking.
- **Be present as fully as possible.** Turn off phones and put away technology that is not being used for participation in the group.
- **Trust and learn from the silence.** Silence is a gift in our noisy world, and a way of knowing in itself. Treat silence as a member of the group. After someone has spoken, take time to reflect without immediately filling the space with words.
- **Observe deep confidentiality.** Safety is built when we can trust that our words and stories will remain with the people with whom we choose to share and are not repeated to others without our permission. Do not record any of the groups.

2. Self-described Ethnicity

Self-Described Ethnicity	Broad Description
South Asian	African
Philippines	Asian
African	Asian
South Asian	Asian
East Asian	Asian
South Asian	Asian
Vietnamese	Asian
East Asian	Asian
South Asian	Asian
Chinese	Asian
Pakistan	Asian
I am of Afro-Caribbean descent	Caribbean
Ashkenazi Jewish	Jewish
White/Hispanic	Cross-Continents
Canadian/ American	North American
Caucasian	White
White	White
Caucasian	White
Black/Caribbean/African	African
Chinese	Asian
Chinese	Asian
Chinese	Asian
indian	Asian
Arab	Asian
My Father (100% Greek) immigrated for Greece as a child and met my mother (unknown) in Canada I identify and relate heavily to Greece culture	European
Polish	European
Honduras/USA	Cross-Continents
Moroccan, Canadian	Cross-Continents
Canadian	North American
Canadian	North American
Caucasian	White
Caucasian	White
White	White

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White (Caucasian)	White
White	White
Egyptian	African
African	African
African	African
Pujabi-Indian	Asian
Chinese	Asian
Asian	Asian
Family from Pakistan, I was born and raised in Canada	Asian
Chinese and Japanese	Asian
Asian	Asian
South Asian(Indian)	Asian
Chinese	Asian
Caucasian. European	European
European	European
European/Dutch/Scottish	European
Irish/Metis	Cross-Continents
Indian/African	Cross-Continents
Middle Eastern,European	Cross-Continents
Chinese	North American
Canadian	North American
Caucasian	White
White	White
White Caucasian	White
Caucasian	White
Egyptian/Coptic/North African,	African
Chinese	Asian
Afghanistan	Asian
Chinese	Asian
South Asian	Asian
Iranian	Asian
Chinese	Asian
Chinese	Asian
Persian	Asian
Taiwanese	Asian
European/Caucasian	European
English Canadian, Italian	North American
White/Caucasian	White
Caucasian	White

3

3. Hair Collection Instructions

STEP 1: GATHER METERIALS FOR SAMPLE COLLECTION.

You will need: Sharp and clean scissors, Clear scotch tape, Hair clip (optional), Pen

STEP 2: LOCATE THE POSTERIOR VERTEX REGION OF THE SCALP.

This region of the head has the most consistent hair growth rate. Sampling from here will minimize the variation in sample measurements.

STEP 3: ISOLATE HAIR WITH HAIR CLIP (OR FINGERS) & CUT HORIZONTALLY WITH SCISSORS AS CLOSE TO SCLAP AS POSSIBLE.

Approx. 100 strands of hair are required, 1cm in length, 5mm in diameter (thickness of pencil eraser). Please ensure hair strands are aligned and secured with tape to the direction of the scalp and that the direction of the scalp is clearly indicated. Please use the collection form provided.

STEP 4:TAPE THE SCALP END OF THE HAIR TO THE HAIR SAMPLE COLLECTION FORM & FILL OUT STUDY ID, SUBJECT ID, & COLLECTION DATE.

Clear scotch tape works best. It is easily removed and leaves no residue on the hair. Fold the paper along the length of the hair & place in pre-addressed envelope to secure the sample. Post the pre-addressed envelope after collecting. The pre-addressed envelope will be addressed to Drug Safety Laboratory, Robarts Research Institute, Western University, 1151 Richmond St N, London, On. Canada.

4

3. *Stress Less* Online Group Description

In keeping with the McMaster Student Wellness group "Stress Less", each group explores the similarity and differences between stress, anxiety, and fear, identify stressors, explore stress physiology, discuss existing stress management strategies such as mindfulness, and introduce progressive muscle relaxation. Verbal facilitation is implemented in all three groups.

*Group guidelines reviewed	Opening Quote & Ice Breaker	Facilitated reflection on a theme related to stress and anxiety	Closing Activity & Quote
Verbal Based Therapy Group	Verbal Check-in.	Journaling, followed by group sharing.	Verbally facilitated progressive muscle relaxation.
Music Therapy (Active)	Therapist will sing and self-accompany with an instrument.	Lyric creation facilitated for a piece of music using either a pre-composed or original melody. Participants will have the option to sing along.	Live music facilitated progressive muscle relaxation.
Music Therapy (Receptive)	Pre-recorded music will be played.	Using music listening (choice of music guided by participants)	Music listening facilitated progressive muscle relaxation.

4. Supplemental Tables

Supplementary Table 1
Descriptive statistics for Heart Rate Variability Scores Pre and Post each Therapy Session

	Pre 1	Post 1	Pre 2	Post 2	Pre 3	Post 3	Pre 4	Post 4	Pre 5	Post 5	Pre 6	Post 6
M	67.485	60.913	60.520	65.000	58.813	64.392	65.122	68.683	59.667	70.637	60.565	77.478
SD	43.690	24.005	26.063	25.678	29.974	28.828	25.619	24.810	28.121	24.986	26.995	48.660
Minimum	3.300	14.000	14.000	15.000	13.000	4.000	23.000	19.000	10.000	25.000	19.000	27.000
Maximum	298.000	100.000	106.000	106.000	179.000	109.000	105.000	100.000	100.000	115.000	109.000	267.000

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Chapter 4

Group music therapy for the proactive management of stress and anxiety

Finnerty, R., Trainor, L.J. (2024). *Group music therapy for the proactive management of stress and anxiety*, PLOS Mental Health (manuscript submitted July 10, 2024)

4.1 Preface

In Chapter 4, I present a randomized controlled trial that we conducted to build upon the research findings of Chapter 3. We implemented in-person group music therapy as opposed to online group music therapy and collected data from a larger sample size than the research study in Chapter 3. Our results continue to support the use of group music therapy for proactive wellness on campus. We also collected qualitative feedback from students about their experience with music therapy, and their interest to continue with music therapy. Additionally, we collected data about personality types and music sophistication as potential covariates. The results of our analyses suggests that individual differences in personality types and music sophistication are not strong predictors of music therapy outcomes. The overall results highlight both the effectiveness and universality of in-person group music therapy, as well as its potential to increase students' help seeking behaviours.

4.2 Abstract

Mental health interventions are often implemented in response to a crisis as opposed to a management model. This randomized controlled study explored the use of group music therapy to proactively manage undergraduate university students' stress and anxiety. Data were collected from 148 students who were randomly assigned to six-weeks of weekly group music therapy or a control group. Significant reductions in cortisol levels from hair samples, as well as psychometric measures of stress and anxiety were observed in the music therapy group in comparison to the control group. The results support the use of group music therapy to proactively manage stress and anxiety on university campuses.

4.3 Introduction

Advocating for proactive mental health interventions on university campuses is not a new concept, yet services remain predominantly reactive to mental health concerns. The Ontario Undergraduate Student Alliance (OUSA) 2012 report included the recommendation of anti-stigma and preventative mental health campaigns as well as workshops for students at post-secondary levels to enhance coping and stress management (1). Six years later, in the 2018 OUSA report, students remarked that there remains a lack of proactive care and crisis prevention on campuses (2), and a scoping review of post-secondary stress and mental well-being highlighted the need for prevention strategies (3). In 2022, an online survey delivered to post-secondary students across Ontario, Canada, revealed that 66.5% of respondents ($n = 290/436$) reported a decline in their mental health since starting post-secondary education (4). Despite these mental health concerns, most students reported that they were not receiving counselling

or psychotherapy for their mental health (71.5% ; $n = 318/445$). Some changes have been implemented to mental health delivery on campuses since the 2012 OUSA report, but proactive engagement in mental health support is still not a part of campus culture. An overview of campus student wellness services across Canada, revealed that mental health services are predominantly reactive, meaning current services are for students already in crisis or with a specific diagnosis (5).

The present research explored the effectiveness of group music therapy to proactively manage undergraduate students' stress and anxiety under conditions where participants did not require a diagnosis. The effectiveness of group music therapy was examined through both physiological and psychological measures. Group music therapy was chosen as a more cost-effective and feasible option compared to individual music therapy. The interpersonal nature of group therapy also provides the opportunity to recognize one's own experiences in others, hence validating and normalizing experiences (6). Music is considered to be a healthy activity, and it is typically not linked to being mentally ill (7,8). As such, the tool of music within a therapeutic context could increase mental health support-seeking behaviours. Recognizing that many students do not seek mental health support when needed due to negative stigma (9, 4), music therapy could offer an alternative to often stigmatized verbal therapies. Additionally, music therapy has a higher participation and retention rate over verbal based therapies (10-12). It should be noted that participants do not require any background in music to participate or benefit from music therapy.

The profession of music therapy initially developed in the USA in the 1950s as a response to soldiers returning from World War II with post-traumatic stress disorder (13). In 1974, the Canadian Association of Music Therapists was established; its role is to set the standards and qualifications for music therapists across Canada. Music therapists work with a diversity of age groups and diagnoses using music purposely within a therapeutic relationship to support a variety of healthcare goals. Engaging in music therapy has led to improvements in verbal fluency, reduced anxiety, reduced symptoms of depression, reduced pain perception, improved psychosocial functioning, and improved motivation for treatment (14-18). However, systematic reviews have also reported a need for clinical trials with larger sample sizes, appropriate experimental methodology, and objective measurements of treatment effectiveness to substantiate these claims (14-18).

The present randomized controlled trial analyzed the effects of undergraduate university students' proactive participation in group music therapy for stress and anxiety management. One study to date has been published reporting the effects of group music therapy to proactively manage stress and anxiety with undergraduate university students; the study implemented online delivery of music therapy using Zoom during COVID-19 restrictions (10). The present study followed a very similar protocol to the online study, with the main difference being that the music therapy groups were delivered in-person on campus. In keeping with the online study, the music therapy groups followed a community music therapy approach, which does not require an intake form, an assessment, or a treatment plan. Additionally, the community music therapy approach aims to effect change both within the therapeutic space and the overall environment of the

client (19). For instance, the present study aimed to assist with the management of stress and anxiety within the therapeutic space, as well as address the need to normalize the maintenance of mental health.

In recognition of the literature already supporting the outcomes of music therapy in comparison to the standard of care (verbal based therapy) (10, 20-25), a standard of care group was not part of the present study design. Rather, stress and anxiety measures were compared between students who proactively participated in a music therapy group and students who experienced 'student life as usual' (the control group). Stress measures included cortisol, heart rate variability (HRV), the standardized perceived stress scale (PSS), and a 1-5 scale of self-perceived stress; and anxiety was measured using the standardized state trait anxiety inventory (STAI-S). The state version of the STAI-S was implemented as we were interested in changes in participants' anxiety in the moment as opposed to participants predisposition to anxiety (trait anxiety). Cortisol was collected as a known biomarker for stress (26). Collecting hair cortisol provides a proxy for total hypothalamic pituitary adrenal axis activity in the preceding months; each centimeter of hair growth reflects the average cortisol released in the previous month (27).

In the present study, as we wanted to compare participants' average cortisol release for the month before the study to their average cortisol release during the last month of the study, we therefore collected the first centimeter of hair growth from the scalp at the beginning and at the end of the six-week intervention for analyses. Heart rate variability was collected as an additional non-invasive measure of the autonomic nervous system that is recognized as a reliable assessment of stress (28), with increased variability

in heart rate being associated with a greater ability to cope with uncertain environments (29). The standardized perceived stress scale is designed to assess feelings about life events and situations over the previous months. This enabled the comparison of perceived stress before the study to after the study. The 1-5 scale of self-perceived stress provided a quick, in the moment, subjective experience of stress. In addition to collecting measures in week 1 and 6 of the study, the STAI-S 1-5 stress scale and HRV measures were also collected before and after each group music therapy session. These data provided information about the immediate effects of music therapy on stress and anxiety. This is important as experiencing low levels of stress, even for a short period of time, can have benefits (30).

Recognizing that demographic variables, personality traits, and extenuating circumstances could influence the stress and anxiety scores of students during the six-week study period, a Demographics questionnaire, the Ten Item Personality Inventory, and the World Health Organization – Quality of Life questionnaire were administered. Data from these questionnaires were examined to determine if it was necessary to include these variables in the main analyses examining the effects of the intervention on the stress and anxiety measures. Personality type can predict propensity to manage stress and anxiety, but there are only a few published research papers addressing the extent to which personality type affects the degree to which stress or anxiety scores change during a therapeutic intervention (i.e., music therapy) (31-33).

Participants also completed the Goldsmith Music Sophistication Index to determine if music sophistication predicts stress and anxiety outcomes, as it is possible

that participants with greater music sophistication would have a proclivity to benefit more from music therapy. Music sophistication is defined as a psychometric construct that refers to musical skills, expertise, achievements, and related behaviors across a range of facets (34). There is currently a gap in the literature regarding the impact of personality types and music sophistication on music therapy outcomes. Despite these variables not being explicitly measured in previous music therapy research, we hypothesized that neither personality type nor music sophistication would be related to therapy outcomes, based on the diversity of individuals who reportedly benefit from music therapy, and music sophistication not being a requirement of participating in music therapy.

In addition to the collection of physiological and psychological data, subjective participant reports of their experience can provide insight not only into the effectiveness of an intervention, but the applicability. Participants' subjective experiences are often not accorded the same weight as intervention outcomes, yet they are invaluable in understanding if individuals will seek out and/or continue to engage in supports (35). For this reason, the present study included a feedback questionnaire for participants in the music therapy group, consisting of both closed- and open-ended questions about their experience and their interest in continuing in the intervention if it was offered.

In summary, the present research gathered behavioural and physiological measures of stress and anxiety, as well as data about potential moderating variables (demographics, personality traits, music sophistication, quality of life), and asked two main questions, and two secondary questions, as follows.

Two main questions:

(1) *Does participating in a 45-minute group music therapy session reduce stress and anxiety from before to after the session?*

(2) *Does participating in six weeks of weekly group music therapy reduce stress and anxiety in comparison to a "student life as usual" control group?*

Two secondary questions:

(1) *Do participants in music therapy report finding the intervention helpful?*

(2) *Would participants engage in music therapy if it was offered on campus?*

We hypothesized that a reduction in stress and anxiety would be observed both before and after each music therapy session (as measured by STAI-S, self-rating scale, HRV), as well as from week 1 to week 6 of the study (STAI-S, self-rating scale, HRV, PSS, cortisol). We also anticipated that participants would find the music therapy groups helpful, and that most participants would be interested in continuing to engage in music therapy if it was offered on campus.

4.4 Materials and Methods

4.4.1 Overall Study Design

A randomized controlled trial, pretest-posttest study design with two groups was approved by the Hamilton Integrated Research Ethics Board (project #15143). The two groups consisted of an experimental group (music therapy) and a control group (student life as usual). University students were randomly assigned to participate in a 45-minute group music therapy session every week for six weeks, or to the control group. Demographic data, including a personality questionnaire and a music sophistication questionnaire were collected at the start of the study. A quality of life questionnaire was

distributed in week 1 and week 6 of the study. Measures of stress and anxiety were taken before and after each group music therapy session, and in week 1 and week 6 of the study from all participants (see details below). Participants in the music therapy group were asked to complete a feedback survey at the end of the study.

4.4.2 Participants

A total of 148 full-time undergraduate university students (80% females) aged 18-24 (M = 20 years) at a Canadian university participated in the study. A power analysis was conducted using G*Power version 3.1 (36) to determine the sample size required to test whether the average change in the state anxiety and self-rated stress scores reduced from before to after each group music therapy session, with 80% power for detecting a medium effect (d= 0.5), at a significance criterion of α = .05. These parameters were determined by referencing a similar study (10). The sample size determined for this within group one-tailed paired t-test was n = 27.

A power analysis was also conducted to determine the sample size required to test whether the average change in stress and anxiety scores from week 1 to week 6 differed between the music therapy group and the control group with 80% power for detecting a medium effect (d= 0.5), at a significance criterion of α = .05. These parameters were determined by referencing a similar study (10). The sample size determined for this between group one-tailed t-test was n = 102 (51 participants per group).

In block 1 of the present study (conducted in February-March 2023), a total of 25 students provided consent to participate and responded to the follow-up emails and questionnaires. The 25 students were randomly assigned to the music therapy group or the

control group. Six students opted out before further data were collected due to scheduling conflicts. In total, 19 students (7 males, 2 unknown) completed the study: Music Therapy ($n = 10$, 3 males), Control ($n = 9$, 4 males). On average, students in the Music Therapy group attended 4/6 of the weekly sessions.

In block 2 of the study (October-November 2023), a total of 143 students provided consent to participate and responded to the follow-up emails and questionnaires. The 143 students were randomly assigned to the music therapy group, or the control group. The primary researcher's previous experience of participants in the control group not completing the study informed her decision to allocate more students to the control group than the music therapy group. Four students in the music therapy group opted out before the first session, and two did not complete the study. Three students in the control group opted out during the first week, and five did not complete the study. In total, 129 students completed the study (121 recruited as a course component option); Music Therapy ($n = 57$, male =9) Control ($n = 72$, male = 8, prefer not to say =1). On average, students attended 5/6 of the music therapy sessions over the six-week study period.

Demographically, students from all university Faculties were represented but most students were in the Faculty of Science (80%). 143/148 students self-described their ethnicity, broadly reporting: European/White/Caucasian ($n = 46$), South Asian ($n = 30$), Middle-Eastern ($n = 13$), East-Asian ($n = 14$), Mixed Ethnicity ($n = 10$), North American ($n = 7$), sub-Saharan African ($n = 8$), Caribbean ($n = 6$), Indigenous ($n = 3$), Black ($n = 2$), Jewish ($n = 1$), Latino ($n = 2$) North African ($n = 2$). Self-descriptions are presented in S1 Table.

4.4.3 Measures

Initial demographic, personality, musical background, and quality of life questionnaires *(completed by Control and Music Therapy Groups)*

The following four background questionnaires were given to all participants in week 1. The Quality of Life questionnaire was repeated in week 6.

1. Demographic information was collected from each participant through a questionnaire that asked the participants to self-describe gender, year of birth, ethnic origin, use of psychotropic medication, previous or current participation in therapy, and previous or current participation in a music therapy course.

2. Ten Item Personality Inventory (TIPI) is a standardized self-report questionnaire consisting of ten pairs of words to measure a person's Big Five personality dimensions: Extraversion, Agreeableness, Conscientiousness, Emotional Stability, and Openness to experiences (37). Participants rate the extent that each pair of words applies to themselves on a Likert scale from (1) disagree strongly to (7) agree strongly. The TIPI has been shown to have good validity: mean convergent validity with the Big-Five Inventory was r = 0.77 (37).

3. Goldsmith Music Sophistication Index (GOLD-MSI) is a tool for measuring musical attitudes, behaviours, and skills. It is a self-report questionnaire measuring musical sophistication, defined as musical skills, expertise, achievements, and related behaviours (34). There are five subscales within the GOLD-MSI: (1) Active Engagement, (2) Perceptual Abilities, (3) Musical Training, (4) Singing Abilities, and (5) Emotional response to music), as well as an overall music sophistication score. A study by

Mullensiefen et al. (34) reported that the GOLD-MSI possesses good reliability on each subscale (all α and ω > .79).

4. World Health Organization Quality of Life (WHOQOL-BREF) is a questionnaire containing 26 questions to assess four domains: (1) Physical Health, (2) Psychological Health, (3) Social Relationships, and (4) Environmental Quality of Life. The WHOQOL-BREF provides a valid and reliable alternative to the assessment of domain profiles using the WHOQOL-100 (38).

Measures taken in week 1 and week 6 (completed by Control and Music Therapy Groups)

Three questionnaires and two physiological measures were taken in week 1 and again in week 6.

Questionnaires

1. Perceived Stress Scale (PSS-10) is a 10-item self-report questionnaire designed to evaluate the extent to which an individual perceives life to be "unpredictable uncontrollable and overloading" (39). The scale is designed to assess feelings about life events and situations over the previous month using a five-point scale ranging from (0) Never to (4) Very Often. PSS scores have demonstrated adequate reliability (α = .78) and moderate concurrent criterion validity with the amount of stress experienced during an average week (r = .39 p < .001) and the frequency of stressful life events within the past year (r = .32 p < .001) (39). Additional studies reporting the PSS-10 to have good internal consistency and reliability include Barbosa-Leiker et al. (40) Golden-Kreutz et al. (41) and Reis et al. (42).

2. State Trait Anxiety Inventory - State Version (STAI-S) includes twenty questions reporting the intensity of participant anxiety at the moment of testing (43). The STAI-S was administered in the present study to measure how students' anxiety changes as a result of external factors in the moment. When completing the STAI-S, participants rate the intensity of their feelings on a scale from (1) not at all to (4) very much so. The STAI-S has shown good reliability and validity across the different normative groups; Cronbach's alpha = 0.86-0.95 (43). Construct validity was established in two studies by comparing the mean STAI-S scores of college students in anxiety-inducing conditions (43).

3. Self-rated stress scale (1-5). Participants rated their stress from 1-5 (1 = None 2 = Mild 3 = Moderate 4 = High 5 = Extreme).

Physiological Measures

1. Cortisol is a glucocorticoid secreted from the adrenal glands that is often used as a biomarker for stress (26). Hair cortisol acts as a proxy for total HPA activity in the preceding months; approximately one centimeter of hair growth from the scalp represents a preceding month of cortisol released (27). Cortisol from hair samples thus provides information about participant HPA activity retrospectively. Several studies have shown that hair cortisol levels can serve as a reliable approximation of average blood cortisol levels, pointing to the validity of this method relative to established standards (44,27). The hair samples in the present study were analysed at The Drug Safety Lab, Robarts Research Institute, Western University. The process implemented to extract the cortisol is provided in S1 File.

2. Heart rate variability (HRV) is a non-invasive measure of the autonomic nervous system as a reliable assessment of stress (28). Greater variability in heart rate can result in a greater ability to rapidly cope with uncertain and changing environments (29). In this study, HRV was collected using the Welltory smart phone application using the camera of a Samsung tablet or smart phone (S2 File). HRV data was measured using Standard Deviation of Normal-to-Normal Intervals (SDNN), which is a measure used to assess the variation in time intervals between normal heart beats. Participants placed their finger over the phone camera and flash for two minutes. Correlation analysis has shown an almost perfect correlation of the Welltory phone application against the ECG gold standard (45,46).

Measures taken before and after each music therapy session (Music Therapy Group only)

Two of the questionnaires and one of the physiological measures were also taken in the Music Therapy group before and after each music therapy session: STAI-S, Self-rated stress scale (1-5), and HRV.

Measures taken after six-weeks of music therapy (Music Therapy Group only)

A feedback survey was completed by participants in the music therapy group consisting of both closed and open questions.

4.5 Procedure

Students were recruited in two blocks from across campus via printed posters and social media platforms. In addition to the required study detail, the recruitment material communicated that participants would have a choice to participate in a draw for a chance to win one of five prizes of $50. Block 1of the study was offered during the winter

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semester, and block 2 of the study was offered in the Fall semester. An additional form of recruitment was added in block 2, in which students were also recruited from the course HUMBEHAV_2AP3 as an optional component of the course. Potential participants accessed the *Letter of Information* and the *Consent Form* as a Google form via email or a QR code. Students who provided consent received an ID number to complete an online demographic survey, the Goldsmith Music Sophistication Index (GOLD-MSI), the Ten Item Personality Inventory (TIPI) and the World Health Organization Quality of Life BREF (WHO-QOL- BREF). Participants were randomly assigned to the music therapy group or the control group. More participants were allocated to the control group than the music therapy group in anticipation of attrition based on a previous study (Finnerty et al., 2023). Participants in the music therapy group were provided a feedback survey at the end of the study, and participants in the control group were provided the opportunity to participate in one or two music therapy groups at the end of the six-week study period.

Music Therapy Group

Each group music therapy session was conducted in a private room in the University Student Centre building. The music therapists facilitating the music therapy groups were all credentialed and in good standing with the Canadian Association for Music Therapists. To minimize facilitator effects, five different music therapists facilitated the groups. A total of 21 undergraduate student research assistants, who were either completing a research project course for credit or volunteering, assisted with data collection (S3 File).

Upon arriving at the music therapy room, participants were asked to sit in one of the chairs that had been placed in a circle in the room. Research assistants provided each of the participants with a Samsung Tablet (or a link) which had been pre-loaded with the questionnaires to be filled out. In weeks 1 and 6, this included the PSS, STAI-S, and Self-rated stress scale. HRV was also taken using the Welltory Application on the tablets. The de-identified data from all the questionnaires were automatically input into a Google spreadsheet.

In weeks 1 and 6, the research assistants also collected a hair sample from each participant in the music therapy group as per the following steps: (1) cut a small sample of hair and place it on the paper provided in the kit, (2) fold the paper, and place the paper with the hair in the envelope provided. Hair samples were sent to the Drug Safety Laboratory at Western University, Ontario (S4 File).

In all 6 weeks, the Research Assistants gave the participants the tablets before and after each music therapy session to fill out the STAI-S and Self-rated stress scale as well as to record their HRV.

After the initial data had been collected, the research assistants left the music therapy room, and the music therapist conducted a 45-minute music therapy session. After each group music therapy session, the research assistants returned to the music therapy room to collect the end-of-session data. The interventions implemented in the music therapy group included listening to music, song writing, singing, lyric analysis, playing instruments, improvising, and verbal processing. The music therapy groups were informed by the model offered at the McMaster Student Wellness Centre, *Stress Less*

group, and Open Circle's guidelines (S5 File). More specific examples of interventions used in the music therapy group can be found in S6 File.

In block 1 of the study, one music therapy group was offered each week (~ 10 participants/group) for six-weeks, and in block 2 of the study, six music therapy groups were offered each week (~ 10 participants/group) for six-weeks.

Control Group

Participants in the control group were contacted via email in week 1 and week 6 of the study to schedule a day and time to come in to complete the Perceived Stress Scale, the STAI-S, and the self-rated stress scale (all via the Samsung tablets). At this time, their HRV was also recorded, and a hair sample collected for cortisol analysis. As with the Music Therapy Group, the de-identified data were automatically input into a Google spreadsheet.

4.6 Analysis Plan

Analyses were conducted using both JASP 0.14.1 and RStudio 2022.07.02.

4.6.1 Potential Co-variables

Initial exploratory linear regression models examined the relationships between each of the stress and outcome variables, and the potential co-variables of demographic data (gender, year of birth, Faculty of Study, current or previous use of medication, in-progress or completion of Introduction to Music Therapy Course, and previous or current engagement in therapy).

Additionally, exploratory correlations were examined between the outcome variables and each of the demographic variables, WHOQOL-BREF categories and

GOLD-MSI subcategories to determine whether any of these should be included in the main analyses. Correlations were conducted for each of the six demographic questions in relation to the changes in each stress and anxiety measure (cortisol, perceived stress, state anxiety, self-rated stress, and heart rate variability), and for each of the week-six WHOQOL- BREF categories (Physical Health, Psychological Health, Social Relationships, and Environmental Health), in relation to changes in the stress and anxiety measures (cortisol, perceived stress, state anxiety, self-rated stress, and heart rate variability). The week-six WHOQOL-BREF is reflective of the study period. Bayesian correlations were conducted for each of the five TIPI categories (1. Openness, 2. Conscientiousness, 3. Extraversion, 4. Agreeableness, and 5. Emotional Stability), in relation to the changes in each stress and anxiety measure (cortisol, perceived stress, state anxiety, self-rated stress, and heart rate variability), and for each of the six subscales of the GOLD-MSI categories (1. Active Engagement, 2. Perceptual Abilities, 3. Musical Training, 4. Singing Abilities, 5. Emotional response to music, and 6. general music sophistication), in relation to the changes in each stress and anxiety measures (cortisol, perceived stress, state anxiety, self-rated stress, and heart rate variability). Bayesian correlations were implemented as we hypothesized that neither personality types nor music sophistication would be related to therapy outcomes (47).

Two Main Questions

Question 1: *Does participating in a 45-minute group music therapy session reduce stress and anxiety from before to after the session?*

In the experimental group, linear mixed effect models were conducted to determine if there was a reduction in stress (self-rated stress scale (1-5), and anxiety (STAI-S) scores from before to after group music therapy sessions, as well as to determine if there was an average increase in heart rate variability from before to after group music therapy sessions, across the six-weeks. The models consisted of 'participants' as the random intercept, and the random slopes included 'Week' and pre-post music therapy measures.

Question 2: *Does participating in six weeks of weekly group music therapy sessions reduce stress and anxiety in comparison to the control group?*

One-tailed (between groups) Student's *t*-tests or Mann-Whitney-Wilcoxon test (if change data not normally distributed) were conducted to determine if changes from week 1 to week 6 in STAI-S scores, self-rated stress scale (1-5), heart rate variability, perceived stress scale, and cortisol scores were significantly different between the music therapy and control group.

Two Secondary Questions

Question 1: Do participants in music therapy report finding the intervention helpful for managing stress and anxiety?

A feedback form was provided to participants in the music therapy groups after the six-week block of music therapy. Descriptives were gathered for yes/no questions, and thematic analyses were conducted for open ended questions implementing a deductive and semantic approach.

Question 2: Would participants engage in music therapy if it was offered on campus?

Participants in the control group were provided an opportunity to participate in 1 or 2 music therapy groups via a google poll invitation. Results of the invitation were recorded, as well as the number attending.

4.7 Results

4.7.1 Potential Co-variables

Linear models revealed a weak influence of demographic variables in relation to the changes in the stress and anxiety outcome scores (S2 Table). Regarding the four WHOQOL-BREF categories, significant correlations ($p < .05$) were found between changes in anxiety scores and week-six Physical Health scores ($r = 0.19$), changes in anxiety and week-six Social Relationships ($r = 0.24$), and changes in stress and week-six Social Relationships ($r = 0.29$). After Bonferroni corrections, only the correlation between changes in stress (1-5) and week-six Social Relationships remained significant ($r(122) = 0.29$, $p=.02$). The week-six Social Relationships data did not meet the assumptions of normality; therefore the Mann-Whitney U-test was conducted to compare week-six Social Relationship scores between the music therapy group and the control group. The test revealed no significant difference in Social Relationships between the two groups, W=2385.5, $p = .25$ (S3 Table). Please see S2 Fig. for individual changes in WHOQOL-BREF scores by group. Therefore, none of the demographic variables or WHOQOL-BREF categories were included in the main analyses.

We conducted Bayesian correlations to explore the relationships between the five personality categories (TIPI) and the six GOLD-MSI categories with the outcome variables of change in anxiety, self-rated stress (1-5), PSS, and cortisol, under the

hypothesis of no relation. Bayesian correlations provided anecdotal to moderate evidence against all of these correlations (BF$_{10}$ 0.11-0.38), with the exception of changes in the variable state anxiety (STAI-S scores) and the GOLD-MSI category of Emotional Response to Music (BF$_{10}$ 1.8, r = -0.215), which only provided anecdotal evidence for a weak negative correlation (S4 and S5 Tables). Therefore, we did not include any of the potential co-variables in the analyses.

4.7.2 Two Main Questions

Question 1: Does participating in a 45-minute group music therapy session reduce stress and anxiety from before to after the session?

STAI-S, self-rated stress scores (1-5), and HRV were collected before and after each music therapy group session (n=67). The HRV data were not analysed beyond reporting descriptives due to questionable results and challenges incurred with the Welltory app (S6 Table). The average HRV using SDNN for a healthy 20 year old is 153 +/- 44 ms (49), and according to the Welltory website 149 ms is the average SDNN for young adults (50). In the present study the average SDNN of participants in week 1, in the music therapy group was 58 +/- 43 ms, with a range of 11ms - 319ms. This topic is discussed further in the Limitations section.

Linear mixed effects models were used to analyse the pre-post STAI-S and self-rated stress (1-5) scores that were collected across weeks (1-6). These models revealed significant reductions from pre-post group music therapy sessions in STAI-S, F(1, 341.7) = 82.03, p <.001, and self-rated stress scores (F(1, 377) = 48.8, p <.001), with large effect sizes (STAI-S, rank-biserial correlation, 0.91; and self-rated stress, rank-

biserial correlation 0.85). A significant effect of Week in STAI-S, $F(1, 59.8) = 29.96$, $p <$ .001, and self-rated stress scores, $F(1, 58) = 13.5$, $p < .001$, was also observed (Figure 1). Additionally, an interaction was observed between Week and STAI-S scores, $F(1,445.3) = 4.1$, $p = .04$, but not the self-rated stress scores, $F(1, 426.9) = 2.1$, $p = .15$. The main effects of week indicate that participants' anxiety and stress fluctuated from week to week. The significant interaction indicates that the magnitude of the benefit of the music therapy sessions for anxiety also varied across weeks. Because these fluctuations were consistent enough across individuals to produce significant effects, they likely reflect varying demands from week to week as the university term progressed. Weekly changes in STAI-S and self-rated stress are reported in S7 Table.

--------------------------- Insert Figure 1 -----------------------------

Question 2: Does participating in six weeks of weekly group music therapy sessions reduce stress and anxiety in comparison to the control group?

A total of 125 students (music therapy group $n=58$; control group $n=67$) completed the STAI-S in both week 1 and week 6. All change scores data met the assumptions of normality as per the Shapiro Wilk test. A one-tailed Student t-test comparing the average change in the STAI-S scores from week 1 to week 6 between the music therapy group and the control group revealed a reduction in STAI-S scores in the music therapy group in comparison to the control group, with a large effect size, $t(123) = 5.6$, $p = <.001$, $d = 1.02$ (Figure 2A).

A total of 125 students (music therapy group ($n=58$), control group ($n=67$)) completed the self-rated stress scale in both week 1 and week 6. The change scores did

not meet the assumptions of normality as per the Shapiro Wilk test. The Mann-Whitney U test was used to compare changes in self-rated stress scores from week 1 to week 6 between the music therapy group and the control group, revealing a significant reduction in perceived stress in the music therapy group in comparison to the control group, with a medium effect size, $W=3094$, $p = <.001$, $r =0.59$ (Figure 2B).

A total of 135 students (music therapy group ($n=63$), control group ($n=72$)) completed the perceived stress scale in both week 1 and week 6. The change scores met the assumptions of normality as per the Shapiro Wilk test. A one-tailed Student t-test comparing the average change in the perceived stress scale from week 1 to week 6 between the music therapy group and the control group revealed a reduction in perceived stress in the music therapy group in comparison to the control group with a medium effect size, $t(133)$ 2.9, $p = .002$, $d = 0.51$ (Figure 2C).

A total of 116 students (music therapy group $n=56$; control group $n=60$), provided paired hair samples in both week 1 and week 6. The change scores did not meet the assumptions of normality as per the Shapiro-Wilk test. Therefore, the one-tailed Mann-Whitney U test was used to compare average change scores in cortisol from week 1 to week 6 between the music therapy group and the control group. This revealed a reduction in cortisol in the music therapy group in comparison to the control group, with a small effect size, $W=2042$, $p = .023$, $r = 0.22$ (Figure 2D)

--------------------------- Insert Figure 2 -----------------------------

It should be noted that the average cortisol levels in the music therapy group were higher at baseline (266.3ng) than the control group (213.7 ng), but due to the non-

normality of the data, further exploration of the cortisol change scores using an ANOVA or linear model would not be appropriate. However, further exploration of the baseline scores was conducted using the Mann-Whitney U test, revealing a non-significant difference between groups at baseline, W=1338, $p = .06$. To further explore average cortisol at baseline for the music therapy and control group a Bayesian Mann-Whitney U test was conducted, revealing anecdotal evidence for no difference between groups at baseline (Bayes Factor 0.98).

Please see S1 Fig. for individual changes in each of the four stress and anxiety measures from week 1 to week 6, by group. One outlier in the measure of cortisol can be observed (S1D Fig.), however, the difference between groups remains significant with its removal.

4.7.3 Two Secondary Questions

Question 1: Do participants in music therapy report finding the intervention helpful for managing stress and anxiety?

Music therapy participants (n=68) completed a feedback form, which consisted of five questions. 71% of students responded that they found group music therapy helpful, and 66% responded that they would continue to participate in group music therapy if offered on campus. 122 comments were identified in response to an open-ended question (Question 2) which asked students what they found helpful/unhelpful. A thematic analysis was conducted on these responses revealing six subthemes related to helpfulness and five subthemes related to challenges (Figure 3). Responses to the five questions in the feedback form are displayed in S8 Table. Please refer to S8 File for individual responses.

-------------------------- Insert Figure 3 -----------------------------

Question 2: Would participants engage in music therapy if it was offered on campus?

Participants in the control group in Block 1 were provided the option to be in the music therapy group in Block 2 which was scheduled to take place in May 2023. Unfortunately, as there are fewer students on campus in the Spring semester, we held Block 2 in the Fall semester (October 2023). Block 2 was the final Block of the study and participants in the control group of Block 2 were offered the option to participate in one or two group music therapy sessions after the conclusion of the study. A total of 49/72 (68%) of participants from the control group in Block 2 responded to an email that included a google form asking their interest and availability to participate in group music therapy sessions. Five different dates and times were offered (the same days of the week and times that the group music therapy sessions had been offered during the six -week study period). 6/49 participants indicated they did not want to participate in a music therapy group. 32 participants indicated that they would like to attend one session, but 6/32 were unable to attend the dates offered. 11 indicated they would like to attend two sessions, but 4/11 were not available on the dates offered. In the end, 22/26 (85%) of the students who indicated they were interested and available to attend one session, actually attended one group music therapy session, and 4/7 (57%) of the students who indicated they were interested and available to attend two sessions, actually attended two group music therapy sessions.

4.7.4 Post-hoc Question

Data about quality of life were collected to determine if any of the quality-of-life categories needed to be considered as covariates in the stress and anxiety analyses. Week-6 data from the WHOQOL-BREF did not correlate with any of the stress and anxiety outcomes, but an average increase in quality-of-life scores was observed in the music therapy group and an average decrease in quality-of-life scores was observed in the control group over the 6-week period of the study. An exploratory post-hoc question was therefore developed: *Is there a difference in change scores across the 6 weeks of the intervention in any of the WHOQOL-BREF categories between the music therapy and control group?* If yes, these observations could suggest that engaging in music therapy positively influences ratings of quality of life.

A total of 131 students (music therapy group (*n*=62), control group (*n*=69)) completed the WHOQOL-BREF in both week 1 and week 6. The WHOQOL-BREF data are reported in four different categories: (1) Physical Health, (2) Psychological Health, (3) Social Relationships and (4) Environmental Health. Independent t-tests were conducted between the music therapy and control group comparing change scores of each of the four categories of quality of life to determine if any of these increases were significant. This revealed a significantly greater increase in participants' Psychological Health scores in the music therapy group in comparison to the control group, with a medium effect size (t(130)=-2.57, p = .01, d=0.45) (S9 Table). Please see S2 Fig. for individual changes in stress and anxiety measures by group.

4.8 Discussion

Mental health interventions for undergraduate students are often reactive rather than proactive. In recognition of the paucity of research exploring proactive interventions for wellness on campus, the present randomized controlled trial was conducted to explore the use of group music therapy to proactively manage undergraduate university students' stress and anxiety. Considering that the highest levels of anxiety (33.5%) and depression (27.7%) are observed among younger Canadians (15-39 years of age) in comparison to other age groups (51) and that globally suicide is the fourth leading cause of death among youth aged 15-29 (53), preventative strategies for undergraduate university students are required.

In the present study, we found that participating in a 45-minute group music therapy session reduced stress and anxiety, as measured by changes in the STAI-S and self-rated stress of participants from before to after individual sessions. These observations provide support for immediate, short-term relief of stress and anxiety. This is important as experiencing low levels of stress, even for a short period of time, can have benefits (30). Further, over the six weeks of the study, stress and anxiety decreased to a greater extent in those who participated in the six weeks of therapy in comparison to those in a student-life-as-usual control group, as measured by the STAI-S, self-rated stress, PSS, and hair cortisol. Thus, both self-report and physiological measures indicated that group music therapy is effective in a proactive group setting.

Despite random assignment to group, hair cortisol was higher on average at the beginning of the study in the participants in the music therapy group compared to those in the control group, although these baseline measures were not statistically significant

between groups. Analysing cortisol from hair samples is still a relatively new measure (54), and there are no established normative scores for cortisol. As such, we analysed the average within-participant changes in cortisol levels between groups, as opposed to comparing the average cortisol levels between groups at the end of the study. This within-participant study design also helped to reduce potential variability associated with demographic factors, hair color, and hair washing regimes (55).

The present study also asked participants in the music therapy group about their experience of music therapy, and if they would continue to seek out music therapy if it was offered on campus. 71% of the participants in the music therapy group reported that they found music therapy helpful for proactive management of stress and anxiety, and 66% stated that they would continue to seek out music therapy if it was offered on campus. Participants in the control group were offered the option to participate in group music therapy after the completion of the study period. 68% expressed interest, and 79% of these actually attended a music therapy class (a number had scheduling conflicts), providing confirmation of interest in group music therapy. Together, these responses highlight that students are interested in options beyond verbal-therapies, and the importance of offering more choices for student wellness on campus. Providing more choices to engage in wellness enhances student autonomy and offering supports inclusive of music can help to reduce the stigma associated with therapy, as music is often associated with healthy and socially acceptable activities (8,7).

The present research study also highlights the potential universal benefits of group music therapy despite participant differences in demographics, music sophistication

scores, and personality traits. Using inferential and Bayesian statistics, we found that changes in stress and anxiety over the six-week study period did not significantly correlate with any of the demographic information collected, including gender, ethnicity, area of study, age, or previous/current engagement in therapy/medications. Regarding differences in music sophistication scores, the profession of music therapy is based on an assumption that all humans can engage in music therapy regardless of background or experience with music, despite music being the therapeutic tool through the use of singing, song writing, listening, improvising, and lyric analysis. After conducting Bayesian correlations between the six GOLD-MSI categories and changes in the stress and anxiety measures, the low Bayes Factors indicated anecdotal to moderate evidence that changes in stress and anxiety scores did not differ as a result of music sophistication (GOLD-MSI scores). To our knowledge, this is the first study to explore correlations between the GOLD-MSI domains and changes in stress and anxiety as a result of participation in a therapy context. The third potential covariate that we explored was personality traits. Previous research suggests that personality domains are correlated with an individual's propensity for stress management (31). In our study, Bayesian correlations indicated anecdotal to moderate evidence for weak correlations between the different personality traits and changes in stress and anxiety measures. There is a paucity of research about personality traits and changes in stress or anxiety pre-post therapy. Our research contributes to this gap and supports that personality domains are not strong predictors of therapy outcomes (32,33). Collectively, the exploration of these three potential covariates demonstrates that individual differences in demographics, music

sophistication, and personality traits, are not strong predictors of successful outcomes in group music therapy, highlighting its universal effect.

In addition to its effects, accessibility and universality, group music therapy is cost-effective. By accommodating up to 10 students per session, group music therapy not only addresses individual needs, but also alleviates strains on overall campus support systems. This proactive approach helps to mitigate crisis events and foster a campus culture of wellness, thereby promoting a financially viable healthcare model (56,57). The role of stress in adverse mental and physical health outcomes underscores the importance of proactive group interventions. Research has shown that proactive stress management can reduce the risk of conditions such as dementia (31), diabetes (58), and coronary heart disease (59). As well, it can assist with symptom management, potentially minimizing the need for costly supports associated with conditions like dementia (60).

To support proactive wellness options on campus to manage stress and anxiety, universities might consider including mental health options and experiences as part of course curricula. This can help to normalize proactive mental health practices and remove logistical barriers to accessing support. For instance, in our study, many students were recruited through a course offering that included an experiential component related to mental health. By incorporating wellness activities into course requirements, students can access mental health support without the burden of scheduling additional time amidst their academic and extracurricular commitments. The promotion of mental health opportunities by professors is essential for fostering a proactive wellness culture on campus. By making mental health supports logistically accessible and integrating them

into academic programs, universities can play a vital role in promoting student well-being.

Overall, integrating stress management strategies like group music therapy on university campuses is effective for stress and anxiety management, is universally accessible, promotes a positive mental health campus culture, and offers a cost-effective solution to the increasing challenge of meeting the mental health needs of students.

4.9 Limitations

There were a few reasons why not all data were collected from all participants. First, regarding the collection of the hair samples, some participants did not feel comfortable having a research assistant cut a sample of hair. And some who did provide the first sample, did not feel comfortable providing a second hair sample six weeks later. While this reduced the total number of paired hair samples we could analyze, the sample size was still large enough to meet the a priori power analysis. Second, and more seriously, the heart rate variability data was sufficiently noisy that it was unanalyzable. As we needed a simple, cost-effective, portable option, we chose the free version of the Welltory Application (46, 47). However, as described above, the data were not reliable, perhaps because the readings took place within a group setting, where there was talking and distractors, despite attempts to keep this to a minimum. Collecting HRV across participants with different devices could have also contributed to the variability. For future applications, it would likely be better to use individual application licenses or a more traditional measure of heart rate. Third, data were not collected if a participant arrived late to a music therapy session, or needed to leave early, as the group nature of the

sessions did not allow time flexibility. Therefore, the participation numbers for some weeks are higher than the data points collected. As well, although attendance to the music therapy groups was generally good, there was a bus strike and several student protests during the study period, which likely effected attendance. Fourth, females are overrepresented in this study, which is reflective of undergraduate students at the university. Finally, recognizing that the control group was engaging in 'student life as usual', it is possible that the results of this study are reflective of the Hawthorne effect. However, previous research has found music therapy to be as effective, or to outperform the standard of care (5,11,63), and those in the control group were offered the chance to participate in two music therapy sessions at the end of the study.

4.10 Conclusion

The present randomized control trial highlights the benefits of offering group music therapy on campus to undergraduate university students as a proactive intervention for stress and anxiety related to student life. Significant average reductions in all measures of stress and anxiety were observed from week 1 to week 6 in the music therapy group in comparison to the control group. Specifically, this included the self-report questionnaires STAI-S, Self-rated stress (1-5), and Perceived Stress Scale, as well as the physiological hair cortisol measure. Significant average reductions in anxiety (STAI-S) and self-rated stress (1-5) were also observed from before to after each of the group music therapy sessions. Outcomes were largely independent of demographic variables, music sophistication, or personality traits, suggesting that group music therapy can positively affect stress and anxiety outcomes regardless of differences in these domains. This study

elucidates the effectiveness of group music therapy and the benefits of including group music therapy as part of a proactive student wellness campus culture.

4.11 Acknowledgments

4.12 References

1. Pin L, Martin C. Student Health: Bringing Healthy Change to Ontario's Universities. Toronto: Ontario Undergraduate Student Alliance; 2012.

2. Rosenthal B, Wilson WC. Mental health services: Use and disparity among diverse college students. J Am Coll Health. 2008;57(1):61-68. https://doi.org/10.3200/JACH.57.1.61-68.

3. Linden B, Stuart H, Ecclestone A. Trends in post-secondary student stress: A pan-Canadian study. Can J Psychiatry. 2022;070674372211113.

4. Moghimi E, Stephenson C, Gutierrez G, et al. Mental health challenges, treatment experiences, and care needs of post-secondary students: A cross-sectional mixed-methods study. BMC Public Health. 2023;23:655. https://doi.org/10.1186/s12889-023-15452-x.

5. Read A, Lutgens D, Malla A. A Descriptive Overview of Mental Health Services Offered in Post-Secondary Educational Institutions Across Canada. Can J Psychiatry. 2023;68(2):101-108. DOI: 10.1177/07067437221128168.

6. Rutan JS. Reasons for Suggesting Group Psychotherapy to Patients. Am J Psychother. 2021;74(2):67-70. https://doi.org/10.1176/appi.psychotherapy.20200032.

7. Tuastad L, Johansen B, Østerholt AL, Nielsen I, McIvor DSH. Being a person who plays in a band rather than being a person with a mental illness playing in a band: A qualitative study of stigma in the context of music therapy in mental health aftercare. Nord J Music Ther. 2022;32(2):121-139. https://doi.org/10.1080/08098131.2022.2075437.

8. Rosenthal B, Wilson WC. Mental health services: Use and disparity among diverse college students. J Am Coll Health. 2008;57(1):61-68. https://doi.org/10.3200/JACH.57.1.61-68.

9. Finnerty R, McWeeny S, Trainor LJ. Online Group Music Therapy: Proactive Management of Undergraduate Students' Stress and Anxiety. Front Psychiatry. 2023;14(4):1183311.

10. Beck BD, Meyer SL, Simonsen E, Søgaard U, Petersen I, Arnfred SMH, Tellier T, Moe T. Music therapy was noninferior to verbal standard treatment of traumatized refugees in mental health care: Results from a randomized clinical trial. Eur J Psychotraumatol. 2021;12(1):1930960. https://doi.org/10.1080/20008198.2021.1930960.

11. Gold C, Mössler K, Grocke D, Heldal TO, Tjemsland L, Aarre T, Aarø LE, Rittmannsberger H, Stige B, Assmus J, Rolvsjord R. Individual Music Therapy for Mental Health Care Clients with Low Therapy Motivation: Multicentre Randomised Controlled Trial. Psychother Psychosom. 2013;82(5):319-331. https://doi.org/10.1159/000348452.

12. Beyers KL. A history of the music therapy profession: Diverse concepts and practices. 2016.

13. Caponnetto P, LaMattina G, Quattropani MC. Music therapy and psychological clinical impact in surgery: A systematic review. Health Psychol Res. 2022. https://doi.org/10.52965/001c.38615.

14. Carter T, Panisch LS. A systematic review of music therapy for psychosocial outcomes of substance use clients. Int J Ment Health Addict. 2021;19:1551-1568. https://doi.org/10.1007/s11469-020-00246-8.

15. Lam HL, Li WTV, Laher I, Wong RY. Effects of music therapy on patients with dementia-A systematic review. Geriatrics. 2020;5(4):62. https://doi.org/10.3390/geriatrics5040062.

16. Liwang F, Nadobudskaya D, Lestari I, Hendrarto T. Preterm infant physiological responses to music therapy: A systematic review. Paediatr Indones. 2018;58(5):242-251. https://doi.org/10.14238/pi58.5.2018.242-51.

17. Marquez-Garcia AV, Magnuson J, Morris J, Iarocci G, Doesburg S, Moreno S. Music therapy in autism spectrum disorder: A systematic review. Rev J Autism Dev Disord. 2021;9(1):91-107. https://doi.org/10.1007/s40489-021-00246-x.

18. Ansdell G. Community music therapy and the winds of change-A discussion paper. In: Kenny C, Stige B, editors. Contemporary Voices in Music Therapy: Communication, Culture and Community. Oslo Norway: Unipub Forlag; 2002. p. 109-143.

19. Geretsegger M, Mössler KA, Bieleninik Ł, Chen XJ, Heldal TO, Gold C. Music therapy for people with schizophrenia and schizophrenia-like disorders. Cochrane Database Syst Rev. 2017;5:CD004025. https://doi.org/10.1002/14651858.CD004025.pub4.

20. Castillo-Pérez S, Gómes-Pérez V, Velasco MC, Pérez-Campos E, Mayoral M. Effects of music therapy on depression compared with psychotherapy. Arts Psychother. 2010;37:387-390.

21. Erkkilä J, Punkanen M, Fachner J, Ala-Ruona E, Pöntiö I, Tervaniemi M, Gold C. Individual music therapy for depression: Randomised controlled trial. Br J Psychiatry. 2011;199:132-139.

22. Lin M, Hsieh Y, Hsu Y, Fetzer S, Hsu M. A randomised controlled trial of the effect of music therapy and verbal relaxation on chemotherapy-induced anxiety. J Clin Nurs. 2011;20:988-999.

23. Talwar N, Crawford MJ, Maratos A, Nur U, McDermott O, Procter S. Music therapy for in-patients with schizophrenia: Exploratory randomised controlled trial. Br J Psychiatry. 2006;189:405-409.

24. Yang M, Li L, Zhu H, Alexander IM, Liu S, Zhou W, Ren X. Music therapy to relieve anxiety in pregnant women on bedrest: A randomized, controlled trial. Am J Matern Child Nurs. 2009;34:316-323.

25. Dhama K, Latheef SK, Dadar M, Samad HA, Munjal A, Khandia R, Karthik K, Tiwari R, Yatoo MI, Bhatt P, Chakraborty S, Singh KP, Iqbal HMN, Chaicumpa W, Joshi SK. Biomarkers in stress related diseases/disorders: Diagnostic, prognostic, and

therapeutic values. Front Mol Biosci. 2019;6:91.
https://doi.org/10.3389/fmolb.2019.00091.

26. Wright KD, Hickman R, Laudenslager ML. Hair cortisol analysis: A promising biomarker of HPA activation in older adults. Gerontologist. 2015;55(Suppl 1):S140-S145. https://doi.org/10.1093/geront/gnu174.

27. Kim HG, Cheon EJ, Bai DS, Lee YH, Koo BH. Stress and heart rate variability: A meta-analysis and review of the literature. Psychiatry Investig. 2018;15(3):235-245. https://doi.org/10.30773/pi.2017.08.17.

28. Shaffer F, Ginsberg JP. An Overview of Heart Rate Variability Metrics and Norms. Front Public Health. 2017;5:258. https://doi.org/10.3389/fpubh.2017.00258.

29. Jones BJ, Kaur S, Miller M, Spencer RMC. Mindfulness-based stress reduction benefits psychological well-being, sleep quality, and athletic performance in female collegiate rowers. Front Psychol. 2020;11:572980. https://doi.org/10.3389/fpsyg.2020.572980.

30. Luo J, Zhang B, Cao M, Roberts BW. The Stressful Personality: A Meta-Analytical Review of the relation between personality and stress. Pers Soc Psychol Rev. 2022;27(2):128-194. https://doi.org/10.1177/10888683221104002.

31. Vassend O, Willumsen T, Hoffart A. Effects of dental fear treatment on general distress. Behav Modif. 2000;24(4):580-599. https://doi.org/10.1177/0145445500244006.

32. Steinert C, Klein S, Leweke F, Leichsenring F. Do personality traits predict outcome of psychodynamically oriented psychosomatic inpatient treatment beyond initial symptoms? Br J Clin Psychol. 2014;54(1):109-125. https://doi.org/10.1111/bjc.12064.

33. Jaworska N, De Somma E, Fonseka B, Heck E, MacQueen GM. Mental health services for students at postsecondary institutions: A national survey. Can J Psychiatry. 2016;61(12):766-775. https://doi.org/10.1177/0706743716640752.

34. Müllensiefen D, Gingras B, Musil J, Stewart L. The musicality of non-musicians: An index for assessing musical sophistication in the general population. PLoS One. 2014;9(2). https://doi.org/10.1371/journal.pone.0089642.

35. Planner C, Bower P, Donnelly A, Gilles K, Turner K, Young B. Trials need participants but not their feedback? A scoping review of published papers on the measurement of participant experience of taking part in clinical trials. Trials. 2019;20:381. https://doi.org/10.1186/s13063-019-3444-y.

36. Faul F, Erdfelder E, Lang AG, Buchner A. G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. Behav Res Methods. 2007;39(2):175-191. https://doi.org/10.3758/bf03193146.

37. Gosling SD, Rentfrow PJ, Swann WB Jr. A very brief measure of the big five personality domains. J Res Pers. 2003;37(6):504-528. https://doi.org/10.1016/S0092-6566(03)00046-1.

38. WHOQOL Group. WHO-BREF Manual.

39. Cohen S. Perceived stress in a probability sample of the United States. In: Spacapam S, Oskamp S, editors. The Social Psychology of Health. Newbury Park, CA: Sage; 1988. p. 31-67.

40. Cohen S, Kamarck T, Mermelstein R. Perceived Stress Scale [Database record]. APA PsycTests. 1983. https://doi.org/10.1037/t02889-000.

41. Barbosa-Leiker C, Kostick M, Lei M, McPherson S, Roper V, Hoekstra T, Wright B. Measurement invariance of the perceived stress scale and latent mean differences across gender and time. Stress Health. 2013;29(3):253-260. https://doi.org/10.1002/smi.2463.

42. Golden-Kreutz DM, Browne MW, Frierson GM, Andersen BL. Assessing stress in cancer patients: A second-order factor analysis model for the perceived stress scale. Assessment. 2004;11(3):216-223. https://doi.org/10.1177/1073191104267398.

43. Reis RS, Hino AA, Rodriguez-Añez CR. Brazilian perceived stress scale. PsycTESTS Dataset. 2010. https://doi.org/10.1037/t15878-000.

44. Spielberger CD. State-Trait Anxiety Inventory for adults. PsycTESTS Dataset. 1983. https://doi.org/10.1037/t06496-000.

45. Cirimele V, Kintz P, Dumestre V, Goullé JP, Ludes B. Identification of ten corticosteroids in human hair by liquid chromatography–ionspray mass spectrometry. Forensic Sci Int. 2000;107(1-3):381-388. https://doi.org/10.1016/s0379-0738(99)00180-2.

46. Plews DJ, Scott B, Altini M, Wood M, Kilding AE, Laursen PB. Comparison of heart-rate-variability recording with smartphone photoplethysmography, Polar H7 chest strap, and electrocardiography. Int J Sports Physiol Perform. 2017;12(10):1324-1328. https://doi.org/10.1123/ijspp.2016-0668.

47. Moya-Ramón M, Mateo-March M, Peña-González I, Zabala M, Javaloyes A. Validity and reliability of different smartphone applications to measure HRV during short and

ultra-short measurements in elite athletes. Comput Methods Programs Biomed. 2022;217:106696. https://doi.org/10.1016/j.cmpb.2022.106696.

48. National Academies Press (US). Using Bayes analysis for hypothesis testing. Reproducibility and Replicability in Science. 2019. https://www.ncbi.nlm.nih.gov/books/NBK547526/.

49. Umetani K, Singer DH, McCraty R, Atkinson MD. Twenty-Four Hour Time Domain Heart Rate Variability and Heart Rate: Relations to Age and Gender over Nine Decades. J Am Coll Cardiol. 1998;31(3):593-601. https://doi.org/10.1016/s0735-1097(97)00554-8.

50. Welltory. RMSSD, pNN50, SDNN and other HRV measurements. Welltory. 2023. https://welltory.com/rmssd-and-other-hrv-measurements/.

51. Anxiety, feelings of depression and loneliness among Canadians spikes to highest levels since spring 2020. CAMH. 2024. https://www.camh.ca/en/camh-news-and-stories/anxiety-depression-loneliness-among-canadians-spikes-to-highest-levels.

52. Centre for Addiction and Mental Health. Anxiety, feelings of depression and loneliness among Canadians spikes to highest levels since spring 2020. CAMH. 2022. Retrieved February 24, 2023, from https://www.camh.ca/en/camh-news-and-stories/anxiety-depression-loneliness-among-canadians-spikes-to-highest-levels.

53. Public Health Agency of Canada. Suicide in Canada: Key Statistics (infographic). 2023. https://www.canada.ca/en/public-health/services/publications/healthy-living/suicide-canada-key-statistics-infographic.html.

54. World Health Organization: WHO. Suicide. 2021. https://www.who.int/news-room/fact-sheets/detail/suicide.

55. Raul J, Cirimele V, Ludes B, Kintz P. Detection of physiological concentrations of cortisol and cortisone in human hair. Clin Biochem. 2004;37(12):1105-1111. https://doi.org/10.1016/j.clinbiochem.2004.02.010.

56. Stalder T, Steudte-Schmiedgen S, Alexander N, Klucken T, Vater A, Wichmann S, Kirschbaum C, Miller R. Stress-related and basic determinants of hair cortisol in humans: A meta-analysis. Psychoneuroendocrinology. 2017;77:261-274. https://doi.org/10.1016/j.psyneuen.2016.12.017.

57. Epel ES, Crosswell AD, Mayer SE, Prather AA, Slavich GM, Puterman E, Mendes WB. More than a feeling: A unified view of stress measurement for population science. Front Neuroendocrinol. 2018;49:146-169. https://doi.org/10.1016/j.yfrne.2018.03.001.

58. McEwen BS. The brain on stress: How behavior and the social environment "get under the skin." In: Kaplan R, Spittel M, David DH, editors. Population Health:

Behavioral and Social Science Insights. Rockville, MD: Agency for Healthcare Research and Quality and Office of Behavioral and Social Sciences Research, National Institutes of Health; 2015. p. 233-250.

59. Luo J, Beam CR, Gatz M. Is Stress an Overlooked Risk Factor for Dementia? A Systematic Review from a Lifespan Developmental Perspective. Prev Sci. 2022;24(5):936-949. https://doi.org/10.1007/s11121-022-01385-1.

60. Sharma K, Akre S, Chakole S, Wanjari MB. Stress-Induced Diabetes: A review. Cureus. 2022. https://doi.org/10.7759/cureus.29142.

61. Richardson S, Shaffer JA, Falzon L, Krupka DJ, Davidson KW, Edmondson D. Meta-Analysis of perceived stress and its association with incident coronary heart disease. Am J Cardiol. 2012;110(12):1711-1716. https://doi.org/10.1016/j.amjcard.2012.08.004.

62. Bleibel M, Cheikh AE, Sadier NS, Abou-Abbas L. The effect of music therapy on cognitive functions in patients with Alzheimer's disease: a systematic review of randomized controlled trials. Alzheimers Res Ther. 2023;15(1). https://doi.org/10.1186/s13195-023-01214-9.

63. Maratos A, Gold C. Music therapy for depression. Cochrane Database Syst Rev. 2003. https://doi.org/10.1002/14651858.cd004517.

4.13 Figures
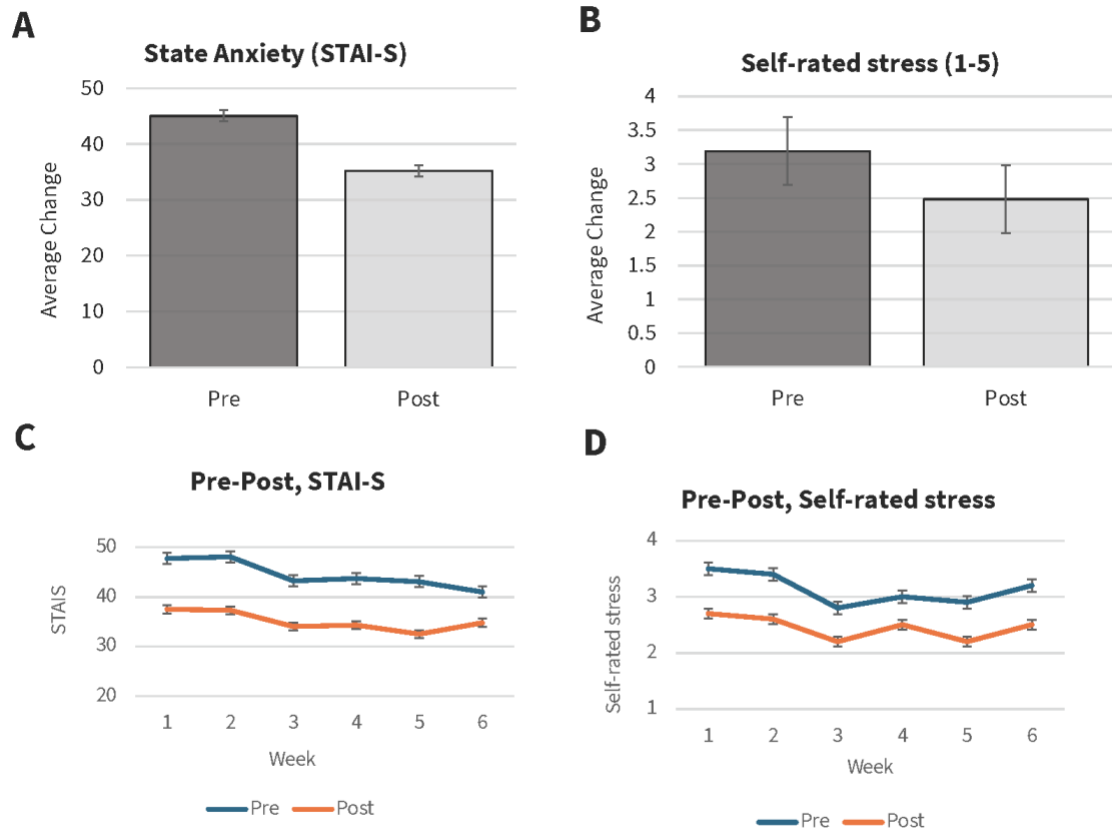
Figure 1. Average Changes in (**A**) state anxiety (STAI-S) and (**B**) self-rated stress from pre- to post- each music therapy session and average pre-post scores across weeks in (**C**) STAI-S and (**D**) self-rated stress. Error bars reflect ±1 standard error of the mean.
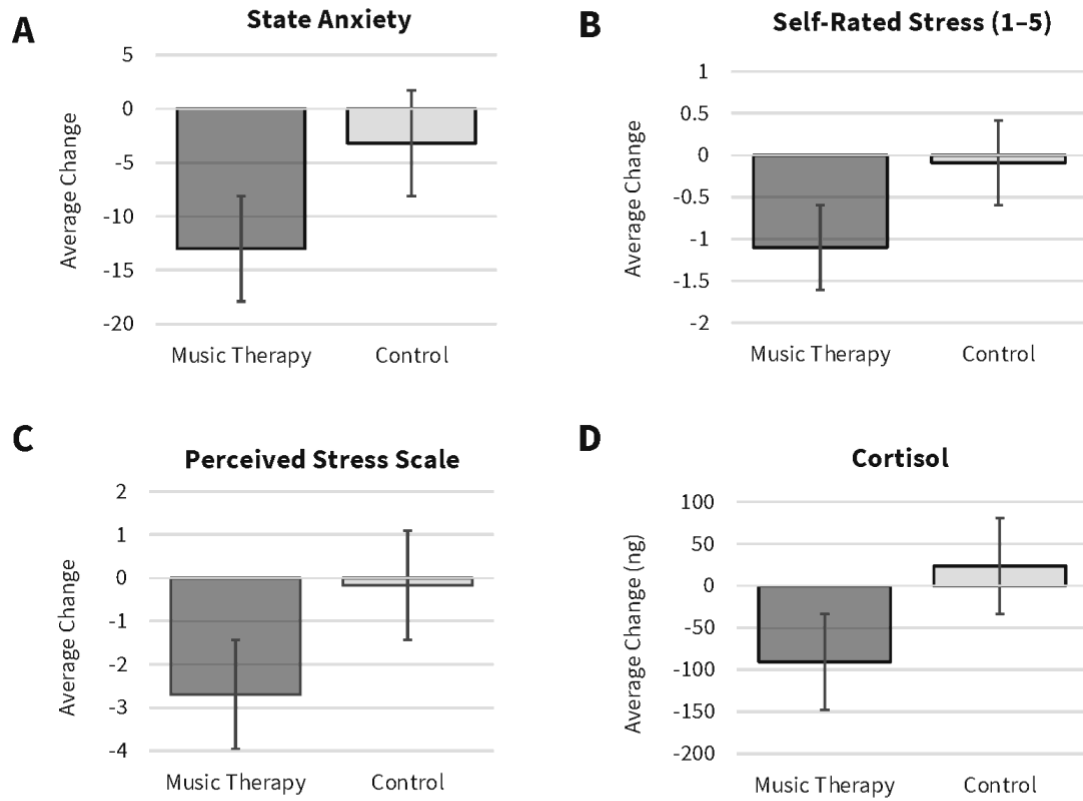
Figure 2. Week 1 to Week 6 changes in STAI-S, Self-rated stress, PSS and Cortisol.
Average change in (A) state anxiety (STAI-S), (B) self-rated stress (C) Perceived Stress Scale and (D) cortisol by group, from week 1 to week 6. Error bars reflect ±1 standard error of the mean.

Figure 3. Six themes related to group music therapy being helpful (total comments = 85); and five themes related to the challenges of engaging in group music therapy (total comments = 37)

4.14 Supplemental Material
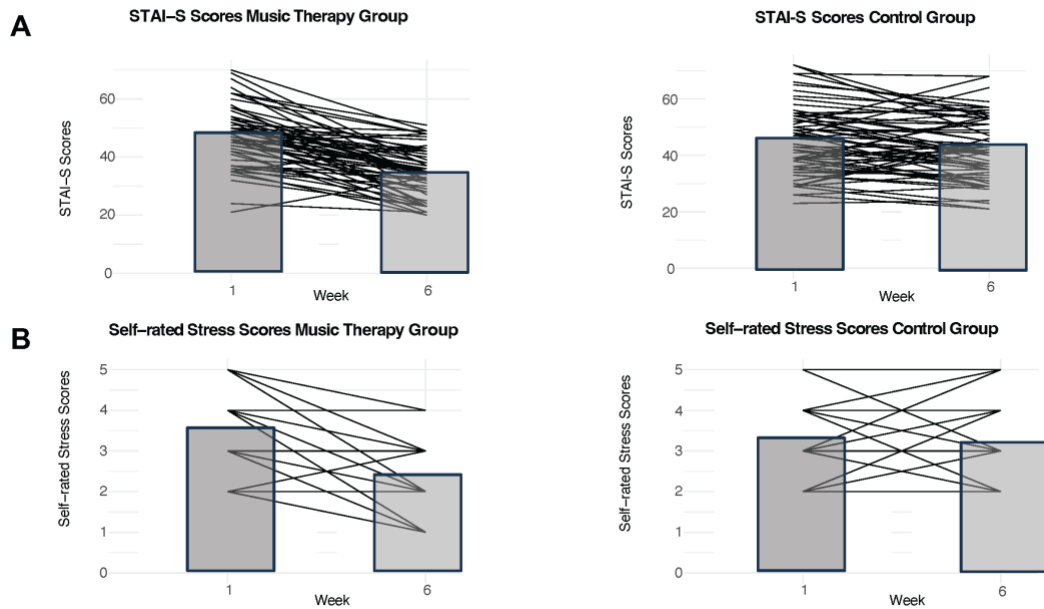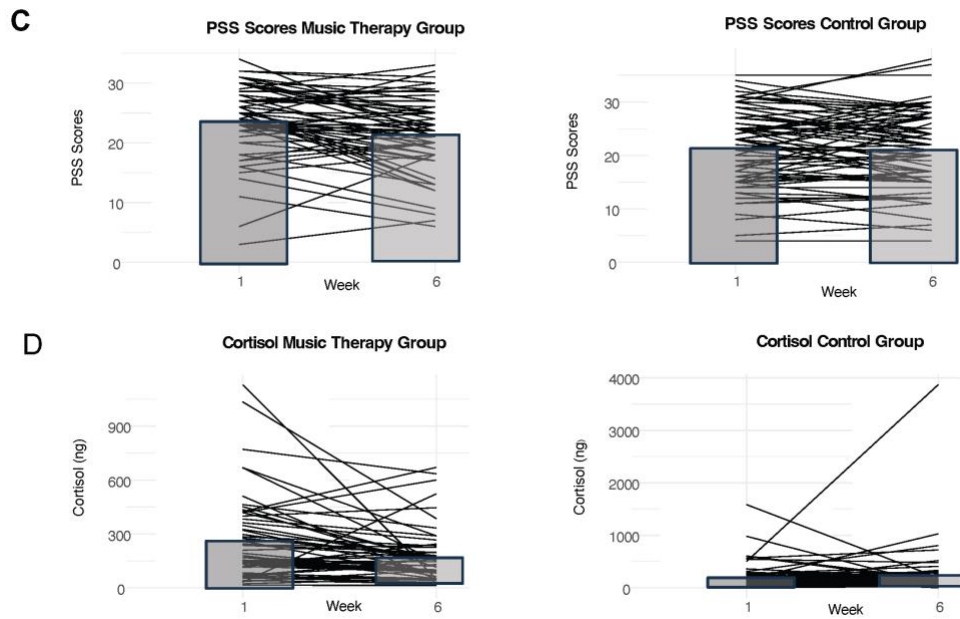
S1 Fig. Changes in Stress and Anxiety by group. Individual changes in (A) STAI-S, (B) Self-rated Stress, (C) PSS and (D) Cortisol by group.
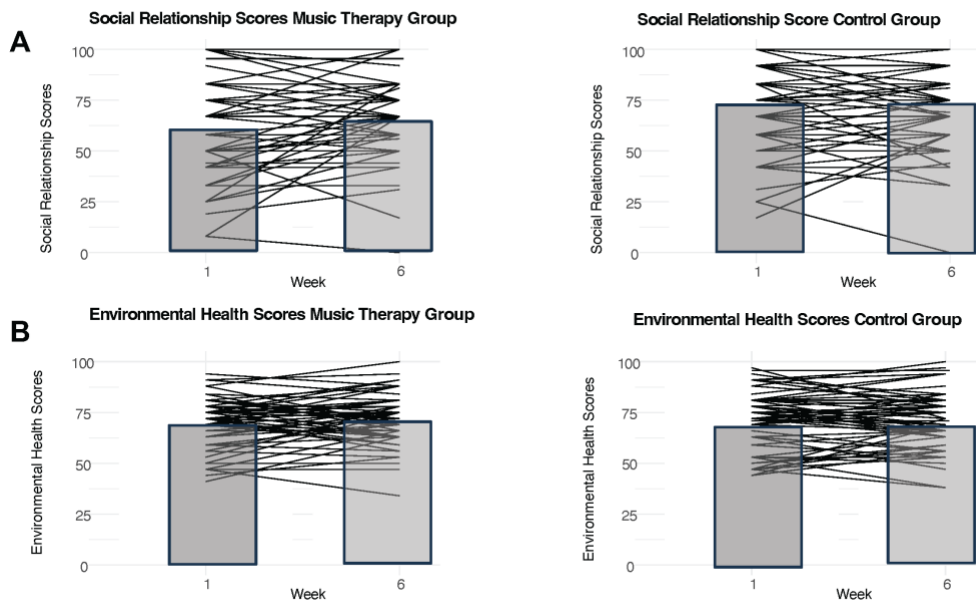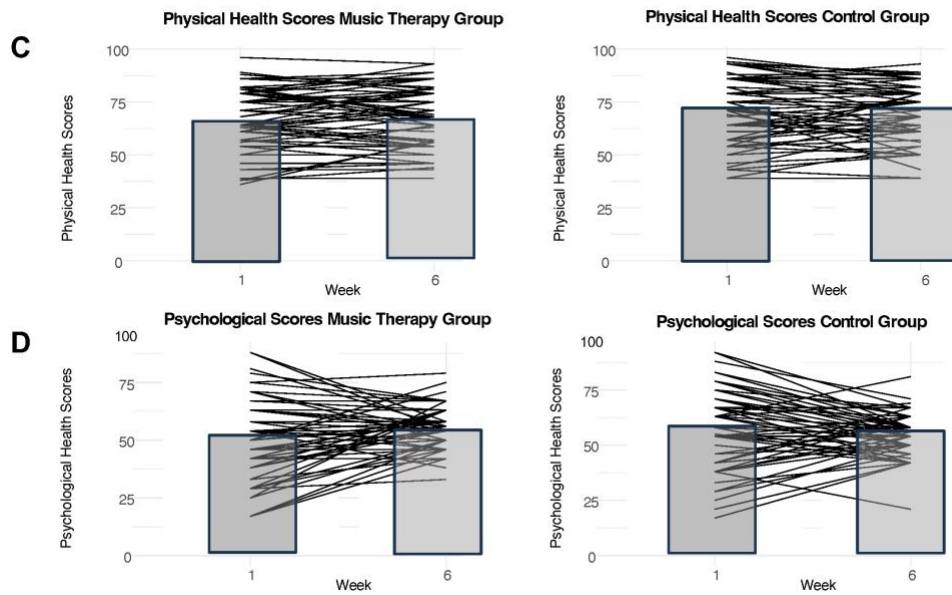
S2 Fig. WHOQOL-BREF scores by group. Individual changes in (A) Physical Health, (B) Psychological Health, (C) Social Relationships and (D) Environmental Health.

S1 Table: Participants' Self-Described Ethnicity

Group	Self-described	Category
MT	Black	Black
C	Black	Black
MT	Guyanese	Caribbean
MT	Caribbean	Caribbean
C	Canadian born – Trinidadian and Congolese	Caribbean
C	Jamaica	Caribbean
C	½ trinidadian ½ guyanese	Caribbean
C	Trinidadian, Jamaican, and Vincentian	Caribbean
MT	Chinese	East Asian
MT	Chinese	East Asian
MT	Chinese	East Asian
MT	Filipino	East Asian
MT	Korean	East Asian
C	Filipino	East Asian
C	Chinese	East Asian
C	Korean	East Asian

C	East Asian	East Asian
C	Asian (Chinese)	East Asian
C	Chinese	East Asian
C	Mainland Chinese, Shan Xi	East Asian
C	Korean	East Asian
C	East Asian	East Asian
MT	European (England and Ireland)	European (white)
MT	Italy	European (white)
MT	Caucasian (white)	European (white)
MT	Caucasian	European (white)
MT	White	European (white)
MT	White Canadian	North American
MT	Italian	European (white)
MT	Caucasian	European (white)
MT	Caucasian	European (white)
MT	Caucasian	European (white)
MT	Greek and Cypriot Canadian	European (white)
MT	Canadian citizen (Greek and Italian ethnicities)	European (white)
MT	Romanian	European (white)
MT	White	European (white)
MT	British	European (white)
MT	Caucasian	European (white)
MT	Caucasian	European (white)
MT	Caucasian	European (white)
MT	Caucasian	European (white)
MT	Taiwanese	East Asian
MT	White	European (white)
MT	European	European (white)
MT	European	European (white)
MT	White	European (white)
MT	White	European (white)
MT	White	European (white)
C	Caucasian	European (white)
C	Spanish/Irish	European (white)
C	My background is Romanian, my entire family is from there, but I was born and raised in Canada	European (white)

C	European	European (white)
C	European	European (white)
C	Ukrainian (Caucasian)	European (white)
C	White	European (white)
C	White	European (white)
C	Caucasian	European (white)
C	Canadian	North American
C	European	European (white)
C	White	European (white)
C	White	European (white)
C	Caucasian	European (white)
C	European descent	European (white)
C	Caucasian	European (white)
C	Italian & French Canadian	European (white)
C	Caucasian	European (white)
C	White (English)	European (white)
C	Caucasian, born in Ukraine	European (white)
MT	Kichwa-Otavalo Ecuador (indigenous)	Indigenous
C	Canadian & Métis	Indigenous
C	Indigenous-White	Indigenous
C	Jewish	Jewish
C	Latina	Latino
C	Latin	Latino
MT	Middle eastern	Middle Eastern
MT	Lebanese	Middle Eastern
MT	I am Syriac Middle Eastern	Middle Eastern
MT	Egyptian	Middle Eastern
MT	Persian	Middle Eastern
MT	Iraqi Turkmen	Middle Eastern
MT	Caucasian	Middle Eastern
MT	Asian	Middle Eastern
C	Born in Saudi, lived in India, now a Canadian citizen	Middle Eastern
C	Iranian/Persian	Middle Eastern
C	Persian	Middle Eastern
C	Iranian	Middle Eastern
C	Middle eastern	Middle Eastern
MT	Vietnamese Chinese	Mixed Ethnicity

MT	French, English and Metis	Mixed Ethnicity
C	Italian/ Arab	Mixed Ethnicity
C	Indigenous and European Canadian	Mixed Ethnicity
C	I am half Japanese, Italian and Irish	Mixed Ethnicity
C	Canadian born, parents are Romanian and Armenian.	Mixed Ethnicity
C	Caribbean, West Indian	Mixed Ethnicity
C	Chinese, Vietnamese	Mixed Ethnicity
C	Canadian, Portuguese	Mixed Ethnicity
C	Half Filipino with a little bit of Spaniard, Half white: French, English, Scottish, Irish, with a little bit of Ojibwe	Mixed Ethnicity
C	Egyptian	North African
C	Arab (North African)	North African
MT	Canadian	North American
MT	Canadian	North American
MT	French Canadian	North American
C	Canadian	North American
C	Canadian	North American
C	Canadian	North American
MT	Sri-Lankan Canadian	South Asian
MT	South Asian (Punjabi)	South Asian
MT	South Asian	South Asian
MT	Pakistani	South Asian
MT	Bangladeshi	South Asian
MT	Pakistani	South Asian
MT	Bangladesh, South Asian	South Asian
MT	South Asian- Indian	South Asian
MT	Indian – Punjabi	South Asian
MT	Indian/South Asian	South Asian
MT	Sri Lankan	South Asian
MT	Asian	South Asian
C	Sri Lankan	South Asian
C	South Asian	South Asian
C	Indian	South Asian
C	South Asian	South Asian
C	Indian	South Asian

C	Pakistani	South Asian
C	Filipino	South Asian
C	India	South Asian
C	South Asian (Pakistani)	South Asian
C	Pakistani, south Asian	South Asian
C	South Asian	South Asian
C	Pakistani – brown	South Asian
C	Pakistan	South Asian
C	Indian (Punjabi)	South Asian
C	Indian (South Asian)	South Asian
C	South Indian	South Asian
C	Central South Indian	South Asian
C	South Asian	South Asian
MT	Nigerian	Sub-Saharan African
MT	Black Nigerian	Sub-Saharan African
MT	African	Sub-Saharan African
C	East African – Rwanda, Burundi, Congo (DRC)	Sub-Saharan African
C	Congo, DR	Sub-Saharan African
C	Nigerian	Sub-Saharan African
C	Nigerian	Sub-Saharan African
C	Somali	Sub-Saharan African

Self-described data were initially independently collated by two student research assistants (S4 File). Data were then collaboratively assigned to a category. MT = Music Therapy Group; C = Control Group.

S2 Table: Linear model summaries including demographic variables (gender, year of birth, Faculty of Study, current or past use of psychotropic medication, currently attending or completed Introduction to Music Therapy course, past or present engagement in therapy) in relation to each stress and anxiety outcome (A. STAI-S, B. Stress 1-5, C. Perceived Stress Scale, D. Cortisol).

A.

Model Summary – STAI-S

Model	R	R^2	Adjusted R^2	RMSE
M_0	0.000	0.000	0.000	10.771
M_1	0.350	0.123	-0.011	10.830

Note. M_1 includes Gender, Year of Birth, Faculty, PsychometricMedications(past/present), IntroMusicTherapyCourse (past/present), Therapy(past/present)

B.

Model Summary – Stress (1-5)

Model	R	R²	Adjusted R²	RMSE
M_0	0.000	0.000	0.000	1.004
M_1	0.399	0.159	0.031	0.988

Note. M_1 includes Gender, Year of Birth, Faculty, PsychometricMedications(past/present), IntroMusicTherapyCourse (past/present), Therapy(past/present)

C.

Model Summary – Perceived Stress Scale

Model	R	R²	Adjusted R²	RMSE
M_0	0.000	0.000	0.000	5.039
M_1	0.280	0.078	-0.042	5.145

Note. M_1 includes Gender, Year of Birth, Faculty, PsychometricMedications(past/present), IntroMusicTherapyCourse (past/present), Therapy(past/present)

D.

Model Summary - Cortisol

Model	R	R²	Adjusted R²	RMSE
M_0	0.000	0.000	0.000	412.517
M_1	0.362	0.131	-0.022	416.950

Note. M_1 includes Gender, Year of Birth, Faculty, PsychometricMedications(past/present), IntroMusicTherapyCourse (past/present), Therapy(past/present)

S3 Table

Change Measure	Week 6 WHOQOL	n	Pearon's r	p	Bonferonni
STAI-S	Physical Health	122	0.190	.04	.57
STAI-S	Psychological Health	123	-0.115	.21	1.0
STAI-S	Social Relationships	122	0.241	.01	.11
STAI-S	Environmental Health	122	0.07	.43	1.0
Self-rated stress	Physical Health	122	.11	.23	1.0
Self-rated stress	Psychological Health	123	-0.04	.66	1.0
Self-rated stress	Social Relationships	122	0.29	.001	.02*
Self-rated stress	Environmental Health	122	0.03	.7	1.0
Perceived Stress Scale	Physical Health	129	-0.01	.9	1.0
Perceived Stress Scale	Psychological Health	130	0.02	.84	1.0
Perceived Stress Scale	Social Relationships	129	-0.1	.26	1.0

Perceived Stress Scale	Environmental Health	129	-0.17	0.06	.99
Cortisol	Physical Health	109	-0.15	0.13	1.0
Cortisol	Psychological Health	110	-0.12	.22	1.0
Cortisol	Social Relationships	109	.02	.83	1.0
Cortisol	Environmental Health	109	-.15	.12	1.0

S4 Table. Bayesian Correlations between changes in stress/anxiety scores and personality categories (TIPI)

Change Measure	TIPI	Sample Size (n)	Pearson's r	Bayes Factor (BF_{10})
STAI-S	Extroversion	99	0.055	0.145
STAI-S	Agreeableness	100	-0.111	0.226
STAI-S	Conscientiousness	100	-0.024	0.129
STAI-S	Emotional Stability	100	0.105	0.214
STAI-S	Openness	100	-0.003	0.125
Self-rate stress (1-5)	Extroversion	99	0.127	0.271
Self-rate stress (1-5)	Agreeableness	100	-0.139	0.317
Self-rate stress (1-5)	Conscientiousness	100	0.043	0.137
Self-rate stress (1-5)	Emotional Stability	100	0.046	0.138
Self-rate stress (1-5)	Openness	100	0.016	0.126
Perceived Stress Scale	Extroversion	106	-0.010	0.122
Perceived Stress Scale	Agreeableness	107	0.074	0.160
Perceived Stress Scale	Conscientiousness	107	-0.027	0.126
Perceived Stress Scale	Emotional Stability	107	0.145	0.363
Perceived Stress Scale	Openness	107	-3.535e -4	0.121
Cortisol	Extroversion	92	-0.021	0.133
Cortisol	Agreeableness	93	-0.097	0.198
Cortisol	Conscientiousness	93	-0.072	0.164
Cortisol	Emotional Stability	93	0.044	0.141
Cortisol	Openness	93	0.104	0.210

S5 Table Bayesian Correlations between changes in stress/anxiety scores and music sophistication (GOLD-MSI)

Change Score	GOLD MSI Category	Sample Size	Pearson's r	Bayes Factor (BF_{10})
STAI-S	Active Engagement	119	-0.142	0.368

Change Score	GOLD MSI Category	Sample Size	Pearson's r	Bayes Factor (BF_{10})
STAI-S	Perceptual Abilities	119	-0.074	0.157
STAI-S	Musical Training	119	0.022	0.118
STAI-S	Emotional Response to Music	119	-0.215	1.763*
STAI-S	Singing Abilities	119	0.043	0.128
STAI-S	General Sophistication	119	-0.056	0.137
Self-rated stress (1-5)	Active Engagement	119	-0.009	0.115
Self-rated stress (1-5)	Perceptual Abilities	119	-0.085	0.173
Self-rated stress (1-5)	Musical Training	119	0.128	0.298
Self-rated stress (1-5)	Emotional Response to Music	119	-0.042	0.127
Self-rated stress (1-5)	Singing Abilities	119	0.043	0.127
Self-rated stress (1-5)	General Sophistication	119	0.014	0.116
Perceived Stress Scale	Active Engagement	126	-0.025	0.116
Perceived Stress Scale	Perceptual Abilities	126	-0.139	0.368
Perceived Stress Scale	Musical Training	126	0.002	0.111
Perceived Stress Scale	Emotional Response to Music	126	-0.058	0.137
Perceived Stress Scale	Singing Abilities	126	-0.034	0.120
Perceived Stress Scale	General Sophistication	126	-0.048	0.128
Cortisol	Active Engagement	111	-0.113	0.237
Cortisol	Perceptual Abilities	111	-0.066	0.150
Cortisol	Musical Training	111	0.146	0.377
Cortisol	Emotional Response to Music	111	-0.032	0.125
Cortisol	Singing Abilities	111	-0.047	0.134
Cortisol	General Sophistication	111	0.021	0.122

S6 Table. Descriptive Statistics of heart rate variability before and after each group music therapy session

Week*	n	Average Pre (*SD*) Heart Rate Variability (SDNN)	Average Post (*SD*) Heart Rate Variability (SDNN)
2	58	61.8 (55.55)	61.4 (32.16)
3	54	58.3 (29.92)	59.0 (28.82)
4	53	53.6 (24.50)	67.4 (38.10)
5	47	55.0 (34.91)	58.8 (33.74)
6	59	76.7 (71.35)	71.4 (09.29)

*In week 1, HRV was only collected before the music therapy session, therefore it is not included in this table.

S7 Table Average STAI-S and self-rated stress scores from pre-post each group music therapy session

	n	**Pre-Music Therapy** STAI-S mean(SD)	**Post-Music Therapy** STAI-S mean (SD)	*n*	**Pre-Music Therapy** Self-rated stress mean(SD)	**Post-Music Therapy** Self-rated stress mean (SD)
Week 1	63	47.4 (10.7)	37.2(8.7)	62	3.5 (0.8)	2.7 (0.9)
Week 2	58	48.1 (10.8)	37.3 (8.3)	58	3.4 (0.9)	2.6 (0.9)
Week 3	48	43.3 (12.9)	34 (8.1)	47	2.8 (1.0)	2.2 (0.9)
Week 4	48	43.6 (10.9)	34.1 (8.7)	47	3.0 (0.9)	2.5 (1.1)
Week 5	44	43.1(12.3)	32.5 (8.3)	44	2.9 (1.0)	2.2 (0.8)
Week 6	46	41 (10)	34.8 (8.7)	46	3.2 (0.7)	2.6 (0.8)

S8 Table Responses from Music Therapy group feedback form.

Question	Result
1. Did you find this group helpful as a means of proactively managing stress and anxiety?	71% of the participants answered *yes*.
2. Please share any information you would like to share, such as examples of what was helpful/unhelpful, and if you learned anything through this experience about proactively managing your own wellbeing.	122 comments were identified. 70% of the comments related to music therapy being helpful. 30% of the comments related challenges. A thematic analysis was conducted revealing six subthemes related to helpfulness and five subthemes related to challenges (S7 File).
3. Would you participate in a music therapy group if it was offered at the University?	66% of the participants answered *yes.*
4. Would you attend the University's verbal based online therapy groups?	46% responded *yes*.
5. Please share any further information you would like to share.	- I don't think I'd care for online sessions. - It was my first time participating in a study so it was interesting. Thank you. - I am currently in verbal therapy as well, but I find I get different things out of that. That helps me find the root of some of my patterns, but music therapy helps me deal with everyday emotions.

	● I have sought these out once and it was helpful when I did it. Also, it was online so maybe that made it seem easier to reach out for help.		

S9 Table
World Health Organization Quality of Life BREF Scores, Week 1 and Week 6

	Week 1 Music Therapy mean (SD)	Week 6 Music Therapy mean (SD)	Week 1 Control mean (SD)	Week 6 Control mean (SD)
Physical health	66.2 (14.2)	67.7 (13.5)	70.9(15.1)	70.7 (13.2)
Psychological health	50.6 (17.7)	54.5 (9.1)	58.4 (17.5)	54.0 (8.9)
Social Relationships	60.6 (22.8)	64.7 (19.5)	67.5 (19)	68.2 (18.4)
Environmental Health	69.9 (12.2)	71.6 (12.1)	71.3 (13.6)	71.2 (13.9)

S1 File. Process to extract cortisol from hair sample at The Drug Safety Lab (Greff et al. 2019)
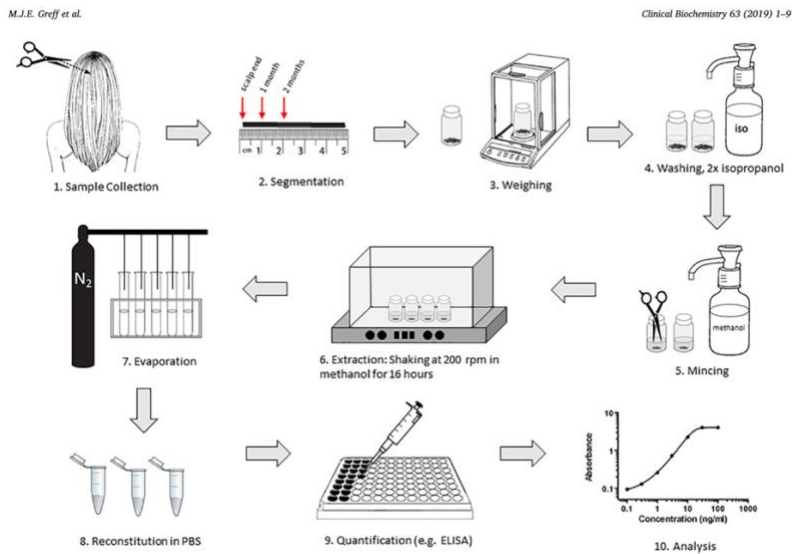

Fig. 1. Standard method for the quantification of hair cortisol concentration.

S2 File. Types of smart phones utilized by Welltory application for HRV data.

Smart phone	Data Collectors
Pixel 4a	x 1
iPhone 8	x 1
iPhone 10	x 1
iPhone 11	x 1

iPhone 12	x 4
iPhone 13 Pro	x 1
iPhone 13 ProMax	x 3
iPhone 14	x 1
iPhone 15	x 1
Samsung Galaxy S20	x 1

S3 File. Student Research Assistants. Group Music Therapy Sessions offered Tuesdays & Wednesdays 3-4 & 4:30-5:30

Student	Role
Erica Park	**Lead Research Assistant**
Fatima Arshad	**Lead Research Assistant** Control Group
Tia Suomela	Data Collector
Shely Patel	Data Collector
Shruthi Raghuraman	Data Collector, Thematic Analysis
Navishka Brahmbhatt	Data Collector, Thematic Analysis
Melody Tjong	Data Collector
Gethmie Dep	Data Collector
Ayesha Gaba	Data Collector, Thematic Analysis
Jason Chung	Data Collector
Rayirth Sivakumar	Data Collector
McKenna ODonnell	Data Collector
Mansi Patel	Data Collector
Farhan Abdul Vaheed	Data Collector
Yatharth Utkarshkumar Dave	Data Collector
Josh Tony	Data Collector
Sana Alibhai	Data Collector (Group Lead)
Chloe Ko	Data Collector (Group Lead)
Cora House	Data Collector (Group Lead)
Matthew Wiebe	Data Collector (Group Lead)
Joyce Qiu	Data Collector (Group Lead)
Karina Kueviakoe	Data Collector, Scored Data, Organized Data, Categorized Ethnic origin comments
Carina Runco	Categorized Ethnic origin comments

S4 File. Hair Collection Protocol

STEP 1: GATHER METERIALS FOR SAMPLE COLLECTION.
You will need: Sharp and clean scissors, Clear scotch tape, Hair clip (optional), Pen

STEP 2: LOCATE THE POSTERIOR VERTEX REGION OF THE SCALP.

This region of the head has the most consistent hair growth rate. Sampling from here will minimize the variation in sample measurements.

STEP 3: ISOLATE HAIR WITH HAIR CLIP (OR FINGERS) & CUT HORIZONTALLY WITH SCISSORS AS CLOSE TO SCLAP AS POSSIBLE.
Approx. 100 strands of hair are required, 1cm in length, 5mm in diameter (thickness of pencil eraser). Please ensure hair strands are aligned and secured with tape to the direction of the scalp and that the direction of the scalp is clearly indicated. Please use the collection form provided.

STEP 4:TAPE THE SCALP END OF THE HAIR TO THE HAIR SAMPLE COLLECTION FORM & FILL OUT STUDY ID, SUBJECT ID, & COLLECTION DATE.
Clear scotch tape works best. It is easily removed and leaves no residue on the hair. Fold the paper along the length of the hair & place in pre-addressed envelope to secure the sample. Post the pre-addressed envelope after collecting. The pre-addressed envelope will be addressed to Drug Safety Laboratory, Robarts Research Institute, Western University, 1151 Richmond St N, London, On. Canada.

S5 File. Structure of music therapy groups based upon: McMaster Wellness Centre Stress Less Group and Open Circle's Group Guidelines.

In keeping with the McMaster Student Wellness group "Stress Less" each group will explore the similarity and differences between stress, anxiety, and fear, identify stressors, explore stress physiology, discuss existing stress management strategies such as mindfulness.

*Group guidelines reviewed	Opening Quote & Ice Breaker	Facilitated reflection on a theme related to stress and anxiety	Closing activity & Quote

*Group Guidelines
Adopted with permission from McMaster University Open Circle

- Give and receive welcome. People learn best in hospitable spaces. In this space we support each other's learning by giving and receiving hospitality.
- Respect: Listen to each other with openness and curiosity, being respectful of different ideas and opinions while open to learn from everyone.
- No fixing, saving, advising or correcting each other. This is one of the hardest guidelines for those of us who like to "help." But it is vital to welcoming the soul.
- Set aside reaction and judgment and turn towards wonder and compassionate inquiry. Ask yourself, "I wonder why they feel/think this way?" or "I wonder what my reaction teaches me about myself?" Set aside judgment to listen to others—and to yourself—more deeply.
- Speak your truth in ways that respect other people's truth. Our views of reality may differ, but speaking one's truth in this space does not mean interpreting, correcting or debating what others say. Speak from your center to the center of the group, using "I" statements, trusting people to do their own sifting and growth.
- Creating inclusive space for diversity. We work together to hold a safe space for all forms of diversity, including ethnicity, religion, gender identity and expression, sexual orientation, ability, and socio-economic status.
- Freedom to share or to pass. Be here with your listening as well as your speaking.
- Be present as fully as possible. Turn off phones and put away technology that is not being used for participation in the group.
- Trust and learn from the silence. Silence is a gift in our noisy world, and a way of knowing in itself. Treat silence as a member of the group. After someone has spoken, take time to reflect without immediately filling the space with words.
- Observe deep confidentiality. Safety is built when we can trust that our words and stories will remain with the people with whom we choose to share and are not repeated to others without our permission. Do not record any of the groups**.**

S6 File. Examples of specific Music Therapy interventions implemented.

- Musical check-in. Participants created a sound that described how they were feeling that day.
- Exploring different instruments, passing the various instruments around in a circle
- Participants sat in a circle facing the wall and engaging in improvisation and then turned around to face the group and improvise.
- Shared strategies on how to utilize mindfulness to help with stress and anxiety. Discussed importance of incorporating mindfulness as part of self-care in promoting wellness and healthy functioning.
- While playing "Rhapsody and Blue", each participant had a blank piece of paper and was asked to draw anything on their page based on what they heard, felt, pictured, when listening. After 2-3 minutes of listening, the music would pause and participants passed their sheet to the person to their right to continue to add to

the drawing until each person's original paper returned to them. At the end, each participant held up their artwork.

- Music and breathing, box breathing technique
- Lyric analysis to the song "Stop this Train" by John Mayer. Participants listened to the music while following along to the lyrics on paper. Participants asked to reflect and think about the message of the song and if there were any specific lines in the piece that resonated with them.
- Utilized a template to the song "About Damn Time" by Lizzo and encouraged participants to create a song that is reflective of how they were feeling, values, etc. This provided the opportunity for participants to externalize their thoughts and emotions, tell their story, develop a sense of self, gain insight or clarify thoughts and feelings, choice and decision making.
- Collectively created a group music playlist which allowed participants to share some of their favourite songs.
- Participants reflected on songs that provide them with a sense of peace/grounding/reassurance/relief in the midst of stressful experiences.
- Split the group into two groups, participants selected an instrument to create a short piece with their group.
- Main themes included school stress and relationships (romantic and family)
- Music therapist sang and accompanied themself on guitar using songs chosen by the students (students played along with an instrument).
- Each week students were prompted to reflect on a quote accompanied by either recorded or live guitar music.
- Improvisation on themes related to stress (playing from stressed to relaxed).
- Collaborative song writing on stress using the song Stressed Out by 21 Pilots.
- Mantra writing/intention setting to music.
- Song share/discussion with drawing to music.

S7 File. Music therapy participants' individual responses to Question 2 of feedback form.

2. Please add any information you would like to share, such as examples of what was helpful/unhelpful, and if you learned anything through this experience about proactively managing your own wellbeing.
I was slightly stressed about the size of the hair sample taken from my head because I didn't know what to expect initially.
Very helpful group
Listening to music was helpful, as was progressive relaxation
That music is so versatile and you can use it in more than one way to cope with your stress or anxiety.

Though the last month I have had a lot of stuff going on in my life that have exacerbated some mental health issues, these sessions have helped me with tools to cope like the iso principle playlist as well as having a much deeper appreciation for music and what it can do for your brain and feelings. I find myself rereading and studying lyrics to specific songs over and over again as a means of therapy as well.

Anthony was absolutely fantastic! I knew that music was something that was therapeutic to me, but Anthony and this group really put into perspective to me how valuable music actually is to me as a stress relief resource. Between the Iso principles and just gaining an overall understanding of ways to implement music more purposefully as a stress relief tool in my life, I feel like I have a lot of good strategies and ideas to move forward with.

It was helpful having something to go to and feeling a sense of belonging

It was helpful in managing stress by making me actively think about how I subconsciously handle stressful situations and how to create better coping strategies

I really liked that the atmosphere was quiet and private really awesome. Cant think of any negatives

I think the question well reflected the focus on anxiety and student wellness.

I don't think I personally learned anything that I would use to proactively manage stress and anxiety but there were definitely things one could use such as progressive muscle relaxation if you notice you're beginning to feel stressed. I think a lot of the techniques are better for winding down from stress rather than preventing it. I find the "fun" aspect of it is most beneficial for me, seeing some friendly faces and having fun with music and conversing in a judgement free zone.

I found improvising with instruments particularly helpful and improved mindfulness. Music therapy was a place where I could feel secure and release any stressful obligations and worries. I enjoyed the reflection portion of music therapy and being able to talk and brainstorm with a small cohort of people. My least favourite part of music therapy was song writing. This part made me uncomfortable and did not improve mindfulness.

Sharing of thoughts and feelings towards songs, playing instruments wuth the therapist

Learning about the intentional therapy playlist was very helpful

I think it was helpful in that is provides prompts to actively think about mental wellbeing more in daily life; but it is hard to provide tangible help for immediate stressful situations, and a small group of strangers is not always very encouraging for mental health discussions

It was helpful to be given a place that kinda forced you to take time out of your day to be mindful. It was freeing to play with instruments like a littke kid again. Some parts felt almost 183vailable183t183 when in a group settimg, and felt like I I fully engage without feeking like others were watching. Afterwards I always felt more relaxed however, and I did enjoy hearing others experiences

It is great to get a chance to participant in the thearpy group. It is nice to share our thoughts and do not have to worry about our concerns.

I found the environment as the main source of relief, having positive relationships with the therapist and other participants was fun and offered me the chance the relax in an unfamiliar environment

I found the activities done in the group were really helpful, such as the drawing while listening to music and progressive muscle relaxation. I tried these at home too and they really helped.
It is pleasant at the moment but after that theres no difference
I felt content after the sessions.
During this process, I have learned to pay attention to the sources of my stressors. When I have many tasks to do for school as well as outside of school, I tend to ruminate about everything I have not done. This leads to more stress for the future. I have attempted to finish priority tasks and doing pieces of tasks overtime to manage my time effectively. Without the music therapy intervention, much of my stress management has been in my own hands. It has allowed me to practice different methods through trial and error.
Learning mindfulness and breathing techniques
The activities done during the sessions had a positive effects in the moment, but once the session was over it did not last.
I really enjoyed the progressive muscle relaxation, I can see myself using that as a way to be mindful og how im holding stress in my body.
I found that once I left the session I quickly returned to an anxious or stressed state. I also have my own strategies for coping with stress and anxiety that I feel work better for me. Some of the interventions in the sessions felt a bit awkward or forced, like people did not really want to do them but participated out of obligation.
It was nice to be in a group and talk about stressors altogether
Making music with instruments was a great experience for reducing/distracting anxiety
There were always new things stressing me out each week so I was worried it wohld effect the study, and sometimes I also felt anxious to leave at the end to catch a bus which I felt may have effected my hrv
I foumd the muscle tensing and then relaxing exercise really helpful
The instrument parts, the feelings/thougths that were shared between us were helpful
Talking about stressors thru thenweek
Group therapy is just difficult for me
It was helpful however it would have been more helpful one on one.
The fact that it was in a group I help. People were less likely to share their thoughts because it was weird. Session also wasn't long enough.
It was a good exoerience but I feel that I would've gainee more if it waw one-on-one so I csn talk about things happening to me
I think that it was only mildly helpful during the sessions. Otherwise, I just forget about the coping strategies that were taught and cannot apply them in real life.
I feel as though any benefits in reducing stress through music therapy are minimal at best for me.

The sessions were helpful but I think they are only effective for a temporary period of time. I found the PMR at the end of the session relaxing though.
I appreciated the opportunity to participate overall however, I just feel as though group music therapy is not my thing. I may have felt differently if the sessions were one on one. I felt rather awkward at times participating in the activities with a group of people that I hardly know.
Not really
It was hard to take the tasks seriously
It is great to get the chance meet with the group and it is very fun being 185vailable185t in the group.
Using the instruments was very fun
Grouo setting just activated my social anxiety. Mindfulness excercises were goos to practice but private setting 185vailabl been more beneficial to me
I enjoyed when we drew pictures when listening to music but performing with instruements in front of everyone made be anxious
I learned to be present in the moment
I learned how music can be very helpful to maintain and imorove moods
I found this helped me to be present
I think in the final session, doing a group song and putting everyone on the spot for a solo kind of forced us to get out of our shell and participate, which was engaging.
Different methods to managr stress
I think this session mskes me feel relaexed and there are no right or wrong for music therapy
The therapist made the environment feelnsafe and casual with no pressure
I thought that the improvising with the instruments was too simple asnyou cant play any other note other than the bell that you have. Then again not everyome plays instruments
Being able to reflect my feelings was the best because I did not feel obligated to anything
I learned different techniques to use when managing stress to protect my mental wellbeing
I enjoyrd the drawing to music amd progressive muscle relaxation, both really relaxed me
I feel like just staying on campus longer getting work done waiting for this had is what hrloed mange my wellbeing
Made me feel less stress and gave some group emgagment
I liked sharing music we liked with the group amd drawimg to songs.
I found that listening to music was helpful but the progressive relaxation technique was unhelpful. I learned that it's important to stop and think about what you can control and not what you can't control.

I enjoyed learning how music can help with mental health and experimenting different instraments

Therapost made this space very safe

I feel like music therapy is a goof outlet for stress, I just I think it is a good outlet for me personally. I did not feel significant difference and I thought it was very time consuming,

While I did enjoy parts of the music therapy, I found that the group setting made it difficult to engage as it's very awkward with people you don't know really well. If music therapy was offered as a one on one therapy session, I think most people would be more comfortable opening up. However, I did find some of the techniques (especially the muscle relaxation) to be super helpful, and I will try incorporating them into my daily routine much more.

I really liked the muscle relaxation at the end of each session. I also liked listening to music together as that is something that has always helped me with stress. I did not love playing instruments because I found it a bit stressful, but I can see the value in it.

- Example of what was helpful: creating thoughtful, Iso-Principle playlists – to validate my current emotion and then using music purposefully to alter my state of mind gradually (travelling from an undesired (e.g., sadness/depression) to a desired/goal emotion (e.g., happiness))
- Example of what was helpful: improvising with instruments together, sometimes according to themes (e.g., confidence and connectedness) – enhanced sense of unity, was enjoyable to focus on my musical role in the group (wanted to make it sound good – allowed me to remain in the present moment and not let my thoughts interfere), etc.
- Something I have learned through this experience about proactively managing my well-being: to engage in the progressive muscle relaxation technique when I notice heightened stress/anxiety levels to ground myself, feel more secure and reframe my thoughts (from music therapy experience in a GROUP, I may consider engaging in this technique with friends/family rather than alone to achieve the same successful results – helps me to focus more by feeling motivated in the presence of others)

I will really miss these sessions, if they became available again at McMaster I would really like to be informed and take part.

I think music therapy is a powerful proactive measure and I wish it could be made 186vailable to younger populations and more routinely

Perhaps the group aspecf made it feel less personal. If it was one on one I believe I would have benefitted more

I would participate if it was one on one instead of a group.

I think I great practice and the instructor was very talented, though movimg forward Id prefer somerhing like a band over therapy. Even so, hearing the opinions of everyone in the session was insightful.

I think that having groups with a specific healthcare goal in common would be helpful.

Overall, I thoroughly enjoyed participating in weekly group music therapy sessions! Rather than feeling like an endless, tedious chore or task to complete every Wednesday at 3:00pm, these felt like a fun, educational break from the business and stresses of life. The psychotherapist/music therapist fostered a safe, supportive, and enjoyable environment for myself and the rest of my group members! Through engaging in a progressive muscle relaxation technique every session, analyzing song lyrics, improvising together with instruments according to positive themes, and creating brief playlists that allow you to travel from an undesired to a desired emotion or to complete a daily task, such as fully waking up in the morning, I have better learned how to manage my stress/anxiety levels by incorporating different mediums of music into my life! To future HUMBEHV 2AP3 students: I highly recommend partaking in this study if you have the opportunity to do so.

Chapter 5

General Discussion

In this thesis, I examined the concept and implementation of group music therapy for proactive wellness on a university campus. This examination was conducted through the dissemination of a survey (Chapter 2) and two randomized controlled trials (Chapters 3 & 4). There are a substantial number of research articles reporting the positive impacts of music and music therapy on stress and anxiety outcomes related to a specific diagnosis (deWitte et al., 2020). However, my research is the first to investigate the use of music therapy for the general population of undergraduate university students as a proactive intervention.

5.1 Overall Main Findings and Unique Contributions

Many surveys have been conducted to determine the mental health of university students; however, none appear to ask students about the type of mental health support that they would like to receive. The wellness programs of Ontario Universities offer options for mental health supports that are predominantly for individuals experiencing a crisis or with a diagnosis and are verbal based (Supporting Student and Community Resilience Through Mental Health Resources and Programming – Ontario's Universities, 2024). Surveys such as the Canadian Campus Wellbeing Survey helped to inform whole campus health and wellbeing, and included questions about mental health assets, student experiences, mental health deficits, health service utilization, physical health behaviours, academic achievement, substance use, food security, and sexual health and behaviour (Canadian Campus Wellbeing Survey, 2024). Asking students about which type of

supports they would *want* offered on campus, or would seek out, was typically not an included question. Neglecting to ask students about how they would like to engage in their own mental health removes student autonomy and students' voices from the conversation. Options to proactively engage in mental health supports on campus are limited, whereas there is a myriad of physical health options on campus for students to proactively choose.

In recognition of the importance of determining students' preferences for mental health supports, the survey described in Chapter 2 asked students about the type of mental health supports they would choose to seek out (music therapy, art therapy, or verbal-based therapy). The survey also asked students about the activities they were already engaging in for wellness. Chapter 2 appears to be the first published research article reporting upon university students' preferences for mental health support on campus. This is an important contribution to determine how to increase students' help-seeking behaviours for mental health. Data from the survey supported that students are interested in trying music therapy, and that they are already using music for their own wellness.

Building upon the research findings in Chapter 2, my research in Chapter 3 provided the first study of online group music therapy to proactively manage stress and anxiety with university students. This research was unique due to its remote delivery, the focus on proactive wellness in university students, and for its use of cortisol from hair samples to retrospectively assess changes in stress from one month to another. Previous research using hair samples for cortisol analysis have explored stress in the contexts of PTSD (Luo et al., 2012), endurance athletes, shift workers, unemployment, chronic pain,

neonates, depression, bi-polar disorder, and generalized anxiety disorder (Staufenbiel et al., 2013).

Most research about non-pharmaceutical interventions for mental health and mental illnesses has included verbal-based interventions, which have come to be known as the evidence-based standard of care (Smith and Glass, 1977; Cook et al., 2017). My research did not seek to prove that music therapy outperforms the standard of care, but that music therapy should be considered as a standard of care option.

The delivery of music therapy over an online platform such as Zoom is not typical within the profession of music therapy. As such, only a few research studies have implemented online music therapy (Baker et al., 2009; Baker et al., 2014; Lightstone et al., 2015; Levy et al., 2017; Spooner et al., 2018; Gvili 2021; Nnanyelugo et al., 2022; Ahessy et al., 2023). These online music therapy studies collected data from people with ASD, PTSD, visual impairments, anxiety, and from war veterans, as well as an intergenerational study. As a result of the COVID-19 pandemic restrictions, I designed a research study that offered undergraduate university students the opportunity to proactively engage in group music therapy online. To my knowledge, online group music therapy had not been previously offered to undergraduate students at any university across Canada. My research in Chapter 3 provided the groundwork and support to conduct a similar version of the study in-person post-COVID-19 restrictions, resulting in the research study presented in Chapter 4.

My research study in Chapter 4 provided the first evidence to support the use of in-person group music therapy for the proactive management of stress and anxiety on

campus with undergraduate university students. In this research, I collected physiological data, psychometric data, and qualitative data.

My research in Chapters 3 and 4 also addressed the question of whether personality types and music sophistication influence the effiveness of group music therapy. Personality types have been associated with stress, anxiety and overall health (Strickhouser et al., 2017), as well as preference of activities (Wolfradt and Pretz, 2001; Aaron et al., 2011; Gil De Zuniga et al., 2017; Gjermunds et al., 2020). It could therefore be hypothesized that personality types associate with different outcomes in therapy. I conducted Bayesian-correlations between the stress and anxiety outcomes of music therapy, and personality types. These analyses provided evidence that personality types are not correlated with stress and anxiety outcomes of music therapy.

When discussing *music* therapy, it could be hypothesized that an individual's music sophistication would influence music therapy outcome. My research contributed to the limited publications on the relation between music therapy outcomes and music sophistication scores. Bayesian analyses provided evidence that none of the Music Sophistication categories are correlated with stress or anxiety outcomes of music therapy.

Overall, my research suggests that both in-person and online group music therapy can be an effective tool to help undergraduate university students to proactively manage their stress and anxiety, regardless of personality type or music sophistication. This research contributes to filling the gap in the literature about proactive mental health options beyond verbal based therapies.

5.1.1 Chapter 2: Unique contributions and limitations

The research in Chapter 2 highlighted that university undergraduate students are engaging in music to manage stress and anxiety. Specifically, 92% of the students surveyed were engaging in music listening for wellness during the first COVID-19 lockdown in Ontario, Canada. Additionally, students rated music listening as the third most helpful activity to support wellness. Conducting this survey during this time provided a naturalistic forum to collect data about students' behaviour and wellness during a stressful event. The survey was motivated by the COVID-19 lockdown and, as such, the data only reflected anxiety scores and activities during the pandemic. A comparison of data pre-lockdown to data during the lockdown would have provided the opportunity to examine changes in anxiety scores and potential changes in activities, but we are not able to do that now, of course.

5.1.2 Chapter 3: Unique contributions and limitations

The research in Chapter 3 was the first of its kind to proactively offer online group music therapy to undergraduate university students. I collected *both* short-term and long-term data about the impact of engaging in weekly online group music therapy sessions. A key aspect of this study is its contribution to the proactive wellness research. The western medical model was built upon diagnosing and healing individuals who have an existing health condition. As such, medical research is dominated by the goals of understanding and curing a multitude of illnesses, or reactive care. Overall, the medical model has been successful in enhancing longevity and improving quality of life. These incredible successes have shone a bright light on reactive care while giving much less attention to preventative care. Although the medical model acknowledges that diet, sleep, and

exercise are critical health factors, and recognizes that they are negatively affected by unmanaged stress and anxiety, proactive engagement in mental health strategies remains under-promoted, and interventions are not easily accessible. My research presented in Chapter 3 supports the proactive use of online group music therapy to manage stress and anxiety.

The research also supports both active and receptive music therapy interventions. Music therapy typically combines both active and receptive music therapy interventions. Active interventions include singing, song writing, playing instruments and improvising, while receptive interventions typically include client-directed music listening. I conducted Bayesian analyses in Chapter 3 to determine if there were differences in stress and anxiety outcomes as a result of active or receptive music therapy interventions. Bayesian analyses provided evidence for no difference between stress and anxiety outcomes based on active or receptive interventions.

I also explored both short-term and long-term measures of stress. Statistically significant changes in stress and anxiety scores from pre-post each online group music therapy session were observed. These findings highlight that online group music therapy can effectively reduce stress and anxiety in the moment. I collected hair samples for cortisol as a long-term measure of stress, reflective of the whole six-week study period. My study was the first to measure cortisol from hair samples in university students to test a proactive wellness intervention. A significant increase in cortisol in the control group was observed, and no significant changes in cortisol in the therapy groups were observed.

The short-term relief of stress and anxiety lends support to the group music therapy drop-in model. Offering drop-in groups on campus can be appealing to students whose schedules restrict them from regular attendance. The research study in Chapter 3 was not designed as a drop-in model because I was also interested in collecting data about the long-term effects of music therapy as measured through hair cortisol.

The research in Chapter 3 had several limitations that were predominantly due to the COVID-19 restrictions and the online nature of the study. I was restricted to recruiting remotely, and experienced a considerable attrition rate from the time students completed the consent form and the pre-questionnaires, to the time the therapy sessions began. Due to the attrition before the group therapy sessions began, the sample size was smaller than desired which affected statistical power, particularly for the between-group analyses. Collecting the physiological data remotely was also a challenge. Participants received training over Zoom to collect the heart rate variability (HRV) data using an app on their phone, but it was not possible to control for several variables, such as how each participant used the mobile phone application to collect the data, the accuracy of their reporting, and what activity they were engaged in immediately prior to collecting the heart rate measure. Upon reviewing the final HRV data, it was highly variable and determined to be non-analyzable. Finally, although the cortisol analyses yielded significant results, only about half of the participants sent in their hair samples from both week 1 and week 6 to the lab for analysis; so the results were underpowered.

5.1.3 Chapter 4: Unique contributions and limitations

My research in Chapter 4 was the first of its kind to collect data about *in-person* group music therapy as a proactive intervention for undergraduate university students. Like the research in Chapter 3, I collected both short-term and long-term data about the impact of engaging in weekly group music therapy sessions. Once again, statistically significant changes in stress and anxiety scores from pre-post each music therapy session were observed. I also observed statistically significant changes in stress and anxiety scores from week 1 to week 6 of the study for the music therapy group in comparison to the control group for state anxiety, self-rated stress, Perceived Stress, and cortisol.

Unlike the research in Chapter 3, my research in Chapter 4 was not underpowered. Students were recruited from across campus, as well as from a second year *Human Behaviour* course. Students in the *Human Behaviour* course were provided the choice to participate in the research study and complete a reflection paper, or to not participate in the study and complete a health related assignment. Over 85% of the students in the class chose to participate in the research study and to complete a reflection paper. Providing opportunities for students to proactively engage in wellness helps to normalize mental health help-seeking behaviours.

The study had several limitations. The largest set back was the inability to reliably collect heart rate variability. These data would have been a strong complement to the data collected. Due to the design of the study, a portable, financially viable and easy to use device was required to measure heart rate variability. As such, I implemented the same phone app utilized in Chapter 3 reasoning that it would be possible to control for the difficulties experienced during the online research study. Even though more variables

were controlled for in-person, there was too much variability between readings to be confident about the results.

I also experienced minor setbacks with the hair collection. Some participants did not feel comfortable having a research assistant cut a sample of hair, and some students who did provide the first sample, did not feel comfortable providing a second hair sample six-weeks later. The reluctancy to provide hair samples affected the total number of paired hair samples, however, enough paired hair samples were collected to align with the a priori power analysis.

If a participant arrived late to a music therapy session, or needed to leave early, no data were collected from that participant, to maintain fluidity of the sessions. Therefore, the participation numbers for some weeks were higher than the data points collected. This mismatch of data points with actual attendance likely limited the ability to accurately interpret the effects of attendance over the six-week study period. Self-described females were overrepresented in this study, limiting observations between genders. And despite random assignment, selection bias could have limited the results as participants self-selected to participate in this study (regardless of which group they ended up assigned to), which could have biased the outcomes. For example, students who self-selected to participate may have already had some 'buy in' to mental health supports such as music therapy.

Another potential limitation of the study was that most of the students who participated were from either the Faculty Science or the Faculty of Health Science, both of which have a high proportion of students interested in a career in either health or health

research. Although I did not observe any correlations between Faculty of study and stress and anxiety outcomes, this could have been a result of over representation by the Faculties of Science and Health Sciences. However, considering that health care professionals suffer a high risk of burnout, learning about proactive mental health options as part of an undergraduate education could help to mitigate professional burnout in the future.

My study in Chapter 3, and the first block of my study in Chapter 4 did not include the additional recruiting method of participating in the study as a course component option. Recruiting consistency would have been preferred as these differences could have had an impact on student motivations and participation. However, the stress and anxiety outcomes between the two recruitment methods produced similar outcomes. Lastly, recognizing that the control group was engaging in 'student life as usual', it is possible that the results of the study in Chapter 4 are reflective of the Hawthorne effect. However, previous RCTs have found music therapy to be as effective, or to outperform the standard of care (Finnerty et al., 2023; Erkkilä et al., 2011; Gold et al., 2013; Aalbers et al., 2017).

5.2 Theoretical contributions and future directions

My thesis presents three research studies that offer evidence for implementing music therapy to proactively manage stress and anxiety. It makes an important theoretical contribution to the mental health and well-being literature as the first study to show that both online and in-person group music therapy are effective interventions for proactive stress and anxiety management for university students.

Two of my research studies within this thesis implemented the collection of hair samples to compare changes in cortisol levels over a six-week study period. The collection of hair samples to measure changes in cortisol over time is not as common as the short term measure of cortisol via saliva or blood. However, it is the regular exposure to stress over time that contributes to the greatest health risks. Therefore, reporting upon long-term changes in cortisol provides an important theoretical contribution to the stress management and proactive wellness literature. Additionally, my online group music therapy research provides support for the remote collection of hair samples, a technique that had not previously been implemented.

Recognizing that increased levels of stress can expose tissues to excessive and damaging concentrations of cortisol (O'Connor et al., 2021), and that a number of studies have found evidence that increased cortisol reactivity to stress is associated with negative health outcomes (O'Connor et al., 2021), proactive implementation of music therapy should be considered beyond the scope of this thesis.

University undergraduate students were chosen for this study due to the increasing mental health challenges and suicide rates on university campuses. However, stress is a major precursor to many physical and mental health conditions beyond this population, and interventions to proactively manage stress are integral to their prevention. For example, stress management can help to prevent cardiovascular disease (Steptoe et al., 2012; Wirtz et al., 2017), stroke (Koltega et al., 2016; Booth et al., 2015), diabetes (Lloyd et al. 2005), and dementia (Kim et al., 2023). In addition to these negative health outcomes related to poor stress management, cortisol may be related to cellular aging by

mediating the relationship between psychological stress and cellular aging (Steptoe et al., 2017). Participating in group music therapy is not going to eliminate cardiovascular disease, strokes, or dementia, but focusing more attention on proactive interventions for stress and anxiety management, such as music therapy, could help to reduce negative health outcomes associated with stress.

Stress is also a major contributor to absenteeism from employment. Canadian companies lost an estimated $16.6 billion in productivity per year due to absenteeism as a result of mental health issues (*How Much Are You Losing to Absenteeism?*, May 14, 2024). Globally, approximately 12 billion workdays per year are lost to depression and anxiety, translating into an estimated $1 trillion loss in productivity (World Health Organization: WHO, 2022). These statistics underscore the potential benefits of proactively addressing stress and anxiety in the workplace. Learning how to proactively manage stress and anxiety as a university student could potentially translate into reducing sick days, and costs to both the employer and the health care system, when the students enter the work force.

My research highlights the importance of offering students choices to engage in proactive wellness, and creating a campus culture that promotes mental health-seeking behaviours. A shift in campus culture could benefit student well-being across campuses globally. A study conducted by Henderson et al. (2018), reported that students' willingness to seek support was related to their perceptions of campus culture, globally demonstrating the importance of campus culture for student mental health. Poor mental health was associated with declines in the motivation required to succeed in post-

secondary education (Keyes et al., 2012). A study by Chen, Romero, and Karver (2016) examined the relationship among students' perception of campus culture, personal stigma, and help-seeking behaviours. The study found that students' views of mental health stigma and help-seeking behaviours were related to their perceptions of the campus environment.

A proactive wellness campus culture also provides cost savings to the campus. For example, a student experiencing a mental health crisis often requires one-to-one support from a therapist or counsellor, whereas proactive supports often occur in a group format supporting approximately 10 students for the same cost. These savings have the potential to transcend beyond graduation, reducing the current projected cost of mental health to the global economy, which is projected to be approximately $6 trillion per year by 2030 (Ministerie van Algemene Zaken, 2023).

My research in Chapters 3 and 4 incorporated a music therapy approach known as Community Music Therapy (CMT). CMT involves group music therapy techniques designed to unite a population and provide a sense of community. In this music therapy approach, the typical clinical steps are not necessary such as a referral, assessment, treatment plan, and progress reports. However, to classify these group sessions as music therapy, they must be facilitated by a credentialed music therapist. CMT can feel less like a treatment modality and more like an enjoyable social activity with added therapeutic value. This model lends itself to proactively managing stress and anxiety with healthy individuals and reducing stigma about mental health interventions.

I am currently collaborating with Brock University to replicate a version of this study with undergraduate university students in the teacher education program. Narrative inquiry will be added to the research design to gain a further understanding of student experiences and perspectives. Bringing music therapy to more university campuses through research projects will add to the data collected thus far, while providing the opportunity for more students to proactively engage in music therapy. Collaborating with universities across Ontario, and eventually Canada, will provide a platform to advocate and educate for a shift in campus culture which embraces the importance of making proactive wellness accessible.

Future research would benefit from including a reliable measure of heart rate variability and exploring differences between six-week blocks of therapy and the offering of continual drop-in music therapy groups. The six-week block was implemented in my studies to allow for hair cortisol analysis, but a drop-in model could be a better logistical fit for students, similar to drop-in classes at a gym.

Additionally, replicating my studies with high school students could provide support for incorporating proactive wellness experiences as part of high school education. Providing high school students with wellness experiences could better prepare teenagers for university or college life.

During the group music therapy sessions in my studies, students learned how to build and use intentional playlists. Considering that youth are already listening to music regularly, learning how to use music listening for wellness could result in a logistically

manageable tool for mental health. Follow-up studies could include assessing the implementation of intentional playlists.

Lastly, future studies should consider gathering additional biomarker data and genetic information. Additional biomarkers could include oxytocin, BDNF and dopamine, which all play different roles in the experience of stress and mental health (Noushad et al., 2021; Baik JH., 2020). Genetic measures could include changes in telomeres as indicators of stress over longer periods of time (Mathur et al., 2016). Longitudinal studies could help to better inform the impact of proactive wellness interventions. For example, exploring if there are reductions in the percentage of students engaging in crisis support as a result of engaging in proactive wellness. Longitudinal studies could also include the collection of biomarkers at two time points a year throughout a students' undergraduate career. There are many challenges that accompany longitudinal studies, primarily attrition, but this kind of a study would be incredibly valuable to understanding the impacts of providing proactive wellness options for students on campus.

5.5 Conclusion

Collectively, Chapters 2-4 indicate that students are interested in engaging in music therapy for proactive wellness, and that both online and in-person group music therapy are effective for the proactive management of stress and anxiety. My research provides support for the inclusion of music therapy as a standard of care on university campuses, and the importance of a proactive wellness campus culture.

5.6 References

Aalbers, S., Fusar-Poli, L., Freeman, R. E., Spreen, M., Ket, J. C., Vink, A. C., Maratos, A., Crawford, M., Chen, X., & Gold, C. (2017). Music therapy for depression. *Cochrane Library*, *2017*(11). https://doi.org/10.1002/14651858.cd004517.pub3

Aaron, R. E., Rinehart, K. L., & Ceballos, N. A. (2011). Arts-based interventions to reduce anxiety levels among college students. *Arts & Health*, *3*(01), 27-38.

Ahessy, B. (2023). 'Boom boom in the zoom zoom room': Online music therapy with children and adolescents with visual impairment. *British Journal of Visual Impairment*, 41, 143–161. https://doi.org/10.1177/02646196211029342

Baik, JH. Stress and the dopaminergic reward system. *Exp Mol Med* **52**, 1879–1890 (2020). https://doi.org/10.1038/s12276-020-00532-4

Baker, F., & Krout, R. (2009). Songwriting via skype: An online music therapy intervention to enhance social skills in an adolescent diagnosed with Asperger's syndrome. *British Journal of Music Therapy*, 23, 3–14. https://doi.org/10.1177/135945750902300202

Booth, J., Connelly, L., & Lawrence, M. (2015). Evidence of perceived psychosocial stress as a risk factor for stroke in adults: A meta-analysis. *BMC Neurology, 15*(233). https://doi.org/10.1186/s12883-015-0456-4

Canadian Campus Wellbeing Survey. (2024, May 8). https://www.ccws-becc.ca/

Chen, J. I., Romero, G. D., & Karver, M. S. (2016). The relationship of perceived campus culture to mental health help-seeking intentions. *Journal of Counseling Psychology*, *63*(6), 677–684. https://doi.org/10.1037/cou0000095

Cook, S. C., Schwartz, A. C., & Kaslow, N. J. (2017). Evidence-Based Psychotherapy: Advantages and challenges. *Neurotherapeutics*, *14*(3), 537–545. https://doi.org/10.1007/s13311-017-0549-4

Crowe, M., Andel, R., Pedersen, N. L., & Gatz, M. (2007). Do work-related stress and reactivity to stress predict dementia more than 30 years later? *Alzheimer Disease & Associated Disorders, 21*(3), 205-209. https://doi.org/10.1097/WAD.0b013e31811ec10a

de Witte, M., Da Silva Pinho, A., Stams, G., Moonen, X., Bos, A. E., & Van Hooren, S. (2020). Music therapy for stress reduction: a systematic review and meta-analysis. *Health Psychology Review*, *16*(1), 134–159. https://doi.org/10.1080/17437199.2020.1846580

Dobkin, R. D., Rubino, J. T., Friedman, J., Allen, L. A., Gara, M. A., & Menza, M. (2013). Barriers to mental health care utilization in Parkinson's disease. *Journal of Geriatric Psychiatry and Neurology, 26*, 105-116. https://doi.org/10.1177/0891988713481269

Dorsey, E. R., George, B. P., Leff, B., & Willis, A. W. (2013). The coming crisis: Obtaining care for the growing burden of neurodegenerative conditions. *Neurology, 80*, 1989-1996. https://doi.org/10.1212/WNL.0b013e318293e2ce

Erkkilä, J., Punkanen, M., Fachner, J., Ala-Ruona, E., Pöntiö, I., Tervaniemi, M., Vanhala, M., & Gold, C. (2011). Individual music therapy for depression: randomised controlled trial. *British Journal of Psychiatry*, *199*(2), 132–139. https://doi.org/10.1192/bjp.bp.110.085431

Finnerty, R., McWeeny, S., & Trainor, L. (2023). Online group music therapy: Proactive management of undergraduate students' stress and anxiety. *Frontiers in Psychiatry*, *14*. https://doi.org/10.3389/fpsyt.2023.1183311

Gil de Zúñiga, H., Diehl, T., Huber, B., & Liu, J. (2017). Personality Traits and Social Media Use in 20 Countries: How Personality Relates to Frequency of Social Media Use, Social Media News Use, and Social Media Use for Social Interaction. *Cyberpsychology, behavior and social networking*, *20*(9), 540–552.

Gjermunds, N., Brechan, I., Johnsen, S., & Watten, R. G. (2020). Personality traits in musicians. *Current Issues in Personality Psychology*, *8*(2), 100-107.

Gold C, Mössler K, Grocke D, Heldal TO, Tjemsland L, Aarre T, Aarø LE, Rittmannsberger H, Stige B, Assmus J, Rolvsjord R. Individual Music Therapy for Mental Health Care Clients with Low Therapy Motivation: Multicentre Randomised Controlled Trial. Psychother Psychosom. 2013;82(5):319-331. https://doi.org/10.1159/000348452.

Government of Canada, Statistics Canada. (2023, June 19). The daily — Work-related stress most often caused by heavy workloads and work-life balance. https://www150.statcan.gc.ca/n1/daily-quotidien/230619/dq230619c-eng.htm

Gvili, R. L. (2021). An intergenerational zoom music therapy group during COVID-19. *Innovation in Aging*, 5(Suppl. 1), 566. https://doi.org/10.1093/geroni/igab046.2175

How much are you losing to absenteeism? (May 14, 2024). https://www.mercer.com/en-ca/insights/total-rewards/employee-wellbeing/how-much-are-you-losing-to-absenteeism/

Henderson, L., Thompson, K., Hudson, A., Dobson, K., Chen, S.-P., & Stewart, S. (2018). An analysis of campus culture, mental health, and drinking at three Canadian universities. *Canadian Journal of Community Mental Health, 37*(3), 97-113. https://doi.org/10.7870/cjcmh-2018-013

International Association for the Study of Pain. (2021, July 20). *IASP announces revised Definition of Pain - International Association for the Study of Pain (IASP)*. International Association for the Study of Pain (IASP). https://www.iasp-pain.org/publications/iasp-news/iasp-announces-revised-definition-of-pain/

Kim, H., Park, Y. S., & Kim, S. H. (2023). Association between stress-related disorders and the risk of dementia using the Korean National Sample Cohort: A matched cohort study. *Scientific Reports, 13*(16487). https://doi.org/10.1038/s41598-023-43884-3

Lightstone, A. J., Bailey, S. K., & Voros, P. (2015). Collaborative music therapy via remote video technology to reduce a veteran's symptoms of severe, chronic PTSD. *Arts & Health*, 7, 123–136. https://doi.org/10.1080/17533015.2015.1019895

Lloyd, C., Smith, J., & Weinger, K. (2005). Stress and diabetes: A review of the links. *Diabetes Spectrum, 18*(2), 121-127.

Luo, J., Beam, C.R. & Gatz, M. Is Stress an Overlooked Risk Factor for Dementia? A Systematic Review from a Lifespan Developmental Perspective. *Prev Sci* **24**, 936–949 (2023). https://doi.org/10.1007/s11121-022-01385-1

Machado Sotomayor, M. J., Arufe-Giráldez, V., Ruíz-Rico, G., & Navarro-Patón, R. (2021). Music therapy and Parkinson's disease: A systematic review from 2015–2020. *International Journal of Environmental Research and Public Health, 18*(21), 11618. https://doi.org/10.3390/ijerph182111618

Mathur, M. B., Epel, E., Kind, S., Desai, M., Parks, C. G., Sandler, D. P., & Khazeni, N. (2016). Perceived stress and telomere length: A systematic review, meta-analysis, and methodologic considerations for advancing the field. *Brain, Behavior, and Immunity*, *54*, 158–169. https://doi.org/10.1016/j.bbi.2016.02.002

McDaniels, B., Subramanian, I., Kurian, S., & Chitnis, S. (2023). Early-onset Parkinson's disease: An assessment of unmet psychosocial needs. *Parkinsonism & Related Disorders, 110*(105395). https://doi.org/10.1016/j.parkreldis.2023.105395

Ministerie van Algemene Zaken. (2023, November 10). MHPSS worldwide: Facts and figures. *Mental Health and Psychosocial Support in Crisis Situations | Government.nl*. https://www.government.nl/topics/mhpss/mhpss-worldwide-

facts-and-
figures#:~:text=According%20to%20the%20WEF%2C%20poor,in%20MHPSS%
20has%20economic%20benefits.

Nnanyelugo, C. E., Iyendo, T. O., Emmanuel, N. O., Okwuowulu, C., John, E. I., Apuke,
O. D., et al. (2022). Effect of internet-mediated music therapy intervention on
reduction in generalized anxiety disorder symptoms among displaced Nigerians of
the Russia–Ukraine war. *Psychology of Music*, 1–12.
https://doi.org/10.1177/03057356221129649

Noushad, S., Ahmed, S., Ansari, B., Mustafa, U., Saleem, Y., & Hazrat, H. (2021,
October 1). *Physiological biomarkers of chronic stress: A systematic review*.
PubMed Central (PMC).
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8434839/

O'Connor, D. B., Thayer, J. F., & Vedhara, K. (2021). Stress and Health: A review of
Psychobiological processes. *Annual Review of Psychology*, *72*(1), 663–688.
https://doi.org/10.1146/annurev-psych-062520-122331

Parkinson's disease. (2024). In *Merriam-Webster Dictionary*. https://www.merriam-
webster.com/dictionary/Parkinson%27s%20disease

Pontone, G. M., Dissanayaka, N., Dobkin, R. D., Mari, L., Marsh, L., Vernaleo, B. A.,
Weintraub, D., & Mari, Z. (2019). Integration and extension of specialty mental
healthcare services to community practice in Parkinson disease. *The American
Journal of Geriatric Psychiatry, 27*(712-719).
https://doi.org/10.1016/j.jagp.2019.03.005

Smith, M. L., & Glass, G. V. (1977). Meta-analysis of psychotherapy outcome studies.
American Psychologist, 32(9), 752-760. https://doi.org/10.1037/0003-
066X.32.9.752

Spooner, H., Lee, J. B., Langston, D. J., Sonke, J., Myers, K. J., & Levy, C. E. (2019).
Using distance technology to deliver the creative arts therapies to veterans: Case
studies in art, dance/movement and music therapy. *The Arts in Psychotherapy*,
62, 12–18. https://doi.org/10.1016/j.aip.2018.11.012

Staufenbiel, S. M., Penninx, B. W., Spijker, A. T., Elzinga, B. M., & Van Rossum, E. F.
(2013). Hair cortisol, stress exposure, and mental health in humans: A systematic
review. *Psychoneuroendocrinology*, *38*(8), 1220–1235.
https://doi.org/10.1016/j.psyneuen.2012.11.015

Steptoe, A., & Kivimäki, M. (2012). Stress and cardiovascular disease. *Nature Reviews
Cardiology, 9*, 360-370. https://doi.org/10.1038/nrcardio.2012.45

Steptoe, A., Hamer, M., Lin, J., Blackburn, E. H., & Erusalimsky, J. D. (2017). The longitudinal relationship between cortisol responses to mental stress and leukocyte telomere attrition. *The Journal of Clinical Endocrinology & Metabolism*, *102*(3), 962-969.

Strickhouser, J. E., Zell, E., & Krizan, Z. (2017). Does personality predict health and well-being? A metasynthesis. *Health psychology*, *36*(8), 797.

Supporting Student and Community Resilience through Mental Health Resources and Programming - Ontario's Universities. (2024, March 28). Ontario's Universities. https://ontariosuniversities.ca/reports-resources/mental-health-resources-and-programming/

Taylor, J., Anderson, W. S., Brandt, J., Mari, Z., & Pontone, G. M. (2016). Neuropsychiatric complications of Parkinson disease treatments: Importance of multidisciplinary care. *The American Journal of Geriatric Psychiatry, 24*(1171-1180). https://doi.org/10.1016/j.jagp.2016.08.017

Wirtz, P. H., & von Känel, R. (2017). Psychological stress, inflammation, and coronary heart disease. *Current Cardiology Reports, 19*(111). https://doi.org/10.1007/s11886-017-0919-x

Wolfradt, U., & Pretz, J. E. (2001). Individual differences in creativity: personality, story writing, and hobbies. European Journal of Personality, 15(4), 297-310. https://doi.org/10.1002/per.409

World Health Organization: WHO. (2022, June 17). Mental health. https://www.who.int/news-room/fact-sheets/detail/mental-health-strengthening-our-response

World Health Organization: WHO. (2022, September 28). Mental health at work. https://www.who.int/news-room/fact-sheets/detail/mental-health-at-work

World Health Organization. (2019). Health evidence network synthesis report: What is the evidence on the role of the arts in improving health and well-being? A scoping review. https://apps.who.int/iris/bitstream/handle/10665/329834/9789289054553-eng.pdf

World Health Organization: WHO & World Health Organization: WHO. (2023, March 15). *Dementia*. https://www.who.int/news-room/fact-sheets/detail/dementia