



common overuse injuries involving the muscle-tendon unit (Brandfonbrener, Burkholder, 2004; Lockwood, 1989).

Performance-related musculoskeletal injuries are especially prevalent amongst collegiate musicians (Brandfonbrener, 2009; Guptill, Paul, Zaza, 2000; Kok, Groenewegen, Haitiema, Nelissen, Rietveld, 2018; Komes, Murdock, Stanek, 2017). Ensemble-related performance demands, coupled with practice expectations for applied lessons, require collegiate musicians to spend an exceptional amount of time working on their craft. The ensuing overuse can be exacerbated by lack of conditioning, muscle weakness or imbalance, lack of body awareness, the presence of pre-existing conditions, and even stress. Students may also be at risk for developing performance-related injuries due to an absence of education about anatomy and body awareness, which can cause inefficient movements that are often injury-producing (Conable, Conable, 2000). The origins of these injuries can even begin prior to the college experience, amplifying the importance of ensuring that developing musicians cultivate self-awareness regarding performance-based pain they may be experiencing, as well as a clear protocol to address pain-related issues.

Musculoskeletal problems are not the only problem music students face. Many music students also suffer from non-musculoskeletal related issues, including sleep disturbance, tiredness, sensitivity to the weather, concentration problems, and headaches requiring medication (Ginsborg, Kreutz, Williamon, 2008). Experiencing these issues can naturally add additional stressors to the performance experience. In the book *Playing (Less) Hurt*, Janet Horvath states that stress is “the most obvious external factor that can radically affect our physical and emotional well-being on a daily basis”.

There are two primary types of stress; eustress (i.e., a positive form of stress with a beneficial effect on health, motivation, performance, and well-being) and distress (i.e., a negative form of stress, such as pain or suffering affecting the body or mind) as defined by *Merriam-Webster*. Performance anxiety, one manifestation of stress, is experienced by a majority of collegiate musicians (Chesky, Miller, 2004). Salmon defines performance anxiety as “the experience of persisting, distressful apprehension about and/or actual impairment of performance skills in a public context, to a degree unwarranted given the individual’s musical aptitude, training, and level of preparation” (Dattilio, Freeman, Salmon, 1992). Although some aspects of performance anxiety can have positive impacts on performance, the valence of reaction is largely dependent on the individual’s anxiety sensitivity.

Unfortunately, little research has been conducted with the relationship between general stress levels and the prevalence of performance-related pain and pain severity in collegiate musicians (Altenmüller, Hafer, Ioannou, Lee, 2018; Fountain, Wristan, 2013). Although there are several studies on the incidence of performance-related pain among collegiate music students, examining the relationship between musculoskeletal pain and associated stress can help collegiate music programs support students’ challenges with health-related concerns.

## 2. Literature Review

Performance-based injury and pain has been researched at length over the past several decades, particularly amongst collegiate musicians. The majority of these musicians begin their collegiate careers already experiencing some level of performance-related injury or pain. For example, Brandfonbrener (2009) found that, among 330 incoming freshmen music students from four consecutive entering classes at an American university, a total of 79% reported a history of performance-related pain. These findings suggest that performance-related pain begins in students before they enter college.

Related studies confirm that these conditions typically persist once students begin their collegiate training. In a large-scale, cross-sectional study conducted in colleges throughout the United States by Stanek, Komes & Murdock (2017), including a total of 1,001 participants, 67% of collegiate musicians reported experiencing some form of performance-related pain. Earlier studies conducted by

Guptill, Zaza, and Paul (2000), among others, also demonstrated that the majority of collegiate musicians experience some sort of musculoskeletal injury or pain (Hagglund, Jacobs, 1996; Anderson, Martinez, Roach, 1994).

According to the findings of Chesky, Dawson & Manchester (2006), there are a range of reasons why these injuries may occur, including both overuse (i.e., “asking more of our bodies than they are capable of” p. 36) and misuse (i.e., improper playing technique). For example, Hagglund & Jacobs (1996) found a positive correlation between the number of hours spent performing and the incidence of performance-related injury, cautioning against such overuse. This finding contrasted the earlier research of Roach, Martinez, and Anderson (1994), who found that there was no significant difference between musicians’ self-reported pain per the number of hours spent playing music, suggesting additional research is needed in this area.

Unfortunately, collegiate musicians face many barriers in seeking treatment for their symptoms. Less than half of injured students will consult a medical professional for their pain, as demonstrated through findings by Guptill, Zaza, & Paul (2000) and Stanek, Komes, & Murdock (2017). Some students may resist seeking treatment because a common recommendation is to restrict music activity or take time off completely, which may feel like an impossibility given their rigorous schedules and high expectations. Others may not be aware of where to go to seek help or what resources are available to them and may be experiencing financial hardship that prevents them from getting the help they need. While targeted treatment and rehabilitation options are available, preventative measures are also encouraged. Practice modifications, as well as instrument modifications, can offer musicians some respite while establishing workable, sustainable habits.

Of course, performance-related pain and injury can have more than just physiological effects on musicians. The mind-body connection is strong, and there is a reciprocal relationship between musculoskeletal pain and chronic stress and anxiety. When an individual is feeling stressed or anxious, the body reacts as if it is under attack. The stress response activates the immune system, which explains why chronic stress can take a serious toll on the body if the immune system is constantly being overworked. Chronic stress disrupts the balance within the immune system, leading to increased inflammation in the body (Goehler, 2017).

Researchers have found that the more frequently a person experiences the physical or cognitive symptoms of performance anxiety, the more debilitating their anxiety becomes (Chesky, Schneider, 2011). A study by Ioannou, Hafer, Lee, & Altenmüller (2018) that examined the relationship between long-term playing-related pain symptoms and general levels of trait anxiety revealed that 40% of students affected by playing-related pain had increased levels of trait anxieties based on a psychodiagnostics questionnaire. Although some research demonstrates that performance anxiety may have positive impacts (Chesky, Schneider, 2011), negative emotion elicited in musicians during performance can restrict the potential of leading a promising career in the music industry and can take the joy out of performing (Steptoe, 2001).

Because many musicians experience anxiety and depression (Ackermann, Kenny, 2016), and because there can be a strong correlation between depression and pain as well as anxiety and pain as demonstrated in a study by Wristan & Fountain (2013), it is important to examine mental health and emotional well-being alongside the incidence of performance-related injury.

Although there has been an increase in health and wellness class offerings and educational initiatives at collegiate music schools (Barton, Feinberg, 2008; Manchester, 2006; Manchester, 2007), these efforts alone are not enough to remedy issues surrounding performance-related pain and injury, and related stress-centered health issues occurring at epidemic level rates in collegiate musicians.

## 2.1. Purpose of the Study

The primary purpose of this study was to determine the prevalence of musculoskeletal performance-related pain and injury in undergraduate and graduate students at a large, Midwestern university. The second purpose of this study was to determine stress levels related to performance-related pain to examine any possible relationship between general stress levels and pain severity and frequency. Coping mechanisms for symptoms of stress and performance-related pain and injury were also investigated.

## 3. Methodology

In the Fall of 2017, a one-time electronic questionnaire was sent to a listserv of all undergraduate and graduate music students at a large, Midwestern university. 394 participants were invited to participate in the study, and a total of 43 participants completed the questionnaire, for a response rate of 11%. The questionnaire was a total of 40 items, and it took approximately 10 minutes to complete. Participants have provided written informed consent, and the study has been performed following standard ethical guidelines for human and animal subjects. This study has been deemed exempt from the Bowling Green State University Institutional Review Board approval referencing Case #1124774-4, The Music Students' Guide to Playing Without Pain on November 17, 2017.

A total of 30 participants (70%) were undergraduate students, while a total of 8 students were graduate students (19%); five participants chose not to respond to this item. The gender identification of participants demonstrated a majority of participants identified as female (56%,  $n = 24$ ), 28% ( $n = 12$ ) identified as male, 5% ( $n = 2$ ) identified as non-binary, and 5 participants chose not to respond.

Most respondents (42%,  $n = 18$ ) were woodwind players, 16% ( $n = 7$ ) were string musicians, and 12% ( $n = 5$ ) were vocalists, and six participants chose not to respond. Only 9% ( $n = 4$ ) were brass musicians, and only 7% ( $n = 3$ ) were guitarists or pianists. On average, participants practiced around 2 hours per day, during which participants reported taking one to two breaks. Participants were expected to sing or play their instruments anywhere from five to 36 hours per week, between practicing, rehearsals, and other performance responsibilities.

In addition to demographic information, participants answered a series of questions regarding their experiences with performance-based pain, including the types of pain they experience while playing their instruments or singing, the frequency of their pain, the severity of their pain, and the primary areas they experienced pain. These items were derived from the Musculoskeletal Pain Intensity and Interference Questionnaire for Musicians (Berque, Gray, McFadyen, 2016). For example, participants answered the item, "Have you ever had pain problems that have interfered with your ability to play your instrument/sing at the level to which you are accustomed? Additional items on pain were derived from Stanek, Komes, and Murdock (2017), which prompted participants to indicate the location(s) and characteristics of their pain. Participants also responded to items specific to coping mechanisms, treatments, and exercise routines related to pain management.

Items on stress were adapted from the Perceived Stress Scale (Cohen, Williamson, 1988) to fit a music-specific context. For example, the original item, "In the last month, how often have you found that you could cope with all of the things that you had to do?" was adapted to read, "In the last month, how often have you found that you could not cope with all of the music performance expectations you have for yourself/others have of you?" Participants responded to these items on a 5-point Likert-type scale, ranging from "Never" to "Very Often." Reliability estimates for the stress inventory were strong ( $\alpha = .91$ ).

#### 4. Results

Approximately 88% ( $n = 38$ ) of participants experienced performance-based pain that interfered with their ability to play their instruments/sing to the level at which they were accustomed in the past 12 months, while 56% ( $n = 24$ ) of participants reported experiencing such levels of performance-based pain in the last week alone. Around 67% ( $n = 29$ ) of participants experienced mild to moderate pain on average in the last week. Most participants experienced moderate to severe pain at its worst the week leading up to a major performance, recital, or jury (77%,  $n = 33$ ), with a slight majority (58%,  $n = 25$ ) having experienced moderate to severe pain on average the week leading up to a major performance. We can conclude that in general, pain intensity was most severe when leading up to a major performance, recital, or jury. Notably, 16% of participants ( $n = 7$ ) did not experience any pain at all.

Participants reported experiencing the most pain in their front right wrists (35%,  $n = 15$ ) and their right shoulders (33%,  $n = 14$ ). Thirty percent of participants ( $n = 13$ ) experience pain in their left/right fingers, the back of their right wrist, and the front of their left wrist. Overall, the majority of pain seemed to be located in the extremities of the arm, within the finger and wrist area. Most participants described the pain they experienced as feeling sore (61%,  $n = 26$ ) or tight 56%,  $n = 24$ ), while others described feelings of cramping, aching, or weakness.

The most frequently applied coping mechanisms included decreasing personal practice time (61%,  $n = 26$ ) and changing performance technique in some manner (44%,  $n = 19$ ). Participants also reported coping by taking time off completely from rehearsals and practicing (37%,  $n = 16$ ). Participants reported using massage and yoga as the most common strategies for treatment, with Alexander Technique and physical therapy also serving as popular treatment choices.

A factorial ANOVA revealed that there were no significant differences between groups (e.g., instrument or voice type) with regard to experience of pain frequency or severity. There were also no significant differences according to gender, level (e.g., undergraduate versus graduate students), or major area (e.g., music education versus music performance).

Perceived stress was measured using an adapted version of the Perceived Stress Scale (Cohen, Kamarck, & Mermelstein, 1983). A composite stress score was calculated, with a possible range of 13 (stress never experienced) to 65 (stress very often experienced). Participants reported a mean stress level of 42.24 ( $SD = 6.50$ ; Range 13-53), suggesting overall elevated levels of perceived stress. Descriptive statistics for reported stress levels are summarized in Table 1.

**Table 1.** Perceived Stress Scale Means and Standard Deviations<sup>1</sup>

Item	<i>M</i>	<i>SD</i>
In the last month, how often have you felt nervous and stressed regarding your playing progress in your practice sessions?	3.97	1.24
In the last month, how often have you felt nervous and stressed regarding your playing progress in your ensemble rehearsals?	3.16	1.35
In the last month, how often have you felt confident about your ability to manage the amount of repertoire you are expected to practice per week for your lessons?	3.05	1.18

<sup>1</sup> Participants responded to each item on a 5-point Likert-Type scale ranging from 1 (Never) to 5 (Very Often).

In the last month, how often have you felt confident about your ability to manage the amount of repertoire you are expected to practice per week for your ensembles?	3.16	1.31
In the last month, how often have you found you could not cope with all of the things you have to prepare for your lessons?	3.18	1.27
In the last month, how often have you found you could not cope with all of the repertoire you have to prepare for your ensembles?	2.74	1.20
In the last month, how often have you felt that you were on top of your responsibilities for your private lessons?	2.82	1.23
In the last month, how often have you felt that you were on top of your responsibilities for your ensembles?	3.26	1.18
In the last month, how often have you felt tasks given to you by your professors were piling up so high that you could not overcome them?	3.39	1.29
In the last month, how often have you felt your preparation for lessons was productive and positive?	3.08	1.12
In the last month, how often have you felt your preparation for ensembles was productive and positive?	3.34	.99
In the last month, how often have you been frustrated with your progress in your preparation for private lessons?	4.11	1.23
In the last month, how often have you been frustrated with your progress in your preparation for ensembles?	2.97	1.26

There was a significant, modest positive correlation between pain severity and music-related stress ( $r = .40, p < .05$ ). This suggests that as participants' stress levels rose, the severity of performance-related pain worsened. A factorial ANOVA determined that there were no significant differences between demographic groups with regard to overall self-reported stress levels.

Open-ended responses revealed several patterns. Many students shared that they were aware of the issue of ignoring performance-related pain and are feeling overwhelmed by the amount of work they are expected to do in school while also making sure to take care of their own health. When given the prompt, "Please give a brief description of your stress regarding your classes, private lessons, and ensemble preparation in this semester," participants submitted responses such as, "I feel that there are not enough hours in the day to accomplish everything that we are expected to accomplish and still be healthy. Many teachers harp on wellness, but how can we be expected to take care of ourselves when we have 6 hours of practicing and 6 hours of homework that we are expected to complete?" Another participant shared, "My hands and forearms get inflamed, so I try to rest as much as I can, but the problem with that is I'm trying to rest myself to be able to keep playing, by not playing. The solution to me being able to play shouldn't be to stop playing for a while," while another wrote, "I just worry that the pain I'm experiencing could end up causing long term issues in my music career."

## 5. Discussion

Results from this study suggest that the vast majority of collegiate musicians experience some form of performance-related pain that impacts their ability to play, which supports the findings of several previous studies. These results demonstrate a strong need for the implementation of musicians' wellness initiatives in collegiate music programs. While many major conservatories and public music schools are

in the midst of developing performing arts health programs, many institutions still do not have access to these resources.

Many participants cited concern regarding the pain they were experiencing, and participants were most commonly directed to either decrease personal practice time or make changes to their playing technique. While some participants mentioned seeking professional help for their pain, there was a general lack of awareness surrounding injury prevention, treatment, and collaborative return-to-play recovery methods. These findings echo research by Stanek, Komes & Murdock (2017), where less than 25% of injured students reported that they consulted a medical professional for their pain.

A lack of education about injury prevention and treatment strategies can contribute to the development and severity of performance-based injury early in students' careers. Since research by Brandfonbrener (2009) has demonstrated that the majority of students experiencing performance-related pain encounter it before entering their collegiate studies, implementing performing arts health education in musical curriculums as early as possible can have a major, positive impact on the student's ability to manage and treat performance-related pain should it arise and can help them become less vulnerable to developing severe, long-term injuries.

Participants' pain severity and frequency demonstrate a strong positive correlation with overall elevated levels of stress, a finding that corroborates the work of Wristan & Fountain (2013). The open-ended responses from this study reveal that students feel overwhelmed with the amount of work that they are assigned in both academic and performance settings and feel that they do not have time to implement or prioritize self-care strategies. Participants also felt concerns about falling behind in their educational progress when considering making time for self-care.

Because chronic stress disrupts the balance within the immune system and often leads to increased inflammation, implementing stress management techniques is important in reducing risk factors for the development of performance-related injuries. This may include meditation, breathwork or breathing exercises, yoga, cardiovascular exercise, constructive rest (Likar, 2019), getting a massage or engaging in self-massage strategies, journaling, and experiencing rewarding social interactions (Antony, 2019). It is essential to address these general stress levels and psychological problems when developing wellness programming for musicians, because examining the relationship between musculoskeletal pain and associated stress can help collegiate music programs support students' challenges with these and other health-related concerns, thereby meeting the need for a common and unifying framework to be implemented in all schools of music (Chesky, Dawson & Manchester, 2006).

## **6. Recommendations**

The clinical research presented supports the findings of similar studies. It is notable that the percentages of injured musicians has remained unchanged over the past few decades and continues to grow at an alarming rate. There is also clear evidence presented that the mind, body, and spirit connection play an integral role in a musician's overall sense of well-being. Despite the continued high prevalence of injured musicians, little action has been taken to help empower musicians, educate them, and provide them with the tools they need to prevent and address injury. There are many things that can and should be done to change these devastating statistics.

One of the most important aspects of injury prevention is education and forming healthy habits as soon as a musician begins playing. Institutions preparing musicians for a career in music can play an integral role in injury prevention and helping students learn about wellness from a holistic perspective. Implementing a required course for all music students that covers a basic understanding of human anatomy as well as an understanding of ergonomics, body mechanics, and posture would be best practice.



In the event that an internal course is not a possibility, institutions can help students become aware of various external courses that are available to them.

Standard music curriculums can be altered to incorporate common causes of injury and prevention techniques. Providing students with an understanding of the effects of muscle tension, guarding, and poor practice habits can bring a profound sense of awareness and improve the student's instrumental technique, breathing and musicality. It is also important to cultivate an understanding of how anxiety, limiting beliefs, negative self-talk and stress specific to musicians can contribute to their overall well-being.

A critical component in injury prevention is having musicians fitted to their instrument by a qualified practitioner. Healthcare specialists that have an advanced understanding of anatomy, physiology, and kinematics can be extremely beneficial in identifying compensatory motions, noticing when joints are in adverse positions, and setting students up for success.

If a student is dealing with an injury, having network of qualified practitioners to treat them is paramount. Practitioners that understand the unique demands of musicians can enhance their recovery process. Bringing awareness of injury statistics and health and wellness techniques to music educators can play a critical role in the prevention of injury. Faculty that understands general causes of injury can help support their students and provide them with a safer place to talk about what is going on and how to handle it. Ideally, collaborating between the teacher, student, and healthcare provider will maximize the student's success and ability to recover from an injury as it brings all areas of expertise together.

One must recognize that there is no one-size-fits-all approach to musicians' wellness and injury prevention. Each musician's body is different, as well as their life experiences and how they handle stressors. Providing a well-rounded music education curriculum that is inclusive of an all-encompassing health and wellness course is critical in decreasing the percentage of musicians who experience injuries in the future.

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